The Status of EU Protected Habitats and Species in Ireland

Backing Documents, Article 17 forms, Maps
Volume 2

Contents - Conservation Status Assesment Backing Documents

Code(s)	Description	Part	Merge Page Number	**Volume Number**
1013	*Vertigo geyeri*	Backing document	1	1
		Article 17 form	24	1
		Map	28	1
1014	*Vertigo angustior*	Backing document	29	1
		Article 17 form	55	1
		Map	59	1
1016	*Vertigo moulinsiana*	Backing document	60	1
		Article 17 form	83	1
		Map	87	1
1024	Kerry slug (*Geomalacus maculosus*)	Backing document	88	1
		Article 17 form	97	1
		Map	99	1
1029	Freshwater pearl mussel (*Margaritifera margaritifera*)	Backing document	100	1
		Article 17 form	142	1
		Map	148	1
1065	Marsh fritillary (*Euphydryas aurinia*)	Article 17 form	149	1
		Map	151	1
1092	White-clawed crayfish (*Austropotamobius pallipes*)	Backing document	152	1
		Article 17 form	182	1
		Map	185	1
1095, 1096, 1099	**All Lamprey species**	Backing document	186	1
1095	Sea lamprey (*Petromyzon marinus*)	Article 17 form	200	1
		Map	202	1
1096, 1099	Brook & River lamprey (*Lampetra planeri, L. fluviatilis*)	Article 17 form	203	1
1096	Brook lamprey (*Lampetra planeri*)	Map	205	1
1099	River lamprey (*Lampetra fluviatilis*)	Map	206	1
1102, 1103	Allis & Twaite shad (*Alosa alosa, A. fallax fallax*)	Backing document	207	1
1102	Allis shad (*Alosa alosa*)	Article 17 form	223	1
		Map	225	1
1103	Twaite shad (*Alosa fallax fallax*)	Article 17 form	226	1
		Map	228	1
1106	Salmon (*Salmo salar*)	Backing document	229	1
		Article 17 form	291	1
		Map	295	1
1110	Sandbanks which are slightly covered by sea water all the time	Backing document	296	1
		Article 17 form	303	1
		Map	305	1
1130	Estuaries	Backing document	306	1
		Article 17 form	311	1
		Map	314	1
1140	Mudflats and sandflats not covered by seawater at low tide	Backing document	315	1
		Article 17 form	319	1
		Map	322	1
1150	Coastal lagoons	Backing document	323	1
		Article 17 form	390	1
		Map	394	1
1160	Large shallow inlets and bays	Backing document	395	1
		Article 17 form	400	1
		Map	403	1
1170	Reefs	Backing document	404	1
		Article 17 form	414	1
		Map	418	1
1202	Natterjack Toad (*Bufo calamita*)	Backing document	419	1
		Article 17 form	428	1
		Map	431	1
1210	Annual vegetation of drift lines	Article 17 form	432	1
		Map	434	1
1213	Common Frog (*Rana temporaria*)	Backing document	435	1
		Article 17 form	440	1
		Map	443	1
1220	Perennial vegetation of stony banks	Backing document	444	1
		Article 17 form	481	1
		Map	483	1
1223	Leatherback turtle (*Dermochelys coriacea*)	Backing document	484	1
		Article 17 form	492	1

Code(s)	Description	Part	Merge Page Number	**Volume Number**
		Map	494	1
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts	Article 17 form	495	1
		Map	497	1
1303	Lesser horseshoe bat (*Rhinolophus hipposideros*)	Backing document	498	1
		Article 17 form	522	1
		Map	525	1
1310	Salicornia and other annuals colonizing mud and sand	Backing document	526	1
		Article 17 form	540	1
		Map	542	1
1320	Spartina swards (*Spartinion maritimae*)	Backing document	543	1
		Article 17 form	555	1
		Map	557	1
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Backing document	558	1
		Article 17 form	575	1
		Map	577	1
1309, 1314, 1317, 1320, 1330, 1322, 1326, 1331, 5009	**All Vesper Bats**	Backing document	578	1
1309	Common pipistrelle (*Pipistrellus pipistrellus*)	Article 17 form	599	1
		Map	601	1
1314	Daubenton’s bat (*Myotis daubentoni*)	Article 17 form	602	1
		Map	605	1
1317	Nathusius pipistrelle (*Pipistrellus nathusii*)	Article 17 form	606	1
		Map	609	1
1320, 1330	Whiskered & Brandt’s bat (*Myotis mystacinus, M. brandti*)	Article 17 form	610	1
1320	Brandt’s bat (*Myotis brandti*)	Map	612	1
1330	Whiskered bat (*Myotis mystacinus*)	Map	613	1
1322	Natterer’s bat (*Myotis nattereri*)	Article 17 form	614	1
		Map	617	1
1326	Brown long-eared bat (*Plecotus auritus*)	Article 17 form	618	1
		Map	620	1
1331	Leisler’s bat (*Nyctalus leisleri*)	Article 17 form	621	1
		Map	623	1
5009	Soprano pipistrelle (*Pipistrellus pygmaeus*)	Article 17 form	624	1
		Map	626	1
1334	Mountain Hare (*Lepus timidus (hibernicus)*)	Backing document	627	1
		Article 17 form	634	1
		Map	636	1
1355	Otter (*Lutra lutra*)	Backing document	637	1
		Article 17 form	649	1
		Map	652	1
1357	Pine marten (*Martes martes*)	Backing document	653	1
		Article 17 form	661	1
		Map	663	1
1364	Grey seal (*Halichoerus grypus*)	Backing document	664	1
		Article 17 form	685	1
		Map	688	1
1365	Common seal (*Phoca vitulina*)	Backing document	689	1
		Article 17 form	713	1
		Map	715	1
1376, 1377	Maerls (*Lithothamnion corralloides, Phymatolithon calcareum*)	Article 17 form	716	1
		Map	719	1
1393	Shining sickle moss (*Hamatocaulis vernicosus*)	Backing document	720	1
		Article 17 form	733	1
		Map	736	1
1395	Petalwort (*Petalophyllum ralfsii*)	Backing document	737	1
		Article 17 form	751	1
		Map	754	1
1400	*Leucobryum glaucum*	Article 17 form	755	2
		Map	757	2
1409	*Sphagnum spp.*	Article 17 form	758	2
		Map	760	2
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Backing document	761	2
		Article 17 form	777	2
		Map	779	2
1413	*Lycopodium* group	Article 17 form	780	2
		Map	782	2

Code(s)	Description	Part	Merge Page Number	**Volume Number**
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)	Backing document	783	2
		Article 17 form	792	2
		Map	794	2
1421	Killarney fern (*Trichomanes speciosum*)	Backing document	795	2
		Article 17 form	809	2
		Map	812	2
1528	Marsh saxifrage (*Saxifraga hirculus*)	Backing document	813	2
		Article 17 form	821	2
		Map	823	2
1833	Slender naiad (*Najas flexilis*)	Backing document	824	2
		Article 17 form	836	2
		Map	840	2
1990	Pearl mussel (*Margaritifera durrovensis*)	Backing document	841	2
		Article 17 form	878	2
		Map	882	2
1345, 1348, 1349, 1350, 1351, 2027, 2028, 2029, 2030, 2031, 2032, 2034, 2035, 2037, 2038, 2618, 2619, 2621, 2622, 5020, 5029, 5031, 5033, 5034	**All Cetaceans**	Backing document	883	2
1345	Humpback whale (*Megaptera novaeangliae*)	Article 17 form	896	2
		Map	898	2
1348	Northern right whale (*Eubalaena glacialis*)	Article 17 form	899	2
1349	Bottle-nosed dolphin (*Tursiops truncatus*)	Article 17 form	901	2
		Map	903	2
1350	Common dolphin (*Delphinus delphis*)	Article 17 form	904	2
		Map	906	2
1351	Harbour porpoise (*Phocoena phocoena*)	Article 17 form	907	2
		Map	909	2
2027	Killer whale (*Orcinus orca*)	Article 17 form	910	2
		Map	912	2
2028	False killer whale (*Pseudorca crassidens*)	Article 17 form	913	2
2029	Pilot whale (*Globicephala melas*)	Article 17 form	915	2
		Map	917	2
2030	Risso's dolphin (*Grampus griseus*)	Article 17 form	918	2
		Map	920	2
2031	White-sided dolphin (*Lagenorhynchus acutus*)	Article 17 form	921	2
		Map	923	2
2032	White-beaked dolphin (*Lagenorhynchus albirostris*)	Article 17 form	924	2
		Map	926	2
2034	Striped dolphin (*Stenella coeruleoalba*)	Article 17 form	927	2
		Map	929	2
2035	Cuvier's Beaked whale (*Ziphius cavirostris*)	Article 17 form	930	2
		Map	932	2
2037	True's beaked whale (*Mesoplodon mirus*)	Article 17 form	933	2
2038	Sowerby's beaked whale (*Mesoplodon bidens*)	Article 17 form	935	2
2618	Minke whale (*Balaenoptera acutorostrata*)	Article 17 form	937	2
		Map	939	2
2619	Sei whale (*Balaenoptera borealis*)	Article 17 form	940	2
		Map	942	2
2621	Fin whale (*Balaenoptera physalus*)	Article 17 form	943	2
		Map	945	2
2622	Pygmy sperm whale (*Kogia breviceps*)	Article 17 form	946	2
5020	Blue whale (*Balaenoptera musculus*)	Article 17 form	948	2
		Map	950	2
5029	Beluga (*Delphinapterus leucas*)	Article 17 form	951	2
5031	Sperm whale (*Physeter macrocephalus*)	Article 17 form	953	2
5033	Northern Bottlenose whale (*Hyperoodon ampullatus*)	Article 17 form	955	2
		Map	957	2
5034	Gervais beaked whale (*Mesoplodon europaeus*)	Article 17 form	958	2
2110	Embryonic shifting dunes	Backing document	960	2
		Article 17 form	986	2
		Map	988	2
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Backing document	989	2

Code(s)	Description	Part	Merge Page Number	Volume Number
		Article 17 form	1018	2
		Map	1020	2
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Backing document	1021	2
		Article 17 form	1058	2
		Map	1062	2
2140	Decalcified fixed dunes with *Empetrum nigrum*	Article 17 form	1063	2
		Map	1065	2
2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	Article 17 form	1066	2
		Map	1068	2
2170	Dunes with *Salix repens* ssp.*argentea* (*Salix arenariae*)	Article 17 form	1069	2
		Map	1071	2
2190	Humid dune slacks	Article 17 form	1072	2
		Map	1075	2
21A0	Machairs	Backing document	1076	2
		Article 17 form	1106	2
		Map	1109	2
3110, 3130, 3140, 3150, 3160	**All Freshwater Lake Habitats**	Backing document	1110	2
3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	Article 17 form	1242	2
		Map	1244	2
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	Article 17 form	1245	2
		Map	1247	2
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Article 17 form	1248	2
		Map	1250	2
3150	Natural euthrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation	Article 17 form	1251	2
		Map	1253	2
3160	Natural dystrophic lakes and ponds	Article 17 form	1254	2
		Map	1256	2
3180	Turloughs	Backing document	1257	2
		Article 17 form	1294	2
		Map	1297	2
	All Freshwater River Habitats	Backing document	1298	2
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Article 17 form	1327	2
		Map	1329	2
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation	Backing document	1330	2
		Article 17 form	1340	2
		Map	1342	2
4010	Northern Atlantic wet heaths with *Erica tetralix*	Article 17 form	1343	2
		Map	1346	2
4030	European dry heaths	Backing document	1347	2
		Article 17 form	1374	2
		Map	1376	2
4060	Alpine and Boreal heaths	Backing document	1377	2
		Article 17 form	1427	2
		Map	1436	2
5046	Killarney Shad (*Alosa fallax killarnensis*)	Backing document	1437	2
		Article 17 form	1442	2
		Map	1444	2
5113	*Cladonia* subgenus *Cladina*	Article 17 form	1445	2
		Map	1447	2
5130	*Juniperus communis* formations on heaths or calcareous grasslands	Backing document	1448	2
		Article 17 form	1469	2
		Map	1471	2
6130	Calaminarian grasslands of the *Violetalia calaminariae*	Article 17 form	1472	3
		Map	1474	3
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites)	Backing document	1475	3
		Article 17 form	1507	3
		Map	1510	3

Code(s)	Description	Part	Merge Page Number	**Volume Number**
6230	Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)	Backing document	1511	3
		Article 17 form	1532	3
		Map	1534	3
6410	Molinia meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*)	Article 17 form	1535	3
		Map	1537	3
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Article 17 form	1538	3
		Map	1540	3
6510	Lowland hay meadows (*Alopecurus pratensis* , *Sanguisorba officinalis*)	Article 17 form	1541	3
		Map	1543	3
7110	Active raised bogs	Backing document	1544	3
		Article 17 form	1571	3
		Map	1574	3
7120	Degraded raised bogs still capable of natural regeneration	Backing document	1575	3
		Article 17 form	1603	3
		Map	1606	3
7130	Blanket bog (*active only)	Backing document	1607	3
		Article 17 form	1648	3
		Map	1654	3
7140	Transition mires and quaking bogs	Backing document	1655	3
		Article 17 form	1710	3
		Map	1712	3
7150	Depressions on peat substrates of the *Rhynchosporion*	Article 17 form	1713	3
		Map	1716	3
7210	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	Backing document	1717	3
		Article 17 form	1767	3
		Map	1769	3
7220	Petrifying springs with tufa formation (*Cratoneurion*)	Backing document	1770	3
		Article 17 form	1820	3
		Map	1822	3
7230	Alkaline fens	Backing document	1823	3
		Article 17 form	1873	3
		Map	1875	3
8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)	Backing document	1876	3
		Article 17 form	1921	3
		Map	1927	3
8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)	Backing document	1928	3
		Article 17 form	1965	3
		Map	1968	3
8210	Calcareous rocky slopes with chasmophytic vegetation	Backing document	1969	3
		Article 17 form	2013	3
		Map	2019	3
8220	Siliceous rocky slopes with chasmophytic vegetation	Backing document	2020	3
		Article 17 form	2064	3
		Map	2070	3
8240	Limestone pavements	Backing document	2071	3
		Article 17 form	2152	3
		Map	2158	3
8310	Caves not open to the public	Backing document	2159	3
		Article 17 form	2165	3
		Map	2167	3
8330	Submerged or partly submerged sea caves	Backing document	2168	3
		Article 17 form	2172	3
		Map	2174	3
91A0	Old sessile oak woods with Ilex and Blechnum in British Isles	Backing document	2175	3
		Article 17 form	2198	3
		Map	2200	3
91D0	Bog woodland	Backing document	2201	3
		Article 17 form	2227	3
		Map	2229	3

Code(s)	Description	Part	Merge Page Number	**Volume Number**
91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion* , *Alnion incanae* , *Salicion albae*)	Backing document	2230	3
		Article 17 form	2259	3
		Map	2261	3
91J0	*Taxus baccata* woods of the British Isles	Backing document	2262	3
		Article 17 form	2272	3
		Map	2274	3
Other	Pollan (*Coregonus autumnalis*)	Backing document	2275	3
		Article 17 form	2284	3
		Map	2286	3

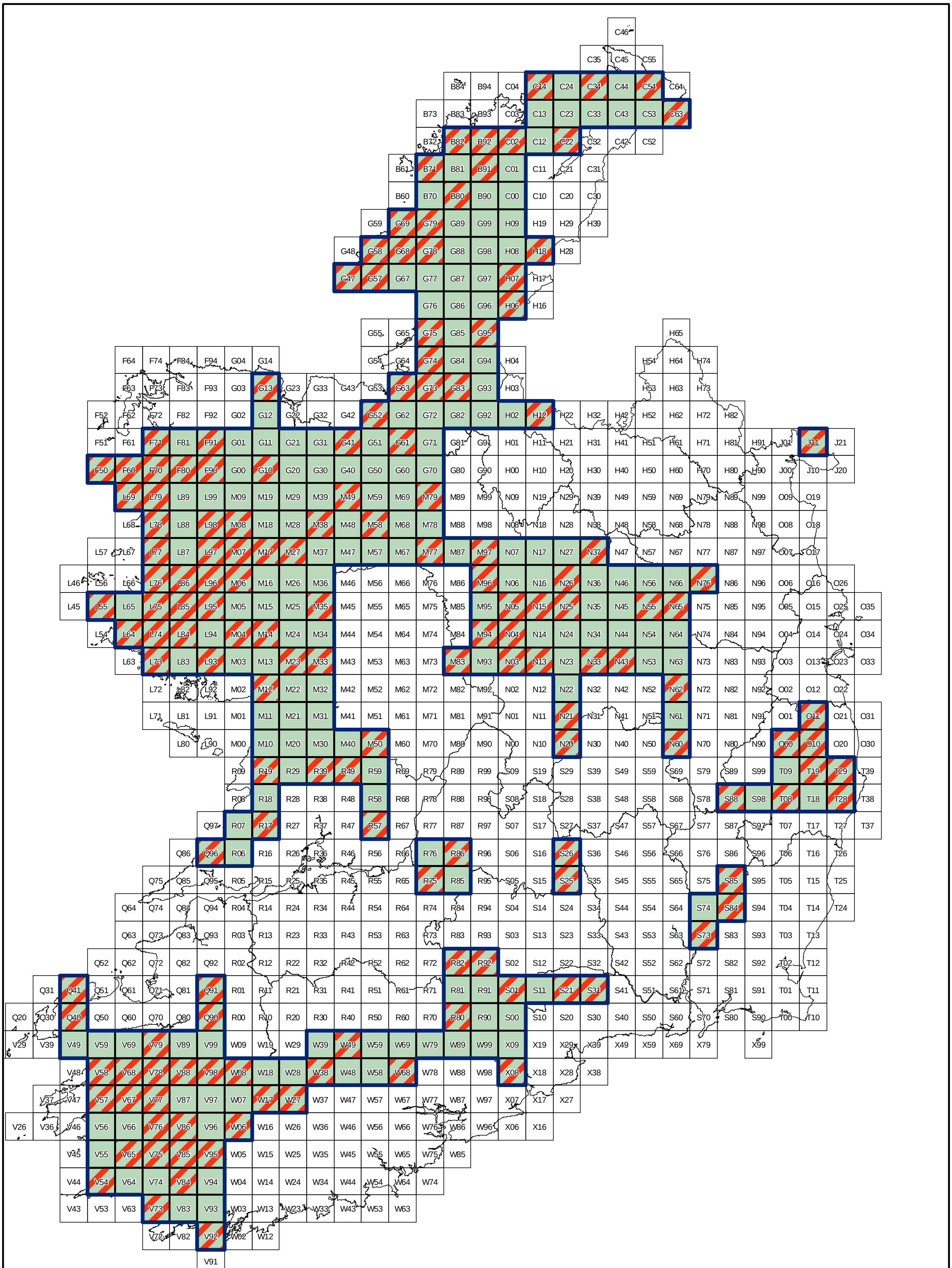
1400 *Leucobryum glaucum*

1. National Level	
Species code	1400
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	http://www.searchnbn.net
2.3 Range	
2.3.1 Surface area	31600
2.3.2 Date	2007
2.3.3 Quality of data	1 = poor
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	1966-2002
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	146 10 km2
2.4.2 Date of estimation	1988
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	1 = poor
2.4.5 Trend	0 = stable
2.4.7 Trend-Period	1966-1988
2.4.8 Reasons for reported trend	NA
2.4.9 Justification of % thresholds for trends	NA
2.4.10 Main pressures	140 grazing
2.4.11 Threats	140 grazing
2.5 Habitat for the species	
2.5.2 Area estimation	11,346 km²
2.5.3 Date of estimation	2000 (Corine Heath, Peatlands, Woodlands & Forestry within range)
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	– = net loss
2.5.6 Trend-Period	1990-2000
2.5.7 Reasons for reported trend	Assumed main reasons for change of species habitat where known 3 = direct human influence (restoration, deterioration, destruction)
2.6 Future prospects	Is the species viable in the long term? 1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	31600
2.7.2 Favourable reference population	146 10 km2
2.7.3 Suitable Habitat for the species	11,346 km² - area of habitat which the species could potentially occupy (if available):
2.7.4 Other relevant information	A study was commissioned in 2006 by the National Parks & Wildlife Service, Department of Environment, Heritage & Local Government, Ireland to investigate Wildlife trade in Ireland. There was no evidence of exploitation of this species presented in the report, however the quality of many of the habitats that the species occurs in is declining due to inappropriate grazing regimes. As this species occurs in a wide variety of habitat types its future prospects are considered to be favourable.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Favourable (FV)
Habitat for the species	Inadequate (U1)

Future prospects	Favourable (FV)
Overall assessment of CS[1]	Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Leucobryum glaucum

1400

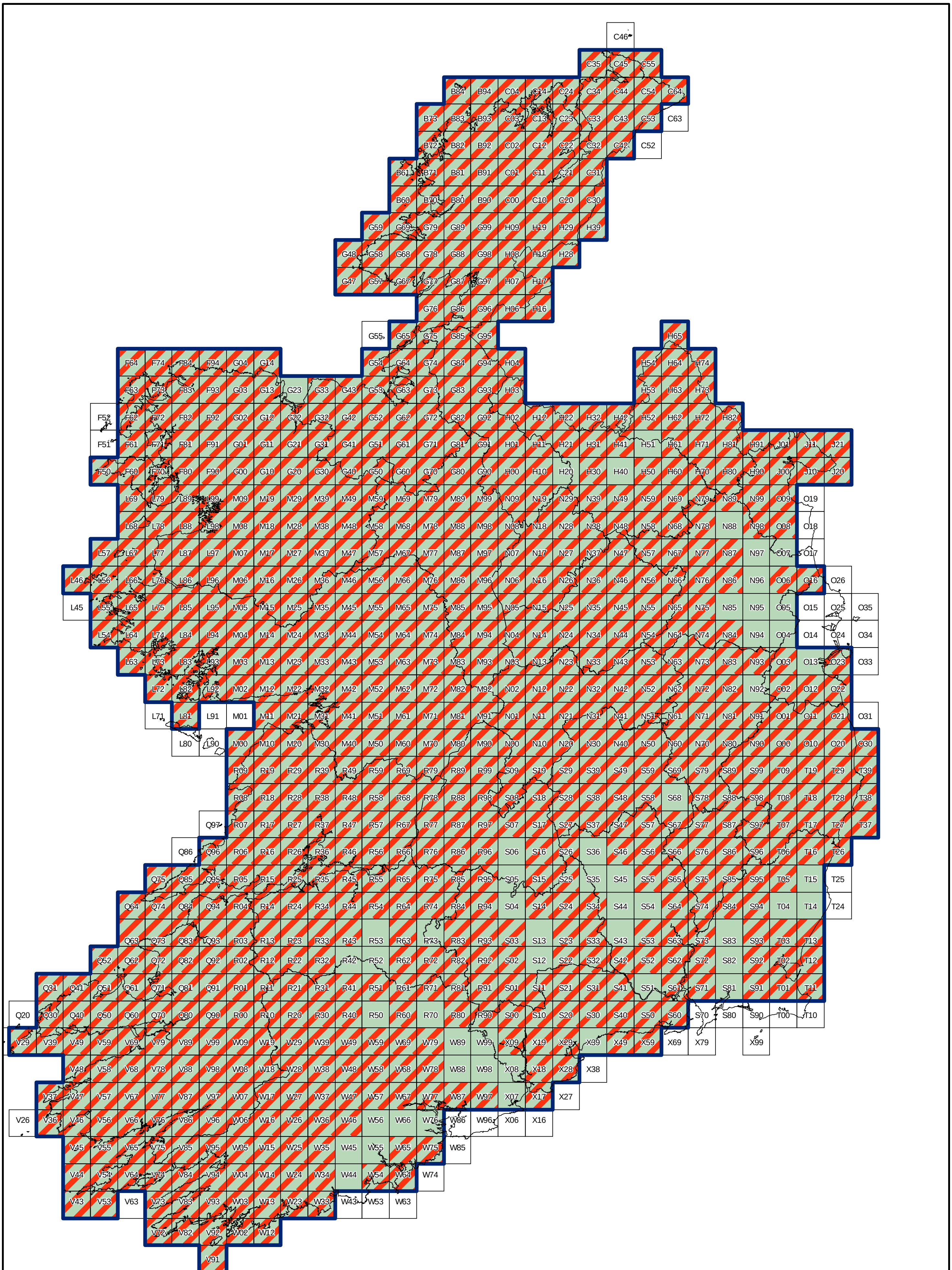
Date: August 2007

1. National Level	
Species code	1409 Sphagnum spp.
Member State	IE
Biogeographic regions concerned within the MS	ATL

2. Biogeographic level	
2.1 Biogeographic region	ATL
2.2 Published sources	None
2.3 Range	
2.3.1 Surface area	82000
2.3.2 Date	1845-2006
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Stable
2.3.6 Trend-Period	1845-2006
2.3.7 Reasons for reported trend	NA
2.4 Population	
2.4.1 Population size estimation	767 grid squares occupied
2.4.2 Date of estimation	1845-2006
2.4.3 Method used	2 = extrapolation from surveys
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Stable
2.4.7 Trend-Period	1845-2006
2.4.8 Reasons for reported trend	NA
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	NA for genus
2.4.11 Threats	NA for genus
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	2006
2.5.4 Quality of data	1 = poor
2.5.5 Trend	Declining
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	3 = direct human influence (restoration, deterioration, destruction)
2.6 Future prospects	poor

2.7 Complementary information	
2.7.1 Favourable reference range	82000
2.7.2 Favourable reference population	767 (grid squares)
2.7.3 Suitable Habitat for the species	Unknown

2.7.4 Other relevant information	Distribution records collated for this genus were, in many cases, incidental to habitat surveys. Pressures & threats were not listed as they would not have the same impact on all of the species in the genus. A study was commissioned in 2006 by the National Parks & Wildlife Service, Department of Environment, Heritage & Local Government, Ireland to investigate Wildlife trade in Ireland. 17 garden centres were visited, two stocked *Sphagnum* moss all of which were sourced in the UK. Four others sold mosses seasonally but did not have any in stock when visited. One noted that they occasionally collect mosses from the local woodland to line hanging baskets. They all noted that demand was generally very low, and that synthetic products were usually used instead of moss. Of eleven additional garden centres contacted by phone, two centres stocked moss. One outlet did not know which species they used; however, all moss was artificially propagated and imported from the UK for use in hanging basket displays. They stated that demand was seasonal. The other stocked *Sphagnum cristatum* from wild sources outside the EU to meet a high demand. Two other centres stated they did not stock any mosses due to lack of demand. ***Conservation impact*** Although some trade in protected species was noted, it appeared to be low-level and, with one exception, did not involve plants collected in Ireland. Government officers felt that illegal collection of these species was not widespread and unlikely to pose a conservation problem. Similarly, the director of the Irish Peatlands Conservation Council noted that *Sphagnum* had in the past been collected for use in hanging baskets, but that this has not really been going on in the last ten years. Although this genus occurs in many widespread habitats, the condition and extent of these habitats is considered to be inadequate. The conservation assessments for Blanket bog and Raised bog and Fen habitats should be taken into consideration for this assessment.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Favourable (FV)
Habitat for the species	Inadequate (U1)
Future prospects	Inadequate (U1)
Overall assessment of CS[1]	Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Sphagnum spp.

1409

Current Distribution (767 cells)
Current Range (820 cells)
Favourable Reference Range (820 cells)
W48 10km grid cells

Date: January 2008

MEDITERRANEAN SALT MEADOW (1410)
CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat Characteristics in Ireland
2. Habitat Mapping
3. Habitat Range
    3.1. Conservation Status of Habitat Range
4. Habitat Area
    4.1. Conservation Status of Habitat Area
5. Structures and Functions
    5.1. Habitat Structures and Functions
        5.1.1. Physical Structure: Creeks and Pans
        5.1.2. Vegetation Structure: Zonation
        5.1.3. Vegetation Structure: Sward Cover
        5.1.4. Vegetation cover: Sward Height
        5.1.5. Vegetation Structure: Characteristic Species
        5.1.6. Vegetation Structure: Negative Indicators (*Spartina anglica*)
        5.1.7. Other Negative Indicators
        5.1.8. Indicators of Local Distinctiveness
        5.1.9. Conservation Status of Habitat Structures and Functions
    5.2. Typical Species
        5.2.1. Geographic distributions
        5.2.2. Conservation Status of Habitat Typical Species
6. Impacts and Threats
    6.1. Grazing
    6.2. Infilling and Reclamation
    6.3. Invasive Species
    6.4. Other Impacts
7. Future Prospects
    7.1. Negative Future Prospects
    7.2. Positive Future Prospects
    7.3. Overall Habitat Future Prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

1. HABITAT CHARACTERISTICS IN IRELAND

Mediterranean salt meadows (1410) is one of five Annex I saltmarsh habitats found in Ireland. Saltmarsh vegetation generally develops in sheltered areas flooded by the tide, such as in estuaries and in the lee of barrier islands and spits, where muddy sediments can accumulate. The slope of the saltmarsh allows the development of several ecological gradients such as tidal submergence and salinity, and this influences the development of distinctive zones of halophytic and salt tolerant plant communities.

Irish saltmarshes may contain several Annex I saltmarsh habitats. Mediterranean salt meadows (from here known as MSM) generally occupy the upper zone of the saltmarsh and is more likely to occur adjacent to the boundary with terrestrial habitats. Other Annex I saltmarsh habitats represent some other distinctive saltmarsh zones. Stands of *Salicornia* on mud and sand (1310) can occur as a pioneer zone to the seaward side of Atlantic salt meadows (ASM). *Spartina* swards (1320) can also form extensive swards to the seaward side of the ASM. Atlantic salt meadows (1330) generally occupy the widest zone of the saltmarsh. Transitional communities between these Annex I habitats may occur and these habitats may also form mosaics with each other.

Irish saltmarshes have been classified according to their morphology (Curtis & Sheehy-Skeffington 1998) with five major types identified (estuary, bay, sandflats, lagoon and fringe). Mediterranean salt meadows can occur in all of these types. Fringe saltmarshes generally have some proportion of MSM and may be dominated by this Annex I habitat. Some regional differences in saltmarsh vegetation have also been identified (Sheehy-Skeffington & Curtis 2000) and these have been related to variation in climatic and management factors.

The Interpretation Manual of EU Habitats (Commission of the European Communities 2003) defines MSM as various Mediterranean communities of the phytosociological alliance Juncetalia maritimi*,* (which belongs to the class Juncetea maritimi). Several sub-types are listed. Most Irish MSM falls into the first sub-type, tall rush saltmarshes dominated by *Juncus maritimus* and/or *J. acutus* (15.51). *Juncus maritimus* is by far the most common tall rush found on saltmarsh in Ireland. Sites containing the rare sedge *Carex divisa* also fall into this sub-type. Some saltmarsh vegetation containing the rare *Puccinellia fasciculata* falls into the fourth sub-type, Iberian salt meadows (Puccinellion fasciculatae*)* (15.54). Mediterranean salt meadows vegetation belongs to Fossitt (2000) habitat class, upper saltmarsh (CM2).

The phytosociological classification of tall rush communities dominated by *Juncus maritimus* in Ireland is somewhat uncertain. *Juncetalia maritimi* is not listed in White and Doyle (1982) and they place the association Junco-maritimi-Oenanthetum lachenalii within the Armerion maritimae, which the Commission of the European Communities (2003) places within Atlantic salt meadows. Wymer (1984) identified several communities dominated by *J. maritimus*. Some of the vegetation was placed within the association Junco-maritimi-Oenanthetum lachenalii. Some of the vegetation communities described in Wymer (1984) were not assigned a specific phytosociological association but were placed within Armerion maritimae and some of the vegetation remained unclassified.

This uncertainly probably reflects the ecological variability of vegetation dominated by *J. maritimus*. Wymer (1984) identified several plant communities with *Juncus maritimus*. Stands and clumps containing *Juncus maritimus* (occasional or frequent but not abundant) can occur in the upper marsh with most of the other species typical of upper zone Atlantic salt meadows also present, such as *Agrostis stolonifera*, *Festuca rubra*, *Juncus gerardii*, *Plantago maritima*, *Glaux maritima* and *Cochlearia officinalis*. Other vegetation may occur that has a high abundance of *Juncus maritimus* and other species present such as *Oenanthe lachenalii*, *Trifolium repens and Leontodon autumnalis*. Dense clumps of species-poor *Juncus maritimus* stands also occur lower down on the saltmarsh zone in the west of Ireland (Curtis 2003) and may occur adjacent to *Spartina* swards. Zonation within stands of *Juncus maritimus* may be observed where several communities occur together (McCorry 2007).

Puccinellia fasciculata and *Carex divisa* are both listed in the Red Data Book (Curtis & McGough 1988) as rare and extinct respectively. *Carex divisa* has subsequently been re-found on two grid squares in Wexford (Curtis & Fitzgerald 1994). Both these species are listed on the Flora Protection Order (Anon. 1999). These two species are found in brackish areas of the upper saltmarsh behind sea walls and embankments where seepage still creates saline conditions (Curtis 2003).

A comprehensive survey of the conservation status of Annex I saltmarsh habitats in Ireland is currently ongoing (McCorry 2007). An initial list containing 31 sites was surveyed in 2006 and a further 100 sites will be surveyed in 2007-2008. The initial list was a representative sample encompassed the variation in Irish saltmarshes with several different saltmarsh types (fringe, estuary, bay, sand flats & lagoon) and different substrates (mud, sand, gravel peat) included (Curtis & Sheehy-Skeffington 1998). Geographical variation was also covered with sites included from the northern, western, southern and eastern coasts of Ireland. Saltmarshes inside and outside designated areas (SACs) were also selected. The completion of the extended list will mean that over 50% of saltmarshes listed on the national inventory (Curtis & Sheehy-Skeffington 1998) will be surveyed.

2. HABITAT MAPPING

The following data sources were used to map the occurrence of ASM in Ireland on 10km square basis:

- Saltmarsh Monitoring Project 2006 (McCorry 2007)
- Coastal Monitoring Project 2004-2006 (Ryle *et al.* 2007)
- Other data sources (Wymer 1984)
- OSI (Ordnance Survey Ireland) 2000 series aerial photographs
- OSI 6 inch maps
- Information on designated sites, (c)SACs and (p)NHAs held on file by the National Parks and Wildlife Service (NPWS)
- National saltmarsh inventory (Curtis & Sheehy-Skeffington 1998)

McCorry (2007) mapped the extent of each Annex I habitat including MSM at 31 saltmarsh sites around Ireland (28 from national inventory). Ryle *et al.* (2007) also mapped some Annex I saltmarsh habitat at 48 other coastal sites (mainly sand dune and machair) during the Coastal Monitoring Project 2004-2006. Some but not all of these sites are also listed on the national saltmarsh inventory (Curtis & Sheehy-Skeffington 1998).

The entire coastline of Ireland was examined for this report to map general saltmarsh vegetation using OSI 2000 series colour aerial photos in conjunction with OSI 6 inch maps. General saltmarsh was mapped using a GIS - Geographic Information System (ESRI Arcview 3.2) by drawing polygons over background aerial photos and/or OSI 6 inch maps. Locations of most saltmarshes (238) were known from the national saltmarsh inventory (Curtis &

Sheehy-Skeffington 1998). These include nearly all of the larger sites. An additional 157 sites were identified from the survey of aerial photos. This group includes a number of sub-sites of some of the larger sites (e.g. Shannon Estuary) and many small sites at locations not included in the original national inventory.

Most saltmarsh sites have more than one Annex I saltmarsh habitat present (McCorry 2007). However, individual Annex I saltmarsh habitats can only be identified with certainty in conjunction with field based surveys. *Spartina* swards may be distinguished in some instances from other saltmarsh vegetation from the aerial photos, particularly where the original saltmarsh is mapped on the OSI 6 inch map. By overlaying the OSI 6 inch map over the aerial photos the change in extent of saltmarsh is visible and significant changes usually indicates the spread of *Spartina* swards. This habitat also has a distinctive morphology with large circular clonal patches of *Spartina anglica* at the seaward side of *Spartina* swards that can be used to identify this habitat from aerial photos.

Fringe type saltmarshes generally contain some element of MSM and may be dominated by this Annex I habitat. The locations of these saltmarshes are known from Curtis and Sheehy-Skeffington (1998). All of these saltmarshes were assigned the habitat category - mosaic of Atlantic and Mediterranean salt meadows.

Wymer (1984) mapped the distribution of different saltmarsh communities around the Irish coast and these data were used to identify saltmarsh sites with MSM plant communities. Each mapped polygon was assigned to a potential saltmarsh habitat using the data sources described above and best expert opinion. Many polygons were assigned a generic saltmarsh habitat category (mosaic of Atlantic and Mediterranean salt meadows) where there was no information to identify the specific Annex I habitat present.

These data were used to plot the distribution of sites known to have MSM. The distribution of this habitat is illustrated on a 10km square grid by selecting those squares where the habitat is estimated to be present. Some data was also available from NPWS files and databases about the relative distribution of MSM. This habitat is listed as a qualifying interest for 32 SACs in Ireland. Some grid-squares within these SACs were selected as part of the distribution of MSM where MSM was already identified during the GIS survey of aerial photos. Additional grid squares were also selected for MSM within these SACs where general saltmarsh was also identified during the GIS survey of aerial photos.

This data set was also used to plot the range of MSM. Range was defined by mapping a minimum polygon around the identified occurrences. Breaks in the range were justified when there was a gap of 2 grid squares or greater between occurrences. Breaks in the range were also justified where the gaps did not contain general saltmarsh habitat as identified during the GIS survey of aerial photos. These gaps were usually dominated by other coastal habitats more typical of exposed coastlines such as cliffs and rocky shorelines.

3. HABITAT RANGE

Mediterranean salt meadows are distributed around most of the coastline of Ireland. The indented topography of the Irish coastline with many inlets has created an abundance of sites that are sheltered and allow muddy sediments to accumulate, leading to the development of saltmarsh. Several sections of the Irish coastline, such as the eastern Wexford and Wicklow coasts, contain fewer saltmarsh sites as the topography is much less indented and the coastline is more exposed. These coastlines are dominated by coastal habitats such as cliffs, rocky shorelines, beach and shingle banks that are associated with higher energy coastal environments. Gaps in the range of this habitat along the coastline contain other coastal habitats that are typical of more exposed environments or contain saltmarsh sites where MSM has not been confirmed. The range of MSM may expand as more information becomes available from future ground surveys of saltmarshes.

The range of MSM may have contracted slightly in the past due to the infilling and reclamation of some former saltmarsh for agricultural purposes at many sites around the country. Most of this reclamation occurred in the 18-19th century. Some saltmarsh habitat is likely to have been lost along the landward side of the some of the existing sites. This type of reclamation is more likely to have had a more significant effect on MSM compared to ASM due to the more common position of MSM adjacent to the terrestrial boundary. Saltmarsh is still maintained at most of the sites where reclamation has occurred so its impacts are probably minor. Former saltmarsh was also infilled and reclaimed in most of the major estuaries for port, urban and industrial purposes (Curtis 2003). This is likely to have contracted the historical range of the habitat by several grid squares at locations like Dublin Bay and the Boyne Estuary along the estuaries seaward towards the coast (McCorry pers. obs. 2007).

3.1. Conservation Status of Habitat Range

The habitat range at the beginning of the assessment period (i.e. 1995 when the Irish Ordnance Survey first produced a nationwide series of aerial photos) is taken as the favourable reference range (FRR). This habitat range is the same as the current reference range and still encompasses all the ecological variation of this habitat in Ireland. The MSM habitat is still widespread around the coast of Ireland and all sub-types are still present. The historical habitat range was likely to be been somewhat greater compared to the FRR but only by several grid squares. However, historical losses of habitat are not considered (i.e losses due to large scale reclamation in the 18-19th century). There are virtually no prospects for restoration of former saltmarsh habitat back into urban areas, industrial areas and ports, as these areas are protected by sea walls and will be maintained. So the FRR is as large as can be achievable.

Many large poldered areas used for agriculture are also currently being protected by large maintained embankments and there are very limited prospects for restoration of habitat. Mediterranean salt meadows is redeveloping naturally at some sites where drainage and attempts at reclamation occurred. This, however, is unlikely to have a significant impact on the range of this habitat.

Small losses of habitat during the current assessment period have not affected the current range. The habitat range of MSM is assessed as **favourable**.

4. HABITAT AREA

As described above, saltmarsh has been reclaimed in the past. Some estuaries and bays had sections that were poldered or cut off by sea walls and embankments from the sea. These areas of intertidal mudflats, saltmarsh and other habitats have been drained and improved for agricultural purposes. Smaller scale reclamation can be seen in the upper saltmarsh zone of many sites around the country, where small areas have been embanked and infilled or drained. Some of these reclaimed areas have now been abandoned and are redeveloping or may redevelop saltmarsh in the future. Saltmarsh was also infilled and reclaimed for urban and industrial purposes. Substantial areas of MSM are likely to have been reclaimed so the current habitat area is less compared to the historical habitat area.

The favourable reference area (FRA) is taken as the habitat area at the beginning of the reporting period. This habitat area is similar to the current habitat area and still encompasses all the ecological variation of MSM and has the capacity to sustain this habitat in Ireland. As described above, there are virtually no prospects for the restoration of former habitat destroyed in the 18^{th} and 19^{th} centuries for urban and industrial purposes. There are some prospects for the restoration of former habitat within areas reclaimed for agriculture, as un-maintained embankments deteriorate and allow the sea to flood former habitat areas. However, the proportion of habitat that can be restored in this way is minor as embankments and seawalls are largely maintained.

The current national area of MSM as estimated by the survey of aerial photos of the entire coastline is 570 ha (calculated by summing the area of polygons assigned to this habitat category). This figure is 17% of the total national saltmarsh area (total area of polygons), not including *Spartina* swards. However, the area of MSM is probably under-estimated due to the difficulty of distinguishing Annex I habitats from aerial photographs. McCorry (2007) mapped 675 ha of Annex I saltmarsh habitat at 31 sites and MSM made up 25% of this area. Only 12% of the saltmarshes listed on the national saltmarsh inventory (Curtis & Sheehy-Skeffington 1998) were surveyed during the initial Saltmarsh Monitoring Project (McCorry 2007) so this estimate should also be treated with caution.

For this conservation assessment a figure of 20% is taken as the actual proportion of established saltmarsh that is MSM. The total national resource of established saltmarsh has been estimated to be 3,240 ha from the GIS survey of aerial photos of the entire coastline of the Republic of Ireland. Therefore, the estimated area of MSM is 650 ha (20% of 3240 ha).

4.1. Conservation Status of Habitat Area

The habitat area of MSM decreased slightly during the current assessment period with a reported loss of 0.13 ha from sites surveyed by McCorry (2007). There were no losses of habitat in SACs reported by NPWS site inspections during the current reporting period. The most significant losses were caused by developing a car park at one site and by some infilling and reclamations at two other sites. These reported losses represent an estimated 0.02% reduction in the FRV. There are likely to be some unreported losses.

Erosion was not noted as a significant impact on MSM by McCorry (2007). The MSM is protected to some extent by its location close towards the landward side of the saltmarsh, with ASM or *Spartina* swards as a buffer. Coastal erosion does not seem to be affecting Irish saltmarshes to the same extent as in Britain, where erosion and coastal squeeze has resulted in a significant loss of saltmarsh habitat (Boorman 2003). Erosion was not reported as an impact by NPWS staff during site inspections of Annex I saltmarsh habitats in SACs. However, while there is no published data to indicate that saltmarshes are eroding in the Republic of Ireland, studies in the Northern Ireland of ‘soft coastlines’ indicates that they are eroding at various rates (Carter & Bartlett 1990). This was attributed to natural shoreline adjustment to secular or long-term changes in sea level. However, extraction of sands and gravels was found to greatly enhance the rates of erosion occurring at sites.

Spartina anglica has been planted and has also spread onto many of the established Irish saltmarshes along the eastern, southern and north-western coasts in the past 90 years. This species is a characteristic part of the lower saltmarsh zone of several sites and in some cases has transformed portions of former ASM into *Spartina*-dominated swards (1320). This species was recorded at several locations on MSM, but it generally does not have a significant impact on this habitat. There are no examples of MSM dominated by *J. maritimus* being replaced by *Spartina* swards in Ireland. The second sub-type of MSM that is characterised by *Puccinellia fasciculata* is affected by *S. anglica* at one site.

The conservation status of habitat area was assessed at 21 sites in 2006 (McCorry 2007). Nineteen sites had a favourable habitat area. Two sites had an unfavourable-bad habitat area due to losses of habitat by infilling and reclamation.

The conservation status of the habitat area is assessed as **favourable (FV)** because the estimated 0.02% loss of the favourable reference area in the current reporting period represents a negligible amount.

5. STRUCTURES AND FUNCTIONS

5.1. Habitat Structures and Functions

The following generalised attributes were assessed for Irish Annex I saltmarsh habitats at 31 sites selected as a representative sample of Irish saltmarshes during the Saltmarsh Monitoring Project 2006 (McCorry 2007). The site list was a representative sample encompassed the variation in Irish saltmarshes with several different saltmarsh types (fringe, estuary, bay, sand flats & lagoon) and different substrates (mud, sand, gravel & peat) included (Curtis & Sheehy-Skeffington 1998). Geographical variation was also covered with sites included from the northern, western, southern and eastern coasts of Ireland. Saltmarshes inside and outside designated areas (SACs) were also selected. These attributes have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of saltmarshes (JNCC 2004) with inputs from NPWS, Research Branch staff.

- Physical structure: creeks and pans
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation structure: sward height
- Vegetation composition: characteristic species
- Indicators of negative trend (*Spartina anglica*)
- Other negative indicators
- Indicators of local distinctiveness, such as notable plant species or vegetation mosaics. These are site-specific features, which are not adequately covered by the other attributes.

The structure and functions data from this representative survey (McCorry 2007) has been extrapolated to assess structure and functions at a national level. However, as only 12% of the sites on the national inventory were surveyed, this extrapolation may be vulnerable to regional or localised variation in condition of saltmarsh habitats and management. For example, Curtis and Sheehy-Skeffington (1998) stated that grazing was much more predominant on the west coast of Ireland. It is anticipated that when the survey sample is increased, the impact of grazing will also increase as more of these sites are located on the west coast.

5.1.1. Physical structure – creeks and pans

This attribute assessed the condition of the creeks and pans in the saltmarsh habitats. Signs such as the dissection and enlargement of creeks and pans could indicate erosional trends. The main target was no further human alternation of creek function. The drainage structure of some creeks within MSM has been affected in the past by the creation of artificial drains at various saltmarsh sites (McCorry 2007). However, there were no signs that the structure of creeks and pans has been affected within the current reporting period. The physical structure of many saltmarshes is still adjusting to past reclamation and disturbance such as old sea walls, embankments and drains. The structure and functions of this attribute are assessed as **favourable**.

5.1.2. Vegetation structure: zonation

This attribute assessed the presence of plant zonation. The main target was to maintain a range of plant zonation typical of the site. The size of a site and habitat was taken into account, as a small patch of habitat may be significantly zoned. Some stands of *J. maritimus* were quite uniform, but this may be a natural feature. Saltmarsh zonation was maintained at all of the sites surveyed in 2006 (McCorry 2007). This attribute is assessed as **favourable**.

5.1.3. Vegetation structure: sward cover

This attribute assessed the amount of plant cover over the saltmarsh surface. This attribute was useful for identifying areas damaged by poaching and disturbance by livestock or eroding saltmarsh. Stops with greater than 5% bare substrate cover failed structure and functions. About 5% of monitoring stops failed to reach this target or an associated target for levels of poaching (McCorry 2007). This attribute is assessed as **unfavourable-inadequate**.

5.1.4. Vegetation structure: sward height

This attribute assessed the diversity of the sward structure. The main target was to maintain site specific structural variation in the sward of MSM. The main guideline is to maintain a 25%:75% ratio of tall/short sward height. This attribute is assessed as **favourable**.

5.1.5. Vegetation structure characteristic species

This attribute assessed the species diversity of the Annex I habitats. The target for each habitat was to maintain the presence of typical species. Zonation should be taken into account with typical species varying for different zones. The status of typical species is described in more detail in Section 6.2.

5.1.6. Vegetation structure –negative indicators (*Spartina anglica*)

This attribute assessed the impact of *Spartina anglica*, which is considered a negative indicator. The main target was no evidence of recent expansion of *Spartina anglica* into MSM during the current monitoring period (< 10% during the reporting period). For sites with no previously known *S. anglica* cover the target was no new sites with this species. McCorry (2007) only recorded this species on MSM at on site. Mediterranean salt meadows habitat was recorded adjacent to *Spartina* swards at three sites (McCorry 2007).

5.1.7. Other negative indicators

This attribute assessed the impact of other negative indicators such as dumping, trampling or vehicle use, which may affect an individual part of the saltmarsh. The main target was that negative indicators should not affect more than 5% of the habitat area during the assessment period. The most frequent 'other' damaging impact was wheel ruts created by agricultural vehicles using the saltmarsh for access. There were also some instances of dumping of construction and other waste on MSM. This attribute was assessed as **favourable** as 'other' damaging activities were not significant.

5.1.8. Indicators of local distinctiveness

This attribute assessed the presence of known records of rare plants, certain habitats or other features during site visits. The main target was to maintain the presence and extent of the elements of local distinctiveness. This attribute was site specific. Features of local distinctiveness in the MSM recorded during McCorry (2007) included the presence of rare species such as *Puccinellia fasciculata* (also listed in Red Data Book - Curtis and McGough 1988) and uncommon species such as *Juncus acutus*. This attribute was assessed as **favourable**.

5.1.9. Conservation Status of Habitat Structures and Functions

Fifteen sites (71%) surveyed during 2006 (McCorry 2007) were assessed as having favourable structure and functions, 2 sites (10%) had an unfavourable-inadequate conservation status and 4 sites (19%) were assessed as having an unfavourable-bad conservation status.

When individual site data is combined, McCorry (2007) found that 5% of monitoring stops carried out in 2006 failed (attributes did not reach their targets). This indicates that these failed monitoring stops were distributed widely. The most common attribute not to reach its target was plant cover, indicating that grazing and associated poaching was by far the most significant activity affecting the structure and functions of MSM. These results compare with observations by Curtis and Sheehy-Skeffington (1998) that many saltmarshes on the west coast of Ireland were overgrazed and many sites on the east coast were not significantly grazed. The sample studied during 2006 was quite small and it is anticipated that when the sample is increased, the proportion of monitoring stops (and the survey area) that will not reach their target may also increase as most of these sites are on the west coast where grazing is more prevalent. However, as current data indicates that at most 5% of MSM has an unfavourable habitat structure and functions, the conservation status of the habitat structure and functions is assessed as **unfavourable inadequate**.

5.2. Typical Species

All of the species found in the various sub-types of MSM may be found in other saltmarsh communities, particularly those of the ASM and in *Spartina* swards (Table 1). The key habitat attribute of the main MSM sub-type is the dominance of *Juncus maritimus*. The other sub-types are characterised by the presence of characteristic species such as *Puccinellia fasciculata* and *Carex divisa*. Most species found in MSM may be found in other coastal habitats such as machair, sand dunes, brackish habitats and around coastal lagoons, while grass species such as *Agrostis stolonifera* and *Festuca rubra* are both found in a variety of grassland habitats.

5.2.1. Geographical variations

Several species found on Irish saltmarshes display distinctive geographical variations. Stands of *Juncus acutus* also fall into the main sub-type of MSM. This species is much more uncommon compared to *J. maritimus* and has a restricted distribution around the south-east and southern coasts of Ireland. *Puccinellia fasciculata* also has a similar distribution. *Carex divisa* is only found in the Barrow Estuary.

5.2.2. Conservation Status of Habitat Typical Species

The presence of typical or characteristic species was one of the attributes assessed for structure and functions during the Saltmarsh Monitoring Project 2006. Typical species for this habitat are listed in Table 1. Nomenclatuture follows Stace (1997). The conservation status of typical species of ASM is assessed as **favourable,** considering that targets were reached for typical species.

Table 1. Typical species for Mediterranean salt meadows in Ireland.

Species	**Listed in Interpretation Manual of EU Habitats (Commission of the European Communities 2003)**	**Listed in White and Doyle (1982) Character species of MSM syntaxa**	**Most common species recorded during McCorry (2007)**
Agrostis stolonifera			*
Apium graveolens		*	
Armeria maritima		*	*
Aster tripolium	*	*	
Althaea officinalis		*	
Atriplex portulacoides			*
Atriplex prostrata			*
Bolboschoenus maritimus		*	
Carex divisa	*		
Carex distans		*	
Carex extensa	*		*
Cochlearia officinalis			*
Festuca rubra		*	*
Glaux maritima		*	*
Juncus acutus	*		
Juncus gerardii	*	*	*
Juncus maritimus	*	*	*
Oenanthe lachenalii		*	*
Parapholis strigosa		*	
Plantago maritima		*	*
Potentilla anserina			*
Puccinellia fasciculata	*		*
Spergularia media		*	
Triglochin maritimum		*	*
Trifolium repens			*

6. IMPACTS AND THREATS

McCorry (2007) summarised the main impacts affecting MSM surveyed at 31 sites in 2006. There were few impacts or activities that have caused irreparable damage and loss of saltmarsh area and most activities were assessed as either having a reparable negative impact or no significant impact. The most common impact in the current assessment period is over-grazing by cattle (143) or sheep (142). There has been some minor losses of habitat during the current assessment period to infilling (800) and reclamation (802).

Additional information is also available from the NPWS Site Inspection Reporting (SIR) database about impacts and activities affecting Annex I habitats in SACs during the current reporting period. Curtis (2003) also discusses the main uses of and impacts on saltmarshes in Ireland and these generally reflect the data from McCorry (2007). The MSM habitat has been subject to much more extensive reclamation, infilling and drainage in the past. Old drains cross this habitat and some creeks have also been channelised. Some drains may be fairly regularly cleaned or deepened. As these impacts have occurred prior to the current assessment period they are not assessed. Curtis (2003) also discusses the motivations for historical infilling and reclamation of saltmarshes most prevalent in the 18th and 19th centuries and the pressure of development in more recent times.

6.1. Grazing

Grazing (140) was the most common impact with 67% of the total MSM area surveyed in 2006 grazed by sheep and or cattle (includes sustainable and unsustainable grazing levels) (McCorry 2007). Mediterranean salt meadows is also naturally grazed by rabbits and hares (146). The impact of grazing is lower on MSM compared to ASM. This is because the dense clumps of *Juncus maritimus* shield the other vegetation somewhat. Various levels of over-grazing were recorded during the survey. Few sites were completely affected by overgrazing and it was more common to have a portion of the site affected. McCorry (2007) also stated that overgrazing by cattle affected about 12% of the total MSM area surveyed in 2006, and overgrazing by sheep affected 5%, and these areas overlapped (overall area damaged by over-grazing is 14%).

Sheep will move through this habitat but will selectively graze small patches of Atlantic salt meadow amongst the clumps of *Juncus maritimus*. This means that the MSM is generally in better condition compared to ASM on sites that are grazed. Very heavy sheep grazing can damage this habitat and create bare substrate patches. Heavy cattle grazing is more likely to damage this habitat and cattle will poach this habitat severely and create bare patches of substrate if they are left on the saltmarsh for a relatively long time. Curtis and Sheehy-Skeffington (1998) in compiling the national saltmarsh inventory noted a regional variation in the levels of grazing. Most western coastline saltmarshes were grazed by livestock while most eastern saltmarshes were not.

Most studies and reports on the impact of grazing on saltmarshes and on the management of saltmarshes suggest that light grazing has a positive influence (Boorman 2003). As well as the direct removal of green shoots by the grazing animals, grazing also reduces the build-up of the surface litter layer. Adam (1990) points out that this could favour plant species diversity but this is only likely to be of overall significance at low grazing densities. At higher grazing intensities the impact of trampling may well outweigh any benefits of the control of the coarser vegetation. Heavy grazing in the lower marsh leads to a lowering of species diversity.

Poaching by cattle was a significant negative impact recorded during the 2006 survey. However, Boorman (2003) noted that low trampling intensities provided micro-habitats that allowed pioneer species such as *Salicornia* sp. and *Suaeda maritima* to persist. Trampling at low intensities may have a positive influence. However, heavy poaching leads to the destruction of the saltmarsh surface.

Current trend

No comparable records are available.

6.2. Infilling and reclamation

The position of MSM along the landward side of the ASM and frequently adjacent to the landward boundary of the saltmarsh means it is more vulnerable to infilling, reclamation and dumping. However, these activities have not occurred frequently during the current reporting period. Small portions of several sites were infilled (800) and reclaimed (802) during the current reporting period. These reclaimed areas can then be used for development (490). The 2006 survey (McCorry 2007) found that 0.15 ha of the total surveyed MSM had been destroyed with most of this habitat being covered by a car park. A car park had been constructed on part of one site by the local authority (to help limit the impact of amenity traffic on the rest of the saltmarsh). A small patch of MSM was infilled with construction waste at another site (422, 423) and reclaimed. Infilling has two roles, the elimination of unwanted waste material and reclamation of poorer land. Site inspection reports of SACs by NPWS staff also list several sites where there has been dumping (423), infilling and reclamation (802) of MSM habitat that has been used for development of housing (402), factories (411) or for industrial purposes. However, the reported loss only represents an estimated 0.02% of the MSM area at the beginning of the reporting period and is a negligible area.

These impacts were much more widespread in the past when significant areas of saltmarsh were reclaimed for agricultural, urban and industrial purposes.

Current trend

Likely to be reducing

6.3. Invasive species

The only invasive species (954) that was recorded on MSM was *Spartina anglica* (McCorry 2007). This species has a widespread distribution around the coast of Ireland, although it is not frequently found on many saltmarshes between Clare and Sligo on the west coast. It is more likely to be found on Atlantic salt meadows rather than MSM due to the relative position of MSM in the upper zone of the salt marsh. This species was only recorded on MSM at one site and *Spartina* swards occur adjacent to MSM at three sites. However, Wymer (1984) notes several sites along the west coast of Ireland where stands of *Juncus maritimus* are found adjacent to *Spartina* swards. There are no examples of MSM dominated by *J. maritimus* being replaced by *Spartina* swards in Ireland. The second sub-type that is characterised by *Puccinellia fasciculata* may be affected by *S. anglica* at one site. This vegetation community is probably more vulnerable to the spread of *S. anglica* as this species has the competitive edge due to its morphology. However, this community usually favours less brackish conditions, which usually do not favour *S. anglica*. The overall impact of *S. anglica* on MSM is likely to be quite low overall.

Current trend

Stable.

6.4. Other impacts

Erosion (900) also affects this habitat, although not to the same extent as it affects ASM. Rivers and large channels flowing through the MSM can erode and accrete this habitat and this occurs at several sites. Some of this habitat at one site is eroding down to underlying gravel or rocky deposits, but this is being induced by heavy grazing levels (143). Tracks are also quite frequent on saltmarshes (501). These tracks are used by farm vehicles and other vehicles to access other parts of the saltmarsh and to access the shoreline and intertidal area. Tracks were also created by walkers and horse-riders. The intensity of use varies from tracks where the sward height is affected by trampling or compaction to tracks where the vegetation cover and sediment has been eroded away to rocky bedrock or rocky substrates from heavy use. Telegraph or Electricity poles are sometimes positioned on the habitat (511).

Current trend

Stable or reducing. Some of the tracks used to access the shoreline for the purposes of the collection of seaweed are now disused.

7. FUTURE PROSPECTS

7.1. Negative Future Prospects

McCorry (2007) reported that the future prospects of MSM at 38% of individual sites were unfavourable-inadequate or unfavourable-bad. This site-specific assessment was based mainly on the assumption that current grazing levels, which were negatively affecting the structure and functions of many of these sites were likely to continue in the future. Grazing is likely to continue on many western sites in Ireland.

Climate change predictions of increases in sea-level in the future are expected to increase erosion of saltmarsh in Ireland (Devoy 2003, Fealy 2003). Mediterranean salt meadows are likely to be less affected initially compared to the impact on ASM due to its position in the upper zone of the saltmarsh. Saltmarsh is predicted to move landward in response to sea-level rise and may be subject to ‘coastal squeeze’ where this migration is impeded by artificial defensive structures such as sea walls. However, there were no significant indications of any erosional trends on saltmarshes due to sea level rise at the sites visited during the 2006 survey (McCorry 2007). There is little data in Ireland to assess with accuracy the potential impacts of climate change on MSM.

7.2. Positive Future Prospects

The Saltmarsh Monitoring Project 2006 (McCorry 2007) reported that 12 of 31 sites (39%) were assessed as having a favourable conservation status.

A significant proportion of saltmarsh sites on the national inventory (Curtis & Sheehy-Skeffington 1998) are completely or partially located within SACs (77%), with some additional sites within NHAs (7%), and therefore should be partially protected from infilling and reclamation. Notifiable actions have been set for saltmarsh habitats within SACs. Actions such as alteration of watercourses, reclamation, and the use of the saltmarsh for commercial activities require consent from the Department of Environment, Heritage and Local Government.

Grazing of livestock is also a notifiable action and grazing levels should also be controlled within SACs by NPWS Conservation Plans, but this does not always occur in practise on many coastal sites. The intensity of grazing and number of sites being grazed may decrease in the future due to several reasons. Some NPWS Conservation Plans and Department of Agriculture Farm Plans are setting sustainable grazing levels for designated areas (SACs and NHAs) and for farms working in the Rural and Environment Protection Scheme (REPS). Overgrazing should decrease as these stocking rates are enforced. Stocking rates of livestock in Ireland in general are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (FAPRI-Ireland Partnership 2003). This is also likely to have a significant effect on future numbers of livestock grazing on marginal land such as saltmarsh.

The position of MSM in the upper zone of the saltmarsh means this habitat may be more vulnerable to infilling and reclamation than other saltmarsh habitats. However, only a negligible area of MSM was reported as destroyed during the current reporting period (McCorry 2007). The MSM habitat has been subject to much more extensive reclamation, infilling and drainage in the past, prior to the current reporting period.

Several large infrastructural projects in Ireland have had to mitigate the environmental impact of development on saltmarsh. These mitigation measures have significantly reduced the impact of some large-scale developments like motorway bridges on saltmarsh habitat (Murray 2003). The impact of *S. anglica* on MSM is likely to be much less significant compared to the predicted impact on ASM. Mediterranean salt meadows have the capacity to re-develop on land disturbed by reclamation attempts.

7.3. Overall Habitat Future Prospects

Grazing is the most significant impact affecting the future prospects of this habitat. Currently some grazing levels outside and within SACs are still unsustainable and are affecting the structure and functions of this habitat. While some grazing level agreements are in place and are having a positive impact at several sites, there are no agreements or no proper enforcement of grazing agreements at most other sites. Saltmarsh can, however, recover from heavy grazing quite quickly (several years). The 2006 survey (McCorry 2007) estimated that only 14% of the area surveyed during 2006 was affected by over-grazing and various levels of over-grazing were recorded during the survey.

The amount of infilling and reclamation of saltmarsh within designated areas should decrease due to monitoring and enforcement by NPWS staff. Infilling of non-designated sites should be regulated by local authorities as this normally requires a waste licensing permit. *Spartina anglica* is not likely to have a significant impact on MSM in Ireland in the future.

Overall, the habitat future prospects are assessed as **unfavourable inadequate,** as less than 25% of monitoring stops were affected by over-grazing, while infilling and reclamation is likely to decrease.

8. OVERALL ASSESSMENT OF THE HABITAT CONSERVATION STATUS

The habitat conservation status of the four main attributes has been assessed either as **Favourable** or as **Unfavourable Inadequate** at national level.

- The Natural Range of Mediterranean Salt Meadows is considered to be **Favourable**. The Favourable Reference Range is defined by the current range of MSM.
- The Area of Mediterranean Salt Meadows habitat has decreased by an estimated 0.02% in an eleven year reporting period (1995-2006). This attribute was assessed as **Favourable** with a negligible loss.

- The habitat Structure and Functions have been assessed as **Unfavourable-Inadequate**. About 14% of ground-surveyed MSM had a damaged sward cover with < 5% bare ground and/or heavy poaching caused by over-grazing (McCorry 2007).
- The Future Prospects are assessed as **Unfavourable-Inadequate**. Unsustainable grazing levels are likely to only decrease slowly.

The overall conservation status for Mediterranean Salt Meadow habitat is **Unfavourable-Inadequate**.

9. REFERENCES

Adam, P. (1990). *Saltmarsh ecology.* Cambridge University Press, London.

Anonymous (1999). *Flora Protection Order 1999.* Government of Ireland.

Boorman, L.A. (2003). *Saltmarsh Review. An overview of coastal saltmarshes, their dynamic and sensitivity characteristics for conservation and management.* JNCC Report, No. 334, JNCC, Peterborough.

Carter, R.W.G. and Bartlett, D.J., 1990. Coastal erosion in Northeast Ireland – Part I: Sand beaches, dunes and river mouths. *Irish Geography* **23,** 1–16.

Commission of the European Communities (2003). *Interpretation manual of European Union Habitats-EUR 25.* DG Environment-Nature and Biodiversity. Brussels.

Curtis, T.G.F. & Fitzgerald, R.J. (1994). The re-discovery of *Carex divisa* Hudson, divided sedge, in Ireland. *Irish Naturalists Journal*, **24**, 496-498.

Curtis, T.G.F. & McGough, H.N. (1988). *The Irish Red Data Book*. Stationary Office, Dublin.

Curtis, T.G.F.C. and Sheehy-Skeffington, M.J. (1998). The Salt Marshes of Ireland: An Inventory and Account of their Geographical Variation. *Biology and Environment: Proceedings of the Royal Irish Academy* **98B**, 87-104.

Curtis, T.G.F. (2003). Salt marshes. In: *Wetlands in Ireland*, (Ed. M.J. Otte). UCD Press, Dublin.

Devoy, J. (2003). Coastal vulnerability and the implications of sea-level rise for Ireland. *Journal of Coastal Research*. Submitted for publication. http://geography.nuim.ie/ICARUS/present/Coastal%20Vulnerability.pdf

FAPRI-Ireland Partnership (2003). *An analysis of the effects of decoupling of direct payments from production in the Beef, Sheep and Cereal Sectors.* Report prepared for the Department of Agriculture and Food. Teagasc Rural Economy Research Centre. Sandymount, Dublin. www.tnet.teagasc.ie/fapri

Fealy, R. (2003). The impacts of climate change on sea level and the Irish coast. In, *Climate change: Scenarios and impacts for Ireland*. (Eds. J. Sweeney *et al.*). (2000-LS-5.2.1-M1). Environmental Protection Agency, Johnstown.

Fossitt, J. (2000). *A guide to habitats in Ireland*. Heritage Council, Kilkenny.

JNCC. (2004). *Common Standards Monitoring guidance for saltmarsh habitat*. JNCC, Peterborough.

McCorry, M. (2007). *Saltmarsh Monitoring Project 2006 – Summary Report*. An unpublished report for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Murray, A. (2003). *Monitoring of saltmarsh flora during the construction of the Northern Motorway Project 2001-2003.* Unpublished report for Fingal County Council.

Ryle T, Connelly, K. and Murray, A. (2007). *Coastal Monitoring Project.* A survey for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Sheehy Skeffington, M.J. & Curtis, T.G.F. (2000). The Atlantic element in Irish salt marshes. In, *Biodiversity: The Irish dimension,* (Ed. B.S. Ruston). Proceedings of a Royal Irish Academy Seminar 1998. Royal Irish Academy, Dublin, pp. 179-196.

Stace, C. (1997). *New Flora of the British Isles* (2nd Ed.). Cambridge University Press, Cambridge.

White, J. & Doyle, G.J. (1982). *The Vegetation of Ireland: A Catalogue Raisonné*. Journal of Life Sciences, Royal Dublin Society 3, 289-368.

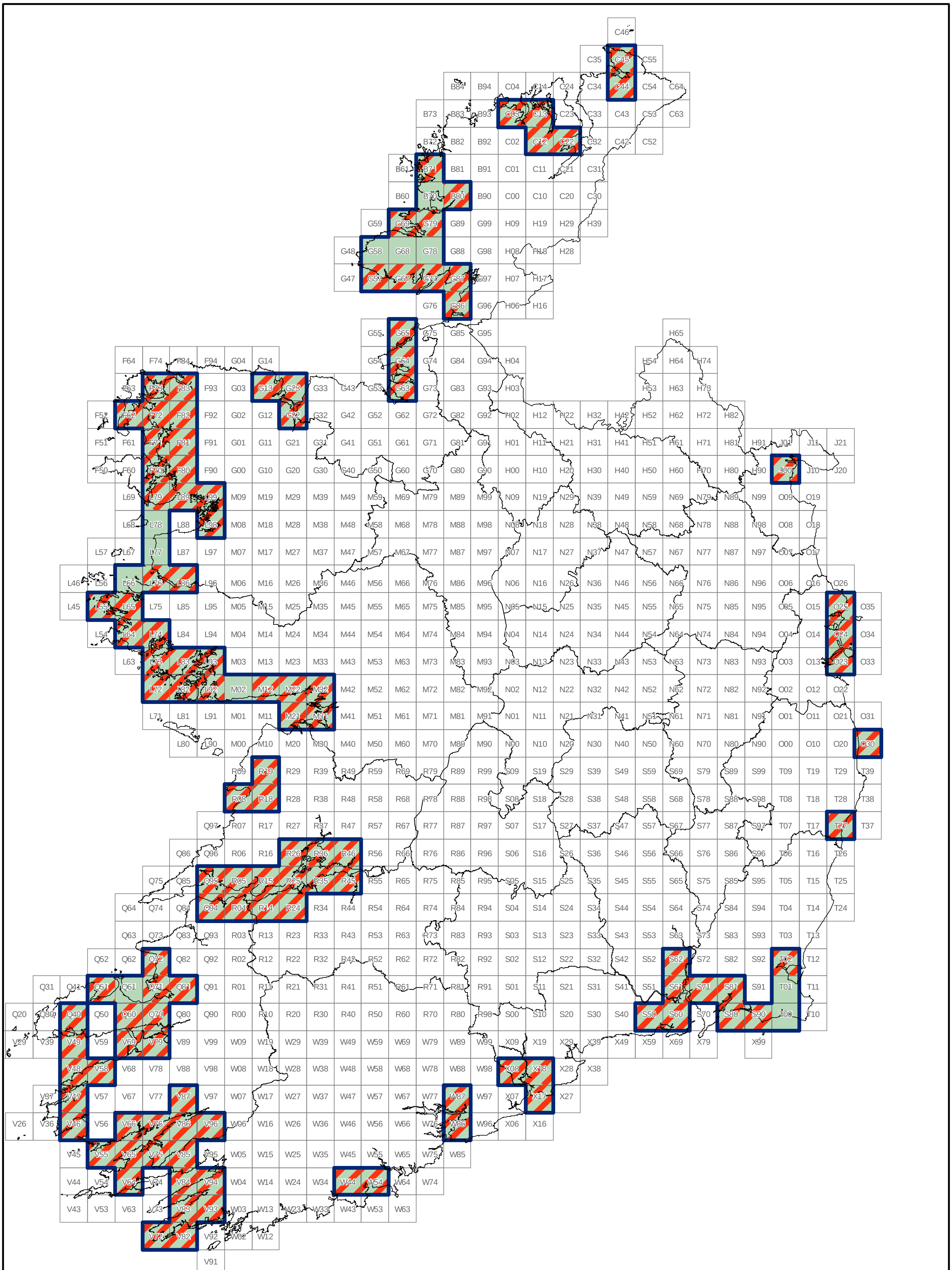
Wymer, E.D. (1984). *The phytosociology of Irish saltmarsh vegetation*. M.Sc. Thesis, National University of Ireland, Dublin.

1410 Mediterranean salt meadow

National Level	
Habitat Code	1410
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Widespread around the coast of Ireland
Map	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Curtis, T.G.F.C. and Sheehy-Skeffington, M.J. (1998). The Salt Marshes of Ireland: An Inventory and Account of their Geographical Variation. *Biology and Environment: Proceedings of the Royal Irish Academy* 98B, 87-104. ▪ Curtis, T.G.F. (2003). Salt marshes. In: *Wetlands in Ireland*, (ed. M.J. Otte). UCD Press, Dublin. ▪ McCorry, M. (2007). *Saltmarsh Monitoring Project 2006 – Summary Report*. An unpublished report for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin. ▪ Wymer, E.D. (1984). *The phytosociology of Irish saltmarsh vegetation*. M.Sc. Thesis, National University of Ireland, Dublin.
Range	Concentrated around the coastline of Ireland with a widespread distribution
Surface area	13,000 km² (13 grid cells x 100 km²)
Date	05/2007
Quality of data	3 = good
Trend	Stable
Trend-Period	1995-2006
Reasons for reported trend	No changes
Area covered by habitat	
Distribution map	See map attached
Surface area	6.5 km² (based on a proportion of the total estimated national area of saltmarsh)
Date	05/2007
Method used	2 = mainly based on remote sensing data with some ground surveys
Quality of data	2 = moderate
Trend	- (0.02%)
Trend-Period	1995-2006
Reasons for reported trend	3 = direct human influence
Justification of % thresholds for trends	
Main pressures	140 Grazing 142 Over-grazing by sheep 143 Over-grazing by cattle 402 discontinuous urbanization (development) 422 disposal of industrial waste (dumping) 423 disposal of inert materials (dumping) 490 Other urbanisation, industrial and similar activities (development) 501 paths, tracks, cycling tracks 800 Landfill, land reclamation and drying out, general 802 reclamation of land from the sea, estuary or marsh 900 erosion

Threats	142 Over-grazing by sheep 143 Over-grazing by cattle 402 discontinuous urbanization (development) 422 disposal of industrial waste (dumping) 423 disposal of inert materials (dumping) 490 Other urbanisation, industrial and similar activities (development) 501 paths, tracks, cycling tracks 800 Landfill, land reclamation and drying out, general 802 reclamation of land from the sea, estuary or marsh 900 erosion
Complementary information	
Favourable reference range	13,000 km² (13 grid cells x 100 km²)
Favourable reference area	6.5 km² (based on a proportion of the total estimated national area of saltmarsh)
Typical species	*Agrostis stolonifera, Armeria maritima, Aster tripolium, Atriplex prostrata, A. portulacoides, Carex divisa, C. extensa, Cochlearia officinalis, Festuca rubra, Glaux maritima, Juncus acutus, J. gerardii, J. maritimus, Oenanthe lachenalii, Plantago maritima, Potentilla anserina, Puccinellia fasciculata, Spergularia media, Triglochin maritimum, Trifolium repens.* Methods: all the species above are characteristic of Mediterranean salt meadow habitat in Ireland. McCorry (2007) assessed characteristic species as favourable.
Other relevant information	Reported loss of habitat (0.14 ha) during the current reporting period is negligible.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Favourable (FV). Negligible loss of habitat within the current reporting period (0.02%)
Specific structures and functions (incl. typical species)	Unfavourable-Inadequate (U1). About 14% of ground-surveyed area had a damaged sward cover with > 10% bare ground and heavy poaching caused by over-grazing.
Future prospects	Unfavourable-Inadequate (U1). Grazing levels likely to only slowly decrease in the near future. Infilling and reclamation likely to decrease in the future.
Overall assessment of CS	Unfavourable-Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Mediterranean salt meadows

1410

- Current Distribution (119 cells)
- Current Range (130 cells)
- Favourable Reference Range (130 cells)
- W48 10km grid cells

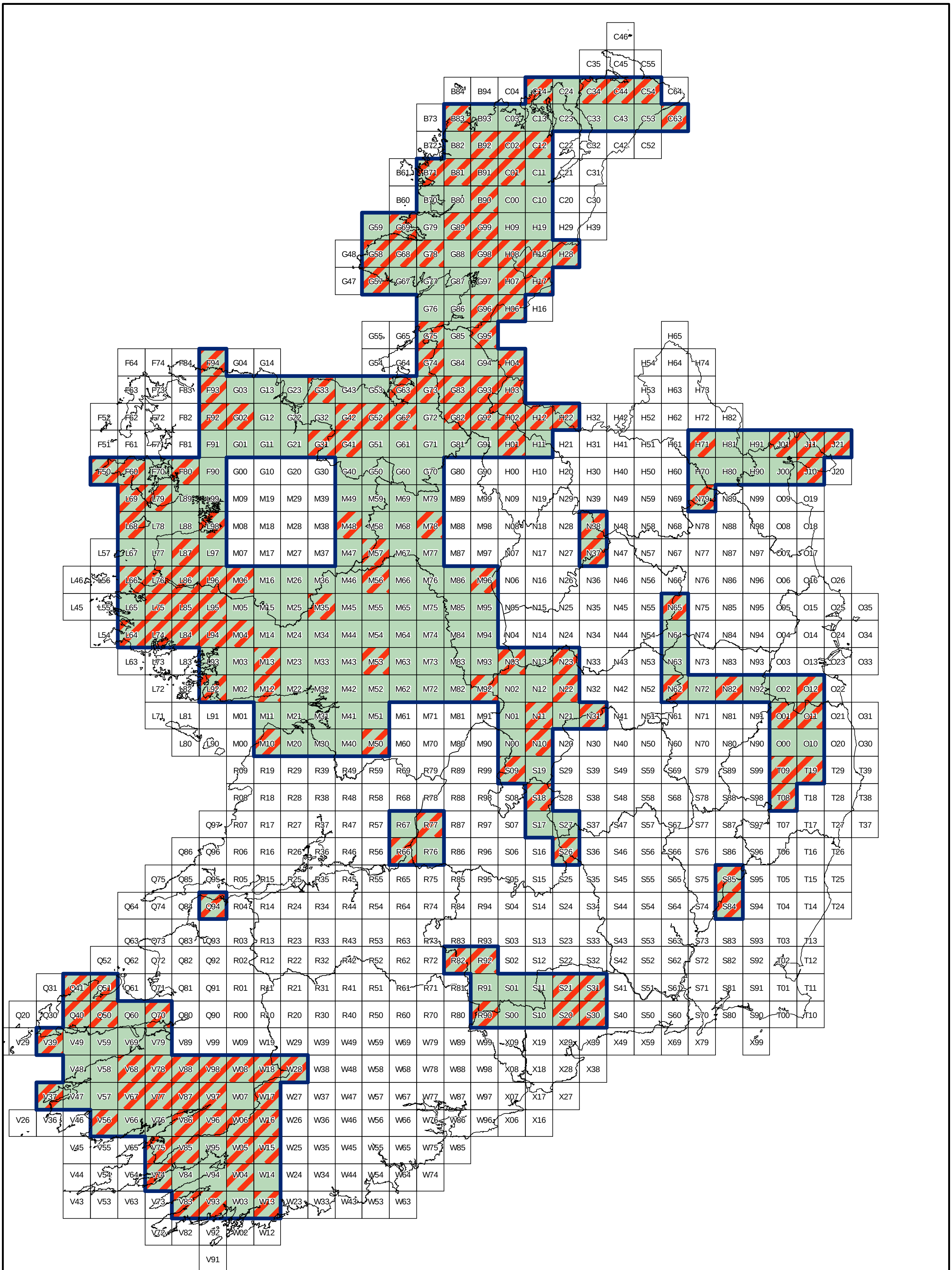
Date: January 2008

1. National Level	
Species code	1413 Lycopodium group
Member State	IE
Biogeographic regions concerned within the MS	ATL

2. Biogeographic level	
2.1 Biogeographic region	ATL
2.2 Published sources	Preston, C.D., Pearman, D.A. & Dines, T.A. (2002) *New Atlas of the British and Irish Flora*. CD-ROM. Oxford University Press, Oxford, UK
2.3 Range	
2.3.1 Surface area	32500
2.3.2 Date	1857-2006
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Stable
2.3.6 Trend-Period	1857-2006
2.3.7 Reasons for reported trend	NA
2.4 Population	
2.4.1 Population size estimation	159 grid squares occupied
2.4.2 Date of estimation	1857-2006
2.4.3 Method used	2 = extrapolation from surveys
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Stable
2.4.7 Trend-Period	1857-2006
2.4.8 Reasons for reported trend	NA
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	NA for species group
2.4.11 Threats	NA for species group
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	2006
2.5.4 Quality of data	1 = poor
2.5.5 Trend	Declining
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	3 = direct human influence (restoration, deterioration, destruction)
2.6 Future prospects	poor

2.7 Complementary information	
2.7.1 Favourable reference range	32500
2.7.2 Favourable reference population	159 (grid squares)
2.7.3 Suitable Habitat for the species	Unknown

2.7.4 Other relevant information	Distribution records collated for this species group were, in many cases, incidental to habitat surveys. Pressures & threats were not listed as they would not have the same impact on all of the species in the species group. A study was commissioned in 2006 by the National Parks & Wildlife Service, Department of Environment, Heritage & Local Government, Ireland to investigate Wildlife trade in Ireland. There was no evidence of collection of any species from this grouping for trade in Ireland. Preston *et al*. (2002) noted that many lowland sites of *L. clavatum* were lost before 1930 and that populations elsewhere are somewhat transient, with losses owing to overgrazing, heather burning, conversion to scrub and agricultural improvement. However many apparent losses for all species reported in Preston *et al*. (2002) may be due to under-recording. Although this group of species occurs in a variety of habitat types, e.g. alpine heath, wet heath, Nardus grassland and blanket bog, the condition of these habitats is considered to be inadequate. The conservation assessments for these habitats should be taken into consideration for this assessment.
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Population	Inadequate (U1)
Habitat for the species	Inadequate (U1)
Future prospects	Inadequate (U1)
Overall assessment of CS[1]	Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Lycopodium
group

1413

Current Distribution (159 cells)
Current Range (325 cells)
Favourable Reference Range (325 cells)
W48 10km grid cells

Date: January 2008

HALOPHILOUS SCRUBS (1420)

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat Characteristics in Ireland
2. Habitat Mapping
3. Habitat Range
   3.1. Conservation Status of Habitat Range
4. Habitat Area
   4.1. Conservation Status of Habitat Area
5. Structures and Functions
   5.1. Habitat Structures and Functions
      5.1.1. Conservation Status of Habitat Structures and Functions
   5.2. Typical Species
      5.2.1. Conservation Status of Habitat Typical Species
6. Impacts and Threats
7. Future Prospects
   7.1. Negative Future Prospects
   7.2. Positive Future Prospects
   7.3. Overall Habitat Future Prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

1. HABITAT CHARACTERISTICS IN IRELAND

Mediterranean and thermo-Atlantic Halophilous scrubs (1420) (from here known as Halophilous scrubs) are one of five saltmarsh habitats found in Ireland. This habitat is characterized by the presence of as single species, Perennial Glasswort (*Sarcocornia perennis,* previously known as *Arthrocnemum perenne*) on saltmarsh. This fleshy, slightly woody perennial can grow up to 30 cms tall and often extends to form tussocks up to 1 metre in diameter. This species is very rare in Ireland and is listed on the Flora Protection Order (Anon. 1999) and is also listed in the Red Data Book (Curtis & McGough 1988) as 'Vulnerable'. Consequently, this habitat is the rarest Annex I saltmarsh habitat found in Ireland and is known from only five saltmarsh sites in the south-east coast of Ireland. *Sarcocornia perennis* was only recorded quite recently in Ireland (Ferguson 1962, 1964) and is considered to represent a South Atlantic element in the flora (Cross 2006).

Halophilous scrubs are defined by the EU Habitats Interpretation Manual (Commission of the European Communities 2003) as perennial vegetation of saline muds that belongs to the phytosociological class (*Sarcocornetea fruticosi*). Three British NVC communities listed include the "SM 21 *Suaeda vera-Limonium binervosum* saltmarsh community", "SM25 *Sueda vera* saltmarsh community" and "SM7 *Arthrocnemum perenne* stands". Irish vegetation corresponds most closely with the latter community, *Arthrocnemum perenne* stands (SM7). The phytosociological class *Sarcocornetea fruticosi* is not listed in White and Doyle (1982). The fact that this habitat is categorized by a single species leads to difficulties in establishing the extent, characteristics and structure of Halophilous scrubs.

A study of the ecology of *Sarcocornia perennis* in Ireland (Wallace 1995) concluded that *Sarcocornia perennis* was restricted to a very specific habitat (i.e. pans and areas subject to waterlogging in a narrow band of salt marsh). This study also stated that the species may be restricted in Ireland country due to climatic factors.

Halophilous scrubs was surveyed by McCorry (2007) at Ballyteige Burrow, which is an extensive saltmarsh dominated by Atlantic salt meadows (1330) and also containing *Salicornia* stands (1310) and *Spartina* swards (1320). *Sarcocornia perennis* generally does not form an important part of the vegetation. It is found amongst lower saltmarsh zone vegetation associated with *Puccinellia martima*, *Limonium humile*, *Suaeda maritima*, *Spartina anglica*, *Salicornia* sp. and *Spergularia media* on a muddy substrate. It was also recorded amongst the band of *Salicornia* sp. Small amounts of bare substrate are generally present in this habitat (5-10%). It was only found frequently at one location along Ballyteige Burrow in a small sheltered area that protrudes into the dunes where it is found on sandier substrate.

A comprehensive survey of the conservation status of Annex I saltmarsh habitats in Ireland is currently ongoing (McCorry 2007). An initial list containing 31 sites was surveyed in 2006 and a further 100 sites will be surveyed in 2007-2008. The initial list was a representative sample encompassed the variation in Irish saltmarshes with several different saltmarsh types (fringe, estuary, bay, sand flats & lagoon) and different substrates (mud, sand, gravel peat) included (Curtis & Sheehy-Skeffington 1998). Geographical variation was also covered with sites included from the northern, western, southern and eastern coasts of Ireland. Saltmarshes inside and outside designated areas (SACs) were also selected. The completion of the extended list will mean that over 50% of saltmarshes listed on the national inventory (Curtis & Sheehy-Skeffington 1998) will be surveyed. Two sites thought to contain Halophilous scrubs were surveyed in 2006 (McCorry 2007). It is anticipated that the four remaining unsurveyed sites will be surveyed in 2007-2008 when 100 additional saltmarsh sites are surveyed.

2. HABITAT MAPPING

The following data sources were used to map the occurrence of Halophilous scrubs in Ireland on 10km square basis:

- Information on designated sites, (c)SACs and (p)NHAs and rare species (*Sarcocornia perennis*) held on file by the National Parks and Wildlife Service (NPWS)
- Saltmarsh Monitoring Project 2006 (McCorry 2007)
- Other data sources (Preston *et.al.* 2002)
- Aerial photographs (OSI (Ordnance Survey Ireland) 2000 series)
- OSI 6 inch maps
- National saltmarsh inventory (Curtis & Sheehy-Skeffington 1998)

Information held in NPWS databases and files was used to identify saltmarshes where *Sarcocornia perennis* (and consequently Halophilous scrubs) was present. McCorry (2007) mapped the extent of Halophilous scrubs at one of these known sites and visited a second site, where *Sarcocornia perennis* was not recorded. Halophilous scrubs formed a mosaic with Atlantic salt meadows. The extent of Halophilous scrubs was mapped by drawing boundaries around records of *Sarcocornia perennis* noted by GPS. These patches of habitat generally had a very low frequency of this species, although it was frequent in one patch. There were no maps of habitat area of Halophilous scrubs for the remaining 4 sites.

These data were used to plot the distribution of sites known to have Halophilous scrubs. The distribution of this habitat is illustrated on a 10km square grid by selecting those squares where the habitat is present. The distribution of sites where this habitat is present reflects the current distribution of records from Preston *et al.* (2002) for *Sarcocornia perennis.* The estimation of the national area of Halophilous scrubs is described in Section 4.

This data set was also used to plot the range of Halophilous scrubs. Range was defined by mapping a minimum polygon around the identified occurrences. Breaks in the range were justified when there was a gap of 2 grid squares or greater between occurrences or when the gaps were dominated by other coastal habitats more typical of exposed coastlines such as cliffs and rocky shorelines. The current range of Halophilous scrubs is the same as the current distribution.

3. HABITAT RANGE

Halophilous Scrubs are distributed in a small area along the south-east coastline of Ireland in Co. Wexford. Six different saltmarsh sites are thought to contain this habitat and are found in two SACs, Bannow Bay and the adjacent Ballyteige Burrow. Wallace (1995) stated that *Sarcocornia perennis* may be restricted in Ireland due to climatic factors.

The range of Halophilous scrubs may have contracted slightly in the past due to infilling and reclamation of saltmarsh for agricultural purposes, particularly at Ballyteige Burrow. Most of this reclamation occurred in the 19-20th century. However, it is not known if this former saltmarsh contained *Sarcocornia perennis* and Halophilous scrubs.

Conservation Status of Habitat Range

The habitat range at the beginning of the assessment period (i.e. 1995 when the Irish Ordnance Survey first produced a nationwide series of aerial photos) is taken as the favourable reference range (FRR). This habitat range is the same as the current reference range and still encompasses all the ecological variation of this habitat and all known sites where *Sarcocornia perennis* has been recorded. Historical losses of habitat are not considered (i.e losses due to large scale reclamation in the 18-19th century). The current habitat range may be somewhat contracted compared to the historical reference range. However, there are virtually no prospects for the restoration of former saltmarsh habitat in areas reclaimed for agriculture. There are no indications from the current records of *Sarcocornia perennis* that the habitat range is expanding or contracting.

The habitat range of Halophilous scrubs is assessed as **favourable**.

4. HABITAT AREA

There is limited information on the national area of this habitat. A former estimate taken from NPWS files (Natura Form Explanatory Notes) indicated that there was about 10 ha of this habitat in Ireland. This was based on estimates of area of various Annex I saltmarsh habitats within the two SACs where this habitat is known to occur.

Data from the Natura form indicated that about 7% of saltmarsh habitat at Ballyteige Burrow was Halophilous scrubs and that there was a total of about 75 ha of saltmarsh at this site. However, McCorry (2007) mapped a total of 34 ha of saltmarsh at Ballyteige in 2006 and only 0.73 ha (2.1%) of the total saltmarsh habitat was mapped as Halophilous scrubs. Previous surveys of *Sarcocornia perennis* show that this species formerly had a wider distribution at Ballyteige than indicated by McCorry (2007). Its current area was probably under-estimated in 2006 and further survey work may increase records of *Sarcocornia perennis* at Ballyteige. A second site at Ballyteige Burrow thought to contain *Sarcocornia perennis* was also visited during 2006 but it was not recorded.

The favourable reference area is taken as the habitat area at the beginning of the reporting period (1995). This habitat area is likely to be similar to the area of the habitat when the Habitats Directive came into force (Commission of the European Communities 1992). This is estimated to be 5 ha based on older estimates of habitat area from the Natura Form Explanatory Notes. However, this estimate is not very accurate. (It is based on the possible likelihood that the previous estimate of national habitat area was over-estimated by about 100%, considering the total saltmarsh area at Ballyteige was over-estimated by about 100%).

Conservation Status of Habitat Area

Even small losses can be significant as the favourable reference area is so small. There have been no reported losses of saltmarsh containing this habitat by NPWS site inspection reports. Wallace (Former NPWS Ranger Pers. comm. 2007) has indicated that there has been no significant loss of habitat since he carried out his study of *Sarcocornia perennis* (Wallace 1995). McCorry (2007) mapped Halophilous scrubs at only one site (Ballyteige) and previous surveys of *Sarcocornia perennis* indicate that this species was formerly more extensive, but it may have been under-recorded. *Sarcocornia perennis* was not recorded during a survey of a second site thought to have contained this species (McCorry 2007).

NPWS files (Natura Form Explanatory Notes) have indicated that at one site containing this habitat, saltmarsh is being replaced by sand dune habitats due to natural inland movement of sand (accretion) and this may be affecting the area of Halophilous Scrubs. Information available about the status of this species in one of the SACs (Bannow Bay) indicates that it may be extinct at two of its known sites due to the spread of *Spartina anglica* (Natura Form Explanatory Notes). However, these records are somewhat out of date (recorded before 2000).

There are conflicting reports about the status of *Sarcocornia perennis* and Halophilous Scrubs and some information may be out of date. The loss of habitat is estimated to be 20% less than the favourable reference area because of potential loss of habitat at two sites ground surveyed during 2006 (McCorry 2006). This gives a current national habitat area of 4 ha. However, this is likely to change as more accurate information about distribution of *S. perennis* and Halophilous Scrubs becomes available after future ground surveys of the remaining unsurveyed sites in 2007-2008.

The conservation status of the habitat area is tentatively assessed as **unfavourable-bad**.)

5. STRUCTURES AND FUNCTIONS

Habitat Structures and Functions

The following generalised attributes were assessed for Irish Annex I saltmarsh habitats at 31 sites selected as a representative sample of Irish saltmarshes during the Saltmarsh Monitoring Project 2006 (McCorry 2007). The site list was a representative sample encompassed the variation in Irish saltmarshes with several different saltmarsh types (fringe, estuary, bay, sand flats & lagoon) and different substrates (mud, sand, gravel peat) included (Curtis & Sheehy-Skeffington 1998). Geographical variation was also covered with sites included from the northern, western, southern and eastern coasts of Ireland. Saltmarshes inside and outside designated areas (SACs) were also selected. These attributes have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of saltmarshes (JNCC 2004) with inputs from NPWS, Research Branch staff.

- Physical structure: creeks and pans
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation composition: characteristic species
- Indicators of negative trend (< 5% cover of *Spartina anglica*)
- Other negative indicators
- Indicators of local distinctiveness, such as notable plant species or vegetation mosaics. These are site-specific features, which are not adequately covered by the other attributes.

The structure and functions data from this representative survey (McCorry 2007) has been extrapolated to assess structure and functions at a national level. However, as only 2 out of the 6 sites thought to have Halophilous scrubs were surveyed, this extrapolation may be vulnerable to localised variation in condition of saltmarsh habitats and management.

The habitat structure and functions of Halophilous scrubs were assessed as favourable at Ballyteige. Two monitoring stops were carried out in this habitat and both passed all attributes (which used ASM targets). This species is found generally in the mid-lower saltmarsh zone with *Puccinellia martima* and *Limonium humile* predominant. It is also found with frequent *Salicornia* sp. at another location. It is also found amongst clumps of *Spartina anglica*. Wallace (1995) concluded that *Sarcocornia perennis* was restricted to pans and areas subject to waterlogging in a narrow band of salt marsh. However information from NPWS files indicates that this species may be negatively affected by accretion of sand on saltmarsh and the spread of *Spartina anglica* at two sites.

5.1.1. Conservation Status of Habitat Structures and Functions

The conservation status of the habitat structure and functions is tentatively assessed as **unfavourable-inadequate,** due to reports that *Sarcocornia perennis* may be negatively affected by accretion of sand on saltmarsh and the spread of *Spartina anglica* at two sites.

Typical Species

Other saltmarsh species found in Halophilous scrubs are also typical of *Salicornia* swards (1310) and Atlantic salt meadows (1330).

Halophilous scrubs are defined by the EU Habitats Interpretation Manual (Commission of the European Communities 2003) as perennial vegetation of saline muds that belongs to the phytosociological class (*Sarcocornetea fruticosi*). Other saltmarsh species that are associated with this habitat and are found in Ireland include *Atriplex portulacoides*, *Aster tripolium* and *Salicornia* sp. Irish Halophilous scrub vegetation corresponds most closely with the British National Vegetation Classification plant community, '*Arthrocnemum perenne* stands' (SM7) (Rodwell 2000). This community is described as an open mosaic of *Sarcocornia perennis* with *Atriplex portulacoides*, *Puccinellia martima* and *Suaeda maritima* at the lower limit of Atlantic salt meadows.

In Ireland it is found amongst lower saltmarsh zone vegetation associated with *Puccinellia martima*, *Limonium humile*, *Suaeda maritima*, *Spartina anglica*, *Salicornia* sp. and *Spergularia media* on a muddy substrate. *Atriplex portulacoides* was recorded at Ballyteige but it is quite rare and is not an important part of this habitat.

5.1.2. Geographical variations

There are no geographical variations for this Annex I habitat owning to its restricted distribution.

5.1.3. Conservation Status of Habitat Typical Species

The conservation status of typical species of Halophilous scrubs is assessed as **favourable,** due to the lack of information to categorise this habitat.

6. IMPACTS AND THREATS

McCorry (2007) summarised the main impacts affecting Halophilous scrubs at one site visited during 2006. The saltmarsh at this site was mainly being affecting by cattle poaching (143) and by tracks (501) created by off-road vehicles (623). These impacts did not affect Halophilous scrubs directly but have the capacity to affect this habitat in the future. *Spartina anglica*, an invasive species, was noted as being associated with *Sarcocornia perennis* in some parts of the saltmarsh and *S. anglica* has the capacity to increase its cover and reduce the frequency of *Sarcocornia perennis.* No additional information is present in the NPWS Site Inspection Reporting (SIR) database about impacts and activities affecting Annex I habitats in SACs during the current reporting period.

Information in the NPWS Conservation plan for one site indicates that the habitat was damaged by horse riding activities (622) in the recent past (past 5 years) but has been in recovery since then. Part of the saltmarsh was harrowed to create a track but this practise has since been stopped. The NPWS conservation plan noted that *Sarcocornia perennis* was also affected by sand accretion related to disturbance on the upper marsh.

Information available about the status of this species in Bannow Bay indicates that it may be extinct at two of its known sites due to the spread of *Spartina anglica*. An additional site is also being negatively impacted by the accretion of sand onto saltmarsh due to natural erosion.

Current trends

Unknown.

7. FUTURE PROSPECTS

Negative Future Prospects

McCorry (2007) assessed the future prospects of this habitat as unfavourable-inadequate at one site visited in 2006. This assessment was based on the potential for *Spartina anglica* to spread, increase its cover and reduce the frequency of *Sarcocornia perennis*. *Spartina anglica* is thought to have led to the possible extinction of *Sarcocornia perennis* at two additional sites.

A second site may be currently affected by natural geomorphological transition of saltmarsh habitat to sand dune habitat due to accretion of sand onto saltmarsh. This may affect the area of Halophilous scrubs in the future.

Climate change predictions of increases in sea-level in the future are predicted to increase erosion of saltmarsh in Ireland (Devoy 2003, Fealy 2003). Saltmarsh is predicted to move landward in response to sea-level rise and may be subject to 'coastal squeeze' where this migration is impeded by artificial defensive structures such as sea walls. However, there were no significant indications of any erosional trends on saltmarshes due to sea level rise at the sites visited during the 2006 survey (McCorry 2007).

Positive Future Prospects

All of the sites thought to contain Halophilous scrubs are found within 2 separate SACs and therefore should be partially protected from pressures such as infilling, reclamation and unsustainable grazing. Two of these sites are also located within a Nature Reserve, so NPWS has direct responsibility for its management. Notifiable actions have been set for saltmarsh habitats within SACs. Actions such as alteration of watercourses, reclamation, and the use of the saltmarsh for commercial activities require consent from the Department of Environment, Heritage and Local Government.

An NPWS Conservation plan for Ballyteige Burrow SAC and Nature Reserve noted that Halophilous scrubs had previously been affected by horse-riding activities at this site in the recent past, but had recovered somewhat since the cessation of this activity. The prospects for sensitive management to promote the conservation status of this habitat on this site are good.

Overall Habitat Future Prospects

Overall, the future prospects of Halophilous scrubs are assessed as **Unfavourable-Bad** due to the potential for *Spartina anglica*, natural transition of habitat or other impacts to affect this habitat. It should be noted that as the national area of this habitat is so small, any small losses of area will be very significant. There is little data in Ireland to assess with accuracy the potential impacts of climate change on Halophilous scrubs.

8. OVERALL ASSESSMENT OF THE HABITAT CONSERVATION STATUS

The habitat conservation status of the four main attributes has been assessed either as Favourable, Unfavourable Inadequate or Unfavourable Bad at national level.

- The Natural Range of future prospects is considered to be **Favourable**. The Favourable Reference Range is defined by the current range of Halophilous scrubs.
- The Area of Halophilous scrubs habitat is estimated to have decreased by 20% an eleven year reporting period (1995-2006). The area of this habitat is therefore assessed as **Unfavourable-Bad**.
- The habitat Structure and Functions have been assessed as **Unfavourable-Inadequate**. The habitat that was surveyed at one site was generally in good condition but may not be at other sites.
- The Future Prospects are assessed as **Unfavourable-Bad**. This habitat is quite vulnerable to even small changes in the distribution and frequency of *Sarcocornia perennis.* This habitat is vulnerable to further invasion by *Spartina anglica*.

The overall conservation status for Halophilous scrubs is **Unfavourable-Bad**.

9. REFERENCES

Anonymous (1999). *Flora Protection Order 1999.* Government of Ireland.

Commission of the European Communities (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna. *Official Journal of the European Union* L 206, 22/07/92. European commission. Brussels. 1992/95/2003.

Commission of the European Communities (2003). *Interpretation manual of European Union Habitats-EUR 25.* DG Environment-Nature and Biodiversity. Brussels.

Cross, J. (2006). The potential natural vegetation of Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* **106B**, 65-106.

Curtis, T.G.F. & McGough, H.N. (1988). *The Irish Red Data Book*. Stationary Office, Dublin.

Curtis, T.G.F.C. and Sheehy-Skeffington, M.J. (1998). The Salt Marshes of Ireland: *An Inventory and Account of their Geographical Variation. Biology and Environment: Proceedings of the Royal Irish Academy* **98B**, 87-104.

Devoy, J. (2003). Coastal vulnerability and the implications of sea-level rise for Ireland. *Journal of Coastal Research*. Submitted for publication. http://geography.nuim.ie/ICARUS/present/Coastal%20Vulnerability.pdf.

Fealy, R. (2003). The impacts of climate change on sea level and the Irish coast. In, *Climate change: Scenarios and impacts for Ireland*. (Eds. J. Sweeney *et al.*). (2000-LS-5.2.1-M1). Environmental Protection Agency, Johnstown.

Ferguson, I. K. (1962). *Salicornia perennis* Mill. In Ireland. *Irish Naturalists Journal*, **14**, 18-19.

Ferguson, I. K. (1964). A new station for *Salicornia perennis* Mill in Ireland. *Irish Naturalists Journal*, **14** 215.

JNCC. (2004). *Common Standards Monitoring guidance for saltmarsh habitat*. JNCC, Peterborough.

McCorry, M. (2007). *Saltmarsh Monitoring Project 2006 – Summary Report*. An unpublished report for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Preston, C.D. Pearman, A. & Dines, D. (2002). *New atlas of the British and Irish Flora*. Oxford University Press.

Rodwell, J.S. (ed.) (2000). *British Plant Communities, Volume 5: Maritime communities and vegetation of open habitats*. Cambridge University Press, Cambridge.

Wallace, E. (1995). *Aspects of the Ecology of* Arthrocnemum perenne *in Ireland.* Unpublished study, University College Cork.

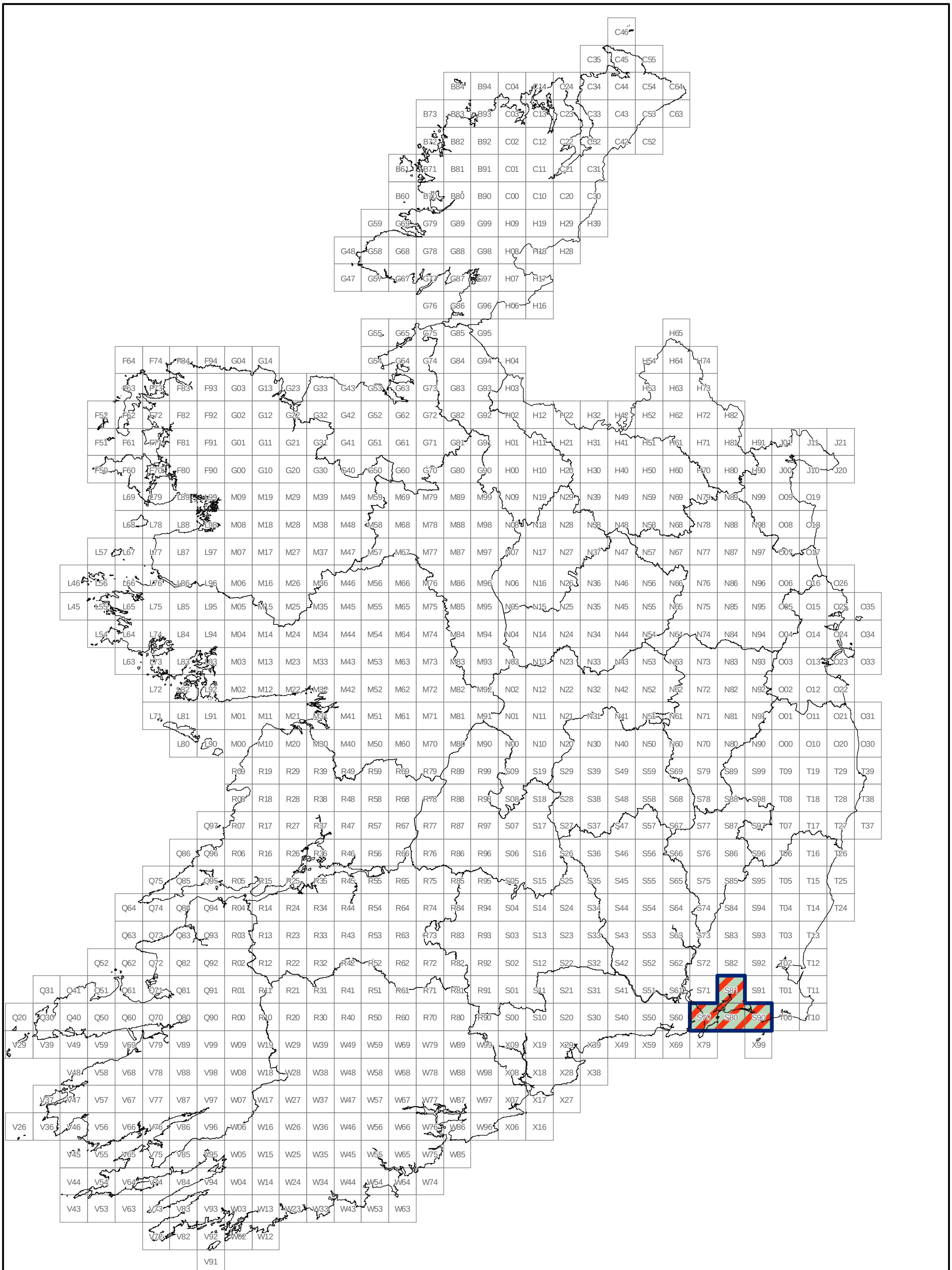
White, J. & Doyle, G.J. (1982). The Vegetation of Ireland: A Catalogue Raisonné. *Journal of Life Sciences, Royal Dublin Society* **3**, 289-368.

1420 Halophilous scrubs

National Level	
Habitat Code	1420
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Restricted to a small part of the south-east coast of Ireland
Map	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Curtis, T.G.F.C. and Sheehy-Skeffington, M.J. (1998). The Salt Marshes of Ireland: An Inventory and Account of their Geographical Variation. *Biology and Environment: Proceedings of the Royal Irish Academy* 98B, 87-104. ▪ McCorry, M. (2007). *Saltmarsh Monitoring Project 2006 – Summary Report*. An unpublished report for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin. ▪ Wallace, E. (1995). *Aspects of the Ecology of* Arthrocnemum perenne *in Ireland.* Unpublished study, University College Cork.
Range	Restricted to a small part of the south-east coast of Ireland
Surface area	400 km² (4 grid cells x 100 km²)
Date	05/2007
Quality of data	3 = good
Trend	Stable
Trend-Period	1994-2006
Reasons for reported trend	No changes
Area covered by habitat	
Distribution map	See map attached
Surface area	0.04 km² (estimated to be 20% less than the favourable reference area)
Date	05/2007
Method used	1 = based on expert opinion
Quality of data	1 = poor
Trend	Decreasing
Trend magnitude	Unknown
Trend-Period	1995-2006
Reasons for reported trend	3 = direct human influence
Justification of % thresholds for trends	
Main pressures	143 Overgrazing by cattle 501 paths, tracks, cycling tracks 622 walking, horseriding and non-motorised vehicles 623 motorised vehicles 900 erosion 954 Invasion by species (*Spartina anglica*) 990 Other natural processes (transformation of saltmarsh to sand-dune habitats)
Threats	143 Overgrazing by cattle 501 paths, tracks, cycling tracks 622 walking, horseriding and non-motorised vehicles 623 motorised vehicles 900 erosion 954 Invasion by species (*Spartina anglica*) 990 Other natural processes (transformation of saltmarsh to sand-dune habitats)
Complementary information	
Favourable reference range	400 km² (4 grid cells x 100 km²) (known distribution of *Sarcocornia perennis* in Ireland)

Favourable reference area	0.05 km²
Typical species	Vascular species: *Sarcocornia perennis, Limonium humile, Puccinellia martima*, *Salicornia* sp., *Spartina anglica*, *Spergularia media* and *Suaeda maritima*. Methods: the species above are characteristic of Halophilous scrubs habitat in Ireland. McCorry (2007) assessed characteristic species as favourable.
Other relevant information	
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Bad (U2)
Specific structures and functions (incl. typical species)	Unfavourable-Inadequate (U1). *Spartina anglica*, an invasive species, is found in this habitat.
Future prospects	Unfavourable-Bad (U2). Quite vulnerable to even small changes in the distribution and frequency of *Sarcocornia perennis.* This habitat is vulnerable to further invasion by *Spartina anglica*.
Overall assessment of CS	Unfavourable-Bad (U2)



1:1,800,000

0 12.5 25 50 Kilometers

Mediterranean and thermo-Atlantic halophilous scrubs

1420

Current Distribution (4 cells)

Current Range (4 cells)

Favourable Reference Range (4 cells)

W48 10km grid cells

Date: October 2007

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL

DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

Conservation Assessment of Killarney Fern (*Trichomanes speciosum* Willd.) in Ireland

Backing Document

June 2007

1.0 ECOLOGY *TRICHOMANES SPECIOSUM* IN IRELAND 3

2.0 MAPPING ASSESSMENT DATA 4

2.1 DISTRIBUTION 4
2.2 RANGE 4
2.3 HABITAT 4

3.0 RANGE 5

3.1 RANGE CONSERVATION STATUS 5

4.0 POPULATION 6

4.1 POPULATION ESTIMATION 6
4.2 POPULATION TRENDS 8
4.3. POPULATION CONSERVATION STATUS 8

5.0 HABITAT 9

5.1 HABITAT CONSERVATION STATUS 9

6.0 FUTURE PROSPECTS 10

6.1 NEGATIVE IMPACTS AND THREATS 10
6.2 POSITIVE IMPACTS 10
6.3. CONSERVATION STATUS 10

APPENDIX I 12

RANGE OF *TRICHOMANES SPECIOSUM* IN IRELAND (2007) 12

APPENDIX II 13

DISTRIBUTION OF *TRICHOMANES SPECIOSUM* IN IRELAND (2007) 13

APPENDIX III 14

REFERENCES & FURTHER READING 14

1.0 Ecology *Trichomanes speciosum* in Ireland

Trichomanes speciosum Willd (Killarney fern) is a large filmy fern in the family Hymenophyllaceae. Members of this family are extremely sensitive to desiccation and are not adapted to control water loss (Rumsey 1994). *T. speciosum* has a typical fern 2-stage life cycle, the second "fern" like stage is known as the sporophyte and the first stage the gametophyte, which is in this case, consists of a filamentous structure instead of a prothallis. Both the sporophyte and gametophyte stages are capable of asexual reproduction by mean of rhizomes (in the former) and gemmae (in the latter) (Vogel *et al.* 1993). Gametophyte colonies can exist and reproduce in the absence of sporophytes (Rumsey *et al.* 1998a). In Ireland when the sporophyte and gametophyte occur together occupy similar habitats in dripping caves, cliffs, crevices and gullies by waterfalls, crevices in woodland, and occasionally the floor of damp woodland; all deeply shaded humid habitats (Ratcliffe *et. al* 1993; Johnson *et al.* 2000; Kingston & Hayes 2005). Sporophyte colonies however, are more limited in their distribution in Ireland than gametophyte colonies. Gametophyte colonies have been found in less humid habitats and have also been found with differing associated species (Kingston & Hayes 2005). *Trichomanes speciosum* has been found in elevations ranging from 50m to 380m in the British Isles in predominately north or north-east aspects on acidic substrates such as quartzites, slates and sandstones (Ratcliffe *et al.* 1998a; Kingston & Hayes 2005).

This Macronesian/European endemic species is considered a relic from the ancient Tertiary flora (Jermy 1994). Sporophyte and gametophyte colonies are found in Ireland, Great Britain, Maderia, the Canaries, the Azores, France, Spain, Portugal and the west coast of Italy (Ratcliffe *et al* 1993 & Kingston & Hayes 2005). Gametophyte colonies have been found inland on continental Europe in Germany (Rumsey *et al*. 1998a), the Czech Republic (Vogel *et al.* 1993) and Luxembourg (Krippel 2001).

2.0 Mapping assessment data

2.1 Distribution

Distribution records for *Trichomanes speciosum* have been compiled by the National Parks and Wildlife Service. The first known record of the species in Ireland was made before 1804 by Dr. Whitley Stokes at Powerscourt Waterfall (Colgan & Scully 1898). All sites for *Trichomanes speciosum* sporophyte have been visited by NPWS staff and other researchers since the 1960's. The gametophyte was discovered growing in Ireland as recently as the 1990's and several new gametophyte locations have been discovered since (Rumsey *et al*. 1998a; NPWS unpublished records).

2.2 Range

According to EC (2006), range is taken to be '*the outer limits of the overall area in which a habitat or species is found at present. It can be considered as an envelope within which areas actually occupied occur as in many cases not all the range will actually be occupied by the species or habitat'*. This can be a difficult concept to define for species such as *Trichomanes speciosum* which occurs in scattered and disjunct populations and occupies small specific areas within larger, more recognised habitats such as damp woodland. However, it is relatively easy to determine the range of *Trichomanes speciosum* sporophyte because habitat locations near ravines and cascades for the sporophyte are well-known. The damp woodland and mountainous cascades where this species grows are highly characteristic. Gametophyte habitat however, is not so easy to define as it can survive in less humid sites (Kingston & Hayes 2005).

The range outline following IUCN guidelines would be taken as the *'area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy'* (EC, 2006). Owing to its specific niche requirements, attempts by NPWS staff and field workers to define a specific habitat type for the species have been unsuccessful. Surveys to find additional sporophyte and gametophyte colonies in apparently suitable habitat have failed , and it was felt that overlaying grid squares which contain woodland and mountainous terrain would not provide any sensible range estimate or "*inferred or projected sites*" (IUCN) (Kingston *pers. comm*; Kingston & Hayes 2005). *Trichomanes speciosum* range distribution is more a reflection of the current climatic conditions (Ratcliffe *et al.* 1993) and a relictual distribution (Jermy 1994). It thus can be considered that the current range of *Trichomanes speciosum* more or less reflects its potential range.

2.3 Habitat

A list of typical habitats for *Trichomanes speciosum* was derived from a number of information sources:

- NPWS database where colonies of *Trichomanes speciosum* are recorded
- Published literature (Appendix I)
- Unpublished field notes held by NPWS
- *Trichomanes speciosum* sites designated as Special Areas of Conservation

3.0 Range

The range of *Trichomanes speciosum* in Ireland is centred on the extreme south in Kerry and West Cork. There are restricted sites in Carlow, Clare, Donegal, Limerick, Waterford, Wicklow and Sligo (Curtis & McGough 1998 & NPWS unpublished data). The gametophyte range is similar but is more widespread and occurs in counties Galway and Mayo (Rumsey *et al.* 1998a & Preston *et al*. 2002).

3.1 Range Conservation Status

The Favourable Reference Range (FRR) for *Trichomanes speciosum* in Ireland is taken to be its present range (i.e. a polygon drawn around all the 10 km^2 squares from which *Trichomanes speciosum* has been recorded since the 1960's). The current range is thought to encompass the ecological range of variation for the species in Ireland, and therefore has been set as the FRR.

Important native woodland areas have been surveyed in recent years, and populations of sporophyte *Trichomanes speciosum* are likely to have been found had they been present. As a consequence of finding the gametophyte in Ireland during the 1990's (Rumsey *et al.* 1998a), the current known range of *Trichomanes speciosum* is greater than it has been at any time in the past, simply because the gametophyte was not known to occur in Ireland previously.

As the current range of the species is the same as the FRR, it is allocated a Favourable conservation status in this respect.

- **Species Range Area:** Can be considered the area of the polygon, which contains all of the grid cells, which is 5300 km^2.
- **Favourable Reference Range:** 5300 km^2

4.0 Population

4.1 Population estimation

Survey work by NPWS has included some observations on the abundance of *Trichomanes speciosum* at its known sites. In the case of small populations, population estimates are counts of individual fronds. In the case of large populations, frond estimates are derived by extrapolating upwards from direct counts of smaller samples, and are therefore no more than approximations. The term "colony" is useful as a population estimate and is used here and is defined as a discrete i.e. unconnected "patch" or "plant" (Rumsey 1997). In the case of *Trichomanes speciosum* information in unpublished NPWS records has provided a colony or frond count for the sporophyte populations, and an area was crudely estimated from NPWS records and field record knowledge of colonies size.

Table 1. Location and population estimates for *Trichomanes speciosum* in Ireland.

County	Record for site with counts Δ	Sporophyte Colony (count)	Number of fronds	Gametophyte Colony (count)	Grid ref.	Area est. km^2	Conservation status of site
Clare/Limerick	Kingston 2006	x	x	1	R75	0.0001	SAC 930
Cork	Rumsey & Jermy 1998	x	x	1	W13	0.0001	
Cork	Rumsey & Jermy 1998	x	x	1	V75	0.0001	SAC 001879
Galway	Jermy 1994, Kingston 1995	x	x	12	L66	0.012	
Kerry	Rumsey & Jermy 1998	x	x	1	V86	0.0001	
Kerry	Hollyoak 2006	1	?		V56	0.0001	
Kerry	Rumsey & Jermy 1998	x	x	1	V67	0.0001	
Kerry	Rumsey & Jermy 1998	x	x	1	V98	0.0001	
Kerry	Rumsey & Jermy 1998	x	x	1	V98	0.0001	
Kerry	Rumsey & Jermy 1998	x	x	1	Q40	0.0001	
Kerry	Rumsey & Jermy 1998	x	x	1	Q41	0.0001	
Limerick	Rumsey & Jermy 1998	x	x	1	R75	0.0001	
Mayo	Jermy 1994; Kingston	x	x	5	L96	0.0001	
Mayo	Rumsey & Jermy 1998	x	x	1	G10	0.0001	
Mayo	Rumsey & Jermy 1998	x	x	>15	G20	1	NHA 519
Mayo	Rumsey & Jermy 1998	x	x	1	F50	0.0001	
Mayo	Rumsey & Jermy 1998	x	x	1	G10	0.0001	
Mayo	Rumsey & Jermy 1998	x	x	1	F93	0.0001	
Wicklow	Rumsey 1994	x	x	1	O21	0.0001	NHA 1767
Wicklow	Rumsey 1994	x	x	1	T29	0.0001	
Kerry	M. Wyse Jackson 2002	1	50-80	x	Q40	0.0001	SAC 375
Kerry	Hodgetts 2006	1	8	x	Q40	0.0001	SAC 375
Waterford	Green. P & I 2001	1	x	x	X08	0.0001	SAC 2170
Carlow	Dowlen 1993	1	>50	x	S74	0.0001	SAC 2162
Cork	*Lockhart 1979	*1	*3-4	x	V75	0.0001	SAC 1879

County	Record for site with counts ∆	Sporophyte Colony (count)	Number of fronds	Gametophyte Colony (count)	Grid ref.	Area est. km^2	Conservation status of site
Cork	Curtis 2000	2	610	x	V65	0.0002	SAC 1043
Donegal	EIS 1999	1	?	x	G89	0.0001	
Donegal	Simpson & Williams 1961	1	?	x	B91	0.0001	SAC 2047
Kerry	Ratcliffe et al. 1967	1	20	x	V86	0.0001	SAC1342
Kerry	Ratcliffe 1977	1	60	x	V56	0.0001	
Kerry	*Pankhurst 1975, Ratcliffe 1961	2	65-70	x	V77	0.0001	SAC 365
Kerry	Pankhurst 1975	*1	*40	x	V77	0.0001	SAC 365
Kerry	Waldren 1993	1	20	x	V77	0.0001	SAC 365
Kerry	Tarrant 1987	1	?	x	V88	0.0001	
Kerry	Ratcliffe et al. 1967	2	24	x	V88	0.0001	SAC 365
Kerry	O Sullivan, Byrne, Mhic Daeid & Kingston 1995	1	20-30	x	V88	0.0001	SAC 365
Kerry	O Sullivan 1995	1	11	x	V98	0.0001	SAC 365
Kerry	Ratcliffe et al. 1961	2	29	x	V68	0.0001	NHA 365
Kerry	Ratcliffe 1983	1	?	x	V58	0.0001	NHA 365
Kerry	M. Wyse Jackson 1997	1	500 ~	x	Q70	0.03	SAC 2184
Kerry	Hodgetts 2006			x	Q50	0.0001	
Kerry	Foley 1995; O Brien 1996	1	?	x	V47	0.0001	NHA
Kerry	Hodd 1994	1	11	x	V98	0.0001	
Kerry	Ratcliffe et al. 1983	1	<10	x	Q50	0.0001	SAC 375
Kerry	T& R Hodd 1998 & Curtis 1998	1	?	x	Q40	0.0001	SAC 375
Kerry	Curtis 1998	3	102	x	Q40	0.0001	SAC 375
Kerry	Ratcliffe 1977	3	100	x	Q40	0.0001	SAC 375
Kerry	Rumsey 1993	2	>58	x	Q41	0.0001	SAC 376
Limerick	*Kingston & Hassett 2005; Reynolds & Conaghan	1	*120	x	R61	0.0001	SAC 930
Sligo	Cotton & Dunleavy 2005	23	?	x	G52	0.0001	SAC 1669
Kerry	O Sulliva, Mhic daeid & Byrne 1995	*1	*200	x	Q41	0.0001	SAC 375
Kerry	*Byrne, O Sullivan, Mhic Daeid & Kingston 1995,	*1	*40	**1	V98	0.04	SAC 365
Limerick	Kingston, Higgins & Barron 2006	4	69	>10	R75	0.05	SAC1432
Donegal	O Sullivan, Byrne, Mhic Daeid & Kingston 1995	1	300	1	G98	0.0004	SAC 163
Cork	*O Donnell & Graham 2006 ** Kingston 1995	*7	*615+	**1	W23	0.0001	SAC 1070
Donegal	O Sullivan, Byrne, Mhic Daeid & Kingston 1995	1	30	1	B91	0.0001	SAC 2047
Kerry	**Rumsey 1994 & * Hodd 1995	*3	*187	**>10	V98	0.05	SAC 365
Carlow	*Rumsey 1993	1	?	*1	S74	0.0001	
Clare/Limerick	**Kingston 2006; * O Sullivan 1995	*1	*500	**1	R75	0.0001	SAC930
Clare/Limerick	**Kingston 2006; * O Sullivan 1995	*1	*250-300	**1	R75	0.005	SAC930
Cork	**Kingston & Hayes 1995; * Curtis, Fitzgerald & BSBI	*1	* >500	**1	W13	0.02	SAC 1547
Kerry	**Rumsey 1994 & *Ratcliffe 1961	*2	*55	**1	V66	0.002	NHA 365
Kerry	**Rumsey 1994 & Hodd 1995	*2	*40-50	**2-5	V98	0.002	SAC 365
Kerry	*Curtis 1997, **Rumsey 1994	*1	?	**2-5	Q41	0.0001	SAC 375

County	Record for site with counts Δ	Sporophyte Colony (count)	Number of fronds	Gametophyte Colony (count)	Grid ref.	Area est. km^2	Conservation status of site
Waterford	Wyse Jackson 2003	21	>2390	>10 est	X29	0.01	SAC 2324
Waterford	*Fitzgerald, Hogan, Clancy & Ryan 1991 &**Rumsey & Jermy 1998	*1	*50	**1	S00	0.05	SAC 667

Δ Not in all cases the most recent record

Trichomanes speciosum **current population summary from Table 1**

- **Total number of populations = 66**
- **Total number of coexisting sporophyte and gametophyte populations = 15**
- **Total number of gametophyte only populations = 20**
- **Total number of sporophyte only populations = 31**
- **Total number of sporophyte colonies = 165 approx. (vary from 1 to >15 per pop.)**
- **Total number of fronds = 7151-7252 approx**
- **Mean no of fronds per colony = 155.45-157.65**
- **Total cover area in km^2 = 1.23km^2 approx**

4.2 Population trends

Some limited monitoring of colonies by Ratcliffe *et al* (1993) in Ireland suggests there is a reasonable level of stability over a ten to thirty year period in the number of fronds found in each colony and their position within the habitat. Some colonies remain constant while others develop or decline according to annual variations in weather (Ratcliffe *et al.* 1993). One of the Irish populations in Waterford is the largest in the British Isles with at least 23 sporophyte colonies and 2390 fronds (NPWS unpublished data).

4.3. Population Conservation Status

The Favourable Reference Population (FRP) is '*the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species*' (EC, 2006). At present there are at least 65 populations in Ireland of which at least 39 of these are protected within pNHA or SAC sites (see Table 1). This is considered the minimum necessary to ensure long-term viability of the species.

Following the General Evaluation Matrix for assessing the Conservation Status of Annex II Species (EC, 2006); as the Estimated Present Population is the same as the Favourable Reference Population, the Conservation Status of *Trichomanes speciosum* in Ireland is Favourable.

- **Species population: 66**
- **Favourable Reference Population: 66**

5.0 Habitat

There is abundant evidence for the correlation between the presence of *Trichomanes speciosum* in an area and availability of suitable habitat – it is confined to deeply shaded habits near cascades and waterfalls in dripping caves, in cliff crevices and on vertical wooded ravines.

See Section 2.3. for sources of Habitat information.

5.1 Habitat Conservation Status

NPWS staff and other workers have visited the locations and habitats occupied by *Trichomanes speciosum* frequently in recent years. Observations suggest that the microsites *Trichomanes speciosum* occupies in shaded native and invaded woodland, caves, crevices, and cliffs is still in good condition. Therefore it can be inferred that the Conservation Status of Habitat is Favourable.

In one population frond numbers appear to have declined, the decline attributed to a natural of fire in the vicinity (NPWS unpublished records). It is too early to ascertain whether a decrease in numbers is a temporary fluctuation or the possible cause a long-term decline, but the situation needs to be monitored. The waterfalls, caves, cliffs and crevice microhabitats and macro woodland habitat it occurs in often come under pressure (see Section 6.1), and more detailed work on the specific habitat requirements such as that carried out by Kingston & Hayes (2005) is needed.

6.0 Future Prospects

6.1 Negative impacts and threats

Because of the specific nature of its habitat and its specialised ecology, *Trichomanes speciosum* is potentially threatened by a number of factors, including sample collecting, recreational activities, and desiccation. Having said that, many sites are good and are recorded as having no perceived current threats. The main pressures and threats can be summarised as follows:

- Collection of samples (250)
- Outdoor sport and leisure (620)
- Human disturbance in localities used for recreational purposes (690)
- Woodland clearance (164)
- Overgrazing (148)
- Natural processes such as wind felling of trees (990)
- Modifications to the hydrology of a site through afforestation, road development or hydro-electric engineering (850)
- Water pollution (sewage, fertilisers) (701)
- Air pollution hydrocarbons) (702)
- Global warming (990)
- Climate change (990)

6.2 Positive Impacts

A number of these threats are being addressed through national legislation. Some of the rarest plants in Ireland, including *Trichomanes speciosum*, are protected under the Flora Protection Order (1999). It is an offence to cut, uproot or damage plants included in this list. The Habitats Directive (which specifically protects *Trichomanes speciosum* in Annex IIb) is transposed into Irish law in the European Communities (Natural Habitats) Regulations (S.I. 94 of 1997). The Habitats Directive provides protection for the habitats of listed plants as well as the plants themselves.

Under Annex IIb, each member state must designate Special Areas of Conservation for *Trichomanes speciosum*. Ireland to date has 39 SACs in which *Trichomanes speciosum* is one of the key features (Table 1).

The Irish Government is a signatory to The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), 1982, on which the species is also listed.

6.3. Conservation Status

The range of *Trichomanes speciosum* can be considered to have increased marginally. The only historic county record missing from the current distribution is from Co. Clare. The situation would appear more drastic had not a number of gametophyte populations close to locations of sporophyte records in the past been discovered in the 1990's. Thus there is no evidence of a decline in the overall population, although there has been a decline in the historic sporophyte population. It still occurs at the great majority of the sites from which it has been recorded. It has a Favourable Conservation Status.

The population of *Trichomanes speciosum* in Ireland is of extreme importance in a European context. One of the sites where it occurs is considered one of the largest in the British Isles and appears to be fairly stable.

However, longer-term trends are difficult to distinguish. Certainly it was more widespread and was collected extensively during the Victorian fern craze (Allen 1969), and while the number of populations may have not significantly fallen it may be that the number of plants in each population has decreased. Population therefore has a Favourable Conservation Status.

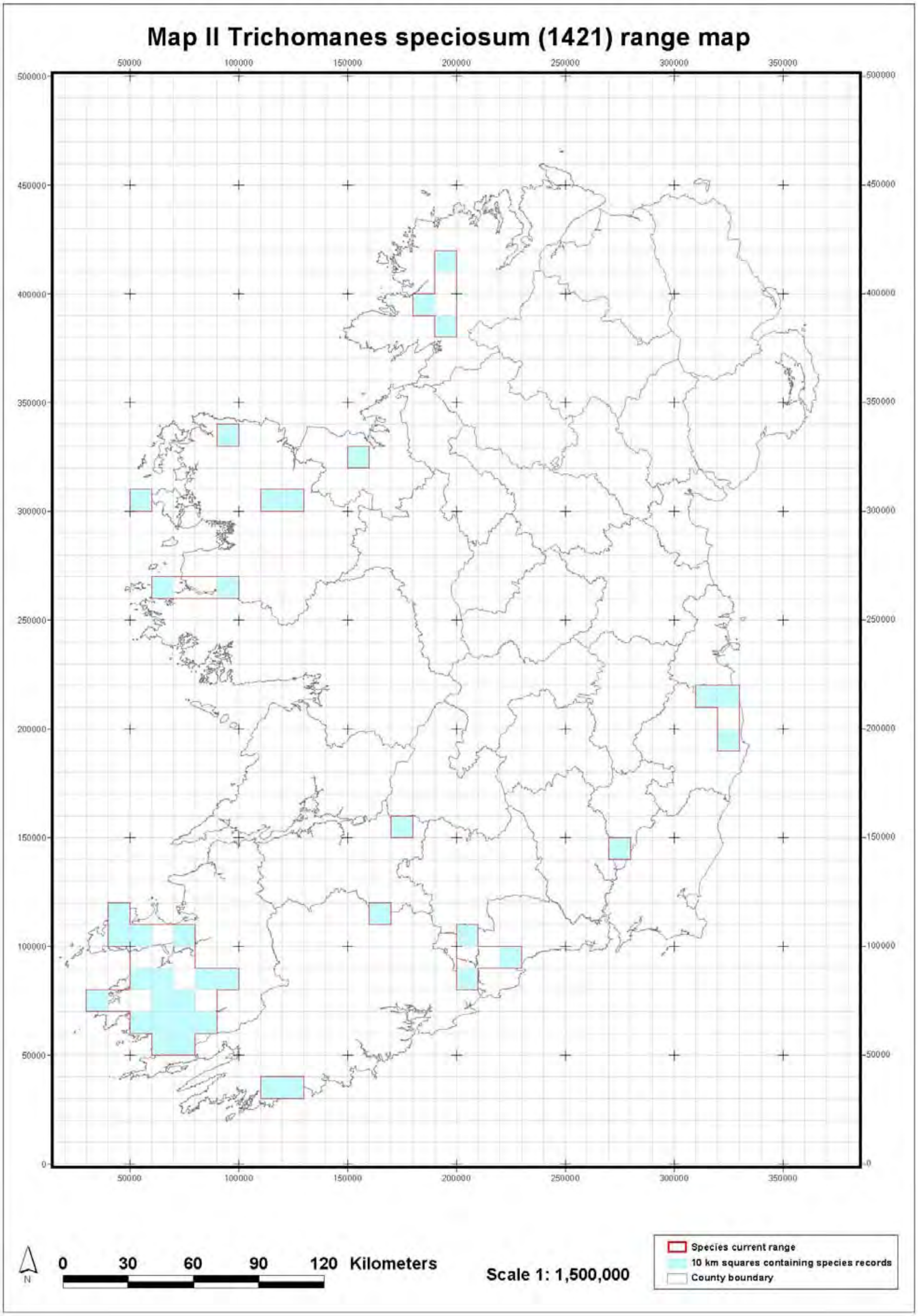
The habitat of *Trichomanes speciosum* is largely in good condition, and most identified suitable areas still support *Trichomanes speciosum*. Habitat has a Favourable Conservation Status.

Considering the impacts, pressures and threats to *Trichomanes speciosum* in Ireland today and the measures in place that will assist its protection, it is expected that this species will survive. The overall Conservation Status for Future Prospects of *Trichomanes speciosum* is Favourable.

Range of *Trichomanes speciosum*:	**Favourable**
Population of *Trichomanes speciosum*:	**Favourable**
Habitat for *Trichomanes speciosum*:	**Favourable**
Future Prospects for *Trichomanes speciosum*:	**Favourable**
Overall Assessment:	**Favourable**

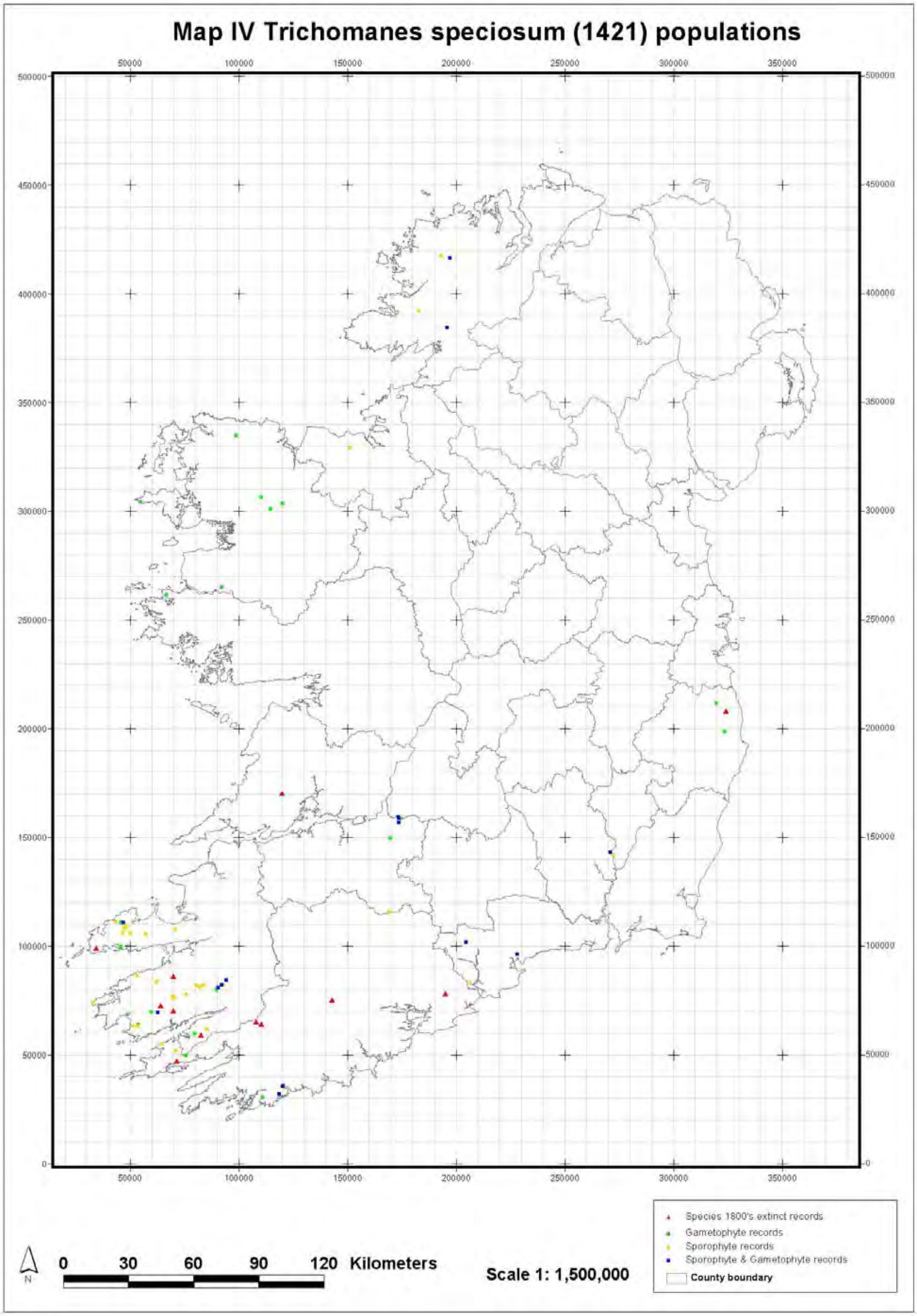
Appendix I

Range of *Trichomanes speciosum* in Ireland (2007)



Appendix II

Distribution of *Trichomanes speciosum* in Ireland (2007)



Appendix III

References & Further reading

Anon. 2007. Draft All Ireland Species Action Plan- Killarney Fern. Department of the Environment Heritage and Local Government.

Allen, D.E. 1969. The Victorian Fern Craze. Hutchinson, London.

Colgan, N. & Scully, R.W. 1898. Contributions towards a Cybele Hibernica. 2nd Ed. Edward Ponsonby, Dublin.

Curtis, T.G.F. & McGough, H.N. 1988. The Irish Red Data Book 1: Vascular Plants. Government Stationary Office, Dublin.

Doyle, G.J. 1987. A new station for the Killarney Fern (*Trichomanes speciosum* Willd.) in Killarney oakwoods (Blechno-Quercetum). *Irish Naturalists' Journal* **22**:353-356.

IUCN 2001. IUCN Red List Categories & Criteria. Version 3.1. IUCN, Gland, Switzerland.

Jermy, A.C. 1994. *Trichomanes speciosum* and its gametophyte in Ireland. Unpublished Report, Natural History Museum, London.

Johnson, G.N., Rumsey, F.J., Headley, A.D. & Sheffield, E. 2000. Adaptations to extreme low light in the fern *Trichomanes speciosum*. *New Phytologist* **148**:423-431.

JNCC 2007 accessed 13/06/07: www.jncc.gov.uk/protectedsites/SACselection/species.asp?FeatureIntCode=S1421

Kingston, N. & Hayes, C. 2005. The ecology and conservation of the gametophyte generation of the Killarney Fern (*Trichomanes speciosum* Willd.) in Ireland. *Biology and Environment: Proceedings of the Royal irish Academy* **105B** (2):71-79.

Krippel, Y. 2001. Aire de réartition et statut de *Trichomanes speciosum* Willd. (Hymenophyllaceae) au Luxembourg. *Bulletin des Naturalistes Luxembourgeois* **102**:3-13.

Preston, C.D., Pearman, D.A. & Dines, T.D. 2002. New Atlas of the British & Irish Flora. Oxford University Press, Oxford.

Ratcliffe, D.A., Birks, H.J.B., & Birks, H.H. 1993. The ecology and conservation of the Killarney Fern *Trichomanes speciosum* Willd. in Britain and Ireland. *Biological Conservation* **66**:231-247.

Rumsey, F.J. 1994. The distribution and population biology of the Killarney Fern (*Trichomanes speciosum* Willd.) Unpublished PhD. thesis, University of Manchester.

Rumsey, F.J. 1997. Guidelines for monitoring *Trichomanes speciosum*. In: Report of the proceedings of a workshop on *Trichomanes speciosum*, the Killarney Fern, held at the Natural History Museum, London 15th May 1997.

Rumsey, F.J., Gibby, M. & Vogel, J.C. 2002a The UK Biodiversity Action Plan (BAP) process in action: the Killarney Fern (*Trichomanes speciosum* Willd.) – a case study. *Fern Gazette* **16**:344-349.

Rumsey, F.J., Headley, A.D., Farrar, D.R. & Sheffield, E. 1991. The Killarney Fern (*Trichomanes speciosum* Willd.) in Yorkshire. *Naturalist* **116**:41-43.

Rumsey, F.J., Jermy, A.C., & Sheffield, E., 1998a. The independent gametophytic stage of *Trichomanes speciosum* Willd. (Hymenophyllaceae), the Killarney Fern and its distribution in the British Isles . *Watsonia* **22**:1-19.

Rumsey, A.J., Vogel, J.C., Russell, S.J., Barrett, J.A., & Gibby, M. 1998b. Climate, colonization and celibacy: population structure in central European *Trichomanes speciosum* (Pteridophyta) *Botanica Acta* **111**:481-489.

Rumsey, F.J., Vogel, J.C., Russell, S.J., Barrett, J.A. & Gibby, M. 1999. Population structure and conservation biology of the endangered fern *Trichomanes speciosum* Willd. (Hymenophyllaceae) at its Northern distributional limit. *Biological Journal of the Linnean Society* **66**:333-344.

Rumsey, F.J., Vogel, J.C., Russell, S.J., Barrett, J.A. & Gibby, M. 2002b A review of progress towards the conservation of the Killarney Fern (*Trichomanes speciosum* Willd.) in the British Isles. *Botanical Journal of Scotland* **54**:37-47.

Vogel, J.C., Jessen, S., Gibby, M., Jermy, A.C. & Ellis, L. 1993. Gametophytes of *Trichomanes speciosum* (Hymenophyllaceae: Pteridophyta) in Central Europe. *Fern Gazette* **14**:227-232.

1421 Killarney Fern (*Trichomanes speciosum*)

National Level	
Species code	1421
Member State	Ireland IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	5,300 km^2 (53 grid cells x 100km)

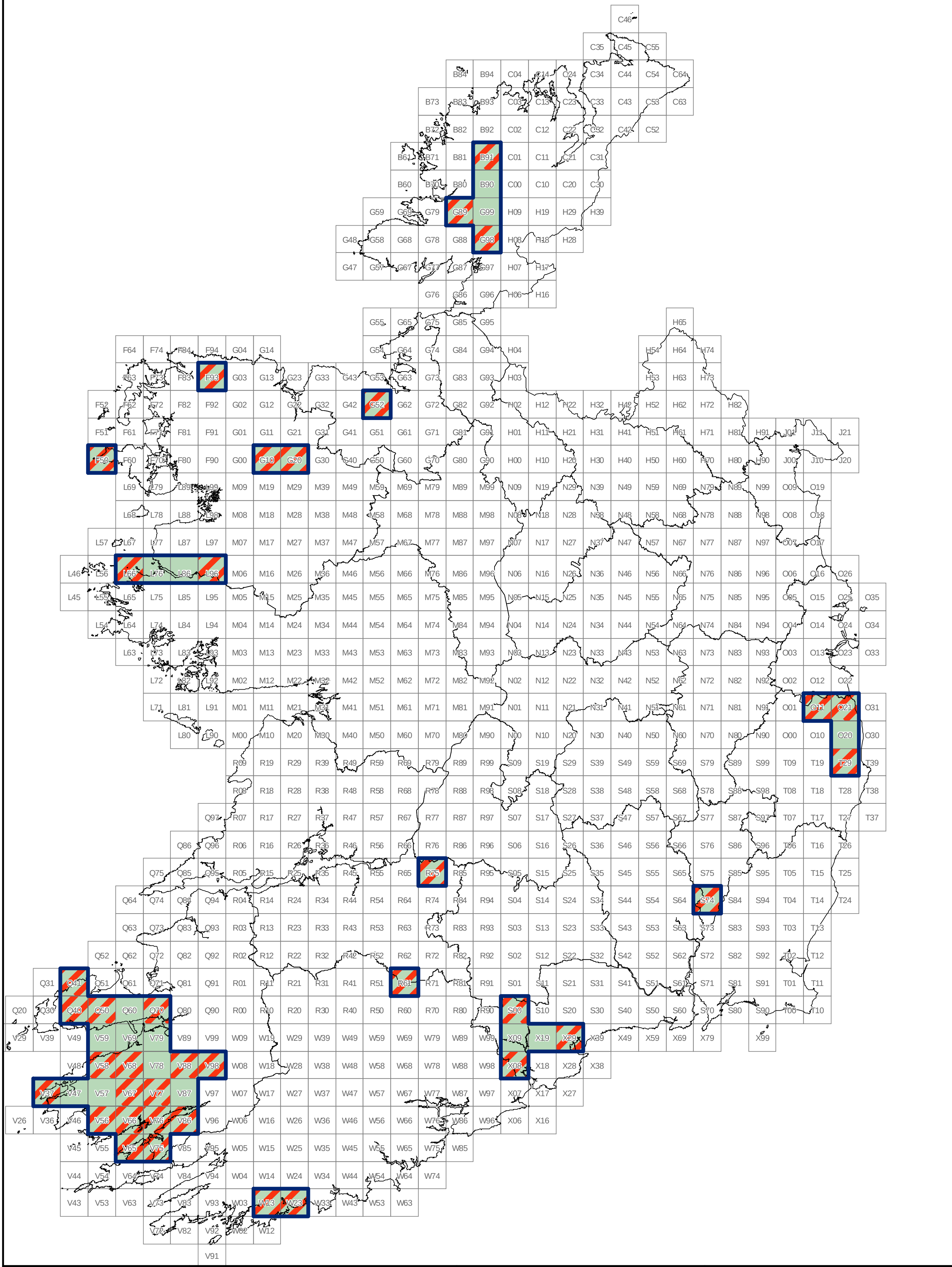
Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Anon. 2007. Draft All Ireland Species Action Plan- Killarney Fern. Department of the Environment Heritage and Local Government. ▪ Allen, D.E. 1969. <u>The Victorian Fern Craze</u>. Hutchinson, London. ▪ Colgan, N. & Scully, R.W. 1898. <u>Contributions towards a Cybele Hibernica</u>. 2nd Ed. Edward Ponsonby, Dublin. ▪ Curtis, T.G.F. & McGough, H.N. 1988. <u>The Irish Red Data Book 1: Vascular Plants</u>. Government Stationary Office, Dublin. ▪ Doyle, G.J. 1987. A new station for the Killarney Fern (*Trichomanes speciosum* Willd.) in Killarney oakwoods (Blechno-Quercetum). *Irish Naturalists' Journal* 22:353-356. ▪ IUCN 2001. <u>IUCN Red List Categories & Criteria</u>. Version 3.1. IUCN, Gland, Switzerland. ▪ Jermy, A.C. 1994. *Trichomanes speciosum* and its gametophyte in Ireland. Unpublished Report, Natural History Museum, London. ▪ Johnson, G.N., Rumsey, F.J., Headley, A.D. & Sheffield, E. 2000. Adaptations to extreme low light in the fern *Trichomanes speciosum*. *New Phytologist* 148:423-431. ▪ JNCC 2007. accessed 13/06/07: <u>www.jncc.gov.uk/protectedsites/SACselection/species.asp?FeatureIntCode=S1421</u> ▪ Kingston, N. & Hayes, C. 2005. The ecology and conservation of the gametophyte generation of the Killarney Fern (*Trichomanes speciosum* Willd.) in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* 105B (2):71-79. ▪ Krippel, Y. 2001. Aire de réartition et statut de *Trichomanes speciosum* Willd. (Hymenophyllaceae) au Luxembourg. *Bulletin des Naturalistes Luxembourgeois* 102:3-13. ▪ Preston, C.D., Pearman, D.A. & Dines, T.D. 2002. <u>New Atlas of the British & Irish Flora</u>. Oxford University Press, Oxford. ▪ Ratcliffe, D.A., Birks, H.J.B., & Birks, H.H. 1993. The ecology and conservation of the Killarney Fern *Trichomanes speciosum* Willd. In Britain and Ireland. *Biological Conservation* 66:231-247. ▪ Rumsey, F.J. 1994. The distribution and population biology of the Killarney Fern (*Trichomanes speciosum* Willd.) Unpublished PhD. thesis, University of Manchester. ▪ Rumsey, F.J., Gibby, M. & Vogel, J.C. 2002a The UK Biodiversity Action Plan (BAP) process in action: the Killarney Fern (*Trichomanes speciosum* Willd.) – a case study. *Fern Gazette* 16:344-349. ▪ Rumsey, F.J., Headley, A.D., Farrar, D.R. & Sheffield, E. 1991. The killarney fern (*Trichomanes speciosum* Willd.) in Yorkshire. *Naturalist* 116:41-43. ▪ Rumsey, F.J., Jermy, A.C., & Sheffield, E., 1998a. The independent gametophytic stage of *Trichomanes speciosum* Willd. (Hymenophyllaceae), the Killarney Fern and its distribution in the British isles. *Watsonia* 22:1-19.

	▪ Rumsey, A.J., Vogel, J.C., Russell, S.J., Barrett, J.A., & Gibby, M. 1998b. Climate, colonization and celibacy: population structure in central European *Trichomanes speciosum* (Pteridophyta) *Botanica Acta* 111:481-489. ▪ Rumsey, F.J., Vogel, J.C., Russell, S.J., Barrett, J.A. & Gibby, M. 1999. Population structure and conservation biology of the endangered fern *Trichomanes speciosum* Willd. (Hymenophyllaceae) at its Northern distributional limit. *Biological Journal of the Linnean Society* 66:333-344. ▪ Rumsey, F.J., Vogel, J.C., Russell, S.J., Barrett, J.A. & Gibby, M. 2002b A review of progress towards the conservation of the Killarney Fern (*Trichomanes speciosum* Willd.) in the British isles. *Botanical Journal of Scotland* 54:37-47. ▪ Stace, C.A. 1997. New flora of the British Isles, 2nd Ed. Cambridge University Press, Cambridge. ▪ Vogel, J.C., Jessen, S., Gibby, M., Jermy, A.C. & Ellis, L. 1993. Gametophytes of *Trichomanes speciosum* (Hymenophyllaceae: Pteridophyta) in Central Europe. *Fern Gazette* 14:227-232.
Range	
Surface area	5,300km^2
Date	June 2007
Quality of data	3=good
Trend	0=stable
Trend-Period	1960-2007
Reasons for reported trend	1=improved knowledge
Population	
Population size estimation	66 populations (15 sporophyte & gametophyte populations; 20 gametophyte populations and 31 sporophyte populations)
Date of estimation	2007
Method used	3= from complete inventory
Quality of data	3= good
Trend	0=stable (since 1960)
Trend-Period	1960-2007
Reasons for reported trend	1=improved knowledge
Justification of % thresholds for trends	The overall population number has increased marginally due to the discovery of gametophyte populations in the 1990's. There was a loss of some historic sporophyte populations but overall the number of sporophyte populations has remained stable since the 1960's.
Main pressures	250 Collection of samples 620 Outdoor sport and leisure 164 Woodland clearance 148 Overgrazing general 501 Paths, tracks, cycling tracks 990 Natural processes such as wind felling of trees 850 Modifications to the hydrology of a catchments through afforestation, road development or hydro-electric engineering 701 Water pollution 120 Fertilisation 702 Air pollution (hydrocarbons)

Threats	250 Collection of samples 620 Outdoor sport and leisure 690 Human disturbance in localities used for recreational purposes 164 Woodland clearance 148 Overgrazing general 990 Natural processes such as wind felling of trees 850 Modifications to the hydrology of a site through afforestation, road development or hydro-electric engineering 701 Water pollution (Sewage, fertilisers) 702 Air pollution (hydrocarbons) 990 Global warming drought 990 Climate change
Habitat for the species	
Area estimation	Total area of woodland, cliff, ravine and crevice habitat with *Trichomanes speciosum* estimated at ~20km^2
Date of estimation	May 2007
Quality of data	3=good
Trend	Stable
Trend-Period	1960-2007
Reasons for reported trend	1=improved knowledge
Future prospects	1=good

Complementary information	
Favourable reference range	5,300km^2 (53-10km grid squares within favourable reference range polygon: 38:10km grid squares with species records and 15:10km grid squares without records)
Favourable reference population	66 populations (15 sporophyte & gametophyte populations; 20 gametophyte populations and 31 sporophyte populations)
Suitable Habitat for the species	20km^2
Other relevant information	**Positive Impact**: *Trichomanes speciosum* is protected under the Wildlife Act, 1976- Flora Protection order 1999 and the European Union Habitats Directive, 1992 [92/43] **Possible negative impacts**: Very specialized habitat preferences and ecology and very slow growing potentially threatened by a number of factors including sample collection, recreational activities, habitat destruction and desiccation.

Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Population	Favourable (FV)
Habitat for the species	Favourable (FV)
Future prospects	Favourable (FV)
Overall assessment of CS	**Favourable (FV)**



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Killarney Fern
Trichomanes speciosum

1421

Current Distribution (38 cells)
Current Range (53 cells)
Favourable Reference Range (53 cells)
W48 10km grid cells

Date: October 2007

Conservation Assessment of *Saxifraga hirculus* in Ireland

May, 2007

Table of Contents

1 Ecology of Saxifraga hirculus in Ireland 1
2 Mapping 1
2.1 Distribution 1
2.2 Range 1
2.3 Habitat 2
3 Range 2
3.1 Range Conservation Status 2
4 Population 3
4.1 Population Estimate 3
4.2 Population Trends 3
4.3 Population Conservation Status 3
5 Habitat 3
5.1 Habitat Conservation Status 3
6 Future Prospects 4
7 References 4

1 Ecology of *Saxifraga hirculus* in Ireland

Saxifraga hirculus L. is one of thirteen members of the Saxifragaceae found in the island of Ireland. (Webb, 1996). It is a small perennial plant with orange/brown hairs on the stem, opposite leaves and an erect yellow flower (1.5 – 2.5mm) with a superior ovary. Flowers range from one to seven per flowering stem with orange spots on each petal (pers obs). A protandrous species it has male and female phases of nine and three days respectively (Olesen, 1989). Flowering in Ireland begins in mid July and continues until early October.

S. hirculus reproduces sexually by pollination and asexually by means of runners. The flowers are non-specialised and in Ireland are visited by a wide range of pollinators including Lepidoptera and Diptera. To date no research on pollinators have been carried out in Ireland but studies in Sweden and Demark give similar results (Warnke, 1993, Olsen, 1989).

S. hirculus is widespread in the Arctic where optimum conditions with access to sufficient light are found due to low vegetation. Now declining and threatened throughout Europe, *Saxifraga hirculus* L. once had a relatively wide distribution across the European Union (EU). This trend is well documented across the continent with the species now extinct in Austria, the Czech Republic and the Netherlands (Jalas *et al*, 1999). Severe depletion has been documented in other countries such as Switzerland where 27 sites were reduced to 1 by the 1960's and France where 25 sites were reduced to 3 (Hallam, 1999). In Ireland the plant appears to be restricted to mineral flushes in what is otherwise ombrotrophic blanket bog.

2 Mapping

2.1 Distribution

In addition to the current extant sites, *S. hirculus* was previously recorded from a number of midland counties in Ireland namely Tipperary, Westmeath, Offaly and Laois (Moore and More, 1866; Praeger, 1901). However by the 1970s, the Irish Red Data book (Curtis and McGough, 1988), record only two sites, one in Mayo and one in Antrim. The midlands sites having been lost due to drainage and peat removal (Lockart, 1989).

Identification of new sites in the Mayo region in particular has been ongoing since the 1980's (Lockhart and Douglass, NPWS). In the Republic of Ireland, *S. hirculus* is currently found only in County Mayo with eight sites documented (NPWS). A number of additional sites adjacent to an existing documented site were observed in May 2004 (pers obs) and another new site identified in the summer of 2006 (Lockhart, NPWS). All known sites lie within 5 of the Irish 10km^2 grid.

2.2 Range

According to EC (2006), range is taken to be *'the outer limits of the overall area in which a habitat or species is found at present. It can be considered as an envelope*

within which areas actually occupied occur as in many cases not all the range will actually be occupied by the species or habitat'.
The known sites of *S. hirculus* were placed on the Irish $10km^2$ grid and the area calculated. The range outline following IUCN guidelines would be taken as the '*area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy'* (EC, 2006). A recent inventory of fens has been carried out by National Parks and Wildlife (Foss 2007). This divides fens into six categories as outlined in Appendix 1. *S. hirculus* has been found in two of these fen types namely Poor fens and Non-Calcareous springs. This could therefore raise the area of potential habitat to 11,873 (ha). However it is known that *S. hirculus* does not inhabit all of these flushes. As seed dispersal is restricted to no more than one metre and the clonal spread is restricted to the flushes it appears that *S. hirculus* can not extend its range outside its current extent.

2.3 Habitat

As stated above *S. hirculus* has been found in two of the fen types described by Foss namely Poor fens and Non-Calcareous springs. It appears *S. hirculus* cannot extent its range, living in what in effect are small islands separated by large swathes of blanket bog. These have been identified and mapped in conjunction with NPWS.

3 Range

The range of *S. hirculus* in Ireland is in small flushes occurring in the blanket bogs of North West Mayo.

3.1 Range Conservation Status

The Favourable Reference Range (FRR) is *'the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species'* (EC, 2006). This will be ascertained following genetic analysis of the known populations. But for the present it is taken as its present range (i.e. a polygon drawn around all the 10 km^2 squares from which *S. hirculus* has been recorded recently) as far as can be inferred the population appears to be stable.

Old records for the midlands are no longer valid as they have been lost due to drainage and peat removal (Lockart, 1989). Although this is a reduction in range the habitat no longer exists so it cannot be considered part of its natural range.

As the current range of the species is the same as the FRR, it is allocated a Favourable conservation status in this respect.

4 Population

4.1 Population Estimate

All known sites of *S. hirculus* have been surveyed and population estimates carried out within the last three years as part of a NPWS funded PhD. Population estimates are arrived at by extrapolating upwards from smaller samples as populations consist of many thousands and direct counting would not be feasible. There are a number of problems in estimating *S. hirculus* populations, notably the difficulty in deciding what constitutes 'an individual'. In the case of *S. hirculus*, a single rosette is taken to be an individual, although this takes no account of the fact that rosettes might be connected by rhizomes, or that some populations might consist of only a few clonal groups.

4.2 Population Trends

Because of the lack of historical population estimates, and the tendency for past assessments to be based on floral counts rather than rosettes it is almost impossible to assess population trends in individual colonies of *S. hirculus* at this stage. From the last three years it appears that the species is stable at all sites, but it is difficult to draw firm conclusions from such a short time frame.

4.3 Population Conservation Status

As discussed in 3.1 the Favourable Reference Population (FRP) is '*the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species'* (EC, 2006). At present there are at least 9 populations in Ireland, Sheean being a metapopulation. See Appendix 2 for details.

The unit for population provided in the form is the *number of populations*. A population number has estimated 581,795 individual rosettes in eight sites (one is a metapopulation containing 6 sites). As the diversity within populations has not yet been established it is imperative that the number of populations should be maintained and not the number of rosettes.

Following the General Evaluation Matrix for assessing the Conservation Status of Annex II Species (EC, 2006); because the Estimated Present Population is the same as the Favourable Reference Population as it is considered the minimum necessary to ensure the long term viability of the species, the Conservation Status of *S. hirculus* in Ireland is Favourable.

5 Habitat

S. *hirculus* occurs in flushes in Blanket bog.

5.1 Habitat Conservation Status

The flushes occupied are not currently considered to be threatened. There appears to be enough habitat available to support the current distribution of the species. The habitat does not appear to be declining in area or quality.

6 Future Prospects and Overall Assessment

Grazing remains a concern as high levels of flower loss has been recorded. However the implementation of sheep destocking levels proposed by the Commonage Framework Plan through the Rural Environmental Scheme (REPS 3) and National Farm Plan Scheme should reduce the pressure from overgrazing.

Any threats to the intact blanket bog which surrounds the flushes may threaten the species in the future, these include drainage, wind farm development and potential problems with changing weather patterns due to climate change.

The future prospects of *S. hirculus* are considered to be Favourable. There have been historic declines in the distribution of this species due to habitat loss, however the current distribution is deemed to be adequate for the future survival of the species in Ireland.

Overall Assessment

Range	Favourable
Population	Favourable
Area of suitable habitat	Favourable
Future prospects	Favourable
Overall Assessment	Favourable

7 References

Curtis, T. G. F. & Mc Gough, H.N. (1988). *The Irish Red Data Book. I Vascular Plants.* Stationary Office Dublin

European Commission, 2006. *Assessment, monitoring and reporting under Article 17 of the Habitats Directive: Explanatory Notes and Guidelines. Draft 4, September, 2006.*

Foss, P., 2007. Study of the extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. Report to National Parks and Wildlife. The Department of the Environment.

Foss, P., O'Connell, C and Crushell. P., 2001. Bogs and Fens of Ireland Conservation Plan 2005. Irish Peatland Conservation Council.

Hallam, C. J., Kelly, P. & Sydes, C. *Effects of Grazing on Flower Production and Fruit Survival in a Rare Plant Species, Marsh Saxifrage, Saxifraga hirculus, in Upland Britain*. Unpublished Report.

Lockhart. N. D. *Three new localities for Saxifraga hirculus L. in Ireland*. Irish Naturalists Journal 23: 65-69. 1999

Moore, D and Moore, A.G. (1866). *Contributions towards a Cybele Hibernica*. Hodges and Smith. Dublin

Olesen. J. M. and Warncke, E. 1989. Flowering and seasonal changes in flower sex ratio and frequency of flower visitors in a population of *Saxifraga hirculus.* - Holarct. Ecol. 12: 21-30.

Praeger, R. L. (1901). *Irish Topographical Botany*. Royal Irish Academy. Dublin (1934).

Warnke, E., U. Terndrup, V. Michelsen, and A. Erhardt. (1993). Flower visitors to Saxifraga hirculus in Switzerland and Denmark, a comparative study. Botanica Helvetica 103:141-147.

Webb, D.A., Parnell,J. and Doogue, D. (1996). *An Irish Flora* (7th edition). Dundalgan press, Dundalk.

Appendices

Appendix 1

Fen type and area as assessed in 2007

NPWS Fen Study Type	Number of sites	Fen Area (ha)
*Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* 7210 (PF1)	1 2 2	1,486
Alkaline fens 7230 (PF1)	380	6,830
Poor fens (PF2)	379	11,841
Transition mires and quaking bogs 7140 (PF3)	173	1,955
Petrifying springs tufa formation (*Cratoneurion*)7220 (FP1)	112	36
Non-Calcareous springs (*Montio Cardaminetea*) (FP2)	33	32
Total		22,180

Taken from: Foss, P., 2007. Study of the extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. Report to National Parks and Wildlife. The Department of the Environment

Appendix 2

Extant sites in Mayo

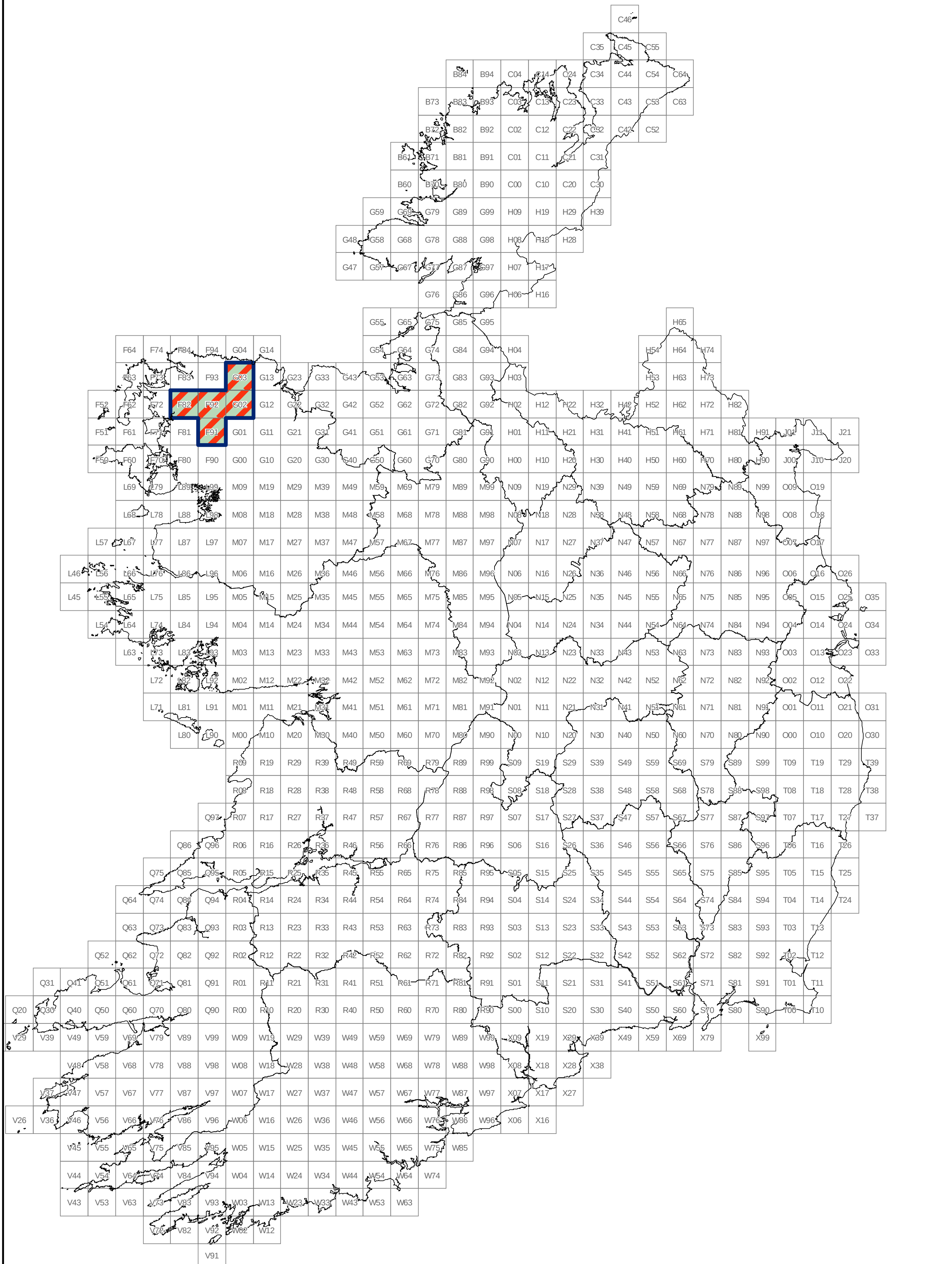
Site	Grid references
Sheean	091972 320034
Uggool	F92546 18935
Largan Mor A	F89371 22564
Largan Mor B	F89922 24056
Sheskin	F98134 29147
Bellacorrick	G00613 24707
Formoyle	G05400 22300
Barroosky	F93575 28595
Aghoo	G08312 35099

1528 Saxifraga hirculus

National Level	
Species Code	1528
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	500 km^2

Bio geographic level	
Bio geographic region	Atlantic (ATL)
Published sources	Curtis, T. G. F. & Mc Gough, H.N. (1988). *The Irish Red Data Book. I Vascular Plants.* Stationary Office Dublin European Commission, 2006. *Assessment, monitoring and reporting under Article 17 of the Habitats Directive: Explanatory Notes and Guidelines. Draft 4, September, 2006.* Foss, P., 2007. Study of the extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. Report to National Parks and Wildlife. The Department of the Environment. Foss, P., O'Connell, C and Crushell. P., 2001. Bogs and Fens of Ireland Conservation Plan 2005. Irish Peatland Conservation Council. Curtis, T. G. F. & Mc Gough, H.N. (1988). *The Irish Red Data Book. I Vascular Plants.* Stationary Office Dublin Hallam, C. J., Kelly, P. & Sydes, C. *Effects of Grazing on Flower Production and Fruit Survival in a Rare Plant Species, Marsh Saxifrage, Saxifraga hirculus, in Upland Britain*. Unpublished Report. Lockhart. N. D. *Three new localities for Saxifraga hirculus L. in Ireland*. Irish Naturalists Journal 23: 65-69. 1999 Moore, D and Moore, A.G. (1866). *Contributions towards a Cybele Hibernica*. Hodges and Smith. Dublin Olesen. J. M. and Warncke, E. 1989. Flowering and seasonal changes in flower sex ratio and frequency of flower visitors in a population of *Saxifraga hirculus.* - Holarct. Ecol. 12: 21-30. Praeger, R. L. (1901) *Irish Topographical Botany*. Royal Irish Academy. Dublin (1934). Webb, D.A., Parnell,J. and Doogue, D. (1996). *An Irish Flora* (7th edition). Dundalgan press, Dundalk.
Range	
Surface area	500km^2
Date	04/2007
Quality of data	3 = good
Trend	+ - increasing 20%
Trend-Period	1994-2006
Reasons for reported trend	1 = improved knowledge/more accurate data
Population	
Distribution map	See habitat map
Population size estimate	**9 populations**
Date	2006
Method used	3 = from complete inventory
Quality of data	3 = good

Trend	*+ increasing 12.5% (ie by one population)*
Trend-Period	1994-2006
Reasons for reported trend	1 = improved knowledge
Justification of % thresholds for trends	While known population number has increased, this reflects better knowledge of the species distribution rather than biological growth.
Main pressures	142 Overgrazing by sheep 800 Land reclamation 810 Drainage
Threats	142 Overgrazing by sheep 512 Wind Farm development 791Climate change 810 Drainage
Habitat for the species	
Area estimation	0.014km^2 (area polygon derived field measurements). This area corresponds to the area within the flushes known to contain *Saxifraga hirculus*.
Date of estimation	04/2007
Quality of data	3 = good
Trend	+ - increasing
Trend period	2004 - 2007
Reason for Reported Trend	1 = improved knowledge/more accurate data
Future prospects	1 = good prospects
Complementary information	
Favourable reference range	500km^2
Favourable reference population	9 populations
Suitable Habitat for the species	0.014km^2
Other relevant information	**Population** The unit for population provided in the form is the *number of populations*. A population number has estimated 581,795 individual rosettes in eight sites (one is a metapopulation containing 6 sites). As the diversity within populations has not yet been established it is imperative that the number of populations should be maintained and not the number of rosettes. **Area of suitable habitat** The area of suitable habitat for the species may be much larger than the value presented, it is not clear why *S. hirculus* is not found in areas of apparently suitable flushes, it may be due to physiochemical parameters. **Positive actions** The implementation of sheep destocking levels proposed by the Commonage Framework Plan through the Rural Environmental Scheme (REPS 3) and National Farm Plan Scheme should reduce the pressure from overgrazing. Coillte Teoranta current policy of "no-new" planting on blanket bog should also reduce the pressure on the habitat. Restoration initiatives have been undertaken by: Coillte "Redesigning Western Peatland Forests 2006" project should positively impact the habitat once specific objectives are set and implemented. Coillte initiated in 2002 an "Active Blanket Bog Restoration" Project founded by an EU Life - Nature Programme. The project aim is to restore 1,212ha of the habitat within SACs. Bord na Mona restoration project of Oweninny bog (north-west Mayo) in the period 2001-2006.
Conclusions (assessment of conservation status at end of reporting period)	
Range	**Favourable (FV)**
Population	**Favourable (FV)**
Habitat for the species	**Favourable (FV)**
Future prospects	**Favourable (FV)**
Overall assessment of CS	**Favourable (FV)**



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Saxifraga hirculus

1528

Current Distribution (5 cells)
Current Range (5 cells)
Favourable Reference Range (5 cells)
W48 10km grid cells

Date: October 2007

Conservation Assessment of Slender Naiad (*Najas flexilis* (Willd.) Rostk.& W.L.E.Schmidt) in Ireland

March 2007

INTRODUCTION

Najas flexilis is a rare water plant within the European Union, consequently it is listed in Annexe 2 of the 1992 Habitats Directive, as a species in need of protection in the member states. Ireland and Scotland are the species' main location in Europe, although it is widespread in North America. The plant is a small annual which grows on the bottom of lakes, so it is difficult to find and is often overlooked. Year to year fluctuations in seed germination may also result in large variations in annual population size.

A compilation of records of *Najas* in Ireland by NPWS, drawn up before 2002 showed that the plant had been recorded from a total of 37 loughs between 1851 and 1999. Subsequent surveys carried out between 1999 and 2005 have added a further 12 sites to this list. Such additional records almost certainly reflect an increase in knowledge about the plants distribution rather than any recent expansion in the plant's range. The species occurs in Donegal, Leitrim, Mayo, Galway and Kerry. Connemara in west Galway appears to be the species Irish stronghold with 25 of the 49 recorded populations occurring there.

The plant is most abundant in mesotrophic loughs often within a few kilometers of the sea coast, but few populations are found either in truly oligotrophic lakes or in hard water

loughs on limestone . A wide range of associated macrophytes have been recorded in Ireland but two species, *Isoetes lacustris*-often an indicator of oligotrophic water- and *Potamogeton perfoliatus* -usually found in more base rich water- have been found in over 90% of surveyed sites. This overlap of contrasting species highlights the intermediate nature of *Najas* lakes. Other macrophytes such as *Hydrilla verticillata, Callitriche hermaphroditica, Potamogeton obtusifolius* and the charophyte *Nitella confervacea* which are scarce along the west coast of Ireland also appear to favour this type of mesotrophic lough. *H.verticillata* is only known from two Irish lakes both of which also contain *Najas flexilis*.
Such mesotrophic lakes are vulnerable both to nutrient enrichment and acidification. To date, one population of *Najas* has become extinct due to eutrophication caused by farmed fish cages and a failure to locate the species in another lake raises the possibility of lake acidification. The majority of sites however appear to hold sustainable populations of the plant.

Data sources

Najas flexilis was first recorded in Ireland in 1852 in Cregduff Lough (Webb and Scannell 1983) or 1850 (Praeger 1934) by Daniel Oliver. (However the NPWS database notes an 1851 record from Lough Namanawaun about 5 km to the west of Cregduff Lough). Most early discoveries were based on drift material found more or less by chance by botanists doing general fieldwork.

1875	**1900**	**1925**	**1950**	**1975**	**2000**	**2003**	**2004**	**2005**
2	**7**	**8**	**12**	**17**	**38**	**41**	**44**	**49**

Table 1. The increase in recorded populations of N. flexilis in Ireland from 1875 to 2005.

Between 1977 and 1984 a lake survey (Heuff 1984) based on inspection of benthic communities using snorkeling discovered many new populations and a further series of snorkeling surveys between 1999 and 2005 revealed more populations (Roden 2002, 2003, 2004, J. Ryan pers. com). Wingfield et al. (2004) as part of a survey of Scottish populations also re-examined 10 Irish sites in 2000. Table 1 shows the steady increase in recorded populations since the first discovery. At present a total of 49 lakes are known to contain, or to have contained, *N. flexilis*. Since 1999 Roden (op. cit.) has examined 45 of these sites and Wingfield a further 2 locations. For all these sites the abundance of *N.flexilis* and lists of associated species are available as well as estimates of conservation status and possible threats. Some lake chemistry data is available for 28 of these sites. This data is presented in Appendix 1.

RANGE

Area and trend

The records' locations were imported into a GIS programme (Arcview 3.2.) using the Irish National Grid format. The actual location of each population was used to map the species distribution on a 10km grid basis. Additionally some 10km squares were added to the final map as they intersected the boundaries of lakes where the species is present. An exception was Lough Corrib where, because of its large size and the fact that the species was restricted to its northwestern section, only some sections of the lake were taken to intersect the 10km grid.

The mapping of the species range is based on the 10km grid square distribution. The range polygon is defined by the smallest polygon size containing all grid squares, where the species was recorded, drawn using a minimum number of 90 degrees angles. Gaps in the species distribution of more than 2 square grids, as a result of unsuitable ecological conditions for the occurrence of the species, were deemed enough to justify a break in the range

Range is then calculated as the area of the polygons which enclose all 10 km grid square records. A total of 48 squares gives a range of 4800 square kilometers. With the discovery of new sites, range has increased since 1977, but this increase reflects the still incomplete knowledge of the sub littoral macrophyte flora of Irish lakes. The increase does not indicate that the species is spreading to new sites.

While it is very likely that further populations may be found in the core areas of the species' distribution especially along the south and west coast of Connemara, it is less certain that further populations exist in other areas. Searches in 2005 by Roden in apparently suitable lakes (as indicated by the associated flora) in south Galway, west

Clare, Mayo, Donegal and Kerry, (Roden, unpublished) failed to locate additional populations.

Eriocaulon aquaticum is an easily observed littoral plant which frequently occurs in *Najas* lakes. Like *Najas* it also occurs far more frequently in North America than in Europe. In Ireland and in Scotland it only grows close to the Atlantic coast. It is possible that the less easily mapped *N.flexilis* is also largely confined to similar areas and should not be expected in other Irish lakes, irrespective of nutrient status. Van Groenendael et al. (1982) have shown that the chemical composition of lakes in the west of Ireland is strongly influenced by the neighbouring Atlantic. However *N.flexilis* does occur rarely both in eastern Scotland and north east Europe, so it's natural range cannot be taken to be solely controlled by oceanic influence. Thus it is not possible at present to model the species potential range either on the basis of companion species or distance from the sea. An empirical approach seems the most reliable and recorded distribution is taken to co-incide with potential range.

POPULATION

Population estimation

Given the sub littoral habitat of *Najas flexilis* it is very difficult to estimate population number in a given lake. A subjective estimate of population size in each lake is given in Appendix 1. The plant appears most abundant in mesotrophic lakes including Ballinakill, Rusheenduff, Sessiagh, Port, Carragh, Leane and least abundant in oligotrophic lakes such as Acoose or Altora but also lakes such as Easard and Clooney which resemble *Chara* dominated hard water lakes. Thes observations support the thesis that *Najas* is a plant of lakes transitional between hard and soft water.

Population trends

Najas flexilis is an annual therefore year to year fluctuations in population density may be expected, but species continuity demands that at least some seeds germinate and produce viable seeds on a regular basis if the species is not to become extinct. Little is known about the species' ability to spread between lakes or watersheds and here it is assumed that lake populations are isolated from each other unless connected by streams or rivers. It is known that *N. flexilis* was more widespread in Europe during the early post glacial (e.g. Godwin 1975) and there is little evidence of the species colonizing new locations in recent times. Existing populations may be regarded as relicts, thus continuity in site occupancy is the best indicator of population health.

Years elapsed between first record and 2006.	>150	150-100	100-50	50-10	10-0
Number of populations discovered in the period	1	3	4	18	10
Extinct populations	1		1	1	
Uncertain status		2	2	6	
Total	2	7	14	39	49

Table 2. The known age and statusof Irish Najas populations.

Table 2 shows that the great majority of *N.flexilis* populations have persisted since first discovery with only 3 extinctions, thus indicating the overall continuity and thus health of the species' populations in Ireland. The three extinct populations occurred in small lakes (< 3ha.) thus the loss to the total Irish population is small.

The exact status of 10 populations is questionable. Two populations have not been examined since 1985 and 1977 repectively but there is no reason to doubt their continuing existence. However the remaining eight were searched for since 1999, but were not found. This failure cannot be taken as proof of extinction as there is no obvious sign of habitat deterioration. It is known that the population present at some sites was never large and may well have been missed as snorkelling only allows a small part of each lake to be surveyed. However if these small populations are not confirmed in the future, it will indicate that the species is declining in some lakes in Ireland.

Main pressures and threats

Threat/pressure	**Population concerned**	**Current situation**
120 Fertilization	Nafeakle, Keel,Ibby,Leane, Natawneymore	ongoing
200 Fish and shellfish aquaculture	Nafeakle	N.flexilis now extinct
421 Disposal of household waste	Ibby, Keel	N.flexilis now extinct in Ibby, nearly so in Keel

601 Golf course	Leane, Clooney	ongoing
800 Landfill	Mullaghderg	Occurred in past
810 Drainage	Mullaghderg	Occurred in past
952 Eutrophication	Nafeakle, Keel,Ibby,Leane, Natawneymore	ongoing
954 Invasion by a species	Tully	ongoing

Table 3 summarizes threats and pressures affecting N.flexilis.

Reasons for extinction include fish farm waste (Nafeakle), eutrophication and scraw development (Ibby) and unknown (Namanawaun). *Najas* was recorded from Lough Ibby in 1955, but by 2002 the lake was largely covered with *Potamogeton* species, this change may have been a natural development but drainage and housing development have occurred in the area. Namanawaum is a small coastal Lough with no benthic macrophytes in 2003 other than *Potamogeton obtusifolius*. The species was supposedly found here in 1851 according to the NPWS database, but is not mentioned by Praeger (1934) in his description of the area.

Two populations seem to be close to extinction; Keel Lough and Tully Lough. Less than five plants were found in either location. In Keel Lough the water was dark with plentiful blue green algae and the euphotic zone less than 2m based on maximum plant growth depth. There is a possibility that the lake is becoming eutrophic due to housing development around it and that *Najas flexilis* was once more abundant.

Najas flexilis was first recorded as drift material by L. Farrell at Tully Lough in 1978, (Farrell, pers. com.)during a survey of *Eriocaulon aquaticum*. She recorded 10 drift plants. Despite snorkell surveys in 2003, 2004 and 2005 only 2 growing plants were seen by Roden. This limited evidence strongly suggests a population decline between 1978 and 2003. A striking factor in the ecology of Tully Lough in 2003-05 was the great abundance of *Elodea canadensis*., Farrell (pers. com.) did not notice drift material of this plant in 1978; it may be that the spread of this alien has displaced *N.flexilis*. While *Elodea* does co exist with *Najas* in seven Lakes (Nahaltora, Corrib, Glenade, Kindrum, Keel, Leane and Tully) it is disturbing that *N. flexilis* was not located in two of these during recent surveys and only a few plants were seen in two others. From this evidence one cannot discount the possibility of *Elodea* sp. displacing or reducing *Najas* populations. Wingfield et al (op. cit.) discuss *Elodea* spread in Scottish Lochs but do not

regard evidence of *N.flexilis* displacement as very strong. They also observe that *Najas* and *Elodea* co-exist in some Scottish Loughs.
Other pressures include golf course construction near Clooney and Leane with the consequent threat of fertilization and increased sedimentation. Drainage and lowering of the lake level occurred many years ago at Mullaghderg to the point that the lake is now divided in two by a newly formed isthmus. Part of this lake was also infilled to form a football pitch.

HABITAT

Habitat area estimation

As Wingfield et al. (2004) have shown, it is possible to consider habitat of *N.flexilis* both on a lake basin scale and as a smaller habitat within each lake. Appendix 1 shows that *N.flexilis* occurs in a wide variety of lakes on igneous, metamorphic or sandstone, but rarely limestone, bedrock. It can be seen that *N.flexilis* occurs both in lakes with an essentially oligotrophic or softwater flora with *Isoetes lacustris* and *Lobelia dortmanna* but also in more hard water lakes with *Chara* and *Potamogeton* species (see Appendix 1). To an extent these differences reflect different rock types but water chemistry is also influenced by saltwater spray or drift. Wingfield et al. (2004) report similarly wide ecological preferences of *N. flexilis* in Scotland. Thus it is not possible to directly link suitable habitat for *Najas* with easily recognized vegetation units as the species seems to occur in lakes which are transitional between hard and softwater types. This transitional nature is emphasized by the co-occurrence of *Isoetes lacustris* and *Potamogeton perfoliatus* in most Irish *Najas* lakes. Detailed data on the distribution of these two easily recorded species might allow suitable lakes to be recognized, however such data is not available at present.
The micro habitat of *Najas* is more easily defined, it grows on mud to fine sand sediment in sheltered areas and can grow close to the base of the euphotic zone. Here it is accompanied by species listed in the Appendix 1. It usually occurs in open areas between other plants. In favourable conditions large areas of the lakebed can be colonized by a *Najas* monoculture. The depth of colonization depends on water clarity but in general the

species does not grow below 5m depth. It rarely grows at depths less than 1m, so the potential habitat for the species is the area between 1 and 5 m on the bed of each lake. However as accurate bathymetric data is unavailable for most Irish lakes it is not possible to calculate this area and therefore the entire area of each lake is taken as potential habitat. The one exception is Lough Corrib, where only the NW basin is included, as *Najas* has never been recorded from the lower hard water basins).This figure of 4960ha provided is thus an overestimate but is the only one that can be provided using available data.

Habitat trends

The most widespread threat to the habitat of *Najas flexilis* is eutrophication. This problem affects N. flexilis in two ways. The increase in nutrient availability promotes competition from larger perennial macrophytes which can shade out smaller species such as *Najas*. It also supports greater plankton densities and consequently increased turbidity in the water column which deprives macrophytes of light, especially if like *Najas* they grow near the base of the euphotic zone. Populations have been lost in England, Scotland and Ireland due to rising phosphorous and nitrogen levels. The loss of the population in Lough Nafeakle means that available habitat has diminished by 2 ha during the reference period. In theory site designation as an SAC or NHA should give legal protection against this threat, but the insidious nature of eutrophication is such that locating and stopping such non point source pollution is difficult. The implementation of the Water Framework Directive should help protect vulnerable sites as it should result in an improvement in water quality in the long term. As an indication of threat from septic tank pollution, the number of planning permissions sought close to *Najas* sites is shown in Appendix 1. In certain lakes the threat appears large with over 70 applications made along the shore of Lough Caragh or 20 around the shore of the much smaller Sessiagh Lough. On this basis habitat quality may be at risk in Mullaghderg, Natawneymore, Keel, and Leane, while eutrophication is known to have destroyed the population in Nafeakle.

Habitat prospects

Despite the decline in habitat area and quality during the trend period and the extinction of one population, these adverse changes are restricted to a minority of lakes to date. However, as in the majority of lakes there is no indication of habitat decline or loss, future prospects overall are rated as amber rather than red.

Complementary information

Favourable reference range

This is set equal to 4800 square kilometers, the minimum number of 10 km^2 grid squares necessary to include all recorded populations of the species the area shown in Map 1.

Favourable Reference population

This figure is set at 46 viable separate lake populations. This figure includes the ten populations not seen since 1999 (even when searched for). These populations are included on the assumption that they still persist and have been missed due to small size or imprecise data on location. If future surveys show these populations are in fact extinct this will indicate a decline in population size and range. Such a trend would indicate a serious threat to the species in Ireland.

Suitable habitat for the species

As explained above (habitat area estimation), this figure is set at 4960 ha which is an overestimate.

Other relevant information

Positive impacts

Newer survey methods especially snorkeling have allowed the discovery of many new sites and provided accurate data on the species sub littoral habitat.

Under the 1976 and 2000 Wildlife Acts *N.flexilis* is listed as a protected species whose habitat or population may not be disturbed or damaged unless under license from NPWS. Under the Habitats Directive, *N.flexilis* is listed as an Annex II species and most sites have been incorporated in SACs. National legislation allows for the designation of other sites as National Heritage Areas. The *Najas* sites in SACs are included in the Register of Protected Areas under Water Framework Directive (WFD) which is required to ensure that their water requirements are protected or restored. Outside SACs the general WFD objective of preventing any deterioriation in water quality throughout Ireland should, if implemented successfully, have a significant positive impact on the long term future of the species.

Anglers Associations have resisted environmental threats at several sites, especially Sessiagh Lough in Donegal.

Negative impacts and threats

The extent of the threats was outlined above under Populations – Main Pressures and Threats and were summerised in Table 3.

The greatest threat to the species is a deterioration in water quality either through eutrophication or acidification.. Irish (Roden 2004) and Scottish data (Wingfield et al. 2004) agree that *N.flexilis* is a plant of mesotrophic loughs which is less abundant or absent from oligotrophic or eutrophic lakes. Eutrophication or acidification therefore will pose a threat to the species. The extent of these threats is outlined above under **Habitat trends**. Here it is sufficient to note that the species' future is closely linked to success in preventing adverse water quality changes in Irish lakes.

Elodea canadensis or *E. nuttallii* spread may threaten *Najas flexilis* locally. It is important that the future of *Najas* in Tully Lough be monitored as an indicator of the impact of *Elodea sp*. on *N.flexilis*.

Other threats to the species include infilling of lakes (Mullaghderg) and drainage (Mullaghderg).

It is uncertain how future climate change will affect the species. The plant has a circumpolar distribution in northern Europe and America. Given that it encounters warmer summers in North America than in Ireland at present, increased summer warmth may not affect Irish populations.

A future failure to relocate the 10 populations not seen since before 1999 would indicate a substantial decline in the species' Irish population and range. While some of these records (e.g. Clonee loughs) may be doubtful, the majority are thought to be valid records. If these populations are not refound the number of extinctions in Ireland increases from 3 to 13 or more than 25% of recorded populations. This decline would result in a red rather than amber rating for population and in turn an overall red rating for *N. flexilis* in Ireland

Some of the best sites for *Najas* are not protected or designated. Very important unprotected sites include Ballnakill Lough where the species occurs with the rare *Hydrilla verticillata* and large parts of the lake bed are covered by a unique species mixture of *N.flexilis, H.verticillata, Callitriche hermaphroditica* and *Nitella confervacea.* This site is of greater size and species richness than the well known and protected Rusheenduff or Renvyle location which supports a similar community. Other undesignated sites (mainly discovered post 1999) include Lough Nageltia in south Mayo and several Loughs in southeast Connemara (e,g, Loch na Creibhinne and Loughauneala). See the Appendix 1 for a complete list of undesignated sites.

CONCLUSIONS

The range of *N.flexilis* has increased since 1984 due to new survey work and is thus rated favourable.

The populations of the species have been maintained at 34 sites and is threatened at two sites, but its' status is uncertain at a further ten sites. While the species may have survived at these locations further surveys are required to clarify their status. As ten populations represent 22% of the total, if extinctions of these populations were confirmed it would constitute a serious decline since 1984. Currently the population status is rated unfavourable inadequate.

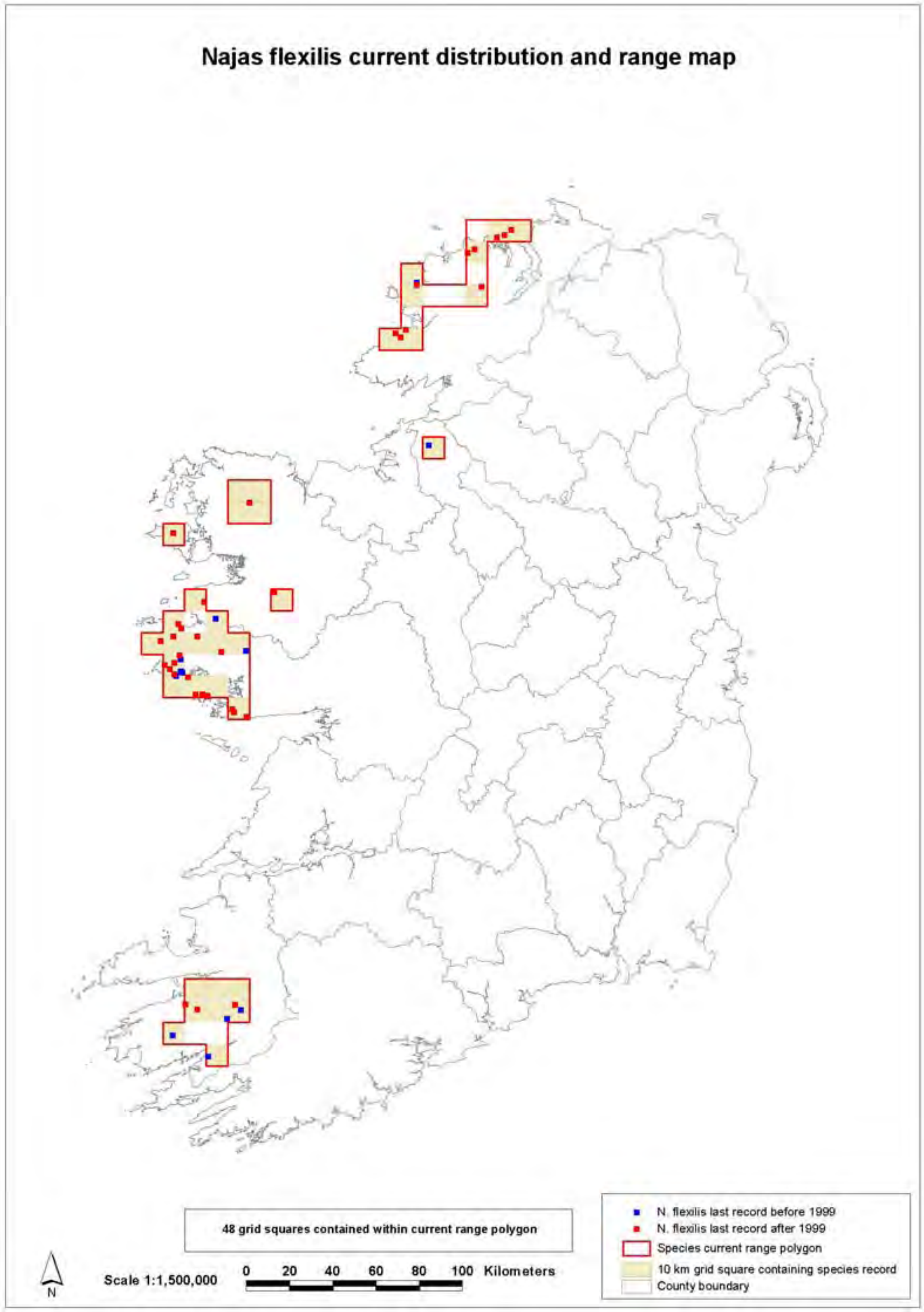
In most lakes the habitat appears to be adequate but loss of habitat may be occurring at Keel, Mullaghderg and Natawneymore and has disappeared completely at Nafeakle. Thus habitat is rated unfavourable inadequate.

Combining the increase in the species known range, the size of many populations and the intended protection of the species' habitat its' future prospects appears reasonably favourable.

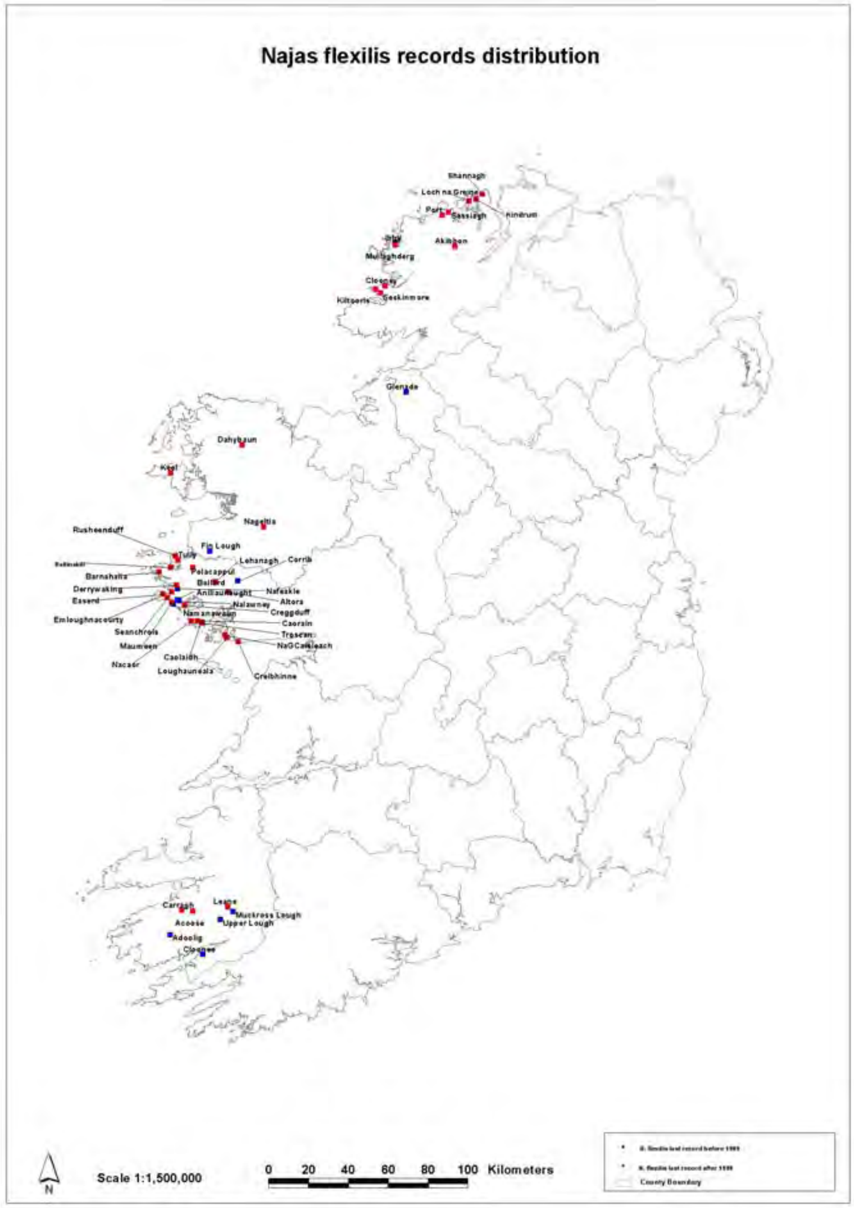
The overall assessment is given as amber because of the unfavourable inadequate assessments for populations and habitat.

Published sources	Caffrey, J.M. and Rorslett, B. (1989) *The macrophytic vegetation of Rusheenduff (Renvyle) Lough, Co. Galway*. Ir Nat. J. 23 Godwin, H. (1975) History of the British Flora edn 2, Cambridge University Press, Cambridge. Heuff, H.(1984) *The vegetation of Irish Lakes*, NPWS Dublin. Krause, W., King, J.J., (1994). *The ecological status of Lough Corrib, Ireland as indicated by physiographic factors, water chemistry and macrophytic flora*. Vegetation 110, 149–161. O l i v e r ,D.(1 8 5 1) . *Notes o f a botanical ramble in Ireland last autumn* . Phytologist ,4 , 125 - 8 . Oliver, D.(1 8 5 2) . *Botanical notes of a week in Irelad during the present month (A u g u s t ,1 8 5 2)* . Phytologist, 4 , 676 - 9 . Roden, C.M. (2002) *Najas flexilis in Donegal*, report to NPWS Roden , C.M. (2003) *Najas flexilis in Connemara* Report to NPWS Roden, C.M (2004) *The distribution of Najas flexilis in Ireland 2002-2004*, Report to NPWS Roden, C.M. (2005) *A new station for Hydrilla verticillata in Connemara*, Irish Naturalists' Journal 28 3 138-139. Roden , C.M. (1999) *A survey of the sublittoral vegetation of 15 machair Loughs in north west Ireland*. Report to the National Heritage Council. Scully, R. (1916) *Flora of Kerry*, Dublin. Van Groenendael, J.M., Hochstenbach, S.M.H., Van Mansfeld, M.J.M., Roozen, M.J.M. & Westhoff, V.(1982) The influence of the sea on the vegetation of lakes in southwest Connemara. Journal of Life Sciences of the Royal Dublin Society, 3, 221-242. Webb, D.A. & Scannell, M.J.P. (1983*) Flora of Connemara and the Burren* Royal Dublin Society, Dublin and Cambridge University Press, Cambridge. Wingfield, R.A., Murphy, K.J., Hollingsworth, P. and Gaywood, M.J. (2004). *The Ecology of Najas flexilis.* Scottish Natural Heritage Commissioned Report No.017 (ROAME No. F98PA02).

1833 Slender Naiad (*Najas flexilis*)

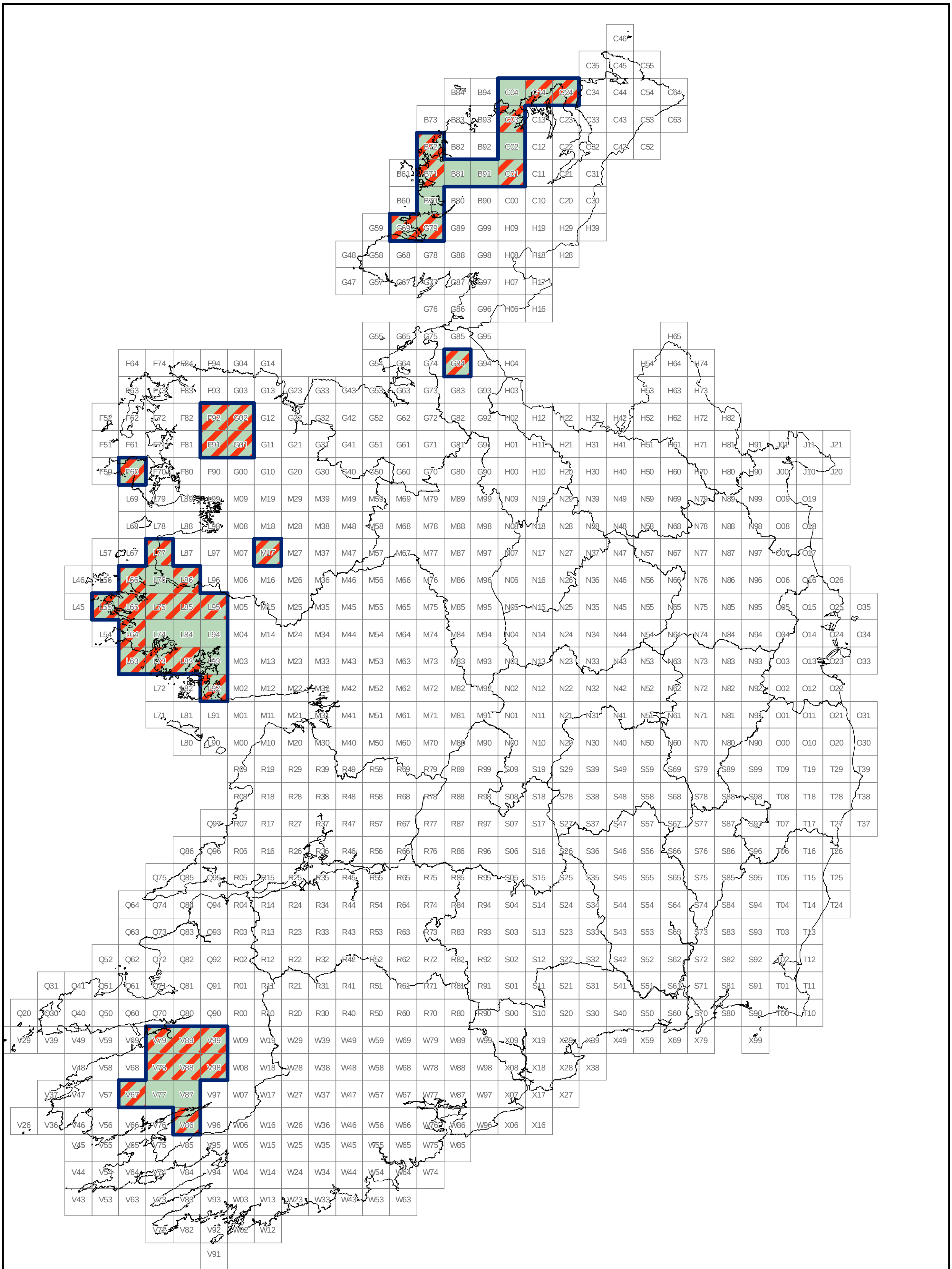
National Level	
Species code	1833
Member State	Ireland IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	4,800 km^2 (48 grid cells x 100 km)
Map	

Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	Caffrey, J.M. and Rorslett, B. (1989) *The macrophytic vegetation of Rusheenduff (Renvyle) Lough, Co. Galway*. Ir Nat. J. 23 Heuff, H.(1984) *The vegetation of Irish Lakes*, NPWS Dublin. Krause, W., King, J.J., (1994). *The ecological status of Lough Corrib, Ireland as indicated by physiographic factors, water chemistry and macrophytic flora*. Vegetation 110, 149–161. Roden, C.M. (2002) *Najas flexilis in Donegal*, report to NPWS Roden , C.M. (2003) *Najas flexilis in Connemara* Report to NPWS Roden, C.M (2004) *The distribution of Najas flexilis in Ireland 2002-2004*., Report to NPWS Roden, C.M. (2005) *A new station for Hydrilla verticillata in Connemara*, Irish Naturalists' Journal 28 3 138-139. Roden , C.M. (1999) *A survey of the sublittoral vegetation of 15 machair Loughs in north west Ireland*. Report to the National Heritage Council. Wingfield, R.A., Murphy, K.J., Hollingsworth, P. and Gaywood, M.J. (2004). *The Ecology of Najas flexilis.* Scottish Natural Heritage Commissioned Report No.017 (ROAME No. F98PA02). Oliver,D.(1 8 5 1) . *Notes of a botanical ramble in Ireland last autumn.* Phytologist, 4, 125 - 8. Oliver, D.(1 8 5 2) . *Botanical notes of a week in Ireland during the present month (A u g u s t, 1 8 5 2)*. Phytologist, 4, 676 - 9. Scully, R. (1916) *Flora of Kerry*, Dublin.
Range	
Surface area	4800 square kilometers
Date	March 2006
Quality of data	3 = good
Trend	+ increase from 1900 to 4800 square kilometres
Trend-Period	1977-2006
Reasons for reported trend	1 = improved knowledge/more accurate data
Population	

Distribution map	
Population size estimation	36 populations recorded since 1999, 10 additional populations of uncertain status and 3 known extinctions since 19th century. 1 extinction in trend period.
Date of estimation	March 2006
Method used	3 = from complete inventory
Quality of data	3 = good
Trend	- decreasing one population lost in trend period
Trend-Period	1977-2006
Reasons for reported trend	4 = indirect anthropogenic influence (fish farming)
Justification of % thresholds for trends	While known population number has increased, this reflects better knowledge of the species distribution rather than colonisation of additional sites. In contrast, at least one extinction has occurred in trend period.
Main pressures	120 Fertilisation 200 Fish and shellfish aquaculture 421 Disposal of household waste 601 Golf course 701Water pollution 800 Landfill 810 Drainage 952Eutrophication 954 Invasion by a species

Threats	120 Fertilisation 421 Disposal of household waste 701Water pollution 952 Eutrophication 954 Invasion by a species
Habitat for the species	
Area estimation	Area of lakes with *N.flexilis* is 4960 ha. (only the northwest basin of the large Lough Corrib is included in this estimation).
Date of estimation	March 2007. The mapping base used is the OS Discovery series, 1995-2006
Quality of data	3 = good
Trend	– = net loss of 2ha.
Trend-Period	1977-2005
Reasons for reported trend	4 = indirect anthropo(zoo)genic influence. One population has become extinct due to fish aquaculture
Future prospects	1 = good prospects

Complementary information	
Favourable reference range	4800 square kilometres
Favourable reference population	47 separate lake populations
Suitable Habitat for the species	4960 ha.
Other relevant information	Positive Impacts: protected under Wildlife Acts of 1976 and 2000. Significant conservation measures are in place in the country at present e.g. 33 lake populations are within SACs, implementation of the Water Framework Directive will require lakes designated for *N.flexilis* to be protected. There is also pressure for clean water brought by Anglers' associations, e.g. at Port Lough and Sessiagh Lough. Negative Impacts: Sustained pressure on lakes from new housing, e.g. 70 planning applications within 200m of Carragh Lough and 23 close to Mullaghderg Lough in the last 10 years. Problem of eutrophication due to agricultural use of fertilisers and manure spreading, Lack of conservation designation for important newly recorded sites such as Ballinakill Lough. Possible spread of *Elodea* sp. which may compete with *N.flexilis*.
Conclusions (assessment of conservation status at end of reporting period)	
Range	**Favourable** Increase in recorded range since 1977 due to further survey work
Population	**Unfavorable Inadequate** 1 population has become extinct since 1977, the status of 10 populations is uncertain (attempts to locate 8 of these populations have been unsuccessful) and 2 populations contain less than 10 plants. However 34 populations are secure.
Habitat for the species	**Unfavorable Inadequate** in several lakes increasing eutrophication has probably diminished habitat quality and area.
Future prospects	**Favourable** There are large populations present in many lakes which are not threatened by eutrophication or other environmental problems. It is probable that further populations may be discovered. Many sites are within SACs / NHAs and all should be protected in the long term from increasing eutrophication by the Habitats and Water Framework Directives. The species is protected under the Irish Wildlife Acts of 1976 and 2000.
Overall assessment of CS[1]	**Unfavorable Inadequate**



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Najas Flexilis

1833

- Current Distribution (36 cells)
- Current Range (48 cells)
- Favourable Reference Range (48 cells)
- W48 10km grid cells

Date: August 2007

Margaritifera durrovensis (the Nore freshwater pearl mussel) conservation assessment

Backing Document

July 2007

Prepared by Evelyn A. Moorkens, Ian J. Killeen and Eugene Ross

Edited by Áine O Connor

A Report to:
The National Parks and Wildlife Service
Department of Environment Heritage and Local Government
7 Ely Place
Dublin 2
Ireland

Table of Contents

1. ECOLOGY **3**

2. DATA SOURCES **5**

3. RANGE **5**

3.1. CURRENT RANGE 5
3.2. FAVOURABLE REFERENCE RANGE 6
3.3. CONSERVATION ASSESSMENT OF THE RANGE 6

4. POPULATION **7**

4.1. CURRENT POPULATION 8
4.2. FAVOURABLE REFERENCE POPULATION 8
4.3. CONSERVATION ASSESSMENT OF THE POPULATION 9

5. HABITAT **9**

5.1. CURRENT CONDITION OF *MARGARITIFERA* HABITAT 11
5.2. SUITABLE HABITAT FOR THE SPECIES 11
5.3. CONSERVATION ASSESSMENT OF *MARGARITIFERA* HABITAT 12

6. PRESSURES **12**

7. THREATS **19**

8. FUTURE PROSPECTS **20**

8.1. NEGATIVE INDICATORS 20
8.2. POSITIVE INDICATORS 21
8.3. CONSERVATION ASSESSMENT OF FUTURE PROSPECTS 21

9. COMPLEMENTARY INFORMATION **22**

9.1. SURROUNDING TERRESTRIAL HABITAT 22
9.2. THREAT STATUS OF *MARGARITIFERA DURROVENSIS* 23

10. OVERALL CONSERVATION ASSESSMENT **23**

11. REFERENCES **24**

F *33*

1. Ecology

The freshwater pearl mussel *Margaritifera durrovensis* does not live in acid waters like *M. margaritifera*. It is currently only known only from the lime-rich waters of the River Nore.

Margaritifera durrovensis has a relatively short history, being known to science for less than 100 years. In 1926, B.B. Woodward found an unusual shell in the P.B. Mason collection, which was labelled from the river Nore at Durrow (Phillips 1928). He wrote to R.A. Phillips, who went to look for further specimens in the river. In October 1926, Phillips, along with A.W. Stelfox, R.J. Welch and C. Oldham found the population. Five specimens from this expedition are preserved in spirit in the Dublin museum, labelled from the river Nore below Abbeyleix. Descriptions of the Nore mussels were given Bloomer (1927, 1928) and followed by Phillips naming *M. durrovensis* as a species new to science (Phillips 1928).

The taxonomic status of *M. durrovensis* has been argued ever since Phillips first published his species description. A year after Phillips' paper, Stelfox (1929) published additions to his Irish list. He included *M. durrovensis*, but compared its thickened form with the forms of *Pisidia* found in hard water, and stated, in his opinion, that the Nore mussel was a variety of *M. margaritifera* which had become acclimatised to hard water. However, he stated that "considerable research work will be necessary before these problems can be settled", thereby demonstrating his uncertainty.

Haas (1948) concurred with Stelfox, and called *M. durrovensis* the "lime-phase" of *M. margaritifera*. His investigation was limited to one Nore specimen, which he thought was similar in form to *Unio brunneus* Bonhomme, 1840, of which he had also seen only one specimen.

The species and subspecies classification of *M. durrovensis* was dismissed by Chesney *et al.* (1993), who formed their conclusions on the basis of shell, anatomical and enzyme polymorphism comparisons of *M. durrovensis* and a number of *M. margaritifera* populations. Unfortunately, they did not investigate any further than *M. margaritifera*, thus any conclusions they made could only be relative to that one species.

Subsequently, Moorkens (1996) looked at morphometric taxonomical differences between shell sets from various rivers and different species within the *Margaritifera* genus. While it was evident that there were large "within species" differences between populations of *M. margaritifera*, it was shown in the study that *M. durrovensis* showed greater morphometric differences to *M. margaritifera* than *M. falcata* and *M. auricularia* do.

Traditionally, most molluscan taxonomic divisions have been based on shell and body comparisons. This has caused difficulty within the freshwater pearl mussels, as shell variation can be great among populations in different waters (Eager 1977). The progress in genetic analyses in recent years has allowed the debate to resume in a more informed manner.

Holmes *et al.* (2001) found good genetic separation between *M. durrovensis* and *M. margaritifera* populations.

Machordom *et al*. (2003) found that Ireland had populations linked genetically to two separate lineages. Two mitochondrial lineages (albeit very closely related) were identified: a northern lineage extending from Ireland to the Kola Peninsula including the western Atlantic coast, and a second cluster distributed from Ireland to the Iberian Peninsula. The Irish population from the latter lineage was the *M.durrovensis* population.

Geist & Kuehn (2005) studied the genetics of 24 European pearl mussel populations. The analyses of nine microsatellite loci with different levels of polymorphism revealed a high degree of fragmented population structure and very different levels of genetic diversity within populations. These patterns were explained by historical and demographic effects and have been enforced by anthropogenic activities. Even within drainages, distinct conservation units were detected. Early indications from examination of *M. durrovensis* genetic material by Geist (pers. comm.) suggest that this genetic population fits into this fragmented population model.

The taxonomic status of *Margaritifera durrovensis* remains inconclusive but is probably best described as a rare ecophenotype of *M. margaritifera*, a status which concurs with Machordom *et al*. (2003) and Chesney *et al.* (1993), the most recent bivalve guide to the region (Killeen *et al*. 2004), and the most recent published Irish list of molluscs (Anderson 2005).

Margaritifera durrovensis was known from the Barrow and Nore main channels, but living specimens have not been found outside the Nore since 1993 (Moorkens 1996). During 1993 one living specimen was found in the River Barrow. Mc Millan & Zeissler (1990) describe dead shells from the Suir main channel as *M. durrovensis*, but Moorkens (1996) found all dead shells in the Suir, including museum specimens, were *M. margaritifera*. Surveys of the River Suir from 1991-1993 led to the discovery of dead shells only (Moorkens 1996).

Some rivers with hardness levels that are intermediate between the Nore and the typically acid stream habitats of *Margaritifera* have been found, e.g. the varieties known as *Unio brunneus* from the River Viaur, France (Haas 1948) and *M. margaritifera var. siluriana*, from the River Wye, Wales (Ellis 1962). However, none have the distinctive slender shape that is particular to *M. durrovensis*. The taxon that relates to *Margaritifera durrovensis* is therefore considered to be restricted to the River Nore in the Republic of Ireland.

The Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna placed *Margaritifera durrovensis* on Annex II and Annex V as a separate taxon.

Life history of *M. durrovensis* was extensively studied by Moorkens (1996), who captively bred this species up to the post-parasitic stage.

In a field brooding survey, *M. durrovensis* was found to begin brooding from mid-July each year. All glochidia were released between mid-August and mid-September. In the captive breeding study, sexes were found to be separate with no evidence of hermaphroditism. The percentage of Nore mussels brooding in hatchery conditions varied significantly with those in the wild, with a maximum of 71% brooding in the hatchery in 1993 compared to 20% in the wild the same year (Moorkens 1996).

Glochidia were found to be similar to those of *M. margaritifera*, simple organisms with little more than a pair of shells, an adductor muscle to snap them shut, and a layer of cells which can absorb and digest nutrients (Ziuganov *et al*. 1994). *M. durrovensis* glochidia readily utilised native trout hosts, with the same process as other *Margaritifera* species, the valves closing over a filament of the salmonid gills, with nourishment taken from this fish host until the glochidia are large and mature enough to exist independently (Nezlin *et al.* 1994, Ziuganov *et al.* 1994). During the captive breeding studies, glochidia encapsulated and increased to about 6 times their original length. In the experimental breeding, encysted glochidia were seen as raised pale spheres on the fish gills. Occasionally encystment was not completed and the glochidia could be seen to be bivalves, otherwise the development of the mussels was obscured by the cysts. Fish had up to a maximum of 1020 *M. durrovensis* glochidia attached to them. Numbers of glochidia on trout varied widely, and no temporal decline was evident until the summer. Juvenile mussels dropped off their fish hosts in early July, after tank temperatures were increased to 18º C. Juvenile mussels survived for up to 53 days post metamorphosis in an aquarium, but further breeding was beyond the scope of the experiment.

It is presumed that juvenile mussels bury into the river bed substrate in the same way as all other members of the *Margaritifera* family do, and spend at least 5 years within the interstitial habitat.

2. Data sources

The original investigative work into the population was carried out by R.A. Phillips in the 1920s (Phillips 1928). His work centred on the Durrow area, but there is anecdotal information of their presence as far downstream as Kilkenny Town.

The theses of E.Ross (1984, 1988) included some demographic studies on the Nore pearl mussel but this did not include distribution survey. NPWS funded H. Ross to carry out some survey work in the late 1980s to determine the limits of the *M. durrovensis* population (Moorkens *et al.* 1990). NPWS funded MSc and PhD research, and large elements of both included studies into the distribution, status, taxonomy, life history and captive breeding of *M. durrovensis* (Moorkens 1991, 1996; Moorkens *et al.* 1992, Moorkens & Costello 1994).

The most recent full distribution survey took place in 1991 (Moorkens 1991, 1996). As a result, the trend period for *M. durrovensis* was selected as 1991 to 2006. Monitoring work took place at irregular intervals between 1995 and 2003, mainly as part of monitoring for planning conditions, which contributed to further publications (Costello *et al*. 1997, 1998). NPWS SAC monitoring on the Nore took place in 2004, with a repeat survey in 2005 (Moorkens 2004, 2005). It should be noted that survey of the River Nore is made extremely difficult as a result of the depth and turbidity of the water.

3. Range

3.1. Current Range

The current range of *Margaritifera durrovensis* in Ireland is considered to be the known range within the main channel of its only extant population, i.e. in the Nore River. The Nore population stretches from Poorman's Bridge (S 407 859) to Lismaine Bridge(S 442 660), with most of the population found between Poorman's Bridge and the Avonmore Creamery above Ballyragget (S 440 722).

The area of the current *Margaritifera durrovensis* range is 300 km^2.

The range of *Margaritifera durrovensis* in Ireland at the start of the trend period, i.e. 1991, also included one stretch within the Barrow main channel. The area of the range in 1991 was, therefore, 400 km^2.

The Suir records are omitted, as examination of shells from the River Suir from both museum and survey sources found that they were not *M. durrovensis* (Moorkens 1996).

Appendix I shows the current and historical distribution of *Margaritifera durrovensis* in Ireland.

3.2. Favourable Reference Range

Margaritifera durrovensis is critically endangered in world terms and in Ireland (Moorkens 2006a). For a species to have a chance of survival, a single population is not enough. The aim, therefore, is to introduce a second population to at least one other river to give the species a better chance of survival. A captive breeding programme is underway to aid this process. Surveys are also ongoing to identify suitable tranlocation sites within the wider Nore catchment.

The favourable reference range (FRR) for *Margaritifera durrovensis* in Ireland is taken, as a minimum, to be the 1991 range, i.e. 400 km^2 distributed among at least two populations.

While the pre- 1970 range of *Margaritifera durrovensis* was larger, the Barrow genetic stock is extinct and it is unlikely that the stretches of the Nore previously inhabited by mussels could be rehabilitated. As a result, emphasis must be placed on the translocation programme.

It is recognised, however, that further survey work is required to check for potential outlying populations and habitats where rehabilitation may be successful within the lower stretches of the Nore catchment. This work is ongoing as part of the Action Plan for the species.

3.3. Conservation assessment of the range

As the current range includes only a single population, there has been a decline of 25% in the area of that range since 1991 and the current range is at least 25% lower than the favourable reference range, the conservation status of the range is Unfavourable – Bad.

Table 1 The conservation assessment for *Margaritifera durrovensis* range in the Republic of Ireland.

Range Parameter	Value
Current Range	**300 km^2**
Range in 1991	**400 km^2**
Trend	**-25%**
Favourable Reference Range	**400 km^2**
Range Conservation Assessment	**Un-favourable**

4. Population

For the purposes of the assessment of the conservation status of *Margaritifera durrovensis* populations, the chosen unit was the number of **viable populations**.

A *Margaritifera durrovensis* **population** was defined as a group of mussels occupying an area of a catchment that are capable of genetic exchange, either through sexual reproduction or through transportation of glochida on host fish. As has been noted in Section 3 above, there is currently one extant population of *M. durrovensis*.

Whether or no a *Margaritifera margaritifera* population was **viable** was determined by a series of population structure parameters which formed the basis of the *M. durrovensis* condition assessment (See Table 2).

Table 2 The *Margaritifera durrovensis* condition assessments for mussel population structure attributes.

Attribute	Target to pass	Notes
Mussels		
Density 1	Potentially suitable habitat is at capacity (or at least 10 mussels/m^2) in at least part of one transect area.	Measurements made by standard transect counts or best available data. In declining rivers, high density may still exist towards river banks. Target in UK protocol (Young et al. 2003) is given as 10/m^2 in favourable habitat.
Density 2	Potentially suitable habitat is at capacity (or at least 10 mussels/m^2) in favourable habitat, including range of river length and width in each transect.	In favourable rivers, density should be high in open areas as well as closes to banks. Target in UK protocol (Young *et al*. 2003) is given as 10/m^2 in favourable habitat
Numbers of live individuals	No recent decline	Based on comparative results from the most recent surveys
Numbers of dead shells	<1% of population and scattered distribution	1% considered to be indicative of natural losses. Age of dead shells can be used to provide information if loss level is otherwise in doubt – if all dead shells are fresh this would indicate a more serious problem than scattered disintegrating shells of various ages.
Age structure 1	At least 20% of population ≤65mm in one or more quadrats	Target in UK protocol (Young *et al*. 2003)
Age structure 2	At least 20% of population ≤65mm in total monitoring quadrat count for river	N.B. Quadrats must be carried out in suitable habitat areas for juveniles
Age structure 3	At least 5% of population ≤ 30mm	If there are known historical percentages from previous survey of < 30mm in populations that were considered to be sustainable, these percentages should be used as favourable, otherwise 5% min.

Attribute	Target to pass	Notes
Age structure 4	At least 5% of population ≤ 30mm in total monitoring quadrat count for river	If there are known historical percentages from previous survey of < 30mm in populations that were considered to be sustainable, these percentages should be used as favourable, otherwise 5% min. N.B. Quadrats must be carried out in suitable habitat areas for juveniles

As the population of *M. durrovensis* in the River Nore is known not to have reproduced successfully since 1970, recent survey work has concentrated on counting, by snorkelling survey, the total number of live and dead mussels along repeated, standard sections or rivers.. Such total counts have been made for *M. durrovensis* since 1991.

4.1. Current Population

The most recent estimate of the total number of extant *Margaritifera durrovensis* adults in Ireland, based on surveys from 1991 to 2005 is 500 individuals. This represents a decline of 75% from the total of 2,000 individuals found in 1991. Trends in adult mussel numbers are illustrated in Appendix II.

In 2004, more dead than live individuals were counted.

M. durrovensis has not reproduced successfully in the River Nore since 1970. Recruitment of juvenile mussels is being prevented by the poor quality of the river substrate.

The population continues to age, and as older mussels die, they are not replaced.

The conclusion, therefore, was that the single extant *Margaritifera durrovensis* population in the Republic of Ireland is un-viable and on the verge of extinction.

4.2. Favourable Reference Population

The favourable reference population (FRP) is defined as '*the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species*' (European Commission 2006). Expert opinion has indicated that the current 500 adult mussels cannot sustain *Margaritifera durrovensis* into the future and that significant efforts are needed to increase the size of the population. Assisted breeding has been identified as the only method by which the current population of 500 adult mussels can be increased in the medium to long term.

As a result, adult mussels have been taken into captivity in an attempt to breed glocidia. In 2006, female mussels in captivity successfully released live glochidia, a number of which attached to the gills of host fish. Juvenile mussels will be held within vivaria in captivity until they emerge above the substratum. At this stage, it is hoped the juvenile mussels will be translocated to suitable habitat within the Nore catchment.

The objective is to create at least two viable, self-sustaining populations of *M. durrovensis* from mussels bred in captivity, each population totalling a minimum of 5,000 mussels.

4.3. Conservation assessment of the population

As there has been a decline of 75% in the number of adult *Margaritifera durrovensis* mussels since 1991, and as the current number of viable populations is zero and the favourable reference population is two viable populations, the conservation status of the population in **unfavourable – bad** (See Table 3)**.**

Table 3 The conservation assessment for *Margaritifera durrovensis* population in the Republic of Ireland.

Population Parameter	Value
Current Population	1 un-viable population, with 500 adult mussels
Population in 1991	2 un-viable populations, with more than 2,000 adult mussels
Trend	-50%
Favourable Reference Population	2 viable populations, each with more than 5,000 mussels
Population Conservation Assessment	Un-favourable - Bad

5. Habitat

The habitat of *Margaritifera durrovensis* in Ireland does not fit well with any particular Habitat's Directive Annex I or CORINE habitat. It is a stretch of large lowland river, with medium flow and cobble and gravel substrate. The habitat required by this species is very different from its current habitat, in terms of water and river bed quality. *Margaritifera durrovensis* is very demanding of high water quality and high river bed quality (see table 4), and loss of habitat quality quickly reduces recruitment capability.

Table 4 The *Margaritifera durrovensis* condition assessments for habitat attributes.

Attribute	Target to pass	Notes
Water Quality		
Orthophosphate	0.01mg/l median value with no max value over 0.03 mg/l.	Based on historical values for Nore main channel, and the fact that it is a large shaded channel. Translocated sites will require more stringent quality if they are smaller systems cf. *M. margaritifera*.
Nitrate	0.2mg/l median value	Based on historical values for Nore main channel, and the fact that it is a large shaded channel. Translocated sites may require more stringent quality.
Suspended Solids	<10mg/l maximum value associated with natural events	Suspended solids should be rare rather than chronic and attributable to natural conditions.

Attribute	Target to pass	Notes
BOD	<1.0mg/l median	No target given in UK FCT but should be at very low natural levels for the river.
Substrate Condition		
Siltation	No plumes of silt when substrate kicked to 10cm depth	a 'plume' is an obvious flush of silt, produced when stones are lifted from the substrate or submerged vegetation is disturbed, such that visibility of the river bed is momentarily obscured
Redox measurements	<20% loss in redox value at 5cm depth	Based on work by Geist *et al*. in prep. Results from a recent survey of the River Ehen in Cumbria (Killeen 2006) show that young mussels and juveniles were present only in the most highly oxygenated riffle areas where the loss in redox value was less than 20% at 5cm depth.
Plant Growth		
Filamentous algae	None	Any filamentous algae should be wispy and ephemeral, and never form mats.
Macrophytes	None	*Fontinalis* on rock is a positive indicator, *Ranunculus, Myriophyllum* and any other substrate macrophytes are negative indicators.

Essential habitat attributes include stable cobble and gravel substrate with very little fine material (below pea-sized gravel). The lack of fine material in the river bed substrate allows for free water exchange between the open river and the water within the substrate. The free exchange of water means that oxygen levels within the substrate do not fall below those of the open water. This is essential for juvenile recruitment, as this species requires continuous high oxygen levels.

The clean substrate must be free of inorganic silt, organic peat, and detritus, as these can all block oxygen exchange. Organic particles within the substrate can exacerbate the problem by consuming oxygen during the process of decomposition. The habitat must be free of filamentous algal growth and rooted macrophyte growth. Both block the free exchange of water between the river and the substrate and may also cause night time drops in oxygen at the water-sediment interface.

The open water must be of high quality with very low nutrient concentrations, in order to limit algal and macrophyte growth. Nutrient levels must be close to reference levels for oligotrophic rivers. Phosphorus must never reach values that could allow for sustained, excessive filamentous algal growth.

The quality of the open water in the Nore is of key importance. Oligotrophic nutrient levels need to be restored to 1970 levels if the population is to survive naturally. If this target is deemed to be physically impossible as a result of the infrastructure that has built up over the last 40 years, two new translocated populations should be pursued.

As salmonid fish are host to the larval form of *M. durrovensis* they are essential to the completion of the life cycle. Sufficient young native fish of the year must be present in restored habitats.

Intact natural catchments prevent fine sediment and nutrient losses to the river (see Section 9.1, Surrounding terrestrial habitat, Complementary information). As fine sediment losses become chronic, siltation of the substrate can provide a rooting medium for higher plants. Nutrients can also accumulate in the sediment (and may be chronically or intermittently available in the open water), promoting the growth of algae and macrophytes. This exacerbates the stressful environment for the adult and juvenile mussels, and as more adults are lost, further niches for macrophyte growth become available. There is a resultant trophic cascade in the habitat, where oligotrophic conditions succeed to eutrophic conditions and the suite of invertebrate species changes accordingly. Thus, the conservation targets for mussel populations include maintenance of free water exchange between the river and the substrate and minimal coverage by algae and weed. The particular emphasis is on maintenance of recruitment i.e. the river bed structure required to breed the next generation.

5.1. Current condition of *Margaritifera* habitat

The above habitat criteria were used to assess the condition of the River Nore, using data from mussel monitoring and EPA water quality monitoring. The Nore failed for all water quality and substrate condition habitat attributes (Appendix V).

Records of severe siltation, made during mussel monitoring, indicated that the population is not reproducing as a result of poor substrate quality.

The current condition of the habitat of *M. durrovensis* is very poor (Appendices V to VIII). Water quality has been deteriorating significantly for many years in the Nore, as reflected by the EPA macroinvertebrate data (Appendix VII). It should be noted that adult *Margaritifera* are considered sensitive indicators under the EPA Q-system and their presence can improve the Q-value score. As a result, the Q-vales for some EPA sampling sites containing adult mussels may be higher than they should be. Nevertheless the data shows many unsatisfactory Q-values have been recorded. Reproducing *Margaritifera* populations require the highest Q-value (currently Q5). It can be argued, however, that a new, specialist Q6 is required for *M. durrovensis* and *M. margaritifera* rivers.

The decline in chemical parameters in the Nore is shown in Appendix VIII. Concentrations of median ortho-phosphate, colour, conductivity and BOD indicate chronic pollution, as well as pulses of pollutants. Both median and maximum values are in excess of the reference levels set as targets in the condition assessment (Table 4). Colour is often an indicator of fine peat suspended in the water body, phosphate, conductivity and BOD indicate sources of diffuse nutrient and organic pollution.

5.2. Suitable Habitat for the Species

The habitat that *M. durrovensis* currently occupies is not suitable and cannot ensure the survival of the species. It is, therefore, necessary to restore the habitat currently occupied by adult mussels or move the mussels to alternative suitable habitat. Furthermore, at least one new *M. durrovensis* population must be created in order to ensure the species' survival.

The area of habitat that the species could potentially occupy is currently unknown. Calculating such an area would be complex, as it is combination of the following:

1. the area of habitat the adult mussels can occupy,
2. the area of habitat the juvenile mussels can occupy and
3. the area of spawning and nursery habitats the host fish can occupy.

These three are naturally heterogeneous and determined by flow and substratum conditions. Area estimates would require mapping of the suitable habitats within the river, such as loose gravel spawning grounds or stable gravel mussel beds, and exclusion of unsuitable habitats, such as bedrock or deep pools.

The approximate area of river occupied by the extant adult mussels has been calculated as 0.225 km^2. This is based upon an area of occupancy of approximately 15km of river, multiplied by an average width of 15m, and does not take into account the availability of suitable habitats within this stretch of river, or fish habitats upstream and downstream.

5.3. Conservation assessment of *Margaritifera* habitat

From the above assessment it is clear that Nore pearl mussel habitat is poor throughout the River Nore. The current habitat condition cannot support the survival of adult mussels and is, thus, completely unsuitable to the recruitment of the next generation. Consequently the conservation assessment of *M. margaritifera* habitat is **unfavourable - bad**.

Table 5 The conservation assessment for *Margaritifera durrovensis* habitat in the Republic of Ireland.

Habitat Parameter	Value
Current Habitat	**Habitat quality fails mussel requirements throughout the areas occupied by the single population**
Area of Suitable Habitat for the Species (current and potential)	**Unknown**
Target	**High quality juvenile and adult mussel habitat available within the area occupied by two populations**
Habitat Conservation Assessment	**Un-favourable - Bad**

6. Pressures

The loss of pearl mussel populations typically occurs from continuous failure to produce new generations of mussels. Recruitment cannot take place because of the loss of clean gravel beds, through infiltration of fine sediment and/or smoothering growth by algae or macrophytes. These block the required levels of oxygen from reaching young mussels. Juvenile mussels spend their first five to ten years buried within the river bed substrate.

Other ways in which mussel populations can decline and be lost is through adult mussel kills, or loss of the host fish which are essential to the life cycle of *Margaritifera*. Further details of the life cycle can be found in Moorkens (1999).

Fine sediment, once introduced to a pearl mussel river, can continue to cause very serious effects on a long term basis (Ellis 1936, Marking & Bills 1979, Naden *et al*. 2003, Araujo & Ramos 2001, Killeen *et al*. 1998). Direct ingestion of silt by adult mussels can lead to rapid death. Turbidity, particularly from fine peat entering the water, causes adult mussels to clam up (they close their shells tightly and do not filter water through their siphons), a response that provides a protection against ingesting damaging fine particles. If the river water remains strongly turbid for a number of days, mussels can die from oxygen starvation, either from remaining clammed, or from ingesting contaminated water while stressed. During a time of year when water temperatures are high, oxygen depletion in the body occurs more rapidly, and mussels die more quickly. The evolutionarily primitive *Margaritifera* gills and the annual brooding of young in all four of the gills, demand a continuous, high supply of oxygen. Even if the adult mussels survive an initial silt episode, food/oxygen deprivation from clamming will have caused them to become stressed, from which they will take a long time to recover. If during that recovery period, there are further incidents of mobilisation of this or other silt, then the stressed mussels will be more susceptible to death than mussels in a cold river in unstressed conditions. Thus, adult mussels may continue to die over a period of several months. Higher temperatures throughout the summer further exacerbate this problem.

Once a silt load enters a river that holds a pearl mussel population, it can continue to cause harm. Silt causes river changes, which in turn change the dynamics of the river into the future (Curran & Wilcock 2005, Colosimo & Wilcock 2005, Dietrich *et al*. 1989). Increases in fine material in the bed and suspended in the water column, and consequent changes in channel form, may affect mussels in many ways and at various stages in their life cycle. The direct kill of adults is only the first stage in the damage that silt causes to the population. Sediment that infiltrates the substrate decreases oxygen supply in the juvenile habitat, which prevents recruitment of the next generation. The sediment subsequently provides a medium for macrophyte growth, a negative indicator in pearl mussel habitats. Macrophytes then smother the juvenile habitat even further, and the macrophytes trap more sediment, exacerbating the problem in the long term. One of the most essential requirements for pearl mussel conservation is the removal of the risk of any sediment reaching the river, as any one single incident has such long term ramifications.

Silt infiltration of river bed gravels can also have a negative effect on the essential species of fish that host the mussel glochidial stage (Levasseur *et al*. 2006).

As with siltation, nutrient enrichment can have serious and ongoing impacts on both juvenile and adult mussels. Increased inputs of dissolved nutrients to mussel rivers tend to lead to filamentous algal growth, unless combined with siltation, where macrophyte growth can dominate. Filamentous algae can lead to the death of juvenile mussels, through blocking oxygen exchange with the sediment, and cause adults to become stressed, as a result of night time drops in oxygen. Even if filamentous algae are destroyed in a flood, adult mussels may not make a full recovery before the algae re-grows. Adult mussels may eventually die as a result of oxygen/food deprivation.

Death and decomposition of filamentous algae and macrophytes contributes fine particulate organic matter to the river substrate. This further blocks water exchange between the river and the substrate and causes additional oxygen depletion through the process of decomposition. Decomposition also releases dissolved nutrients, promoting further primary productivity. Inputs of organic material, such as slurry, to the river have similar effects on the mussel substrate as dying/decomposing algae and macrophytes.

Major pressures that are leading to damage of river bed substrate from infiltration of inorganic silt, organic fine peat and decaying organic detritus and from eutrophication are listed below. These pressures are present in the Nore catchment and their cumulative effects have had very severe impacts on the Nore pearl mussels.

101 Modification of cultivation practices

103 Agricultural improvement

Explanation: any practice that leads to exposure of bare ground and/or fertiliser applications increase can increase the fine sediment and nutrient load to the river. The cumulative effects of such practices can have very severe impacts on mussels.

110 Use of pesticides

Explanation: Toxic pollution can have very serious and long term effects on a pearl mussel river. Of particular concer is agricultural, including forestry, pesticides. Chemical sheep dip is considered to be a very serious ongoing risk to pearl mussel populations, and the most likely cause of a number of major mussel kills (Moorkens 1999, Skinner *et al*. 2003, Young 2005, Cosgrove & Young 1998). Organophosphates and synthetic pyrethroides used in sheep dipping are highly toxic to species that are a lot less sensitive to nutrient and silt pollution than *Margaritifera*. The pearl mussel is too endangered to justify specific laboratory toxicity testing, but this should not be used as a reason to be ambiguous about the threat such pesticides present to *Margaritifera*. Pesticides present the greatest risk when used in a form that requires dissolving in large quantities of water, which is why sheep dip is the most obviously damaging.

120 Fertilisation

Explanation: any applications of chemical fertiliser or manure can lead to direct run-off of dissolved and particulate nutrients, as well as gradual nutrient release from the soil. The Nore exceeds the recommended range of nutrient levels for *Margaritifera durrovensis*. The most seriously damaging nutrient is most probably phosphorus. Phosphorus promotes algal and macrophyte growth, which can lead to loss of oxygen in the system.

142 Overgrazing by sheep

143 Overgrazing by cattle

148 Overgrazing, general

Explanation: Overgrazing by sheep of the moor and blanket bog habitats in the upper reaches of the Nore catchment has led to loss of vegetation and exposure of peaty soils. These bare peaty soils erode easily and releases fine sediment into the river. Overgrazing by cattle, and other animals, along the banks of the lowland parts of the Nore has lead to, and continues to cause, bank erosion.

150 Restructuring agricultural land holding

Explanation: Removal of hedges, copses and scrub from lands surrounding the Nore has made field size much larger over the years. These land changes have lead to exposure of bare ground, causing the release of silt into the river. They are often accompanied by drainage. Drains themselves can continuously erode and be a source of fine sediment. Newly drained areas are more conducive to more intensive agricultural practices, thus the problem is exacerbated and ongoing.

160 General forestry management

Explanation: Forestry is one of the main human activities in the upper reaches of the Nore catchment. Forestry planting, drainage, ground preparation, fertilisation, thinning, clear-felling, replanting, and all management practices associated with clear fell plantation are likely to have been a major source of both silt and nutrients in pearl mussel catchments. Drainage and ground preparations for planting, and the practice of clear felling, lead to the exposure of bare ground that can erode and release silt into rivers. Fertilisation of forestry leads to a release of nutrients into the watercourse, especially on peat and peaty soils. These nutrients, alone or in association with other nutrient sources, raise the trophic level of the river above limits that are tolerable for the mussel. Brash left on site during and following harvesting operations provides further, long-term inputs of damaging nutrients. Ongoing forestry operations do not allow for recovery of the *Margaritifera* habitat and the future for pearl mussels in catchmentss with continued forestry operations is bleak. Restoration of pearl mussel populations will only be possible if there are significant initiatives to remove clear-fell forestry from *Margaritifera* catchments. Even given such a commitment, major mitigation works will be necessary during the removal of the forestry and restoration to low-intensity or semi-natural landuses. The upper Nore catchment is extensively afforested.

171 Stock feeding

Explanation: The introduction of nutrients to the Nore catchment through the importation of artificial stock feed, e.g. silage, allows increases in the stock numbers. This in turn can cause trampling damage, soil erosion and nutrient releases.

220 Leisure fishing

Explanation: If anglers are allowed to enter rivers at pearl mussel beds, serious trampling damage can occur. Systematic physical changes to the Nore have occurred in the vicinity of pearl mussels, for the purposes of enhancing fish numbers for angling. These changes can be very damaging to pearl mussel habitats and include bank reinforcement, and the installation of weir and croy structures. Damage occurs during construction, and through changes to flow patters, leading to scouring of stable gravels and the loss of mussels and their habitat from stretches of the river. In other areas, ponds are created where silt accumulates, causing further loss of juvenile and adult habitat.

240 Taking / removal of fauna

Explanation: Pearl fishing has been a major problem in the past, but low number remaining are unlikely to attract fishing in the present.

300 Sand and gravel extraction

301 Quarries

Explanation: Pearl mussel populations have been directly damaged in the past through removal of gravel from pearl mussel river beds, and indirectly through silt and other pollution from quarrying activities. Currently, there is a number of unauthorised quarries releasing polluting materials to the Nore. Another common problem is the release of calcium from limestone quarries, which increases growth rate in adult mussels, thus lowering life expectancy and reducing the long fertile period required by pearl mussel life history strategy.

310 Peat extraction

Explanation: Hand and machine cutting of peat, including the drainage necessitated by the process, lead to erosion of bare soil, infiltration of river substrates by fine peat particles and losses of juvenile pearl mussel habitat. Some commercial peat extraction still occurs in the upper Nore catchment.

330 Mines

Explanation: Pollution of water courses from mining may be contributing to the decline of habitat conditions in the Nore.

420 Discharges

400 Urbanised areas, human habitation

Explanation: *Margaritifera* is a species of near natural conditions. Continuous urbanisation, discontinuous urbanisation and dispersed habitation have all been associated with depressed water and habitat quality in pearl mussel rivers. Lack of appropriate water treatment (water must reach the river at reference levels), including even small elevations in BOD levels, and even minor increases in ortho-phosphate levels can lead to loss of juvenile habitat. Inappropriately plumbed washing machines can lead to serious nutrient elevations and subsequent filamentous algal growth. Development within the Nore Catchment over the last 40 years has been substantial. While wastewater treatment may have improved, it is technically difficult to restore the water quality needed for functioning pearl mussels in a catchment which such volumes of discharges.

410 Industrial and commercial areas

Explanation: The Nore population (apart from outliers) ends at the outfall of the Glanbia creamery, where severe pollution, in terms to pearl mussel requirements, has occurred in the past. High BOD levels and other pollutants from discharges throughout the catchment, have led to loss of juvenile habitat and severe depletion of adult mussels.

421 Disposal of household waste

422 Disposal of industrial waste

423 Disposal of inert materials

Explanation: There is evidence of changes to the flood plain in parts of the River Nore from in-filling. Dumping in the river has also been a problem.

500 Communications networks

501 Paths, tracks, cycling tracks

502 Routes, autoroutes

Explanation: There is evidence of reduced habitat quality for pearl mussels in rivers where functioning flood plain has been impeded by hard surfaces of roads or paths. It has been reported that juvenile mussels require high quality groundwater discharging to the interstitial gravels, for which a direct connection between the river and unimproved, low-nutrient vegetation in the flood plain is necessary (Hruska 1999). Building of hard surfaces can release damaging silt into the river. Hard surfaces near a pearl mussel population can also lead to run-off of pollutants into the river. These are permanent effects, i.e. both from construction and operation. As road construction and upgrading is still actively underway in the Nore Catchment, road development is considered to present a significant threat to this species.

507 Bridge, viaduct

Explanation: There is evidence of reduced habitat quality for pearl mussels in rivers where bridges have been built, even where they have clear spanned the river. In general, the main negative impacts have occurred where structures were not spaced wide enough and, thus, insufficient flood plain habitat has been left on either side of the river (see above). The damage is exacerbated where flow changes have occurred, and hard measures such as revetments, walls or rock armouring have been built along the banks in the vicinity of the bridge to prevent bank erosion. Building of bridges can release damaging silt and nutrients into the river. The bridge and nearby road can also lead to run-off of pollutants into the river. These are both temporary and permanent effects, i.e. from construction and operation. Other permanent effects include excessive shading under the bridge, and disturbance to adult mussels and their reproductive processes on a long-term basis. Where the population of mussels is dense, the mussels form an intrinsic part of the river bed structure, and damage at one area can cause knock-on, long-term damage to beds of mussels upstream and downstream of the structure. Some more bridges are planned for the Nore Catchment in the coming years. All are clear span with all possible mitigation measures being taken to prevent further reduction of river bed and water quality. Risks from this source, however, cannot be eliminated.

700 Pollution

Explanation: Water pollution, particularly nutrient pollution, leading to increased primary productivity, is associated with agriculture, coniferous clearfell forestry, industrial effluents and insufficient treatment of domestic, municipal or industrial sewage. Very small increases, above natural background nutrient loads, can lead to damage. In particular, the normal background ortho-phosphate level of 0.01 mg/l P is considered to be essential in the Nore, to the maintenance of oligotrophic waters for reproducing *Margaritifera durrovensis* (Moorkens 2006d). Small increases in ortho-phosphate can lead to deleterious algal and/or macrophyte growth, so maintaining low levels at all times is considered to be essential. One large input of ortho-phosphate can lead to an algal incident, which in turn leads to detritus/particulate organic matter. These cause adult and juvenile deaths and increase the trophic status of the river on a long term basis. Growing algae causes problems by blocking oxygen exchange between the substratum and the water column and through night-time depletion of oxygen. Decaying algae generates detritus that not only clogs the interstices, but also causes oxygen depletion because oxygen is used up during its decomposition.

An increase in trophic status can lead to major habitat changes, particularly a change from *Fontinalis*-dominated flora/macrophytes to *Myriophyllum* and *Ranunculus*-dominated flora where nutrient pollution is accompanied by siltation. These macrophytes are indicative of poor *Margaritifera* habitat and provide conditions for trapping further silt and continued loss of habitat, as a result of changes in flow, sediment and nutrient dynamics (Clarke 2002, Wood 1997, Madsen *et al*. 2001, Barko *et al*. 1991). Phosphorus that led to macrophyte growth continues to be released and mobilised as the macrophytes decompose (Barko & Smart 1980, Rooney *et al*. 2003).

810 Drainage

830 Canalisation

Explanation: Both arterial drainage of the river and catchment and field drainage associated with agriculture and forestry impact on Nore pearl mussels. Arterial drainage, canalisation, boulder removal, etc. have destroyed river habitat by replacing natural channel reach patterns of pools and riffles with more uniform runs that suit neither the pearl mussel nor its host fish (Valovirta 2001, Moorkens 1999, 1996; Hastie *et al*. 2000). Bank reinforcement actions often accompany or are deemed necessary following canalisation. They are a response to external damage to river banks at the site of reinforcement or that has taken place elsewhere but has had ramifications at the site of reinforcement. The reinforcement structures in themselves can affect river dynamics both upstream and downstream of the works Fischenick, 2003, O'Grady 2006). Hard reinforcement measures are considered to be damaging activities in pearl mussel rivers.

The increased drainage network has led to an increase in the release of silt into the Nore and its tributaries, with the subsequent destruction of juvenile habitat. Drainage of peaty catchments has been shown to increase run-off rates and flood peaks (Müller 2000). Such hydrological changes lead to instability in mussel habitat and increased disturbance.

840 Flooding

850 Modification of hydrographic functioning

853 Management of water levels

Explanation: Habitat destruction through bog drainage in upper reaches, and flood plain destruction has led to changed hydraulic flows in the River Nore.

860 Dumping, depositing of dredged deposits

Explanation: Dredging has taken place in the past in the large lowland pearl mussel habitats, with large numbers of dead mussels being found afterwards. Kills are likely to have included pearl mussels in the range of the dredging through habitat destruction, and mussels downstream, through siltation. Dredging of lower stretches of the Nore probably contributed to the loss of the lower end of the population.

900 Erosion

Explanation: Erosion of river banks is a serious cause of silt entering the river. Its cause is rarely natural, even when no immediate explanation is obvious, but rather a knock-on effect from river bed or bank changes elsewhere. Where cattle or sheep are allowed to enter the river, serious erosion can occur. Soil erosion has been dealt with under Sections 101, 103, 142, 143, 148, 150, 160, 171, 300, 301, 310 and 330 above.

960 Interspecific faunal relations

964 Genetic pollution

Explanation: Loss of host fish is regularly cited as a potential reason for pearl mussel decline (Araujo & Ramos 2001, Anon 2005). A study on the status of host fish populations and on fish species richness in European pearl mussel populations characterised typical fish communities in pearl mussel streams and revealed that a lack of host fish only seems to be limiting pearl mussel reproduction in specific areas (Geist *et al*. 2005). Intact and functional pearl mussel populations were found to occur under extremely oligotrophic conditions with lower host fish density and biomass than in disturbed populations without juvenile recruitment. In Ireland, adequate numbers of host fish occur in at least some rivers with inadequate *Margaritifera* recruitment, however, where nutrient levels have increased, more host fish may be required as compensation for lower glochidial production rates in stressed mussels (Geist 2005).. A comparison of trout versus salmon dominated rivers of Ireland quickly shows that 100% of pearl mussel rivers are associated with salmon and sea trout. Thus, while brown trout make an effective host fish, the rivers occupied by *Margaritifera* in Ireland, are of naturally low productivity dominated by salmonids that went to sea to get nutrition. Salmon and *Margaritifera* have been cited as symbiotic in their relationship, with both species providing a beneficial role for the other (Ziuganov & Nezlin 1988, Ziuganov *et al*. 1994). Pearl mussels filter the river water and increase its purity, and salmon gills host mussels during their glochidial stage. Pearl mussels have also been shown to prevent early senility in salmon and thus extend their life expectancy (Ziuganov 2005). It is likely that host fish numbers in ultra-oligotrophic situations were never very high, as pearl mussels are naturally adapted to live in rivers with low food levels and very low productivity (Bauer *et al*. 1991), but an unnatural decline in host fish will inevitably threaten *Margaritifera*. As well as habitat decline and acidification (see above), impediments to fish movement from artificial barriers can result in losses of mussel populations (Bogan 1993).

Genetic pollution through the introduction of fish stocks not native to the catchment is considered to be a problem, as there appears to be a strong level of adaptation between genetic mussel and fish stocks.Conservation of Nore trout and salmon genetic strains is considered to be important.

7. Threats

All the pressures referred to above are ongoing and will remain as threats to the population in the future, and in some cases are likely to be exacerbated.

In addition, the following are likely threats:

890 Other human induced changes in hydraulic (and other) conditions – Climate change

Explanation: Climate change is likely to further threaten the survival of *Margaritifera durrovensis*. It is unlikely (in the foreseeable future) that the Irish habitat will be outside the temperature range of the species, but increased temperatures will lead to a higher metabolic rate and consequently a shorter life expectancy and, thus, reduced reproductive episodes per individual. This may exacerbate an already lowered recruitment level. The likely scenario of increased summer droughts and winter storm and flood events may negatively affect the species by increasing the frequency of stressful “natural” events. These may result in increased siltation incidents during flooding. Habitat space may be reduced as a result of loss of river bed in drought conditions, or instability of gravel beds that are currently stable, through frequent flooding. Climate change may have an as yet unforeseen affect on the salmonid host species or on the food web that they rely upon. Changes in potential smaller translocation rivers may be more severe, thus climate change should be considered when choosing receptor sites for Nore pearl mussels bred in captivity.

966 Antagonism arising from introduction of species

Explanation: The introduction of the zebra mussel (*Dreissena polymorpha*) or other exotic species into the Nore could result in major declines of the native pearl mussel, as it has to the native duck and swan mussels where zebra mussels have spread. Although the level of calcium needed for zebra mussels is higher than that found in most *Margaritifera margaritifera* rivers, there could be concern for the Nore where calcium levels are high.

8. Future Prospects

This assessment is based on current and future pressures and the likelihood that current and planned policy and management will reduce or eliminate such pressures.

8.1. Negative indicators

Although the Nore has been designated as a Special Areas of Conservation, much work is required, throughout its catchment, in order to restore and sustain mussel populations for the future. The success of the SAC designation for the conservation of this species is heavily dependent on future developments in catchment management, especially the removal/prevention of damaging activities.

Buffer zones along rivers are widely recognised as important in protecting water quality. Since the reduction of river SAC boundaries in Ireland from 30-100 m to 2.5 m, however, no mechanism for ex situ control of riparian zones has yet been implemented.

There is significant continuing concern about the effects of coniferous forestry in pearl mussel catchments. The response by the authorities to date has concentrated on producing draft “Forestry and Freshwater Pearl Mussel Requirements” for forestry in certain *Margaritifera* catchments, which are not yet implemented. A number of pearl mussel experts have indicated that they consider these insufficient for the protection of the species. Conservation management for pearl mussel would strongly recommend a ban on clearfelling in their catchments. Forestry specialists, however, believe there is a high risk of large-scale windthrow in extant forests on peat, which would generate large quantities of peat silt. As a result, they recommend that the current mature crop is clear felled.

Similarly, agricultural operations have continued to intensify in Ireland. In the Nore catchment these need to be reduced to levels that are compatible with the life cycle of the pearl mussel. Recent intensification has resulted from both economic drivers and environmental policy. Pressure on dairy farmers to intensify operations and increase herd sizes has led to use of previously marginal land. A policy for compensation of farmers for more compatible practices should be urgently undertaken, as part of a management plan for the Nore catchment. The mechanism for compensation needs to be put in place before demands can be made on the landowners.

8.2. Positive indicators

It is hoped that the Water Framework Directive may help develop policies, legislation and management strategies that could work towards managing damaging land uses and improving water and habitat quality. It is imperative that recoverable pearl mussel populations are given the highest priority and that everyone involved in the implementation of this Directive understands the very demanding habitat requirements of the pearl mussel.

A draft Species Action Plan has been written in order to identify steps taken and monitor milestones toward improved conditions. The overall improved monitoring regime for the Nore pearl mussel is a positive step.

At the moment the negative indicators currently operating and likely to continue operating mean that the above positive indicators may have limited effect. The political will to save the Nore pearl mussel from world-wide extinction must become evident in order for positive actions to make a real difference. Time is also limited as the last population continues to decline, and extinction becomes imminent.

8.3. Conservation assessment of future prospects

As the negative indicators outweigh the positive ones in both number and magnitude, and the Nore pearl mussel is rapidly reaching the point of world extinction, there is no doubt that the assessment of future prospects is Unfavourable – bad.

Table 7 The conservation assessment for the future prospects of *Margaritifera durrovensis* in the Republic of Ireland.

Future Prospects Parameter	Value
Negative Indicators	• **Management of SACs** • **Reduction of the buffers around SAC rivers** • **Forest management** • **Agricultural intensification and policy** • **Documented trends of loss of high quality river sites** • **Lack of comprehensive catchment plans for *Margaritifera* populations** • **Failures in the planning process**

Future Prospects Parameter	**Value**
Positive Indicators	• **Future policy, legislation and management under the WFD** • **Draft *Margaritifera durrovensis* SAP** • **Improved *Margaritifera* monitoring**
Future Prospects Conservation Assessment	**Un-favourable - Bad**

9. Complementary Information

9.1. Surrounding terrestrial habitat

The terrestrial habitat surrounding both banks of *Margaritifera* rivers is very important. Like *M. margaritifera*, it is assumed that *M. durrovensis* requires catchment conditions that are natural enough to produce very low levels of silt and nutrients. The open water quality and river bed substrate conditions are determined by the land use in the catchment above and within the range of the mussel population. As a consequence, riparian land-uses have been incorporated within the condition assessment for *Margaritifera durrovensis* (Table 6 and Appendix IV).

Table 6 The *Margaritifera durrovensis* condition assessments for land-use attributes.

Attribute	Target to pass	Notes
Adjacent Land Use Issues	No damaging activities	Damaging activities are those considered to contribute more suspended solids and/or nutrients than would be expected in functioning mussel habitats.

It is critical that the river bed habitat be restored, as the species is very demanding of high substrate quality, and loss of habitat quality quickly reduces recruitment capability.

The terrestrial habitat surrounding both banks of the Nore and/or future receptor rivers is very important. This is important in the area where the mussel population is found, in the river catchment upstream of the mussel population, including the wider catchment of all drains and streams that feed the river. As restoration of the Nore is unlikely to be feasible, a new site for the population and/or captively bred young mussels is essential. Research is underway to identify potential receptor sites (Moorkens 2006 c). Otherwise captive breeding will remain a necessity in the long term.

Suitable habitat within at least a 30m zone along each bank, and a similar zone surrounding any stream or drain entering the river would include the following CORINE 2000 habitats:

2.3.1.2 Unimproved grassland
3.1.1 Broad-leaved forests
3.2.1 Natural grassland
3.2.2 Moors and heathlands
3.2.4 Transitional woodland scrub
4.1.2.1.2 Intact raised peat bog (early headwaters of rivers)
4.1.2.2.1.2 Intact upland blanket bogs
4.1.2.2.2.2 Intact lowland blanket bogs
4.1.2.2.3.2 Intact mountain blanket bogs (early headwaters of rivers)

9.2. Threat status of *Margaritifera durrovensis*

The Nore freshwater pearl mussel *Margaritifera durrovensis* is listed as **critically endangered** in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs (Moorkens 2006a).

10. Overall conservation assessment

Table 8 Overall Conservation Assessment for *Margaritifera durrovensis*.

Range of *Margaritifera durrovensis*	**Unfavourable**
Population of *Margaritifera durrovensis*	**Unfavourable**
Habitat of *Margaritifera durrovensis*	**Unfavourable**
Future prospects of *Margaritifera durrovensis*	**Unfavourable**
Overall Assessment for *Margaritifera durrovensis*	**Unfavourable**

11. References

Anderson, R. (2005). An annotated list of the non-marine Mollusca of Britain and Ireland. *J. Conch*. **38**, 607-638.

Araujo, R. & Ramos, M.A. (2001). *Action plans for* Margaritifera auricularia *and* Margaritifera margaritifera *in Europe*. Nature and Environment, No. 117. Council of Europe Publishing, Strasbourg.

Bloomer, H. H. (1927). *Margaritifera margaritifera* notes on the variation of the British and Irish forms. Proc. Malac. Soc. Lond. **17**, 208-216.

Bloomer, H.H. (1928). *Margaritifera durrovensis*. Anatomical notes. Proc. Malac. Soc. Lond. **18**, 74-76.

Chesney, H.C.G., Oliver, P.G. and Davis, G.M. (1993). *Margaritifera durrovensis* Phillips, 1928: Taxonomic status, ecology and conservation. J. Conch. Lond. **34**, 267-299.

Cosgrove, P.J., & Young, M. (1998). *The status of the freshwater pearl mussel* Margaritifera margaritifera *in Scotland.* A report to Scottish Natural Heritage, Edinburgh.

Costello, M.J., Moorkens E.A., Larkin M. and Kurz I. (1997). The River Nore and its almost extinct pearl mussel: a priority for management and river restoration. In: *Colloquy on conservation, management and restoration of habitats for invertebrates: enhancing biological diversity. Killarney, Ireland, 26-29 May 1996.* Council of Europe, Strasbourg, Environmental encounters no. **33**, 31-37.

Costello, M.J., Moorkens E.A., Larkin M., Kurz I. and Dowse J. (1998) Management priorities for the River Nore (Ireland) to conserve the pearl mussel, *Margaritifera durrovensis. Journal of Conchology Special Publication* No. **2**, 257-264.

Cranbrook, Earl of (1976). The commercial exploitation of the freshwater pearl mussel, *Margaritifera margaritifera* L. (Bivalvia: Margaritiferidae) in Great Britain. *J. Conch. Lond*. **29**: 87-91.

Dolmen, D., Arnekliev, J.V., & Haukebo, T. (1995). Rotenone tolerance in the freshwater pearl mussel *Margaritifera margaritifera.* Nord. J. Freshwater Res. **70**, 21-30.

Eagar, R.M.C. (1977). Shape of shell in relation to weight of *Margaritifera margaritifera* (L.) (Bivalvia: Margaritiferidae). J.Conch. Lond. **29**, 207-218.

Ellis, A.E. (1962). *British freshwater bivalve Molluscs*. Synopses of the British Fauna, No.13. Linnean Society, London.

European Commission (2006). Assessment, Monitoring and Reporting under Article 17 of the Habitat's Directive: Explanatory Notes and Guidelines. Draft 5. October 2006.

Fischenick, J.C., (2003). *Effects of rip rap on riverine and riparian ecosystems*. Wetlands Regulatory Assistance Programme. US Army corps of Engineers.

Geist, J. & Kuehn, R. (2005). Genetic diversity and differentiation of central European freshwater pearl mussel (*Margaritifera margaritifera* L.) populations: implications for conservation and management. *Molecular Ecology* **14,** 425-439.

Haas, F. (1948). On *Margaritifera durrovensis* Phillips and its affinities. J. Conch. Lond. **23**, 6-8.

Hastie, L.C., & Young, M.R. (2003). *Conservation of the Freshwater Pearl Mussel. 2. Relationship with Salmonids.* Conserving Natura 2000 Rivers. Conservation Techniques Series No. 3. English Nature, Peterborough.

Hastie, L.C., Boon, P.J. & Young, M.R. (2000). Physical microhabitat requirements of freshwater pearl mussels, *Margaritifera margaritifera* (L.). *Hydrobiologia* **429**, 59-71.

Holmes, A., Jones, C., and Noble, L.R. (2001). Conservation genetics of the freshwater pearly mussel *Margaritifera margaritifera* (L., 1758). In: Salvini-Plawen, L., Sattmann, H. & Steiner, G. (Eds.) Abstracts, World Congress of Malacology 2001, Vienna, Austria. Unitas Malacologica, 2001.

Hruska, J. (1999) Nahrungsanspruche def flussperlmuschel und deren halbnatürliche aufzucht in ter Tchechischen Republik. Heldia **4**, 69-80.

Killeen, I. J., Oliver, P.G. & Aldridge, D.C. (2004). *Freshwater bivalves of Britain and Ireland*. Field Studies Council, Shrewsbury. 114pp.

Lucey J. (2005). The Irish Pearl. A cultural, social and economic history. Wordwell, Bray.

Machordom, A., Araujo, R., Erpenbeck, D. and Ramos, M.-A. (2003). Phylogeography and conservation genetics of endangered European Margaritiferidae (Bivalvia: Unionoidea). Biological Journal of the Linnean Society. **78**, 235-252.

McMillan, N. & Zeissler, H. (1990). Recent and fossil Mollusca of the Rivers Barrow, Nore and Suir, South-east Ireland. Bull. Ir. Biogeog. Soc. **13,** 189-199.

Mellinger, P.J. (1973). The Comparative Metabolism of Two Mercury Compounds as Environmental Contaminants in the Freshwater Mussel, *Margaritifera margaritifera* In: D.D.Hemphill (Ed.), Trace Substances in Environmental Health-VI., University of Missouri, Columbia, MO :173-180.

Moorkens, E. A. (1991). *The freshwater pearl mussel* Margaritifera margaritifera *inthe south east of Ireland*. Unpublished M.Sc. Thesis, Trinity College, Dublin.

Moorkens, E. A. (1996). *Studies on the Biology and Ecology of* Margaritifera *in Ireland*. Unpublished PhD Thesis, Trinity College, Dublin.

Moorkens, E.A. (1999). Conservation Management of the Freshwater Pearl Mussel Margaritifera margaritifera. *Part 1: Biology of the species and its present situation in Ireland.* The National Parks and Wildlife Service, Irish Wildlife Manuals No. 8. Series Editor: F. Marnell.

Moorkens, E. A. (2004). Pilot Project for Monitoring Populations of the Freshwater Pearl Mussel. Baseline survey of the Nore River SAC, Counties Laois and Kilkenny. Unpublished report for the National Parks and Wildlife Service.

Moorkens, E. A. (2005). Monitoring Populations of the Freshwater Pearl Mussel. Repeat survey of the Nore River SAC, Counties Laois and Kilkenny. Unpublished report for the National Parks and Wildlife Service.

Moorkens, E. A. (2006a). "Irish non-marine molluscs – an evaluation of species threat status". *Bull. Ir. biogeog. Soc*. **30**, 348-371.

Moorkens, E.A. (2006b) *Research aspects of proposed* Margaritifera durrovensis *captive* breeding programme in Fanure, Roscrea. Unpublished Report for the National Parks and Wildlife Service.

Moorkens, E.A. (2006c) Preliminary assessment of River Nore tributaries for potential translocation areas for extant adult and captive bred Nore pearl mussels Margaritifera durrovensis. Unpublished Report for the National Parks and Wildlife Service.

Moorkens, E.A. and Costello, M.J. (1994). Imminent extinction of the Nore freshwater pearl mussel *Margaritifera durrovensis* Phillips: a species unique to Ireland. *Aquatic Conservation: Marine and Freshwater Ecosystems* **4**, 363-365.

Moorkens, E.A. & Costello, M. J. (2004). Survival of the freshwater pearl mussel *Margaritifera margaritifera* after opening with mussel tongs. In: *Molluscan Biodiversity and Conservation.* Journal of Conchology Special Publication No. **3**, 91-94.

Moorkens, E.A., Costello, M.J. & Ross, H.C.G. (1990). *A study of the pearl mussel,* Margaritifera margaritifera *in south-east Ireland*. Unpublished report for the National Parks and Wildlife Service.

Moorkens, E.A., Costello, M. J. and Speight, M.C.D. (1992). "Status of the freshwater pearl mussels *Margaritifera margaritifera* and *Margaritifera durrovensis* in the Nore, Barrow, and Suir river tributaries". *Irish Naturalists Journal* **24**, 127-131.

Müller, M. (2000)Hydrogeographical studies in the Burrishoole catchment, Newport, Co. Mayo, Ireland: effects of afforestation on the run-off regime of small mountain spate river catchments. Verh. Internat. Verein. Limnol. **27**, 114-1148.

Nezlin, L.P., Cunjak, R.A., Zotin, A.A. and Ziuganov, V.V. (1994). Glochidium morphology of the freshwater pearl mussel (*Margaritifera margaritifera*) and glochidiosis of Atlantic salmon (*Salmo salar*): a study by scanning electron microscopy. Can. J. Zool. **72**, 15-21.

O'Grady, M. (2006). Channels and Challenges. The enhancement of salmonid rivers. Central Fisheries Board, Dublin. 142pp.

Phillips, R.A. (1928) On *Margaritifera durrovensis*, a new species of pearl mussel from Ireland. Proc. Malac. Soc. Lond. **18**, 69-74.

Ross, E.D. (1984). Studies on the biology of freshwater mussels (Lamellibranchia: Unionacea) in Ireland. MSc Thesis, UCG, National University of Ireland.

Ross, E.D. (1988). The reproductive biology of freshwater mussels in Ireland, with observations on their distribution and demography. PhD Thesis, UCG, National University of Ireland.

Skinner, A., Young, M. & Hastie, L. (2003 Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers. Ecology Series No. 2. English Nature, Peterborough.

Stelfox, A.W. (1929). Land and freshwater Mollusca. *Proc. R. Ir. Acad*. **39B**, 6-10.

Valovirta, I. (2001). Restoration of Rivers for *Margaritifera margaritifera*. In: *The* Freshwater pearl mussel in Europe: Population status and conservation strategies. P120-123. Wasserwirtschaftsamt, Hof.

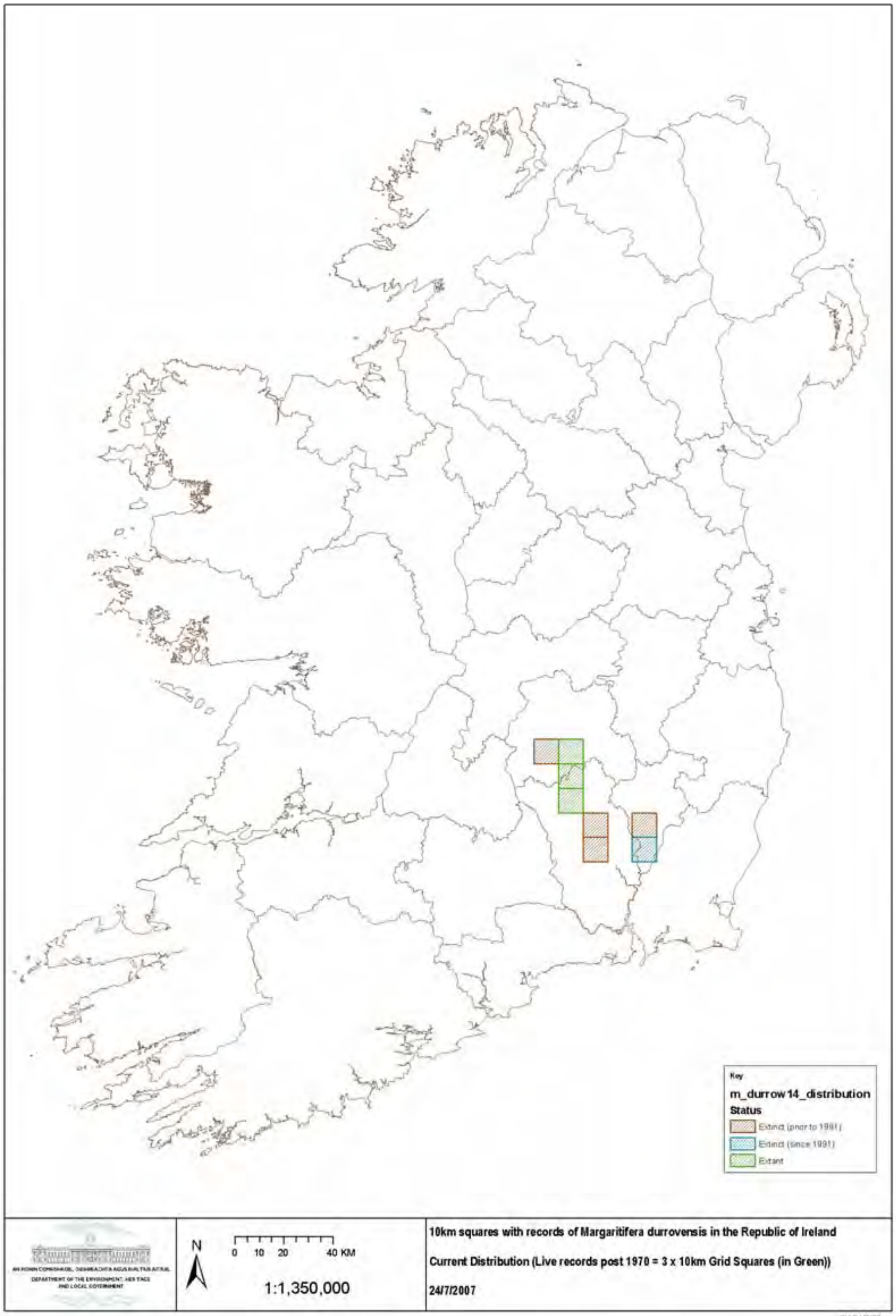
Young, M. (2005). A literature review of the water quality requirements of the freshwater *pearl Mussel (*Margaritifera margaritifera*) and related freshwater bivalves*. Scottish Natural Heritage Commissioned report No. 84.

Ziuganov,V., Zotin, A., Nezlin, L. and Tretiakov, V. (1994). *The freshwater pearl mussels and their relationships with salmonid fish.* VNIRO, Moscow. 104pp.

Appendix I

Map of the Range and Distribution of adult *Margaritifera durrovensis* in Ireland

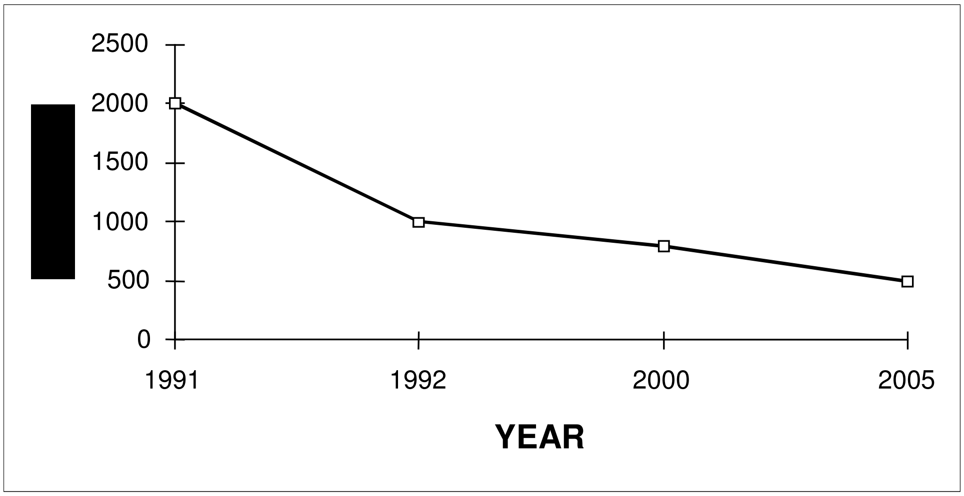
10km squares with records of *Margaritifera durrovensis* in the Republic of Ireland



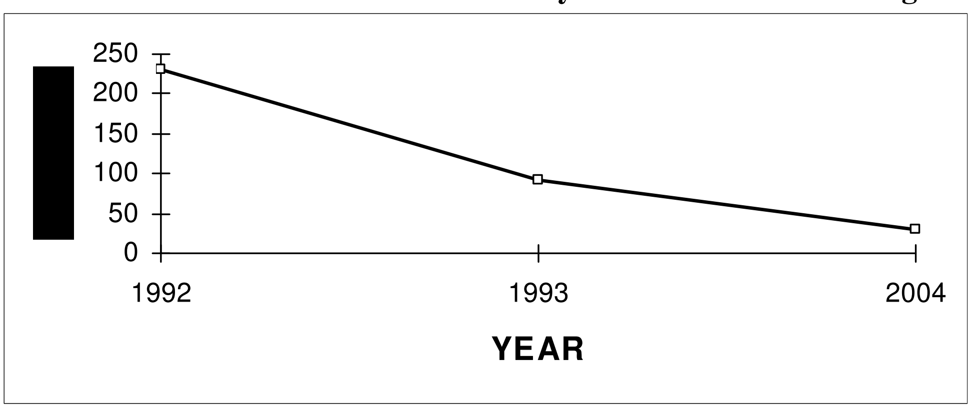
Appendix II

Population trends in *Margaritifera durrovensis* 1991 - 2004

Total *M. durrovensis* population estimate.



***M. durrovensis* counts from River Gully confluence to New Bridge.**



Appendix III

Special Areas of Conservation (SACs) designated for *Margaritifera durrovensis* in Ireland

SAC Site Code	Name of SAC	County	Rivers / Lakes
002162	RIVER BARROW AND RIVER NORE SAC	Laois, Kilkenny	Nore

Appendix IV

Condition assessment categories for *Margaritifera durrovensis*

Attribute	Target to pass	Notes
Mussels		
Density	Potentially suitable habitat is at capacity (or at least 10 mussels/m^2)	Target in UK protocol (Young *et al*. 2003) is given as 10/m^2 in favourable habitat
Numbers of live individuals	No recent decline	Based on comparative results from the most recent surveys
Numbers of dead shells	<1% of population and scattered distribution	1% considered to be indicative of natural losses. Age of dead shells can be used to provide information if loss level is otherwise in doubt – if all dead shells are fresh this would indicate a more serious problem than scattered disintegrating shells of various ages.
Age structure 1	At least 20% of population ≤65mm in one or more quadrats	Target in UK protocol (Young *et al*. 2003)
Age structure 2	At least 20% of population ≤65mm in total monitoring quadrat count for river	N.B. Quadrats must be carried out in suitable habitat areas for juveniles
Age structure 3	At least 5% of population ≤ 30mm	If there are known historical percentages from previous survey of < 30mm in populations that were considered to be sustainable, these percentages should be used as favourable, otherwise 5% min.
Age structure 4	At least 5% of population ≤ 30mm in total monitoring quadrat count for river	If there are known historical percentages from previous survey of < 30mm in populations that were considered to be sustainable, these percentages should be used as favourable, otherwise 5% min. N.B. Quadrats must be carried out in suitable habitat areas for juveniles
Water Quality		
Orthophosphate	0.01mg/l median value with no max value over 0.03 mg/l	Based on historical values for Nore main channel, and the fact that it is a large shaded channel. Translocated sites may require more stringent quality.
Nitrate	0.2mg/l median value	Based on historical values for Nore main channel, and the fact that it is a large shaded channel. Translocated sites may require more stringent quality.
Suspended Solids	<10mg/l maximum value associated with natural	Suspended solids should be rare rather than chronic and attributable to natural conditions.

Attribute	Target to pass	Notes
	events	
BOD	<1.0mg/l median	No target given in UK FCT but should be at very low natural levels for the river.
Substrate Condition		
Siltation	No plumes of silt when substrate kicked to 10cm depth	a 'plume' is an obvious flush of silt, produced wl stones are lifted from the substrate or submerged vegetation is disturbed, such that visibility of the river bed is momentarily obscured
Redox measurements	<20% loss in redox value at 5cm depth	Based on work by Geist *et al*. in prep. Results from a recent survey of the River Ehen in Cumbria (Killeen 2006) show that young mussels and juveniles were present only in the most highly oxygenated riffle areas where the loss in redox value was less than 20% at 5cm depth.
Plant Growth		
Filamentous algae	None	Any filamentous algae should be wispy and ephemeral, and never form mats.
Macrophytes	None	*Fontinalis* on rock is a positive indicator, *Ranunculus, Myriophyllum* and any other substrate macrophytes are negative indicators
Adjacent Land Use Issues	No damaging activities	Damaging activities are those considered to contribute more suspended solids and/or nutrients than would be expected in functioning mussel habitats.
Evidence of pearl fishing	None	Based upon evidence (i.e. opened shells caches on banks) or information e.g. from locals

Appendix V

Condition assessment of SAC rivers designated for *Margaritifera durrovensis*

Attribute	Nore
Mussels	
Density 1	F
Density 2	F
Numbers of live individuals	F
Numbers of dead shells	F
Age structure 1	F
Age structure 2	F
Age structure 3	F
Age structure 4	F
Water Quality	
Orthophosphate	F
Nitrate	F
Suspended Solids	F
BOD	F
Substrate Condition	
Siltation	F
Redox measurements	F
Plant Growth	
Filamentous algae	P
Macrophytes	P
Adjacent Land Use Issues	F
Evidence of pearl fishing within reporting period	P

Total # fails	15F
Total # data deficients	0D
Total # passes	3P

Population	**F**
Water quality	**F**
Overall	**F**

P = pass, F = fail, D = data deficient

Appendix VI

Comparison of *Margaritifera durrovensis* abundance categories assessed in Ross (1988) with more recent surveys

River	Grid Reference	Abundance Category 1988	More recent Abundance Category
Nore	S4279	A	O (2004)

A=abundant, C=common, R=rare, O=occasional, D=data deficient, Ab=absent

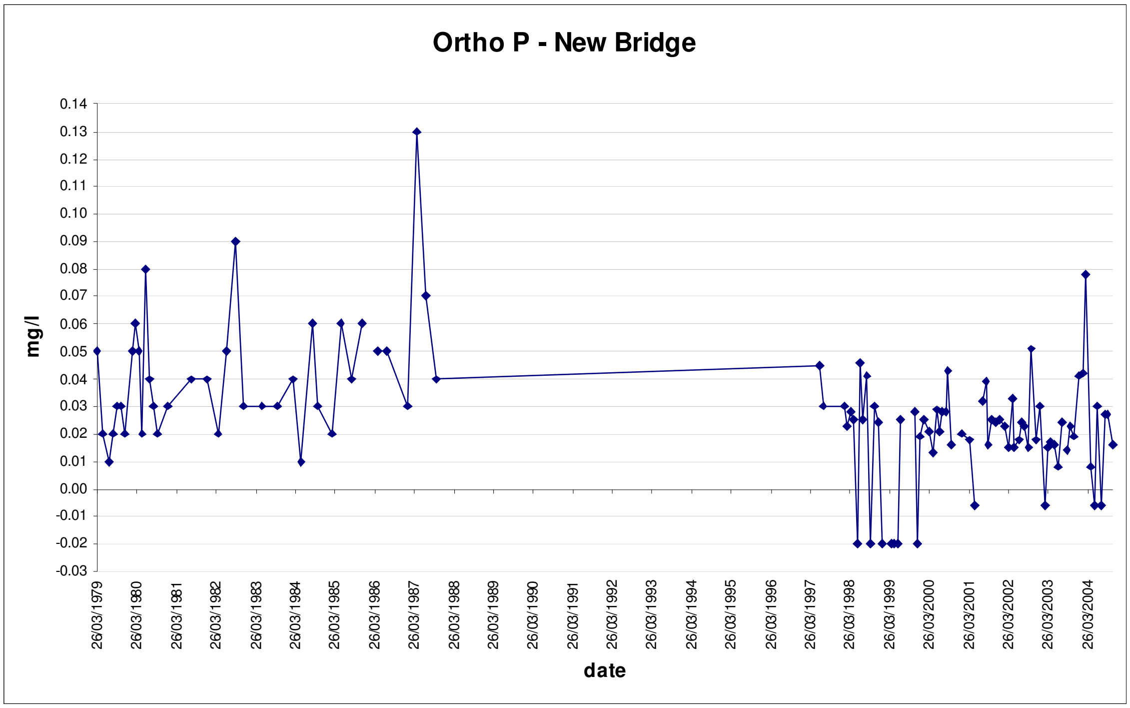
Appendix VII

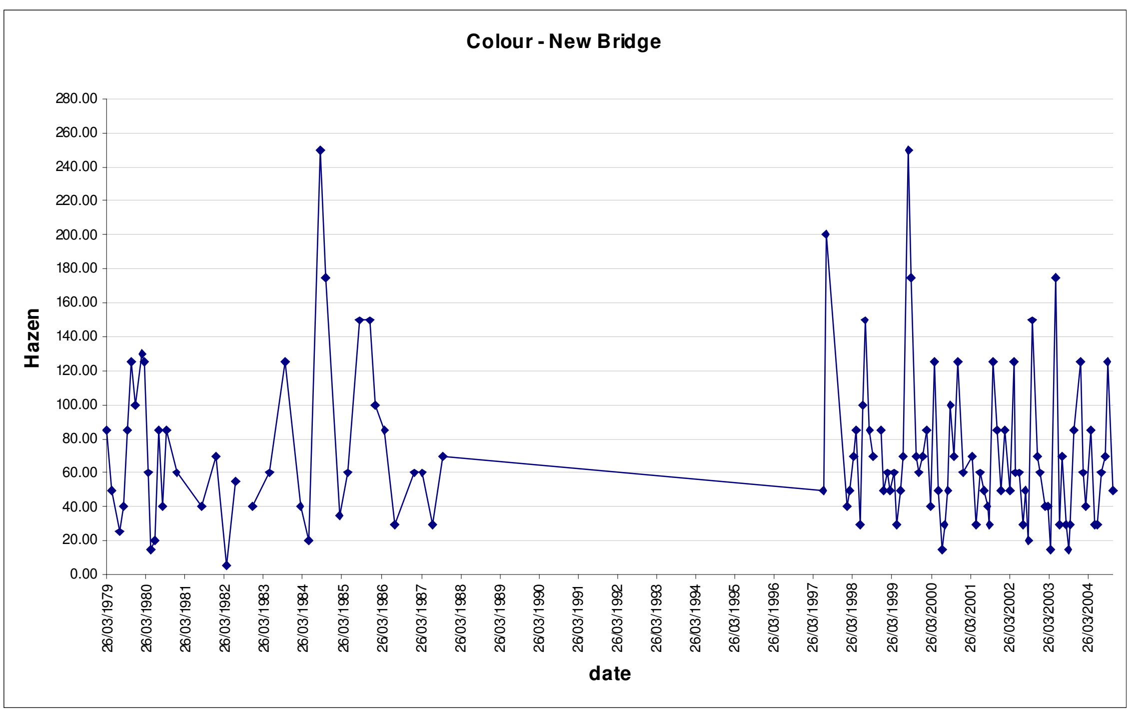
Historical EPA biological water quality (Q-value) data for the river Nore

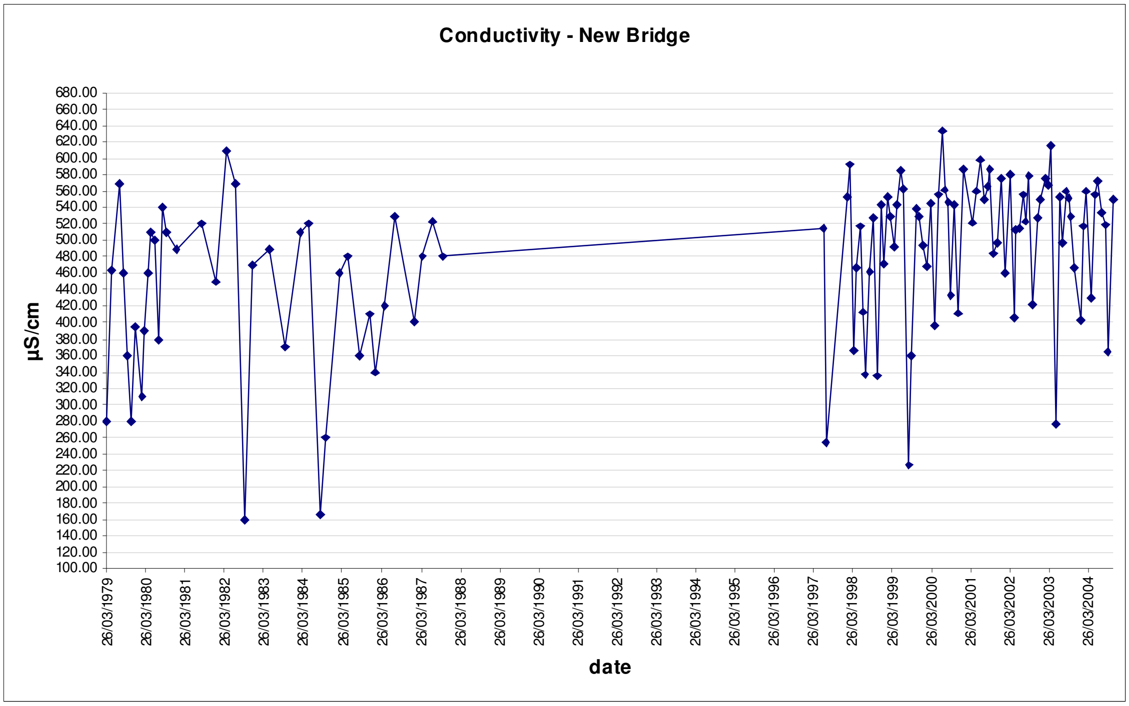
River	EPA Biological Station Number	EPA Biological Station Name	Grid Reference	1971	1975 / 1976	1979 / 1980	1984 / 1985	1987 / 1988	1991	1995	1998	2001
Nore	0030	Br sw Clonakenny	S 111 798							3	4	3
Nore	0080	Nore Bridge	S 134 809						3-4	3-4	3-4	3-4
Nore	0200	Nore Bridge se Roscrea	S 172 857			3	3-4	3-4	4	3	3-4	3-4
Nore	0300	Quaker's Bridge	S 214 765	5	4-5	4	4	3-4	3-4	3-4	3-4	3-4
Nore	0400	New Bridge 1	S 237 878	5	5	4-5	3-4	3-4	4	4	3-4	3-4
Nore	0500	Br s of Coolrain	S 293 903	4-5	4-5	4-5		4		4	4	4
Nore	0580	Danganroe Bridge	S 326 927							3-4	3-4	4
Nore	0700	Br near Kilbricken House	S 409 858			4	3-4	4	4	4	3-4	3-4
Nore	0900	Poorman's Bridge	S 407 856				4	4-5	4	4	3-4	3-4
Nore	1100	Watercastle Bridge	S 427 800	5	5	4-5	4	4	4-5	3-4	3-4	4
Nore	1300	Tally-Ho Bridge	S 427 760	4-5	4-5	4-5	4	4	4	3-4	4	4-5
Nore	1450	Ballyragget Bridge	S 447 706	5	4-5	4	4	4	3-4	3-4	4	3-4
Nore	1600	Lismaine Bridge	S 447 639	5	5	3-4	3-4	4	4	3-4	4	4
Nore	1700	Threecastles Bridge	S 460 624			4	4	4	4	4	4	4
Nore	1800	1km us Green's Br	S 503 570	5	4-5	5	5	5	4	4	4-5	4
Nore	1950	Fennessy's Mill (Ossory Br)	S 524 550	3-4	3	-	2 to 3	4	3-4	3-4	3-4	3-4
Nore	2000	NE Warrington	S 541 541			3	3-4	4	4	3	3-4	2
Nore	2200	Ballylinch Bridge	S 550 432			4	3-4	4	4	3-4	3-4	3-4
Nore	2320	Thomastown Bridge	S 595 415	4 to 5	4 to 5	3 to 4	3	2	2	3	3 to 4	3 to 4
Nore	2400	Brownsbarn Bridge	S 620 387			4	4	4	3 to 4	3 to 4	4	4

Appendix VIII

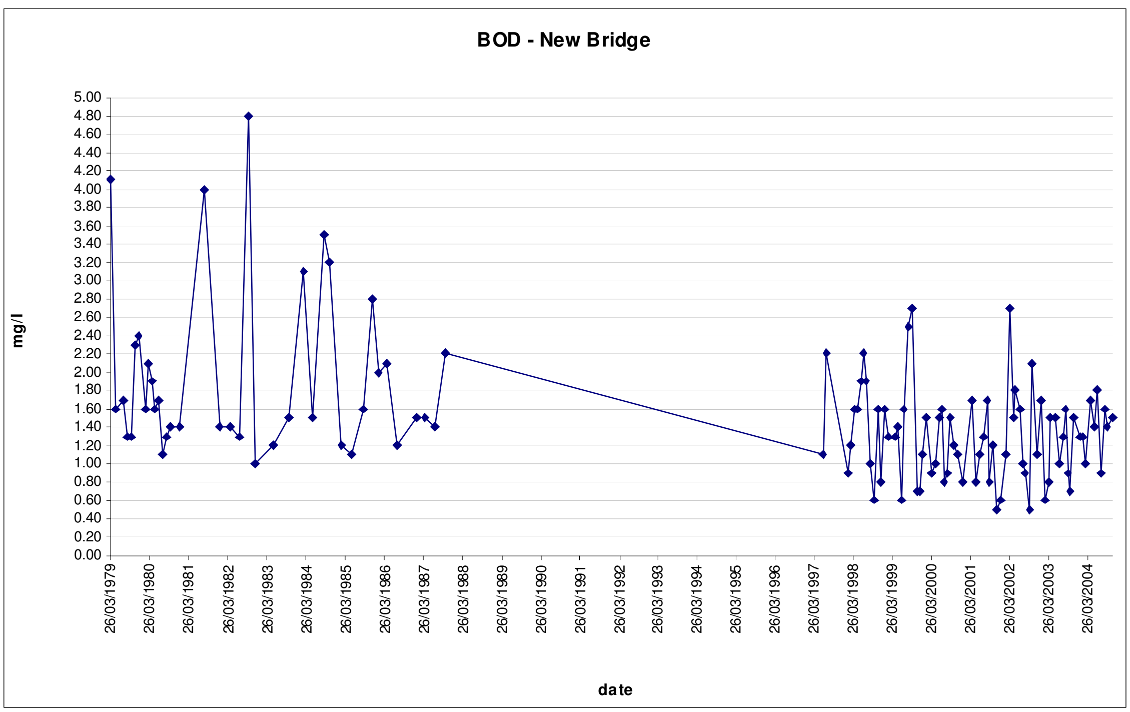
Water quality changes over time at New Bridge, River Nore







Conductivity - New Bridge
µS/cm
date



BOD - New Bridge
mg/l
date

1990 The Nore freshwater pearl mussel (*Margaritifera durrovensis*)

1. National Level	
Species code	1990
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Moorkens, E. A. (1991). *The freshwater pearl mussel* Margaritifera margaritifera *in the south east of Ireland*. Unpublished M.Sc. Thesis, Trinity College, Dublin. ▪ Moorkens, E. A. (1996). *Studies on the Biology and Ecology of* Margaritifera *in Ireland*. Unpublished PhD Thesis, Trinity College, Dublin. ▪ Moorkens, E. A. (2004). *Pilot Project for Monitoring Populations of the Freshwater Pearl Mussel. Baseline survey of the Nore River SAC, Counties Laois and Kilkenny*. Unpublished report for the National Parks and Wildlife Service. ▪ Moorkens, E. A. (2005). *Monitoring Populations of the Freshwater Pearl Mussel. Repeat survey of the Nore River SAC, Counties Laois and Kilkenny*. Unpublished report for the National Parks and Wildlife Service. ▪ Moorkens, E.A. (2006b) *Research aspects of proposed* Margaritifera durrovensis *captive breeding programme in Fanure, Roscrea.* Unpublished report for the National Parks and Wildlife Service. ▪ Moorkens, E.A. (2006c) *Preliminary assessment of River Nore tributaries for potential translocation areas for extant adult and captive bred Nore pearl mussels* Margaritifera durrovensis. Unpublished report for the National Parks and Wildlife Service. ▪ Moorkens, E.A. and Costello, M.J. (1994). Imminent extinction of the Nore freshwater pearl mussel *Margaritifera durrovensis* Phillips: a species unique to Ireland. *Aquatic Conservation: Marine and Freshwater Ecosystems* **4**, 363-365. ▪ Phillips, R.A. (1928) On *Margaritifera durrovensis*, a new species of pearl mussel from Ireland. Proc. Malac. Soc. Lond. **18**, 69-74. ▪ Ross, E.D. (1984). *Studies on the biology of freshwater mussels (Lamellibranchia: Unionacea) in Ireland*. MSc Thesis, UCG, National University of Ireland. ▪ Ross, E.D. (1988). *The reproductive biology of freshwater mussels in Ireland, with observations on their distribution and demography*. PhD Thesis, UCG, National University of Ireland.
2.3 Range	
2.3.1 Surface area	300 km²
2.3.2 Date	2006
2.3.3 Quality of data	3 (good)
2.3.4 Trend	-25%

2.3.6 Trend-Period	1991-2006
2.3.7 Reasons for reported trend	3 (direct human influence)
2.4 Population	
2.4.1 Population size estimation	0 viable populations
2.4.2 Date of estimation	2006
2.4.3 Method used	2 (extrapolation from surveys of part of the population, sampling)
2.4.4 Quality of data	3 (Good)
2.4.5 Trend	-50%
2.4.7 Trend-Period	1991-2006
2.4.8 Reasons for reported trend	3 (direct human influence)
2.4.9 Justification of % thresholds for trends	In 1991 there was two populations of *Margaritifera durrovensis* in the Republic of Ireland: the River Barrow and River Nore populations. Both of these were un-viable. Since then the Barrow population has gone extinct and the River Nore population has declined significantly. There has been a decline of 75% in the number of adult mussels in the Nore and the population is not recruiting. As a result, the Nore population is not only un-viable, but on the verge of extinction.
2.4.10 Main pressures	101 Modification of cultivation practices 103 Agricultural improvement (for the same reasons) 120 Fertilisation 148 Overgrazing, general 150 Restructuring agricultural land holding 160 General forestry management 171 Stock feeding 220 Leisure fishing 240 Taking / removal of fauna 300 Sand and gravel extraction 301 Quarries 310 Peat extraction 400 Urbanised areas, human habitation 410 Industrial and commercial areas 420 Discharges 421 Disposal of household waste 500 Communications networks 502 Routes, autoroutes 507 Bridge, viaduct 700 Pollution 810 Drainage 830 Canalisation 850 Modification of hydrographic functioning 900 Erosion

2.4.11 Threats	101 Modification of cultivation practices 103 Agricultural improvement (for the same reasons) 120 Fertilisation 148 Overgrazing, general 150 Restructuring agricultural land holding 160 General forestry management 171 Stock feeding 220 Leisure fishing 240 Taking / removal of fauna 300 Sand and gravel extraction 301 Quarries 310 Peat extraction 400 Urbanised areas, human habitation 410 Industrial and commercial areas 420 Discharges 421 Disposal of household waste 500 Communications networks 502 Routes, autoroutes 507 Bridge, viaduct 700 Pollution 810 Drainage 830 Canalisation 850 Modification of hydrographic functioning 900 Erosion 890 Other human induced changes in hydraulic (and other) conditions – Climate change 966 Antagonism arising from introduction of species
2.5 Habitat for the species	
2.5.2 Area estimation	0
2.5.3 Date of estimation	2006
2.5.4 Quality of data	3 (good)
2.5.5 Trend	-100%
2.5.6 Trend-Period	1991-2006
2.5.7 Reasons for reported trend	3 (direct human influence)
2.6 Future prospects	Unfavourable - Bad

2.7 Complementary information	
2.7.1 Favourable reference range	400 km²
2.7.2 Favourable reference population	2 viable populations
2.7.3 Suitable Habitat for the species	Unknown

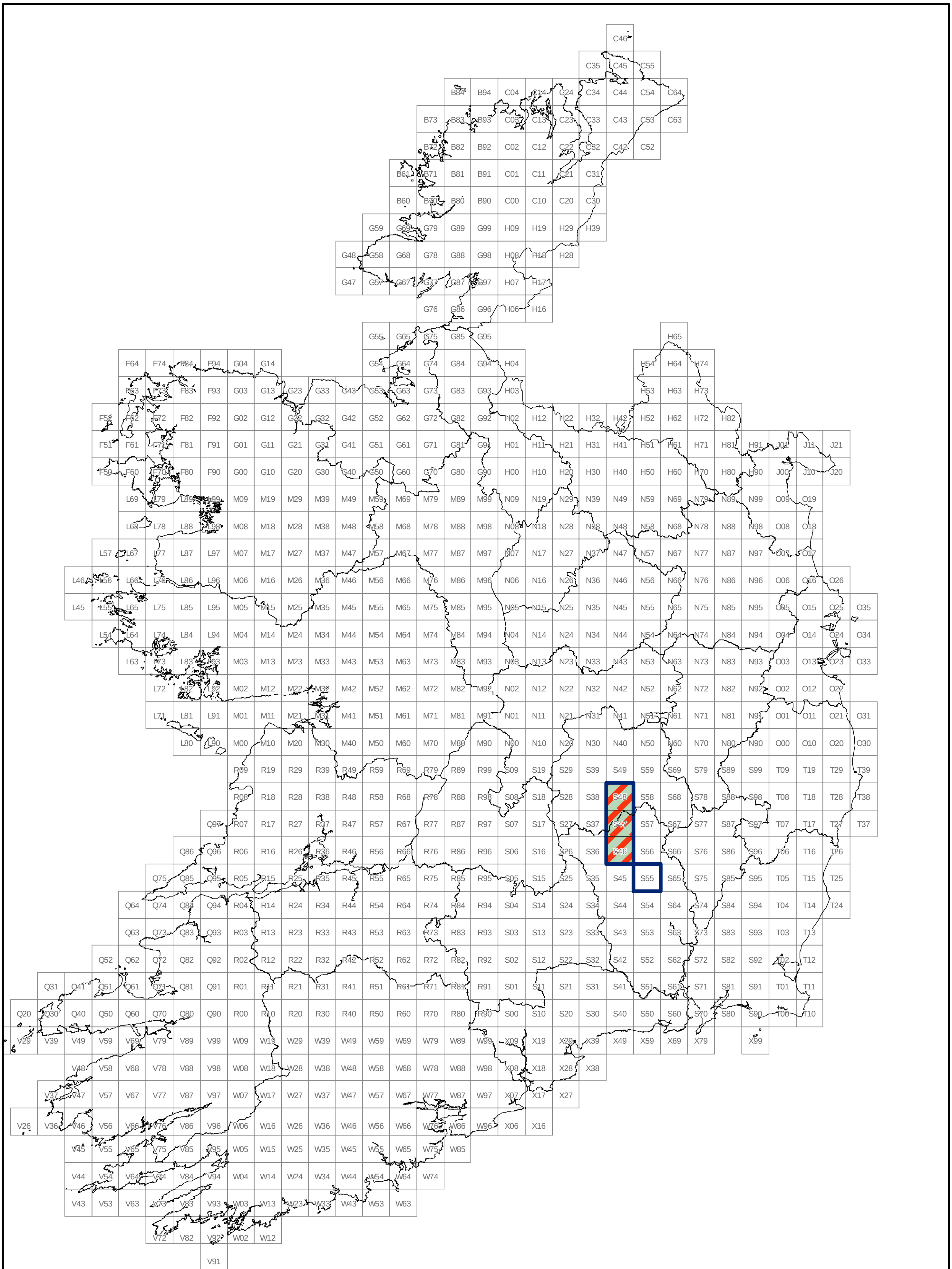
2.7.4 Other relevant information

The unit of population used in this assessment was the number of viable populations.

A *Margaritifera durrovensis* **population** was defined as a group of mussels occupying an area of a catchment that are

capable of genetic exchange, either through sexual reproduction or through transportation of glochida on host fish. Two historical populations of *Margaritifera durrovensis* are, therefore, recognised: the River Nore population and the River Barrow population. Whether or not a *Margaritifera durrovensis* population was **viable** was determined by a series of population structure parameters which formed the basis of the *M. durrovensis* condition assessment, including mussel density, the number of live mussels, the number of dead shells and the percentages of the population <65 mm and <30 mm. The River Barrow *Margaritifera durrovensis* population is believed to have gone extinct in the early 1990's. Therefore, the total number of extant populations is one. The River Nore population has not been viable since 1970. The favourable reference population is considered at least 2 reproducing populations of Nore *Margaritifera durrovensis* within the Nore catchment and totalling approx. 10,000 individual mussels. As the genetic stock of Barrow *Margaritifera durrovensis* has gone extinct, it will not be possible to re-instate the Barrow population. The habitat for the species is currently unsuitable for the survival of adult mussels or the recruitment of juveniles owing to siltation of the substratum and poor water quality. The condition of the mussel habitat in the Nore has declined significantly since 1991. The area of habitat which the species is currently occupying or could potentially occupy is complex and can be considered a combination of: 1. the area of habitat adult mussels can occupy, 2. the area of habitat juvenile mussels can occupy and 3. the area of spawning and nursery habitats the host fish can occupy. These three are determined by flow and substratum conditions and cannot readily be estimated. As a result, the area of "Suitable Habitat for the Species" is currently unknown. (note: The area of habitat occupied by the extant adult mussels is approximately 0.225 km^2. This constitutes approximately 15km in length of river by an average of 15m width.) Suitable riparian habitat within at least a 30 m zone along each river bank, and a similar zone surrounding any stream or drain entering the river would include the following CORINE 2000: 2.3.1.2 Unimproved grassland 3.1.1 Broad-leaved forests 3.2.1 Natural grassland 3.2.2 Moors and heathlands 3.2.4 Transitional woodland scrub 4.1.2.1.2 Intact raised peat bog (early headwaters of rivers) 4.1.2.2.1.2 Intact upland blanket bogs 4.1.2.2.2.2 Intact lowland blanket bogs 4.1.2.2.3.2 Intact mountain blanket bogs (early headwaters of rivers) The freshwater pearl mussel *Margaritifera durrovensis* is listed as **critically endangered** in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs (Moorkens, 2006a).

2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unfavourable – Bad
Population	Unfavourable – Bad
Habitat for the species	Unfavourable – Bad
Future prospects	Unfavourable – Bad
Overall assessment of CS1	Unfavourable - Bad



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Margaritifera durrovensis

1990

Current distribution (3 cells)
Current Range (3 cells)
Favourable Reference Range (4 cells)
W48 10km grid cells

Date: January 2008

Conservation Assessment of Cetaceans in Irish waters

Prepared by the Irish Whale and Dolphin Group
on behalf of the National Parks and Wildlife Service

1.0 Introduction to cetaceans in Irish waters

Irish waters are some of the most important for cetaceans in Europe with 24 species recorded to date (Berrow 2001). Much of the historical information was reviewed by Fairley (1981). Commercial whaling in Ireland dates back to at least the 18th Century and some species are still considered depleted. Between 1908 and 1922, two Norwegian owned whaling stations were established in Co. Mayo and during this period at least 894 whales were killed within a 95-100 km radius of the stations. Most of these were fin whales but blue *Balaenoptera musculus*, sei *B. borealis* and sperm whales *Physeter macrocephalus* were also frequently caught but only a few humpback *Megaptera novaengliae* and Northern right whales *Eubalaena glacialis* as these species were already thought to be scarce in Irish waters due to earlier overexploitation. Bottlenose whales *Hyperoodon ampullatus* were hunted in Irish waters up until 1969 (Evans 1991) and minke whales *Balaenoptera acutorostrata* until 1976 (Fairley 1981).

In recent years there has been a rapid increase in interest in, and our knowledge of the ecology of many cetacean species in Ireland. Surveys deriving absolute abundance estimates have been carried out (Ingram 2000, Hammond et al. 2002, Ó Cadhla *et al*. 2004, Ingram and Rogan 2003, Hammond and MacLeod 2006). There have been detailed studies on the behaviour of bottlenose dolphins (*Tursiops truncatus*) in the Shannon estuary (Berrow *et al.* 1996, Ingram 2000, Ingram and Rogan 2002) and the on ecology of common dolphins (Murphy 2005, 2006). O'Brien *et al.* (in prep) has carried out a recent review of current knowledge of cetaceans in Irish waters which has provided a lot of the background for this conservation assessment.

Eighteen of the 24 species (75%) have been recorded either sighted or stranded during the reporting period 2001-2006.

2.0 Mapping Assessment Data

2.1 Published sources

There are a number of methods that have been used to gain information on the distribution, range and relative abundance of cetaceans in Irish waters. Each has its advantages and limitations but they still provide the best available information.

Ireland has one of the longest running stranded cetacean recording schemes in the world. Although there are difficulties in interpreting strandings data to assess population status and trends, these data are often the only way to record rare species (Berrow and Rogan 1997). In a review of stranding records Berrow and Rogan (1997) suggested although stranding records cannot be used to assess the status of most species in Irish waters but they can be used to identify unusual events or mass strandings.

There are a number of sighting surveys, which can provide useful information on the geographical and seasonal distribution as well as absolute or relative abundance estimates. Casual sighting schemes can provide information on rare species and identify areas worthy of more dedicated surveys. Sighting surveys, which quantify effort, can provide better data on seasonal variation and relative abundance and dedicated surveys can provide information on absolute abundance. Platforms of opportunity such as ferries, whalewatching and research vessels and aircraft have been used to obtain good quality data on cetaceans especially offshore where casual observations are rare. The use of ferries crossing the Irish and Celtic Seas have enabled a better understanding of cetaceans on these routes (Brereton *et al*. 2001) and the research vessels R.V. Celtic Explorer and R.V. Celtic Voyager have also been used extensively in recent years (Wall *et al.* 2006). Whale-watching vessels have been used in the Shannon estuary (Berrow and Holmes 1999) and off west Cork (Whooley *et al.* 2005). The Irish Navy has also provided excellent platforms to combine visual and acoustic survey techniques and also seabird surveys (Pollock *et al*. 1997, de Soto *et al*. 2004, Ó Cadhla *et al*. 2004). Dedicated surveys have been more limited due to their high cost (Hammond *et al*. 2002, Ó Cadhla *et al*. 2004, Hammond and MacLeod 2006,). Aerial surveys for cetaceans have been more limited. A small aircraft with experienced international observers was used to survey the Irish Sea and coastal Ireland for small cetaceans during SCANS II (Hammond and MacLeod 2006).

Evans (1980) reviewed 1,570 sighting records of 20,994 individuals collected between 1958 and 1978 from British and Irish waters and showed the highest overall concentrations occurred off the southwest Irish coasts. A total of 18 cetacean species were reported from Ireland. Further reviews of additional sightings data up to 1985 (Evans *et al.,* 1986) and 1991 (Evans 1992) showed Irish waters to be important for harbour porpoise (*Phocoena phocoena*), common (*Delphinus delphis*) bottlenose, white-sided (*Lagenorhynchus acutus*), white-beaked (*L. albirostris*) and Risso's dolphins (*Grampus griseus*), minke, fin, sperm, Cuvier's beaked (*Ziphius cavirostris*), killer (*Orcus orcinus*) and long-finned pilot whales (*Globiocephala melas*). A similar list of species was reported by Berrow *et al.* (2002a) in a review of 2,851 sighting records collected between 1991 and 2001 by the Irish Whale and Dolphin Group (IWDG). During 996 hours of land-based effort watches highest sighting rates (0.5-1.0 per hour) were reported for harbour porpoise off Co Dublin, bottlenose dolphin in the Shannon estuary, dolphins and minke whale off Co Clare. Berrow *et al*. (2005a) reviewed 3,689 cetacean sightings and 903 quantified effort watches collected between 2003 and 2005. Sighting rates per hour were presented for 11 sites at which there were more than 30 watches carried out.

An analysis of the Joint Nature Conservation Committee (JNCC) cetacean data by Northridge *et al.* (1995) identified possible concentrations of harbour porpoise in the southern Irish Sea and off the coasts of Kerry and west Cork. A total of 9,106 individual cetaceans of 13 species were recorded during 37,563 km of survey effort in all Irish waters between 1980 and 1997 by Pollock *et al*. (1997). Common dolphin and harbour porpoise were the most abundant species and minke whale was the most frequently recorded rorqual. However 25% of survey effort during this survey was during July and August. During 442 survey days at sea, most of which were between April and September, a total of 772 sightings of 20 species were positively identified by Ó Cadhla *et al*. (2004). Rarely observed species identified included right and blue whale, Cuviers beaked whale, Sowerby's (*Mesoplodon bidens*) and True's beaked whale (*Mesoplodon mirus*) and false killer whale (*Pseudorca crassidens*). Areas of importance, which may represent critical habitats, were identified on the basis of species richness and relative abundance. Wall *et al*. (2006) recorded highest species diversity and relative abundance on the Rockall Bank with white-sided dolphin the most abundant species. The common dolphin was the most abundant of all cetacean species recorded on the continental shelf while relative abundance off the north coast was very low. In 2001 as part of the Atlantic Research Coalition (ARC) the IWDG carried out six monthly surveys through the Irish Sea between July and December. Common dolphins were the most frequently sighted species, followed by striped dolphins (*Stenella coeruleoalba*), bottlenose dolphins and harbour porpoises (Brereton *et al.* 2001).

2.2 Range

Range is taken to be '*the outer limits of the overall area in which a species is found at present. It can be considered as an envelope within which areas actually occupied occur as in many cases not all the range will actually be occupied by the species or habitat'* (EC, 2006). A major constraint to mapping cetacean distribution and abundance is that records from Ireland are held in at least three major databases (IWDG, Coastal and Marine Research Centre, UCC and the JNCC). Data were extracted from the IWDG Cetacean database including data up to and including 2005. Some additional records of rarely recorded species were extracted from Ó Cadhla *et al*. (2004) and Reid *et al*. (2003). For this assessment we plotted all sightings on an ArcGIS using ArcMap Version 9.1. We then overlayed a 50 km^2 grid in the projection recommended by the EEA for Article 17 reporting and calculated the number of blocks with records of each species. We then estimated range based on expert opinion taking into account acoustic and visual data. For blue, fin and humpback whales additional information on migration routes and abundance is available from Clark and Charif (1998) and Charif *et al*. (2001) who used passive acoustics to monitor the movements of these species along the western seaboard of Ireland. De Soto *et al.* (2004) provided additional records of sperm whales using a towed hydrophone. The outer limit of the total range is shown by thick black lines on the range map. The area was estimated by counting the number of blocks within these lines. Where records are too few to plot distribution no attempt has been made to calculate range.

2.3 Habitat

Habitat has been mapped in a similar way to range. A 50 km^2 grid was overlayed on an ArcGIS using ArcMap Version 9.1 in the projection recommended by the EEA for Article 17 reporting and habitat was calculated as the number of blocks with suitable habitat for the relevant species. In most cases this could be considered in three main habitat types: continental shelf (<200m), Deep water >2000m and shelf edge 200-2000m.

3.0 Range

The area of the range in Irish waters was calculated in ArcView GIS 3.2. See 2.2 above for detailed information on how Range was calculated.

3.1 Range Conservation Status

All species of cetacean occurring in Ireland are part of a greater population within European waters however some species are sufficiently widespread in Irish waters to make a conservation assessment. For regularly recorded species where records are widespread within the INS and the range large, we have considered range to be favourable. These include minke and fin whale, bottlenose, common and white-sided dolphin and harbour porpoise. It was not possible to assess whether range is favourable for other species due to insufficient information.

4.0 Population

4.1 Population estimations

Cetaceans in Irish waters are likely to be part of a wider North Atlantic population but no information is available on genetic discreteness or stocks. Thus only abundance estimates from discrete areas are available (see Table 1 for summary). Hammond *et al.* (2002) generated an abundance estimate for harbour porpoises in the Celtic Sea as part of the SCANS project (Small Cetacean Abundance in the North Sea). A second broad-scale abundance estimate was carried out under SCANS II in July 2005 (Hammond and MacLeod 2006), which included a re-survey of the Celtic Sea. Hammond and MacLeod (2006) also made shipboard estimates along the western seaboard (including western Scotland) to the edge of the continental shelf. Aerial surveys of coastal Ireland and the Irish Sea were also used to calculate abundance estimates for harbour porpoises, white-beaked, bottlenose and common dolphins and minke whales. Abundance estimates were calculated for common and white-sided dolphins off the western seaboard in 2000 (O'Cadhla *et al*. 2004).

An abundance estimate of 36,280 harbour porpoises, 1,195 minke whales, and 833 *Lagenorhynchus* sp. (Atlantic white-sided dolphins and white-beaked dolphins) were recorded during 2,974 km of survey effort in 1994 (Hammond *et al.* 2002). In 2005, density estimates for harbour porpoise in the Celtic Sea were much higher resulting in an abundance estimate of 80,613 individuals. Minke whale density in the Celtic Sea between 1994 and 2005 was consistent at 0-006 and 0.009 animals per km^{-2}, resulting in similar abundance estimates of around 1200-1700 individuals. An abundance estimate of 15,230 harbour porpoise was calculated for the Irish Sea, while 10,002 and 10,716 for coastal Ireland and offshore along the shelf edge. White-beaked dolphins were very scarce in the Irish Sea (75) and in coastal Ireland (267). Bottlenose dolphins were abundant in the Celtic Sea (density 2.20 km^2, Abundance = 5,370) and common dolphins in coastal Ireland (density 0.40 per km^2, Abundance = 15,327). Minke whales were also abundant in coastal Ireland with a density of 0.058 per km^2 giving and abundance estimate of 2,222). Leopold *et al.* (1992) surveyed an area off southwest Ireland from Galway Bay to west Cork on a platform of opportunity and generated an overall density of 0.77 harbour porpoises per km^2 from five strip transects, which gave an abundance estimate of 19,120 harbour porpoises.

The Shannon estuary is a candidate SAC for bottlenose dolphins. Ingram (2000) derived an abundance estimate for bottlenose dolphins in the Shannon estuary in 1997 of 113±16 (CV=0.14, 95%CI=94-161) and in 2003 of 121±14 (CV=0.12, 95%CI=103-163) (Ingram and Rogan 2003). A third abundance estimate was carried out in 2006 but the results are not yet available (David Lyons *pers. comm.*).

Table 1. Density and absolute abundance estimates generated during dedicated surveys

Species	Location	Year	Density (animals km^{-2})	CV	Abundance	Source
Harbour porpoise	Inshore west coast	1989	0.77	0.49	19,210	Leopold *et al*. (1992)
	Celtic Sea	1994	0.18	0.57	36,280	Hammond *et al*. (2002)
	Celtic Sea	2005	0.41	0.50	80,613	Hammond and MacLeod (2006)
	Irish Sea	2005	0.34	0.35	15,230	Hammond and MacLeod (2006)
	Coastal Ireland	2005	0.28	0.37	10,716	Hammond and MacLeod (2006)
	Offshore shelf edge[1]	2005	0.07	1.24	10,002	Hammond and MacLeod (2006)
White-beaked dolphin	Irish Sea	2005	0.002	0.80	75	Hammond and MacLeod (2006)
	Coastal Ireland	2005	0.007	0.85	267	Hammond and MacLeod (2006)
	Offshore shelf edge[1]	2005	0.014	0.60	2,030	Hammond and MacLeod (2006)
White-sided dolphin	Western seaboard	2000	0.046	0.43	5,490	O'Cadhla *et al*. (2004)
Lagenorhynchus sp.	Celtic Sea	1994	0.004	1.02	88	Hammond *et al*. (2002)
Bottlenose dolphin	Irish Sea	2005	0.005	0.75	235	Hammond and MacLeod (2006)
	Coastal Ireland	2005	0.008	0.81	313	Hammond and MacLeod (2006)
	Celtic Sea	2005	2.72	0.49	5,370	Hammond and MacLeod (2006)
	Offshore shelf edge[1]	2005	0.75	0.68	1,128	Hammond and MacLeod (2006)
	Shannon estuary [2]	1997	-	0.14	113 ± 16	Ingram (2000)
	Shannon estuary [2]	2003	-	0.12	121 ± 14	Ingram and Rogan (2003)
	Shannon estuary [2]	2006				
Common dolphin	Western seaboard	2000	0.039	0.39	4,496	O'Cadhla et al. (2004)
	Irish Sea	2005	0.008	0.73	366	Hammond and MacLeod (2006)
	Coastal Ireland	2005	0.40	0.78	15,327	Hammond and MacLeod (2006)
	Celtic Sea	2005	0.056	0.61	11,141	Hammond and MacLeod (2006)
	Offshore shelf edge[1]	2005	0.10	0.81	1,454	Hammond and MacLeod (2006)
Minke whale	Celtic Sea	1994	0.006	0.49	1,195	Hammond *et al*. (2002)
	Celtic Sea	2005	0.009	0.43	1,719	Hammond and MacLeod (2006)
	Irish Sea	2005	0.024	0.89	1,073	Hammond and MacLeod (2006)
	Coastal Ireland	2005	0.058	0.84	2,222	Hammond and MacLeod (2006)
	Offshore shelf edge[1]	2005	0.012	0.46	1,856	Hammond and MacLeod (2006)

[1] includes shelf edge off western Scotland
[2] abundance estimates derived from mark-recapture modeling using photo-identification

4.2 Population trends

There have been very few repeat surveys in Ireland with which to determine population trends. The SCANS absolute abundance survey in 1994 was repeated in 2005 but included additional areas not surveyed in 1994. Three abundance estimates using mark-recapture population models have been carried out on bottlenose dolphins in the lower River Shannon cSAC, which provides some data on population trend at this site. Although inshore monitoring sites were established in 2005 it is too early to use these data to determine trends in population status.

Fig. 1a. Harbour porpoise density in the Celtic Sea

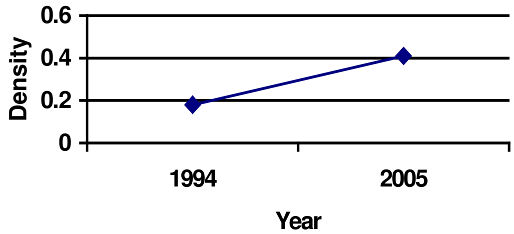
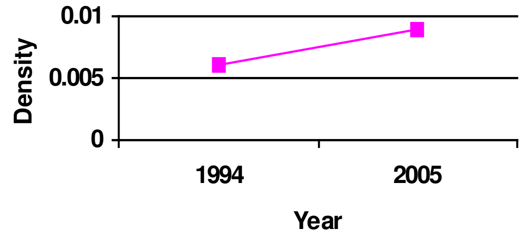


Fig 1b. Minke whale density in the Celtic Sea

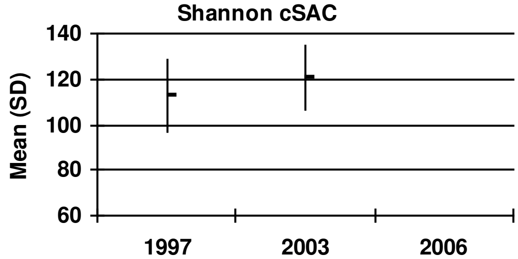


Harbour porpoise density and abundance in the Celtic Sea has more than doubled between 1994 and 2005 which equates to a population increase of 11% per annum (Fig 1a). Although a greater area was covered in 2005 compared to 1994 the density estimates are considered accurate (P. Hammond pers. comm. December 2005). This increase in density might be due to a population recovery following a decline in fishing effort with bottom-set gillnets which was known to catch a large number of porpoises in the Celtic Sea (Tregenza *et al.* 1997). Increases in density may also be due to a change in the distribution of harbour porpoises consistent with those reported from the North Sea where numbers have doubled in the Southern North Sea with a corresponding halving of porpoises in the Northern North sea (Hammond and MacLeod 2006). Minke whale densities in the Celtic Sea have also increased between 1994 and 2005 from 0.006 to 0.009 animals km^{-2} an increase of 50%. These broad-scale surveys provide an abundance estimate at a single point in time and cannot account for any seasonal changes in distribution or abundance. They do compliment long-term monitoring progammes.

There is evidence that the number of sightings of fin and humpback whales are increasing especially off the south and southwest coasts. This reflects similar trends elsewhere especially of humpback whales which are being observed in areas not reported for decades.

Abundance estimates of bottlenose dolphins in the Lower River Shannon CSAC are consistent at around 110-120 animals (Fig 2).

Fig. 2. Abundance estimate of bottlenose dolphins in the Lower River Shannon cSAC



4.3 Population conservation status

The Favourable Reference Population (FRP) is '*the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species*' (EC, 2006). It is not possible to accurately determine the FRP so we have presented the present abundance estimate, where available, as a reference value with which to compare any changes in future assessments as the best available data. For harbour porpoise this estimate is over 100,000 individuals. Harbour porpoise are thought to mature at an early age for odontocetes, reproduce more frequently and live for shorter periods (Reid and Hohn, 1995) which suggests over 100,000 individuals is a viable population. It is not possible to determine whether abundance estimates available for other species (minke whaler, common, bottlenose, white-sided and white-beaked dolphin) are viable and thus favourable.

5.0 Habitat

To date, 24 cetacean species including two species known only from stranding records (Gervais and True's beaked whale), and two species known only from sighting records (beluga *Delphinapterus leucas* and northern right whale) have been recorded in Irish waters (Berrow 2001). This high number reflects the diversity of habitats, from the relatively shallow (<200m) continental shelf to the deep water (>2000m) to the west including the shelf edge which itself comprises an important habitat for some species (Atlantic white-sided dolphin and pilot whale). Both Arctic (Beluga) and sub-tropical species (false killer whale, striped dolphin) occur at the limit of their known range. Offshore banks (Rockall and Hatton banks) provide additional important habitats (Cronin and Mackey 2002, Wall *et al*. 2006). The diversity of beaked whales (Ziphiidae) reported suggests a range of deep-water canyons and troughs must occur, especially off the western seaboard. It has been shown that the western seaboard of Ireland is an important migratory corridor for large baleen whales including blue, fin and humpback whales (Clark and Charif 1998, Charif *et al*. 2001).

Information on habitat use and the identification of critical habitats by cetaceans in Ireland is poor. Sighting surveys, which have mapped distribution and relative abundance, have identified some potentially important offshore habitats (Ó Cadhla *et al*. 2004, Wall *et al*. 2006). In coastal waters, the Shannon estuary has been identified as the most important habitat for dolphins due to its resident population of bottlenose dolphins (Berrow *et al.* 1996, Ingram 2000). Studies on their use of the estuary showed dolphins regularly occurred in two core areas, which were shown to have the greatest slope and depth demonstrating the influence of environmental heterogeneity on habitat use by this species. Minimum convex polygons of known ranges for individual dolphins showed a degree of habitat partitioning occurred in the inner estuary (Ingram 2000, Ingram and Rogan 2002). The high site fidelity and inter-annual occurrence of fin and humpbacks whales inshore along the south coast from County Wexford to County Cork (Berrow *et al*. 2003, Whooley *et al.* 2005) suggest important habitats occur in these areas.

5.1 Habitat Conservation status

Cetaceans occur in a range of marine habitats in Irish waters, from the continental shelf to deep-water canyons off the western seaboard. Some species such as sperm whales favour deep water off the edge of the continental shelf while others such as harbour porpoise are only found in shallow water <200m on the continental shelf. The shelf edge itself is an important habitat especially for pilot whales and offshore bottlenose dolphins. Beaked whales probably associate with deep-water canyons close to the shelf edge and recent modeling has successfully predicted favourable habitats for some species (Ferguson *et al.* 2006). Although these habitats cover a wide area they can be degraded through fishing, pollution and disturbance. Inshore habitats including bays and estuaries are particularly vulnerable.

Two candidate Special area of Conservation (cSAC) have been designated for harbour porpoises (Roaringwater Bay, Co Cork and Blasket Islands, Co Kerry) and one for bottlenose dolphins (Lower River Shannon).

Where suitable habitat for a species is widespread in Irish waters the conservation status is considered favourable. This applies to minke and fin whales, bottlenose, common and Atlantic white-sided dolphin and harbour porpoise. It is not possible to assess the quality of this habitat but if the species is widespread and regularly reported it is considered of good quality and thus favourable. Habitat for sei whale and humpback whalee is presumed to be widespread but more records are required before an assessment can be made.

6.0 Future prospects

6.1 Negative Impacts and threats

As little is known about the status and threats to cetaceans in Irish waters, is assumed that potential threats are similar to those identified for cetaceans elsewhere in the world. These include pollution, fisheries interactions, habitat degradation and disturbance (Table 2).

Fisheries Interactions

Cetaceans may interact with fisheries both operationally and biologically or both. The incidental capture of cetaceans has now been quantified in some gill-net and trawl fisheries in Ireland and by-catch records were recently reviewed by Berrow and Rogan (1998). Tregenza *et al*. (1997) estimated 2,200 harbour porpoises and 230 common dolphins were killed annually by bottom set gillnets in the Celtic Sea in 1993/94. This accounted for 6.2% of the estimated number of harbour porpoise in that area and there was serious concern about the ability of the population to sustain this level of by-catch. No cetacean bycatch was reported in the Celtic Sea Herring fishery (Berrow *et al*. 1998a) but five species (pilot whale, common, white-sided, white-beaked and bottlenose dolphins) were caught by Dutch mid-water trawlers off the south-west coast of Ireland (Couperous, 1995). In addition Berrow and Rogan (1998) reported a further two species (striped dolphin and minke whale) incidentially caught in Irish waters. Although the Irish albacore tuna fishery is largely conducted outside of the territorial waters, especially in the earlier part of the season, an estimated 500 cetaceans, mainly common and striped dolphins but also bottlenose, Risso's and white-sided dolphins and pilot, minke and sperm whales, were caught in 1996 and 1200 common and striped dolphins in 1998 (Rogan and Mackey 2007). Clearly incidental capture in fishing nets is one of the most immediate threats to cetaceans in Irish waters. However not all fisheries experience cetacean bycatch but fisheries need to be monitored to determine which have the biggest impact and what mitigation measures can be developed.

Acoustic deterrents (pingers) are now required in many gill-net fisheries to reduce harbour porpoise bycatch. Acoustic deterrents have also been developed by Bord Iascaigh Mhara (BIM) in order to reduce dolphin bycatch in pelagic trawls. Recent field trials suggest they do alter the behaviour of bottlenose dolphins (Leeney *et al.* 2006) but not common dolphins, the species most frequently caught in this fishery (Berrow *et al.* 2007). This suggests there is still a lot of work required before acoustic deterrents will significantly reduce incidental capture in some fisheries.

Table 2. Potential threats to cetaceans in Irish waters (adapted from Berrow 2001)

Species	Threats	References
Harbour porpoise*	By, Po, Ha	Tregenza *et al.* (1997), Berrow *et al. (1998a),* Smyth *et al.* (2000)
White-beaked dolphin	By	Couperus (1995),
White-sided dolphin	By, Po	Couperus (1995), McKenzie *et al.,* (1998), Rogan and Mackay (2007)
Common dolphin	By, Ha	Couperus (1995), Berrow and Rogan (1998), Rogan and Mackay (2007), Goold (1999)
Bottlenose dolphin*	By, Po, Ha	Couperus (1995), Berrow and Holmes (1999), Berrow et al. (2002b), Rogan and Mackay (2007)
Striped dolphin	By	Berrow and Rogan (1997), Berrow and Rogan (1998), Rogan and Mackay (2007)
Risso's dolphin	By	Rogan and Mackay (2007)
Pilot whale	By	Couperus (1995), Rogan and Mackay (2007)
Bottlenose whale	Ha	Evans (1991), MacLeod and D'Amico (2006)
Cuvier's beaked whale	Ha	MacLeod and D'Amico (2006)
Sowerby's beaked whale	Ha	MacLeod and D'Amico (2006)
Gervais beaked whale	Ha	MacLeod and D'Amico (2006)
True's beaked whale	Ha	MacLeod and D'Amico (2006)
Sperm whale	By, Ha	Berrow *et al.* (1993), Rogan and Mackay (2007), Goold *et al*. (2002)
Humpback whale	By	Bycatch
Fin whale	Ha	Collision
Minke whale	By	Berrow and Rogan (1998), Rogan and Mackay (2007)

* Species on Annex II of the Habitats Directive
By = Bycatch, Po = Pollution, Ha = Habitat degradation

Pollution

There have been a few studies of persistent pollutants in cetaceans in Ireland (Berrow *et al*. 1998, McKenzie *et al*. 1998, Smyth *et al*. 2000, Berrow et al. 2002). These studies suggests radio-nuclide levels are low in harbour porpoises in the Irish Sea (Berrow *et al.* 1998b) and levels of organochlorine pesticide contamination are among the lowest recorded in the north-east Atlantic (McKenzie *et al*. 1998, Smyth *et al.* 2000). However all animals analysed have some level of organochlorine contamination. Contaminant levels in by-caught harbour porpoise and common dolphins were similar to those reported from Scotland but levels were lower than those from Scandinavia (Smyth *et al*. 2000), while concentrations of PCBs in bottlenose dolphins in the Shannon estuary, although 3-4 times higher than harbour porpoises in Ireland, were not thought to pose a risk to health (Berrow *et al*. 1998). McKenzie *et al*. (1998) suggested organochlorine contamination was ubiquitous in white-sided dolphins from Irish and Scottish waters, which demonstrated the difficulties when interpreting results of pollution studies.

The highest concentrations of organochlorines in resident bottlenose dolphins in the Shannon estuary recorded by Berrow *et al.* (2002) were towards the end of the range that may cause concern but that persistent pollutants were not a significant threat to bottlenose dolphins in the estuary.

Contamination with heavy metals is more widespread but the impact of this contamination is difficult to determine. Concentrations of lead in cetaceans stranded in Ireland were far lower than the threshold value indicating toxic effects in human (Caurant *et al*. 2006). Concentrations of mercury from parts of the Irish Sea are at concentrations high enough to give cause concern (Law *et al*. 1991). Levels of the radionuclide ^{137}Cs were elevated in harbour porpoises in the Irish Sea but it was thought unlikely to have a detrimental effect (Berrow *et al.* 1998b).

<u>*Habitat degradation and modification*</u>

The habitat requirements and identification of critical habitats of most cetacean species are not fully understood, but some important areas have been identified. The Shannon estuary is home to the only known resident group of bottlenose dolphins in Ireland (Berrow *et al*. 1996, Ingram 2000) and was nominated as a candidate Special Area of Conservation (cSAC) under the Habitats Directive in 1999. Two cSAC have also been designated for harbour porpoises (Roaringwater Bay, Co Cork and Blasket Islands, Co Kerry) as these represent important habitats for this species.

Ireland has huge potential for whalewatching, which is considered as under-developed (Hoyt 2000). Whalewatching has expanded rapidly in the Shannon estuary (Berrow and Holmes 1999) and dedicated whalewatching operators are now established off the south coast. Whalewatching as part of marine wildlife tourism is also expanding in Counties Donegal, Galway and Kerry. There is potential for whalewatching to cause disturbance and degradation of their habitat. Whalewatching is a notifable activity within a cSAC and operators in the Shannon estuary adhere to a code of conduct and monitoring programme (Berrow and Holmes 1999). A recent Marine Notice (15 of 2005) issued by the Maritime Safety Directorate provide guidelines for recreational and commercial vessels on the correct procedure around cetaceans in Irish coastal waters.

During 1997 and 1998, nearly 47,000km of seismic surveys were carried out off the west coast of Ireland in search of oil and gas deposits. A further 31,000km is planned for between 2008-2013 (Petroleum Affairs Division, April 2007). Seismic surveys utilise airgun arrays to produce sounds of up to 140db at 20-200 Hz frequencies to map the seabed (Goold 2002). The impact of this technique on cetaceans is still unclear but common dolphins at least 8km from the source vessel have been shown to react to seismic activity (Goold 1999). The lower the frequency emitted the greater the area that will be affected. The number and rate of sperm whale strandings in Ireland has increased since the 1960s (Berrow *et al*. 1993) which Gould *et al.* (2002) attributes to a combination of increased recording effort and increased mortality caused by anthropogenic causes rather than population increase or changes in distribution. Some species of Ziiphids may be more susceptible to acoustic disturbance at lower intensities as they tend to occur in underwater canyons (MacLeod and D'Amico 2006). Sound attenuation is thought to be less and recent mass strandings of Cuvier's and Blainvilles's beaked whale *Mesoplodon desirostris* have suggested more consideration should be given to the impact of this activity on cetaceans (Frantzis 1998).

Climate change will have a large effect on the distribution and range of certain species (MacLeod *et al.* 2005). Events such as changes in sea surface temperature and salinity and ocean currents could have dramatic effects on cetacean populations globally. In Irish waters the white-beaked dolphin is thought to be particularly vulnerable due to its limited global range and preferred habitat over the continental shelf. The implications of a dramatic rise in sea level over could have dramatic consequences for coastal populations.

Positive Impacts

As the interest in cetaceans in Irish waters increases so does our knowledge of their ecology. Information on their distribution and abundance has recently included surveys of offshore habitats. Information on diet, breeding biology and social structure has also given us insights into how these animals interact with the environment and help to identify potential threats. Development of new policies for fisheries management should reduce the impact of this activity on cetacean populations. Policies such as multi-species, multi-annual stock assessments should reduce overfishing and discarding. The recent Bycatch Regulation (812/2004) should reduce incidental capture through mitigation measures as well as obtain better information on bycatch rates and identify fisheries with high rates. An ecosystem approach to fisheries and ocean management should consider the role and requirements of cetaceans in the marine environment.

Under the Habitats Directive Ireland is required to designate Special Areas of Conservation for two species (harbour porpoise and bottlenose dolphin). Two sites for harbour porpoise and one for bottlenose dolphins have been designated but Conservation Plans are not yet available for any site. A Conservation Plan states what the conservation objectives are, should identify any potential threats and list management activities to ensure their favourable conservation status. Marine Protected Areas can also be designated under OSPAR and for fisheries management. These MPAs have the potential to benefit cetaceans if managed on a large enough spatial scale.

As whalewatching expands and more people are able to see cetaceans in their natural environment interest and concern about the marine environment should increase. The economic benefits of whalewatching to coastal communities may increase habitat protection and promote mitigation measures to limit the impact of cetacean habitats. Whalewatching has increased the profile of bottlenose dolphins and their habitat in the Shannon estuary and has encouraged new mitigation measures.

Favourable future prospects are reported for minke and fin whale and bottlenose, common and white-sided dolphin and the harbour porpoise. The humpback whale would appear to have favourable prospects if the current increase in range continues. Offshore exploration mitigates against a favorable assessment for deep diving species such as sperm whale or beaked whales.

6.3 Future prospects Conservation status (Systematic list follows Rice 1998)

Species	Range	Population	Habitat	Future Prospects	Overall Assessment
Humpback whale	**Unknown**	**Unknown**	**Favourable**	**Unknown**	**Unknown**
Minke whale	**Favourable**	**Unknown**	**Favourable**	**Favourable**	**Favourable**
Sei whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Fin whale	**Favourable**	**Unknown**	**Favourable**	**Favourable**	**Favourable**
Blue whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Sperm whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Cuvier's beaked whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Northern Bottlenose whales	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Sowerby's beaked whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Bottlenose dolphin	**Favourable**	**Unknown**	**Favourable**	**Favourable**	**Favourable**
Striped dolphin	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Common dolphin	**Favourable**	**Unknown**	**Favourable**	**Favourable**	**Favourable**
White-beaked dolphin	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Atlantic white-sided dolphin	**Favourable**	**Unknown**	**Favourable**	**Favourable**	**Favourable**
Risso's dolphin	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Killer whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Long-finned Pilot whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Harbour porpoise	**Favourable**	**Favourable**	**Favourable**	**Favourable**	**Favourable**

The species listed below are only rarely recorded in Irish waters and are listed separately. There are no records of Northern right whale, True's beaked whale, Gervais beaked whale or Beluga in the reporting period 2001-2006.

Species	Range	Population	Habitat	Future Prospects	Overall Assessment
Northern Right whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Pygmy sperm whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
True's beaked whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Gervais beaked whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
Beluga	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**
False killer whale	**Unknown**	**Unknown**	**Unknown**	**Unknown**	**Unknown**

References

Berrow, S.D., Evans, P.G.H. and Sheldrick, M.C. (1993) An analysis of Sperm whale *Physeter macrocephalus* (L.) stranding and sighting data from Britain and Ireland. Journal of Zoology (London) (230): 333-337.

Berrow, S. D., Holmes, B. and Kiely, O. (1996) Distribution and Abundance of Bottle-nosed Dolphins *Tursiops truncatus* (Montagu) in the Shannon Estuary, Ireland. Biology and Environment 96B(1): 1-9.

Berrow, S. D. and Rogan, E. (1997) Cetaceans stranded on the Irish coast, 1901-1995. Mammal Review 27(1): 51-76.

Berrow, S. D. and Rogan, E. (1998) Incidental capture of cetaceans in Irish waters. Irish Naturalist Journal 26(1/2): 22-31.

Berrow, S. D., O'Neill, M. and Brogan, D. (1998a) Discarding practices and marine mammal bycatch and in the Celtic Sea Herring Fishery. Proceedings of the Royal Irish Academy Biology and Environment 1: 1-8.

Berrow, S. D., Long, S.C., McGarry, A.J., Pollard, D. and Rogan, E. (1998b) Radionuclides (Cs-137 and K-40) in Harbour porpoises *Phocoena phocoena* L. from British and Irish Waters. Marine Pollution Bulletin 36(8): 569-576.

Berrow, S. D. and Holmes, B. (1999) Tour boats and dolphins: A note on quantifying the activities of whale watching boats in the Shannon estuary, Ireland. Journal of Cetacean Research and Management 1(2): 199-200.

Berrow, S.D. (2001) Biological diversity of cetaceans (whales, dolphin and porpoises) in Irish waters. In Marine Biodiversity in Ireland and Adjacent waters. Proceedings of a conference 26-27 April, 2001 Ed. Nunn, J.D. Ulster Museum, Belfast.

Berrow, S.D., Whooley, P. and Ferriss, S. (2002a) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp.

Berrow, S. D., McHugh, B., Glynn, D., McGovern, E., Parsons, K., Baird, R.W. and Hooker, S.K. (2002b)."Organochlorine concentrations in resident bottlenose dolphins (*Tursiops truncatus*) in the Shannon estuary, Ireland." Marine Pollution Bulletin (44): 1296-1313.

Berrow, S.D., Whooley, P. and Wall, D. (2005) ISCOPE-Irish Scheme for Cetacean Observation and Public Education. Final report 2003-2005. Irish Whale and Dolphin Group.

Berrow, S., Cosgrove, R., O'Brien, J. and McGrath, D. (2007) Effects of pingers on the behaviour of common dolphins. (in prep)

Brereton, T., Wall, D., Cermeno, P., Vasquez, A., Curtis, D. and Williams, A. (2001) Cetacean monitoring in North-West European waters. Atlantic Research Coalition (ARC).

Bruton, T. Cotton and Enright (1989) Gulf-stream beaked whale *Mesoplodon europeaus* (Gervais). Irish Naturalists' Journal 23(4), 156.

Caurant, F., Aubail, A., Lahaye, V., Van Canneyt, O., Rogan, E., Lopez, A., Addink, M., Churlaud, C., Robert, M. and Bustamante, P. (2006) Lead contamination of small cetaceans in European waters – the use of stable isotopes for identifying the sources of lead exposure. Marine Environmental Research 62: 131-148.

Carmody, M. and Wilson, J. (1988) White whale *Delphinapterus leucas* (Pallas). Irish Naturalists' Journal 22 (12), 540.

Charif, R. A., Clapham, P.J. and Clark, C.W. (2001). Acoustic detections of singing humpback whales in deep waters off the British Isles. Marine Mammal Science 17(4): 751-768.

Clark, C. W. and Charif, R.A. (1998) Acoustic monitoring of large whales to the west of Britain and Ireland using bottom-mounted hydrophone arrays, October 1996-September 1997. JNCC Report No. 281: 25pp.

Couperus, A. S. (1995). Interactions between Dutch midwater trawl and Atlantic white-sided dolphins (*Lagenorhynchus acutus*) Southwest of Ireland. Journal of Northwest Atlantic Fishery Science(22): 209-218.

Cronin, M. and Mackey, M. (2002) Cetaceans and Seabirds in waters over the Hatton-Rockall Region, Cruise Report To the Geological Survey of Ireland. CRC: 1-69.

European Commission (2006) Assessment, monitoring and reporting under Article 17 of the Habitats Directive: Explanatory Notes and Guidelines. Draft 4, September 2006.

Evans, P.G.H. (1980) Cetaceans in British waters. Mammal Review. 10:1-52.

Evans, P.G.H., Harding, S., Tyler, G., Hall, S. (1986). Analysis of cetaceans sightings in the British Isles, 1958-1985. Report to the Nature Conservancy Council, Peterborough, UK Mammal Society Cetacean Group.

Evans, P.G.H. (1992) Status review of cetaceans in British and Irish Waters. (Report to UK Department of the Environment). Oxford, Sea Watch Foundation.

Fairley, J. S. (1981) *Irish Whales and Whaling*, Blackstaff press. Belfast.

Ferguson, M., Barlow, J., Reilly, S.B. and Gerodette, T. (2006) Predicting Cuvier's (*Ziphius cavirostris*) and *Mesoplodon* beaked whale population density from habitat characteristics in the eastern tropical Pacific Ocean. Journal of Cetacean Research and Management 7(3), 387-299.

Frantiz, A. (1998). "Does acoustic testing strand whales?" Nature 392(29).

Goold, J. C. (1999) Acoustic assessment of populations of common dolphin, *Delphinus delphis*, off the West Wales Coast, with perspectives from satellite infra-red imagery. Journal of the Marine Biological Association (UK) 76: 811-820.

Goold, J. C., Whitehead, H. and Reid, R.J. (2002) North Atlantic Sperm Whale, *Physeter macrocephalus* strandings on the Coastlines of the British Isles and Eastern Canada. Canadian Field-Naturalist 116(3): 371-388.

Hammond, P. S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A., Heide-Jorgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F. and Oien, N. (2002) Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

Hammond, P.S. and MacLeod, K. (2006) SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006.

Hoyt, E. (2000) Whale watching 2000, Worldwide tourism numbers, expenditures and expanding socioeconomic benefits. Whale and Dolphin Conservation Society, UK: 36 pp.

Ingram, S. D. (2000) *The ecology and conservation of bottlenose dolphins in the Shannon estuary, Ireland*, University College Cork. PhD thesis: 213pp.

Ingram, S. and Rogan, E. (2003) Estimating abundance, site fidelity and ranging patterns of bottlenose dolphins (*Tursiops truncatus*) in the Shannon Estuary and selected areas off the west-coast of Ireland. Report to the National Parks and Wildlife Service: 28pp.

Ingram, S.N, and Rogan, E. (2002) Identifying critical areas and habitat preferences of bottlenose dolphins (*Tursiops truncatus*). Marine Ecology Progress Series 244: 247-255.

Law, R.J., Fileman, C.F., Hopkins, A.D., Baker, J.R., Harwood, J., Jackson, D.B., Kennedy, S., Martin, A.R. and Morris, R.J. (1991) Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. Marine Pollution Bulletin 22(4), 183-191.

Leeney, R.H., Berrow, S.D., McGrath, D., O'Brien, J., Cosgrove, R.and Godley, B.J. (2006) Effects of pingers on the behaviour of bottlenose dolphins. Journal of the Marine Biological Association (UK) 86, 5467-6471.

Leopold, M. F., Wolf, P.A. and Van de Meer, J. (1992). The elusive harbour porpoise exposed, strip transect counts off southwestern, Ireland. Netherlands Journal of Sea Research 29(4): 395-402.

MacLeod, C.D., Bannon, S.M., Pierce, G.J., Schweder, C., Learmonth, J.A., Herman, J.S. and Reid, R.J. (2005) Climate change and the cetacean community of north-west Scotland. Biological Conservation 124, 477-483.

MacLeod, C.D., and D'Amico, A. (2006) A review of beaked whale behaviour and ecology in relation to assessing and mitigating impacts of anthropogenic noise. Journal of Cetacean Research and Management 7(3) 211-221.

McKenzie, C., Rogan, E., Reid, R.J. and Wells, D.E. (1998) Concentrations and patterns of organic contaminants in Atlantic white-sided dolphins (*Lagenorhynchus acutus*) from the Irish and Scottish coastal waters. Environmental Pollution 98: 15-27.

Murphy, S., Collet, A., Rogan, E. (2005). Mating strategy in the male common dolphin (*Delphinus delphis*): What gonadal analysis tells us. Journal of Mammalogy 86(6): 1247-1258.

Murphy, S., Herman, J.S., Pierce, G.J., Rogan, E. and Kitchener, A.C. (2006) "Taxonomic status and geographical cranial variation of common dolphins (Delphinus) in the eastern north Atlantic." Marine Mammal Science.

Northridge, S., Tasker, M.L., Webb, A. and Williams, J.M. (1995) Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirosris* Gray), and minke whale (*Balaenoptera acutorostrata* Lacepede) around the British Isles. ICES Journal of Marine Science 52: 55-66.

O'Brien, J. Berrow, S.D., Lyons, D., McGrath, D. and O'Cadhla, O. (in prep) Review of current knowledge of cetaceans in Irish waters. Biology and Environment.

O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004) Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp.

Pollock, C., Reid, J.B., Webb, A. and Tasker, M.L. (1997) The distribution of seabirds and cetaceans in the waters around Ireland. JNCC Report, No. 267.

Reid, A.J. and Hohn, A.A. (1995) Life in the fast lane: the life history of harbour porpoise from the Gulf of Maine. Marine Mammal science 11(4), 423-440.

Reid, J. B., Evans, P.G.H. and Northridge, S.P. (2003) Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp.

Rice, D.W. (1998) Marine Mammals of the World: Systematics and Distribution. Society for Marine Mammalogy, Special Publication 4.

Rogan, E. and Mackey, M. (2007). Megafauna bycatch in drift nets for albacore tuna (*Thunnus alalunga*) in the NE Atlantic. Fisheries Research (in press).

de Soto, N., Rogan, E., O Cadhla, O., Gordon, J.C.D., Mackey, M. and Connolly, N. (2004) Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume III-Acoustic Surveys for Cetaceans. Report on research carried out under the Irish Infastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P))/15 and Offshore Support Group (OSG) project 99/38: 51pp.

Smyth, M., Berrow, S.D., Nixon, E. and Rogan, E. (2000) Polychlorinated biphenyls and organochlorines in by-caught harbour porpoises *Phocoena phocoena* and common dolphins *Delphinus delphis* from Irish Coastal Waters. Biology and Environment. Proceedings from the Royal Irish Academy 100B(2): 85-96.

Tregenza, N. J. C., Berrow, S.D., Leaper, R. and Hammond, P.S. (1997) Harbour porpoise *Phocoena phocoena* L. bycatch in set gill nets in the Celtic Sea. ICES Journal of Marine Science 54: 896-904.

Wall, D., O'Brien, J., Meade, J., Allen, B. (2006) Summer Distribution and Relative Abundance of Cetaceans off the West Coast of Ireland. Biology and Environment: Proceedings of the Royal Irish Academy, Vol. 106B, No. 2, 135-142.

Whooley, P, Berrow, S. and Barnes, C. (2005) Photo-identification of fin and humpback whales off the south coast of Ireland. Proceedings of the 15th Irish Environmental Researchers' Colloquium, Environ 2005. Institute of Technology, Sligo, 28th-30th January, 2005.

Humpback whale

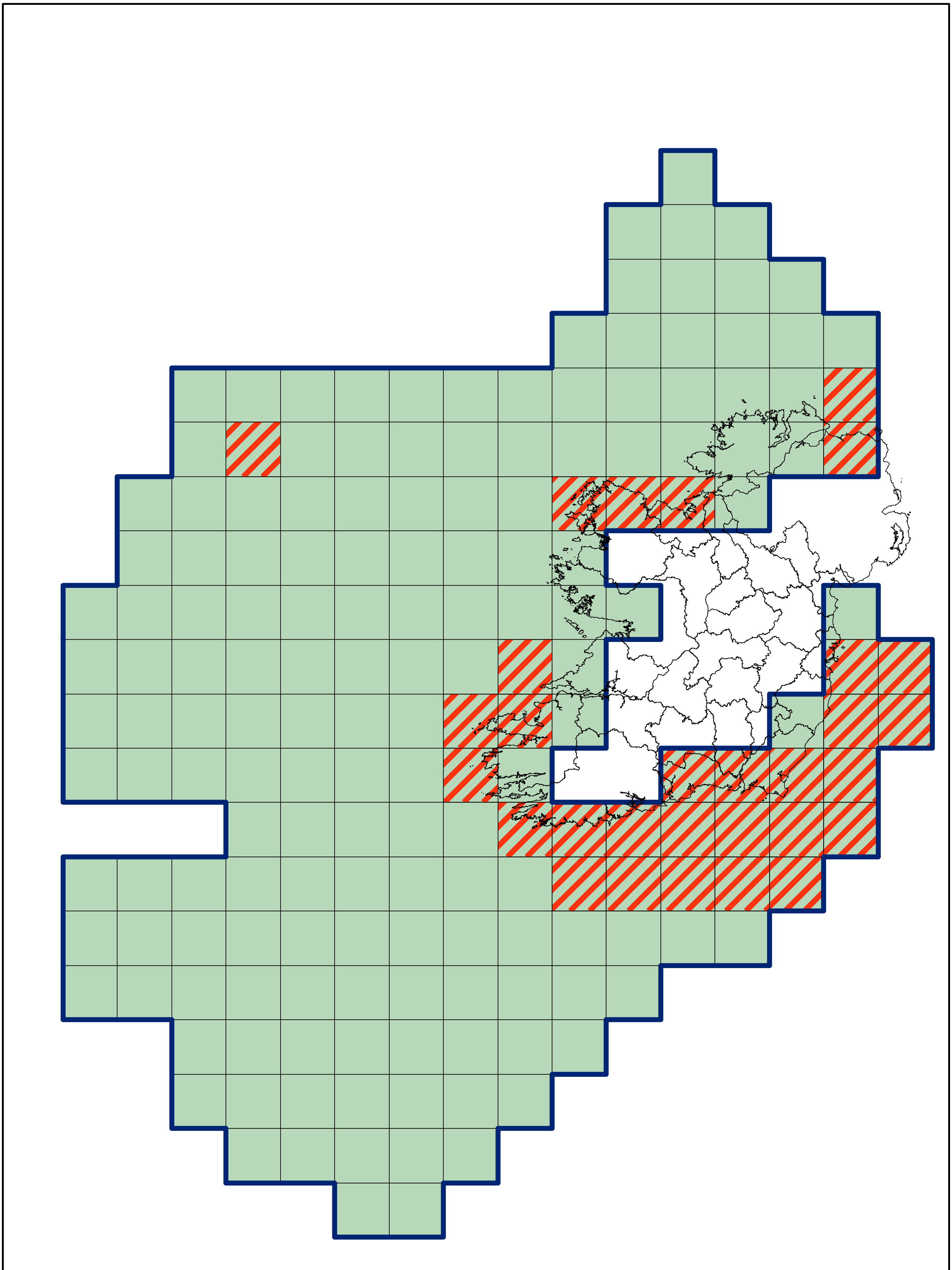
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Humpback whale (1345)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Charif, R. A., Clapham, P.J. and Clark, C.W. (2001). Acoustic detections of singing humpback whales in deep waters off the British Isles. Marine Mammal Science 17(4): 751-768. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	457,500 km² (183 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210
2.4.11 Threats	210, 690, 710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	200000 km² (80 x 2500 km²) (includes inshore distribution and predicted migratory pathway)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	-
2.5.6 Trend-Period	-

2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	457,500 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	200,000 km²
2.7.4 Other relevant information	Positive Impacts: Increase in sightings in recent years suggesting population increasing. Inshore monitoring programme initiated in 2006. Negative impacts: Insufficient data on range, especially offshore. Insufficient data available on diet and potential for competition with fisheries.
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*Insufficient information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Humpback whale
Megaptera novaeangliae

1345

- Current Distribution (30 cells)
- Current Range (183 cells)
- Favourable Reference Range (183 cells)
- 50km grid cells

Date: January 2008

Northern Right whale

Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Northern right whale (1348)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	Range within the country concerned
Map	No contemporary records in Irish waters. Historical records only

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Fairley, J.S. (1981) Irish Whales and Whaling. Blackstaff Press. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp.
2.3 Range	
2.3.1 Surface area	No records within INS
2.3.2 Date	Dataset from 1991-2006 inclusive but no records of right whales within INS
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	No recent records within the INS
2.4.1 Population size estimation	Severely depleted Historical catch records: 18 from NW Mayo between 1908-1920
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	1 = poor
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	(Population possibly not viable)
2.4.11 Threats	(Population too low to recover)
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	-
2.5.4 Quality of data	-
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown

2.7.4 Other relevant information	Occasional record offshore outside of Irish NS.

2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

Bottlenose dolphin

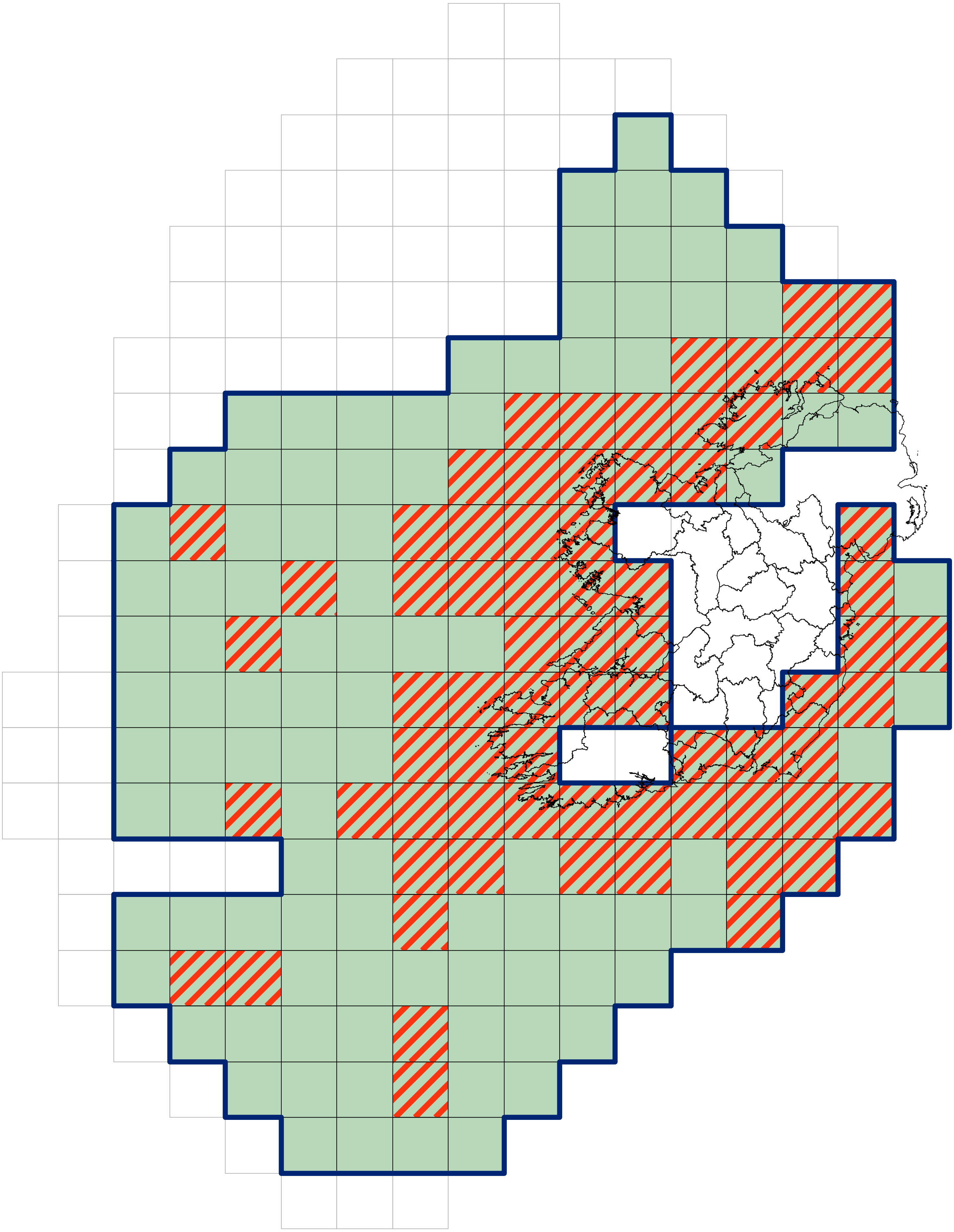
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Bottlenose dolphin (1349)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P.S. and MacLeod, K. (2006). SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006. Ingram, S. D. (2000). *The ecology and conservation of bottlenose dolphins in the Shannon estuary, Ireland*, University College Cork. PhD thesis: 213pp. Ingram, S., Rogan, E. (2003). Estimating abundance, site fidelity and ranging patterns of bottlenose dolphins (*Tursiops truncatus*) in the Shannon Estuary and selected areas off the west-coast of Ireland. Report to the National Parks and Wildlife Service: 28pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	420,000 km² (168 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown but expert opinion is "that it is likely to be stable"
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	6,482 individuals Calculated as sum of abundance estimates recorded from SCANS II from Hammond and MacLeod (2006). Total estimate for Irish Sea included, with estimate for offshore western Scotland and outer Ireland shelf (Area Q) divided by two for Irish section. Celtic Sea area overestimated. Does not include a separate estimate for the Lower River Shannon cSAC.
2.4.2 Date of estimation	July 2005
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	Population considered stable in the Lower River Shannon cSAC
2.4.7 Trend-Period	1997-2006
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 212, 213, 701, 710, 790

2.4.11 Threats	210, 212, 213, 701, 710, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	410000 km² (164 x 2500km²) (includes continental shelf and shelf edge waters to 1000m)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	3 = good
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	-
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	420,000 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	410,000 km²
2.7.4 Other relevant information	Positive: Recent abundance estimates (2005) and monitoring in the Shannon estuary. Inshore monitoring programme initiated in 2006. Negative impacts: Insufficient data on range, especially offshore Insufficient data on bycatch rate in most fisheries. Insufficient data available on diet and potential for competition with fisheries.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			



1:4,500,000

0 25 50 100 Kilometers

Bottle-nosed dolphin
Tursiops truncatus

1349

Current Distribution (71 cells)
Current Range (168 cells)
Favourable Reference Range (168 cells)
50km grid cells

Date: January 2008

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

Common dolphin

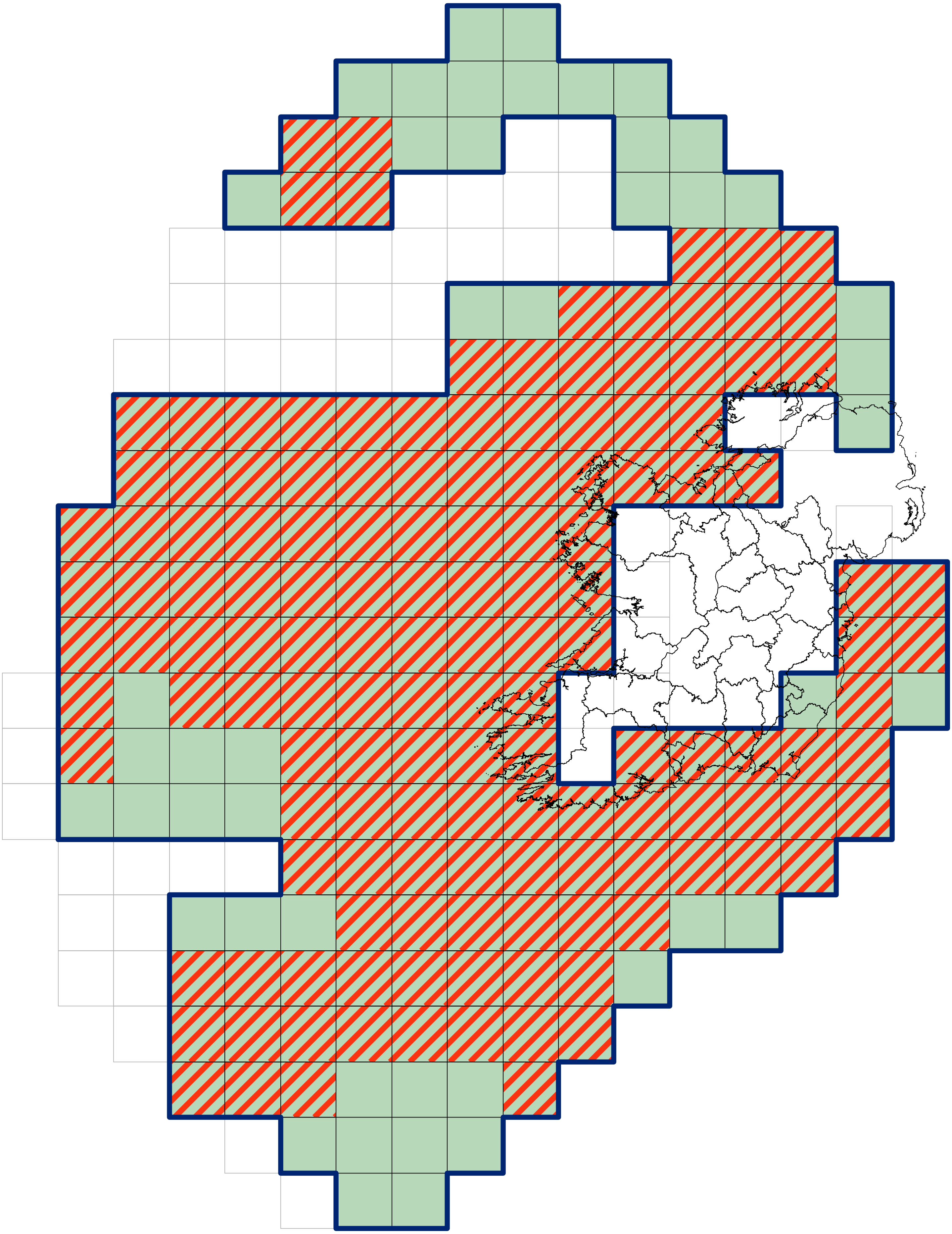
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Common dolphin (1350)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P.S. and MacLeod, K. (2006). SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	472,500 km² (189 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	27,561 individuals Calculated as sum of abundance estimates recorded from SCANS II from Hammond and MacLeod (2006). Total estimate for Irish Sea included with estimate for offshore western Scotland and outer Ireland shelf (Area Q) divided by two for Irish section. Celtic Sea area overestimated.
2.4.2 Date of estimation	July 2005
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	Unknown, expert opinion is “that it is likely to be stable”
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 212, 213, 701
2.4.11 Threats	210, 212, 213, 690, 701, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	502500 km² (201 x 2500km²) (includes all continental shelf and shelf edge waters to 2000m)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	3 = good
2.5.5 Trend	- Unknown but best expert view is “likely to be stable”

2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	N/A
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	472,500 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	502,500 km²
2.7.4 Other relevant information	Positive Impacts: Recent (July 2005) abundance estimate for Irish waters available. Inshore monitoring programme initiated in 2006. Negative impacts: Insufficient data on bycatch rate in most fisheries. Insufficient data available on diet and potential for competition with fisheries.
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable – Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Common dolphin
Delphinus delphis

1350

Current Distribution (143 cells)
Current Range (189 cells)
Favourable Reference Range (189 cells)
50km grid cells

Date: January 2008

Harbour porpoise

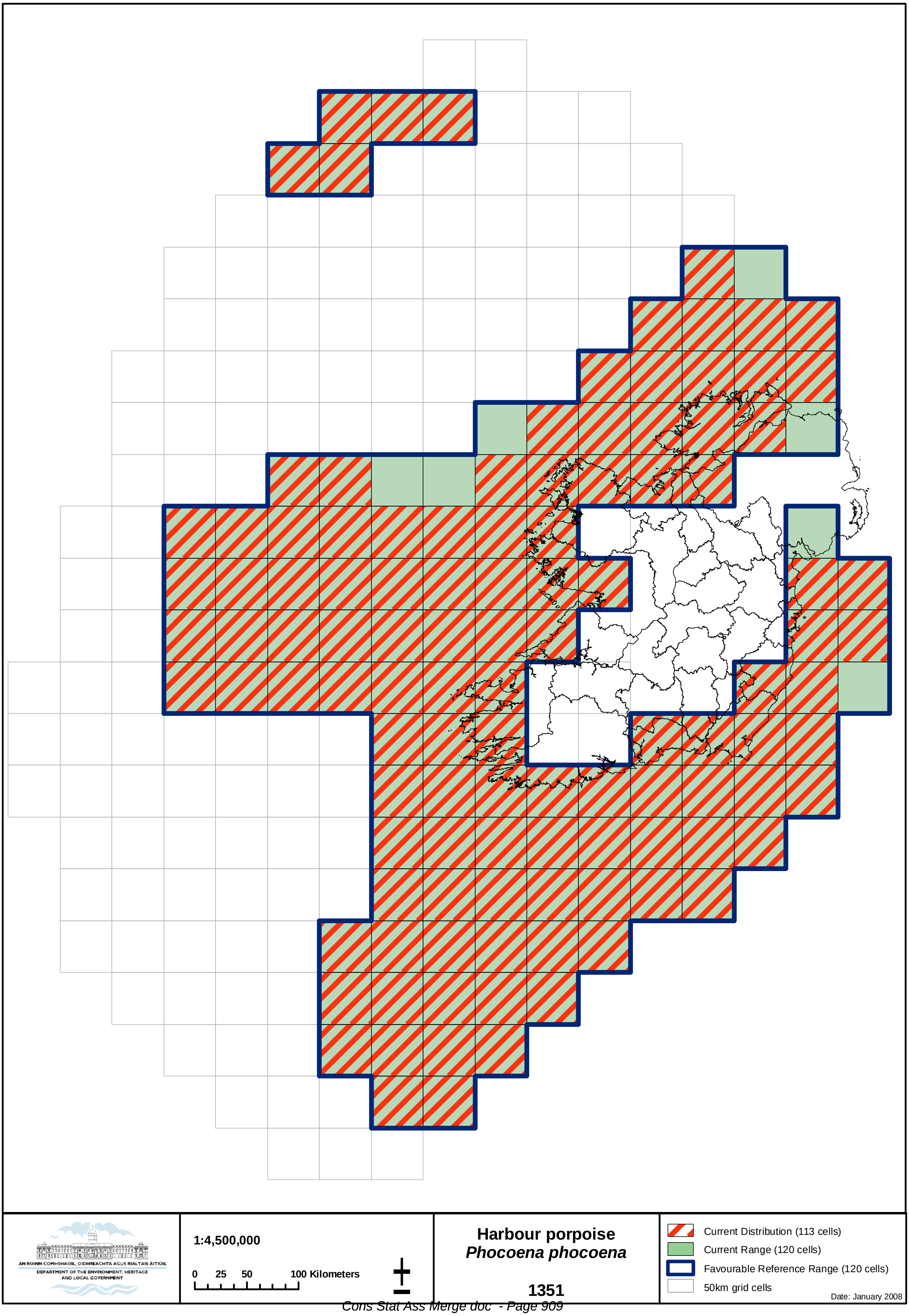
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Harbour porpoise (1351)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P. S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Colle Heide-Jorgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F. and N. (2002). "Abundance of harbour porpoise and other cetaceans in the Nort and adjacent waters." Journal of Applied Ecology 39: 361-376. Hammond, P.S. and MacLeod, K. (2006). SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	300,000 km^2 (120 x 2500km^2)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown but best expert view is “likely to be stable”
2.3.6 Trend-Period	1994-2005
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	100,000-112,000 individuals Estimated from sum of abundance estimates recorded from SCANS II from Hammond and MacLeod (2006). Total estimate for Irish Sea included with estimate for offshore western Scotland and outer Ireland shelf (Area Q) divided by two for Irish section.
2.4.2 Date of estimation	July 2005
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	(density in the Celtic Sea estimated to have increased by 127% between 1994 and 2005, an average of 11% per annum)
2.4.7 Trend-Period	July 1994 – July 2005
2.4.8 Reasons for reported trend	3 = direct human influence (in the Celtic Sea following reduction in fishing effort with gill-nets and re-colonisation/change in distribution of the English Channel and Southern North Sea)
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 213, 690, 701, 710, 790, 990
2.4.11 Threats	210, 213, 690, 701, 710, 790, 990
2.5 Habitat for the species	

2.5.1	
2.5.2 Area estimation	297500 km² (119 x 2500km²) (includes all continental shelf area to 200m contour)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	- Unknown but best expert view is "likely to be stable"
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	300,000 km^2
2.7.2 Favourable reference population	100,000 individuals
2.7.3 Suitable Habitat for the species	297,500 km²
2.7.4 Other relevant information	Positive Impacts: Recent (July 2005) abundance estimate for Irish waters available. Two sites designated as cSAC. Inshore monitoring programme initiated in 2006. Negative impacts: Insufficient data on range, especially offshore. No Conservation Plans/Objectives published for cSACs. Insufficient data on bycatch rate in most fisheries. Insufficient data available on diet and potential for competition with fisheries. 2.3.4 / 2.3.5: Trend estimates based on expert judgement
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Population	Favourable
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population	Favourable			
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			


AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT
1:4,500,000
0 25 50 100 Kilometers
Harbour porpoise
Phocoena phocoena
1351
Current Distribution (113 cells)
Current Range (120 cells)
Favourable Reference Range (120 cells)
50km grid cells
Date: January 2008

Killer whale

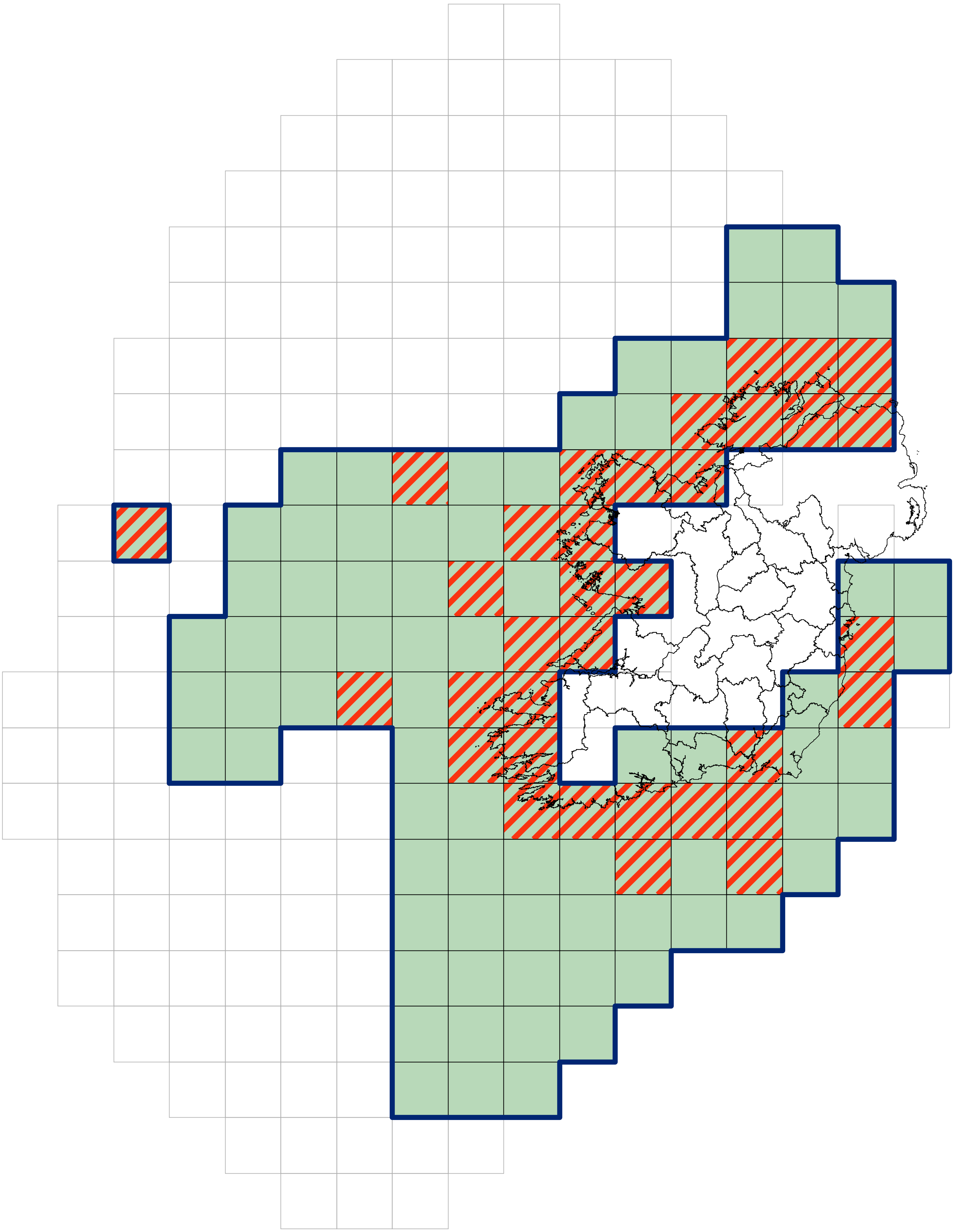
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Killer whale (2027)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	267,500 km² (107 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available.
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	701
2.4.11 Threats	701, 890
2.5 Habitat for the species	
2.5.2 Area estimation	347500 km² (139 x 2500km²) (includes continental shelf and shelf edge to 1000m)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Unknown expert opinion is “that it is likely to be stable”
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information

2.7.1 Favourable reference range	267,500 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	347,500 km²
2.7.4 Other relevant information	Positive Impacts: Inshore monitoring programme initiated in 2006. Negative impacts: Insufficient data on range, especially offshore. No abundance estimate.
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Killer whale
Orcinus orca

2027

Current Distribution (34 cells)
Current Range (107 cells)
Favourable Reference Range (107 cells)
50km grid cells

Date: January 2008

False Killer whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	False killer whale (2028)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	Only two sighting records

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Unknown
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	Only 2 definite sighting records
2.4.1 Population size estimation	No abundance estimate available.
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	890
2.5 Habitat for the species	
2.5.2 Area estimation	Preferred habitat not known
2.5.3 Date of estimation	-
2.5.4 Quality of data	-
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	-
2.7.2 Favourable reference population	-

2.7.3 Suitable Habitat for the species	-
2.7.4 Other relevant information	Positive Impacts: Climate change likely to increase frequency in Irish waters Negative impacts: No information on distribution and abundance
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

Pilot whale

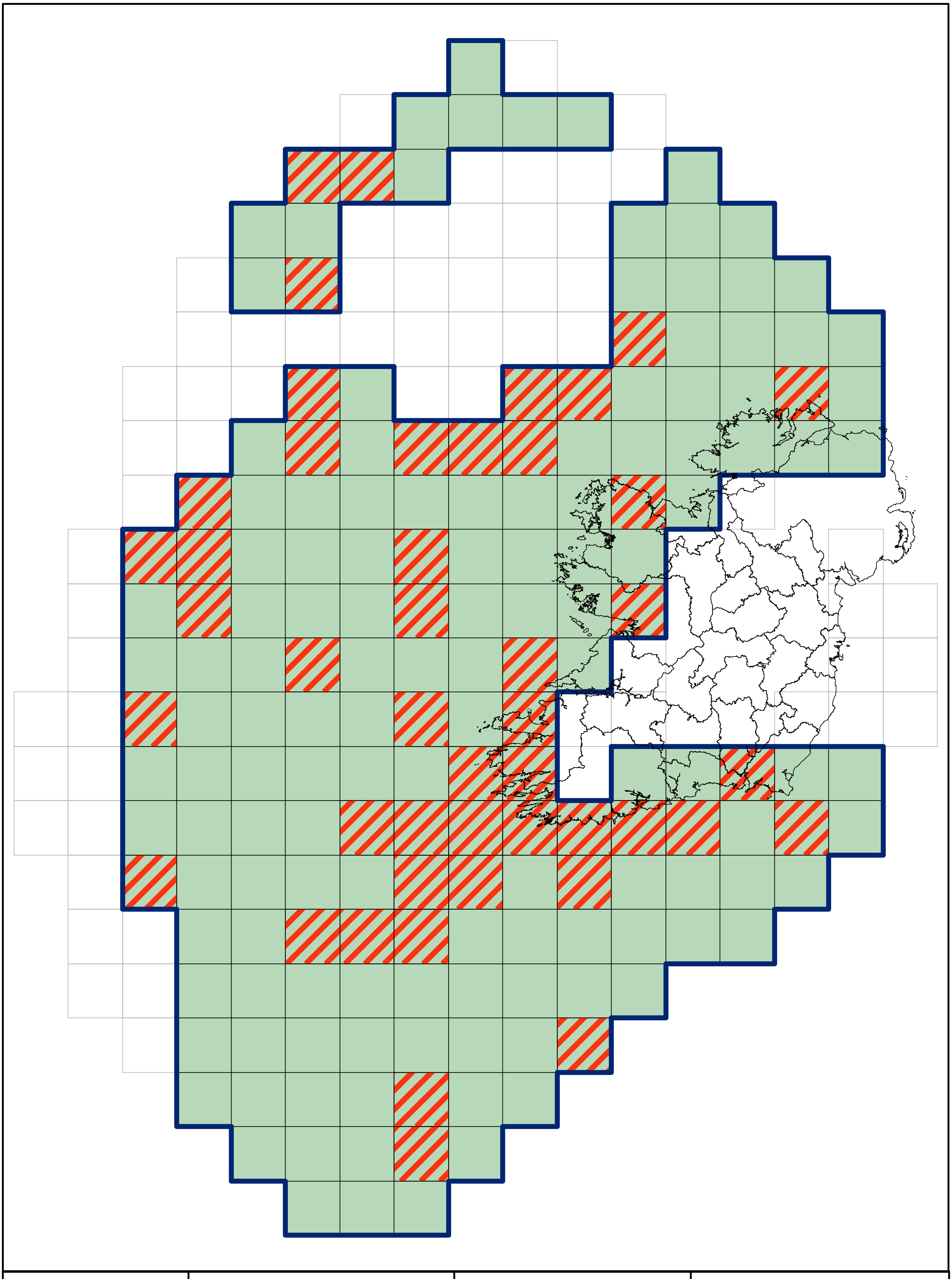
Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Pilot whale (2029)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	440,000 km² (176 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available.
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	701, 710
2.4.11 Threats	701, 710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	522500 km² (209 x 2500km²) (includes all habitats to the west and south, not including Irish Sea)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	unknown
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	440,000 km²

2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	522,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing. Offshore habitat Negative impacts: Insufficient data on range, especially offshore
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Long-finned Pilot whale
Globicephala melas

2029

Current Distribution (46 cells)
Current Range (176 cells)
Favourable Reference Range (176 cells)
50km grid cells

Date: January 2008

Risso's dolphin

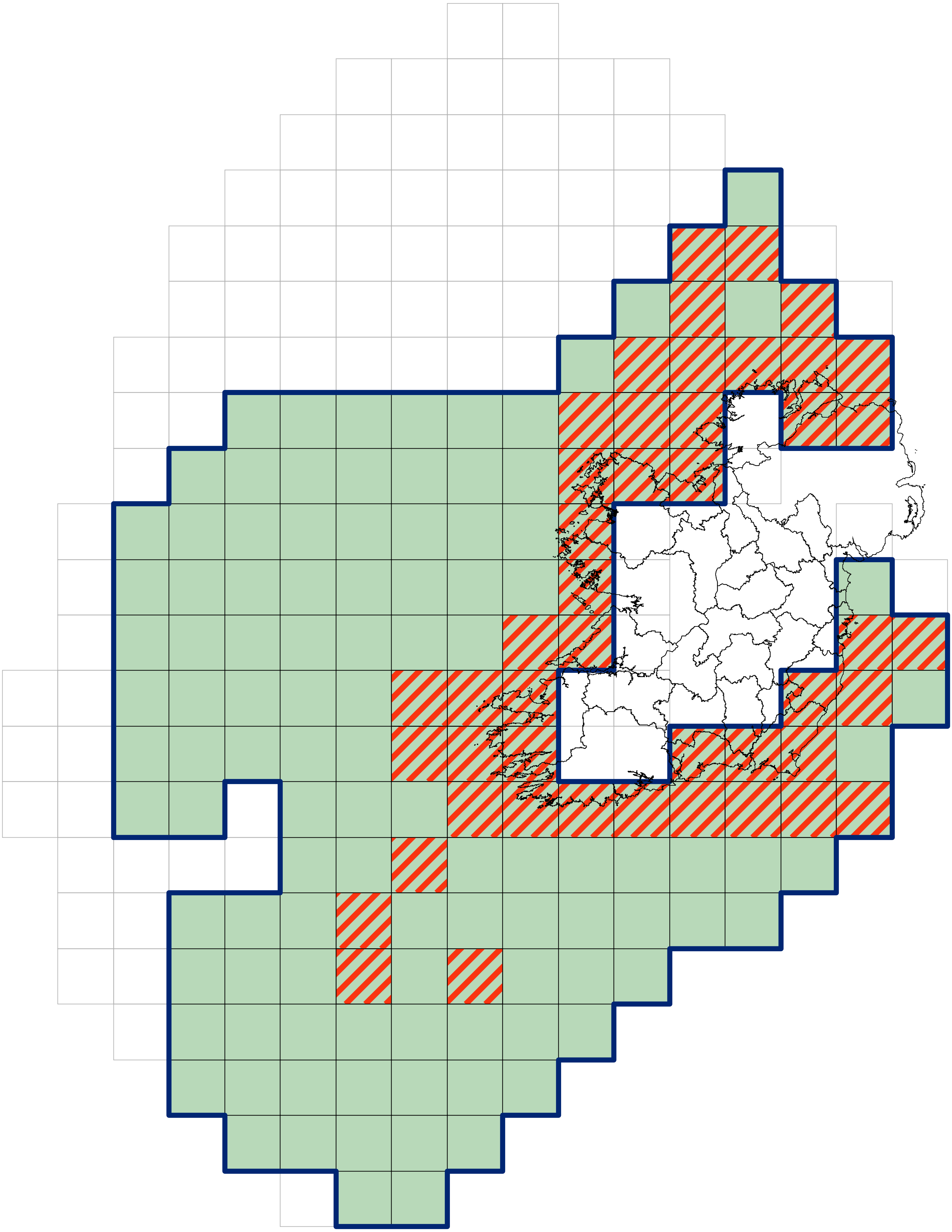
Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Risso's dolphin (2030)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	380,000 km² (152 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	690, 701, 710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	417500 km² (167 x 2500km²) (includes continental shelf and shelf edge waters)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	unknown
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information

2.7.1 Favourable reference range	380,000 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	417,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



1:4,500,000

0 25 50 100 Kilometers

Risso's dolphin
Grampus griseus

2030

Current Distribution (46 cells)
Current Range (152 cells)
Favourable Reference Range (152 cells)
50km grid cells

Date: January 2008

White-sided dolphin

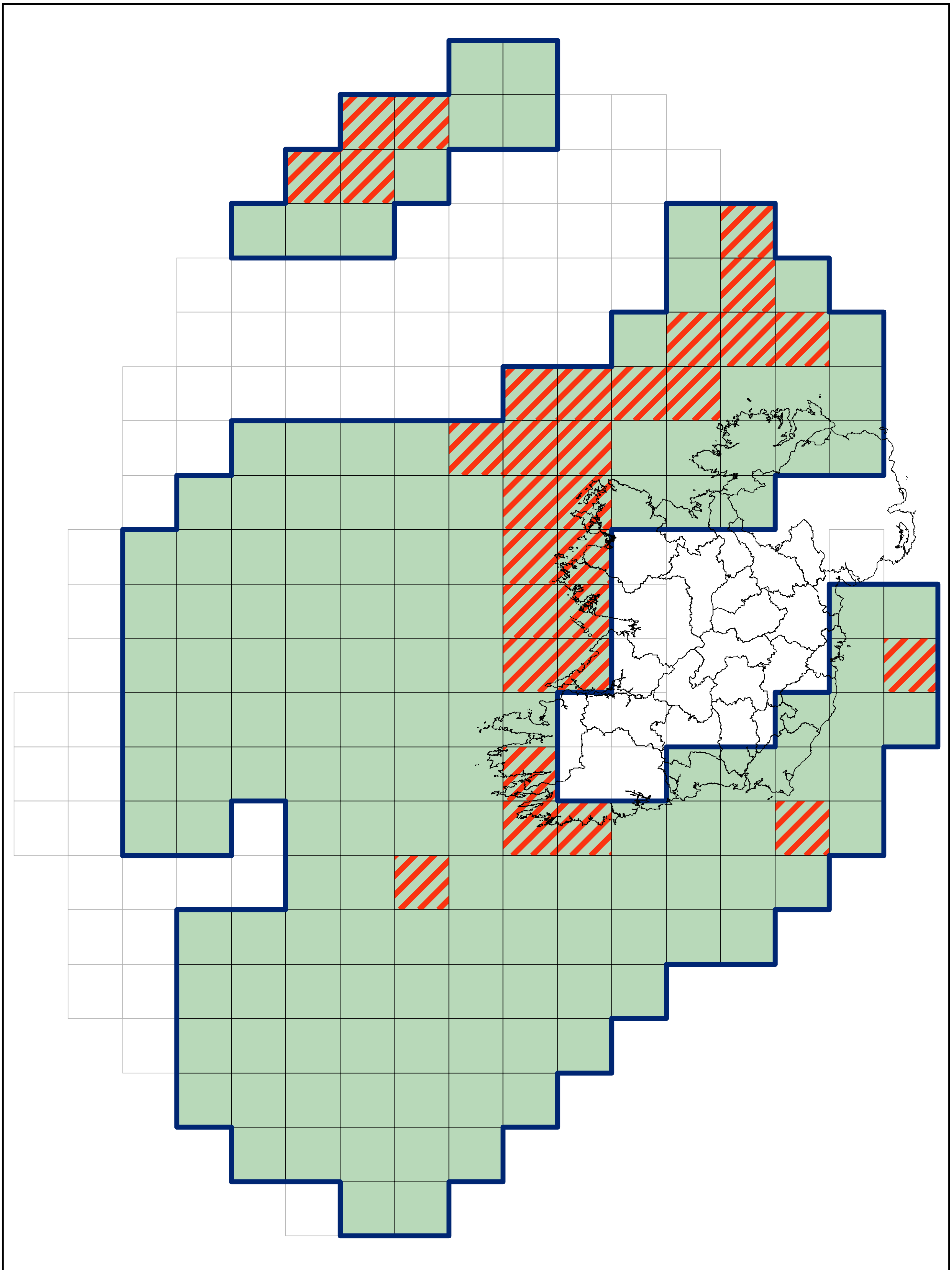
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	White-sided dolphin (2031)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P. S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Colle Heide-Jorgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F Oien, N. (2002). "Abundance of harbour porpoise and other cetaceans i North Sea and adjacent waters." Journal of Applied Ecology 39: 361-376. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	427,500 km² (171 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown but best expert view is “likely to be stable”
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	5490 individuals Abundance estimate from O’Cadhla *et al.* (2004) for an area to the west of Ireland. Estimate of 88 *Lagenorhynchus* sp in the Celtic Sea in 1994 not included.
2.4.2 Date of estimation	August 2000
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	Unknown, expert opinion is “that it is likely to be stable”
2.4.7 Trend-Period	1994-2000
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	212, 213, 701, 710,
2.4.11 Threats	212, 213, 701, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	250000 km² (100 x 2500km²) (includes continental shelf waters, shelf edge and offshore banks)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	- Unknown but best expert view is “likely to be stable”

2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	427,500 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	250,000 km²
2.7.4 Other relevant information	Positive Impacts: One (August 2000) abundance estimate available for Irish waters. Negative impacts: Insufficient data on range and population for significant proportion of range. Insufficient data on bycatch rate in most fisheries. Insufficient data available on diet and potential for competition with fisheries. Trends all assessed as stable using best expert judgement
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			



1:4,500,000

0 25 50 100 Kilometers

White-sided dolphin
Lagenorhynchus acutus

2031

Current Distribution (30 cells)
Current Range (171 cells)
Favourable Reference Range (171 cells)
50km grid cells

Date: January 2008

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

White-beaked dolphin

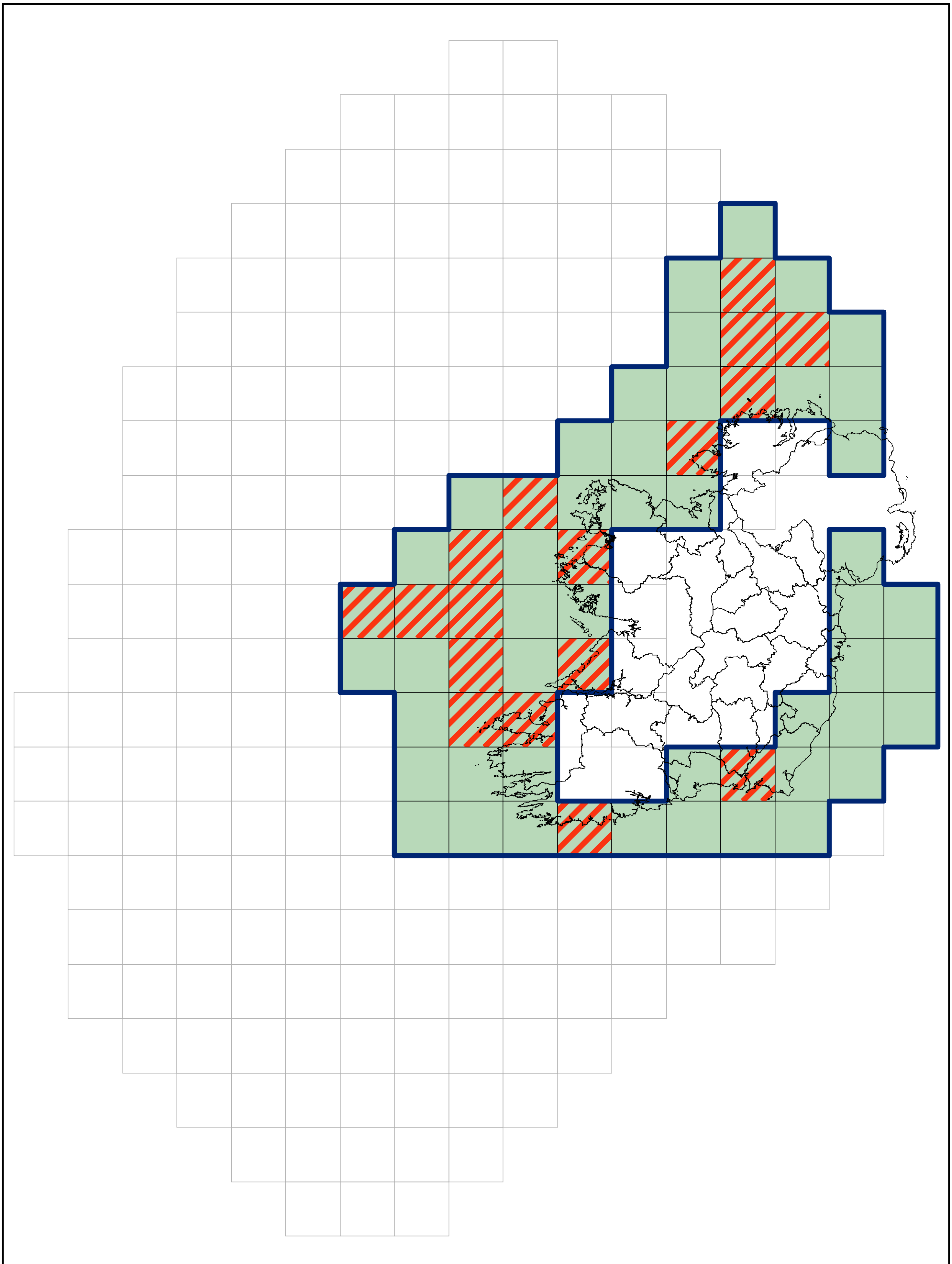
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	White-beaked dolphin (2032)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P.S. and MacLeod, K. (2006). SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	155,000 km² (62 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	1357 individuals Calculated as sum of abundance estimates recorded from SCANS II from Hammond and MacLeod (2006). Total estimate for Irish Sea included with estimate for offshore western Scotland and outer Ireland shelf (Area Q) divided by two for Irish section. None recorded in the Celtic Sea.
2.4.2 Date of estimation	July 2005
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	890
2.4.11 Threats	890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	170000 km² (68 x 2500km²) (continental shelf waters <500m, and northern distribution)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Unknown

2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	155,000 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	170,000 km²
2.7.4 Other relevant information	Positive Impacts: Recent (July 2005) abundance estimate for Irish waters available. Negative impacts: Insufficient data on range especially offshore. Susceptible to increase in sea-water temperatures.
2.8 Conclusions* *(assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



White-beaked dolphin
Lagenorhynchus albirostris

2032

Current Distribution (17 cells)
Current Range (62 cells)
Favourable Reference Range (62 cells)
50km grid cells

Date: January 2008

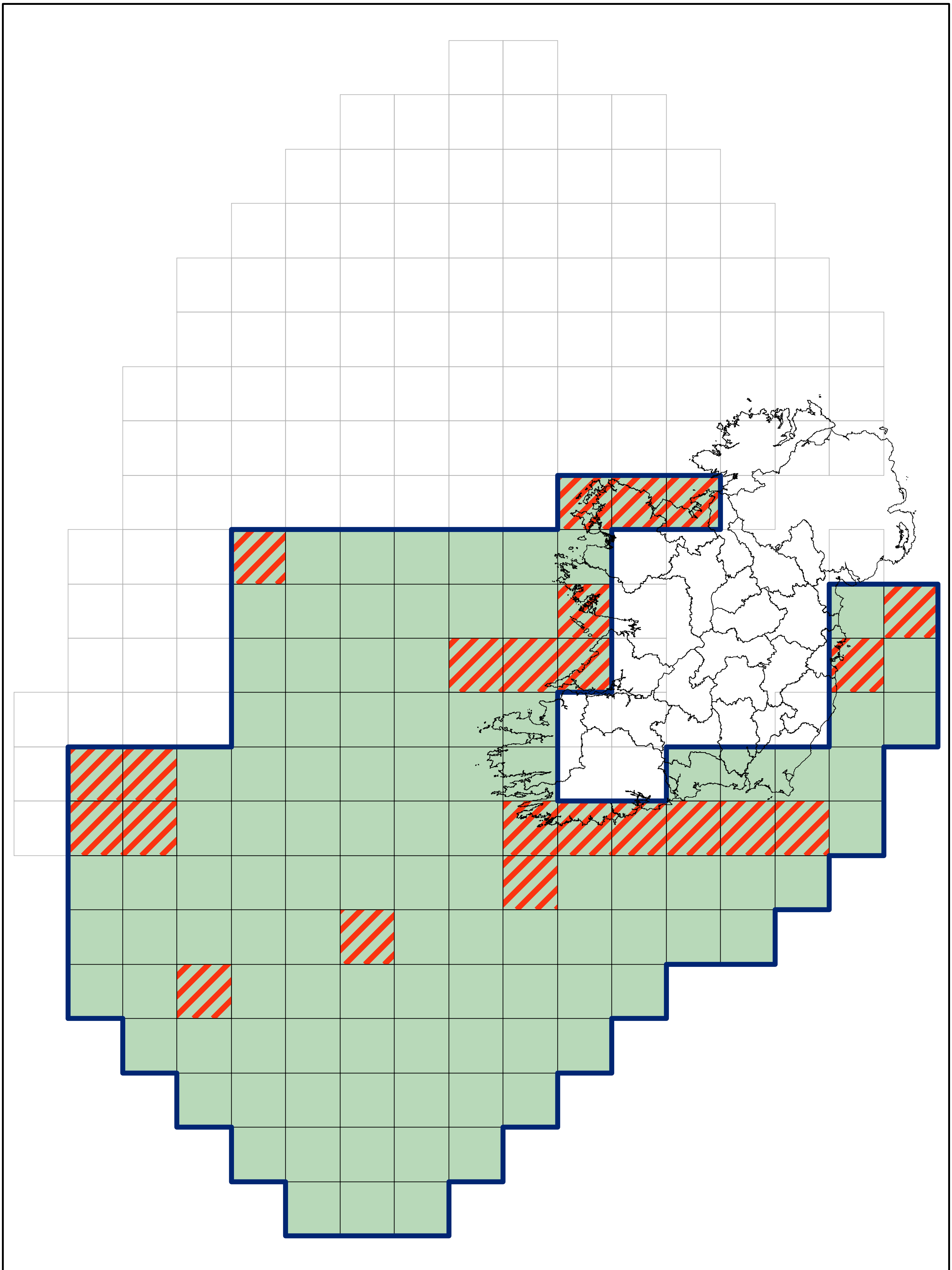
Striped dolphin

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Striped dolphin (2034)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Hammond, P.S. and MacLeod, K. (2006). SCANS-II-Report on Progress. Document for ASCOBANS Meeting of Partis, Egmond aan Zee, September 2006. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	315,000 km² (126 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 212, 213,
2.4.11 Threats	701, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	535000 km² (214 x 2500km²) (includes all continental shelf, shelf edge and deep water habitats)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Unknown
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	N/A
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	315,000 km²
2.7.2 Favourable reference population	unknown
2.7.3 Suitable Habitat for the species	535,000 km²
2.7.4 Other relevant information	Positive Impacts: Climate change likely to increase occurrence in Irish waters. Negative impacts: Insufficient data on range. Insufficient data on bycatch rate in most fisheries. Insufficient data available on diet and potential for competition with fisheries.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable – Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



1:4,500,000

0 25 50 100 Kilometers

Striped dolphin
Stenella coeruleoalba

2034

Current Distribution (23 cells)
Current Range (126 cells)
Favourable Reference Range (126 cells)
50km grid cells

Date: January 2008

Cuvier's beaked whale

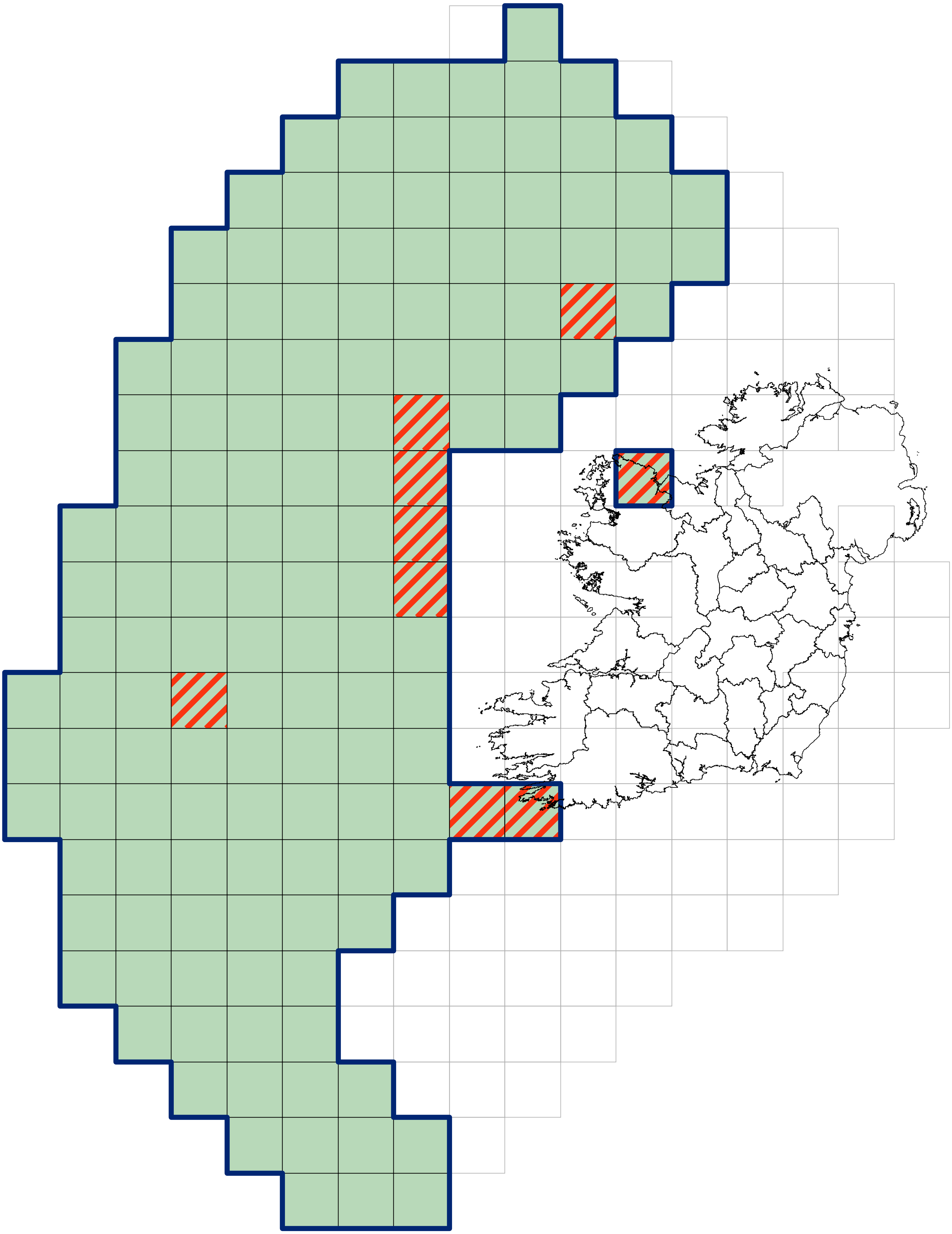
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Cuvier's beaked whale (2035)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	362500 km² (145 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	377500 km² (151 x 2500km²) (includes deep water, shelf edge and some continental shelf waters)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	1= poor
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information

2.7.1 Favourable reference range	362,500 km²
2.7.2 Favourable reference population	-
2.7.3 Suitable Habitat for the species	377,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



Cuvier's Beaked whale
Ziphius cavirostris

2035

Current Distribution (9 cells)
Current Range (145 cells)
Favourable Reference Range (145 cells)
50km grid cells

Date: January 2008

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

True's beaked whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	True's beaked whale (2037)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Unknown
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	Only one confirmed sighting
2.4.1 Population size estimation	None available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	217500 km² (87 x 2500 km²) includes all deep water and shelf edge (>100m) and canyons
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	1= poor
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	-
2.7.2 Favourable reference population	-
2.7.3 Suitable Habitat for the species	217,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				Unknown

Sowerby's beaked whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Sowerby's beaked whale (2038)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D. and Rogan, E. (1997) Cetaceans stranded on the Irish coast, 1901-1995. Mammal Review 27(1), 51-76. Strandings data held on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	No definite sightings, 12 stranding records from Co Wexford to Co Sligo
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	No definite sightings
2.4.1 Population size estimation	None available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	217500 km² (87 x 2500 km²) (includes deepwater >1000m and canyons)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	1= poor
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	217,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats

2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

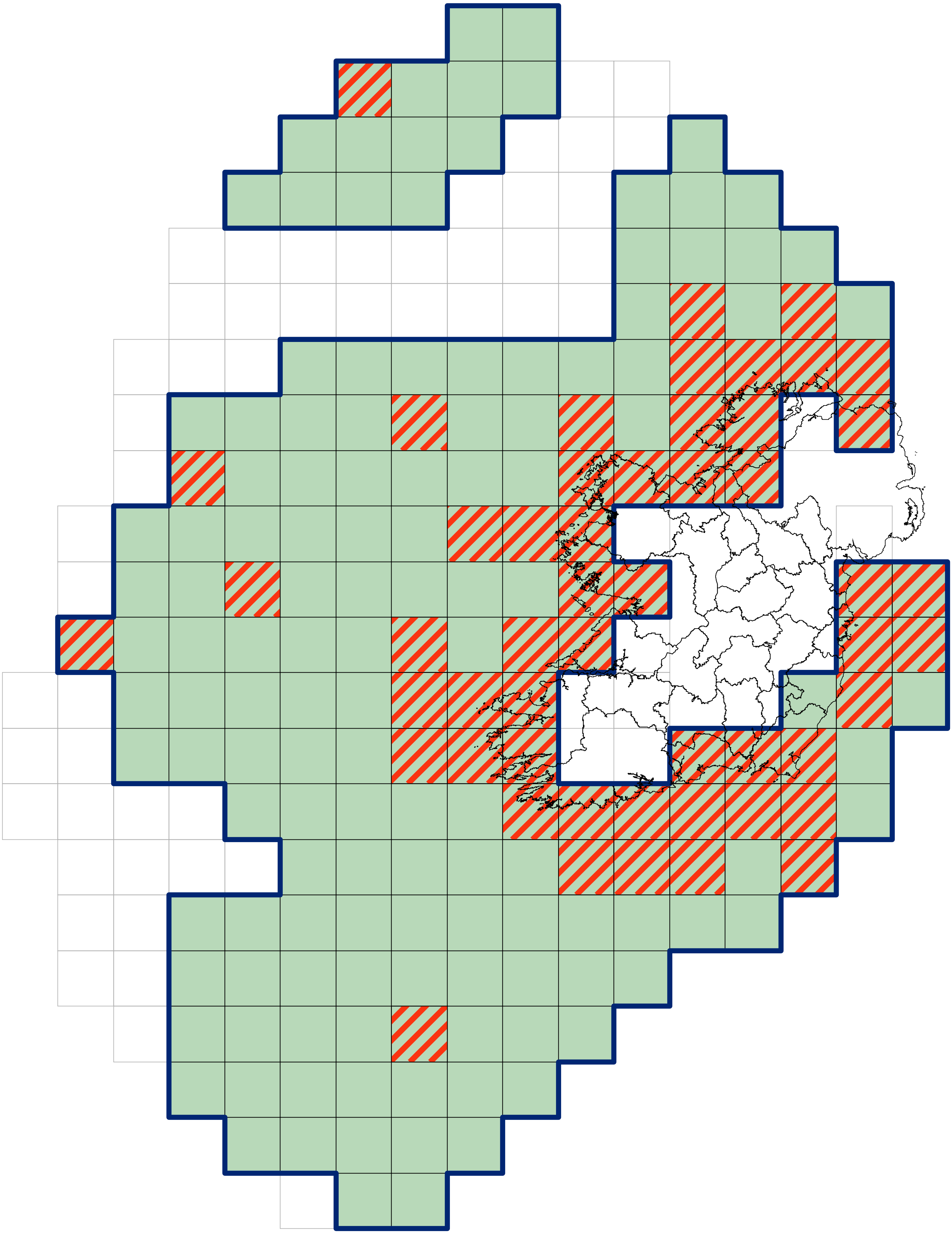
Minke whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Minke whale (2618)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	425000 km² (181 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown but expert opinion is “that it is likely to be stable”
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	5,942 individuals Calculated as sum of abundance estimates recorded from SCANS II from Hammond and MacLeod (2006). Total estimate for Irish Sea included, with estimate for offshore western Scotland and outer Ireland shelf (Area Q) divided by two for Irish section. Celtic Sea area overestimated.
2.4.2 Date of estimation	July 2005
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	3 = good
2.4.5 Trend	Density in the Celtic Sea has increased by approx. 5% per annum
2.4.7 Trend-Period	1994 to 2005
2.4.8 Reasons for reported trend	Better knowledge
2.4.9 Justification of % thresholds for trends	Natural processes
2.4.10 Main pressures	210, 690, 710,
2.4.11 Threats	210, 690, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	475000 km² (190 x 2500 km²) (includes all continental shelf and shelf edge waters)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	-
2.6 Future prospects	1 = good

2.7 Complementary information	
2.7.1 Favourable reference range	425,000 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	475,000 km²
2.7.4 Other relevant information	Positive Impacts: Minke whale is widespread and reported regularly. Habitat widespread and favourable. Recent (July 2005) abundance estimate for Irish waters available. Inshore monitoring programme initiated in 2006. Negative Impacts: potential competition for commercial fish species 2.3.4: The stable trend for range was given using best expert judgement
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Minke whale
Balaenoptera acutorostrata

2618

Current Distribution (52 cells)
Current Range (181 cells)
Favourable Reference Range (181 cells)
50km grid cells

Date: January 2008

Sei whale

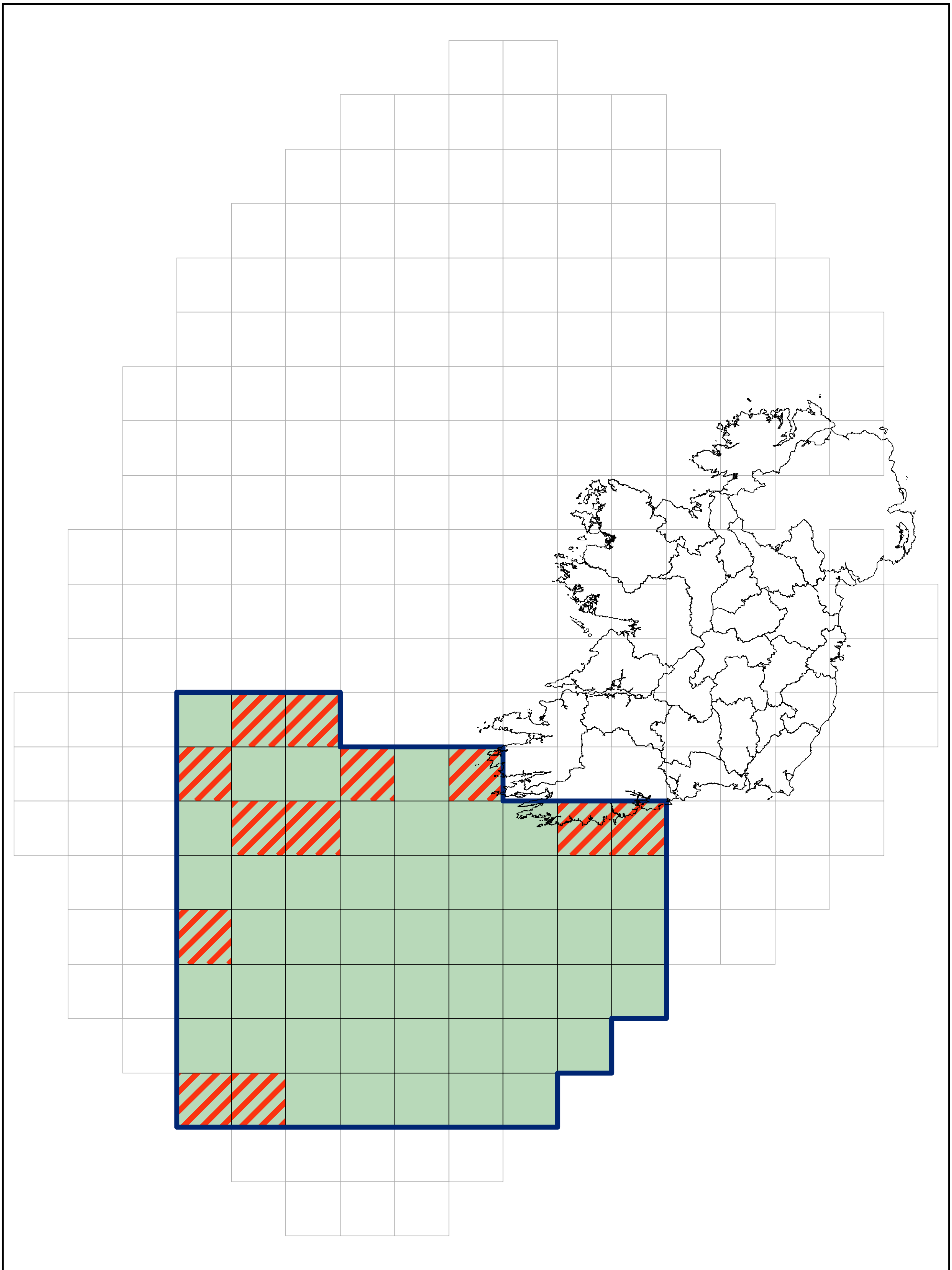
Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Sei whale (2619)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Only 14 sighting records
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	N/A
2.4.3 Method used	N/A
2.4.4 Quality of data	N/A
2.4.5 Trend	N/A
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 710
2.4.11 Threats	210, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	490,000 km² (196 x 2,500 km²) (includes continental shelf and potential migratory pathway)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	- Unknown but best expert view is “likely to be stable”
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information

2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	9,800 km²
2.7.4 Other relevant information	2.5.5:The stable trend for habitat was given using best expert judgement
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



1:4,500,000

0 25 50 100 Kilometers

Sei whale
Balaenoptera borealis

2619

	Current Distribution (12 cells)
	Current Range (60 cells)
	Favourable Reference Range (60 cells)
	50km grid cells

Date: January 2008

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

Fin whale

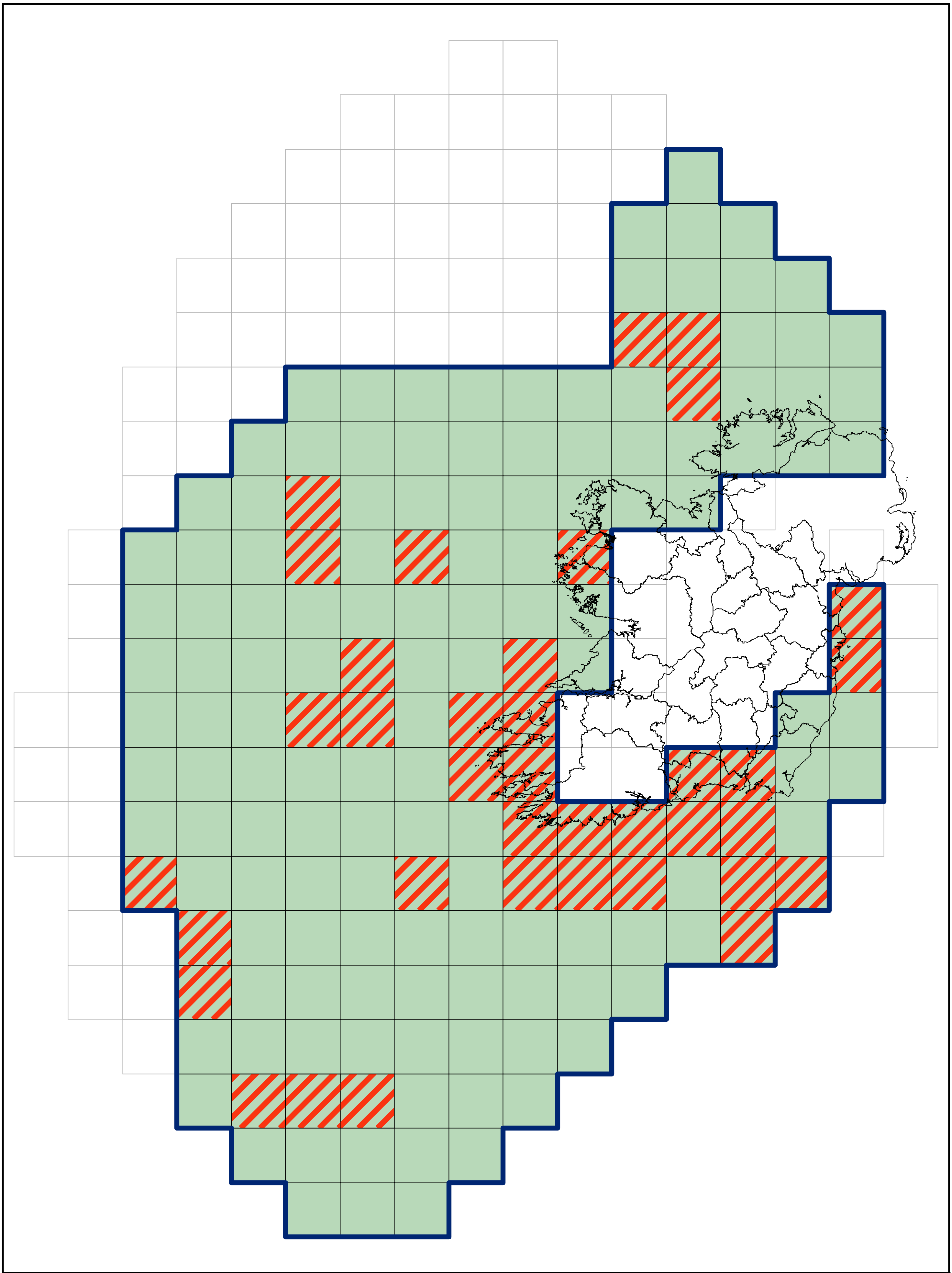
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Fin whale (2621)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Clark, C. W. and Charif, R.A. (1998). Acoustic monitoring of large whales to the west of Britain and Ireland using bottom-mounted hydrophone arrays, October 1996-September 1997. JNCC Report No. 281**:** 25pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	415,000 km² (166 x 2500 km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Increasing number of sightings
2.3.6 Trend-Period	1999-2006
2.3.7 Reasons for reported trend	Unknown
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	300-500 individuals Acoustic detections estimated between 300 – 500 fin whales migrate through Irish waters annually (Clark and Charif, 1998)
2.4.2 Date of estimation	1996-1998
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	1 = poor
2.4.5 Trend	Unknown
2.4.7 Trend-Period	1994-2005
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	210, 690, 710
2.4.11 Threats	210, 690, 710, 730, 790, 890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	490000 km² (196 x 2500km²) (includes continental shelf waters and migratory pathway)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Unknown but best expert view is “likely to be stable”
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	-

2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	415,000 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	490,000 km²
2.7.4 Other relevant information	Positive Impacts: Species protected from hunting and evidence of population increasing as evident from increased presence off south and southwest coasts Negative impacts: potential competition for fish and impact of climate change on preferred habitat 2.5.5: The stable trend in habitat was given using best expert judgement
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Population	Unknown (XX)
Habitat for the species	Favourable
Future prospects	Favourable
Overall assessment of CS	Favourable

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range	Favourable			
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species	Favourable			
2.6 Future prospects	Favourable			
Overall assessment of CS	Favourable			



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Fin whale
Balaenoptera physalus

2621

Current Distribution (37 cells)
Current Range (166 cells)
Favourable Reference Range (166 cells)
50km grid cells

Date: January 2008

Pygmy sperm whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Pygmy sperm whale (2622)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	No sighting records

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D. and Rogan, E. (1997) Cetaceans stranded on the Irish coast, 1901-1995. Mammal Review 27(1), 51-76. Strandings data held on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Unknown
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	6 stranding records between Co Kerry and Co Mayo
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	?
2.5 Habitat for the species	
2.5.2 Area estimation	Habitat preferences not known
2.5.3 Date of estimation	-
2.5.4 Quality of data	-
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	?

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	Negative impacts: no data on distribution or abundance
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

Blue whale

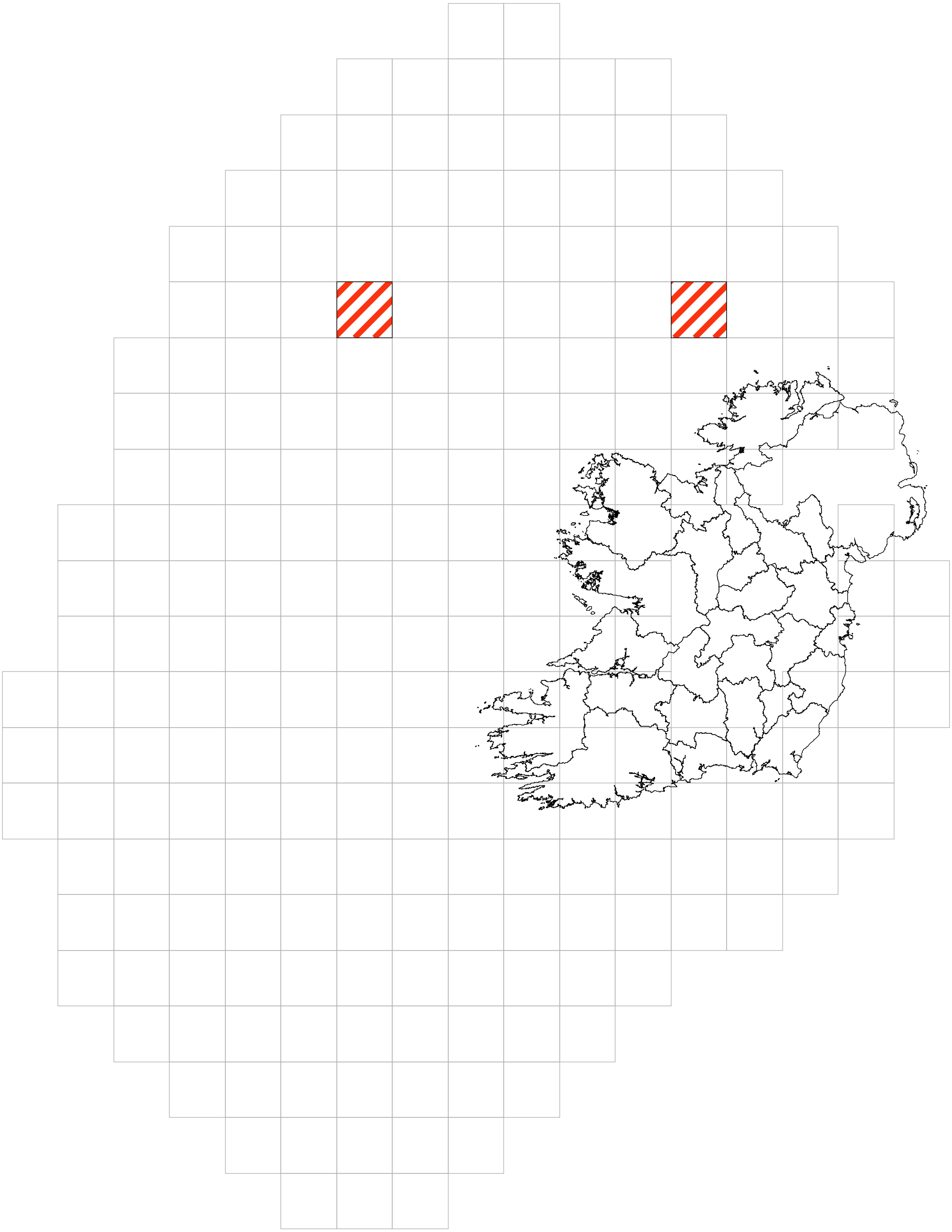
Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Blue whale (5020)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. Clark, C. W. and Charif, R.A. (1998). Acoustic monitoring of large whales to the west of Britain and Ireland using bottom-mounted hydrophone arrays, October 1996-September 1997. JNCC Report No. 281**:** 25pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Unknown
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	30-50 individuals Acoustic detections estimated between 30 – 50 blue whales migrate through Irish waters annually (Clark and Charif, 1998)
2.4.2 Date of estimation	1996-1998
2.4.3 Method used	2 = extrapolation from surveys of part of the population, sampling
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	Unknown
2.4.11 Threats	890
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	165000 km² (66 x 2500km²) (includes migratory pathway)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Unknown

2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	165,000 km²
2.7.4 Other relevant information	Positive Impacts: protected species, acoustic monitoring possible Negative impacts: little evidence of population recovery, still very rare
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



1:4,500,000

0 25 50 100 Kilometers

Blue whale
Balaenoptera musculus

5020

Current Distribution (2 cells)

50km grid cells

Date: January 2008

AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

Beluga

Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Beluga (5029)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	O'Riordan, C.E. (1972). Provisional list of cetacea and turtles stranded or captured on the Irish coast. Proceedings of the Royal Irish Academy 72(B), 15, 253-274. Carmody, M. and Wilson, J. (1988) White whale *Delphinapterus leucas* (Pallas). Irish Naturalists' Journal 22 (12), 540. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Not known
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	2 sighting records
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	890
2.4.11 Threats	890
2.5 Habitat for the species	
2.5.2 Area estimation	Preferred habitat not known
2.5.3 Date of estimation	-
2.5.4 Quality of data	-
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	Very rarely recorded, climate change likely to reduce sightings further
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Unknown (XX)

Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

Sperm whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Sperm whale (5031)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II-Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp de Soto, N., Rogan, E., O Cadhla, O., Gordon, J.C.D., Mackey, M. & Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume III-Acoustic Surveys for Cetaceans. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P))/15 and Offshore Support Group (OSG) project 99/38: 51pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	205,000 km² (82 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Thought to be increasing (Berrow *et al*. 1993)
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	292500 km² (117 x 2500km²) (includes deep water >1000m and acoustic detections, inshore records presumed to be of animals outside preferred habitat)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	-

2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	205,000 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	292,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

Northern bottlenose whale

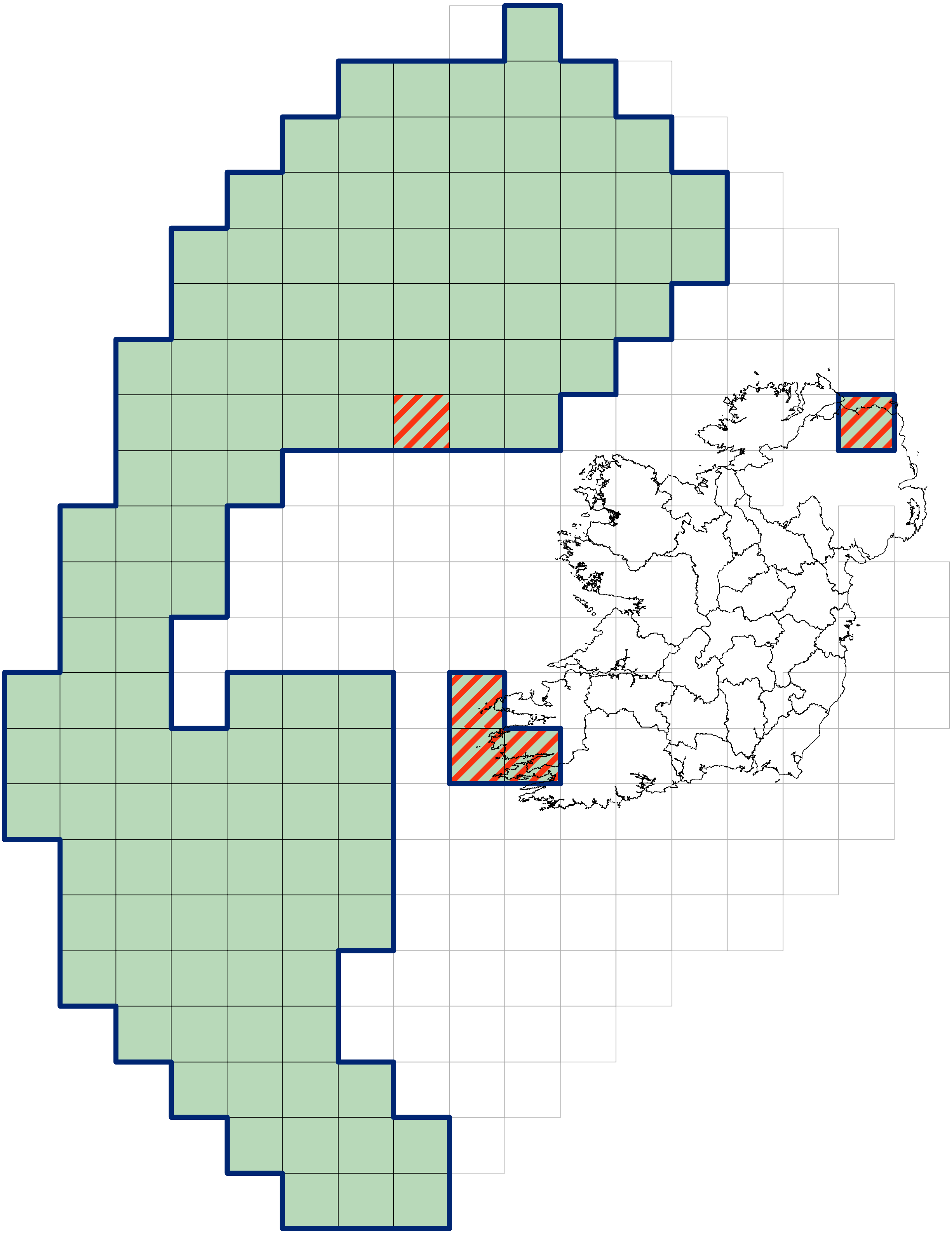
Data	Comments/Guidelines for reporting data
1. National Level	
Species code	Northern bottlenose whale (5033)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D., Whooley, P. and Ferriss, S. (2002) Irish Whale and Dolphin Group Cetacean Sighting Review (1991-2001). Irish Whale and Dolphin Group. ISBN 0-9540552-1-7. 34 pp. O'Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E. and Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II- Cetacean distribution and abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38: 82pp. Reid, J. B., Evans, P.G.H., Northridge, S.P. (2003). Atlas of Cetacean distribution in North-west European waters. Joint Nature Conservation Committee: 75pp. Maps drawn from data on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	312,500 km² (125 x 2500km²)
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	No abundance estimate available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	-
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	
2.5.2 Area estimation	377500 km² (151 x 2500 km²) (includes deep water, shelf edge and some continental shelf waters)
2.5.3 Date of estimation	January 2007
2.5.4 Quality of data	2= moderate
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information

2.7.1 Favourable reference range	312,500 km²
2.7.2 Favourable reference population	-
2.7.3 Suitable Habitat for the species	377,500 km²
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: potential disturbance due to increased seismic activity may displace from preferred habitats
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:4,500,000

0 25 50 100 Kilometers

Northern Bottlenose whale
Hyperoodon ampullatus

5033

Current Distribution (5 cells)
Current Range (125 cells)
Favourable Reference Range (125 cells)
50km grid cells

Date: January 2008

Gervais beaked whale

Data	*Comments/Guidelines for reporting data*
1. National Level	
Species code	Gervais beaked whale (5034)
Member State	IE
Biogeographic regions concerned within the MS	MATL
1.1 Range	
Map	No sighting records

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	MATL
2.2 Published sources	Berrow, S.D. and Rogan, E. (1997) Cetaceans stranded on the Irish coast, 1901-1995. Mammal Review 27(1), 51-76. Bruton, T. Cotton and Enright (1989) Gulf-stream beaked whale *Mesoplodon europeaus* (Gervais). Irish Naturalists' Journal 23(4), 156. Strandings data held on the Irish Whale and Dolphin Group database on-line at www.iwdg
2.3 Range	
2.3.1 Surface area	Unknown
2.3.2 Date	Data from 1991-2006 inclusive
2.3.3 Quality of data	1= poor
2.3.4 Trend	Unknown
2.3.6 Trend-Period	N/A
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	1 stranding record from Co Sligo
2.4.1 Population size estimation	None available
2.4.2 Date of estimation	-
2.4.3 Method used	-
2.4.4 Quality of data	-
2.4.5 Trend	Unknown
2.4.7 Trend-Period	N/A
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	-
2.4.10 Main pressures	Unknown
2.4.11 Threats	710, 730, 790
2.5 Habitat for the species	
2.5.1	Unknown
2.5.2 Area estimation	Habitat requirements not known
2.5.3 Date of estimation	-
2.5.4 Quality of data	-
2.5.5 Trend	-
2.5.6 Trend-Period	-
2.5.7 Reasons for reported trend	-
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	Unknown
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	Positive Impacts: diet of squid of which stocks are less likely to be depleted due to overfishing Negative impacts: No information on distribution or abundance. Potential disturbance due to increased seismic activity may displace from preferred habitats

2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)

Parameter	**Conservation Status**			
	Favourable ('green')	**Unfavourable - Inadequate ('amber')**	**Unfavourable - Bad ('red')**	***Unknown (insufficient information to make an assessment)***
2.3 Range				*No or insufficient reliable information available*
2.4 Population				*No or insufficient reliable information available*
2.5 Habitat for the species				*No or insufficient reliable information available*
2.6 Future prospects				*No or insufficient reliable information available*
Overall assessment of CS				UNKNOWN

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland
2. Habitat mapping
3. Habitat Range
    3.1 Conservation status of habitat range
4. Habitat Area
    4.1 Conservation status of habitat area
5. Structures and Functions
    5.1 Habitat structures and functions
        5.1.1 Conservation status of habitat structures and functions
    5.2 Typical species
        5.2.1 Conservation status of typical species
6. Impacts and Threats
7. Future Prospects
    7.1 Negative future prospects
    7.2 Positive future prospects
    7.3 Overall habitat future prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

APPENDICES

Appendix I – Description of Coastal Monitoring Project 2004-2006
Appendix II – Summary of conservation status assessments from Coastal Monitoring Project (Ryle *et al*. 2007)
Appendix III - Glossary

1. Habitat characteristics in Ireland

Foredunes, or embryo dunes, represent the pioneer stages of dune construction. They are defined as small accumulations of sand (not more than 1m in height) at the seaward side of dune systems and are dominated by the presence of *Elytrigia juncea* and/or in some cases *Leymus arenarius*. Both of these grasses are salt-tolerant species that impede airborne sand. Irish foredunes display a close correspondence with the ‘embryonic shifting dunes’ (code: 2110) Annex 1 habitat type.

Foredune vegetation is assigned to the Agropyro-Honckenyion peploidis within the Ammophiletea (Marram grass class), which includes pioneer vegetation of rhizomatous plants on young and mobile coastal sand dunes in Atlantic and Mediterranean Europe (White & Doyle 1982). Some foredune vegetation can be assigned to two readily recognized associations, the Agropyretum boreo-atlanticum (owing to the presence of the differential species *Leymus arenarius*) and the Euphorbio agropyretum juncei (owing to the presence of the differential species, *Euphorbia paralias* and *Calystegia soldanella*).

The vegetation of the Agropyro-Honckenyion peploidis alliance displays strong affinities with the *Elymus farctus* ssp. *boreo-atlanticus* foredune community (SD4) from the BNVC classification scheme used in Britain (Rodwell 2000). It is also synonymous with vegetation referred to as Agropyretum juncei (Tansley 1911, 1939), Agropyron junceiforme (Géhu & Géhu 1969), Agropyron junceiformis (Tx. 1945 in Br.-Bl. & Tx. 1952), *Elytrigia juncea*-typ (Petersen 1965) and Elymo-Agropyretum junceiforme (Tüxen 1955).

Géhu and Géhu (1969) suggested redefining the Agropyro-Honkenyion peploidis alliance to what they termed an Agropyrion boreo-atlanticum to avoid confusion with the strandline vegetation of the Salsolo-Honkenyion. The frequent occurrence of the Agropyro-Honkenyion peploidis as a mosaic with communities of the Salsolo-Honkenyion, however, makes these two communities difficult to differentiate accurately at the best of times. The distinction between the two communities is the presence of *Elytrigia juncea* in the Agropyro-Honkenyion peploidis, while *Honckenya* can be commonly found in both.

Foredune communities are limited in their species diversity primarily owing to the severity of the environmental conditions that are experienced in the upper beach location. The substrate is highly unstable, with mobile wind-blown sand. The availability of nutrients is low and there is an absence of organic soil and humus. Soil moisture levels are low and the habitat is subject to salt spray and occasional tidal inundation. Exposure increases the risk of water loss due to desiccation of plants. Plants that grow in this habitat are highly specialised and adapted to cope with these harsh environmental conditions.

The vertical and horizontal growth of dunes depends on an interaction between sand supply, vegetation and wind (Carter 1988). Two distinct types of foredunes are recognised: embryonic and ephemeral. Embryonic (or embryo) dunes are the precursors of more permanent dune landforms. Ephemeral dunes generally form in front of eroding unstable dune faces, where most of the sediment supply originates from the dunes to the rear, with some additions from the beach.

Embryo dunes are most common on prograding, regressive coasts where their upward growth potential is only limited when the foredunes become sheltered by further progradation, migrate inland or increase in size. In Ireland, however, foredunes generally function as a repeatedly renewed pioneer assemblage, particularly along the more exposed stretches of beach.

Ephemeral dunes are unstable and are highly susceptible to removal by storms or high tides. Their development is as much a result of wind direction and intensity as the occurrence of tidal drift lines and existing vegetation. In some cases, where the winds are offshore, the foredune forms as a lee-side ramp (Carter 1988). This type of foredune is more commonly found in Ireland than true embryonic dunes of actively prograding systems, with the exception of a few sites including Bull Island (Co. Dublin), Inch (Co. Kerry), Inishcrone, Strandhill (both in Co. Sligo) and Lunniagh (Co. Donegal). The scarcity of well-developed foredune communities in Ireland is mainly due to sediment depletion. Historically, most of the sediment involved in the construction of Irish dune systems was derived from glacial material deposited offshore at the end of the last Ice Age (Carter & Wilson, 1991). Most of this has been depleted as a potential sediment source for dune systems. Modern foredune communities are generally the result of local reworking of sediment.

At most sites the *Elytrigia juncea*-dominated foredune communities occur in close association with the Cakiletalia maritimae, often forming an ill-defined linear mosaic along the top of the strandline. This is most notable in areas where the periods of erosion and accretion are erratic. Where erosional episodes are reduced and accretion can continue unchecked a wider, more defined band of *Elytrigia juncea* foredunes develops. These may be distributed over gently undulating stretches of sand, or on distinct dunes. These can be few and irregularly distributed, or numerous, rising in height towards the beach top and oriented in lines parallel to the shore.

Foredune communities tend to be greatly reduced or absent at many of the west coast sites (Curtis 1991b). This appears to be the combined result of sediment source depletion and exposure to strong winds and frequent storms. At these sites episodes of accretion and erosion are erratic. Where sand supply is not a limiting factor, a transition from strandline, through foredune to yellow dune is displayed.

Most of the following assessment is based on the results of the Coastal Monitoring Project (Ryle *et al*. 2007), details of which can be found in Appendices I & II.

2. Habitat mapping

As part of the Coastal Monitoring Project, Ryle *et al*. (2007) updated the original national coastal inventory produced in Curtis (1991a). Additional or potential sites were identified through the analysis of aerial ortho-photographs (year 2000 series, Ordnance Survey of Ireland), information received from NPWS conservation staff and extensive ground surveys (see Appendix II). Each of the sites identified (with the exception of 4, which were not accessible) was visited over the course of 3 field seasons (2004-2006) and surveyed using GPS (Ryle *et al*. 2007). A habitat map was produced for each site by importing the mapping data into Arcview 3.2 and overlaying it on the year 2000 series ortho-aerial photographs. The area of each individual Annex I sand dune habitat was mapped at a total of 181 sites. The habitat maps produced in Ryle *et al*. (2007) were used to map the distribution and range of embryonic shifting dunes in Ireland on a 10km square basis.

3. Habitat Range

The mapping of habitat range is defined by the smallest polygon size containing all grid squares where the habitat was recorded, drawn using a minimum number of 90 degree angles. Gaps in the habitat distribution of at least 2 square grids, as a result of unsuitable ecological conditions for the development of the habitat were deemed enough to justify a break in the range.

The current distribution of embryonic dunes is widespread, but confined to sandy beaches. Gaps in the current range of this habitat along the coastline are explained by the absence of suitable coastline for this habitat to develop (e.g. hard steep sea cliffs). The current distribution is thought to correspond to the historical range, with any minor changes attributed to an improvement in the quality of the data.

3.1 Conservation status of habitat range

The habitat range at the beginning of the assessment period (1996) is taken as the favourable reference range (FRR) as it encompasses the ecological variation of this habitat. The current range is the same as the favourable reference range. However, it should be emphasized that the figure for both the current area and range should be treated with some caution in view of the often ephemeral and highly dynamic nature of the habitat.

The habitat is still widespread within the relevant geographical range around the coast of Ireland and all sub-types are still present. Embryonic dune habitat range encompasses a total of 129 x 10km grid cells and the habitat is found at 116 sites. The historical habitat range is unlikely to have been greater compared to the current FRR.

Small losses of embryonic dune habitat during the current assessment period have not affected the current range. The habitat range of embryonic shifting dunes is assessed as **favourable**.

4. Habitat Area

The total national area of embryonic shifting dune from the Coastal Monitoring Project (Ryle *et al*. 2007) is estimated at 1.653km^2 (165.3ha). This is considerably lower than the previous figure of 9.4988km^2 from 32 designated sites and is taken from the NATURA 2000 database. However, the figure in the NATURA 2000 database is based on estimates and lacks ground truthing. In addition, the minimum value that could be attributed to a habitat in the database was 1%, leading to a probable exaggeration of the area. The CMP, on the other hand, accurately mapped the habitat. Therefore, it cannot be assumed that this represents a significant loss in the area of the habitat.

4.1 Conservation status of habitat area

The favourable reference area (FRA) is taken as the habitat area at the beginning of the reporting period (1996) as it is considered enough to ensure long term survival of the habitat. The guidelines state that the current area cannot be less than the area at the time of the Directive coming into force. Ryle *et al.* (2007) recorded a loss of area from a total of 63 sites out of 116. Of these 42 were rated as unfavourable-inadequate (U1) and 21 unfavourable-bad (U2). In most cases, however, this loss was not quantified. The current national habitat area is estimated to be 165.3 ha from (Ryle *et al.* 2007). In order to estimate the original area the following extrapolation was made from the dataset. It is assumed that the area of sites with a U1 rating have decreased by 1% and those with a U2 rating by 1.15%. This produces an original estimated area of 176.31ha, although this figure must be treated with some caution in view of the highly ephemeral and cyclical nature of the habitat.

The conservation status of the habitat area is assessed as **unfavourable-inadequate (UI)** because approximately 2.72% (4.8ha) of the favourable reference area has been lost in the current reporting period. However, this figure should be treated with caution in view of the ephemeral and highly dynamic nature of this habitat.

5. Structures and Functions

The following generalised attributes were assessed for Irish sand dune habitats at 181 sites, of which 116 possessed embryonic dunes (Ryle *et al*. 2007). These attributes and their targets have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of dune habitats and machair (JNCC 2004) with inputs from NPWS, Research Branch staff.

- Habitat extent
- Physical structure
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation structure: sward height
- Vegetation composition: typical species
- Indicators of negative trend
- Other negative indicators

Indicators of local distinctiveness, such as notable plant species or vegetation mosaics. These are site-specific features, which are not adequately covered by the other attributes.

5.1 Habitat structures and functions

When individual site data from Ryle *et al*. (2007) is combined, it reveals that out of 254 monitoring stops carried out in 2006, only 9 (i.e 0.4%) failed (attributes did not reach their targets). Overall, 94 sites (81%) surveyed during 2006 (Ryle *et al*. 2007) were assessed as having favourable structure and functions, 16 sites (13%) had an unfavourable-inadequate conservation status and 6 sites (6%) were assessed as having an unfavourable-bad conservation status. Analysis of the % area of the total national resource, however, reveals that 91% of the total area was rated as favourable, while 7% was rated unfavourable-inadequate and only 2% was rated unfavourable bad.

It should be noted, however, that it would be very unusual for a monitoring stop to fail in the embryonic dune habitat. The harshness of the environment (high salinity, mobile substrate, etc.) mean that it is very unlikely to support any species other than those typically found in this habitat. The few stops that did fail, failed on the basis of flowering and fruiting.

Based on the current data and best expert opinion, the conservation status of the habitat structure and functions is assessed as **unfavourable-inadequate**.

5.2 Typical Species

An important distinction between strandlines and foredunes is the gradual shift from the dune-initiating species of the strandlines (*Salsola kali, Cakile maritima* and *Honckenya peploides*) to dune-building foredune species (*Elytrigia juncea* and *Leymus arenarius*). It is the dune-building species that actively trap and stabilise the wind-blown sand in the foredune situation.

The dominant species in Irish foredunes is the salt-tolerant perennial grass, *Elytrigia juncea.* Pseudonyms include *Agropyron junceum*, *Elymus juncei, Triticum junceum*, *Agropyron junceiforme* and *Elymus farctus* ssp *boreali-atlanticus*. This species is widespread on sandy coasts of the British Isles and Western Europe. It has also been introduced into sites along the northeast coast of America (Hubbard 1984).

Initial colonisation by *E. juncea* can be by seed or rhizome fragments that are washed or blown onto small patches of sand that accumulate around strandline plants or their dead remains. Early growth after colonisation is in the form of rosettes of shoots, spreading across the surface of the sand. Growth of this perennial species is rhizomatous, spreading by long, wiry underground stems, which produce sympodial branches. The shoots are distinctly glaucous and reach heights ranging from 20cm to 60cm. The seedlings and single-node pieces of rhizome can withstand burial to depths in excess of 13cm, but cannot tolerate depths of 18cm. Multi-node fragments yield greater emergence results at depth than single node fragments (Harris & Davy 1986). It can also tolerate some degree of sea-water inundation (Gimingham 1974, Chapman 1976).

Some Irish foredunes support *Leymus arenarius*, particularly at sites along the east coast. This is a robust grass species that forms large tufts produced from a creeping rootstock. The glaucous leaves are broad and rigid. It is an effective sand-binder, growing best in loose sand at the seaward side of dunes. This species, which is more robust than *Elytrigia juncea*, was deliberately introduced to County Antrim in Northern Ireland to stabilise dune areas (Scannell & Synnott 1987). Since its introduction, its distribution has extended to at least eight coastal counties in the Republic of Ireland (Synnott 1967). Counties in which *Leymus* is found include Louth, Meath, Dublin, Wicklow, Wexford, Cork, Mayo and Donegal

(Preston *et al*. 2002). It is considered to be naturalized in the Republic of Ireland (Scannell & Synnott 1987, Webb *et al.* 1996), although it is suspected that it may have been deliberately introduced into a number of its current stations (Moore 1977, Doogue *et al*.1998).

Other species occasionally occur, though they may be locally frequent. These include *Honckenya peploides, Atriplex prostrata, Salsola kali, Cakile maritima* and *Tripleurospermum maritimum*, all of which are typically associated with strandlines. These species are often found together with *Elytrigia juncea* where sand accumulation is not excessive. They may persist as remnants after *Elytrigia* has begun to take hold. They may also occur on patches of tidal litter thrown up on the foredunes by extremely high tides or during storms. This being the case, subsequent sand accumulation will soon overwhelm these species. A number of yellow Asteraceae are found occasionally. These include *Senecio jacobaea*, *S. vulgaris*, *Hypochaeris radicata, Leontodon saxatilis, Sonchus oleraceus* and *S. arvensis*. These Asteraceae possess long tap root systems that help anchor them in the unstable sand.

5.2.1 Conservation status of habitat typical species

The presence of typical or characteristic species was one of the attributes assessed for structure and functions during the Coastal Monitoring Project (Ryle *et al*. 2007). Only *Elytrigia juncea, Leymus arenarius* and *Euphorbia* spp. were considered typical species for this habitat by Ryle *et al*. (2007). Only 3 monitoring stops failed to reach the target for characteristic species out of 254 stops carried out over 116 sites (Ryle *et al*. 2007).

The conservation status of typical species of embryo dunes is assessed as **favourable,** considering that targets were generally reached for typical species.

6. Impacts and Threats

There are several sources of information about impacts and activities affecting embryonic dunes in Ireland, including Curtis (1991b) and Crawford *et al*. (1996). However, the most comprehensive source of information is Ryle *et al*. (2007), who summarised the main impacts affecting dunes surveyed at 181 sites during 2004 to 2006 (Table 1). The four impacts noted in embryonic dunes at more than three of the survey sites are listed in Table 1. An additional 16 impacts were recorded in embryonic dunes at less than four sites, making a total of 20 different impacts recorded for the habitat.

Table 1 Most frequently recorded impacts in Embryonic shifting dunes; number of sites at which the impacts were recorded and the total area affected by each impact

Code	Impact/Activity	Number of sites	Total area affected (ha)
900	Erosion	56	17.4
622	Walking, horseriding and non-motorised vehicles	49	32.9
720	Trampling, overuse	19	11.8
871	Sea defence or coastal protection works	16	5.3

Total number of sites at which the habitat was present = 116
Total habitat area = 171.5ha

The limited number of commonly occurring impacts partly reflects the difficulty in recognising certain activities in the more dynamic zones of dune systems, e.g. the affects of *sand extraction* or *motorised vehicles* may be discernible for only a very short period after the activity has occurred and are therefore probably under-recorded.

As is the case with a number of other habitats, *erosion* and *walking*, *horseriding and non-motorised vehicles* were the two most commonly recorded impacts in embryonic dunes, and indeed the four impacts in Table 1 are those that were noted at more than one survey site in annual vegetation of driftlines (EU habitat code: 1210). The total number of sites affected by *erosion* may still be underestimated, as the impact is generally not listed at sites from which the habitat is currently absent, despite the fact that the absence may in fact be due to recent erosion events. The majority of individual site areas were also recorded as ‘unknown’ and therefore do not form part of the overall area. The establishment here of baseline data on the extent of all sand dune habitats will identify those sites at which habitats not present during a particular survey cycle were formerly present and will therefore enable greater refinement of the lists of impacts and activities in future monitoring cycles. However, the fact that foredune and strandline habitats naturally contain a high proportion of bare sand creates difficulties in recognising the impact of activities such as *trampling*, *overuse* or *sand extraction*.

Recognising eroding or accreting embryonic dunes can be difficult due to the limited data available on most sand dune sites. There are very few accreting embryonic dunes throughout the coastline and embryonic dunes are generally less well developed on the west coast than elsewhere. The habitat was mapped at 116 sites – significantly less than the 140 sites at which mobile dunes were present. Where embryonic dunes are apparently accumulating, it is often due to the local recycling of sediment, rather than a substantial build-up arising from a fresh input of sediment into the dune systems. Good quality data, based on accurate GPS mapping, on the extent of habitats at all individual significant sand dune systems and consequently the total national extent of habitats will provide significant insights into the long-term fluctuations of habitat areas, although sediment budget studies of coastal cells would be desirable, if the issues were to be more thoroughly resolved.

Only four separate impact records, which were described under *sand and gravel extraction*, *removal of beach materials* or *sea defence/coastal protection works*, were considered to represent an irreparable negative influence in embryonic dunes. The areas of three of these were considered 'unknown', while the fourth (included under *sea defence/coastal protection works*) was estimated as 0.4ha. However, a certain amount of under-recording, particularly in *sand and gravel extraction* and related impacts, should be considered, as the affects of these activities are likely to be discernible for only a short time after the occurrence.

One of the typical embryonic dune species, *Leymus arenarius*, has been introduced at east coast sites for the purposes of dune stabilisation (Curtis, 1991b). Although planting may perhaps have been concentrated in the mobile dune zone, where the species is also part of the typical vegetation, the introduction of the species has represented a source from which further colonies, perhaps comprising embryonic dunes, may have established. Such effects will have gone largely undetected and may point to an underestimation of the affects of this form of dune protection works. Although the different forms of coastal protection works observed were sometimes viewed differently in terms of their influence, any interference with the natural mobility of a system should, in general, be regarded as undesirable.

Recreational activities have caused severe damage to foredune communities at many Irish dune sites, particularly along the east coast, where visitor numbers are high. Visitors tend to concentrate in the foredune area. The main growing season for foredune plant species is May to July, which coincides with the tourist season. Where accretion rates are higher and recreational pressures are reduced a wide band of foredunes dominated by *Elytrigia juncea* may develop.

7. Future Prospects

The future prospects for Annex I sand dune habitats at each site are based on an assessment of the threats posed or potential benefits likely to accrue from various impacts and activities. These can include management regimes (e.g. coastal protection works and beach cleaning), recreational activities (e.g. walking and horse-riding), agricultural practices (e.g. overgrazing and stock feeding) and potential developments.

There is no threshold for future prospects and the final result is based on a best scientific judgement. Most recorded impacts refer to activities noted during site surveys, although other sources of comparative information include NPWS site notes (NHA and NATURA 2000 information), while relevant data from other agencies such as county councils were also evaluated. NPWS conservation plans, where available, were reviewed and were taken into account when making a final determination.

7.1 Negative future prospects

The Coastal Monitoring Project 2006 (Ryle *et al.* 2007) reported that 38 sites supporting embryonic dune habitat (out of a total of 116) were assessed as having a favourable conservation status for future prospects, while 56 sites were unfavourable-inadequate and 16 sites were unfavourable-bad. The relatively poor rating can be attributed to the on-going issue of erosion. Recreational pressure and construction of coastal protection works represent the main future threats that could exacerbate the problem. This site-specific assessment is highly subjective and was based mainly on the assumption that current factors such as coastal erosion which were negatively affecting the structure and functions of many of these sites were likely to continue in the future.

7.2 Positive future prospects

Statutory site designation plays an important part in the conservation of all dune habitats, including embryonic dunes, through the designation of Special Areas of Conservation (SACs) and Natural Heritage Areas (NHAs). A significant proportion of these embryonic shifting dune sites are completely or partially located within cSACs (77.58%), with some additional sites within pNHAs (13.79%) and they should, therefore, be partially protected from development and damage. Notifiable actions, which require consent from the Department of Environment, Heritage and Local Government, have been set for sand dune habitats within SACs.

At a number of sites that are subject to intense recreational pressure, the local authorities now prevent motorised vehicles from accessing the beaches (e.g. White Strand, Co. Clare) or restrict their movement through the use of boulders (e.g. Bull Island, Co. Dublin). This can, however, lead to pressure to develop car parks on other dune habitats, particularly fixed dunes and dune slacks. Dune rehabilitation works are on-going at a number of sites, (e.g. Fanore, Co. Clare), where the frontal dunes have been fenced off to restrict public access. These measures can result in the re-establishment of embryonic dunes, as is the case at Fanore.

7.3 Overall habitat future prospects

The habitat future prospects are assessed as **unfavourable inadequate,** as the long term viability of the habitat is not assured. Recreational pressure is unlikely to decrease, however, measures to limit the impacts of humans can be put in place. The impacts of sea level rise and coastal erosion, however, are likely to lead to an increased demand for coastal protection works, which are likely to a negative impact on the embryonic shifting dune habitat in the future.

8. Overall Assessment of the Habitat Conservation Status

The habitat conservation status of the four main attributes has been assessed either as **Favourable** or **Unfavourable-Inadequate** at national level.

- The Natural Range of embryo dune habitat is considered to be **Favourable**. The Favourable Reference Range is considered to be equal to the current range of embryonic shifting dunes.
- The Area of embryo dune habitat is estimated to have decreased by about 2.72% in an ten year reporting period (1996-2006), although this figure must be treated with caution in view of the highly ephemeral nature of this habitat. With this in mind, this attribute was assessed as **Unfavourable-Inadequate**.
- The Habitat Structure and Functions have been assessed as **Unfavourable-Inadequate**. Of the 254 monitoring stops recorded in this habitat, only 9 stops failed to meet the targets, while 91% of the total habitat area is rated as favourable and functioning naturally.
- The Future Prospects are assessed as **Unfavourable-Inadequate**. The demand for coastal protection works is likely to increase in the face of sea level rise and coastal erosion associated with climate change.

Based on the above assessments, the overall conservation status for embryo dune habitat is **Unfavourable-Inadequate**.

9. References

Braun-Blanquet, J. and Tüxen, R. (1952). Irische pflanzengesellschaften. *Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich*, **25**: 224-415.

Carter, R.W.G. (1988). *Coastal environments. An introduction to the physical, ecological and cultural systems of coastlines.* Academic Press, London.

Carter, R.W.G. and Wilson, P. (1991). Chronology and geomorphology of the Irish dunes. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.), 18-41. European Union for Coastal Conservation, Dublin.

Chapman, V.J. (1978). *Coastal Vegetation*. 2nd edition. Pergamon Press, London.

Commission of the European Communities (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal no. L 206, 22/07/92.

Commission of the European Communities (2003) *Interpretation manual of European Union Habitats*. Version EUR 25). European Commission DG XI. Brussels.

Curtis, T.G.F. (1991a). The Flora and Vegetation of Sand Dunes in Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Curtis, T.G.F. (1991b). A site inventory of the Sandy Coasts of Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Doogue, D., Nash, D., Parnell, J., Reynolds, S. and Wyse Jackson, P. (1998). *Flora of County Dublin.* Dublin Naturalists' Field Club, Dublin.

Géhu, J.-M. and Géhu, J. (1969). Les associations végétales des dunes mobiles et des bordures de plages de la côte Atlantique française. *Vegetatio*, **18**: 122-166.

Gimingham, C.H. (1974). Plant communities of the machair and floristic relationships with non-dune vegetation. In: *Sand dune machair*, (D.S. Ranwell, Ed.), 13-14. Natural Environment Research Council, Institute of Terrestrial Ecology, Cambridge.

Harris, D. and Davy, A.J. (1986). Regenerative potential of *Elymus farctus* from rhizome fragments and seed. *Journal of Ecology*, **74**: 1057-1067.

Hubbard, C.E. (1984). *Grasses*. 3rd edition. Penguin Books, London.

JNCC. (2004). *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough.

Moore, J.J. (1977). Vegetation of the dune complex. In: *North Bull Island, Dublin Bay, a Modern Coastal Natural History* (Jeffrey, D. Ed.), 104-106. Royal Dublin Society, Dublin.

Petersen, H. (1965). The Collembola of the Hansted Reserve, Thy, North Jütland. *Entomologiske Meddelser*, **30**: 313-395.

Preston, C.D., Pearman, D.A. and Dines, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford.

Ranwell, D.S. (1972). *Ecology of salt marshes and sand dunes.* Chapman and Hall, London.

Rodwell, J.S. (2000). *British plant communities. Vol V: Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge.

Ryle, T., Connolly, K., Murray, A. and Swann, M. (2007). *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished)

Webb, D.A., Parnell, J. and Doogue, D. (1996). *An Irish Flora* (7th edition). Dundalgan Press, Dundalk.

White, J. and Doyle, G.J. (1982). The vegetation of Ireland : a catalogue raisonné. *Journal of Life Sciences*, *Royal Dublin Society*, **3**: 289-368.

APPENDICES

APPENDIX I

Coastal Monitoring Project 2004-2006 (Ryle *et al*., 2007)

The Irish coastline, including the islands, extends to 6,000 kilometres, of which approximately 750 kilometres is sandy (Curtis 1991a). The systems range from simple sandhills to fully developed dune complexes, ranging from ephemeral strandline to dynamic embryonic and mobile dunes to fixed dunes, dune slacks and machair plains. The sand dune resource is under threat from a number of impacts – primarily erosion, changes in agricultural practices and development of land for housing, tourism and recreational purposes. This project, carried out on behalf of the National Parks and Wildlife Service (NPWS), is designed to meet Ireland's obligation under Article 17 of the EU Habitats Dierctive, in relation to reporting on the conservation status of Annex I sand dune habitats in Ireland. The following habitats were assessed:

- Annual vegetation of driftlines (1210)
  - Perennial vegetation of stony banks (1220)
  - Embryonic shifting dunes (2110)
  - Shifting dunes along the shoreline with *Ammophila arenaria* (2120)
  - Fixed dunes with herbaceous vegetation (Grey Dunes) *(2130)
  - Decalcified fixed dunes with *Empetrum nigrum* *(2140)
  - Atlantic decalcified fixed dunes (Calluno-Ulicetea) *(2150)
  - Dunes with *Salix repens* ssp *argentea* (Salicion arenaria) (2170)
  - Humid dune slacks (2190)
  - Machair (21AO)*+

* indicates a Priority Habitat   + Priority Habitat in Ireland only

The project had a number of stated objectives, including:

- Update the inventory of Irish sand dune systems (Curtis 1991a)
- Develop a monitoring programme for Irish sand dune habitats
- Establish the area of total national resource of each habitat
- Produce fully digitised habitat maps for each coastal dune site
- Assess the conservation status of each habitat at all sites
- Establish a database in which the results of this and future sand dune habitats monitoring could be entered and analysed

The project is notable in that it represents the first comprehensive assessments of sand dune systems and their habitats in Ireland. Over the course of three field seasons (2004-2006), all known sites for sand dune habitats were assessed (only 4 sites were not visited owing to access problems). The original inventory of sand dune systems by Curtis (1991a) listed 168 sites for the Republic of Ireland. During the current survey, analysis of ortho-aerial photographs and additional information supplied from NPWS staff increased the site list to 181 sites (Table 1). In addition, 15 sub-sites are recognised on the basis that they are geographically isolated from the main site and are subject to different management regimes.

Detailed site reports provide a clearer understanding of the habitat area, processed and impacts and the conservation status of the sand dune habitats at individual sites. All of the results have been entered into a Coastal Monitoring Project database, which will enable a convenient method of accessing specific data.

The overall condition of each habitat was determined following a methodology that was adapted from the Joint Nature Conservancy Council (the statutory adviser to the UK Government on national and international nature conservation issues), which has been conveyed in a series of Common Standards Monitoring (CSM) guidance documents (JNCC, 1998 and 2004a, b & c). It employs rapid assessment techniques that can be easily repeated in the future implementation of the monitoring programme. This system is based on vegetation surveys, measurement of habitat areas, and assessments of threats and management practices.

The specific attributes that determine the conservation status of a habitat at a site are:

- **Habitat extent (Area)**
- **Structure and Functions** including presence and abundance of typical species, presence and abundance of negative indicator species, bare ground, short turf cover, sward height, plant health and scrub cover (where applicable). Other criteria relating to particular habitats such as cover of *Salix repens,* and the ratio of forbs and grasses in dune slacks.
- **Future prospects** including a number of factors such as
– Threats and their impacts on the site e.g. recreational activities, agricultural practices, development of land
– Management of the site e.g. coastal protection works, beach cleaning etc.
– Indicators of local distinctiveness such as notable plant species or vegetation mosaics

Habitat area is based on survey work using GPS, examination of aerial photographs and the production of detailed GIS maps. Structure and Functions was determined from monitoring stops that were carried out in all habitats and at most sites. Future Prospects are based on apparent impacts/threats to the site or a particular habitat that are likely to occur in the future. Attributes are assigned either a 'Favourable', 'Unfavourable-Inadequate', or 'Unfavourable-Bad' category, using criteria outlined in Chapter 2 of Ryle *et al*. (2007). The Overall Conservation Status is a synthesis of all the collected data. It is derived using the least favourable attribute. In addition, the overall conservation assessment of a habitat takes into account the overall range of the habitat within a biogeographical region.

Table 1 Comparative table highlighting the changes between the original inventory of Irish sand dune sites (Curtis 1991a) and the final site list used in the Coastal Monitoring Project 2004-2006 (Ryle *et al*. 2007).

County	National Site Inventory	New Sites	Sites to be deleted*	Coastal Monitoring Inventory
Louth	2			2
Meath	2			2
Dublin	8			8
Wicklow	10			10
Wexford	21	1		22
Waterford	7	1	3 + 1	8
Cork	10	3		13
Kerry	15		1	14
Clare	8			8
Galway	18	*1*		19
Mayo	22	2		23
Sligo	8			8
Donegal	37	5		42
Total	**168**	**13**	**5**	**181**

* These sites were surveyed as part of the Coastal Monitoring Project but no longer support sand dune habitat and may be deleted during the next monitoring cycle.

Appendix II – Summary of conservation status assessments of Embryonic shifting dunes (Annex I habitat 2110) in Ireland, taken from Coastal Monitoring Project (Ryle *et al*. 2007). Green = Favourable, Amber = Unfavourable-Inadequate, Red = Unfavourable-Bad.

CMP Site name	CMP Site code	Area (ha)	County	Extent	Structure and function	Future prospects	Overall	Comment
Agleam	124	1.476	Mayo	Green	Green	Green	Green	All attributes favourable (FV)
Aillebrack	100	0.559	Galway	Red	Green	Red	Red	Extent and Future Prospects are assessed as U2 due to erosion, and the limited extent and poor zonation of habitat.
Ardamine	26	0.06	Wexford	Red	Green	Amber	Red	Extent rated U2 owing to destruction of the habitat through erosion. Future prospects rated U1due potential re-establishment of habitat.
Ards	165	0.108	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to the limited distribution and zonation of habitat, an excessive cover of unhealthy vegetation, and recreational pressures.
Arklow North	20	0.429	Wicklow	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Arklow South	21	0.09	Wicklow	Green	Green	Red	Red	Future Prospects are assessed as U2 due to heavy recreational pressures.
Askintinny	22	0.103	Wicklow	Red	Green	Red	Red	Extent and Future Prospects are assessed as U2 due to erosion, and the limited extent and poor zonation of habitat.
Augrusbeg	105	0.243	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Ballybla	14	0.059	Dublin	Amber	Green	Amber	Amber	Extent and Future Prospects rated U1 due to scarcity of habitat and ongoing erosion.
Ballydavid	73	0.222	Kerry	Red	Green	Amber	Red	All attributes U2 due to limited extent, and continued disturbance of habitat from erosion and recreational developments.
Ballymacoda	54	0.817	Wexford	Red	Red	Amber	Red	Extent and Structure and Function rated U2 due to limited extent caused by erosion and presence of negative indicator species.
Ballymastocker	173	0.964	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 as a result of natural erosion and anthropogenic activities.
Ballynaclash	33	1.278	Wexford	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to recreational pressures.
Ballyness	161	2.3	Donegal	Green	Green	green	Green	All attributes favourable (FV)
Baltray	2	2.617	Louth	Green	Amber	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to recreational pressures.

Banna Strand	77	2.243	Kerry	Amber	Green	Green	Amber	Extent rated as U1 due to restricted distribution of habitat.
Bartragh Island	131	0.749	Mayo	Green	Green	Green	Green	All attributes favourable (FV)
Beal Point	80	1.26	Kerry	Amber	Green	Green	Amber	Extent is assessed as U1 due to erosion caused by sand and gravel extraction.
Bishopsquarter	88	0.033	Clare	Amber	Green	Amber	Amber	Extent is assessed as U1 due to the limited area and poor zonation of habitat. Future Prospects are assessed as U1 due to recreational pressures and intensive agricultural management.
Brittas Bay	17	0.647	Wicklow	Amber	Amber	Amber	Amber	Rated U1 due to scarcity of habitat and recreational impacts and erosion.
Cahore Point North	28	4.713	Wexford	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Cahore Point South	29	0.059	Wexford	Red	Green	Red	Red	Extent is assessed as U2 due to the very limited area and poor zonation of habitat. Future Prospects are assessed as U2 due to intense recreational pressures.
Carnboy	156	1.4	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Carnsore	39	4.265	Wexford	Green	Green	Green	Green	All attributes favourable (FV)
Cloghmoyle	110	0.03	Mayo	Amber	Green	Green	Amber	Extent rated U1 due to lack of habitat due to erosion.
Clooney	149	3	Donegal	Green	Green	Amber	Amber	Future Prospects assessed as U1 due to trampling by horses and recreational pressure.
Cruit Lower	154	1.3	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Crummies Bay	175	0.095	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to the limited area and poor zonation of habitat.
Culdaff	181	0.086	Donegal	Red	Red	Amber	Red	Extent is assessed as U2 due to the very limited area of habitat. Structure and functions are assessed as U2 due to an excess of unhealthy *Elytrigia juncea* (Sand couch). Future Prospects are assessed as U1 due to recreational pressures.
Curracloe	34	0.845	Wexford	Amber	Red	Amber	Red	Structure and Functions is assessed as U2 due to recreational pressures.
Derrybeg	157	1.4	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Derrynane	66	1.007	Cork	Green	Green	Green	Green	All attributes favourable (FV)
Dog's Bay (& Gorteen Bay)	97	0.53	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Donaghmore	27	0.217	Wexford	Red	Green	Red	Red	Extent is assessed as U2 due to the very limited area, and poor zonation of habitat. Future Prospects are assessed as U2 due to

								erosion and recreational pressures.
Dooey	160	4.8	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Doonloughan	101	0.615	Galway	Red	Green	Red	Red	Extent and Future Prospects are assessed as U2 due to erosion and sediment depletion in the system.
Duncannon	44	0.243	Wexford	Green	Green	Amber	Amber	Future Prospects rated U1 owing to disturbance of recreational users
Dunfanaghy	163	1.2	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 due to high recreational pressure.
Fahan	174	1.506	Donegal	Green	Amber	Green	Amber	Structure and functions rated U1 owing to presence of negative indicator species associated with large volumes of pedestrian traffic.
Fanore	87	0.283	Clare	Red	Green	Red	Red	Extent is assessed as U2 due to the limited area and poor zonation of habitat. Future Prospects are assessed as U2 due to erosion and sediment depletion in the system.
Fermoyle	74	0.173	Kerry	Amber	Amber	Amber	Amber	All attributes U1 due to limited occurrence and highly disturbed nature of the habitat.
Finish Island	94	0.143	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Finner	140	10.786	Sligo	Green	Green	Green	Green	All attributes favourable (FV)
Fintragh	145	1.219	Donegal	Amber	Amber	Amber	Amber	All parameters are rated as U1 due to hard coastal protection.
Glen Bay	146	0.126	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U2 due to erosion, and the limited area of habitat.
Gowlaun	107	0.223	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Grange	43	1.439	Wexford	Green	Green	Amber	Amber	Future Prospects rated U1 owing to net erosion at the site.
Harbour View	57	0.648	Cork	Green	Green	Green	Green	All attributes favourable (FV)
Inch	70	14.405	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Inchydoney	58	0.051	Cork	Red	Amber	Red	Red	Extent is assessed as U2 due to the negligible area and poor zonation of habitat. Structure and functions are assessed as U1 due to presence of much unhealthy vegetation. Future Prospects are assessed as U2 due to heavy recreational pressures.
Inishbofin	106	0.468	Galway	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to erosion, recreational pressures, and the restricted area of habitat.
Inisheer	89	0.257	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Inishmaan	90	1.563	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Inver	144	0.295	Donegal	Amber	Red	Red	Red	Structure and functions are assessed as U2 due to the common

								occurrence of negative indicator species. Future Prospects are assessed as U2 due to erosion and the intensive agricultural use of the site.
Ireland's Eye	8	0.158	Dublin	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to natural erosion compounded by recreational pressures.
Keadew	153	0.466	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Kilgorman	24	0.71	Wexford	Amber	Green	Red	Red	Extent is assessed as U1 due to the limited area and restricted zonation of habitat. Future Prospects are assessed as U2 due to recreational pressures and the spread of scrub species throughout the system.
Killiney	12	0.189	Dublin	Red	Amber	Amber	Red	Extent rated U2, while structure and functions and Future prospects U1 due to highly disturbed nature of vegetation.
Kilmuckridge	30	0.668	Wexford	Green	Green	Green	Green	All attributes favourable (FV)
Kilpatrick	23	0.22	Wicklow	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to the limited area and poor zonation of habitat, erosion and recreational pressures.
Kincaslough	155	0.056	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due to natural erosion and sand extraction.
Lackan (Subsite)	201	0.066	Sligo	Red	Green	Amber	Red	Extent is assessed as U2 due to the limited area and poor zonation of habitat. Future Prospects are assessed as U1 due to erosion, and intensive agricultural management of the site.
Laytown	4	0.891	Meath	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to recreational pressures.
Leam Lough	125	0.217	Mayo	Red	Green	Amber	Red	Extent is assessed as U2, and Future Prospects assessed as U1 due to the very limited extent and poor zonation of habitat, and sediment depletion in the system.
Lettermacaward	151	1.962	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due to natural erosion and recreational activities.
Lough Cahasy	109	1.034	Mayo	Green	Green	Green	Green	All attributes favourable (FV)
Lough Nagreany	169	0.766	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due to on-going sand extraction.
Lurga Point	83	0.712	Clare	Red	Red	Red	Red	All attributes are assessed as U2 due to the very limited area of habitat, erosion, intensive agricultural management, recreational pressures and trampling.
Maghera (Subsite)	202	0.4	Mayo	Green	Green	Green	Green	All attributes favourable (FV)

Magherabeg	16	1.655	Wicklow	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Malahide Island	7	0.27	Dublin	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to natural erosion compounded by recreational pressures.
Mannin Bay	102	1.331	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Marble Hill	164	0.299	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due to natural erosion and recreational activities.
Mason Island	96	0.173	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Melmore	168	0.098	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Mizen Head	18	0.966	Wicklow	Green	Green	Green	Green	All attributes favourable (FV)
Mornington	3	0.665	Meath	Amber	Amber	Amber	Amber	All parameters are assessed as A1 due to recreational pressures.
Mount Charles	143	0.411	Donegal	Green	Amber	amber	Amber	Structure and Functions are assessed as U1 due to the common occurrence of negative indicator species. Future Prospects are assessed as U1 due to the intensive agricultural management of the site.
Mullanasole	142	3.935	Donegal	Amber	Green	Amber	Amber	Structure and Functions are assessed as U1 due to the presence of hard coastal protection.
Mweenish Island	95	0.115	Galway	Amber	Green	Amber	Amber	Extent and Future prospects rated U1owing to erosion and sediment depletion.
North Bull	10	2.479	Dublin	Amber	Green	Amber	Amber	Extent and Future prospects are assessed as U1 due to erosion and recreational pressures.
Omey Island	104	0.569	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Owenahincha & Little Island Strand	61	0.591	Cork	Green	Green	Amber	Amber	Future prospects are assessed as U1 due to heavy recreational pressures.
Pennycomequick	19	0.354	Wicklow	Green	Green	Green	Green	All attributes favourable (FV)
Portmarnock	9	1.552	Dublin	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to human induced erosion caused by estuarine reclamation and compounded by recreational pressures.
Portmurvy	92	0.121	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Portrane	6	1.672	Dublin	Amber	Green	Red	Red	Future Prospects are assessed U2 due to the recreational pressures and hard coastal protection on the site.
Rosapenna	166	3.081	Donegal	Amber	Green	Amber	Amber	Extent and Future prospects are assessed as U1 due to erosion and recreational pressures.
Roshin Point	150	0.374	Donegal	Green	Green	Green	Green	All attributes favourable (FV)

Rosmurrevagh	112	1.38	Mayo	Green	Green	Green	Green	All attributes favourable (FV)
Ross	130	0.662	Mayo	Amber	Green	Amber	Amber	Extent and Future prospects are assessed as U1 due to erosion and probable sediment depletion.
Ross (Subsite)	200	0.145	Mayo	Red	Green	Amber	Red	Extent is assessed as U2 due to the very limited extent of habitat. Future prospects are assessed as U1 due to erosion and the intensive agricultural management of the site.
Rossbehy	68	0.792	Kerry	Red	Green	Amber	Red	Extent is assessed as U2 due to erosion compounded by recreational pressures. Future prospects are assessed as U1 due to recreational pressures.
Rosses Point	135	32.274	Sligo	Amber	Green	Amber	Amber	Extent/Future Prospects are assessed as U1 due to recreational pressures.
Rosslare	36	1.058	Wexford	Red	Red	Red	Red	All parameters are assessed as U2 as most of the site is managed to protect the properties and infrastructure backing the beach.
Rossnowlagh	141	0.2	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due high recreation and beach cleaning.
Rush Sandhills	5	1.169	Dublin	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to recreational pressures.
Shanagarry	55	1.473	Cork	Green	Green	Green	Green	All attributes favourable (FV)
Sheskinmore	148	8.485	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
South Bull	11	0.448	Dublin	Green	Green	Amber	Amber	Future prospects are assessed as U1 due to erosion and recreational pressures.
Srah North	122	0.461	Mayo	Amber	Green	Amber	Amber	Extent and Future prospects are assessed as U1 due to erosion and recreational pressures.
St. Helen's	37	0.427	Wexford	Amber	Amber	Red	Red	Extent is assessed as U1 and Future prospects assessed as U2 due to erosion and recreational pressures. Structure and Functions are assessed as U1 due to the presence of unhealthy vegetation.
St. Margaret's	38	1.164	Wexford	Red	Amber	Red	Red	Extent and Future prospects are assessed as U2 due to erosion and severe recreational pressures. Structure and Functions are assessed as U1 due to the presence of unhealthy vegetation.
Strandhill	133	0.943	Sligo	Green	Green	Green	Green	All attributes favourable (FV)
Streedagh Point	137	0.424	Sligo	Red	Green	Red	Red	Extent and Future prospects are assessed as U2 due to the limited area and restricted zonation of habitat, erosion and recreational pressures.

Termoncarragh Lough	127	1.305	Mayo	Amber	Green	Amber	Amber	Extent and Future prospects are assessed as U1 due to the limited area and poor zonation of habitat, and sediment depletion in the system.
The Raven	35	1.087	Wexford	Red	Amber	Amber	Red	Extent is assessed as U2 due to the very limited area of habitat. Structure and Functions are assessed as U1 due to the presence of unhealthy vegetation. Future prospects are assessed as U1 due to recreational pressures.
Tinnaberna	31	0.009	Wexford	Amber	Green	Green	Amber	Extent rated as U1 owing to paucity of habitat.
Tramore	46	4.036	Wexford	Green	Green	Amber	Amber	Future prospects are assessed as U1 due to recreational pressures.
Tramore (Subsite)	246	0.266	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Tullagh	177	0.22	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Warren (Creggane)	62	0.423	Cork	Green	Green	Green	Green	All attributes favourable (FV)
Waterville	67	0.547	Kerry	Green	Green	Amber	Amber	Future prospects are assessed as U1 due to ongoing recreational threats.
White Strand	81	0.187	Clare	Green	Green	Green	Green	All attributes favourable (FV)
White Strand	180	0.019	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects rated as U1 high natural erosion.
Yellow Strand	136	0.837	Sligo	Green	Amber	Green	Amber	Structure and Functions is rated as U1 due to natural erosion compounded by human activities.

Total number of sites: 116 (including 4 sub-sites)

Total area of habitat assessed: 165.31 ha

Total area of habitat mapped: 171.51 ha

APPENDIX III

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

CMP – Coastal Monitoring Project

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

DoEHLG - Department of Environment, Heritage and Local Government

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

ENCROACHMENT - The invasion of a species (usually plants) into areas previously uncolonised. This term is often used when an undesirable species advances at the expense of a desirable species or habitat.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FAVOURABLE REFERENCE AREA - Total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability. Favourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FAVOURABLE REFERENCE RANGE - Range within which all significant ecological variations of the habitat/species are included for a given biogeographical region and which is sufficiently large to allow the long term survival of the habitat/species. Favourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the “health” quantity or quality of a habitat or species.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURAL RANGE – The spatial limits within which the habitat or species occurs.

pNHAs - proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NPWS - National Parks and Wildlife Service

ORTHO-RECTIFIED IMAGE – The 2000 Ordnance Survey flight colour images were used as part of this project. These images were used in TIF format and were ortho-rectified. These images have been used as base data to identify the location of raised bogs, produce the high bog boundaries and vegetation maps.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

cSACs - candidate Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SAC's have also been known as cSAC's which stands for "candidate Special Areas of Conservation", and pcSAC's which stands for "proposed candidate Special Areas of Conservation."

SPAs - Special Protection Areas for Birds are areas which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas are protected from significant damage.

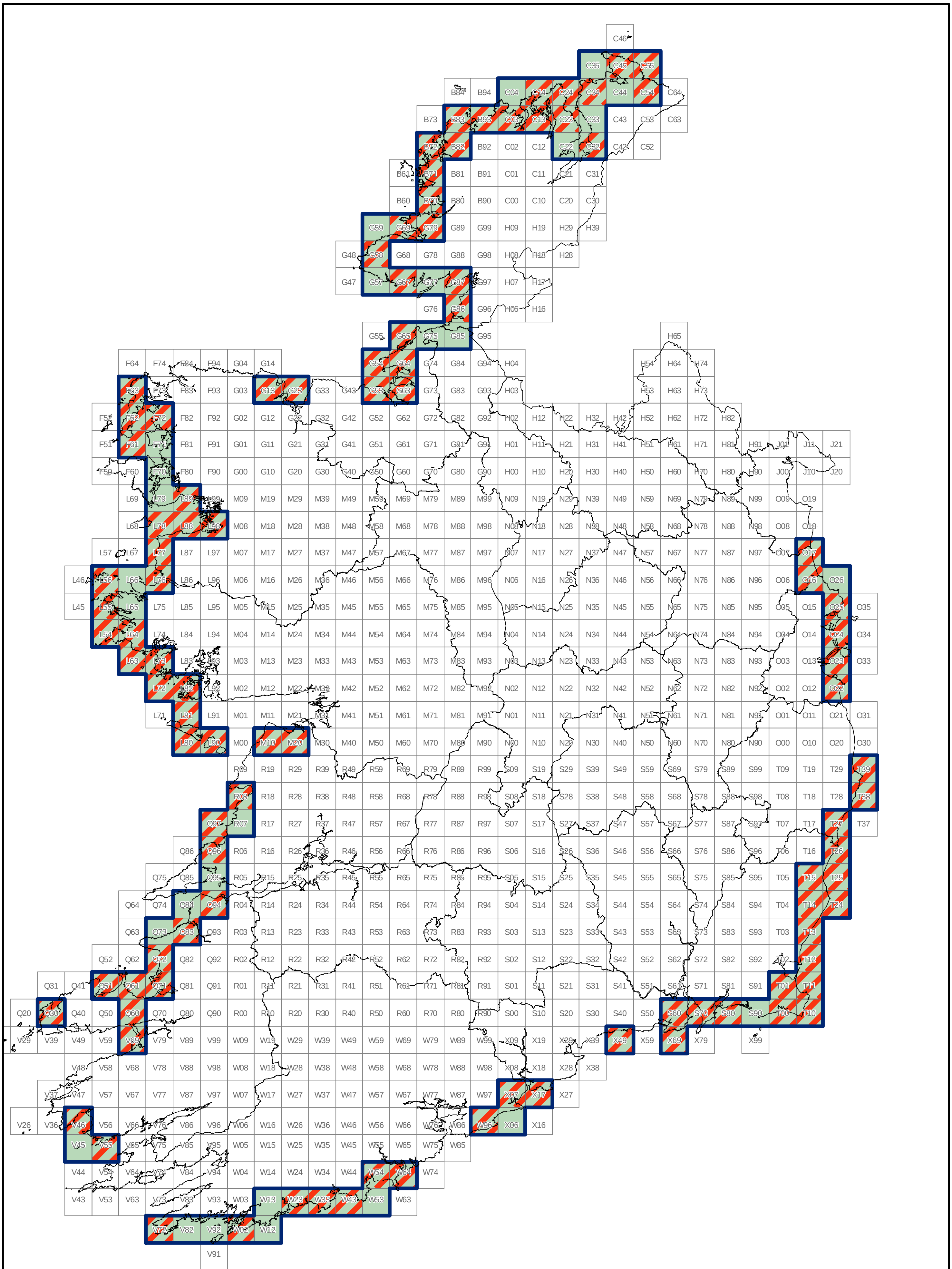
SPECIES - The lowest unit of classification normally used for plants and animals.

2110 Embryonic shifting dunes

1. National Level	
Habitat Code	2110
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See map attached

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished).
2.3 Range	Widespread geographical distribution around the coast of Ireland.
2.3.1 Surface area	12,900 km² (129 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	1.72 km²
1.2 Distribution map	See map I attached
2.4.1 Surface area	1.72 km²
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Decrease of 2.72%
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	3 = direct human influence
2.4.9 Justification of % thresholds for trends	

2.4.10 Main pressures	300 – Sand and gravel extraction 302 – Removal of beach materials 622 - Walking, horseriding and non-motorised vehicles 623 - Motorised vehicles 720 - Trampling, overuse 871 - Sea defence or coastal protection works 900 – Erosion
2.4.11 Threats	622 - Walking, horseriding and non-motorised vehicles 623 - Motorised vehicles 720 - Trampling, overuse 871 - Sea defence or coastal protection works 900 – Erosion 990 – Other natural processes (depletion of sediment source)
2.5 Complementary information	
2.5.1 Favourable reference range	12,900km² (129 grid cells x 100 km²)
2.5.2 Favourable reference area	1.76km² (based on the current area of embryonic dunes in Ireland plus the estimated loss of area since the Habitats Directive came into force)
2.5.3 & 2.5.4 Typical species	Embryo dunes: *Elytrigia juncea, Leymus arenarius, Euphorbia paralias, Calystegia soldanella* Method: the species above are characteristic of embryo dunes as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004) and typical of embryo dunes in Ireland (White & Doyle 1985, Ryle *et al*. 2007). Characteristic species were assessed as favourable by Ryle *et al*. (2007)
2.5.5 Other relevant information	Embryonic dunes are very dynamic systems that are often ephemeral in their appearance. Many sites are subject to natural erosional processes, although human activities exacerbate this problem.
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1).
Specific structures and functions (incl. Typical species)	Unfavourable-Inadequate (U1).
Future prospects	Unfavourable-Inadequate (U1).
Overall assessment of CS	Unfavourable-Inadequate (U1).



1:1,800,000

0 12.5 25 50 Kilometers

Embryonic shifting dunes

2110

Current Distribution (101 cells)

Current Range (129 cells)

Favourable Reference Range (129 cells)

W48 10km grid cells

Date: August 2007

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland
2. Habitat mapping
3. Habitat Range
    3.1 Conservation status of habitat range
4. Habitat Area
    4.1 Conservation status of habitat area
5. Structures and Functions
    5.1 Habitat structures and functions
        5.1.1 Conservation status of habitat structures and functions
    5.2 Typical species
        5.2.1 Conservation status of typical species
6. Impacts and Threats
7. Future Prospects
    7.1 Negative future prospects
    7.2 Positive future prospects
    7.3 Overall habitat future prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

APPENDICES

Appendix I – Description of Coastal Monitoring Project 2004-2006
Appendix II – Sources of Data
Appendix III - Glossary

1. Habitat characteristics in Ireland

Where fresh sand is deposited along the high dunes of the frontal ridges, the vegetation is dominated by *Ammophila arenaria*. These unstable and mobile areas are referred to as 'yellow dunes' (or white dunes in some European countries), owing to the areas of bare sand visible between the tussocks of marram. Bare sandy areas may be colonised by species such as *Carex arenaria, Euphorbia paralias* and *Eryngium maritimum*, along with a number of yellow Asteraceae, including *Hypochoeris radicata, Senecio vulgaris* and *S. jacobaea*. For the purpose of this report, this habitat is referred to as mobile dunes. It is synonymous with the EU Annexed habitat 'Shifting dunes along the shoreline with *Ammophila arenaria*' (code 2120).

The height attained by a frontal dune ridge is limited by a number of factors, including height and frequency of the tides, availability of foreshore sand, the average strength of the on-shore winds, the amount and seasonal distribution of rainfall, combined with the nature of the colonising plants (Salisbury 1952). The sand blown off the top is deposited on the leeward side of the frontal dune ridge, leading to dune regression. The balance between the rate at which the sand blows off the top and the rate at which it blows off the shore and is deposited determines the maximum height attained by a dune system.

The extreme environmental conditions experienced in the foredunes persist in the yellow dunes, once again restricting species diversity. The constant processes of accretion (sand accumulation) and ablation (sand removal), characteristic of mobile dunes, are unfavourable to the majority of species found in the more stable fixed dune areas, landward of the frontal ridge. Plants that grow in these mobile dunes are highly specialised and can cope with some degree of salinity (in the form of salt spray and occasional periods of inundation), an unstable substrate and limited levels of nutrients and moisture.

Mobile dune vegetation is assigned to the Ammophilion borealis within the Ammophiletea (Marram grass class), which includes pioneer vegetation of rhizomatous plants on young and mobile coastal sand dunes in Atlantic and Mediterranean Europe (Géhu & Géhu 1969, Westhoff & den Held 1969, White & Doyle 1982). The Ammophilion borealis is synonymous with the Ammophilion described by Braun-Blanquet (1928) and the Elymion arenarii described by Christiansen (1927). The alliance displays an affinity with the *Ammophila arenaria* mobile dune community (SD6) of the BNVC as outlined in Rodwell (2000)

Some mobile dune vegetation can be assigned to two widely recognized associations (1) the Elymo-Ammophiletum and (2) the Euphorbio-Amophiletum. Vegetation of the Elymo-Ammophiletum is considered to be typical of the Baltic and North Atlantic biogeographical zones. Vegetation of the Euphorbio-Ammophiletum is Cantabrian-Atlantic in its distribution, stretching from the southern British Isles to the western coast of France and the northwest of the Iberian Peninsula. These two associations are not site-specific. In the Flanders dunes, Géhu (1985) points out that the vegetation on the northern side of the foredune belongs to the Elymo-Ammophiletum, while vegetation assignable to the Euphorbio-Ammophiletum grows on the southern, landward side. The explanation proposed for this overlap in distribution is due to localised micro-climatic and micro-topographic differences. Both associations have been recorded from Curracloe, Co. Wexford (Gaynor, unpublished).

Vegetation of the alliance represents “Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)” (CORINE code: 16.212; Natura 2000 code: 2120) as described in the EU Habitats Directive (1992). This is a non-priority habitat type that includes mobile dunes that form the seaward cordon or cordons of the coasts of the Atlantic, North Sea and Baltic (Commission of the European Communities, 1992).

Most of the following assessment is based on the results of the Coastal Monitoring Project (Ryle *et al*. 2007), details of which can be found in Appendices I & II.

2. Habitat mapping

As part of the Coastal Monitoring Project, Ryle *et al*. (2007) updated the original national coastal inventory produced in Curtis (1991a). Additional or potential sites were identified through the analysis of aerial ortho-photographs (year 2000 series, Ordnance Survey of Ireland), information received from NPWS conservation staff and extensive ground surveys (see Appendix II). Each of the sites identified (with the exception of 4, which were not accessible) was visited over the course of 3 field seasons (2004-2006) and surveyed using GPS (Ryle *et al*. 2007). A habitat map was produced for each site by importing the mapping data into Arcview 3.2 and overlaying it on the year 2000 series ortho-aerial photographs. The area of each individual Annex I sand dune habitat was mapped at a total of 181 sites. The habitat maps produced in Ryle *et al*. (2007) were used to map the distribution and range of ‘shifting dunes with *Ammophila arenaria*’ in Ireland on a 10km square basis. Mobile yellow dune habitat was recorded and mapped from a total of 141 sites, which displayed a widespread geographic distribution, being recorded from all coastal counties.

3. Habitat Range

The mapping of habitat range is defined by the smallest polygon size containing all grid squares where the habitat was recorded, drawn using a minimum number of 90 degree angles. Gaps in the habitat distribution of at least 2 square grids, or as a result of unsuitable ecological conditions for the development of the habitat were deemed enough to justify a break in the range.

The current distribution of mobile dunes is widespread, but confined to sandy beaches. Gaps in the current range of this habitat along the coastline are explained by the absence of suitable coastline for this habitat to develop (e.g. hard steep sea cliffs). The current distribution is thought to correspond to the historical range, with any minor changes attributed to an improvement in the quality of the data.

3.1 Conservation status of habitat range

The habitat range at the beginning of the assessment period (1996) is taken as the favourable reference range (FRR) as it encompasses the ecological variation of this habitat in Ireland. The current range is the same as the favourable reference range. However, it should be emphasized that the figure for both the current area and range should be treated with some caution in view of the often ephemeral and highly dynamic nature of the habitat.

The habitat is still widespread within the relevant geographical range around the coast of Ireland and all sub-types are still present. Mobile dune habitat range encompasses a total of 129 x 10km grid cells and the habitat was found at 141 sites. The historical habitat range is unlikely to have been greater compared to the current FRR.

Small losses of mobile dune habitat during the current assessment period have not affected the current range. The habitat range of mobile dunes is assessed as **favourable**.

4. Habitat Area

The total national area of mobile yellow dunes is estimated at 4.0565km^2 (405.65ha). This is considerably lower than the previous figure of 20.111km^2 from 44 designated sites, which is taken from the NATURA 2000 database. However, the figure in the NATURA 2000 database is based on estimates and lacks ground truthing. In addition, the minimum value that could be attributed to a habitat in the database was 1%, leading to a probable exaggeration of the area. The CMP, on the other hand, accurately mapped the habitat. Therefore, it cannot be assumed that this represents a significant loss in the area of the habitat.

4.1 Conservation status of habitat area

The favourable reference area (FRA) is taken as the habitat area at the beginning of the reporting period, as it is considered enough to ensure long term survival of the habitat. The guidelines state that the current area cannot be less than the area at the time of the Directive coming into force. Ryle *et al.* (2007) recorded a loss of area from a total of 85 sites out of 141. Of these 60 were rated as unfavourable-inadequate (U1) and 25 unfavourable-bad (U2). The most significant losses were caused by erosion, recreational pressure, sand extraction and sediment depletion caused by coastal protection works. In most cases, however, losses were not quantified. The current national habitat area is estimated to be 405.65 ha from (Ryle *et al*. 2007). In order to estimate the original area the following extrapolation was made from the dataset. It is assumed that the areas of sites with a U1 rating have decreased by 1% and those with a U2 rating by 1.15%. This produces an original estimated area of 494.82ha. This would suggest that a rating of *Unfavourable-Bad* would be appropriate, as it exceeds the threshold of 10% loss over a 10-year period. However, this figure must be treated with some caution in view of the highly dynamic nature of the habitat.

The conservation status of the habitat area was originally assessed as unfavourable-bad, because approximately 18% (89.2ha) of the favourable reference area has been lost in the current reporting period. However, this figure should be treated with caution for a number of reasons. Firstly, mobile yellow dunes are by their very nature ephemeral and highly dynamic. Secondly, it is very difficult to map the extent of mobile dunes in the field, particularly where they are transitional with semi-fixed dunes, which can be extensive at some sites. During the CMP, semi-fixed dunes were included in the fixed dune area for mapping purposes, reducing the potential area significantly. Finally, it is extremely difficult to establish with any certainty to what degree losses observed are the result of natural processes or are human-induced. Consequently, based on best expert judgement the conservation status of habitat area for mobile yellow dunes is assessed as **Unfavourable-Bad**.

5. Structures and Functions

The following generalised attributes were assessed for Irish sand dune habitats at 181 sites, of which 141 possessed mobile marram dunes (Ryle *et al*. 2007). These attributes and their targets have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of dune habitats and machair (JNCC 2004) with inputs from NPWS, Research Branch staff.

- Habitat extent
- Physical structure
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation structure: sward height
- Vegetation composition: typical species
- Indicators of negative trend
- Other negative indicators

Indicators of local distinctiveness, such as notable plant species or vegetation mosaics. These are site-specific features, which are not adequately covered by the other attributes.

5.1 Habitat structures and functions

When individual site data from Ryle *et al*. (2007) is combined, it reveals that out of 482 monitoring stops carried out in 2004 to 2006, only 81 (i.e 16.8%) failed (attributes did not reach their targets). The most frequent reason for stops failing was poor flowering and fruiting/plant health, which was considered to indicate possible sediment starvation and loss of mobility, which in some cases occurs as a result of coastal protection works. Overall, 75 sites (53%) surveyed (Ryle *et al*. 2007) were assessed as having favourable structure and functions, however, 33 sites (23.5%) had an unfavourable-inadequate conservation status and 33 sites (23.5%) were assessed as having an unfavourable-bad conservation status. In addition, analysis of the % area of the total national resource, reveals that 61% of the total area was rated as favourable, while 25% was rated unfavourable-inadequate and only 14% was rated unfavourable bad.

Based on the current data and best expert opinion, the conservation status of the habitat structure and functions is assessed as **Unfavourable-bad**.

5.2 Typical Species

Where fresh sand is deposited along the high frontal dune ridge, *Ammophila arenaria* is the dominant species, forming distinct tussocks with intervening areas of bare sand. A limited number of other species occupy the bare patches of sand between the tussocks of *Ammophila arenaria* in this unstable, nutrient-poor habitat (Ranwell 1972). These include the thermophilous *Euphorbia paralias, Eryngium maritimum* and *Calystegia soldanella.*

Another important sand-binding species in some Irish dune systems, particularly along the East coast, is *Leymus arenarius*. The distribution of *Leymus* tends to be restricted to the seaward face of the frontal dune ridges. Most perennial dune grasses are capable of generating tillers off the main shoot. In the case of *Leymus arenarius,* these tillers form just below the surface level and develop obliquely to the main stem.

A number of species belonging to the Asteraceae family form an important component of the vegetation and indicate the high degree of disturbance that naturally occurs in the mobile primary dunes. These include *Senecio jacobaea, Sonchus arvensis, S. oleraceus* and *Hypochaeris radicata*. Many of these species develop specialised root systems at the expense of complex infloresence structures. This enables the species to forage a wider area for water, nutrients and minerals. The roots of *Ammophila* have been shown to penetrate to depths of 2m (Salisbury 1952), while *Euphorbia portlandica* and *Hypochaeris radicata* can reach depths of 50cm (Willis 1985).

5.2.1 Conservation status of habitat typical species

The presence of typical or characteristic species was one of the attributes assessed for structure and functions during the Coastal Monitoring Project (Ryle *et al*. 2007). Only *Elytrigia juncea, Leymus arenarius* and *Euphorbia* spp. were considered typical species for this habitat by Ryle *et al*. (2007). Only 18 monitoring stops failed to reach the target for characteristic species out of 482 stops carried out over 140 sites (Ryle et al 2007).

The conservation status of typical species of mobile dunes is assessed as **favourable** considering that targets were generally reached for typical species.

6. Impacts and Threats

There are several sources of information about impacts and activities affecting mobile dunes in Ireland, including Curtis (1991b) and Crawford *et al*. (1996). However, the most comprehensive source of information is Ryle *et al*. (2007), who summarised the main impacts affecting dunes surveyed at 181 sites during 2004 to 2006 (Table 1). The seven impacts noted in mobile yellow dunes at more than three of the survey sites are listed in Table 1. An additional 15 impacts were recorded in mobile dunes at less than four sites, making a total of 22 different impacts recorded for the habitat.

Table 1. Most frequently recorded impacts in Mobile dunes; number of sites at which the impacts were recorded and the total area affected by each impact

Code	Impact/Activity	Number of sites	Total area affected (ha)
900	Erosion	86	37.0
622	Walking, horseriding and non-motorised vehicles	62	142.2
720	Trampling, overuse	32	59.7
871	Sea defence or coastal protection works	25	5.4
623	Motorised vehicles	8	10.7
501	Paths, tracks, cycling routes	6	0.1
140	Grazing	6	0.7

Total number of sites at which the habitat was present = 140
Total habitat area = 405.6ha

In common with a number of other habitats, *erosion* (900) and *walking, horseriding and non-motorised vehicles* (622), were the two most commonly noted impacts in mobile dunes, with records from 86 and 62 sites respectively. The total area affected by *erosion* can, as is the case with other habitats, be considered an underestimate, as the affected areas were recorded as 'unknown' in 53 of the sites from which the impact was noted. Similarly, the areas for *sea defence or coastal protection works* (871) were recorded as 'unknown' at 12 of the sites from which the impact was noted. There is apparently also a high degree of subjectivity in assigning an influence rating to this impact, as *irreparable negative influence* (-2), *repairable negative influence* (-1), *neutral* (0) and *strongly managed positive influence* (+2) were all used with varying frequency to describe the impact of protection works at different sites. Where hard protection works, such as rock armour, were installed to protect property, with little consideration of the likely long-term affects on sediment dynamics, the impact on dune habitats was more likely to be assigned a negative influence rating. The impact was more likely to be considered as either positive or neutral when the protection works are employed to stabilise a stretch of habitat in imminent danger of severe erosion, or where soft protection measures are employed. However, the artificial stabilisation of sediment, which may produce an apparent benefit in the short term, should not necessarily be regarded as a positive impact. In general, any interruption to the natural mobility of a sand dune system should be regarded as having a negative impact.

The inclusion of grazing among the more regularly noted impacts may seem somewhat unusual, as the typical vegetation is not generally grazed, nor are livestock generally free to access the frontal dune areas of sand dune systems. There were however, a number of sites, e.g. Bunduff (site 139), at which livestock had access to the mobile dunes, where some grazing of *Ammophila arenaria* (Marram) was noted.

Only a very few impacts in mobile dunes were thought to have caused irreparable damage to the habitat. Most of these were described under *Sand and gravel extraction* (300), *Removal of Beach Materials* (302) and *Sea defence/coastal protection works* (871). The affected areas were generally very small or were recorded as 'unknown'.

In addition to the most regularly noted recreation-related impact of *walking*, *horseriding and non-motorised vehicles* (622), the inclusion in Table 1 of a number of other recreation based impacts, such as *Trampling*, *overuse* (720), *Motorised vehicles* (623) and *Paths*, *tracks*, *cycling routes* (501) illustrates the degree to which mobile dune habitats may be damaged by amenity pressures. This is particularly so along the more developed and densely populated east coast, where most sites are subject to intense recreational pressures. Mobile home and caravan parks add to the local amenity pressures and a particular feature of mobile dunes was the frequency with which localised damage occurred around access tracks and beside the most heavily used parts of beaches.

Accretion of mobile dunes was under-recorded, probably owing to the lack of previous data. Future surveys will be able to utilise the data generated during the Coastal Monitoring Project as the basis on which more definite conclusions on the accretion or erosion of habitat can be made in the future.

The pioneer species, *Leymus arenarius* (Lyme–grass), has been introduced for dune stabilisation at a number of east coast sites (Curtis, 1991b). All of the planted colonies and particularly, further colonies that have spread from planted areas, are unlikely to have been recognised during the course of the present survey, which suggests a certain underestimation of the total extent of these dune stabilisation or protection works.

7. Future Prospects

The future prospects for Annex I sand dune habitats at each site are based on an assessment of the threats posed or potential benefits likely to accrue from various impacts and activities. These can include management regimes (e.g. coastal protection works and beach cleaning), recreational activities (e.g. walking and horse-riding), agricultural practices (e.g. overgrazing and stock feeding) and potential developments.

There is no threshold for future prospects and the final result is based on a best scientific judgement. Most recorded impacts refer to activities noted during site surveys, although other sources of comparative information include NPWS site notes (NHA and NATURA 2000 information), while relevant data from other agencies such as county councils were also evaluated. NPWS conservation plans, where available, were reviewed and were taken into account when making a final determination.

7.1 Negative future prospects

The Coastal Monitoring Project 2006 (Ryle *et al*. 2007) reported that 40 sites supporting mobile yellow dune habitat (out of a total of 140) were assessed as having a favourable conservation status for future prospects, while 77 sites were unfavourable-inadequate and 24 sites were unfavourable-bad. In addition, only 37% of the total national area was rated as favourable. The relatively poor rating can be attributed to the on-going issue of erosion. Recreational pressure and construction of coastal protection works represent the main future threats that could exacerbate the problem. This site-specific assessment is highly subjective and was based mainly on the assumption that current factors such as coastal erosion which were negatively affecting the structure and functions of many of these sites were likely to continue in the future.

7.2 Positive future prospects

Statutory site designation plays an important part in the conservation of all dune habitats, including mobile dunes, through the designation of Special Areas of Conservation (SACs) and Natural Heritage Areas (NHAs). A significant proportion of these mobile dune sites are completely or partially located within SACs (78.57%), with some additional sites within NHAs (13.57%) and they should, therefore, be partially protected from development and damage. Notifiable actions, which require consent from the Department of Environment, Heritage and Local Government, have been set for sand dune habitats within SACs.

At a number of sites that are subject to intense recreational pressure, the local authorities now prevent motorised vehicles from accessing the beaches (e.g. White Strand, Co. Clare) or restrict their movement through the use of boulders (e.g. Bull Island, Co. Dublin). This can, however, lead to pressure to develop car parks on other dune habitats, particularly fixed dunes and dune slacks. Dune rehabilitation works are on-going at a number of sites, (e.g. Fanore, Co. Clare), where the frontal dunes have been fenced off to restrict public access.

7.3 Overall habitat future prospects

The habitat future prospects are assessed as **unfavourable inadequate,** as the long term viability of the habitat is not assured. Recreational pressure is unlikely to decrease, however, measures to limit the impacts of humans can be put in place. The impacts of sea level rise and coastal erosion, however, are likely to lead to an increased demand for coastal protection works, which are likely to have a negative impact on the mobile yellow dune habitat in the future.

8. Overall Assessment of the Habitat Conservation Status

The habitat conservation status of the four main attributes has been assessed either as **Favourable, Unfavourable-Inadequate** or **Unfavourable-Bad** at national level.

- The Natural Range of mobile dune habitat is considered to be **Favourable**. The Favourable Reference Range is considered to be equal to the current range of mobile dune.
- The Coastal Monitoring Project estimated that the area of mobile dune habitat has decreased by about 18% (89.2 ha) in a ten-year reporting period (1996-2006), which would suggest that an unfavourable-bad assessment is appropriate. However, this figure is misleading, as it does not portray the natural dynamics of the habitat, nor the fact that accretion was noted at a number of sites, including Bull Island, Cahore Point North, Kilmuckridge, Fermoyle (sub-site) and Dooey. Consequently, based on best expert judgement, this attribute was assessed as **Unfavourable-Bad**.
- The Habitat Structure and Functions have been assessed as **Unfavourable-Bad**. Of a total of 482 monitoring stops taken, 81 failed. This represents a failure rate of 17%. However, almost 40% of the total national area was rated as either unfavourable-inadequate or unfavourable-bad, largely due to the health (flowering and fruiting) of the vegetation.
- The Future Prospects are assessed as **Unfavourable-Bad,** as only 37% of the total national area was rated as favourable for this attribute. Recreational pressure is likely to remain high and the demand for coastal protection works is likely to increase in the face of sea level rise and coastal erosion associated with climate change.

Based on the above assessments, the overall conservation status for 'shifting dunes along the shoreline with *Ammophila arenaria'* habitat is **Unfavourable-Bad**.

9. References

Braun-Blanquet, J. (1928). *Pflanzensoziologie. Grundzüge der Vegetationskunde*. Springer, Berlin.

Commission of the European Communities (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal no. L 206, 22/07/92.

Commission of the European Communities (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels.

Crawford, I., Bleasdale, A. and Conaghan, J. (1996*). Biomar survey of Irish machair sites, 1996. Irish wildlife manuals, No. 3.* Dúchas, The Heritage Service, Dublin.

Curtis, T.G.F. (1991a). The Flora and Vegetation of Sand Dunes in Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Curtis, T.G.F. (1991b). A site inventory of the Sandy Coasts of Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Géhu, J.M. (1985). *European dune and shoreline vegetation*. Strasbourg, Council of Europe, European Committee for the conservation of nature and natural resources (Nature and Environment Series 32).

Géhu, J.-M. and Géhu, J. (1969). Les associations végétales des dunes mobiles et des bordures de plages de la côte Atlantique française. *Vegetatio*, **18**: 122-166.

JNCC. (2004). *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough.

Preston, C.D., Pearman, D.A. and Dines, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford.

Ranwell, D.S. (1972). *Ecology of salt marshes and sand dunes.* Chapman and Hall, London.

Rodwell, J.S. (2000). *British plant communities. Vol V: Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge.

Ryle, T., Connolly, K. , Murray, A. and Swann, M. (2007). *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished)

Salisbury, E.J. (1952). *Downs and dunes, their plant life and its environment*. Bell, London.

Westhoff, V. and den Held, A.J. (1969). *Plantengemeenschappen in Nederland*. Thieme, Zutphen.

White, J. and Doyle, G.J. (1982). The vegetation of Ireland : a catalogue raisonné. *Journal of Life Sciences*, *Royal Dublin Society*, **3**: 289-368.

Willis, A.J. (1985). Plant diversity and change in a species-rich dune system. *Transactions of the Botanical Society of Edinburgh*, **44**: 291-308.

APPENDICES

APPENDIX I

Coastal Monitoring Project 2004-2006 (Ryle *et al*., 2007)

The Irish coastline, including the islands, extends to 6,000 kilometres, of which approximately 750 kilometres is sandy (Curtis 1991a). The systems range from simple sandhills to fully developed dune complexes, ranging from ephemeral strandline to dynamic embryonic and mobile dunes to fixed dunes, dune slacks and machair plains. The sand dune resource is under threat from a number of impacts – primarily erosion, changes in agricultural practices and development of land for housing, tourism and recreational purposes. This project, carried out on behalf of the National Parks and Wildlife Service (NPWS), is designed to meet Ireland's obligation under Article 17 of the EU Habitats Directive, in relation to reporting on the conservation status of Annex I sand dune habitats in Ireland. The following habitats were assessed:

- Annual vegetation of driftlines (1210)
    - Perennial vegetation of stony banks (1220)
    - Embryonic shifting dunes (2110)
    - Shifting dunes along the shoreline with *Ammophila arenaria* (2120)
    - Fixed dunes with herbaceous vegetation (Grey Dunes) *(2130)
    - Decalcified fixed dunes with *Empetrum nigrum* *(2140)
    - Atlantic decalcified fixed dunes (Calluno-Ulicetea) *(2150)
    - Dunes with *Salix repens* ssp *argentea* (Salicion arenaria*)* (2170)
    - Humid dune slacks (2190)
    - Machair (21AO)*+

* indicates a Priority Habitat   + Priority Habitat in Ireland only

The project had a number of stated objectives, including:

- Update the inventory of Irish sand dune systems (Curtis 1991a)
- Develop a monitoring programme for Irish sand dune habitats
- Establish the area of total national resource of each habitat
- Produce fully digitised habitat maps for each coastal dune site
- Assess the conservation status of each habitat at all sites
- Establish a database in which the results of this and future sand dune habitats monitoring could be entered and analysed

The project is notable in that it represents the first comprehensive assessments of sand dune systems and their habitats in Ireland. Over the course of three field seasons (2004-2006), all known sites for sand dune habitats were assessed (only 4 sites were not visited owing to access problems). The original inventory of sand dune systems by Curtis (1991a) listed 168 sites for the Republic of Ireland. During the current survey, analysis of ortho-aerial photographs and additional information supplied from NPWS staff increased the site list to 181 sites (Table 1). In addition, 15 sub-sites are recognised on the basis that they are geographically isolated from the main site and are subject to different management regimes.

Detailed site reports provide a clearer understanding of the habitat area, processed and impacts and the conservation status of the sand dune habitats at individual sites. All of the results have been entered into a Coastal Monitoring Project database, which will enable a convenient method of accessing specific data.

The overall condition of each habitat was determined following a methodology that was adapted from the Joint Nature Conservancy Council (the statutory adviser to the UK Government on national and international nature conservation issues), which has been conveyed in a series of Common Standards Monitoring (CSM) guidance documents (JNCC, 1998 and 2004a, b & c). It employs rapid assessment techniques that can be easily repeated in the future implementation of the monitoring programme. This system is based on vegetation surveys, measurement of habitat areas, and assessments of threats and management practices.

The specific attributes that determine the conservation status of a habitat at a site are:

- **Habitat extent (Area)**
- **Structure and Functions** including presence and abundance of typical species, presence and abundance of negative indicator species, bare ground, short turf cover, sward height, plant health and scrub cover (where applicable). Other criteria relating to particular habitats such as cover of *Salix repens,* and the ratio of forbs and grasses in dune slacks.
- **Future prospects** including a number of factors such as
– Threats and their impacts on the site e.g. recreational activities, agricultural practices, development of land
– Management of the site e.g. coastal protection works, beach cleaning etc.
– Indicators of local distinctiveness such as notable plant species or vegetation mosaics

Habitat area is based on survey work using GPS, examination of aerial photographs and the production of detailed GIS maps. Structure and Functions was determined from monitoring stops that were carried out in all habitats and at most sites. Future Prospects are based on apparent impacts/threats to the site or a particular habitat that are likely to occur in the future. Attributes are assigned either a 'Favourable', 'Unfavourable-Inadequate', or 'Unfavourable-Bad' category, using criteria outlined in Chapter 2 of Ryle *et al*. (2007). The Overall Conservation Status is a synthesis of all the collected data. It is derived using the least favourable attribute. In addition, the overall conservation assessment of a habitat takes into account the overall range of the habitat within a biogeographical region.

Table 1 Comparative table highlighting the changes between the original inventory of Irish sand dune sites (Curtis 1991a) and the final site list used in the Coastal Monitoring Project 2004-2006 (Ryle *et al*. 2007).

County	National Site Inventory	New Sites	Sites to be deleted*	Coastal Monitoring Inventory
Louth	2			2
Meath	2			2
Dublin	8			8
Wicklow	10			10
Wexford	21	1		22
Waterford	7	1	3 + 1	8
Cork	10	3		13
Kerry	15		1	14
Clare	8			8
Galway	18	*1*		19
Mayo	22	2		23
Sligo	8			8
Donegal	37	5		42
Total	**168**	**13**	**5**	**181**

* These sites were surveyed as part of the Coastal Monitoring Project but no longer support sand dune habitat and may be deleted during the next monitoring cycle.

Appendix II – Summary of conservation status assessments of Shifting dunes along the shoreline with *Ammophila arenaria* (Annex I habitat 2120) in Ireland, taken from Coastal Monitoring Project (Ryle *et al*. 2007). Green = Favourable (FV), Amber = Unfavourable-Inadequate (U1), Red = Unfavourable-Bad (U2).

CMP Site Name	CMP Site Code	Area (ha)	County	Extent	Structure and Functions	Future Prospects	Overall	Comment
Agleam	124	5.126	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Aillebrack	100	0.184	Galway	Red	Green	Red	Red	Extent and Future Prospects are assessed as U2 due to erosion and sand extraction.
Ardamine	026	0.002	Wexford	Red	Green	Amber	Red	Extent rated U2 due to recent natural destruction of habitat. Future Prospects rated U1 owing to gradual re-accumulation of sediment.
Ards	165	0.479	Donegal	Amber	Amber	Amber	Amber	Extent and Future Prospects are assessed as U1 due to erosion and recreational pressures. Structure and Functions are assessed as U1 due to the prevalence of unhealthy *Ammophila arenaria* (Marram).
Arklow North	020	0.216	Wicklow	Green	Red	Amber	Red	Structure and Functions are assessed as U2 due to trampling and other disturbance caused by recreational pressures. Future Prospects are assessed as U1 due to heavy recreational pressures.
Arklow South	021	0.096	Wicklow	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures and the proximity of construction works.
Ballybunion	079	1.615	Kerry	Red	Amber	Red	Red	Extent is assessed as U2 due to the installation of coastal protection by golf course.
Ballyconeely	099	0.152	Galway	Amber	Green	Green	Amber	Extent rated as U1 owing to limited occurrence of habitat.
Ballydavid	073	0.434	Kerry	Red	Green	Amber	Red	Extent rated as U2, Future Prospects rated as U1 due to agricultural disturbance.
Ballyheige	078	0.616	Kerry	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U2 due to the limited area and poor zonation of habitat, the prevalence of unhealthy *Ammophila arenaria* (Marram), and recreational pressures.

Ballymastocker	173	2.372	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Ballynaclash	033	1.867	Wexford	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as A1 due to recreational pressures.
Ballyness	161	14.15	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Ballyteige Burrow	041	6.236	Wexford	Green	Green	Green	Green	All Attributes favourable (FV)
Baltray	002	4.371	Louth	Green	Amber	Amber	Amber	Structure and Functions/Future Prospects are assessed as A1 due to recreational pressures.
Banna Strand	077	6.787	Kerry	Amber	Red	Amber	Red	Structure and Functions rated as U2 owing to widespread presence of negative indicator species. Extent and Future prospects rated as U1.
Bannow Island	042	0.105	Wexford	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 owing to natural erosion and recreational pressures.
Barley Cove	064	0.150	Cork	Red	Green	Red	Red	Extent and Future Prospects rated as U1 owing to natural erosion and recreational pressures.
Barley Cove (Subsite - Golf course)	208	0.446	Cork	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 due to limited distribution and lack of sediment input into system coupled with recreational impacts.
Bartragh Island	131	7.519	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Bartraw	111	0.184	Mayo	Red	Green	Amber	Red	Extent rated as U2, owing to limited distribution of habitat.
Beal Point	080	0.514	Kerry	Amber	Green	Green	Amber	Extent is assessed as U1, as the limited extent and poor zonation of habitat are partly attributed to sand and gravel extraction.
Bishopsquarter	088	0.143	Clare	Amber	Green	Amber	Amber	Extent is assessed as U1 due to the scarcity and poor zonation of habitat and recreational use. Future Prospects are assessed as U1 due to intensive stock rearing practices and recreational activities.
Brittas Bay	017	3.316	Wicklow	Green	Amber	Amber	Amber	Extent rated as FV. However Structure and Functions and Future prospects rated U1 due to ongoing natural erosion and recreational pressure.
Bunduff	139	5.1	Sligo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects rated as U1 due to natural erosion exacerbated by recreational pressure and grazing by cattle.

Bunmahon	047	0.668	Waterford	Green	Amber	Red	Red	Future Prospects rated as U2 owing to recreational pressures and dune protection works. Extent and Structure and Functions rated U1.
Cahore Point North	028	24.212	Wexford	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Cahore Point South	029	1.005	Wexford	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Carnboy	156	2.4	Donegal	Amber	Amber	Green	Amber	Extent and Structure and Functions rated as U1 due to previous natural erosion.
Carnsore	039	2.521	Wexford	Green	Green	Amber	Amber	Future Prospects rated U1 owing to erosion and impacts of recreational users.
Castlefreke	060	1.785	Cork	Amber	Green	Green	Amber	Extent is assessed as UI due to the invasion of *Pteridium aquilinum.*
Castlegregory	075	9.419	Kerry	Amber	Green	Red	Red	Future prospects are assessed as U1 due to the ongoing threat of natural erosion compounded by human activities.
Cloghmoyle	110	0.615	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Clooney	149	3.5	Donegal	Amber	Red	Amber	Red	Structure and functions rated as U2 due to trampling from high recreational pressure.
Coney Island	134	0.455	Sligo	Green	Green	Amber	Amber	Future prospects are assessed as U1 due to the ongoing threat of natural erosion compounded by rabbit and human activities.
Courtown	025	0.105	Wexford	Red	Amber	Red	Red	Extent and Future Prospects rated U2 due to natural destruction of habitat. Structure and functions rated U1 in remaining patches of habitat.
Cross Lough	126	2.606	Mayo	Amber	Green	Amber	Amber	Extent/Future Prospects are assessed as U1 due the development of an equestrian centre.
Cruit Lower	154	2	Donegal	Amber	Red	Amber	Red	Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram) due to trampling – high recreational pressure.
Crummies Bay	175	0.458	Donegal	Green	Red	Amber	Red	Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram). Future prospects are assessed as U1 due to erosion and sediment depletion.

Culdaff	181	1.033	Donegal	Green	Red	Amber	Red	Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram). Future prospects are assessed as U1 due to high recreational pressures.
Curracloe	034	3.141	Wexford	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to the invasion of *Pteridium aquilinum* and erosion induced by recreational activities.
Derrybeg	157	5	Donegal	Green	Red	Amber	Red	Structure and functions rated as U2 due to presence of rock armour and trampling due to high recreational pressure.
Derrymore Island	076	2.537	Kerry	Green	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram), and probable sediment depletion.
Derrynane	066	1.667	Kerry	Green	Green	Green	Green	All Attributes favourable (FV)
Doagh Isle	178	0.771	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Doaghmore	170	0.832	Donegal	Green	Green	Amber	Amber	Extent is assessed as U1 due to on-going sand extraction.
Dog's Bay (& Gorteen Bay)	097	0.5	Galway	Amber	Amber	Green	Amber	Extent and Structure and Functions rated as U1 due to previous natural erosion and presence of rock armour.
Donaghmore	027	0.138	Wexford	Red	Amber	Red	Red	Extent and Future Prospects are assessed as U2 due to the very limited area and poor zonation of habitat. Structure and Functions are assessed as U1 due to the presence of unhealthy *Ammophila arenaria* (Marram).
Doo Lough	120	4.604	Mayo	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to erosion and sediment depletion.
Dooaghtry	108	18.709	Mayo	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to damage from rabbit burrowing, trampling by grazers and visitors to the site.
Dooey	160	11.505	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)

Dooyork	119	0.140	Mayo	Red	Red	Red	Red	Extent and Future Prospects are assessed as U2 due to the limited area and poor zonation of habitat. Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram).
Duncannon	044	0.582	Wexford	Green	Green	Green	Green	All Attributes favourable (FV)
Dunfanaghy	163	2.2	Donegal	Amber	Amber	Amber	Amber	All attributes rated as U1 due to natural erosion compounded by trampling, high cover of unhealthy *Ammophila arenaria* (Marram) due to trampling.
Eararna	091	1.646	Galway	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to amenity and leisure activities, especially scrambling and trampling.
Fahan	174	1.160	Donegal	Amber	Green	Green	Amber	Extent rated as U1, owing to scarcity of habitat.
Fanore	087	0.379	Clare	Red	Red	Red	Red	Extent, Structure and Functions, and Future Prospects are assessed as U2 due to the very limited extent and poor zonation of habitat, an excessive cover of unhealthy *Ammophila arenaria* (Marram), and sediment depletion.
Fermoyle	074	2.102	Kerry	Amber	Green	Amber	Amber	Extent and Future Prospects rated U1 due to erosion and agricultural degradation of the habitat.
Fermoyle (Subsite - Drom Hill)	204	1.153	Kerry	Green	Green	Green	Green	All Attributes favourable (FV)
Finner	140	7.004	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Fintragh	145	0.742	Donegal	Red	Red	Red	Red	All parameters are assessed as U2 due to recreational activities and the installation of coastal protection.
Garter Hill	128	13.379	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Glen Bay	146	0.939	Donegal	Amber	Red	Amber	Red	Extent and Future Prospects are assessed as U1 due to erosion and recreational pressures. Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram), and the sparseness of vegetation throughout the habitat.
Gola Island	158	0.541	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)

Gortnatraw	171	0.257	Donegal	Amber	Red	Amber	Red	Extent and Future Prospects are assessed as U1 due to erosion, and the limited area and poor zonation of habitat. Structure and Functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram).
Gowlaun	107	1.650	Galway	Green	Amber	Green	Amber	Structure and Functions rated as U1 largely due to presence of negative indicators species.
Grange	043	0.649	Wexford	Red	Amber	Amber	Red	Extent rated as U2 due to limited occurrence due to erosion. Structure and Functions and Future Prospects rated U1 owing to impacts from recreational traffic.
Harbour View	057	0.413	Cork	Green	Green	Green	Green	All Attributes favourable (FV)
Inch	070	25.798	Kerry	Green	Green	Green	Green	All Attributes favourable (FV)
Inchydoney	058	0.420	Cork	Red	Amber	Amber	Red	Extent is assessed as U2 due to the very limited area and poor zonation of habitat. Structure and Functions, and Future Prospects are assessed as U1 due to the trampling and associated damage caused by recreational activities.
Inishbofin	106	0.038	Galway	Red	Green	Amber	Red	Extent is assessed as U2 due to the very limited area and poor distribution of habitat. Future Prospects are assessed as U1 due to erosion and recreational pressures.
Inishcrone	132	3.65	Sligo	Amber	Red	Amber	Red	Structure and Functions rated as U2 due to high cover of dead or dying *Ammophila arenaria* (Marram).
Inisheer	089	0.193	Galway	Amber	Green	Green	Amber	Extent rated as U1 owing to lack of habitat.
Inishmaan	090	1.611	Galway	Green	Green	Green	Green	All Attributes favourable (FV)
Ireland's Eye	008	0.299	Dublin	Amber	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to recreational activities and tourist pressures.
Keadew	153	0.732	Donegal	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to recreational activities.

Keel Lough	113	1.8	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects rated as U1 as very little natural development, only man-made dunes present, little possibility of future development as large shingle ridge to seaward side.
Kilgorman	024	0.499	Wexford	Amber	Green	Red	Red	Extent is assessed as U1 due to the limited area of habitat. Future Prospects are assessed as U2 due to recreational pressures, and scrub encroachment through the entire system.
Killiney	012	0.068	Dublin	Red	Amber	Red	Red	Extent and Future Prospects rated U2 due to limited occurrence of habitat. Structure and Function rated U1 due to occurrence of negative indicator species.
Kilmuckridge	030	2.881	Wexford	Green	Green	Green	Green	All Attributes favourable (FV)
Kilpatrick	023	0.362	Wexford	Amber	Green	Amber	Amber	Extent is assessed as U1 due to erosion and the limited very area of habitat. Future Prospects are assessed as U1 due to erosion, the presence of negative indicator species, and recreational activities.
Kincaslough	155	0.815	Donegal	Amber	Red	Amber	Red	Structure and functions assessed as U2 as a result of severe natural erosion and high cover of dead or dying *Ammophila arenaria* (Marram).
Kinrovar	118	0.951	Mayo	Red	Green	Amber	Red	Extent is assessed as U2 due to the limited area and poor distribution of habitat, erosion and sediment depletion. Future Prospects are assessed as U1 due to sediment depletion and erosion.
Lackan	129	2.543	Mayo	Red	Red	Red	Red	Extent, Structure and Functions, and Future Prospects are assessed as U2 due to poor habitat zonation and extent, erosion, and an excessive cover of unhealthy *Ammophila arenaria* (Marram) in the habitat.
Lackan (Subsite)	201	0.283	Mayo	Amber	Green	Amber	Amber	Extent is assessed as U1 due to the limited area and restricted zonation of habitat. Future Prospects are assessed as U1 due to sediment depletion and erosion.

Lag	179	2.017	Donegal	Amber	Amber	Amber	Amber	Extent is assessed as U1 due to erosion and poor zonation. Structure and Functions are assessed as U1 due to the presence of negative indicator species. Future Prospects are assessed as U1 due to erosion and recreational pressures.
Laytown	004	1.335	Meath	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to human-induced erosion and recreational activities.
Leagaun	103	0.145	Galway	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to recreational activities associated with the caravan park.
Leam Lough	125	2.362	Mayo	Red	Amber	Amber	Red	Extent is assessed as U2 due to the limited area and poor zonation of habitat. Structure and Functions are assessed as U1 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram). Future Prospects are assessed as U1 due to sediment depletion and erosion.
Lenankeel	176	0.36	Donegal	Amber	Red	Amber	Red	Structure and Functions assessed as U2 due to natural erosion and presence of rock armour
Lettermacaward	151	7.349	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Lough Cahasy	109	0.898	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Lough Doo	114	1.07	Mayo	Amber	Red	Amber	Red	Structure and Functions assessed as U2 due to high cover of unhealthy *Ammophila arenaria* (Marram).
Lough Nagreany	169	1.407	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to on-going sand extraction
Lunniagh	159	3.684	Donegal	Amber	Red	Amber	Red	Extent is assessed as U1 due to poor zonation. Structure and Functions are assessed as U2, and Future prospects are assessed as U1 due to trampling and vehicular damage.
Lurga Point	083	0.047	Clare	Red	Green	Red	Red	Extent is assessed as U2 due to limited area and poor zonation. Future Prospects are assessed as U2 due to unsustainable agricultural management practices and the lack of statutory protection for the site.

Maghera	147	6.9	Donegal	Green	Amber	Green	Amber	Structure and Functions assessed as U2 due to high cover of unhealthy *Ammophila arenaria* (Marram) in some areas.
Maghera (Subsite)	202	0.5	Donegal	Green	Red	Green	Red	Structure and Functions rated as U2 due to high cover of dead or dying *Ammophila arenaria* (Marram) and high cover of agricultural weeds.
Magherabeg	016	1.841	Wicklow	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to erosion and recreational pressures.
Maheradrumman	172	2.014	Donegal	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to human-induced erosion and recreational activities.
Malahide Island	007	1.804	Dublin	Amber	Red	Amber	Red	Structure and Functions are assessed as U2 due to trampling from recreational activities.
Marble Hill	164	1.009	Donegal	Amber	Red	Amber	Red	Structure and Functions are assessed as U2 due to natural erosion is exacerbated by recreational use of the dunes.
Melmore	168	2.513	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Mizen Head	018	1.042	Wexford	Green	Green	Green	Green	All Attributes favourable (FV)
Mornington	003	1.737	Meath	Green	Amber	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 as the habitat is under on-going threats from recreational pressures at this site, there is no management strategy for this habitat in the conservation plan.
Mountcharles	143	0.299	Donegal	Green	Red	Red	Red	Structure and functions are assessed as U2 due to an excessive cover of unhealthy *Ammophila arenaria* (Marram). Future Prospects are assessed as U2 due to on-going damage caused by intensive stock rearing practices.
Mullansole	142	2.101	Donegal	Amber	Amber	Red	Red	Future Prospects are assessed as U2 due to the on-going threats from recreational activities and the management of the foredune area in relation to coastal protection.
North Bull	010	7.011	Dublin	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to erosion and recreational pressures.

Pennycomequick	019	0.698	Wicklow	Green	Red	Amber	Red	Structure and functions rated U2 due to condition of the habitat. Future Prospects rated U1 due to sediment starvation and ongoing decline.
Portmarnock	009	3.726	Dublin	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to human-induced erosion and recreational activities. Also due to hard coastal protection installed by the golf course.
Portrane	006	1.232	Dublin	Amber	Green	Red	Red	Future Prospects are assessed U2 due to the recreational pressures and hard coastal protection on the site.
Rinclevan	162	5.746	Donegal	Green	Red	Amber	Red	Structure and functions are assessed as U2 due to recreational activities and an excessive cover of unhealthy *Ammophila arenaria* (Marram). Future Prospects are assessed as U1 due to recreational pressures and erosion.
Rosapenna	166	5.855	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to the limited extent and restricted distribution of habitat, and recreational pressures.
Roshin Point	150	0.389	Donegal	Green	Amber	Green	Amber	Structure and Functions rated as U1 due to some unhealthy *Ammophila arenaria* (Marram).
Rosmurrevagh	112	0.365	Mayo	Amber	Green	Green	Amber	Owing to scarcity of habitat, Extent rated as U1.
Ross	130	1.435	Mayo	Amber	Red	Red	Red	Extent is assessed as U1 due to the limited area and restricted zonation of habitat. Structure and functions are assessed as U2 due to an excessive proportion of unhealthy vegetation. Future Prospects are assessed as U2 due to erosion and sediment depletion.
Ross (Subsite)	200	0.146	Mayo	Red	Green	Amber	Red	Extent is assessed as U1 due to the very limited area and restricted zonation of habitat. Future Prospects are assessed as U1 due to erosion and recreational pressures.
Rossbehy	068	10.418	Kerry	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to erosion and recreational pressures.
Rosses Point	135	0.174	Sligo	Red	Red	Red	Red	All parameteres are assessed as U2 due to recreational pressures.

Rosslare	036	2.245	Wexford	Red	Red	Red	Red	All parameters are assessed as U2 due to human-induced erosion and recreational activities. Also due to hard coastal protection installed by the golf course.
Rossnowlagh	141	1.3	Donegal	Amber	Red	Amber	Red	Structure and Functions assessed as U2 due to high cover of dead or dying *Ammophila arenaria* (Marram), severe alteration of the habitat by recreational pressures and presence of rock armour.
Rush Sandhills	005	0.979	Dublin	Amber	Green	Amber	Amber	Structure and Functions/Future Prospects are assessed as U1 due to recreational activities.
Sheskinmore	148	17.246	Donegal	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to recreational activities associated with the caravan park.
South Bull	011	5.147	Dublin	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to erosion, recreational pressures and the impact of motorised vehicles.
Srah North	122	1.630	Mayo	Green	Red	Amber	Red	Structure and Functions are assessed as U2 due to an excessive proportion of unhealthy vegetation, and damage from recreational pressures. Future Prospects are assessed as U1 due to erosion and recreational pressures.
Srah South	121	2.295	Mayo	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to erosion, and trampling by livestock.
Strandhill	133	5.476	Sligo	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to recreational activities associated with the Blue Flag beach, golf course, caravan park and surfing.
Streedagh Point	137	2.116	Sligo	Red	Red	Red	Red	Extent is assessed as U2 due to severe erosion and poor zonation of habitat. Structure and Functions are assessed as U2 due to an excessive proportion of unhealthy vegetation. Future Prospects are assessed as U2 due to erosion and recreational pressures.
Tacumshin	040	7.906	Wexford	Green	Green	Green	Green	All Attributes favourable (FV)

Termoncarragh Lough	127	2.577	Mayo	Amber	Green	Amber	Amber	Extent is assessed as U1 due to the limited area and poor zonation of habitat. Future Prospects are assessed as U1 due to erosion, sediment depletion, and trampling by livestock.
The Raven	035	5.231	Wexford	Amber	Amber	Amber	Amber	Extent, Structure and Functions, and Future Prospects are assessed as U1 due to erosion and recreational pressures.
Tramore	046	4.122	Waterford	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Tranarossan	167	2.669	Donegal	Amber	Red	Red	Red	Extent is rated as U1 due to the limited area and poor zonation of habitat. Structure and Functions are assessed as U2 due to an excessive proportion of unhealthy vegetation. Future Prospects are assessed as U2 due to erosion, sediment depletion and recreational pressures.
Trawalua	138	5.033	Sligo	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 due to erosion of habitat by pony trekking.
Trawboy	117	3.336	Mayo	Green	Green	Green	Green	All Attributes favourable (FV)
Tullagh	177	4.124	Donegal	Green	Green	Green	Green	All Attributes favourable (FV)
Ventry	071	1.262	Kerry	Amber	Green	Amber	Amber	Extent and Future prospects rated U2 due to sediment depletion.
Warren (Creggane)	062	0.265	Cork	Green	Green	Green	Green	All Attributes favourable (FV)
Waterville	067	0.756	Cork	Amber	Green	Amber	Amber	Extent is assessed U1 due to erosion while Future Prospects rated as U1 due to lack of control of agricultural management.
White Strand	081	2.151	Clare	Amber	Amber	Amber	Amber	All parameters are assessed as U1 due to trampling and erosion caused by recreational activities.

Total number of sites: 141 (including 5 sub-sites)
Total area of habitat assessed: 398.84ha
Total area of habitat mapped: 405.65ha

APPENDIX III

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

DEHLG - Department of Environment, Heritage and Local Government

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

ENCROACHMENT - The invasion of a species (usually plants) into areas previously uncolonised. This term is often used when an undesirable species advances at the expense of a desirable species or habitat.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FAVOURABLE REFERENCE AREA - Total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability. Favourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FAVOURABLE REFERENCE RANGE - Range within which all significant ecological variations of the habitat/species are included for a given biogeographical region and which is sufficiently large to allow the long term survival of the habitat/species. Favourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the “health” quantity or quality of a habitat or species.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURAL RANGE – The spatial limits within which the habitat or species occurs.

pNHAs - proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NPWS - National Parks and Wildlife Service

ORTHO-RECTIFIED IMAGE – The 2000 Ordnance Survey flight colour images were used as part of this project. These images were used in TIF format and were ortho-rectified. These images have been used as base data to identify the location of raised bogs, produce the high bog boundaries and vegetation maps.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

cSACs - candidate Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SAC's have also been known as cSAC's which stands for "candidate Special Areas of Conservation", and pcSAC's which stands for "proposed candidate Special Areas of Conservation."

SPAs - Special Protection Areas for Birds are areas which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas are protected from significant damage.

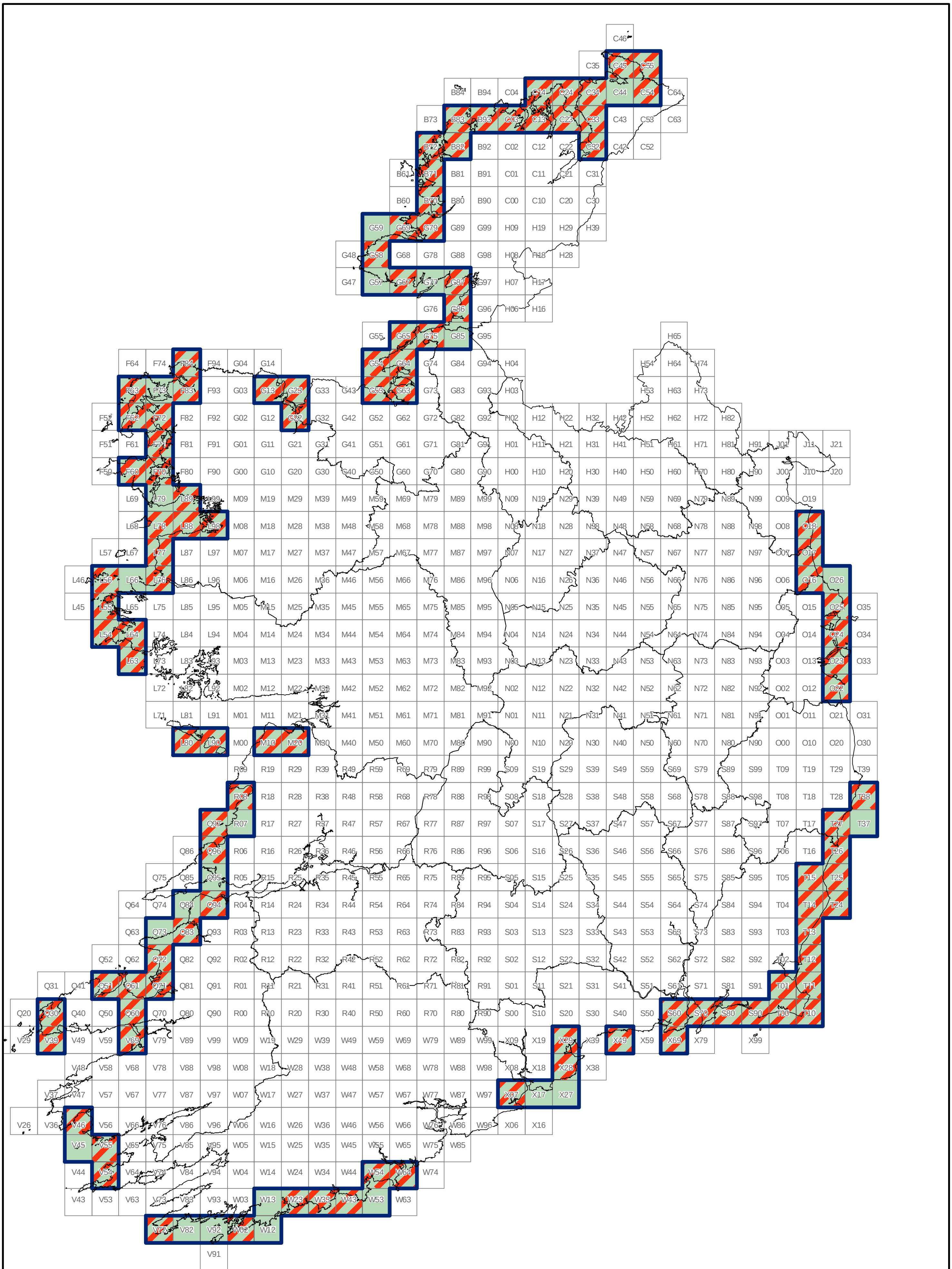
SPECIES - The lowest unit of classification normally used for plants and animals.

2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)

1. National Level	
Habitat Code	2120
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See map attached

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-2006*: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished). ▪ WHITE, J. and DOYLE, G. (1982). The vegetation of Ireland : a catalogue raisonné. *Journal of Life Sciences*, *Royal Dublin Society*, 3: 289-368.
2.3 Range	Widespread geographical distribution around the coast of Ireland (see map).
2.3.1 Surface area	12,900 km² (129 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	4.06 km²
1.2 Distribution map	See map attached
2.4.1 Surface area	4.06 km²
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Decrease of 18%
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	3 = Direct human influence

2.4.9 Justification of % thresholds for trends	Reported loss does not take into account a number of factors, including the following: (a) the natural dynamism of the habitat, (b) mapping issues and (c) the difficulty differentiating between erosion due to natural process and human-induced erosion.
2.4.10 Main pressures	140 – Grazing 300 – Sand and gravel extraction 302 – Removal of beach materials 501 – Paths, tracks, cycling routes 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 720 – Trampling, overuse 871 – Sea defence or coastal protection works 900 – Erosion
2.4.11 Threats	140 – Grazing 300 – Sand and gravel extraction 302 – Removal of beach materials 501 – Paths, tracks, cycling routes 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 720 – Trampling, overuse 871 – Sea defence or coastal protection works 900 – Erosion 990 – Other natural processes (depletion of sediment source)
2.5 Complementary information	
2.5.1 Favourable reference range	12,900km² (129 grid cells x 100 km²)
2.5.2 Favourable reference area	4.95 km² (based on the current area of mobile dunes in Ireland (plus the estimated loss of area since the Habitats Directive came into force)
2.5.3 & 2.5.4 Typical species	**Mobile dunes:** *Ammophila arenaria, Leymus arenarius, Euphorbia paralias, Euphorbia portlandica, Eryngium maritimum, Calystegia soldanella.* **Method:** the species list for mobile dunes is derived from the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004), as well as White & Doyle (1982) and the Coastal Monitoring Project (Ryle *et al*., 2007). Characteristic species were assessed as favourable by Ryle *et al*. (2007).
2.5.5 Other relevant information	
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Bad (U2).
Specific structures and functions (incl. typical species)	Unfavourable-Bad (U2).
Future prospects	Unfavourable-Bad (U2).
Overall assessment of CS	Unfavourable-Bad (U2).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")
2120

Current Distribution (107 cells)
Current Range (129 cells)
Favourable Reference Range (129 cells)
W48 10km grid cells

Date: August 2007

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland
2. Habitat mapping
3. Habitat Range
   - 3.1 Conservation status of habitat range
4. Habitat Area
   - 4.1 Conservation status of habitat area
5. Structures and Functions
   - 5.1 Habitat structures and functions
     - 5.1.1 Conservation status of habitat structures and functions
   - 5.2 Typical species
     - 5.2.1 Conservation status of typical species
6. Impacts and Threats
7. Future Prospects
   - 7.1 Negative future prospects
   - 7.2 Positive future prospects
   - 7.3 Overall habitat future prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

APPENDICES

Appendix I – Description of Coastal Monitoring Project 2004-2006

Appendix II – Sources of Data

Appendix III - Glossary

1. Habitat characteristics in Ireland

Fixed dunes with herbaceous vegetation (code: 2130) is designated as a priority habitat type under the EU Habitats Directive (Commission of the European Communities, 1992). The quality and extent of fixed dune in Ireland is increasingly under threat from human pressures such as housing developments, recreation and changes in agricultural practice.

The term 'fixed' is used to describe any area where the sand is no longer mobile and the dunes have stabilized. This is identified by a decrease in the abundance and vigour of *Ammophila arenaria*, an almost complete vegetation cover, an increase in species diversity and changes in the edaphic status of the substrate. This is a very broad category that displays a great deal of variation in terms of the vegetation communities recorded during the current survey.

There appears to be a great deal of confusion in the literature as to the definition of 'grey dune'. Traditionally, grey dune was used only to describe acid, lichen-rich dune systems, more usually associated with the drier east coast (Tansley, 1939; Rodwell, 2000; Rhind *et al*., 2006). In Ireland, this type of community was found to be particularly common on acidic or decalcified dunes where there is a long history of moderate levels of grazing, particularly by rabbits. In other works, the term 'grey' is derived from the colour of the partially organically-enriched soils of stabilized dune grassland (Salisbury, 1925). This creates a difficulty as 'fixed grey dune with herbaceous vegetation (grey dunes)' (code: 2130) is designated as a priority habitat type under the EU Habitats Directive. The definition given in the Interpretation Manual is 'fixed dunes, stabilized and colonized by more or less closed carpets of lichens and mosses'. Within this definition seven sub-types are described, three of which are particularly relevant to the situation in Ireland. These are a) Northern grey dunes, b) Atlantic dune grasslands and c) dune fine grass annual communities. The Interpretation Manual further states that 'fixed grey dunes with herbaceous vegetation' can consist of a closed cover of grassland, sparse annual grassland on sand, or be dominated by mosses and lichens. Annex I 'fixed dune' priority habitat can therefore be used to describe all fixed grey dune, dune grassland and some dune scrub vegetation. Dune heath, which is also a priority habitat type, is described separately.

'Fixed' areas that are dominated by grass species, while they may possess many fixed grey dune elements, are known as fixed dune grassland. Where systems are composed of calcareous sand, species-rich dune grassland may develop, with *Festuca rubra* a prominent feature. Edaphic and anthropogenic factors are strong determining influences on the diversity of the plant communities recorded. Grazing in particular significantly influences species richness and composition in dune grassland. Where grazing is absent, dune grassland containing *Arrhenatherum elatius* is recorded from several sites around the coast. Another vegetation community, containing several species of dune annual species, is recorded where small patches of the vegetation cover have been exposed, often through the actions of grazing animals. Dune grassland is by far the most common vegetation community on Irish dune systems. Dune grassland vegetation is assigned to the priority habitat type 'fixed dunes with herbaceous vegetation (grey dunes)' (code: 2130).

In the shelter of the high dune ridges wind speed is reduced and the vegetation is removed from the influence of tidal inundation and salt spray. Initially, many of the species that dominated the mobile pioneer phases of dune succession remain, including *Ammophila arenaria*, although there is a noticeable decrease in its abundance and vigour. Over time, the number of sand-binding species to establish increases, leading to the formation of a low-growing, closed carpet of vegetation. Once a complete sward is established and sand mobility has effectively ceased, dunes are said to be stable or 'fixed' and are referred to as 'fixed dunes'. A combination of geomorphologic, edaphic, climatic and anthropogenic factors determine the composition of the fixed dune vegetation that develops at a particular site.

Species diversity and plant distribution in the fixed dunes is strongly controlled by a range of factors, including grazing intensities (White, 1961; Riley, 1984, 1993; Oosterveld, 1985; Van Dijk, 1992; Boorman and Boorman, 2001; Burton, 2001), moisture gradients (Pedmadasa *et al*., 1974), nutrient gradients (Willis and Yemm, 1961; Willis, 1963; Pemadasa and Lovell, 1974a, b, c, d; Kachi and Hirose, 1983) and human disturbance (Trew, 1973; Liddle and Greig-Smith, 1975a,b; Slatter, 1978; Hylgaard and Liddle, 1981).

Over time and depending on the management regime, dune systems can undergo a series of cyclical changes between a range of habitats, including dune grassland, grey dunes, dune heath and dune scrub. On ungrazed sites coarse, rank dune grassland develops that is often dominated by *Arrhenatherum elatius*. If the site remains ungrazed it can quickly develop into dune scrub. A grazed dune system with a high calcium carbonate content supports a species-rich short closed dune turf. On sites derived from siliceous sediments, or where old sites have become decalcified as a result of leaching, the grassland can become somewhat calcifugous and a community dominated by lichens can develop. In some cases, the substrate becomes acidic to such a degree that heath species can colonise. Dune heath is dealt with under two separate EU Annexed habitats ' Atlantic decalcified fixed dunes (Calluno-Ulicetea)' and 'Decalcified fixed dunes with *Empetrum nigrum*', both of which are priority habitats. This dune heath vegetation is dependent on grazing otherwise it develops into dune scrub.

Fixed dune vegetation was by far the most extensive habitat recorded at sites visited during the Coastal Monitoring Project (Ryle *et al*., 2007), often covering vast expanses of the dune landscape. The geographical distribution of fixed dune vegetation is widespread around the coast of Ireland.

Fixed dune vegetation has traditionally been assigned to the Galio-Koelerion within the Koelerio-Corynephoretea (Moore, 1977; Ní Lamhna, 1982; Crawford *et al*., 1996). This class includes the vegetation of pioneer communities and grasslands on dry infertile soils.

The Galio-Koelerion is well-known from Irish sand dune systems. It was first recognized here by Braun-Blanquet and Tuxen (1952). It has been used to describe vegetation of dry, stabilized but unleached parts of coastal sand dunes, in areas usually grazed by rabbits or hares, or converted to golf links (White & Doyle, 1982). Three associations belonging to this alliance have been recognized in Ireland to date, although the distinctions between the three associations are not clearly defined.

1. Violo curtisii-Totuletum ruraliformis (Br.-Bl. et Tx, 1952).
This is the association most commonly assigned to Irish fixed dune vegetation. It has been recorded from Dooaghtry, Co. Mayo (Beckers *et al*., 1976), Fanore, Co. Clare (Ivimey-Cook & Proctor, 1966), and Malahide Island, Co. Dublin (Ní Lamhna, 1982).

2. Phleo-Tortuletum ruraliformis (Massart 1908) Br.-Bl. et De Leeuw 1936.
This has been assigned to fixed dune vegetation on North Bull Island, Co. Dublin (Moore, 1977) and Ballyteigue Burrows, Co. Wexford (Nooren & Schouten, 1977). White & Doyle (1982) suggest that this association may be more commonly found where treading is more severe.

3. Festuco-Galietum maritimi (Omno 1933). Br.-Bl. et De Leeuw 1936.
This association is more usually used to describe closed vegetation of leached areas of base poor sand dunes, usually heavily affected by grazing. Ní Lamhna (1982) suggests that some ungrazed fixed dune vegetation on Malahide Island resembles this association, with *Thymus polytrichus* as a preferential species.

The vast majority of Irish fixed dune displays a close affinity with a *Festuca rubra-Galium verum* fixed dune community (SD8), which is used to describe the vegetation of calcareous sands that have become more or less completely stabilized Rodwell (2000). This community is placed within the Plantagini-Festucion ovinae of the Koelerio-Corynephoretea. Five sub-communities are recognized within the SD8 (Rodwell, 2000):
SD8a - Typical sub-community

SD8b – *Luzula campestris* sub-community

SD8c – *Tortula ruralis* ssp *ruraliformis* sub-community

SD8d – *Bellis perennis-Ranunculus acris* sub-community

SD8e – *Prunella vulgaris* sub-community

Phytosociological classification of the vegetation is complicated by the highly dynamic nature of the habitat. Complex mosaics exist as a result of moisture gradients, nutrient gradings, climate, soils, age and human management. Grazing plays an important role in the development and maintenance of fixed dune communities. The removal of grazers from this habitat, for even a short period of time, leads to the development of scrub vegetation.

Most of the following assessment is based on the results of the Coastal Monitoring Project (Ryle *et al*. 2007), details of which can be found in Appendices I & II.

2. Habitat mapping

As part of the Coastal Monitoring Project, Ryle *et al*. (2007) updated the original national coastal inventory produced in Curtis (1991a). Additional or potential sites were identified through the analysis of aerial ortho-photographs (year 2000 series, Ordnance Survey of Ireland), information received from NPWS conservation staff and extensive ground surveys (see Appendix II). Each of the sites identified (with the exception of 4, which were not accessible) was visited over the course of 3 field seasons (2004-2006) and surveyed using GPS (Ryle *et al*. 2007). A habitat map was produced for each site by importing the mapping data into Arcview 3.2 and overlaying it on the year 2000 series ortho-aerial photographs. The area of each individual Annex I sand dune habitat was mapped at a total of 181 sites. The habitat maps produced in Ryle *et al*. (2007) were used to map the distribution and range of 'fixed dunes with herbaceous vegetation' in Ireland on a 10km square basis. Fixed dune habitat was recorded and mapped from a total of 152 sites, which displayed a widespread geographic distribution, being recorded from all coastal counties.

3. Habitat Range

The mapping of habitat range is defined by the smallest polygon size containing all grid squares where the habitat was recorded, drawn using a minimum number of 90 degree angles. Gaps in the habitat distribution of at least 2 square grids, or as a result of unsuitable ecological conditions for the development of the habitat were deemed enough to justify a break in the range.

3.1 Conservation status of habitat range

The habitat range at the beginning of the assessment period (i.e. when the Biomar survey was undertaken in 1996) is taken as the favourable reference range (FRR) as it encompasses the ecological variation of the habitat in Ireland. The current range is the same as the favourable reference range.

The habitat is still widespread within the relevant geographical range around the coast of Ireland and all sub-types are still present (White & Doyle, 1982; Curtis, 1991b; Crawford *et al.*, 1996; Gaynor, unpublished). Fixed dune habitat was recorded from a total of 152 sites, the range encompassing 130 x 10km grid cells. The historical habitat range is unlikely to have been greater compared to the current FRR.

Small losses of fixed dune habitat during the current assessment period have not affected the current range. The habitat range of fixed dune is assessed as **favourable**.

4. Habitat Area

The total national area of fixed dune is estimated from the Coastal Monitoring Project at 72.93 km^2 (7293ha). This compares favourably with the previous figure of 51.54 km^2 from 41 designated sites, which is taken from the NATURA 2000 database.

It can be seen from the old Ordnance Survey 6" maps that the historical area of fixed dunes was significantly greater than the current area. Prior to the reporting period used in this assessment significant areas have been lost to golf courses, forestry, housing and other developments (e.g. airports). These losses were not quantified during the current assessment, which is confined to the period 1996 to 2006.

4.1 Conservation status of habitat area

The favourable reference area (FRA) is taken as the habitat area at the beginning of the reporting period as it is considered enough to ensure long term survival of the habitat in Ireland. The guidelines state that the current area cannot be less than the area at the time of the Directive coming into force. Ryle *et al.* (2007) recorded a loss of area from a total of 96 sites out of 152. Of these 68 were rated as unfavourable-inadequate (U1) and 28 unfavourable-bad (U2). In most cases, however, this loss was not quantified. The current national habitat area is estimated to be 7060.58 ha from (Ryle *et al*., 2007). In order to estimate the original area the following extrapolation was made from the dataset. It is assumed that the areas of sites with a U1 rating have decreased by 1% and those with a U2 rating by 1.15%. It is estimated by the CMP that approximately 232.6ha of fixed dune habitat have been lost during the past ten years. This produces an original estimated area of 7293.2ha, although this figure must be treated with some caution. The most significant loss was caused by the development of a golf course at one site (Doonbeg, Co. Clare). Other losses were the result of both authorised and unauthorised developments (mainly houses) within sites. There are likely to be additional unreported losses of habitat during the current reporting period.

The conservation status of the habitat area is assessed as **unfavourable-inadequate (U1)** because approximately 3.2% of the favourable reference area has been lost in the current reporting period.

5. Structures and Functions

The following generalised attributes were assessed for Irish sand dune habitats at 181 sites, of which 152 possessed fixed dune habitat (Ryle *et al*., 2007). These attributes and their targets have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of dune habitats and machair (JNCC, 2004) with inputs from NPWS, Research Branch staff.

- Habitat extent
- Physical structure
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation structure: sward height
- Vegetation composition: typical species
- Indicators of negative trend
- Other negative indicators

Indicators of local distinctiveness, such as notable plant species or vegetation mosaics. These are site-specific features, which are not adequately covered by the other attributes.

5.1 Habitat structures and functions

When individual site data from Ryle *et al*. (2007) is combined, it reveals that 22% of monitoring stops carried out in 2006 failed (attributes did not reach their targets). The most common attribute not to reach its target was sward height, which could fail due to either an excessively long sward, which generally indicates undergrazing, or an excessively short sward, which indicates overgrazing. In fixed dunes, undergrazing was recorded to be the more widespread and common of the two regimes. Only 28 sites (18.4%) surveyed during 2006 (Ryle *et al*. 2007) were assessed as having favourable structure and functions, while 78 sites (48%) had an unfavourable-inadequate conservation status and 51 sites (33.6%) were assessed as having an unfavourable-bad conservation status. Analysis of the % area of the total national resource reveals that only 16% of the total area was rated as favourable, while 62% was rated unfavourable-inadequate and 22% was rated unfavourable bad.

Based on the current data and best expert opinion, the conservation status of the habitat structure and functions of fixed dunes is assessed as **unfavourable-bad**.

5.2 Typical Species

The list of typical species for fixed dunes has been compiled from a variety of sources including Curtis (1991b), Crawford *et al*. (1996), JNCC (2004) and Gaynor (unpublished). The species list used in the Coastal Monitoring Project (Ryle *et al*., 2007) has been modified for use in Ireland and differs from that defined by the JNCC (2004) for fixed dunes, as it reflects the relative paucity of the Irish flora.

On relatively recently developed dune systems, such as those found at Bull Island, Co. Dublin, or on sites composed of sand with a high shell fragment content, such as on many Irish west coast sites, the substrate remains relatively calcium-rich. On these calcareous sites, the vegetation supports a number of calcicoles, including *Centaurium erythraea, Anthyllis vulneraria, Trifolium campestre, T. arvense, Anacamptis pyramidalis, Echium vulgare, Blackstonia perfoliata* and *Carlina vulgaris*. Other typical species include *Aira praecox, Carex arenaria, Carex flacca, Cerastium fontanum, Crepis capillaris, Erodium cicutarium, Euphrasia* sp., *Festuca rubra, Galium verum, Geranium molle, Hypnum cupressiforme, Hypochaeris radicata, Linum catharticum, Luzula campestris, Odontites vernus, Ononis repens, Peltigera* spp., *Pilosella officinarum, Plantago lanceolata, Prunella vulgaris, Rhinanthus minor, Rhytidiadelphus squarrosus, R. triquetrus, Thymus polytrichus, Trifolium repens, Sedum acre, Veronica chamaedrys, Viola canina* and *Viola tricolor* ssp. *curtisii*. Where there is a considerable calcium carbonate content, particularly along the west coast, *Asperula cynanchica* and *Arabis hirsuta* can be found in abundance. On dune systems that have developed over limestone bedrock, as found at Banna Strand, Lackan, Fanore and Bunduff, the nationally rare and parasitic *Cuscuta epithymum* is found.

On siliceous sites (i.e. where the sediment is principally derived from local rock), or on old dune systems where leaching over a long period of time has led to decalcification of the surface layers, sand plains subject to grazing become superficially acidic. The dune grassland can have a modest contingent of calcifuges including *Festuca rubra*, *Festuca ovina, Agrostis capillaris, Anthoxanthum odoratum, Helictotrichon pubescens, Galium saxatile, Luzula campestris, Dicranum scoparium, Hylocomium splendens* and *Pleurozium schreberi*. Other species commonly recorded include: *Aira praecox, Carex arenaria, Cladonia* spp., *Hypochaeris radicata, Lotus corniculatus, Pilosella officinarum, Polygala vulgaris, Plantago lanceolata, Potentilla erecta, Pseudoscleropodium purum, Thymus polytrichus, Trifolium repens, Veronica chamaedrys* and *Viola canina*. Generally the swards are closed and *Ammophila*, though common, is sparse. Vegetation developed on decalcified sand also occurs where sand is blown over acidic rock such as granite, situations that are frequently encountered along the windswept northwest coast, such as at Sheskinmore and Rinclevan, both in County Donegal. Apart from the siliceous/decalcified nature of the substrate, this vegetation is strongly dependent on grazing, often by domestic stock, as well as, or rather than rabbits.

5.2.1 Conservation status of habitat typical species

The presence of typical or characteristic species was one of the attributes assessed for structure and functions during the Coastal Monitoring Project (CMP) (Ryle *et al*. 2007). Typical species for this habitat are listed in Chapter 2, Ryle *et al*. (2007). A total of 143 monitoring stops (15.5%) failed to reach the target for characteristic species out of 923 stops carried out over 152 sites (Ryle *et al*. 2007). The CSM protocol developed by the JNCC distinguishes between calcareous-based fixed dune and acidic fixed dune. It recommends different targets for the occurrence of typical species – at least 8 present at more than occasional level in the case of the former and at least 6 present at more than rare level for the latter. A separate list of typical species is provided for each, although there is considerable overlap between the two lists. During the CMP, these two sub-types are not differentiated, although the total lichen cover in each monitoring stop was noted as a basic indicator of acidity. Future surveys could differentiate between acidic and calcareous fixed dunes, using the current dataset as a baseline.

Following the modified CSM protocol used in the Coastal Monitoring Project, the conservation status of typical species of fixed dunes is assessed as **unfavourable-inadequate**.

6. Impacts and Threats

There are several sources of information about impacts and activities affecting fixed dunes in Ireland, including Curtis (1991b) and Crawford *et al*. (1996). However, the most comprehensive source of information is Ryle *et al*. (2007), who summarised the main impacts affecting dunes surveyed at 181 sites during 2004 to 2006 (Table 1). The 30 impacts that were noted in fixed dunes at more than three of the survey sites are listed in Table 1. An additional 35 impacts were noted at three or less of the sites, making a total of 65 separate impacts recorded in the habitat.

Of the ten Annex I sand dune habitats surveyed during the Coastal Monitoring Project, fixed dunes have the greatest number of impacts, occurring at a significant number of sites. This may be partly attributed to fact that the habitat occupies by far the largest area of all sand dune habitats, covering approximately 7060ha. In addition, fixed dunes, by their nature, represent a resource for a range of agricultural and amenity uses, unlike most other dune habitats, such as strandlines and foredunes.

Table 1 Most frequently recorded impacts in Fixed dunes; number of sites at which the impacts were recorded and the total area affected by each impact

Code	Impact/Activity	Number of sites	Total area affected (ha)
622	Walking, horseriding and non-motorised vehicles	85	1080.8
900	Erosion	71	408.6
140	Grazing	58	1861.0
149	Undergrazing	58	1087.8
954	Invasion by a species	56	275.3
720	Trampling, overuse	51	494.6
608	Camping and caravans	49	132.6
103	Agricultural improvement	32	506.4
171	Stock feeding	35	115.3
143	Overgrazing by cattle	32	725.8
623	Motorised vehicles	29	117.6
501	Paths, tracks, cycling routes	28	24.9
601	Golf course	26	1132.4
146	Overgrazing by hares, rabbits, small mammals	24	512.6
150	Restructuring agricultural land holding	22	845.4
871	Sea defence or coastal protection works	21	12.4
403	Dispersed habitation	19	12.4
421	Disposal of household waste	18	5.3
300	Sand and gravel extraction	17	5.3
790	Other pollution or human activities	15	16.0
607	Sports pitch	13	16.6
490	Other urbanisation, industrial and similar activities	10	3.6
180	Burning	8	0.4
402	Discontinuous urbanisation	7	4.8
502	Routes, autoroutes	8	6.1
120	Fertilisation	7	250
142	Overgrazing by sheep	7	422
400	Urbanised areas, human habitation	6	8.4
700	Pollution	5	1.2
971	Competition	5	111.5

Total number of sites at which the habitat was present = 152
Total habitat area = 7060.6ha

During the CMP, the most commonly noted impact in the habitat was *walking*, *horseriding and non-motorised vehicles*, which was listed at 85 (or 55 of the survey sites). The almost ubiquitous use of sand dunes for recreational activities makes even this figure seem surprisingly low, although the same activities may frequently have been accommodated under *Trampling*, *overuse*, which was noted at 51 (or 33% of the sites). The affect of the impacts varied considerably, with high intensities common on east coast sites where recreational pressures are generally greater. A number of west coast sites were less intensely impacted by recreational use due to lower population densities and/or agricultural management of the sites. Walking may, when carried out at a low intensity, occasionally exert a positive influence in dune grassland. Where grazing livestock are absent, and the sward is generally of a rank nature, one of the affects of walking may be the creation of some short-turf areas, where plant species diversity often exceeds that of much of the site. However, the impact of walking and associated activities is generally negative and is often sufficiently intense to include soil compaction, surface break-up, or the creation of permanent tracks on which the vegetation cover has been severely eroded, in the list of negative consequences.

Erosion was included among the recorded impacts in fixed dunes at 71 sites, although this may represent an underestimation of the actual total, due to the lack of accurate previous data or sufficiently distinct aerial photographs. Although the 2000 series and 1995 series aerial photographs used in this survey provided useful indications of erosion in sand dunes, it was often not possible to reliably distinguish the individual habitats present. However, during site visits, erosion was generally quite obvious at sites where foredune habitats were absent and fixed dunes formed the seaward boundary of the sand dunes. The slumping of fixed dune vegetation on the front faces of dunes often confirmed the ongoing influence of erosion in the habitat.

The total area affected by *erosion* is also greatly underestimated as the majority of individual site areas affected are recorded as ‘unknown’. This again, is largely due to the lack of accurate previous records with which the current data can be compared. Where specific areas are attributed to the impact, they are usually based on the judgement of the site report authors rather than on changes from previous extent measurements. The CMP will provide the necessary data for more meaningful estimates of habitat loss in future reporting cycles.

Invasion by a species was noted in fixed dunes at 56 sites. On the east coast, *Hippophae rhamnoides* (Sea buckthorn) was a common invasive species – often spreading from golf courses or the hedging around private houses and mobile homes. The species is much less common on the south and west coasts, with extensive stands found only at Castlegregory (Co. Kerry) and Rinclevan (Co. Donegal). In the former case, *H. rhamnoides* has been extensively planted as a means of stabilising the eroding dunes. A number of small east coast sandhill sites have been greatly affected by the spread of *H. rhamnoides*, particularly in the absence of grazing or management regimes that include scrub clearance. At sites such as Kilgorman (Co. Wexford), much of the natural dune area is mapped as scrub and is excluded from the total sand dune area, due to the dense growth form of the shrub over a wide area.

The most commonly occurring and widespread invasive species in fixed dunes was *Pteridium aquilinum* (Bracken), which is included among the list of negative indicator species on the fixed dune monitoring fieldcard. The most commonly occurring and widespread invasive scrub species were *Prunus spinosa* (Blackthorn) and *Rubus fruticosus* (Bramble).

A significant presence of invasive species was often directly related to undergrazing: of the 56 sites at which *invasion by a species* was noted, 24 were among those at which *undergrazing* (code 149) was recorded. The correlation would be even greater were it not for the fact that undergrazing was generally not considered as an impact at east coast sites. Many of the undergrazing records refer to only small, relatively insignificant areas of sites, which are otherwise quite substantially grazed and therefore tend not to have invasive stands of scrub or other species.

There can be a degree of duplication in the recording of *Pteridium aquilinum* (Bracken) insofar as it is included as a negative indicator species in the structure and function assessment and may also be recorded as *invasion by a species* leading to an unfavourable rating for future prospects. However, large stands of scrub or invasive species such as Bracken were generally avoided when choosing the locations of monitoring stops, when it is clear that they are substantial enough to be factored into the assessment of future prospects.

Substantial stands of invasive species were sometimes mapped as scrub, and therefore excluded from the total fixed dune (or other relevant habitat) area. However, there was no consistent minimum area threshold, beyond which these species were always mapped separately and excluded from the sand dune total areas. In the future, a consistent approach to dealing with the issue should be implemented. It may be preferable to retain all or almost all such stands within the areas of sand dune habitat to which they naturally belong (most frequently fixed dunes) and account for the compromised conservation status of the habitat by a negative structure and functions and/or future prospects assessment. The difficulties were illustrated at the Raven (Co. Wexford) where the CMP excluded the large conifer plantation from consideration as sand dune habitat, due to the greatly modified conditions that now exist there. It seems, however, that the removal of significant numbers of trees - which is currently proposed for the management of the site (NPWS, unpublished report) - could see a quite rapid rehabilitation of sand dune vegetation, which would lead to a future increase in the area mapped as sand dune.

Grazing and *undergrazing* were both noted in fixed dunes in 58 of the survey sites, although the former refers to the positive affect of grazing livestock in creating and maintaining the short turf that is crucial for species diversity, while the latter is generally always regarded as a repairable negative influence, leading to rank, grass-dominated swards and a reduction in species diversity.

Undergrazing was noted in 58 (38%) sites, with a total affected area estimated at 1097.8ha, or 15.9% of the national fixed dune area. Each recorded instance of the impact was considered as a repairable negative influence, although the intensity of the impact influence was mostly rated as either medium or high. The affects of undergrazing were often manifested in fixed dune monitoring stops, where sward height was, by some margin, the most commonly failed habitat attribute.

Undergrazing can be considered somewhat under-recorded as it could legitimately be listed at any site where the dune grassland is of a rank, or overgrown nature, but has generally been omitted from any site where there is no current, or recent grazing management. Thus, the only east coast sites where undergrazing has been included among the lists of activities are Magherabeg and Kilpatrick (both in Co. Wicklow), where agricultural use forms a significant part of the land management. At most other east coast sites where the dune grassland is of an overgrown or rank nature, land use is dominated by amenity activities and developments, and grazing is not a realistic option for site management.

The cumulative total number of overgrazing impacts recorded in fixed dunes was 63, consisting of *overgrazing by cattle* (32 sites), *overgrazing by hares, rabbits, small mammals* (24 sites) and *overgrazing by sheep* (7 sites). This only slightly exceeds the number of sites at which undergrazing was noted (58), although the fact that there were several sites where two overgrazing impacts were noted and two sites where three overgrazing impacts were listed (Garter Hill, Co. mayo and Coney Island, Co. Sligo), meant that only 47 different survey sites were affected by overgrazing.

The marked regional variation in land management can be seen in the almost total absence of all grazing impacts from east coast sites, and the frequency with which several impacts under the general grazing category form a major element in south coast, and particularly west coast sites. A very small proportion of east coast sites have a current management regime, or recent history, of livestock grazing and only six east coast survey sites were associated with any of the grazing activities. Development pressures and intense recreational use are almost always more significant factors in east coast sand dune systems.

There were 25 different impacts in fixed dunes under which some of the individual records were thought to represent an irreparable negative influence. The more commonly recorded of these impacts included *sand and gravel extraction*, some of those listed under the general category of *urbanised areas*, *human habitation*, *sports pitch*, *golf course*, *camping and caravans*, *agricultural structures*, and a number listed under the heading of *transportation & communication* that refer to roads and paths etc. The areas involved were often quite small, although occasionally, very large areas, particularly in the case of golf clubs, were affected. The total negative affect and the area of natural dune habitat occupied by golf clubs was somewhat understated, as the impact code was generally only invoked in cases where the course was developed after 1996 - the chosen baseline date with which the current data was compared when estimating changes in habitat extent. In fact, there are more than 400 official clubs in the Republic alone, of which 37 have courses that were constructed on coastal sands and are regarded as ‘true’ links courses (Gaynor and Browne, 1999). The frequency of both authorised and unauthorised developments (including housing and quarries) particularly within designated sites is of major concern.

Although it is feasible that some of the developments or sports facilities deemed to represent irreparable damage could be restored to functioning sand dune habitat, the extreme unlikelihood of this happening in most cases, suggests that the most negative outlook on the impact influence is appropriate, e.g. although some golf courses retain elements of conservation interest and could be readily restored to habitat managed for conservation purposes, the unlikelihood of their being abandoned as golf clubs renders the loss to the conservation value of the dune system all but permanent.

The situation with golf courses illustrates the importance of interpreting impacts in the context of frequency of occurrence, intensity of impact *and* area affected, e.g. although *golf course* (code 601) was only the thirteenth most commonly noted impact in fixed dunes, it was usually regarded as being of high intensity and had the second largest total affected area (after *grazing* (code 140)), although it had a lower proportion of ‘unknown’ areas than a small number of other impacts that affected large areas. Among the larger individual areas affected by golf course developments were those at Termoncarragh Lough (Co. Mayo) and Rosapenna (Co. Donegal), where the affected areas exceeded 100ha and 200ha respectively.

Some other frequently noted impacts, such as *stock feeding* which was the ninth most common impact in fixed dunes, had only a small total affected area, due to the fact that the damage typically associated with the impact is usually concentrated around ring feeders and water troughs.

7. Future Prospects

The future prospects for Annex I sand dune habitats at each site are based on an assessment of the threats posed or potential benefits likely to accrue from various impacts and activities. These can include management regimes (e.g. coastal protection works and beach cleaning), recreational activities (e.g. walking and horse-riding), agricultural practices (e.g. overgrazing and stock feeding) and potential developments.

There is no threshold for future prospects and the final result is based on a best scientific judgement. Most recorded impacts refer to activities noted during site surveys, although other sources of comparative information include NPWS site notes (NHA and NATURA 2000 information), while relevant data from other agencies such as county councils were also evaluated. NPWS conservation plans, where available, were reviewed and were taken into account when making a final determination.

7.1 Negative future prospects

The Coastal Monitoring Project 2006 (Ryle *et al.* 2007) reported that 20 sites supporting fixed dune habitat (out of a total of 152) were assessed as having a favourable conservation status for future prospects, while 89 sites were unfavourable-inadequate and 43 were unfavourable-bad. The poor rating can be attributed to a combination of inappropriate grazing regimes, scrub encroachment and recreational and development pressures, which represent the main future threats. The vast majority of dune systems in Ireland are in private ownership, making it more difficult to implement conservation plans.

7.2 Positive future prospects

A significant proportion of these fixed dune sites are completely or partially located within SACs (76%), with some additional sites within NHAs (14%), and therefore should be partially protected from inappropriate development and damage. The level of enforcement, however, needs to improve significantly. Notifiable actions, which require consent from the Department of Environment, Heritage and Local Government, have been set for fixed dune habitat within SACs.

Grazing of livestock is a notifiable action and grazing levels should also be controlled within SACs by NPWS Conservation Plans, but this does not always occur in practise on many coastal sites. The intensity of grazing and the number of sites being grazed may decrease in the future due to several reasons. Some NPWS Conservation Plans and Department of Agriculture Farm Plans are setting sustainable grazing levels for designated areas (SACs and NHAs) and for farms working in the Rural and Environment Protection Scheme (REPS). Overgrazing should decrease as these stocking rates are enforced. Stocking rates of livestock in Ireland in general are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (FAPRI-Ireland Partnership 2003). However, this could potentially result in sites being abandoned, which would lead to scrub encroachment due to the lack of grazing.

7.3 Overall habitat future prospects

Grazing and recreation area the most significant impacts affecting the future prospects of this habitat. Currently some grazing levels outside and within SACs are still unsustainable and are affecting the structure and functions of this habitat. While some grazing level agreements are in place and are having a positive impact at several sites, there are no agreements or no proper enforcement of grazing agreements at many sites. The amount of unauthorised developments within designated areas should decrease due to monitoring and enforcement by Local Authorities and NPWS staff.

Overall, the habitat future prospects are assessed as **Unfavourable-Bad,** as only 13% of sites and 20% of the total national area were considered by the Coastal Monitoring Project (Ryle *et al*., 2007) to have favourable future prospects. Uncertainty in the future of the agricultural sector, along with continued recreational and development pressures, mean that the long term survival of the habitat is not assured.

8. Overall Assessment of the Habitat Conservation Status

The habitat conservation status of the four main attributes has been assessed either as **Favourable, Unfavourable Inadequate** or **Unfavourable-bad** at national level.

- The Natural Range of fixed dunes is considered to be **Favourable**. The Favourable Reference Range is considered to be equal to the current range of the habitat.
- The Area of fixed dunes habitat has decreased by about 3.2% in a ten year reporting period (1996-2006). This attribute was assessed as **Unfavourable Inadequate**.
- The Habitat Structure and Functions have been assessed as **Unfavourable-Bad**. 204 out of 923 monitoring stops failed to meet the target. The main reasons are a lack of typical species

and the presence of negative indicator species, which are indicative of the agricultural and amenity pressures that this priority habitat is subject to. In terms of habitat area, 62% and 22% respectively of the total area is rated as *unfavourable-inadequate* and *unfavourable-bad* for structure and functions.

- The Future Prospects are assessed as **Unfavourable-Bad**. The ongoing threats of inappropriate agricultural management, recreational and development pressures will continue to be major concerns for the future.

Based on the above assessments, the overall conservation status for ‘fixed dunes with herbaceous vegetation’ habitat is **Unfavourable-Bad**.

9. References

BOORMAN, L.A. and BOORMAN, M.S. (2001). The spatial and temporal effects of grazing on the species diversity of sand dunes. In: *Coastal dune management: shared experience of European conservation practice* (Houston, J.A., Edmondson, S.E. and Rooney, P.J., Eds.), 161-167. Liverpool University Press.

BRAUN-BLANQUET,J. and DE LEEUW, W.C. (1936). Vegetationsskizze von Ameland. *Nederlandsch Kruidkundig archief*, **46**: 359-393.

BRAUN-BLANQUET, J. and TÜXEN, R. (1952). Irische pflanzengesellschaften. *Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich*, **25**: 224-415.

BURTON, P. (2001). Grazing as a management tool and the constraints of the agricultural system: a case study of grazing on Sandscale Haws Nature Reserve, Cumbria, Northwest England. In: *Coastal dune management: shared experience of European Conservation Practice* (Houston, J.A., Edmondson, S.E. and Rooney, P.J., Eds.), 80-85. Liverpool University Press, Liverpool.

COMMISSION OF THE EUROPEAN COMMUNITIES (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal no. L 206, 22/07/92.

COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels.

CRAWFORD, I., BLEASDALE, A. and CONAGHAN, J. (1996*). Biomar survey of Irish machair sites, 1996. Irish wildlife manuals, No. 3.* Dúchas, The Heritage Service, Dublin.

CURTIS, T.G.F. (1991a). A site inventory of the Sandy Coasts of Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

CURTIS, T.G.F. (1991b). The Flora and Vegetation of Sand Dunes in Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

FAPRI-IRELAND PARTNERSHIP (2003). *An analysis of the effects of decoupling of direct payments from production in the Beef, Sheep and Cereal Sectors.* Report prepared for the Department of Agriculture and Food. Teagasc Rural Economy Research Centre. Sandymount, Dublin. www.tnet.teagasc.ie/fapri

FOSSITT, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny

GAYNOR, K. (Unpublished). *The phytosociology and ecology of Irish sand dunes.* Unpublished Ph.D. Thesis presented to the National University of Ireland.

GAYNOR, K. and BROWNE, A. (1999). *Study of Irish links golf courses*. Unpublished report for Dúchas, The Heritage Service, Dublin.

HYLGAARD, T. and LIDDLE, M.J. (1981). The effect of human trampling on a sand dune ecosystem dominated by *Empetrum nigrum*. *Journal of Applied Ecology*, **18**: 559-569.

JNCC. (2004). *Common Standards Monitoring guidance for saltmarsh habitat*. JNCC, Peterborough.

KACHI, N. and HIROSE, T. (1983). Limiting nutrients for plant growth in coastal sand dune soils. *Journal of Ecology*, **71**: 937-944.

LIDDLE, M.J. and GREIG-SMITH, P. (1975a). A survey of tracks and paths in a sand dune ecosystem. I. Soils. *Journal of Applied Ecology*, **12(3)**: 893-908.

LIDDLE, M.J. and GREIG-SMITH, P. (1975b). A survey of tracks and paths in a sand dune ecosystem. II. Vegetation. *Journal of Applied Ecology*, **12**: 909-930.

MOORE, J.J. (1977). Vegetation of the dune complex. In: *North Bull Island, Dublin Bay, a Modern Coastal Natural History* (Jeffrey, D. Ed.), 104-106. Royal Dublin Society, Dublin.

Ní LAMHNA, É. (1982). The vegetation of salt marshes and sand-dunes at Malahide Island, County Dublin. *Journal of Life Sciences*, *Royal Dublin Society*, **3**: 111-129.

NOOREN, M.J. and SCHOUTEN, M.G.C. (1976). *Coastal vegetation and soil features in south-east Ireland*. Doctoraal Verslag, Nijmegen.

OOSTERVELD, P. (1985). Grazing in dune areas: the objectives of nature management and the aims of research for nature conservation management. In: *Sand dunes and their management*, (P. Doody, Ed.), 187-203. Nature Conservancy Council, Peterborough.

PEMADASA, M.A., GREIG-SMITH, P. and LOVELL, P.H. (1974). A quantitative description of the distribution of annuals in the dune system at Aberffraw, Anglesey. *Journal of ecology*, **62**: 379-402.

PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford.

RANWELL, D.S. (1972). *Ecology of salt marshes and sand dunes.* Chapman and Hall, London.

RHIND, P., STEVENS, D. and SANDERSON, R. (2006). A review and floristic analysis of lichen-rich grey dune. *Proceedings of the Royal Irish Academy*, **106B (3)**: 301-310.

RILEY, D.H. (1984). Grazing and changes in a dune grassland in Co. Londonderry, 1969-1980. *Irish Naturalists' Journal*, **21**: 288-296.

RILEY, D.H. (1993). Further changes in a dune grassland in Co. Londonderry, 1980-1990. *Irish Naturalists' Journal*, **24(8)**: 310-315.

RODWELL, J.S. (2000). *British plant communities. Vol V: Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge.

RYLE, T., CONNOLLY, K. , MURRAY, A. and SWANN, M. (2007). *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished)

SALISBURY, E.J. (1925). Notes on the edaphic succession in some dune soils, with special reference to the time factor. *Journal of Ecology*, **13**: 322-328.

SLATTER, R.J. (1978). Ecological effects of trampling on sand dune vegetation. *Journal of Biological Education*, **12**: 89-96.

TANSLEY, A.G. (1939). *The British Islands and their vegetation*. Cambridge University Press, Cambridge.

TREW, M.J. (1973). The effects and management of trampling on coastal sand dunes. *Journal of Environmental Planning and Pollution Control*, **1**: 38-49.

Van DIJK, H.W.J. (1992). Grazing domestic livestock in Dutch coastal dunes: Experiments, experiences and perspectives. In: *Coastal Dunes: Geomorphology, Ecology and Management for Conservation* (Carter, R.W.G., Curtis, T.G.F. and Sheehy Skeffington, M., Eds.). A.A. Balkema, Rotterdam.

WHITE, D.B.J. (1961). Some observations on the vegetation of Blakeney Point, Norfolk, following the disappearance of the rabbits in 1954. *Journal of Ecology*, **49**: 113-118.

WHITE, J. and DOYLE, G.J. (1982). The vegetation of Ireland : a catalogue raisonné. *Journal of Life Sciences*, *Royal Dublin Society*, **3**: 289-368.

APPENDICES

APPENDIX I

Coastal Monitoring Project 2004-2006 (Ryle *et al*., 2007)

The Irish coastline, including the islands, extends to 6,000 kilometres, of which approximately 750 kilometres is sandy (Curtis 1991a). The systems range from simple sandhills to fully developed dune complexes, ranging from ephemeral strandline to dynamic embryonic and mobile dunes to fixed dunes, dune slacks and machair plains. The sand dune resource is under threat from a number of impacts – primarily erosion, changes in agricultural practices and development of land for housing, tourism and recreational purposes. This project, carried out on behalf of the National Parks and Wildlife Service (NPWS), is designed to meet Ireland's obligation under Article 17 of the EU Habitats Directive, in relation to reporting on the conservation status of Annex I sand dune habitats in Ireland. The following habitats were assessed:

- Annual vegetation of driftlines (1210)
    - Perennial vegetation of stony banks (1220)
    - Embryonic shifting dunes (2110)
    - Shifting dunes along the shoreline with *Ammophila arenaria* (2120)
    - Fixed dunes with herbaceous vegetation (Grey Dunes) *(2130)
    - Decalcified fixed dunes with *Empetrum nigrum* *(2140)
    - Atlantic decalcified fixed dunes (Calluno-Ulicetea) *(2150)
    - Dunes with *Salix repens* ssp *argentea* (Salicion arenaria) (2170)
    - Humid dune slacks (2190)
    - Machair (21AO)*+

* indicates a Priority Habitat + Priority Habitat in Ireland only

The project had a number of stated objectives, including:

- Update the inventory of Irish sand dune systems (Curtis 1991a)
- Develop a monitoring programme for Irish sand dune habitats
- Establish the area of total national resource of each habitat
- Produce fully digitised habitat maps for each coastal dune site
- Assess the conservation status of each habitat at all sites
- Establish a database in which the results of this and future sand dune habitats monitoring could be entered and analysed

The project is notable in that it represents the first comprehensive assessments of sand dune systems and their habitats in Ireland. Over the course of three field seasons (2004-2006), all known sites for sand dune habitats were assessed (only 4 sites were not visited owing to access problems). The original inventory of sand dune systems by Curtis (1991a) listed 168 sites for the Republic of Ireland. During the current survey, analysis of ortho-aerial photographs and additional information supplied from NPWS staff increased the site list to 181 sites (Table 1). In addition, 15 sub-sites are recognised on the basis that they are geographically isolated from the main site and are subject to different management regimes.

Detailed site reports provide a clearer understanding of the habitat area, processed and impacts and the conservation status of the sand dune habitats at individual sites. All of the results have been entered into a Coastal Monitoring Project database, which will enable a convenient method of accessing specific data.

The overall condition of each habitat was determined following a methodology that was adapted from the Joint Nature Conservancy Council (the statutory adviser to the UK Government on national and international nature conservation issues), which has been conveyed in a series of Common Standards Monitoring (CSM) guidance documents (JNCC, 1998 and 2004a, b & c). It employs rapid assessment techniques that can be easily repeated in the future implementation of the monitoring programme. This system is based on vegetation surveys, measurement of habitat areas, and assessments of threats and management practices.

The specific attributes that determine the conservation status of a habitat at a site are:

- **Habitat extent (Area)**
- **Structure and Functions** including presence and abundance of typical species, presence and abundance of negative indicator species, bare ground, short turf cover, sward height, plant health and scrub cover (where applicable). Other criteria relating to particular habitats such as cover of *Salix repens,* and the ratio of forbs and grasses in dune slacks.
- **Future prospects** including a number of factors such as
- – Threats and their impacts on the site e.g. recreational activities, agricultural practices, development of land
- – Management of the site e.g. coastal protection works, beach cleaning etc.
- – Indicators of local distinctiveness such as notable plant species or vegetation mosaics

Habitat area is based on survey work using GPS, examination of aerial photographs and the production of detailed GIS maps. Structure and Functions was determined from monitoring stops that were carried out in all habitats and at most sites. Future Prospects are based on apparent impacts/threats to the site or a particular habitat that are likely to occur in the future. Attributes are assigned either a 'Favourable', 'Unfavourable-Inadequate', or 'Unfavourable-Bad' category, using criteria outlined in Chapter 2 of Ryle *et al*. (2007). The Overall Conservation Status is a synthesis of all the collected data. It is derived using the least favourable attribute. In addition, the overall conservation assessment of a habitat takes into account the overall range of the habitat within a biogeographical region.

Table 1 Comparative table highlighting the changes between the original inventory of Irish sand dune sites (Curtis 1991a) and the final site list used in the Coastal Monitoring Project 2004-2006 (Ryle *et al*. 2007).

County	National Site Inventory	New Sites	Sites to be deleted*	Coastal Monitoring Inventory
Louth	2			2
Meath	2			2
Dublin	8			8
Wicklow	10			10
Wexford	21	1		22
Waterford	7	1	3 + 1	8
Cork	10	3		13
Kerry	15		1	14
Clare	8			8
Galway	18	*1*		19
Mayo	22	2		23
Sligo	8			8
Donegal	37	5		42
Total	**168**	**13**	**5**	**181**

* These sites were surveyed as part of the Coastal Monitoring Project but no longer support sand dune habitat and may be deleted during the next monitoring cycle.

Appendix II – Summary of conservation status assessements of Fixed dune (Annex I priority habitat 2130) in Ireland, taken from Coastal Monitoring Project (Ryle *et al*. 2007). Green = Favourable (FV), Amber = Unfavourable-Inadequate (U1), Red = Unfavourable-Bad (U2).

Site name	Site code	Area (ha)	*County*	Overall	Extent	Structure and functions	Future prospects	*Comments*
Agleam	124	318.688	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to agricultural improvement, stripe fencing and overgrazing / undergrazing.
Aillebrack	100	1.319	Mayo	Amber	Green	Green	Amber	Future Prospects are assessed as U1 due to recreational pressures.
Ardamine	026	2.710	Wexford	Red	Red	Amber	Red	Extent and Future Prospects rated U2 largely due to partial destruction of habitat through erosion.
Ards	165	12.074	Donegal	Amber	Green	Amber	Amber	Structure and Functions, and Future Prospects are assessed as U1 due to an excessive proportion of rank, ungrazed sward with low species diversity and invading scrub species.
Arklow North	020	1.606	Wicklow	Red	Amber	Red	Amber	Extent is assessed as U1 due to scrub encroachment. Structure and Functions and Future Prospects are assessed as U2 due to the occurrence of negative indicator species and an excessive proportion of bare ground.
Arklow South	021	0.394	Wicklow	Red	Red	Red	Red	Extent, Structure and Functions, and Future Prospects are assessed as U2 due to heavy recreational pressures, low species diversity, and damage and loss of area caused by construction works.
Ballybla	014	10.564	Wicklow	Amber	Amber	Green	Amber	Extent and Future Prospects rated U1 due to limited dynamic and lack of grazing coupled with considerable recreational impacts.
Ballybunion	079	2.042	Kerry	Red	Red	Red	Red	All attributes rated U2 due to loss of habitat to golf course and condition of habitat.
Ballydavid	073	22.026	Kerry	Red	Amber	Red	Amber	Structure and Functions rated U2, while Extent and Future Prospects assessed as U1. Area is impacted by erosion, development and agricultural management of the habitat.
Ballyheige	078	42.361	Kerry	Red	Amber	Red	Red	Extent is assessed as U1 due to erosion and sediment starvation. Structure and Functions were assessed as U2 due to presence of undergrazed, rank sward with low species diversity, and the presence of negative indicator species. Future Prospects are assessed as U2 due to undesirable agricultural management practices and recreational pressures.
Ballymacoda	054	19.437	Cork	Red	Amber	Red	Amber	Structure and Functions are rated as U2, while Extent and Future Prospects. Habitat condition and diversity is poor.

Ballymastocker	173	24.178	Donegal	Amber	Green	Green	Amber	Future Prospects rated as U1 due to lack of large grazers, encroachment of species and high recreational pressure.
Ballynaclash	033	2.477	Wexford	Red	Amber	Red	Amber	Structure and Functions are assessed as U2 due to undergrazing.
Ballyness	161	91.1	Donegal	Red	Amber	Red	Amber	Structure and Functions rated as U2 as a result of overgrazing by rabbits, high cover of agricultural weeds and low typical species diversity.
Ballyteige Burrow	041	238.638	Wexford	Amber	Green	Amber	Green	Structure and Functions rated as U1 due to decline in the habitat due to maturing.
Ballyvergan East	053	2.086	Cork	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U2 due to erosion, developments, and heavy recreational pressures.
Baltray	002	27.897	Louth	Amber	Amber	Amber	Amber	Extent , Structure and Functions and Future Prospects are assessed as U1 due to recreational activities and the associated activities of the golf course.
Banna Strand	077	143.934	Kerry	Red	Green	Red	Amber	Structure and Functions rated U2 and Future Prospects are assessed as U1. Dunes are largely rank, undergrazed and negative indicator species such as *Senecio* are widespread.
Bannow Island	042	3.233	Wexford	Amber	Amber	Green	Amber	Extent and Future Prospects rated U1 due to natural erosion, sediment depletion, and the spread of scrub.
Barley Cove	064	21.748	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Barley Cove (Subsite - Golf course)	208	9.660	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Bartragh Island	131	120.216	Mayo	Amber	Green	Amber	Green	Structure and Functions rated U1 due to occasional presence of negative indicator species.
Bartraw	111	12.261	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Beal Point	080	28.144	Kerry	Amber	Amber	Amber	Amber	Extent, Structure and Functions, and Future Prospects are assessed as U1 due to erosion, sand and gravel extraction, supplementary feeding of stock, and the presence of some rank, undergrazed sward with low species diversity.
Bishopsquarter	088	4.849	Clare	Red	Amber	Red	Red	Extent is assessed as U1, and Future Prospects are assessed as U2 due to erosion, caused by intensive livestock rearing practices and recreational use. Structure and Functions are assessed as U2 due to excessive bare ground, and a lack of typical species.
Brittas Bay	017	44.94	Wicklow	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects rated as U1 due to maturing sand dune system and considerable pressure from recreational users.
Bunduff	139	40.021	Sligo	Amber	Amber	Green	Green	Extent rated as U1 as a result of high recreational activities leading to erosion.

Bunmahon	047	2.313	Waterford	Red	Amber	Amber	Red	Future Prospects rated U2, while Structure and Functions and Extent rated U1. This is largely due to the development of large parts of the habitat as a caravan park and the decline in condition of the remaining portion.
Cahore Point North	028	78.303	Wexford	Amber	Amber	Amber	Amber	Extent, Structure and Functions, and Future Prospects are assessed as U1 due to erosion, the spread of *Pteridium aquilinum* (Bracken) and scrub species, and the presence of bare and eroded tracks.
Cahore Point South	029	7.280	Wexford	Red	Amber	Red	Amber	Extent and Future Prospects are assessed as U1, and Structure and Functions are assessed as U2, due to scrub encroachment, undergrazing, and intense recreational pressures.
Carnboy	156	61.3	Donegal	Amber	Amber	Amber	Amber	All attributes assessed as U1 as a result of expansion of an airport, erosion due to high recreation and lack of large grazers.
Carnsore	039	48.793	Waterford	Red	Green	Amber	Red	Structure and Functions rated as U2 due to decline in condition of the vegetation. Future Prospects rated as U1 largely due to recreational impacts.
Castlefreke	060	26.593	Cork	Red	Amber	Red	Green	Structure and Functions is assessed as U2 due to a lack of grazing, however recently part of the site is managed by NPWS for grazing.
Castlegregory	075	225.73	Kerry	Amber	Amber	Amber	Green	Extent and Structure and Functions are assessed as U1 due to human induced erosion from recreation and overgrazing by cattle. Also due to the invasion of the dunes by *Hippophae rhamnoides*.
Cloghmoyle	110	4.031	Mayo	Red	Green	Amber	Red	Structure and Functions rated U2 due to widespread presence of negative indicator species. Future Prospects rated as U1 due to continued use of habitat for horse-riding school.
Clooney	149	43.6	Donegal	Amber	Amber	Amber	Amber	All attributes assessed as U1 as a result of expansion of a golf course, erosion, sand extraction, high cover of agricultural weeds and agricultural improvement.
Coney Island	134	37.262	Sligo	Red	Amber	Red	Red	Structure and Functions/Future Prospects are assessed as U2 due to damage caused by the activities of a large rabbit population and also agricultural activities.
Courtown	025	0.543	Wexford	Red	Red	Amber	Red	Extent and Future Prospects U2 due to partial destruction of habitat due to erosion. Structure and Functions rated as U1 due to presence of negative indicator species.
Cross Lough	126	186.753	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to agricultural improvement, stripe fencing and overgrazing.

Cruisetown	001	1.784	Louth	Red	Red	Red	Red	All parameters are assessed as U2. The fixed dune is experiencing 'coastal retreat' and natural erosion is compounded by recreational activities.
Cruit Lower	154	32	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects rated as U1 due to new houses and undergrazing.
Crummie's Bay	175	13.849	Donegal	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to undergrazing and the spread of scrub species.
Culdaff	181	18.103	Donegal	Red	Green	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to undergrazing, scrub encroachment, and amenity and development pressures.
Cunnigar Point	050	8.597	Waterford	Amber	Green	Green	Amber	Future Prospects are assessed as U1 due to overgrazing and supplementary feeding of stock.
Curracloe	034	30.516	Wexford	Red	Red	Red	Amber	Extent and Structure & Functions rated U2 due to human-induced erosion and invasion by *Pteridium aquilinum*. Future prospects rated as U1due to recreational pressures.
Derrybeg	157	5.4	Donegal	Amber	Amber	Green	Amber	Extent and Future Prospects rated as U1 as a result of high recreation leading to erosion and undergrazing.
Derrymore Island	076	0.334	Kerry	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U1 due to erosion, recreational pressures and the prevalence of negative indicator species.
Derrynane	066	22.075	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Doagh Isle	178	335.828	Donegal	Red	Amber	Red	Amber	Structure and Functions are assessed as U2 due to undergrazing.
Doaghmore	170	26.306	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Dog's Bay (& Gorteen Bay)	097	44.6	Galway	Amber	Amber	Amber	Green	Extent and Structure and functions rated as U1 due to erosion by farm vehicles and undergrazing.
Donaghmore	027	0.056	Wexford	Red	Red	Green	Red	Extent and Future Prospects are assessed as U1 due to the widespread invasion of scrub.
Doo Lough	120	53.720	Mayo	Amber	Amber	Amber	Amber	Extent is assessed as U1 due to erosion. Structure and functions were assessed as U1 due to the presence of some rank, undergrazed sward. Future Prospects are assessed as U1 due to erosion, and trampling by livestock.
Dooaghtry	108	75.561	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by cattle, sheep and rabbits and human induced erosion from recreation. The site is in multiple ownership making it difficult to manage for conservation.

Dooey	160	94.826	Donegal	Amber	Green	Green	Amber	Future Prospects rated U1 due to lack of grazing of the sward.
Dooyork	119	3.732	Mayo	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to excessive bare ground, and trampling by livestock.
Duncannon	044	1.226	Wexford	Red	Red	Amber	Red	Extent and Future Prospects rated as U2 owing to spread of Hippophae scrub and development of land for housing and tourism.
Dunfanaghy	163	17.6	Donegal	Amber	Amber	Green	Amber	Extent and Future Prospects rated as U1 as a result of expansion by a golf course and undergrazing.
Dunfanaghy (Subsite-Dunfanaghy Bay)	205	12.7	Donegal	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by rabbits and invasion of species.
Eararna	091	58.106	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Fahan	174	12.990	Donegal	Red	Amber	Red	Amber	Structure and Functions rated U2, while Extent and Future Prospects rated U1 due to the volume of recreational users at the small site.
Fanore	087	61.874	Clare	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to the intensive recreational management of the site, the spread of an invasive species, supplementary feeding of stock, and the presence of worn and eroded tracks.
Fermoyle	074	3.246	Kerry	Red	Red	Amber	Red	Extent and Future Prospects assessed as U2 while Structure and Functions rated U1. Habitat has been degraded through intensive agricultural management coupled with natural erosion.
Fermoyle (Subsite - Drom Hill)	204	6.750	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Finner	140	95.129	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to the presence of the military camp and lack of grazing.
Finner (Subsite - Ballymacaward)	211	44.392	Donegal	Red	Amber	Red	Red	Structure and Functions and Future Prospects are assessed as U2 as the dunes are managed for agricultural purposes. The damaging activities, such as stock feeding, overgrazing, reseeding and trampling are damaging the fixed dunes and threatening the viability of the habitat.
Fintragh	145	7.023	Donegal	Red	Red	Amber	Red	Extent is assessed as U2 due to the presence of two sports pitches and Structure and Functions are assessed as U2 due to overgrazing.
Fisherstreet	200	15.401	Clare	Red	Red	Red	Red	All attributes rated U2 due to agricultural management.
Garretstown	056	1.82	Cork	Red	Red	Red	Red	All three attributes rated as U2 owing to the lack of habitat and its poor condition.
Garter Hill	128	232.887	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by cattle, sheep and rabbits inducing erosion. Dumping is also a main impact here.

Glen Bay	146	13.512	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to erosion, agricultural improvement, crop cultivation and recreational pressures.
Gola Island	158	3.377	Donegal	Red	Green	Red	Amber	Structure and Functions assessed as U2 as a result of undergrazing leading to low species diversity.
Gowlaun	107	9.728	Galway	Amber	Green	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to erosion, agricultural improvement, crop cultivation and recreational pressures.
Grange	043	0.848	Wexford	Red	Red	Amber	Red	Extent and Future Prospects rated as U2 due to severe erosion and recreational impacts.
Harbour View	057	4.552	Cork	Amber	Green	Green	Amber	Future Prospects are assessed as U1 due to the presence of both pedestrian and vehicle tracks.
Inch	070	352.236	Kerry	Green	Green	Green	Green	All attributes favourable (FV)
Inchydoney	058	17.814	Cork	Amber	Green	Amber	Amber	Structure and Functions are assessed as U1 due to an excessive amount of undergrazed sward with low species diversity, and an excessive cover of negative indicator species. Future Prospects are assessed as U1 due to recreational pressures, undergrazing, and the spread of invasive species.
Inishcrone	132	40	Sligo	Red	Amber	Red	Amber	Structure and Functions assessed as U2 due to undergrazing.
Inisheer	089	4.597	Galway	Amber	Amber	Green	Amber	Extent and Future Prospects rated U1 due to loss of habitat due to sand extraction and presence of airport.
Inver	144	0.783	Donegal	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U2 due to erosion, overgrazing by cattle and rabbits, supplementary feeding of stock, and scrub encroachment.
Keadew	153	15.683	Donegal	Amber	Green	Amber	Green	Structure and Functions are assessed as U1 due to overgrazing in parts and abandonment of grazing in other parts.
Kilcoole	013	5.504	Wicklow	Red	Amber	Green	Red	Future Prospects rated as U2 due to erosion of the remnant band of dune grassland.
Kilgorman	024	0.324	Wexford	Red	Amber	Red	Red	Extent and Future Prospects are assessed as U1 due to invasion by scrub species. Structure and Functions are assessed as U1 due to the presence of rank, ungrazed sward with low species diversity.
Killiney	012	0.395	Dublin	Red	Red	Amber	Red	Extent and Future Prospects rated as U2 due to limited extent and unsuitable terrain for expansion. Structure and Functions rated as U1.
Kilmuckridge	030	22.094	Wexford	Red	Red	Amber	Red	Extent and Future Prospects rated U2 due to agricultural destruction of large swathes of land.

Kilpatrick	023	12.992	Wicklow	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to erosion, high recreational pressures and areas of agricultural improvement.
Kincaslough	155	63.94	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to new houses, invasion of species, agricultural practices, undergrazing and overgrazing in places, low species diversity, high cover of agricultural weeds.
Lackan	129	99.860	Mayo	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to erosion, undergrazing, and development pressures.
Lackan (Subsite)	201	3.511	Mayo	Red	Green	Red	Amber	Structure and Functions are assessed as U2, and Future Prospects as U1, due to agricultural improvement, low species diversity and the presence of negative indicator species.
Lag	179	107.917	Donegal	Amber	Green	Green	Amber	Future Prospects are assessed as U1 due to spread of scrub species and *Pteridium aquilinum* (Bracken), agricultural improvement, and supplementary feeding of stock.
Lahinch	085	17.665	Clare	Red	Green	Red	Amber	Structure and Functions are assessed as U2 due to agricultural improvement of the land.
Laytown	004	5.631	Meath	Red	Red	Amber	Red	Extent is assessed as U2 due to the invasion of scrub and also due to erosion caused by the construction of a sea wall further north.
Leam Lough	125	171.752	Mayo	Amber	Green	Amber	Amber	Structure and Functions are assessed as U1 due to agricultural improvement, undergrazing in parts of the habitat, and the presence of negative indicator species. Future Prospects are assessed as U1 due to an intensification of agricultural management practices.
Lenankeel	176	11.4	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects assessed as U1 due to development of new houses and damage due to agricultural practices.
Lettermacaward	151	139.985	Donegal	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1overgrazing and undergrazing in places, some agricultural improvement, and high recreational practices leading to erosion.
Lough Cahasy	109	40.276	Mayo	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects rated U1 due to lack of appropriate management of the largely rank and disturbed habitat.
Lough Nagreany	169	7.645	Donegal	Green	Green	Green	Green	All attributes favourable (FV)

Lunniagh	159	186.723	Donegal	Amber	Amber	Green	Amber	Extent is assessed as U1 due to erosion, and loss of area to agriculture and sports pitches. Future Prospects are assessed as U1 due to sand extraction, camping and caravans, recreational pressures, vehicle damage and dumping.
Lurga Point	083	35.511	Clare	Red	Amber	Amber	Red	Extent is assessed as U1 due to erosion. Structure and Functions and Future Prospects are assessed as U1 due to an excessive cover of negative indicator species, supplementary feeding of livestock, overgrazing by rabbits, recreational pressures and erosion.
Maghera	147	28	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects assessed as U1 due to natural erosion, undergrazing and invasion of species.
Maghera (Subsite)	202	2.8	Donegal	Red	Green	Red	Amber	Structure and Functions are assessed as U2 due to the abandonment of grazing and high cover of agricultural weeds resulting in low species diversity.
Magherabeg	016	7.951	Wicklow	Red	Green	Red	Amber	Structure and Functions are assessed as U2, and Future Prospects are assessed as U1 due to undergrazing and the spread of scrub and negative indicator species.
Maheradrumman	172	54.742	Donegal	Red	Amber	Red	Amber	Structure and Functions are assessed as U2 due to the abandonment of grazing.
Malahide Island	007	21.430	Dublin	Amber	Amber	Amber	Green	Extent, Structure and Functions and Future Prospects are assessed as U1. Extent – due to human induced erosion from recreational activities. Structure and Functions – due to a lack of grazing.
Marble Hill	164	31.065	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to invasion of the dunes by *Pteridium aquilinum* and *Hippophae rhamnoides*. The site is undergrazed and impacted by recreational activities.
Melmore	168	20.860	Donegal	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects rated U1 owing to decline in the condition of habitat and development of land for caravan parks.
Mizen Head	018	41.636	Wicklow	Amber	Green	Amber	Green	Structure and Functions rated as U1 owing to abandonment of agricultural practices/grazing and the decline in the condition of the habitat.
Mornington	003	20.749	Meath	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1. Extent – due to human induced erosion from recreational activities. Structure and Functions – due to a lack of grazing.

Mount Charles	143	7.821	Donegal	Red	Amber	Red	Red	Extent is assessed as U1, and structure and functions and future prospects as U2, due to erosion, overgrazing by cattle and rabbits, trampling by stock, vehicular damage, scrub encroachment and an excessive cover of negative indicator species.
Mullanasole	142	20.152	Donegal	Red	Amber	Red	Amber	Structure and Functions are assessed as U2 due to the impacts of the conifer plantation and also due to undergrazing.
North Bull	010	34.277	Dublin	Amber	Green	Amber	Amber	Structure and Functions are assessed as U1 due to the presence of some rank, ungrazed sward with low species diversity. Future Prospects are assessed as U1 due to high recreational pressures and overgrazing by rabbits.
Owenahincha & Little Island Strand	061	4.776	Cork	Red	Amber	Red	Red	Extent is assessed as U1 due to housing developments. Structure and Functions are assessed as U2 due to low species diversity, a lack of short turf and the spread of negative indicator species. Future Prospects are assessed as U2 due to recreational pressures, housing developments and the lack of statutory protection due to the non-designated status of the site.
Pennycomequick	019	11.431	Wicklow	Red	Amber	Red	Red	All three attributes rated as U2 due to decline in the condition of the habitat and the spread of *Pteridium aquilinum* (Bracken) and (*Rubus fruticosus*) bramble.
Portmarnock	009	4.514	Dublin	Red	Red	Amber	Amber	Extent is assessed as U2. The boundary between the golf course and the fixed dune was not clear in places on the ground during this survey. Part of the fixed dunes (approx. 15ha) at the tip of the spit appears to lie within the cSAC and has been modified by the golf course.
Portmurvy	092	2.457	Galway	Amber	Amber	Green	Amber	Extent and Future Prospects rated U1 due to limited distribution of habitat and land use practices.
Portrane	006	5.712	Dublin	Red	Amber	Amber	Red	Future Prospects are assessed as U2 due to recreational and development pressures on this habitat.
Rinclevan	162	298.607	Donegal	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by sheep and rabbits, supplementary feeding of livestock, recreational pressures, and the spread of scrub and negative indicator species.
Rosapenna	166	221.936	Donegal	Red	Red	Amber	Amber	Extent is assessed as U2 due to golf course developments. Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by rabbits, vehicle tracks, high recreational pressures, supplementary feeding of stock and dumping.

Roshin Point	150	3.613	Donegal	Red	Green	Red	Amber	Structure and Functions are assessed as U2 due to undergrazing leading to low species diversity and rank vegetation with a high cover of agricultural weeds.
Ross	130	78.586	Mayo	Red	Green	Red	Amber	Structure and Functions are assessed as U2 due to a lack of typical species and the excessive cover of rank, undergrazed sward. Future Prospects are assessed as U1 due to undergrazing and supplementary feeding of stock.
Ross (Subsite)	200	24.888	Mayo	Red	Green	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to agricultural improvement and the on-going intensive agricultural management of the site.
Rossbehy	068	99.072	Kerry	Amber	Amber	Amber	Amber	Extent is assessed as U1 due to human-induced erosion. Structure and Functions are assessed as U1 due to undergrazing, the presence in places of a rank, ungrazed sward, and negative indicator species. Future Prospects are assessed as U1 due to erosion, undergrazing, and camping and caravans.
Rosses Point	135	22.181	Sligo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to the associated impacts of the golf course.
Rosslare	036	2.350	Wexford	Red	Red	Red	Red	All parameters are U2 due to loss of habitat caused by changes in sediment circulation as a result of the presence of Rosslare Harbour. Coastal protection works installed to protect the golf course.
Rossnowlagh	141	27.3	Donegal	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U2 due to developments of caravan parks, hotels and severe alteration of the habitat with only remnants remaining
Rush Sandhills	005	3.363	Dublin	Red	Red	Amber	Amber	Extent is assessed as U2 due to the invasion of *Hippophae rhamnoides.*
Shanagarry	055	5.678	Cork	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects rated U1due to rank nature of sward and low species diversity.
Sheskinmore	148	224.370	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to recreational activities associated with the caravan park. Also, parts of the fixed dunes are undergrazed.
Sheskinmore (Subsite-Derryness)	212	20.763	Donegal	Red	Green	Red	Red	Structure and Functions and Future Prospects are assessed as U2. The dunes are managed for agricultural purposes and the damaging activities, such as stock feeding, overgrazing, reseeding, threaten the viability of the habitat.

South Bull	011	53.920	Dublin	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to recreational pressures and the presence in places, of a rank, ungrazed sward.
Spanish Point	084	1.233	Clare	Red	Red	Red	Red	All parameters are assessed as U2 due to the pressures from recreational activities and development.
Srah North	122	5.987	Mayo	Red	Green	Red	Amber	Structure and Functions are assessed as U2 due to undergrazing and damage from vehicle tracks. Future Prospects are assessed as U1 due to undergrazing, recreational pressures and damage from vehicle tracks.
Srah South	121	10.085	Mayo	Amber	Amber	Green	Amber	Extent is assessed as U1 due to erosion caused by livestock movements. Future Prospects are assessed as U1 due to supplementary feeding of livestock.
St. Margaret's	038	4.033	Waterford	Red	Amber	Amber	Red	Extent and Structure and Functions are assessed as U1, and Future Prospects are assessed as U2 due to erosion, recreational pressures, and the spread of invasive species.
Strandhill	133	105.846	Sligo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1. Extent - due to the presence of a conifer plantation and human-induce erosion. Structure and Functions due to undergrazing.
Streedagh Point	137	82.989	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to erosion, recreational pressures, and an excessive cover, in some areas, of negative indicator species.
Tacumshin	040	35.561	Wexford	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects rated as U1 due to decline in condition of the vegetation due in part to the coarse nature of the sediment and recreational impacts.
Termoncarragh Lough	127	230.596	Mayo	Red	Green	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to the on-going agricultural improvements that have resulted in low species diversity, and the spread of negative indicator species.
The Raven	035	26.937	Wexford	Amber	Green	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to high recreational pressures and erosion.
Tramore	046	57.53	Waterford	Red	Amber	Red	Amber	Extent is assessed as U1 due to erosion caused by recreational pressures. Structure and Functions are assessed as U2 due to a lack of typical species and lack of short turf. Future Prospects are assessed as U1 due to recreational pressures and undergrazing.
Tramore(Subsite)	246	4.551	Waterford	Red	Green	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to a lack of species-rich short turf, low species diversity, sand extraction, and disturbance caused by agricultural activities.

Tranarossan	167	15.958	Waterford	Amber	Green	Green	Amber	Future prospects are assessed as U1 due to erosion, and intensive stock rearing practices in parts of the site.
Trawalua	138	75.732	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects rated as U2 as a result of erosion by pony trekking and undergrazing.
Trawboy	117	48.49	Mayo	Amber	Green	Amber	Green	Structure and Functions rated as U1 as a result of undergrazing in some areas.
Tullagh	177	30.844	Donegal	Amber	Green	Green	Amber	Future Prospects rated U1 due to and recreational impacts and a decline in the condition of the habitat .
Ventry	071	12.237	Kerry	Red	Red	Amber	Amber	Extent is rated as U2, while Structure and Functions and Future Prospects are assessed as U1. Remnant habitat is highly degraded through erosion, sediment depletion and agricultural management.
Warren (Creggane)	062	5.664	Kerry	Amber	Amber	Green	Amber	Extent and Future prospects rated as U1 due to loss of habitat to golf course and installation of coastal protection works for recreational purposes.
Waterville	067	12.038	Kerry	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1. Extent – due to human induced erosion from recreational activities and the invasion of *Pteridium aquilinum.* Future Prospects – due to the management of the site for recreation.
White Strand	180	2.34	Donegal	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects assessed as U1 as a result a road fragmenting the habitat, agricultural practices and undergrazing.
White Strand	081	12.005	Clare	Red	Red	Amber	Green	Extent is assessed as U2 due to the recent loss of fixed dune to the development of a golf course.
Woodstown	045	1.359	Waterford	Red	Red	Red	Red	The fixed dune is experiencing 'coastal squeeze', it is restricted landward by development and seaward by human induced/natural erosion.
Yellow Strand	136	22.084	Sligo	Red	Red	Red	Red	All parameters are assessed as U2 due to agricultural improvement of the land.

Total number of sites: 152 (including 9 sub-sites)

Total area of habitat assessed: 6912.34 ha

Total area of habitat mapped: 7060.58 ha

APPENDIX III

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

DEHLG - Department of Environment, Heritage and Local Government

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

ENCROACHMENT - The invasion of a species (usually plants) into areas previously uncolonised. This term is often used when an undesirable species advances at the expense of a desirable species or habitat.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FAVOURABLE REFERENCE AREA - Total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability. Favourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FAVOURABLE REFERENCE RANGE - Range within which all significant ecological variations of the habitat/species are included for a given biogeographical region and which is sufficiently large to allow the long term survival of the habitat/species. Favourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the “health” quantity or quality of a habitat or species.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURAL RANGE – The spatial limits within which the habitat or species occurs.

pNHAs - proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NPWS - National Parks and Wildlife Service

ORTHO-RECTIFIED IMAGE – The 2000 Ordnance Survey flight colour images were used as part of this project. These images were used in TIF format and were ortho-rectified. These images have been used as base data to identify the location of raised bogs, produce the high bog boundaries and vegetation maps.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

cSACs - candidate Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SAC's have also been known as cSAC's which stands for "candidate Special Areas of Conservation", and pcSAC's which stands for "proposed candidate Special Areas of Conservation."

SPAs - Special Protection Areas for Birds are areas which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas are protected from significant damage.

SPECIES - The lowest unit of classification normally used for plants and animals.

2130 Fixed dunes with herbaceous vegetation (grey dunes)

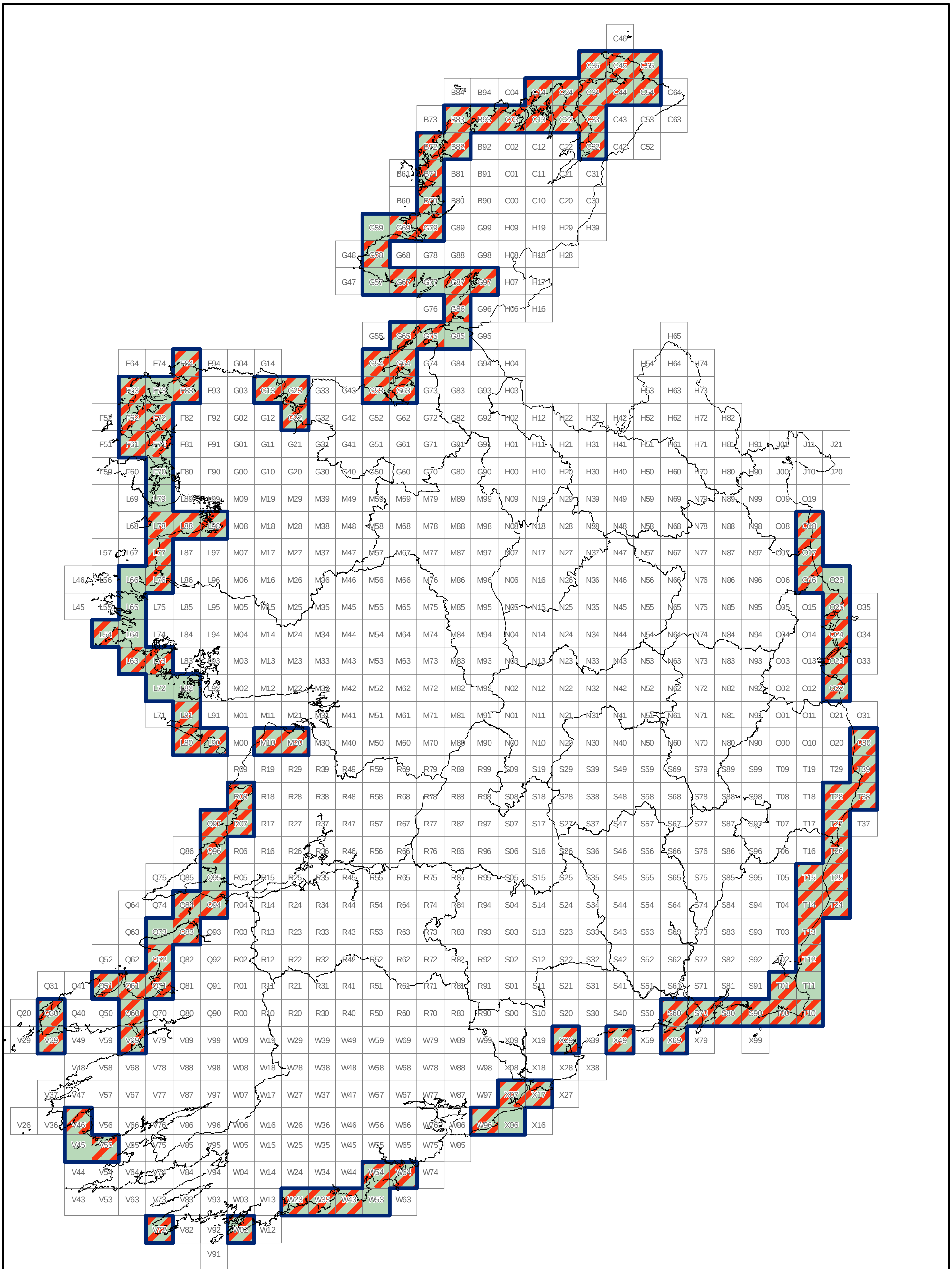
1. National Level	
Habitat Code	2130
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See map attached

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-2006*: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished). ▪ WHITE, J. and DOYLE, G. (1982). The vegetation of Ireland : a catalogue raisonné. *Journal of Life Sciences*, *Royal Dublin Society*, 3: 289-368.
2.3 Range	Widespread geographical distribution around the coast of Ireland (see map I).
2.3.1 Surface area	13,000 km² (130 grid cells x 100 km^2)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	70.61 km^2
1.2 Distribution map	See map attached
2.4.1 Surface area	70.61 km^2
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Decrease of 3.2%
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	3 = Direct human influence
2.4.9 Justification of % thresholds for trends	

2.4.10 Main pressures	102 – Mowing/cutting 103 – Agricultural improvement 120 – Fertilisation 140 – Grazing 141 – Abandonment of pastoral systems 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hares, rabbits, small mammals 149 – Undergrazing 150 – Restructuring agricultural holding 171 – Stock feeding 180 – Burning 300 – Sand and gravel extraction 400 – Urbanised areas, human habitation 402 – Discontinuous urbanisation 403 – Dispersed habitation 421 – Disposal of household waste 490 – Other urbanisation, industrial or similar activities 501 – Paths, tracks, cycling routes 502 – Routes, autoroutes 601 – Golf course 607 – Sports pitch 608 – Camping and caravans 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 700 – Pollution 720 – Trampling, overuse 790 – Other pollution or human activities 871 – Sea defence or coastal protection works 900 – Erosion 954 – Invasion by a species 971 – Competition

2.4.11 Threats	102 – Mowing/cutting 103 – Agricultural improvement 120 – Fertilisation 140 – Grazing 141 – Abandonment of pastoral systems 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hares, rabbits, small mammals 149 – Undergrazing 150 – Restructuring agricultural holding 171 – Stock feeding 180 – Burning 300 – Sand and gravel extraction 400 – Urbanised areas, human habitation 402 – Discontinuous urbanisation 403 – Dispersed habitation 421 – Disposal of household waste 490 – Other urbanisation, industrial or similar activities 501 – Paths, tracks, cycling routes 502 – Routes, autoroutes 601 – Golf course 607 – Sports pitch 608 – Camping and caravans 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 700 – Pollution 720 – Trampling, overuse 790 – Other pollution or human activities 871 – Sea defence or coastal protection works 900 – Erosion 954 – Invasion by a species 971 – Competition
2.5 Complementary information	
2.5.1 Favourable reference range	13,000km² (130 grid cells x 100 km²) See map III attached
2.5.2 Favourable reference area	72.93 km² (based on the current area of fixed dune habitat in Ireland plus the estimated loss of area since the Habitats Directive came into force)
2.5.3 & 2.5.4 Typical species	**Fixed dune species:** *Centaurium erythraea, Anthyllis vulneraria, Trifolium campestre, T. arvense, Anacamptis pyramidalis, Echium vulgare, Blackstonia perfoliata, Carlina vulgaris, Aira praecox, Arrhenatherum elatius, Carex arenaria, Carex flacca, Cerastium fontanum, Crepis capillaris, Erodium cicutarium, Euphrasia* sp., *Festuca rubra, Galium verum, Geranium molle, Hypochaeris radicata, Linum catharticum, Luzula campestris, Odontites vernus, Ononis repens, Pilosella officinarum, Plantago lanceolata, Prunella vulgaris, Rhinanthus minor, Thymus polytrichus, Trifolium repens, Sedum acre, Veronica chamaedrys, Viola canina, Viola tricolor* ssp. *curtisii, Asperula cynanchica, Arabis hirsuta, Cuscuta epithymum, Festuca ovina, Agrostis capillaris, Anthoxanthum odoratum, Helictotrichon pubescens, Galium saxatile, Lotus corniculatus, Polygala vulgaris, Potentilla erecta, Campanula rotundifolia, Cerastium diffusum, Koeleria macrantha, Poa pratensis, Taraxacum* sp., Viola riviniana. **Mosses, liverworts and lichens:** *Peltigera* spp., *Rhytidiadelphus squarrosus, R. triquetrus, Dicranum scoparium, Hylocomium splendens, Hypnum cupressiforme, Pleurozium schreberi, Cladonia* spp., *Pseudoscleropodium purum, Tortula ruralis* ssp. *ruraliformis.* **Method:** Most of the species above are characteristic of fixed dune habitats as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004), but modified for use in Ireland (Ryle *et al*., 2007). Additional species were taken from White & Doyle (1982) and Gaynor (unpublished). Characteristic species were assessed as unfavourable/inadequate by Ryle et al. (2007).

2.5.5 Other relevant information	
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1).
Specific structures and functions (incl. typical species)	Unfavourable- Bad (U2).
Future prospects	Unfavourable-Bad (U2).
Overall assessment of CS	Unfavourable-Bad (U2).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Fixed dunes with herbaceous vegetation ("grey dunes")

2130

- Current Distribution (111 cells)
- Current Range (130 cells)
- Favourable Reference Range (130 cells)
- W48 10km grid cells

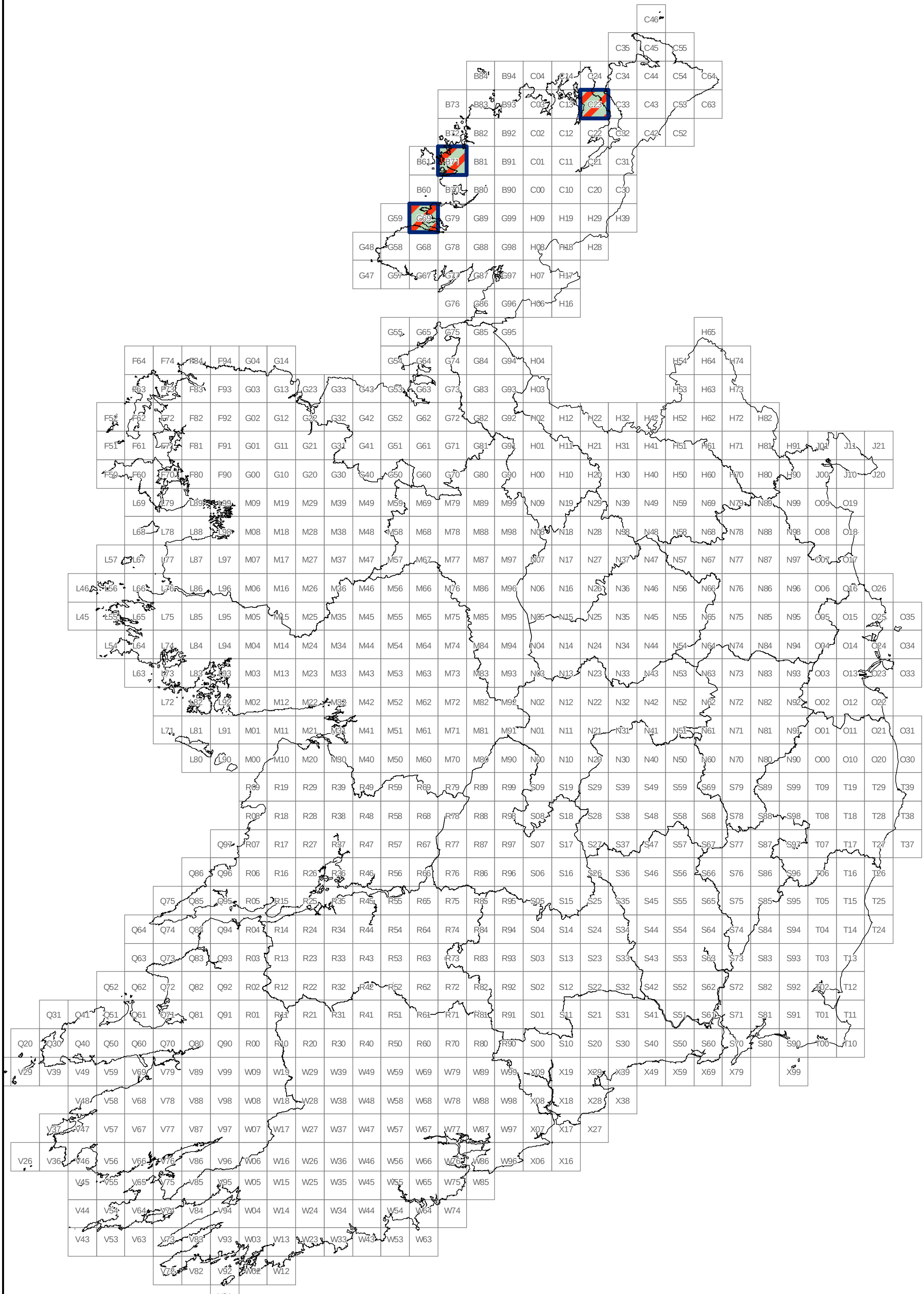
Date: August 2007

2140 Decalcified fixed dunes with *Empetrum nigrum*

1. National Level	
Habitat Code	2140
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See attached map

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ FOSSITT, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny. ▪ GAYNOR, K. (unpublished) *The phytosociology and ecology of Irish sand dune systems*. Ph.D. Thesis submitted to the National University of Ireland. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (1991) *British Plant Communities,* Volume 2: *Mires and heaths.* Cambridge University Press, Cambridge. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished).
2.3 Range	Geographical distribution restricted to the north-west coast.
2.3.1 Surface area	300 km² (3 grid cells x 100 km^2)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	
2.4 Area covered by habitat	0.03 km^2
1.2 Distribution map	See map attached
2.4.1 Surface area	0.03 km^2
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Decrease

2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	1 = Improved knowledge/more accurate data
2.4.9 Justification of % thresholds for trends	A number of sites previously listed for 'Decalcified fixed dunes with *Empetrum nigrum*' were not considered to support the habitat during the Coastal Monitoring Project, which surveyed every dune system in the country during 2004 to 2006.
2.4.10 Main pressures	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 – Undergrazing 150 – Restructuring agricultural land holding 171 – Stock feeding 301 – Quarries 971 – Competition
2.4.11 Threats	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 – Undergrazing 150 – Restructuring agricultural land holding 171 – Stock feeding 301 – Quarries 971 – Competition
2.5 Complementary information	
2.5.1 Favourable reference range	300km² (3 grid cells x 100 km²)
2.5.2 Favourable reference area	0.05 km² (based on the current area of dunes with *Empetrum nigrum'* in Ireland, plus the estimated loss since the Habitats Directive came into force)
2.5.3 & 2.5.4 Typical species	**Species:** *Empetrum nigrum* in association with the following species: *Calluna vulgaris, Erica tetralix, Ulex europaeus, Ulex galii, Agrostis stolonifera, Ammophila arenaria, Carex arenaria, Festuca rubra, Festuca ovina, Vaccinium myrtillus, Arctostaphylos uva-ursi, Molinia caerulea, Phleum arenarium, Armeria maritima, Aira praecox, Erodium cicutsarium, Galium saxatile, Hypochaerris radicata, Lotus corniculatus, Plantago lanceolata, Plantago maritima, Polygala serpyllifolia, Potentilla erecta, Rumex acetosa, Sedum acre, Thymus polytrichus, Viola rivivniana, Peltigera* spp. **Method:** the species above are characteristic of *Empetrum* dunes as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004) and modified for use in Ireland (Ryle *et al*., 2007).
2.5.5 Other relevant information	'Decalcified dunes with *Empetrum nigrum*' are poorly represented in Ireland. Further work is needed to clearly define the habitat characteristics and management requirements. Range may change in the future, subject to further review.
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U2).
Specific structures and functions (incl. typical species)	Unfavourable-Bad (U2).
Future prospects	Unfavourable-Inadequate (U1).
Overall assessment of CS	Unfavourable-Bad (U2).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Decalcified fixed dunes with *Empetrum nigrum*

2140

Current Distribution (3 cells)	
Current Range (3 cells)	
Favourable Reference Range (3 cells)	
W48	10km grid cells

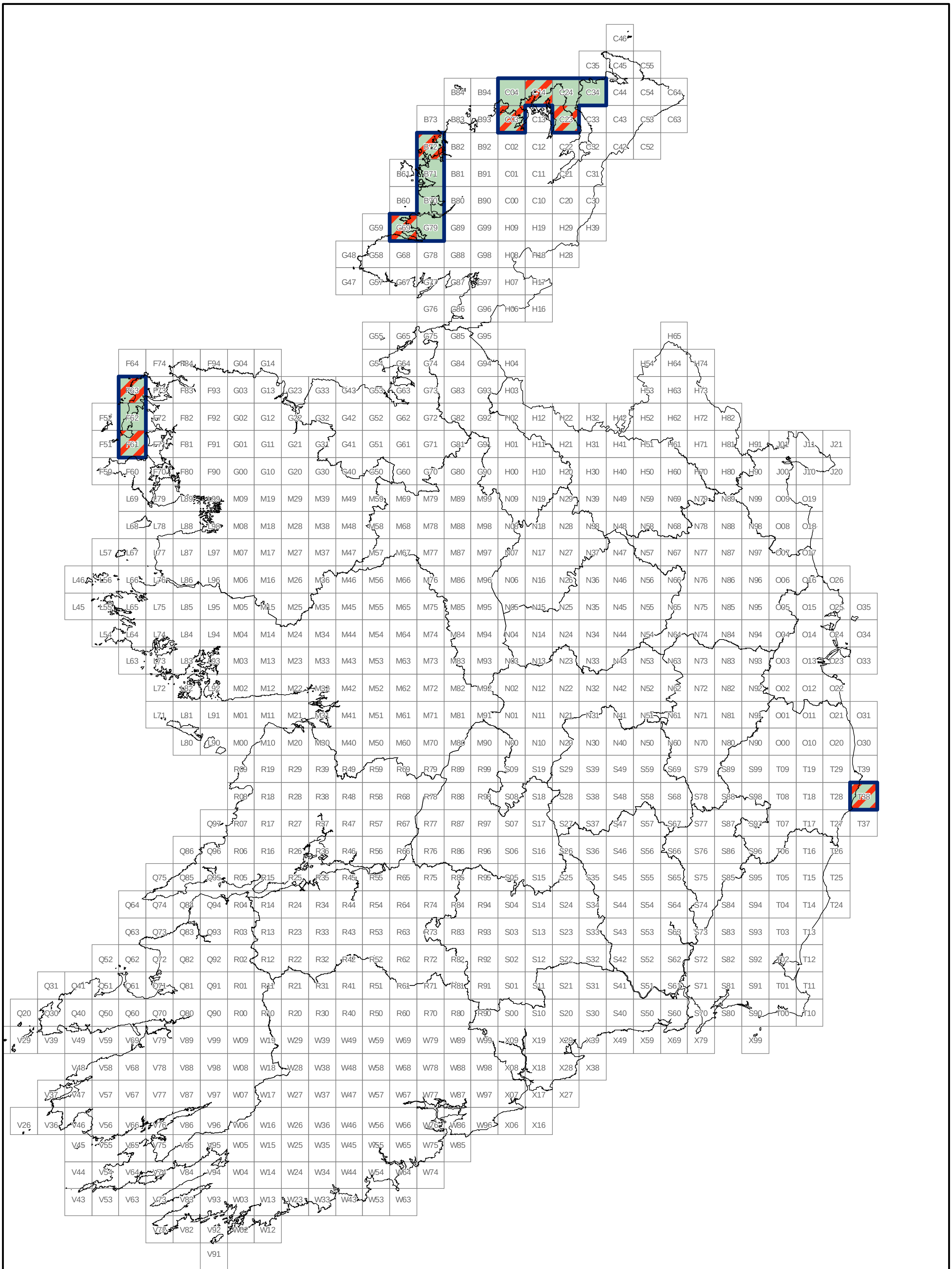
Date: August 2007

2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)

1. National Level	
Habitat Code	2150
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See attached map

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ FOSSITT, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny. ▪ GAYNOR, K. (unpublished) *The phytosociology and ecology of Irish sand dune systems*. Ph.D. Thesis submitted to the National University of Ireland. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (1991) *British Plant Communities,* Volume 2: *Mires and heaths.* Cambridge University Press, Cambridge. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-2006*: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished).
2.3 Range	Concentrated along the north-west coast of Ireland, with additional isolated sites around the east and south coasts.
2.3.1 Surface area	1,500 km² (15 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	
2.4 Area covered by habitat	0.78 km²
1.2 Distribution map	See map I attached
2.4.1 Surface area	0.78 km²
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Decrease

2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	1 = Improved knowledge/more accurate data
2.4.9 Justification of % thresholds for trends	A number of sites previously listed for 'Atlantic decalcified fixed dune' were not considered to support the habitat during the Coastal Monitoring Project, which surveyed every dune system in the country during 2004 to 2006. Additional losses were reported from sites where the presence of the habitat had been confirmed.
2.4.10 Main pressures	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 – Undergrazing 150 – Restructuring agricultural land holding 171 – Stock feeding 301 – Quarries 971 - Competition
2.4.11 Threats	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 - Undergrazing 150 – Restructuring agricultural land holding 171 – Stock feeding 301 – Quarries 971 – Competition
2.5 Complementary information	
2.5.1 Favourable reference range	1,500km² (15 grid cells x 100 km²)
2.5.2 Favourable reference area	1 km² (based on the current area of dune heath in Ireland, plus the estimated loss of area since the Habitats Directive came into force).
2.5.3 & 2.5.4 Typical species	**Species:** *Calluna vulgaris, Erica cinerea, Erica tetralix, Ulex europaeus, Ulex galii,* *Agrostis stolonifera, Ammophila arenaria, Carex arenaria, Festuca rubra, Festuca ovina,* *Vaccinium myrtillus, Arctostaphylos uva-ursi, Molinia caerulea, Phleum arenarium, Armeria maritima, Aira praecox, Erodium cicutsarium, Galium saxatile, Hypochaerris radicata, Lotus corniculatus, Plantago lanceolata, Plantago maritima, Polygala serpyllifolia, Potentilla erecta, Rumex acetosa, Sedum acre, Thymus polytrichus, Viola rivivniana, Peltigera* spp. **Method:** the species above are characteristic of dune heath as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004) and modified for use in Ireland (Ryle *et al*., 2007)
2.5.5 Other relevant information	Atlantic decalcified fixed dunes are poorly represented in Ireland. Further work is needed to clearly define the habitat characteristics and management requirements in Ireland. Range may change in the future, subject to further review.
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1)
Specific structures and functions (incl. typical species)	Unfavourable-Bad (U2)
Future prospects	Unfavourable-Inadequate (U1)
Overall assessment of CS	Unfavourable-Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Atlantic decalcified fixed dunes
(*Calluno-Ulicetea*)

2150

Current Distribution (8 cells)
Current Range (15 cells)
Favourable Reference Range (15 cells)
W48 10km grid cells

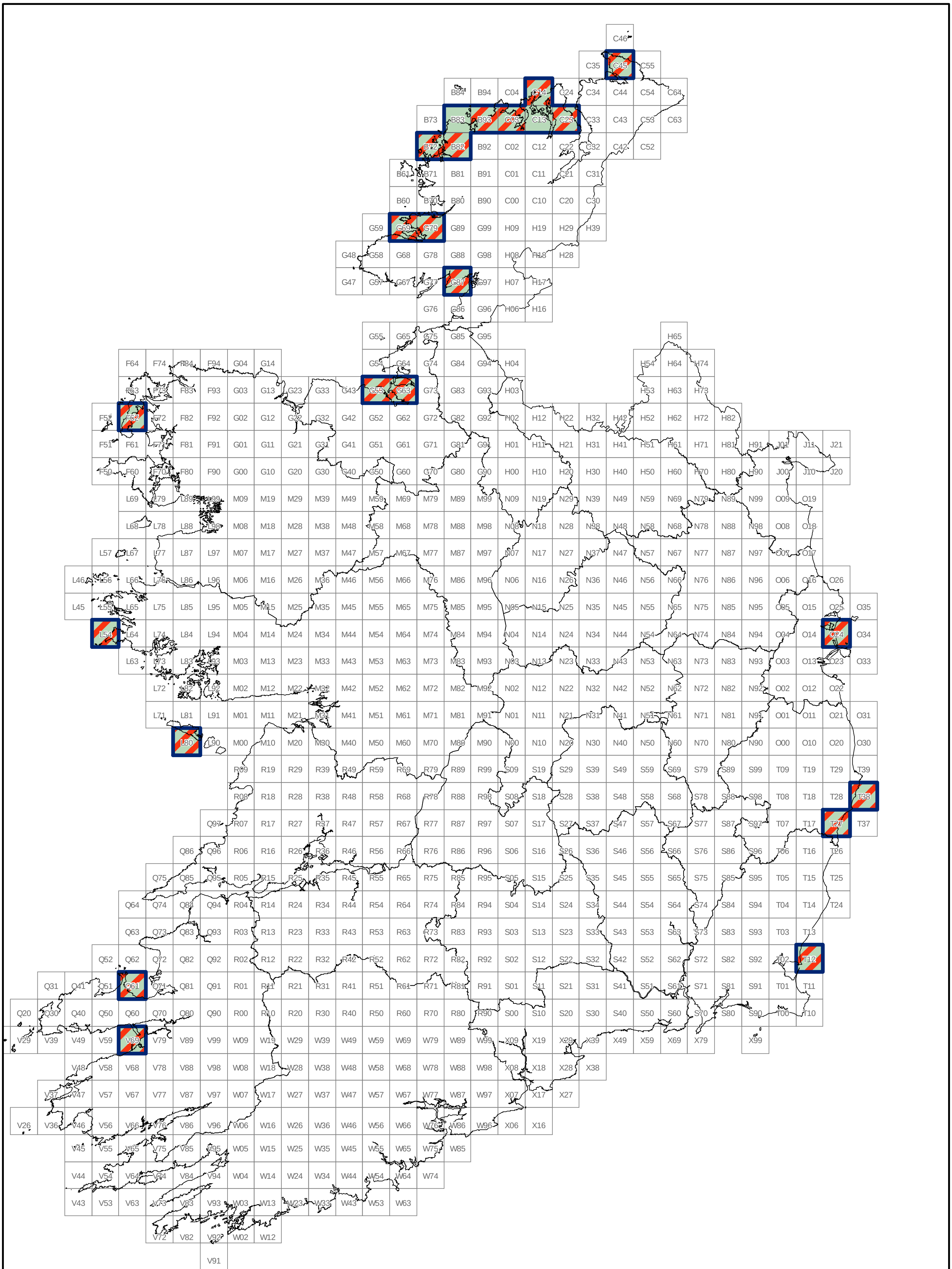
Date: August 2007

2170 Dunes with *Salix repens* ssp *argentea* (*Salicion arenariae*)

1. National Level	
Habitat Code	2170
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See attached map

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ CRAWFORD, I., BLEASDALE, A. and CONAGHAN, J. (1998) *Biomar Survey of Irish Machair Sites, 1996. Irish wildlife manuals, No. 3.* Dúchas, The Heritage Service, Dublin. ▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ FOSSITT, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A., and SWANN, M. (2007) *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished).
2.3 Range	Displays a very dispersed distribution with some concentration in the north-west, along the coast of Donegal.
2.3.1 Surface area	2,300 km² (23 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	1.18 km²
1.2 Distribution map	See attached map
2.4.1 Surface area	1.18 km²
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Stable
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	

2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 – Undergrazing 150 – Restructuring agricultural land holding 160 – Forestry 171 – Stock feeding 430 – Agricultural structures 622 – Walking, horseriding and non-motorised vehicles 720 – Trampling, overuse 954 – Invasion by a species 971 – Competition
2.4.11 Threats	103 – Agricultural improvement 140 – Grazing 143 – Overgrazing by cattle 149 – Undergrazing 150 – Restructuring agricultural land holding 160 – Forestry 171 – Stock feeding 430 – Agricultural structures 622 – Walking, horseriding and non-motorised vehicles 720 – Trampling, overuse 954 – Invasion by a species 971 – Competition
2.5 Complementary information	
2.5.1 Favourable reference range	2,300km² (23 grid cells x 100 km²)
2.5.2 Favourable reference area	1.18 km² (the current estimated area of dunes with *Salix repens* in Ireland is considered equal to the favourable reference area).
2.5.3 & 2.5.4 Typical species	**Species:** *Salix repens, Holcus lanatus, Carex arenaria, Carex flacca, Carlina vulgaris, Festuca rubra, Galium verum, Lotus corniculatus, Ononis repens, Pilosella officinarum, Pyrola rotundifolia* spp *maritima* **Method:** the species above are characteristic of dunes with *Salix repens* as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004), but modified for use in Ireland (Ryle *et al.*, 2007).
2.5.5 Other relevant information	There is considerable overlap between this habitat and humid dune slacks (2190). Further surveys are required to distinguish clearly between 2170 and 2190.
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV).
Area	Favourable (FV).
Specific structures and functions (incl. typical species)	Unfavourable-Inadequate (U1).
Future prospects	Unfavourable-Inadequate (U1).
Overall assessment of CS	Unfavourable-Inadequate (U1).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Dunes with Salix repens ssp. argentea (*Salicion arenariae*)

2170

Current Distribution (21 cells)
Current Range (23 cells)
Favourable Reference Range (23 cells)
W48 10km grid cells

Date: January 2008

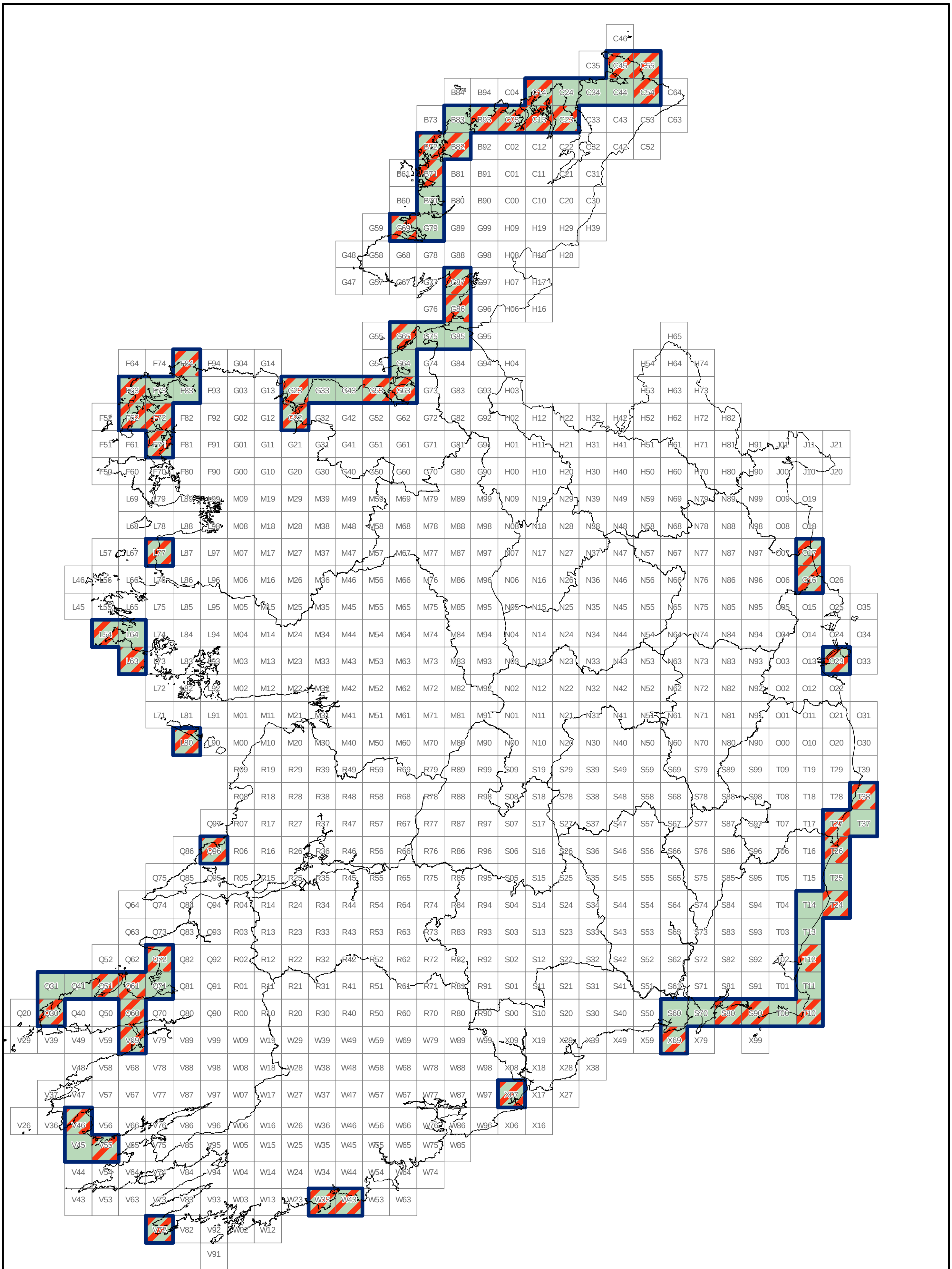
2190 Humid dune slacks

1. National Level	
Habitat Code	2190
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See attached map

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ FOSSITT, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny. ▪ GAYNOR, K. (Unpublished). *The phytosociology and ecology of Irish sand dune systems*. Unpublished thesis submitted to the National University of Ireland. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished)
2.3 Range	Widespread geographical distribution around the coast of Ireland
2.3.1 Surface area	7,900 km² (79 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	2.12 km²
1.2 Distribution map	See attached map
2.4.1 Surface area	2.12 km²
2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Stable
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	

2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	103 – Agricultural improvement 120 – Fertilisation 140 – Grazing 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hare, rabbits, small mammals 149 – Undergrazing 150 – Restructuring agricultural land holding 160 – Forestry 171 – Stock feeding 601 – Golf course 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 720 – Trampling, overuse 810 – Drainage 890 – Other human induced changes in hydraulic conditions 954 – Invasion by a species
2.4.11 Threats	103 – Agricultural improvement 120 – Fertilisation 140 – Grazing 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hare, rabbits, small mammals 149 – Undergrazing 150 – Restructuring agricultural land holding 160 – Forestry 171 – Stock feeding 601 – Golf course 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 720 – Trampling, overuse 810 – Drainage 890 – Other human induced changes in hydraulic conditions 920 – Drying out 954 – Invasion by a species
2.5 Complementary information	
2.5.1 Favourable reference range	7900km² (79 grid cells x 100 km^2)
2.5.2 Favourable reference area	2.12 km² (the current estimated area of dune slacks in Ireland is considered equal to the favourable reference area).

2.5.3 & 2.5.4 Typical species	**Pioneer slacks:** *Bryum pseudotriquetrum, Carex arenaria, Sagina nodosa, Juncus articulatus, Petalophyllum ralfsii.* **Wet slacks:** *Epipactis palustris, Salix repens, Mentha aquatica, Carex arenaria, Carex nigra, Ranunculus flammula, Potentilla anserina, Hydrocotyle vulgaris, Calliergonella cuspidata, Campylium stellatum.* **Dry mature:** *Salix repens* (forming bushy canopy) with *Carex arenaria, Holcus lanatus, Leontodon autumnalis, Prunella vulgaris, Potentilla anserina, Pyrola rotundifolia* ssp *maritima*, along with typical species of fixed dunes (2130). Some of this vegetation may correspond to 'Dunes with *Salix repens* ssp. *Argentea* (Salicion arenariae) (2170). **Saline influence:** *Glaux maritima, Juncus gerardii, Juncus maritimus.* **Method:** the species above are characteristic of dune slacks as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004), but modified for use in Ireland (Ryle *et al*., 2007).
2.5.5 Other relevant information	Although the area is considered stable, the range of ecological variation is not. The two extremes (pioneer slack communities and very wet slack communities) are poorly represented in Ireland and are under considerable threat from dune stabilisation and interference with the local watertable. Therefore, the future prospects for dune slacks, in terms of maintaining all of the ecological variation, are poor. Further surveys are required to distinguish between 2170 and 2190 (and in some cases 21A0).
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1).
Specific structures and functions (incl. Typical species)	Unfavourable-Inadequate (U1).
Future prospects	Unfavourable- Bad (U2).
Overall assessment of CS	Unfavourable-Bad (U2).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Humid dune slacks

2190

Current Distribution (53 cells)

Current Range (79 cells)

Favourable Reference Range (79 cells)

W48 10km grid cells

Date: January 2008

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland
2. Habitat mapping
3. Habitat Range
    3.1 Conservation status of habitat range
4. Habitat Area
    4.1 Conservation status of habitat area
5. Structures and Functions
    5.1 Habitat structures and functions
        5.1.1 Conservation status of habitat structures and functions
    5.2 Typical species
        5.2.1 Conservation status of typical species
6. Impacts and Threats
    6.1 Grazing
    6.2 Agricultural improvement
    6.3 Recreation
    6.4 Other impacts
7. Future Prospects
    7.1 Negative future prospects
    7.2 Positive future prospects
    7.3 Overall habitat future prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

APPENDICES

Appendix I – Description of Coastal Monitoring Project 2004-2006
Appendix II – Inventory of sites supporting machair in Ireland.
Appendix III – Summary of conservation status assessments from Coastal Monitoring Project (Ryle *et al*. 2007)
Appendix IV - Glossary

1. Habitat characteristics in Ireland

Irish machair (code: 21A0) is designated as a priority habitat type under the EU Habitats Directive (Commission of the European Communities, 2003) and as such Ireland has special responsibility for its conservation. The quality and extent of machair in Ireland is increasingly under threat from human pressures such as housing developments, recreation and changes in agricultural practice.

Machair is a distinct geomorphological and ecological habitat that is unique to the north-west coasts of Ireland and Scotland. It is defined as a 'complex habitat comprised of a sandy coastal plain resulting partially from grazing and/or rotational cultivation, in an oceanic location with a cool moist climate' (Commission of the European Communities, 2003). The system is highly calcareous, the sediment containing high shell fragment contents and pH values in excess of 7. The vegetation is herbaceous, with low frequency of sand-binding species, such as *Ammophila arenaria*. Machair is unique in that it is considered a natural landscape that is the product of cultural activities.

Scottish machair was first identified as a distinct habitat in the 1940s (Wilmott 1945, Darling 1947, MacLeod 1949) and has since been extensively described (Ranwell 1974a, b, 1977, 1981, Ritchie 1976, Dargie 1993, 2000, Angus, 1994). Although Tansley (1939) described machair vegetation from Dog's Bay, County Galway, the habitat was not formally recognised in Ireland until 1980, when the first account of Irish machair on the Mullet Peninsula was published (Akeroyd and Curtis 1980). The criteria used to define Scottish machair were tested on a number of sites in the west of Ireland, revealing a close similarity between Irish machair sites and those found in Scotland. Further research subsequently supported this assessment (Bassett 1983, Bassett and Curtis 1985, Crawford *et al*. 1996).

A combination of climatic, edaphic, geographic and anthropogenic factors not only influence the distribution and formation of machair, but the plant communities present. A comparison between the vegetation of Irish and Scottish machair reveals a high degree of similarity, with some variation that can be explained by different land use and/or management practices (Gaynor, 2006).

Although researchers still disagree on what definitely constitutes machair, a series of typical features can be recognised. In most cases, a small escarpment or dune ridge fronts the system. The true machair plain represents the area where the action of the wind has eroded the original dune system down to a level just above the water table, where the wet consistency of the sand prevents further erosion. In general, the degree of flatness depends on the age of the system, as well as the underlying topography, geology, outcropping of local rocks and historical management. The machair plain is often terminated on the landward side by a lake or associated marsh/fen. There are, however, a number of exceptions to this typical sequence. Flat machair-like surfaces may form over rock platforms by the sea, by-passing the dune building phase. Where the wind is particularly strong and the direction suitable, large quantities of sand can even be deposited on the seaward face of hills inland to form hilly machair (e.g. Garter Hill, Co. Mayo).

Curtis (1991b) expanded on the definition of Ritchie (1976) to develop the following five criteria used to define machair:

1. A mature coastal sandy plain, with a more or less level surface;
2. A significant proportion of shell fragments in the sand producing a lime-rich soil (pH>7.0);
3. Grassland vegetation with a low frequency of sand-binding species, and a majority of the following species, listed in Gimingham (1974); *Festuca rubra*, *Trifolium repens*, *Lotus corniculatus*, *Achillea millefolium*, *Galium verum*, *Plantago lanceolata*, *Euphrasia* spp., *Bellis perennis* and the moss *Rhytidiadelphus squarrosus*.
4. A history of human interference, principally through grazing, during the recent historical period, and
5. A moist, cool, oceanic climate.

The highly dynamic nature of machair makes it very difficult to classify the vegetation. As the sand moves across the machair plain, wet areas can become infilled, while new damp patches are exposed continually as the system is eroded down to the water-table. As a consequence, much of the vegetation is transitional between wet and dry communities. In addition, no suite of species is unique to machair. In most instances, the vegetation can best be described as a mosaic of calcareous fixed dune, mesotrophic grassland and dune slack communities (Gaynor, 2006). There is generally an obvious distinction between dry and wet machair, although transitional communities are common. Dry machair supports elements of vegetation assignable to the Galio-Koelerion (Tx., 1937), as well as the Cynosurion cristati (Tx., 1937). The former of these is more usually used to describe fixed dune vegetation, while the latter is used to describe mesotrophic grassland. As the ground starts to become damp, the vegetation displays a closer affinity with that of the Elymo-Rumicion crispi (Nordhagen, 1940). In some cases, where the machair is backed by a lake that is becoming infilled by the deposited sand, the vegetation can be closer to the Caricion davallianae (Klika, 1934). This order is generally assigned to the vegetation of rich fens on calcareous, alkaline peats. Under the Irish habitat classification scheme, machair is assigned to the category ‘machair CD6’ (Fossitt, 2000).

Most of the following assessment is based on the results of the Coastal Monitoring Project (Ryle *et al*. 2007), details of which can be found in Appendices I, II & III.

2. Habitat mapping

As part of the Coastal Monitoring Project, Ryle *et al*. (2007) updated the original national coastal inventory produced in Curtis (1991a). Additional or potential sites were identified through the analysis of aerial ortho-photographs (year 2000 series, Ordnance Survey of Ireland), information received from NPWS conservation staff and extensive ground surveys (see Appendix II). Each of the sites identified (with the exception of 4, which were not accessible) was visited over the course of 3 field seasons (2004-2006) and surveyed using GPS (Ryle *et al*. 2007). A habitat map was produced for each site by importing the mapping data into Arcview 3.2 and overlaying it on the year 2000 series ortho-aerial photographs. The area of each individual Annex I sand dune habitat was mapped at a total of 181 sites. The habitat maps produced in Ryle *et al*. (2007) were used to map the distribution and range of machair in Ireland on a 10km square basis.

Curtis (1991a) originally listed 50 machair sites, while Ryle *et al*. (2007) recorded a total of 59 sites (including 3 sub-sites). Sites supporting machair were restricted to four coastal counties (Galway, Mayo, Sligo and Donegal) in the west and north-west. The greater number of sites is primarily the result of an improved data set for machair.

3. Habitat Range

The mapping of habitat range is defined by the smallest polygon size containing all grid squares where the habitat was recorded, drawn using a minimum number of 90 degree angles. Gaps in the habitat distribution of at least 2 square grids, as a result of unsuitable ecological conditions for the development of the habitat, were deemed enough to justify a break in the range.

Machair in Ireland, within the limits of current understanding and knowledge, occurs on sandy plains and has an exclusively Atlantic distribution extending from County Galway, northwards to Donegal (Akeroyd and Curtis 1980, Bassett and Curtis 1985, Ryle *et al*. 2007). The restricted distribution is thought to be owing to climatic, edaphic and geographic factors.

A comparison of the range of machair sites surveyed in 2006 and those listed in the national inventory (Curtis, 1991a) would indicate that the range is stable. Details of the differences between these two inventories can be found in Appendix II. One of the sites that was previously listed as machair has been destroyed by development at Rossnowlagh, Co. Donegal. The additional sites that have been added to the list lie within the historical range indicated by Curtis (1991a), such as Rinclevan, Co. Donegal. Therefore any minor change in the range can be attributed to an improvement in the quality of the data.

Within Ireland, there has been some speculation that a number of sites south of Galway Bay may also qualify as machair (Gaynor, 2006). In particular, Fanore (Co. Clare) and the Magharees (Co. Kerry) display a number of machair-like characteristics, such as highly calcareous sand or expanses of flat dune grassland. Machair formation, however, is the result of a unique combination of edaphic, climatic, geographic and anthropogenic conditions or influences. A site must meet all of the criteria in order to be classified as machair. It is feasible that some sites south of Galway Bay could become machair in time, but as the climatic conditions are less severe, the process will take a lot longer than occurs north of Galway Bay (Gaynor, 2006). In most cases, the formation of new machair sites would be limited by the aspect and sheltered nature of the sites, in conjunction with the absence of an appropriate sediment source.

3.1 Conservation status of habitat range

The habitat range at the beginning of the assessment period (1996 i.e. when the Biomar machair maps were produced) is taken as the favourable reference range (FRR) as it encompassed all ecological variation of machair habitat in Ireland.

The habitat is still widespread within the relevant geographical range around the coast of Ireland and all sub-types as outlined in Gaynor (2006) are still present. The range for machair encompasses a total of 44 x 10km grid cells and is found at 59 sites. The historical habitat range is unlikely to have been greater compared to the current FRR.

Small losses of machair habitat during the current assessment period have not affected the current range. The current range is considered to be equal to the favourabel reference range. Therefore, the habitat range of machair is assessed as **favourable**.

4. Habitat Area

The total national area of machair plain is estimated at 27.5275km^2 (2,752.75ha) (Ryle *et al*. 2007). This compares favourably with the previous figure of 23.8770 km^2 from 19 designated sites, which is taken from the NATURA 2000 database. Curtis (1991b) originally estimated the area of machair to be 7,500ha. However, this is not thought to represent a significant loss in the area of the habitat for two reasons. Firstly, previous estimates of the area of machair considered the machair system as a whole (including the mobile dunes, fixed dunes, fen etc.), while Ryle *et al*. (2007) mapped the machair plain as a separate entity within the machair system. Secondly, when the sites were ground truthed by Ryle *et al*. (2007), machair was not found at a number of sites that were previously considered to support the habitat. These two factors help to explain the large discrepancy between the current estimate of 2,752.75ha and Curtis' estimate of 7,500ha for the area of machair.

4.1 Conservation status of habitat area

The favourable reference area (FRA) is taken as the habitat area at the beginning of the reporting period (i.e. when the Biomar survey was conducted in 1996) as it is considered enough to ensure the long term survival of the habitat. The guidelines state that the FRA cannot be less than the area at the time of the Directive coming into force. Ryle *et al.* (2007) recorded a loss of area from a total of 25 sites out of 59. Of these, 24 were rated as unfavourable-inadequate (U1) and only one unfavourable-bad (U2). In most cases, however, this loss was not quantified. The current national habitat area is estimated to be 27.5275 ha from (Ryle *et al*., 2007). In order to estimate the original area the following extrapolation was made from the dataset. It is assumed that the area of sites with a U1 rating have decreased by 1.05% and those with a U2 rating by 1.15%. This produces an original estimated area of 2819.15 ha, although this figure must be treated with some caution. The habitat area of machair has decreased slightly, with an estimated loss of 66.4 ha, based on the calculations above. The reported losses represent 2.35% of the FRA. Coastal erosion was evident at most sites and was exacerbated mainly by recreational activities and overgrazing. The most significant losses were caused by erosion induced by overgrazing, intensification of agricultural practices and developments such as one-off housing. There are likely to be additional unreported losses of habitat during the current reporting period.

The conservation status of the habitat area is assessed as **unfavourable-inadequate (UI)** because approximately 2.35% of the favourable reference area has been lost in the current reporting period.

5. Structures and Functions

The following generalised attributes were assessed for Irish machair habitats at 59 sites (Ryle *et al*. 2007). These attributes and their targets have been adapted from the Joint Nature Conservancy Council's Common Standards Methodology guidelines on monitoring of dune habitats and machair (JNCC 2004) with inputs from NPWS, Research Branch staff.

- Habitat extent
- Physical structure
- Vegetation structure: zonation
- Vegetation structure: sward cover
- Vegetation structure: sward height
- Vegetation structure: flowering and fruiting
- Vegetation composition: typical species (including bryophytes)
- Indicators of negative trend
- Other negative indicators

Indicators of local distinctiveness, such as notable plant species or vegetation mosaics are also recorded. These are site-specific features, which are not adequately covered by the other attributes.

5.1 Habitat structures and functions

When individual site data from Ryle *et al*. (2007) is combined, it reveals that 17.62% of monitoring stops carried out in 2006 failed (attributes did not reach their targets). The most common attributes not to reach their targets were negative indicators and sward height, indicating that agricultural improvement was by far the most significant activity affecting the structure and functions of machair.

Twenty-two sites (37.3%) surveyed during 2006 (Ryle *et al.* 2007) were assessed as having favourable structure and functions, 23 sites (39%) had an unfavourable-inadequate conservation status and 14 sites (23.728%) were assessed as having an unfavourable-bad conservation status. Analysis of the % area of the total national resource, however, reveals that only 22% of the total area was rated as favourable, while 50.73% was rated unfavourable-inadequate and 27.05% was rated unfavourable bad. In addition, monitoring stops were not placed in a number of areas that were intensively used for agriculture or were cultivated, which would have increased the number of stops that would have failed for structure and functions.

The conservation status of the habitat structure and functions is assessed as **unfavourable-bad**.

5.2 Typical Species

The list of typical species for machair sites has been complied from a variety of sources including Curtis (1991), Bassett (1983), JNCC (2004) and Gaynor (2006). The JNCC list has been modified for use in Ireland through input from K. Gaynor, NPWS research branch for use in the Coastal Monitoring Project (Ryle *et al*. 2007). The species list differs from that defined by the JNCC (2004) for machair, in order to reflect the paucity of the Irish flora and the fact that most machair systems in Ireland are uncultivated and mostly used for grazing purposes.

Typical dry machair species include: *Achillea millefolium, Aira praecox, Bellis perennis, Carex arenaria, Cerastium fontanum, Crepis capillaris, Erodium cicutarium, Euphrasia officinalis agg., Festuca rubra, Galium verum, Linum catharticum, Lotus corniculatus, Odontites vernus,* Orchid spp., *Plantago lanceolata, Poa subcaerulea, Prunella vulgaris, Rhinanthus minor, Sedum acre, Trifolium repens, Thymus polytrichus, Viola canina, Viola tricolor, Viola riviniana.*

Typical wet machair species include: *Agrostis stolonifera, Carex arenaria, Carex flacca, Carex nigra, Hydrocotyle vulgaris, Mentha aquatica, Potentilla anserina, Prunella vulgaris, Ranunculus flammula.*

Bassett (1983) considered *Festuca rubra, Trifolium repens, Plantago lanceolata, Lotus corniculatus, Bellis perennis, Carex arenaria, Galium verum, Poa subcaerulea, Carex arenaria* and *Brachythecium albicans* to be the core species for Irish machair. These species also dominate the vegetation examined in Gaynor (2006), with the exception of *Poa subcaerulea* and *Brachythecium albicans*. In the case of *P. subcaerulea*, separate taxa within *Poa pratensis* agg. (which was commonly recorded) were not identified. Although not considered one of the most abundant bryophytes, *Brachythecium albicans* was recorded from all three syntaxa. The most commonly recorded bryophytes were *Homalothecium lutescens, Tortula ruralis* ssp. *ruraliformis* and *Rhytidadelphus squarrosus* on the dry machair; while *Calliergonella cuspidata* is more frequent on the wet machair (Gaynor 2006).

Ranwell (1974b) highlighted the relative species paucity of machair systems, establishing the first botanical distinction between machair vegetation and that of more ‘typical’ dune grassland. The species-poor nature of the vegetation was partly attributed to introduced species on the non-machair sites and the ‘island effect’ on the more isolated machair sites. Species diversity in Gaynor (2006) ranged between 6 and 33 (in a 2m x 2m quadrat), with a mean of 18. These figures, however, are not significantly lower than would be expected from a typical dune grassland in Ireland as all of the sites surveyed are located on the mainland, eliminating the 'island effect'. In addition, cultivation of the machair is likely to further reduce species diversity.

A notable difference between Irish and Scottish machair systems is the occurrence in Ireland of *Petalophyllum ralfsii*, an Annex II species under the EU Habitats Directive. This rare liverwort is a species of damp, sandy, calcareous grassland that has been recorded from 18 machair sites in Ireland (Neil Lockhart, pers. comm.). It is only known to occur at a single machair site in Scotland (Rothero and Long, 1995). Calcicoles such as *Arenaria serpyllifolia, Koeleria macrantha* and *Leucanthemum vulgare* are a prominent feature of machair vegetation. One calcicole of note commonly recorded on Irish machair sites is *Asperula cynanchica*, which is absent from Scotland (Preston *et al*., 2002).

5.2.1 Conservation status of habitat typical species

The presence of typical or characteristic species was one of the attributes assessed for structure and functions during the Coastal Monitoring Project (Ryle *et al*. 2007). The typical species list used during this survey for this habitat is listed in Chapter 2 (Ryle *et al*. 2007). A total of 35 monitoring stops out of 369 stops, distributed through 19 sites, failed to reach the target for characteristic species carried out over 59 sites (Ryle *et al*. 2007). This is largely due to agricultural improvement and to a lesser extent overgrazing.

The conservation status of typical species of machair is assessed as **favourable** considering that targets were reached for typical species in more than 90% of stops.

6. Impacts and Threats

There are several sources of information about impacts and activities affecting machair in Ireland including Curtis (1991b), Crawford *et al*. (1996) and Gaynor (2006). However, the most comprehensive source of information is Ryle *et al*. (2007), who summarised the main impacts affecting machair, surveyed at 59 sites in 2006 (Table 1). In addition to the 25 impacts included in Table 1, a further 25 were noted at three or less sites, making a total of 50 separate impacts for the habitat.

Table 1. Most frequently recorded impacts in Machair; number of sites at which the impacts were recorded and the total area affected by each impact.

Code	Impact/Activity	Number of sites	Total area affected
140	Grazing	34	1140.4
900	Erosion	28	160.7
150	Restructuring agricultural land holding	28	676.8
142	Overgrazing by sheep	23	714.7
622	Walking, horseriding and non-motorised vehicles	24	382.1
103	Agricultural improvement	20	424.2
143	Overgrazing by cattle	19	499.4
623	Motorised vehicles	19	101.6
171	Stock feeding	16	66.3
720	Trampling, overuse	15	279.0
149	Undergrazing	13	90.8
608	Camping and caravans	12	40.1
607	Sports pitch	11	17.9
146	Overgrazing by hares, rabbits, small mammals	11	386.1
120	Fertilisation	9	314.9
403	Dispersed habitation	8	14.5
421	Disposal of household waste	8	2.4
954	Invasion by a species	8	28.3
501	Paths, tracks, cycling routes	7	7.4
790	Other pollution or human activities	7	40.0
430	Agricultural structures	5	16.2
300	Sand and gravel extraction	4	6.4
400	Urbanised areas, human habitation	4	1.4
423	Disposal of inert materials	4	2.0
601	Golf course	4	172.8

Total number of sites at which the habitat was present = 59
Total habitat area = 2752.75ha

Machair, like fixed dunes, represent a generally stable grassland habitat where agricultural or amenity management may dominate large areas of habitat. Consequently there were a wide range of impacts recorded at a significant number of sites. Like fixed dunes, several common impacts, such as *overgrazing by sheep*, *overgrazing by cattle*, *stock feeding* and *agricultural structures* were directly attributable to livestock rearing practices, while others such as *camping and caravans, golf course* and *sports pitch*, reflect the frequency with which machair is used for recreational purposes. Ryle *et al*. (2007) estimated that restructuring agricultural land holding affected about 47.5% of the sites surveyed.

Individual instances of impacts considered to have an irreparable negative influence in machair sites were included under 16 different impact codes. Those with the greatest numbers of sites were *Dispersed habitation* – which generally describes 'one-off' housing - and *Paths*, *tracks*, *cycling tracks*, under which seven and four records respectively, were deemed to represent an irreparable negative influence. The areas affected by these impacts were generally not large, with the largest individual area of 4.5ha recorded under *Dispersed habitation* and a total affected area of only 14.5ha (plus one 'unknown'). None of those listed in *Paths*, *tracks*, *cycling tracks* exceeded 2ha in area. There was only one instance in which *agricultural improvement* was deemed to represent an irreparable negative influence, which, given the frequency with which the impact was noted, and the intensification of agricultural management practices that have radically compromised the conservation value of many machair sites - particularly on the Mullet Peninsula in Northwest Mayo - may seem surprising. However, as almost the entire affected habitat was thought to be restorable to a more favourable condition, the impact was generally considered as a repairable negative influence. Only at Lettermacaward (Co. Donegal), where a large portion of the machair plain has been managed intensively for farming purposes for a long period of time, to the extent that it can scarcely be considered as part of the functioning dune system, was the impact deemed to represent an irreparable negative influence. Other impacts, of which some instances were thought to represent an irreparable negative influence, included *Sand and Gravel extraction*, several of those listed in the broad category of *Urbanised areas*, *human habitation*, *Agricultural structures* and a number of 'Leisure and Tourism' impacts such as *Golf course* and *Sports pitch*.

6.1 Grazing

Machairs are extensively used in both Ireland and Scotland as commonage areas for grazing under the traditional agricultural practice of what is known in Irish as *duach*. Under this code stock are summered on the hills and mountains adjoining the machair and wintered on the commonage. Historically, these commonage areas were open. However, these areas are increasingly being fenced into individual holdings that are then subject to very different management regimes. All machair sites are grazed by cattle or sheep, or both, in Ireland and Scotland. Sheep are commonly the main grazing animal, but the grazing density and sheep:cattle ratio is vital in determining the quality and diversity of the machair (Angus 1994).

Ryle *et al*. (2007) estimated that overgrazing by sheep affected about 40.7%, overgrazing by cattle affected 32.2% and overgrazing by small mammals affected 17% of the total machair sites surveyed in 2006. (About 16% of monitoring stops were affecting by over-grazing.)

Current trend

No comparable records are available. Need to check commonage data?

6.2 Agricultural improvement

Impacts associated with livestock rearing dominate the list of significant impacts in machair, with several grazing impacts (those included under the general category of grazing) and others such as *agricultural improvement* and *restructuring of agricultural holdings,* all prominent on the list of significant impacts (Table 1). The introduction of strip fencing at many machair systems that were formerly held as commonage has led to intensification of some parts of the machair, resulting in a decline in the conservation status of the machair habitat. Of the 28 sites (47.5 % of all machair sites) at which the impact was noted, it was rated as being of high intensity (A) at 16. The impact was most apparent on the Mullet Peninsula in Northwest Mayo, where several large tracts of open machair - some of which were formerly considered to be among the best examples of the habitat in the country - have been divided up and strip fenced, with serious consequences for their conservation value.

The contrast between machair land use in Ireland and Scotland can be seen in the rarity with which cultivation appears on lists of impacts here. Only two machair sites had cultivation among the lists of recorded impacts and the total affected area of 1.5ha indicates the small scale on which the activity now takes place. However, the former extensive use of machair for potato production is evidenced by the reasonable frequency with which old cultivation ridges, or 'lazy beds', are seen in the habitat..

Current trend

No comparable records are available.

6.3 Recreation

There are more than 400 official golf clubs in the Republic alone, of which 37 have courses that were constructed on coastal sands and are regarded as 'true' links courses (Gaynor and Browne, 1999). Four machair sites were found to possess golf links by Ryle *et al*. (2007)

A frequent feature of Irish machair systems is their use as football pitches, which account for all 11 recorded instances of the *sports pitch* impact, a disproportionately high number compared to 13 instances of the impact recorded in fixed dunes (Table 1). This is due to the fact that machair plains often represent the only suitable level area for playing fields, in landscapes that may be dominated by tall dunes, mountains, bogs, fens and intensively farmed land. Several of the football fields were not intensively managed and retain much of the characteristic machair vegetation. Only three of the pitches were thought to be of High (A) intensity, and of these, only one was deemed – due to the construction of a wall around the field – to represent an irreparable negative influence. Other leisure activities to which extensive, flat machair plains lend themselves include horse or pony racing, causing concern due to poaching and surface break up. An interesting management aspect on Irish sites is the frequent occurrence of the rare *Petalophyllum ralfsii*, which as a pioneer species, favours the slightly compacted and disturbed conditions of these sports pitches.

Current trend

No comparable records are available.

6.4 Other impacts

The following is a list of impacts that occur less frequently on machair:

Camping and caravans

Motorised vehicles

Stock feeding

Sand extraction

Urbanised development (one-off housing etc.)

As was the case with other habitats, the area of *erosion* in machair is (at 66.4ha) a considerable underestimate, due to the frequency with which the area affected at individual sites was considered ‘unknown’. Over 60% of individual site records for the impact were recorded as having ‘unknown’ areas. The data produced in the present survey can be used to provide more accurate assessments of habitat loss in future surveys.

7. Future Prospects

The future prospects for Annex I sand dune habitats at each site are based on an assessment of the threats posed or potential benefits likely to accrue from various impacts and activities. These can include management regimes (e.g. coastal protection works and beach cleaning), recreational activities (e.g. walking and horse-riding), agricultural practices (e.g. overgrazing and stock feeding) and potential developments.

There is no threshold for future prospects and the final result is based on a best scientific judgement. Most recorded impacts refer to activities noted during site surveys, although other sources of comparative information include NPWS site notes (NHA and NATURA 2000 information), while relevant data from other agencies such as county councils were also evaluated. NPWS conservation plans, where available, were reviewed and were taken into account when making a final determination.

7.1 Negative future prospects

The Coastal Monitoring Project 2006 (Ryle *et al*. 2007) reported that only 9 sites supporting machair habitat (out of a total of 59) were assessed as having a favourable conservation status for future prospects, while 50 sites were unfavourable-inadequate or unfavourable-bad. The poor rating can be attributed to agricultural improvement, with strip fencing and intensification of agricultural practices on machair representing the main future threats. Grazing was a major factor and this site-specific assessment was based mainly on the assumption that current grazing levels, which were negatively affecting the structure and functions of many of these sites were likely to continue in the future. Grazing is likely to continue on many western sites in Ireland.

Erosion trends are difficult to record, a site is not always obvious whether erosion is human induced or natural or a combination of the two. The causes of human induced erosion were noted at each site and usually included impacts such as trampling and poaching, however, they were not exclusively related to erosion. The area affected by anthropogenic- induced erosion is estimated at approximately 280ha (15 out of 59 sites), however, some of the area affected is described as unknown and could not be estimated. Erosional rates may also increase as sites suffer increasingly from sediment depletion in the future.

7.2 Positive future prospects

A significant proportion of these machair sites are completely or partially located within SACs (51 sites), with some additional sites within NHAs (4 sites), and therefore should be partially protected from development and damage. Notifiable actions, which require consent from the Department of Environment, Heritage and Local Government, have been set for machair habitats within SACs. The Rural Environment Protection Scheme (REPS) has agreed prescriptions for farming machair.

Grazing of livestock is a notifiable action and grazing levels should also be controlled within SACs by NPWS Conservation Plans, but this does not always occur in practise on many coastal sites. The intensity of grazing and number of sites being grazed may decrease in the future due to several reasons. Some NPWS Conservation Plans and Department of Agriculture Farm Plans are setting sustainable grazing levels for designated areas (SACs and NHAs) and for farms working in the REPS scheme. Overgrazing should decrease as these stocking rates are enforced. Stocking rates of livestock in Ireland in general are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (FAPRI-Ireland Partnership 2003). Several machair sites could benefit from a reduction in sheep numbers, as overgrazing is quite severe in a number of cases. The number of sites at which a reduction in cattle stocking density would improve the conservation value of the habitat is considerably fewer, although it includes the large sites on the Mullet Peninsula in Northwest Mayo, formerly renowned for some of the finest examples of machair in the country, but now experiencing an ongoing decline in condition due to the intensification of stock rearing practices.

7.3 Overall habitat future prospects

Grazing and recreation area the most significant impacts affecting the future prospects of this habitat. Currently some grazing levels outside and within SACs are still unsustainable and are affecting the structure and functions of this habitat. While some grazing level agreements are in place and are having a positive impact at several sites, there are no agreements or no proper enforcement of grazing agreements at many sites. Machair can, however, recover from heavy grazing quite quickly (several years).

The amount of unauthorised developments within designated areas should decrease due to improved monitoring and enforcement by NPWS staff, as well as the local authorities.

Overall, the habitat future prospects are assessed as **unfavourable bad.**

8. Overall Assessment of the Habitat Conservation Status

The habitat conservation status of the four main attributes has been assessed either as **Favourable, Unfavourable-Inadequate** or **Unfavourable-bad** at national level.

- The Natural Range of machair is considered to be **Favourable**. The Favourable Reference Range is considered to be equal to the current range of machair.
- The Area of machair habitat has decreased by about 2.35% in an ten year reporting period (1996-2006). This attribute was therefore assessed as **Unfavourable-Inadequate**.

- The Habitat Structure and Functions have been assessed as **Unfavourable-Bad**. There has been a considerable change in farming, which has seen many machair commonages being strip-fenced, often resulting in overgrazed swards, poaching and a spread of negative indicator species. Although only 65 monitoring stops out of 369 stops failed to reach the target criteria, 27% of the total area (14 sites) were considered unfavourable-bad. Monitoring stops were not carried out in much of the destroyed machair. Therefore, based on best expert judgement, the actual area of machair in bad condition is likely to be greater than this figure.
- The Future Prospects are assessed as **Unfavourable-Bad**. The condition of the habitat is unlikely to change without radical changes to current agricultural practices.

Based on the above assessments, the overall conservation status for machair habitat in Ireland is **Unfavourable-Bad**.

9. References

Akeroyd, J.A. and Curtis, T.G.F. (1980). Some observations on the occurrence of machair in western Ireland. *Bulletin of the Irish Biogeographical Society* **4**,1-12.

Angus, S. (1994). The Conservation Importance of Machair Systems of the Scottish Islands, with Particular Reference to the Outer Hebrides. In*: The Islands of Scotland: A Living Marine Heritage* (Baxter, J.M. and Usher, M.B., Eds.). HMSO, Edinburgh.

Bassett, A.J. (1983). *Report on the conservation of Irish coastal sites: Machair in Ireland.* Dublin, Unpublished report for the Forest and Wildlife Service.

Bassett, J.A. and Curtis, T.G.F. (1985). The nature and occurrence of sand dune machair in Ireland. *Proceedings of the Royal Irish Academy*, **85B**, 1-20.

Commission of the European Communities (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal no. L 206, 22/07/92.

Commission of the European Communities (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels.

Crawford, I., Bleasdale, A. and Conaghan, J. (1996). *Biomar Survey of Irish machair sites, 1996. Irish Wildlife Manuals, No. 3.* Dublin. Dúchas, The Heritage Service.

Curtis, T.G.F. (1991a). A site inventory of the Sandy Coasts of Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Curtis, T.G.F. (1991b). The Flora and Vegetation of Sand Dunes in Ireland. In: *A guide to the sand dunes of Ireland*, (M.B. Quigley, Ed.). Galway, European Union for Dune Conservation and Coastal Management.

Dargie, T.C.D. (1993). *Sand dune vegetation survey of Great Britain: a national inventory. Part 2: Scotland.* Joint Nature Conservation Council.

Dargie, T.C.D. (2000). *The sand dune vegetation survey of Scotland.* Scottish Natural Heritage. Edinburgh.

Darling, F.F. (1947). *Natural History in the Highlands and Islands*. London. Collins.

FAPRI-Ireland Partnership (2003). *An analysis of the effects of decoupling of direct payments from production in the Beef, Sheep and Cereal Sectors.* Report prepared for the Department of Agriculture and Food. Teagasc Rural Economy Research Centre. Sandymount, Dublin. www.tnet.teagasc.ie/fapri

Fossitt, J. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny

Gaynor, K. (2006). The vegetation of Irish machair. *Biology and Environment: Proceedings of the Royal Irish Academy*, **106B (3)**: 311-321.

Gaynor, K. and Browne, A. (1999). *Study of Irish links golf courses*. Unpublished report for Dúchas, The Heritage Service, Dublin.

Gimingham, C.H. (1974). Plant communities of the machair and floristic relationships with non-dune vegetation. In: *Sand dune machair* (D.S. Ranwell, Ed.), 13-14. London. Natural Environment Research Council.

JNCC. (2004). *Common Standards Monitoring guidance for saltmarsh habitat*. JNCC, Peterborough.

MacLeod, A.M. (1949). Some aspects of the plant ecology of the island of Barra. *Transactions of the Botanical Society of Edinburgh* **35**, 67-81.

Nordhagen, R. (1940). Studien über die maritime Vegetation Norwegens. I. Die Pflanzengesellschaften der Tangwälle. *Bergens Museums Årbok, 1939-40,* 1-123.

Preston, C.D., Pearman, D.A. and Dines, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford.

Ranwell, D.S. (1974a). *Sand dune machair*. London. National Environment Research Council.

Ranwell, D.S. (1974b). Machair in relation to the British sand dune series. In: *Sand dune machair* (Ranwell, D.S., Ed.), 4-5. Cambridge. Institute of Terrestrial Ecology.

Ranwell, D.S. (1977). *Sand dune machair 2*. Cambridge. Institute of Terrestrial Ecology.

Ranwell, D.S. (1981). *Sand dune machair 3*. Cambridge. Institute of Terrestrial Ecology.

Ritchie, W. (1976). The meaning and definition of machair. *Transactions of the Botanical Society of Edinburgh* **42**, 431-441.

Rothero, G. and Long, D. (1995). *Petalophyllum ralfsii*. Species dossier. Edinburgh. Internal report for Scottish Natural Heritage and Royal Botanic Garden.

Ryle, T., Connolly, K., Murray, A. and Swann, M. (2007). *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished).

Tansley, A.G. (1939). *The British Islands and their vegetation*. Caambridge. Cambridge University Press.

Tüxen, R. (1937). Die Pflanzengesellschaften Nordwestdeutschlands. *Mitteilungen der Floristischsoziologishen Arbeitsgemeinschaft*, **3**, 1-170.

Wilmott, A.J. (1945). Vegetation. In: Campbell, M.S. (Ed.). *The flora of Uig*. Arbroath. Buncle.

APPENDICES

APPENDIX I

Coastal Monitoring Project 2004-2006 (Ryle *et al*., 2007)

The Irish coastline, including the islands, extends to 6,000 kilometres, of which approximately 750 kilometres is sandy (Curtis 1991a). The systems range from simple sandhills to fully developed dune complexes, ranging from ephemeral strandline to dynamic embryonic and mobile dunes to fixed dunes, dune slacks and machair plains. The sand dune resource is under threat from a number of impacts – primarily erosion, changes in agricultural practices and development of land for housing, tourism and recreational purposes. This project, carried out on behalf of the National Parks and Wildlife Service (NPWS), is designed to meet Ireland's obligation under Article 17 of the EU Habitats Directive, in relation to reporting on the conservation status of Annex I sand dune habitats in Ireland. The following habitats were assessed:

- Annual vegetation of driftlines (1210)
- Perennial vegetation of stony banks (1220)
- Embryonic shifting dunes (2110)
- Shifting dunes along the shoreline with *Ammophila arenaria* (2120)
- Fixed dunes with herbaceous vegetation (Grey Dunes) *(2130)
- Decalcified fixed dunes with *Empetrum nigrum* *(2140)
- Atlantic decalcified fixed dunes (Calluno-Ulicetea) *(2150)
- Dunes with *Salix repens* ssp *argentea* (Salicion arenaria) (2170)
- Humid dune slacks (2190)
- Machair (21AO)*+

* indicates a Priority Habitat + Priority Habitat in Ireland only

The project had a number of stated objectives, including:

- Update the inventory of Irish sand dune systems (Curtis 1991a)
- Develop a monitoring programme for Irish sand dune habitats
- Establish the area of total national resource of each habitat
- Produce fully digitised habitat maps for each coastal dune site
- Assess the conservation status of each habitat at all sites
- Establish a database in which the results of this and future sand dune habitats monitoring could be entered and analysed

The project is notable in that it represents the first comprehensive assessments of sand dune systems and their habitats in Ireland. Over the course of three field seasons (2004-2006), all known sites for sand dune habitats were assessed (only 4 sites were not visited owing to access problems). The original inventory of sand dune systems by Curtis (1991a) listed 168 sites for the Republic of Ireland. During the current survey, analysis of ortho-aerial photographs and additional information supplied from NPWS staff increased the site list to 181 sites (Table 1). In addition, 15 sub-sites are recognised on the basis that they are geographically isolated from the main site and are subject to different management regimes.

Detailed site reports provide a clearer understanding of the habitat area, processed and impacts and the conservation status of the sand dune habitats at individual sites. All of the results have been entered into a Coastal Monitoring Project database, which will enable a convenient method of accessing specific data.

The overall condition of each habitat was determined following a methodology that was adapted from the Joint Nature Conservancy Council (the statutory adviser to the UK Government on national and international nature conservation issues), which has been conveyed in a series of Common Standards Monitoring (CSM) guidance documents (JNCC, 1998 and 2004a, b & c). It employs rapid assessment techniques that can be easily repeated in the future implementation of the monitoring programme. This system is based on vegetation surveys, measurement of habitat areas, and assessments of threats and management practices.

The specific attributes that determine the conservation status of a habitat at a site are:

- **Habitat extent (Area)**
- **Structure and Functions** including presence and abundance of typical species, presence and abundance of negative indicator species, bare ground, short turf cover, sward height, plant health and scrub cover (where applicable). Other criteria relating to particular habitats such as cover of *Salix repens,* and the ratio of forbs and grasses in dune slacks.
- **Future prospects** including a number of factors such as
  - Threats and their impacts on the site e.g. recreational activities, agricultural practices, development of land
  - Management of the site e.g. coastal protection works, beach cleaning etc.
  - Indicators of local distinctiveness such as notable plant species or vegetation mosaics

Habitat area is based on survey work using GPS, examination of aerial photographs and the production of detailed GIS maps. Structure and Functions was determined from monitoring stops that were carried out in all habitats and at most sites. Future Prospects are based on apparent impacts/threats to the site or a particular habitat that are likely to occur in the future. Attributes are assigned either a 'Favourable', 'Unfavourable-Inadequate', or 'Unfavourable-Bad' category, using criteria outlined in Chapter 2 of Ryle *et al*. (2007). The Overall Conservation Status is a synthesis of all the collected data. It is derived using the least favourable attribute. In addition, the overall conservation assessment of a habitat takes into account the overall range of the habitat within a biogeographical region.

Table 1 Comparative table highlighting the changes between the original inventory of Irish sand dune sites (Curtis 1991a) and the final site list used in the Coastal Monitoring Project 2004-2006 (Ryle *et al*. 2007).

County	National Site Inventory	New Sites	Sites to be deleted*	Coastal Monitoring Inventory
Louth	2			2
Meath	2			2
Dublin	8			8
Wicklow	10			10
Wexford	21	1		22
Waterford	7	1	3 + 1	8
Cork	10	3		13
Kerry	15		1	14
Clare	8			8
Galway	18	*1*		19
Mayo	22	2		23
Sligo	8			8
Donegal	37	5		42
Total	**168**	**13**	**5**	**181**

* These sites were surveyed as part of the Coastal Monitoring Project but no longer support sand dune habitat and may be deleted during the next monitoring cycle.

APPENDIX II – INVENTORY OF SITES SUPPORTING MACHAIR (FROM RYLE *ET AL*. 2007)
NOTE: * indicates a site that was not listed as machair in Curtis (1991a)

Site name	CMP site no.	Area (ha)	County
Inishmaan	090	46.954	Galway
Eararna	091	33.012	Galway
Portmurvey *	092	5.202	Galway
Finish Island	094	1.985	Galway
Mweenish Island	095	20.701	Galway
Mason Island	096	4.955	Galway
Doolan (Murvey)	098	43.104	Galway
Ballyconeely	099	15.833	Galway
Aillebrack	100	78.493	Mayo
Doonloughan *	101	121.106	Mayo
Mannin Bay	102	73.906	Galway
Leagaun	103	20.615	Galway
Omey Island	104	40.328	Galway
Augrusbeg	105	19.253	Galway
Inishbofin *	106	13.157	Mayo
Gowlaun *	107	16.795	Galway
Dooaghtry	108	137.108	Mayo
Lough Cahasy *	109	15.757	Mayo
Rosmurrevagh	112	33.660	Mayo
Keel Lough	113	92.7	Mayo
Lough Doo	114	96.9	Mayo
Corraun Point	115	19.9	Mayo
Trawboy	117	27.93	Mayo
Kinrovar	118	83.937	Mayo
Dooyork *	119	31.562	Mayo
Doo Lough	120	58.426	Mayo
Srah South	121	16.072	Mayo
Srah North	122	21.761	Mayo
Inishkea Islands	123	108	Mayo
Agleam	124	142.052	Mayo
Leam Lough	125	45.570	Mayo
Cross Lough	126	60.729	Mayo
Termoncaragh Lough	127	222.755	Mayo
Garter Hill	128	121.822	Mayo
Trawalua *	138	33.389	Sligo
Bunduff	139	48.905	Sligo
Sheskinmore	148	16.538	Donegal
Clooney	149	8.8	Donegal
Roshin Point *	150	5.305	Donegal
Lettermacaward	151	59.395	Donegal
Keadew *	153	28.748	Donegal
Cruit Lower	154	9.6	Donegal
Kincaslough	155	12.24	Donegal
Derrybeg	157	120.8	Donegal
Lunniagh	159	42.830	Donegal
Rinclevan *	162	30.428	Donegal
Dunfanaghy	163	2.23	Donegal
Tranarossan	167	74.233	Donegal
Melmore	168	21.868	Donegal
Lough Nagreany *	169	8.541	Donegal

Gortnatraw	171	20.354	Donegal
Maheradrumman	172	146.333	Donegal
Lenankeel *	176	27.5	Donegal
Tullagh	177	20.282	Donegal
Doagh Isle	178	92.516	Donegal
White Strand	180	5.9	Donegal
Cross Lough (Subsite-Beldarra)	203	15.407	Mayo
Inishkea South (Subsite of Inishkea North)	206	7.7	Donegal
Trawboy East (Subsite of Trawboy) *	207	0.86	Donegal

Sites listed in Curtis (1991a) as machair that were not considered to support the habitat by Ryle *et al*. (2007).

Culdaff – Donegal
Lag – Donegal
Doaghmore – Donegal
Gola Island – Donegal
Carnboy – Donegal
Rossnowlagh – Donegal
Gweesalia – Mayo
Dog's Bay – Galway
Inisheer - Galway

Appendix III – Summary of conservation status assessments of Machair (Annex I priority habitat* 21A0) in Ireland, taken from Coastal Monitoring Project (Ryle *et al.* 2007). Green = Favourable, Amber = Unfavourable-Inadequate, Red = Unfavourable-Bad.

Site name	Site no.	Area (ha)	County	Extent	Structure and Functions	Future Prospects	Overall	Comments
Agleam	124	142.052	Mayo	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to quarrying, agricultural improvement, stripe fencing and overgrazing.
Aillebrack	100	78.493	Mayo	Amber	Green	Amber	Amber	Extent is assessed as U1 due to large-scale sand extraction; Future Prospects are assessed as U1 due to sand extraction, pony-racing and dumping.
Augrusbeg	105	19.253	Galway	Amber	Green	Amber	Amber	Extent and Future Prospects rated as U1 due to agricultural improvement and strip-fencing.
Ballyconeely	099	15.833	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Bunduff	139	48.905	Sligo	Green	Green	Green	Green	All attributes favourable (FV)
Clooney	149	8.8	Donegal	Green	Red	Amber	Red	Future Prospects is assessed as U2 due to agricultural improvement, and fencing of the habitat.
Corraun Point	115	19.9	Mayo	Green	Amber	Amber	Amber	Structure and functions and Future prospects assessed as U1 due to strip fencing, lack of grazing in some areas, overgrazing and agricultural improvement.
Cross Lough	126	60.729	Mayo	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to agricultural improvement, strip-fencing and overgrazing.
Cross Lough (Subsite-Beldarra)	203	15.407	Mayo	Green	Red	Amber	Red	Structure and Functions is assessed as U2 due to agricultural improvement.
Cruit Lower	154	9.6	Donegal	Amber	Red	Amber	Red	Extent and Future Prospects assessed as U2 as a result of high recreational activities and undergrazing.
Derrybeg	157	120.8	Donegal	Amber	Amber	Amber	Amber	All three attributes assessed as U1 as a result of presence and expansion of golf course, lack of grazing in some areas and overgrazing and trampling.
Doagh Isle	178	92.516	Donegal	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1due to agricultural improvement and overgrazing of the machair. Also due to recreational activities associated with the presence of a golf course and caravan park.

Doo Lough	120	58.426	Mayo	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to threats from agricultural improvement, supplementary feeding of stock and localised damage from animal tracks.
Dooaghtry	108	137.108	Mayo	Amber	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to overgrazing by rabbits, sheep and cattle resulting in erosion of the machair.
Doolan (Murvey)	098	43.104	Galway	Amber	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to overgrazing of the machair by sheep and erosion induced by overgrazing.
Doonloughan	101	121.106	Mayo	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to overgrazing, erosion and extensive vehicle tracks.
Dooyork	119	31.562	Mayo	Green	Green	Green	Green	All attributes favourable (FV)
Dunfanaghy	163	2.23	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 due to presence and expansion of golf course.
Eararna	091	33.012	Galway	Amber	Amber	Amber	Amber	Extent, Structure and Functions and Future Prospects are assessed as U1 due to overgrazing by rabbits and cattle and associated erosion.
Finish Island	094	1.985	Galway	Amber	Green	Amber	Amber	Extent and Future Prospects rated U1 owing to sediment depletion and degradation of the remaining habitat.
Garter Hill	128	121.822	Mayo	Amber	Red	Amber	Red	Structure and Functions are assessed as U2 due to overgrazing and erosion.
Gortnatraw	171	20.354	Donegal	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to overgrazing, agricultural improvement, supplementary feeding of stock and recreational pressures.
Gowlaun	107	16.795	Galway	Green	Amber	Red	Red	Future Prospects rated as U2 owing to the agricultural influenced decline of the habitat. Structure and Functions rated U1.
Inishbofin	106	13.157	Mayo	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to recreational pressures and overgrazing by sheep and rabbits.
Inishkea Islands	123	108	Mayo	Amber	Amber	Amber	Amber	All three attributes assessed as U1 as a result of overgrazing.

Inishkea South (Subsite of Inishkea North)	206	7.7	Donegal	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects rated as U1 due to overgrazing resulting in natural erosion.
Inishmaan	090	46.954	Galway	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to the presence of a football pitch and agricultural activities.
Keadew	153	28.748	Donegal	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to agricultural impacts.
Keel Lough	113	92.7	Mayo	Amber	Amber	Amber	Amber	All three attributes assessed as U1 as a result of presence and expansion of golf course, and overgrazing and trampling.
Kincaslough	155	12.24	Donegal	Amber	Green	Amber	Amber	Extent and Future Prospects assessed as U1 owing to development of new houses.
Kinrovar	118	83.937	Mayo	Red	Red	Red	Red	Extent, Structure and Functions and Future Prospects are assessed as U2 due to widespread intensification of agricultural management practices.
Leagaun	103	20.615	Galway	Amber	Green	Amber	Amber	Extent and Future Prospects are assessed as U1 due to the presence of a caravan park and one-off housing on the machair and also due to agricultural management of the site.
Leam Lough	125	45.570	Mayo	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to threats from agricultural improvement and unsustainable stock rearing practices.
Lenankeel	176	27.5	Donegal	Amber	Amber	Amber	Amber	All three attributes assessed as U1owing to Strip fencing, Agricultural practices and development
Lettermacaward	151	59.395	Donegal	Amber	Amber	Red	Red	Future Prospects is assessed as U2 due to agricultural improvement, presence of sports pitch, strip fencing, drainage and scrub encroachment.
Lough Cahasy	109	15.757	Mayo	Green	Green	Amber	Amber	Future Prospects assessed as U1 owing to the agricultural degradation of this remnant machair.
Lough Doo	114	96.9	Mayo	Amber	Amber	Amber	Amber	All three attributes assessed as U1 as a result of overgrazing and the presence of a sports pitch.
Lough Nagreany	169	8.541	Donegal	Amber	Red	Amber	Red	Structure and Functions are assessed as U2 due to agricultural improvement.

Lunniagh	159	42.830	Donegal	Amber	Green	Red	Red	Extent U1 and Future prospects are assessed as U2 due to housing developments, overgrazing and vehicle tracks.
Maheradrumman	172	146.333	Donegal	Amber	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to agricultural improvement and overgrazing.
Mannin Bay	102	73.906	Galway	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to overgrazing.
Mason Island	096	4.955	Galway	Green	Amber	Green	Amber	Structure and Functions rated as U1owing to the pressure of grazing and presence of negative indicator species.
Melmore	168	21.868	Donegal	Green	Green	Green	Green	All attributes favourable (FV)
Mweenish Island	095	20.701	Galway	Green	Green	Amber	Amber	Future Prospects rated as U1 owing to sediment depletion.
Omey Island	104	40.328	Galway	Amber	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to overgrazing of the machair by sheep and erosion induced by overgrazing.
Portmurvey	092	5.202	Galway	Green	Green	Green	Green	All attributes favourable (FV)
Rinclevan	162	30.428	Donegal	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to overgrazing by sheep.
Roshin Point	150	5.305	Donegal	Green	Red	Amber	Red	Structure and Functions is assessed as U2 due to undergrazing, and strip fencing.
Rosmurrevagh	112	33.660	Mayo	Green	Amber	Green	Amber	Structure and Functions assessed as U1 owing to severity of grazing and sward height.
Sheskinmore	148	16.538	Donegal	Amber	Amber	Green	Amber	Extent and Structure and Functions are assessed as U1 due to changes in hydrology, which has resulted in a loss of habitat and due to agricultural improvement.
Srah North	122	21.761	Mayo	Green	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to widespread intensification of agricultural management practices.
Srah South	121	16.072	Mayo	Green	Green	Amber	Amber	Future Prospects are assessed as U1 due to recreational use, car parking for beach access, undergrazing in parts of the site, and dumping of rubble.

Termoncaragh Lough	127	222.755	Mayo	Green	Red	Red	Red	Structure and Functions and Future Prospects are assessed as U2 due to the restructuring of agricultural land holdings and an intensification of agricultural management activities.
Tranarossan	167	74.233	Donegal	Green	Amber	Amber	Amber	Structure and Functions and Future Prospects are assessed as U1 due to intensive stock rearing practices in parts of the site, and recreational impacts associated with extensive mobile home parks.
Trawalua	138	33.389	Sligo	Green	Green	Green	Green	All attributes favourable (FV)
Trawboy	117	27.93	Mayo	Amber	Amber	Red	Red	Future Prospects rated as U2 as a result of agricultural improvement and strip fencing.
Trawboy East (Subsite of Trawboy)	207	0.86	Donegal	Green	Green	Amber	Amber	Future Prospects rated as U1 due to overgrazing.
Tullagh	177	20.282	Donegal	Green	Red	Amber	Red	Structure and Functions rated as U2 due to intensive agricultural improvement. Future prospects rated as U1due to ongoing development of land for houses etc.
White Strand	180	5.9	Donegal	Green	Red	Amber	Red	Structure and Functions attribute assessed as U2 as a result of undergrazing and low species diversity.

Total number of sites: 59 (including 3 sub-sites)

Total area of habitat assessed: 2753.179ha

Total area of habitat mapped: 2712.6ha

APPENDIX IV

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

CMP – Coastal Monitoring Project (see Appendix II).

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

DoEHLG - Department of the Environment, Heritage and Local Government

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

ENCROACHMENT - The invasion of a species (usually plants) into areas previously uncolonised. This term is often used when an undesirable species advances at the expense of a desirable species or habitat.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FAVOURABLE REFERENCE AREA - Total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability. Favourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FAVOURABLE REFERENCE RANGE - Range within which all significant ecological variations of the habitat/species are included for a given biogeographical region and which is sufficiently large to allow the long term survival of the habitat/species. Favourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the "health" quantity or quality of a habitat or species.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURAL RANGE – The spatial limits within which the habitat or species occurs.

pNHAs - proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NPWS - National Parks and Wildlife Service

ORTHO-RECTIFIED IMAGE – The 2000 Ordnance Survey flight colour images were used as part of this project. These images were used in TIF format and were ortho-rectified. These images have been used as base data to identify the location of raised bogs, produce the high bog boundaries and vegetation maps.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

cSACs - candidate Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SAC's have also been known as cSAC's which stands for "candidate Special Areas of Conservation", and pcSAC's which stands for "proposed candidate Special Areas of Conservation."

SPAs - Special Protection Areas for Birds are areas which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas are protected from significant damage.

SPECIES - The lowest unit of classification normally used for plants and animals.

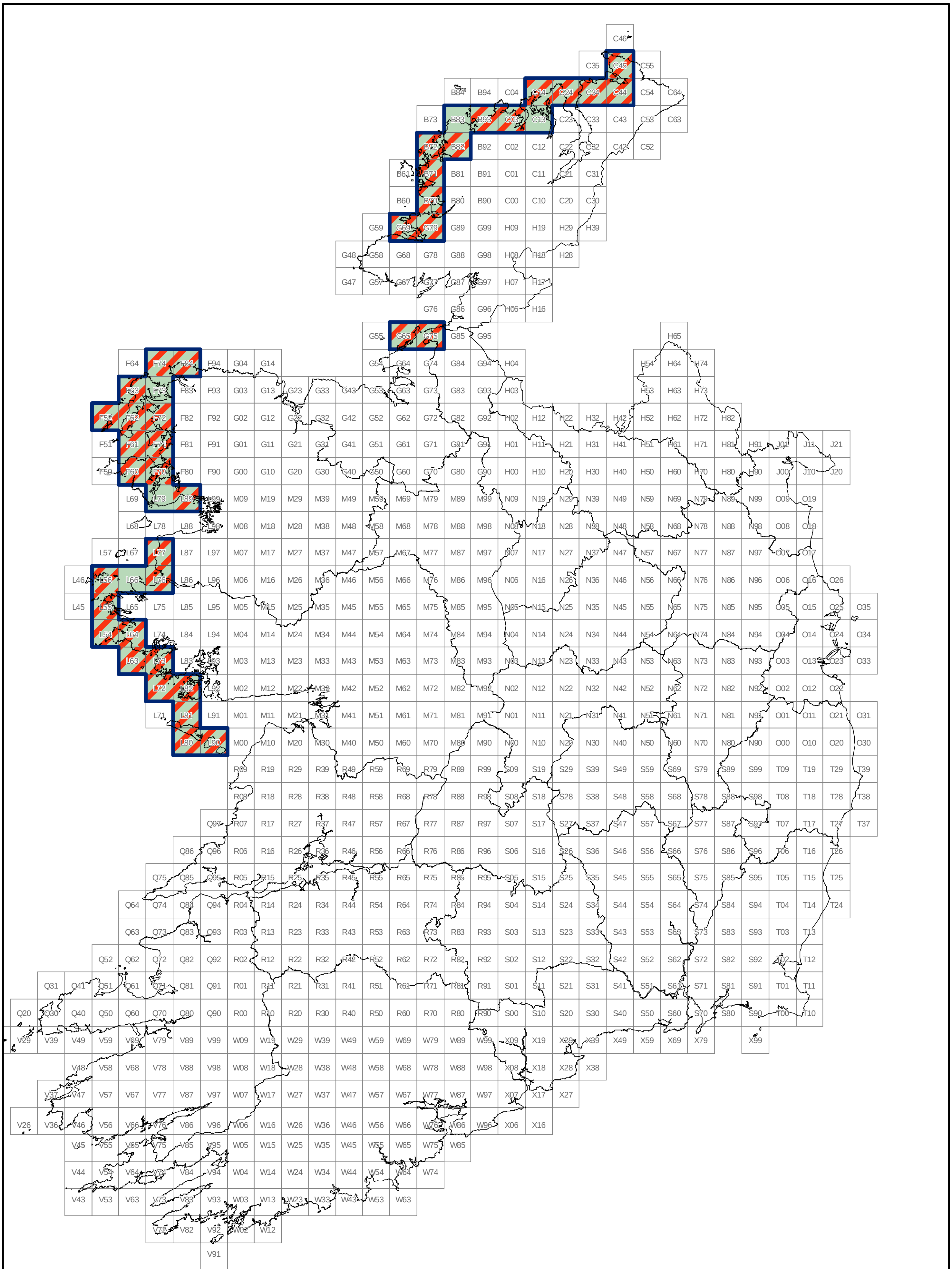
21A0 Machair

1. National Level	
Habitat Code	21A0
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
1.1 Range	Atlantic (ATL)
1.2 Map	See map attached

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ BASSETT, A.J. (1983). *Report on the conservation of Irish coastal sites: machair in Ireland.* Unpublished report for the Forest and Wildlife Service, Dublin. ▪ BASSETT, J.A. and CURTIS, T.G.F. (1985). The nature and occurrence of sand-dune machair in Ireland. *Proceedings of the Royal Irish Academy*, 85B: 1-20. ▪ CRAWFORD, I., BLEASDALE, A. and CONAGHAN, J. (1998) *Biomar Survey of Irish Machair Sites, 1996. Irish wildlife manuals, No. 3.* Dúchas, The Heritage Service, Dublin. ▪ CURTIS, T.G.F. (1991a) A site inventory of the sandy coasts of Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland*, 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 6-17. ▪ CURTIS, T.G.F. (1991b) The Flora and Vegetation of sand dunes in Ireland. In: Quigley, M.B. (ed.) *A Guide to the Sand Dunes of Ireland.* 3rd Congress of the European Union for Dune Conservation and Coastal Management, Galway: 42-66. ▪ COMMISSION OF THE EUROPEAN COMMUNITIES (2003) *Interpretation manual of European Union Habitats*. (Version EUR 25). European Commission DG XI. Brussels. ▪ GAYNOR, K. (2006). The vegetation of Irish machair. *Biology and Environment: Proceedings of the Royal Irish Academy*, 106B (3): 311-321. ▪ JNCC. (2004) *Common Standards Monitoring guidance for sand dune habitats*. JNCC, Peterborough. ▪ PRESTON, C.D., PEARMAN, D.A. and DINES, T.D. (2002). *New atlas of the British and Irish flora*. Oxford University Press, Oxford. ▪ RANWELL, D.S. (1972) *Ecology of Salt Marshes and Sand Dunes*. Chapman and Hall, London. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge. ▪ RYLE, T., CONNOLLY, K., MURRAY, A. and SWANN, M. (2007) *Coastal Monitoring Project 2004-200*6: A report prepared for the National Parks and Wildlife Service, Research Branch Contract Reference D/C/79 (Unpublished)
2.3 Range	Concentrated along the exposed Atlantic coasts of the west and north-west of Ireland (see map).
2.3.1 Surface area	4,400 km² (44 grid cells x 100 km²)
2.3.2 Date	08/2007
2.3.3 Quality of data	3 = good (based on extensive surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1996 - 2006
2.3.7 Reasons for reported trend	No changes
2.4 Area covered by habitat	27.53 km²
1.2 Distribution map	See attached map
2.4.1 Surface area	27.53 km²

2.4.2 Date	08/2007
2.4.3 Method used	3 = ground based survey
2.4.4 Quality of data	3 = good (based on extensive surveys)
2.4.5 Trend	Decrease of 2.35%
2.4.7 Trend-Period	1996 – 2006
2.4.8 Reasons for reported trend	1 = Improved knowledge/more accurate data
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	103 – Agricultural improvement 120 – Fertilisation 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hares, rabbits, small mammals 149 – Undergrazing 150 – Restructuring agricultural land holding 171 – Stock feeding 300 – Sand and gravel extraction 400 – Urbanised areas, human habitation 403 – Dispersed habitation 421 - Disposal of household waste 423 – Disposal of inert materials 430 – Agricultural structures 501 – Paths, tracks, cycle routes 601 – Golf course 607 – Sports pitch 608 – Camping and caravans 622 – Walking, horseriding and non-motorised vehicles 623 – Motorised vehicles 720 – Trampling, overuse 900 – Erosion 954 – Invasion by a species
2.4.11 Threats	103 – Agricultural improvement 142 – Overgrazing by sheep 143 – Overgrazing by cattle 146 – Overgrazing by hares, rabbits, small mammals 149 – Undergrazing 402 – Discontinuous urbanisation 601 – Golf course 607 – Sports pitch 623 – Motorised vehicles 720 – Trampling, overuse 871 – Sea defence or coastal protection works 900 – Erosion 990 – Other natural processes (depletion of sediment source)
2.5 Complementary information	
2.5.1 Favourable reference range	4400km² (44 grid cells x 100 km²) See map attached
2.5.2 Favourable reference area	28.19 km² (based on the current area of machair in Ireland plus the estimated loss of area since the Habitats Directive came into force)

2.5.3 & 2.5.4 Typical species	**Machair grassland:** *Achillea millefolium, Aira praecox, Bellis perennis, Carex arenaria, Cerastium fontanum, Crepis capillaris, Erodium cicutarium, Euphrasia officinalis agg., Galium verum, Linum catharticum, Lotus corniculatus, Odontites vernus, Orchid* spp., *Plantago lanceolata, Poa subcaerulea, Prunella vulgaris, Rhinanthus minor, Sedum acre, Trifolium repens, Thymus polytrichus, Viola canina, Viola tricolor, Viola riviniana* **Wet machair:** *Agrostis stolonifera, Carex arenaria, Carex flacca, Carex nigra, Hydrocotyle vulgaris, Mentha aquatica, Potentilla anserina, Prunella vulgaris, Ranunculus flammula* **Method:** the species list above is considered characteristic of uncultivated machair as defined by the Common Standards Monitoring scheme for sand dune habitats (Joint Nature Conservancy Council, 2004), but has been modified for use in Ireland (Ryle *et al*., 2007). Two grass species *Festuca rubra* and *Poa subcaerulea* have been added to the list as they are considered to be core machair species by Bassett (1983). Characteristic species were assessed as favourable in Ryle *et. al*. (2007)
2.5.5 Other relevant information	
2.6 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1).
Specific structures and functions (incl. Typical species)	Unfavourable-Bad (U2).
Future prospects	Unfavourable-Bad (U2).
Overall assessment of CS	Unfavourable-Bad (U2).



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Machairs

21A0

Current Distribution (39 cells)
Current Range (44 cells)
Favourable Reference Range (44 cells)
W48 10km grid cells

Date: August 2007

CONSERVATION ASSESSMENTS OF FRESHWATER LAKE HABITATS IN THE REPUBLIC OF IRELAND

A DRAFT REPORT

BY

THE FRESHWATER ECOLOGY GROUP, TRINITY COLLEGE DUBLIN

AND

COMPASS INFORMATICS

FOR

THE NATIONAL PARKS AND WILDLIFE SERVICE, DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

APRIL 2007

Minor amendments were made to the text by NPWS.

CONTENTS

1. Introduction and Structure of Report 5

2. Habitat Characteristics in Ireland 7
2.2 Lake Classification 9
2.3. Trophic classification of lakes 10
2.4 Trophic classification of Irish lakes 11
2.5 Vegetation Classification of lakes 14
2.6 Vegetation Classification of Irish lakes 15
2.7 The Water Framework Directive – Lake Monitoring Programme 17

3. Conservation Designation of Lakes
3.1 Sites of National importance....20
3.2 Sites of European importance 20
3.3 The Habitats Directive in Ireland....22
3.4 Designating Lakes Habitats as Special Areas of Conservation 22
3.5 Designating Lakes as Special Areas of Conservation for Annex II species 27
3.6 Conservation Measures for Lake SACs....27

4. Threats and Pressures 33
4.1 Eutrophication/ Nutrient enrichment 33
4.2 Overgrazing 35
4.3 Afforestation 36
4.4 Peat cutting 37

5. Classifying and Mapping Lake Habitats in Ireland 40
5.1 GIS Background 40
5.2 Lakes Datasets 41
5.3 Local Lake Metrics 41
5.3.1 Hydrography 41
5.3.2 Adjacent Topography 42
5.3.3 Adjacent Landcover....42
5.3.4 Protected Area Designations....43
5.3.5 Surveys....43
5.4 Lake Catchment Descriptors....43
5.4.1 Catchment Landcover 44
5.4.2 Catchment Topography....44
5.4.3 Catchment Geology 44
5.5 Methods for Classifying Lakes 44
5.5.1. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140) 46
5.5.2 Oligotrophic waters containing very few minerals of sandy plains (3110) 46
5.5.3. Natural dystrophic lakes and ponds (3160) 47
5.5.4 Oligotrophic to mesotrophic standing waters (3130) 48
5.6 Lake Classification 49
5.7 Lake Modelling Results 50

6. Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)51
6.1 Habitat Mapping 51
6.2 Habitat Range 52
6.2.1 Conservation Status of Range....53

6.3 Habitat Area....53
6.3.1 Conservation Status of Habitat Area....54
6.4 Structures and Functions....54
6.4.1 Conservation Status of Structures and Functions....55
6.4.2 Typical Species....55
6.4.3 Conservation Status of Typical Species....55
6.5 Main Pressures....56
6.6 Threats....56
6.7 Future Prospects....56
6.7.1 Negative Future Prospects....56
6.7.2 Positive Future Prospects....57
6.7.3 Conservation Status of Future Prospects....58
6.8 Overall Assessment of the Habitat Conservation Status for 3110....58

7. Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae* (3130) 62
7.1 Habitat Mapping....62
7.2 Habitat Range....63
7.2.1 Conservation Status of Range....64
7.3 Habitat Area....64
7.3.1 Conservation Status of Habitat Area....64
7.4 Structures and Functions....65
7.4.1 Conservation Status of Structures and Functions....66
7.4.2 Typical Species....66
7.4.3 Conservation Status of Typical Species....66
7.5 Main Pressures....66
7.6 Threats....67
7.7 Future Prospects....67
7.7.1 Negative Future Prospects....67
7.7.2 Positive Future Prospects....68
7.7.3 Conservation Status of Future Prospects....69
7.8 Overall Assessment of the Habitat Conservation Status for 3130....69

8. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140) 72
8.1 Habitat Mapping....72
8.2 Habitat Range....72
8.2.1 Conservation Status of Range....73
8.3 Habitat Area....73
8.3.1 Conservation Status of Habitat Area....74
8.4 Structures and Functions....74
8.4.1 Conservation Status of Structures and Functions....75
8.4.2 Typical Species....75
8.4.3 Conservation Status of Typical Species....76
8.5 Main Pressures....76
8.6 Threats....76
8.7 Future Prospects....77
8.7.1 Negative Future Prospects....77
8.7.2 Positive Future Prospects....77
8.7.3 Conservation Status of Future Prospects....78
8.8 Overall Assessment of the Habitat Conservation Status for 3140....78

9. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation (3150) 82
9.1 Habitat Mapping....82

9.2 Habitat Range 82
9.2.1 Conservation Status of Range 83
9.3 Habitat Extent 83
9.3.1 Conservation Status of Habitat Extent 83
9.4 Structures and Functions including Typical Species 83
9.5 Main Pressures 84
9.6 Threats 84
9.7 Future Prospects 84
9.7.1 Negative Future Prospects 84
9.7.2 Positive Future Prospects 85
9.7.3 Conservation Status of Future Prospects 85
9.8 Overall Assessment of the Habitat Conservation Status for 3150 86

10. Natural dystrophic lakes and ponds (3160) 89
10.1 Habitat Mapping 89
10.2 Habitat Range 89
10.2.1 Conservation Status of Range 90
10.3 Habitat Area 90
10.3.1 Conservation Status of Habitat Area 91
10.4 Structures and Functions 91
10.4.1 Conservation Status of Structures and Functions 92
10.4.2 Typical Species 92
10.4.3 Conservation Status of Typical Species 92
10.5 Main Pressures 92
10.6 Threats 93
10.7 Future Prospects 93
10.7.1 Negative Future Prospects 93
10.7.2 Positive Future Prospects 94
10.7.3 Conservation Status of Future Prospects 94
10.8 Overall Assessment of the Habitat Conservation Status for 3160 95

11. References 99

Appendix 1. Trophic classification scheme for lake waters proposed by the OECD (OECD, 1982). 106

Appendix 2. EPA modified version of the OECD scheme 106

Appendix 3. Macrophyte surveys of the 64 lake SACs 107

Appendix 4. EPA Lake Monitoring Programme 109

Appendix 5. Descriptions of five freshwater habitats as provided by The Interpretation Manual of European Union Habitats 117

Appendix 6. List of lakes proposed by NGOs for designation as SACs (Dwyer 2000). 120

Appendix 7. Site Inspection Report Form 2004-2006 121

Appendix 8. NPWS Guidelines For Form Completion : Site Inspection Report 123

1. Introduction and Structure of Report

Under contract to NPWS, a partnership of Compass Informatics and the Freshwater Ecology Group in the School of Natural Sciences, Trinity College Dublin (TCD) undertook to report on the conservation status of freshwater habitats in Ireland for the purpose of assisting NPWS in reporting under Article 17 of the Habitats Directive. The project was to report on lakes and rivers, but the guidance of the NPWS was to concentrate on lakes, as it was these where there had been little national assessment of habitats or quality. Rivers in the Republic of Ireland are monitored extensively, and comprise the major assessment of Ireland's water quality reports, produced in a three year rolling programme by the Irish Environmental Protection Agency (EPA). However, the methods used by the EPA for river and lake assessments have been based on metrics indicative of water quality, which although linked to conservation status were not designed specially to assess that. Further discussion of the relevance of current water qualirt assessment to conservation status is discussed in Section 2 of this report. Current assessment of river quality is based primarily on extensive sampling of macroinvertebrates to produce a 5-point *Q-value* scale, that of lakes has been much more limited in the area and number of lakes covered. Methods for lake assessment have been based on assessment of open-water concentration of phosphorus and chlorophyll *a,* following a modified version of the OECD (1982) trophic classification scheme. The validity of the OECD scheme, and moreover the modified version used by the EPA, and its relevance as a method to estimate nature conservation value of lakes is of critical importance. This report, therefore, reviews the applicability of the methods used by the EPA for lake assessment because it provides an essential context to an overall assessment of lake habitat quality, structure and function.

There are other general issues that are of importance to provide an objective view of the monitoring and protection of Ireland's freshwater habitats. These include the methods used for original designation of Sites of Conservation Importance (SACs), the applicability and occurrence of the lake and river habitats listed under the Habitats Directive, the applicability of NPWS monitoring protocols, and the role of NPWS in implementation of Directive (2000/60/EC), commonly known as the Water Framework Directive (WFD), including the interaction with the EPA who provide the main input to monitoring under the WFD.

There has previously been no estimate of the conservation status of Irish lakes. The project has had to develop a modelling procedure in order to estimate the range and area, as required for reporting under the Habitats Directive, using data held by the TCD freshwater ecology group and the EPA.

This has highlighted a number of issues in relation to linking the Habitat Directive descriptions of lakes (Habitat codes 3110, 3130, 3140, 3150 and 3160) with the realities of geographical occurrence.

The issues outlined above are relevant to an overall assessment of habitat range and favourable conservation status of Irelands lakes and, but to a lesser extent, rivers. We have therefore provided a report that prefaces the individual reports for each lake habitat type, required for reporting. This preface report has been produced to assist NPWS in habitat assessment and to provide recommendations of where improvements might be made in that process. It is recognised that many of the recommendations, or what might be viewed as criticisms of past practice, arise from a lack of resources and real or perceived political support for the statutory role of NPWS or its predecessor, *Duchas.*

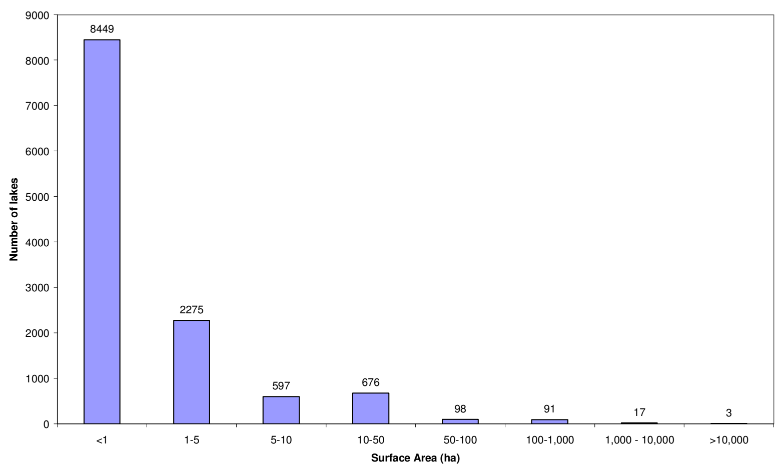
The structure of this report follows the format of the reporting structure to the European Commission, but has necessitated detail that is outside that needed for the reports for each habitat type. Summary points arising from this more detailed review are provided in the individual habitat reports, but we consider it important that the context of those summary reports is presented in this document.

2. Habitat Characteristics in Ireland

2.1 Historical monitoring

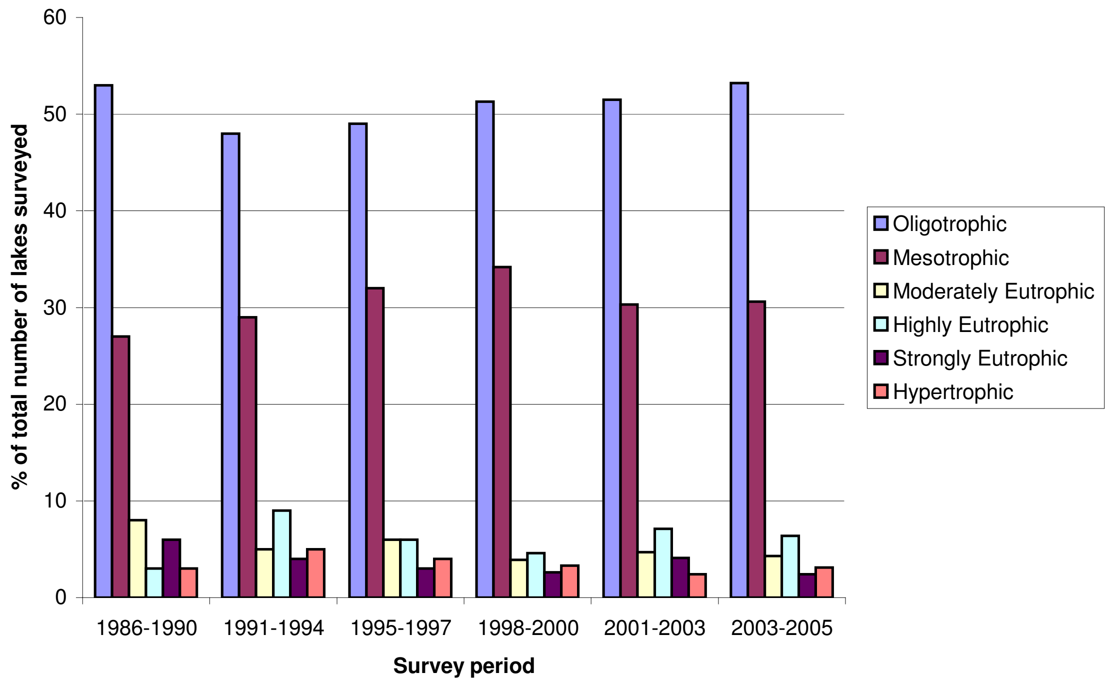
Ireland has a substantial freshwater resource, including lakes, rivers and canals, which accounts for 2.3% of the land cover (apprx: 161,660km^2) (EPA 2004). This is significantly higher than the EU average of 1.3% (EEA 2006). Based on the 1:50000 series of Ordnance survey maps, there are 12,206 freshwater lakes in Ireland, but the majority are less than 1 ha in extent (Fig.2.1). Less than 2% of the lakes in Ireland have a surface area greater than 50ha and only three lakes, Lough Corrib, Lough Derg and Lough Ree exceed 10,000 ha. Irish lakes, even the larger ones, are generally shallow for their area and Lough Leane in Killarney and Lough Mask are the only lakes in the Republic of Ireland to have average depths greater than 50m. Influenced by geology and climate, lakes in Ireland are primarily located in the west, northwest and central lowlands with relatively few lakes in the southeast.

Figure 2.1 The number of lakes by surface area in the Republic of Ireland (EPA 2006).



Monitoring of Irish lakes has, historically, been much less extensive than that of rivers. Surveys of lakes were initially done by the Inland Fisheries Trusts in the late 1960s and early 1970s. The first extensive survey of Irish lakes was by the Water Resources Division of *An Foras Forbartha*, who surveyed 41 lakes between 1973 and 1974 (Flanagan and Toner 1975). This survey included mainly large lakes and provided the first assessment of water chemistry for many sites and classified the lakes as either oligotrophic or eutrophic, with some more detailed studies following (Toner, 1979; Horkan and Toner, 1984; Bowman, 1982, 1985). Since the 1970s much of the information regarding Irish lakes has been collected by government agencies to assess, primarily water quality or fish stocks. Information on lake trophic status is included in national water quality reports compiled every three years by the EPA (Fig 2.2). The EPA monitored the Shannon lakes since the late 1980s, including detailed studies of Loughs Derg and Ree (Bowman *et al.,* 1993; Bowman, 1998). A detailed study of Lough Conn and its catchment was done in the early 1990s (McGarrigle *et al.,* 1994).

Figure 2.2. Trophic status of lakes surveyed from 1986 – 2005 as reported in national water quality reports (EPA 2006)



Although the EPA has a duty under Section 65 of the Environmental Protection Agency Act 1992 to monitor lakes, recent requirements under the WFD have driven a much more extensive programme than that previously proposed. A national monitoring scheme under the WFD to assess overall ecological status of lakes will be implemented in 2007. In recent years, partly in preparation for the Water Framework Directive (WFD) or in response to national legislation (DELG, 1998) there has been increased monitoring of lakes by the EPA through funded research (Irvine *et al*., 2001; McCarthy *et al*., 2006) and by local authorities. Detailed studies of individual or small groups of lakes undertaken by universities, non-governmental organisations and specific interest groups have made a significant contribution to Irish limnology, but these have rarely been coordinated at a national level. The history of lake monitoring is in marked contrast to the extensive programme for monitoring rivers that has been ongoing since the 1970s, and which has been used as the barometer of the quality of Irish surface waters.

The increasing number of lakes monitored is reflected in the most recent EPA *Water Quality Report* (Toner *et al.,* 2005) (Table 2.1), which also includes a substantial number of smaller lakes. However most of these lakes were monitored very infrequently, and largely in response to the forthcoming needs of monitoring under the WFD.

Table 2.1 Total number and area of lakes included in the national survey reports in the Republic of Ireland from 1976-2005

Years	Number of lakes surveyed	Total area km^2
1976- 1981	39	-
1982 – 1986	90	-
1987 – 1990	172	-
1991 – 1994	135	750
1995 – 1997	120	889
1998 – 2000	304	957
2000 – 2003	492	1084
2003 - 2005	421	1049

2.2 Lake Classification

The natural biotas of lakes, like any other habitat, are shaped by physical, chemical and climatic factors. It is expected that, for instance, ecological communities in a shallow lake in a lowland catchment would have a character quite distinct from an upland, deep lake. While this philosophy is now enshrined in EU legislation (WFD 2000/60/EC/), leading to the definition of lake types (Table 2.2), heretofore classification of lakes has, in practice, relied on an evaluation of either nutrient (trophic) or, acid status. These classifications relate almost entirely to assessing whether, respectively, a lake has been enriched from inputs of nutrients (mainly phosphorus) or protons (H^+). While either the consequential increase in productivity (fuelled by nutrients) or acidification can impact on nature conservation interests of lakes, monitoring programmes to gauge that impact has, traditionally, been neglected; although there is substantial research that has documented the effects of both nutrient enrichment and acidification on freshwater habitats and species. The emphasis within the WFD on monitoring biotic elements to assess *ecological status* relative to a baseline unimpacted *reference state* attempts to address the potential mismatch between water quality and ecological classification. The WFD defines the reference state as a condition where there are "no, or only very minor, anthropogenic alterations…[relative to] undisturbed conditions" (Annex V: 1.2 of the WFD). How *ecological status,* as defined by the normative definition of Annex V of the WFD, relates to *conservation status* under Article 1 of the Habitats Directive is unclear, although obviously related. The main difficulty likely arises not so much for favourable conservation status of habitats that requires maintenance of *long-term natural distribution, structure and function* [and] *survival of its typical species,* which appears to concur well with definitions of *high* and *good status* under the WFD, but for the protection of some Annex II species (especially birds) listed in the Habitats Directive.

Table 2.2 The Water Framework lake typology for the Republic of Ireland (EPA 2006)

Type	Description	Alkalinity ($mg l^{-1}$ $CaCO_3$)
1	Low alkalinity, shallow and small	< 20
2	Low alkalinity, shallow and large	
3	Low alkalinity, deep & small	
4	Low alkalinity, deep & large	
5	Moderate alkalinity, shallow & small	20-100
6	Moderate alkalinity, shallow & large	
7	Moderate alkalinity, deep & small	
8	Moderate alkalinity, deep & large	
9	High Alkalinity, shallow & small	>100
10	High alkalinity, shallow & large	
11	High Alkalinity deep and small	
12	High alkalinity, deep & large	

While the nuances of terminology used in the two Directives requires further discussion at national and international level, it has, nevertheless, been the case that the national assessment of lakes in Ireland has been based on interpretations of nutrient or acid status based on chemical data (e.g. Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005). There is a valid question, therefore, as to whether current or previous monitoring of lakes, especially SACs whose designation under the Habitats Directive was based primarily on their submerged plant communities, can be used to evaluate conservation status. In order to address that question it is necessary to, first, review the way lakes in the Republic of Ireland are monitored and, second, to evaluate if that monitoring can identify the range, distribution, and structure and function of lake habitats; and hence provide an overall evaluation of trends in the conservation status of lakes.

2.3. Trophic classification of lakes

Driven by a philosophy that open water concentration of phosphorus and phytoplankton provides adequate assessment of lakes, and the need to monitor for "water quality", lake classification in Europe and America has been dominated by the trophic classification scheme proposed by the Organisation for Economic Cooperation and Development (OECD 1982). This scheme was derived from an analysis of nutrients and other measures of eutrophication in 144 northern hemisphere lakes. The OECD scheme describes five trophic categories based on the annual mean values of total phosphorus, chlorophyll, and water transparency. The categories represent a gradient from clear, nutrient poor lakes with low productivity to murky, nutrient rich lakes with high productivity (Appendix 1). The scheme effectively places, within fixed boundaries, the transition from clear water *oligotrophic*, through intermediately enriched *mesotrophic,* to nutrient enriched *eutrophic* lakes. Highly enriched lakes are often characterized by surface phytoplankton scums and dense littoral growths of filamentous algae.

The simplicity and ease of reporting of the OECD (1982) scheme as a means of classifiying lakes has probably given it a credence that was never intended (Premazzi and Chiaudani, 1992, Johnes, 1994, Moss *et al.,* 1996), because the ecological quality of lakes form a continuum along trophic and other gradients. In addition, inherent uncertainty of misclassification within the fixed boundaries decreases with sample frequency (Irvine *et al*., 2001); and criteria used for assessment are affected by other factors such as lake colour (Eloranta, 1978), lake retention time (Vollenweider, 1968) and biotic interactions, notably grazing of phytoplankton by invertebrates (Irvine *et al*., 1989).

In the OECD trophic scheme the change from oligotrophic through to eutrophic is mainly caused by the production and accumulation of organic matter within the lake, as a result of nutrients supplied from the catchment, or in some cases recycled within the lake.

2.4 Trophic classification of Irish lakes

In order to classify lakes using the OECD trophic system, information relating to the three key indicator parameters (total phosphorus, chlorophyll and transparency) are required. Since the 1970s measurements of water chemistry have been carried by the Environmental Research Unit and in its successor the Environmental Protection Agency (EPA). Local authorities, other public bodies (especially the Central and Regional Fisheries Boards) and Universities (including, but not exclusively, programmes funded by the these other agencies) also monitor lakes. The EPA, however, has the statutory obligation to report on lake quality, which it does in triannual *Water Quality* reports. The total number of lakes included in that reporting has increased during the last twenty years (Table 2.1).

Under the Irish 1998 nutrient regulations (DELG, 1998), the minimum number of samples required for the assessment of total phosphorus (TP) is either 10 samples taken at intervals of four weeks or longer in one twelve month period, or 15 samples over a two year period**.** Alternatively, lake quality can be reported based on a value of maximum chlorophyll *a,* with no requirement for a minimum number of samples. It is this latter strategy that is used in the latest EPA reports. Therefore, the recent EPA reporting of water quality (Bowman *et al*., 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) is not based on an assessment of TP (or transparency) because, for the majority of lakes there is insufficient data to calculate the trophic status using either the OECD (1982) or the DELG (1998) scheme. Instead the EPA use the modified, and less statistically reliable (Irvine *et al*., 2001) trophic classification scheme based on the annual maximum chlorophyll value (Appendix 2). It may need to be emphasized in order to provide the appropriate context that this could, and frequently is, derived from only a single, or very few, measurements taken within the year. The EPA scheme also merges the OECD ultra-oligotrophic and oligotrophic categories into a single oligotrophic category and divides both the mesotrophic and eutrophic categories into two sub-categories. The local authorities and the Regional Fisheries Boards record information on TP and transparency for a small number of lakes, which are important fisheries or water abstraction sites. Some further detailed work is provided by University research (e.g. Irvine *et al.,* 2001; Donohue *et al.,* 2005; McCarthy *et al.,* 2006; De Eyto *et al.,* 2007), the results of which may or may not be included in the triannual EPA reports. The use of the EPA reports to assess trends in lake quality, therefore, requires caution. The main issues are:

a) The EPA trophic classification is based solely on maximum chlorophyll measurements and this can indicate a tropic status that is inconsistent with the OECD scheme. Comparing the trophic status of one lake as determined by both the OECD and the EPA scheme demonstrates the problem. In 2003 Lough Carra (south) was surveyed 12 times by the Central Fisheries Board and the mean annual values for total phosphorus, chlorophyll and transparency were:

   Total Phosphorus (mg/m^3) = 12.6
   Chlorophyll (mg/m^3) = 3.1 (max = 6.7)
   Transparency (m) = 3.8 (min = 2.1)

   The EPA scheme classifies this lake as oligotrophic but the OECD system classifies the lake as mesotrophic. This example also reflects the consequence of reporting according to a fixed boundary system (upper max TP for an oligotrophic lake is 10 ug/l^{-1}).

b) The EPA trophic classification system is based on the principle that measurements of chlorophyll are directly related to the level of phosphorus in the water (Dillon and Rigler, 1974). However the presence of grazing animals and water colour alters that relationship. In recent years many Irish lakes have become infested with the zebra mussel (*Dreissena polymorpha*), which reduces the chlorophyll a: TP ratio. According to the EPAs own recommendations (Lucey *et al.*, 2005) concentrations of chlorophyll *a* should not be used to assess trophic status in lakes where zebra mussel occur. In Ireland infestation with zebra mussels has been shown to be associated with increased water clarity, decreased abundance of phytoplankton and increased coverage by macrophytes (Maguire *et al.,* 2005). Zebra mussels are now present throughout the Shannon river system and there are major infestations in five of the large lakes (Loughs Key, Derg, Ree, Gill and Sheelin) that are included in the EPA monitoring programme. Despite the presence of zebra mussels the trophic status of these lakes is still reported using maximum chlorophyll values.

The EPA reporting compares lakes with inconsistent sampling frequencies, follows the modified OECD scheme and may be based on a single annual sample e.g. 45% of the 492 lakes reported by

Toner *et al.*, (2005) to cover 2003-2005 were only sampled once per year, and 43% of these were only sampled once during the three-year period. Only 28 lakes had been sampled at a frequency that would be likely to adequately take into account seasonal variation and provide reliable information on average values for concentrations of chlorophyll *a* or TP. There is, therefore, uncertainty associated both with inter and intra-annual variation. Previous reporting periods suggested a similar lack of intensive sampling. In the report covering the period 1995-1997 (Lucey *et al.,* 1999) assessment of lakes was based on 120 lakes, of which 39 were sampled once during the three year period and 43 lakes sampled only once per year. For the period 1991-94, out of the 135 lakes reported by Bowman *et al.* (1996), 94 had been sampled once during the three year period and 57 sampled once per year, although some of them may have been sampled in successive years. The assessment of lakes does include the majority of the 24 larger (>750 ha area), which enhances the total lake area reported on.

It is reasonable to conclude, therefore, that the reporting of trophic status of Irish lakes has not provided nearly as comprehensive an assessment as the reporting on river quality, with very few lakes having the frequency of seasonal monitoring required for a confident assessment of trophic status (Irvine *et al.,* 2001). Of the 492 lakes included in the 2003-2005 reporting cycle only 24 lakes reported on by Toner *et al.,* (2005) were sampled in a way that is compatible with the OECD (1982) scheme. Of the 64 sites designated as SACs for their lake habitats under Annex II of the Habitats Directive, only 5 of these were among those 24. For the majority of sites, therefore, there are no measurements of chemistry on which to base an estimate of current trophic state. For that reason we have applied a modelling process to provide an estimate of the trophic state of the national lake resource, and relate that to likely impact and, hence diminished conservation status.

The introduction of a lake monitoring programme in 2007 as required by the Water Framework Directive should have a significant effect on the availability of not only information on water chemistry of Irish lakes, but also on other elements, including macrophyte communities, that form the basis for SAC designation of lakes. However, it is worth bearing in mind that the WFD lake monitoring programme includes only one lake with a surface area less than 1 ha which account for over 69% of the lakes in Ireland. The new WFD monitoring programme is not, however, targeted to assess conservation status, or designed in order to provide a stratified sampling of the categories of lakes identified in Annex I of the Habitats Directive. In particular, dystrophic lakes are likely to be neglected as they have been in the past. The EPA reporting of lakes has focussed primarily on trophic assessment, with additional consideration of lakes threatened by acidification under a separate monitoring programme. While some of the lakes in that programme may be dystrophic owing to the geological association between lakes in peatland catchments and the risk of acidification, the monitoring is not designed *per se* to evaluate conservation status anymore than the EPA reporting of trophic status is. Hence, an expectation that future monitoring by the EPA to meet the needs of the WFD will be any more useful than previous monitoring for assessment of conservation status may be a forlorn hope.

2.5 Vegetation Classification of lakes

Aquatic vegetation in a lake reflects hydromorphology, water chemistry and climate. The Habitats Directive identifies submerged, floating, emergent and amphibious plant communities associated the particular habitat types. National lake vegetation classification schemes have been developed in several EU countries including the UK, Germany, Sweden, Finland and Lithuania. In Northern Ireland a comprehensive survey of the vegetation and water chemistry of 617 lakes identified 16 lake groups (Wolfe-Murphy *et al.,* 1992). In the UK a classification of lakes based on macrophyte flora identified 11 lake types using species lists from 770 lakes in Scotland, 330 in England and 30 in Wales (Palmer 1992). A revised classification system and lake key of the British Isles with records from 3447 sites has just been published (Duigan *et al*., 2006). It is noteworthy that this has identified eleven plant communities, which while bearing some concordance with those listed in the Habitats Directive also represent considerable overlap of sites with Habitat Directive descriptions (Table 2.3).

Table 2.3. The relationship between the eleven lake types in the UK and the Annex 1 lake habitats in the Habitats Directive. The closest relationship is found between groups shaded black but equally important representatives or regional variants may occur in groups shaded grey (Duigan *et al*,. 2006).

Lake Habitats	1	2	3	4	5	6	7	8	9	10	11
3110											
3130											
3140											
3150											
3160											

Some of the variance is likely related to effects of anthropogenic impact on lakes, especially through nutrient enrichment (which even at moderate levels may effect changes in plant communities), but also suggests a mismatch between the original descriptors and real community structure of vegetation communities in lakes.

2.6 Vegetation Classification of Irish lakes

A large proportion of the pre-1970 literature relating to aquatic vegetation in Ireland is primarily records of single species or taxonomic groups (King and Caffrey 1998). Some groups of aquatic plants (e.g. charophytes) are well recorded, while others such as the Potamogetonaceae have received little attention. In general, surveys of submerged aquatic plants for conservation interest are limited. There has been no comprehensive vegetation survey of lakes in Ireland but in the last 25 years there have been a number of small surveys and individual lake studies that have provided some baseline information.

Much of the information used by NPWS stems from a survey of 41 lakes, done in the 1980s to provide a baseline against which the conservation value of other lakes could be assessed (Heuff 1984). Data collected on macrophytes was classified using two-way indicator species analysis (TWINSPAN) and identified six lake types (Table 2.4). These communities, identified by a hierarchical statistical process, corresponded only loosely with the Habitat Directive community descriptions.

Table 2.4. Lake types and characteristic vegetation (Heuff 1984)

Lake Type	Characteristic vegetation
Nitella lakes	Sparse vegetation with *Nitella* communities
*Lobelia l*akes	Communities of the Littorelletalia
Najas lakes	Asssociation of *Najas flexilis* and *Potamogeton berschtoldii*
Elodea lakes	Community of *Elodea canadnsis* and *Lema trisulca*
Chareturm asparae lakes	Community of *Chara aspera, Myriophyllum spicatum* and *Potamogeton pectinatus*
Marl lakes	Communities of *Chara contraria* and *Chara desmacantha*

Seven benthic algal communities and ten plankton groups were also identified from the data collected. Heuff (1984) recognised that further surveys were required to produce a more comprehensive overview of the vegetation of Irish lakes, but the recommendation for a more comprehensive survey of the macrophytes of Irish lakes was not effected.

The Central and Regional Fisheries Boards have surveyed the macrophytes communities of several lakes, which are important trout fisheries. Macrophytes are important in lake trout fisheries as they provide cover and grazing surfaces for a range of invertebrates that are a food source for trout. The Inland Fisheries Trust surveyed the vegetation of Loughs Corrib, Carra, Sheelin, Ennell, Owel and Derravaragh during the 1970s (John *et al*., 1982). The Central Fisheries Board (CFB) surveyed the aquatic flora of Loughs, Carra, Conn, Cullin, Corrib and Mask in the mid 1980s and again in the 1990s (King and Caffrey, 1988; King and Champ 1997). These surveys provided details of the macrophytes at each sites and indicated that there were six aquatic plant assemblages in Lough Corrib (Krause and King, 1994). A survey of 17 lakes in the Shannon-Erne by the CFB found macrophytes communities that differed from those found in the midland limestone lakes and the large western lakes (Monahan and Caffrey, 1997). TWINSPAN analysis of the data collected from the seventeen lakes identified three aquatic plant communities. However, comparison of the lake types identified across surveys is difficult because of different methods of sampling and analysis.

The WFD has provided the impetus for increased ecological assessment of lakes in both the Republic of Ireland and Northern Ireland. Analysis of the macrophyte data from 58 lakes identified six distinct lake types (Table 2.5) (Free *et al.,* 2005) although only 17 lakes with surface areas less than 50 ha were included in the programme. A cross-border project (NS SHARE) designed to develop ecological classification tools has also sampled macrophytes from 30 lakes

Table 2.5. Descriptions of lake types based on macrophyte samples from 58 lakes (Free *et al*., in press; Free *et al*., 2005)

Group	Description
Type1	Low alkalinity (median = 4 mg l^{-1} CaCO3) of medium transect depth (x = 4.2 m) with no significant indicator taxa but consistently had *Isoetes lacustris*, *Litorella uniflora* and *Fontanalis antipyretica* in low abundance.
Type 2	Alkalinity was significantly higher than all other clusters (median = 131 mg l^{-1}CaCO3), mean depth was variable, colour was significantly lower than 2 other clusters. *Chara* spp. and *Elodea canadensis* were significant indicator taxa. *Chara* spp. occurred in 100% of this clusters lakes and the majority (70%) of the abundance of *Chara* spp. in the 58 reference lakes was concentrated into this cluster
Type 3	Low alkalinity (median = 6 mg l^{-1} CaCO3) of medium transect depth (x = 3.3 m) with *Myriophyllum alterniflorum* as a significant indicator taxa occurring in 91% of lakes in this cluster.
Type 4	Low alkalinity (median = 6 mg l^{-1} CaCO3) with a shallow transect depth (x = 1.6 m) that was significantly shallower than 2 other clusters, and had higher estimated light levels. Significant indicators were *Eriocaulon septangulare*, *Lobelia dortmanna*, *Isoetes lacustris*, *Litorella uniflora*, *Juncus bulbosus* and *Myriophyllum spicatum*. In addition to these taxa being frequent in this cluster there was also a notable concentration of abundance into this group
Type 5	Low alkalinity (median = 3 mg l^{-1} CaCO3) with a deep transect depth (x = 5.5 m) that was significantly deeper than 2 other clusters. *Nitella* spp., filamentous algae and *Potamogeton perfoliatus* were significant indicator taxa.
Type 6	Low alkalinity (median = 4 mg l^{-1} CaCO3) with a medium transect depth (x = 4.2 m) and tended to have a higher lake area (Figure 5.8). No significant indicator taxa were found, both diversity and abundance were low in this cluster

The introduction of the WFD lake monitoring programme in 2007 (see Section 2.7) will sample macrophyte and phytoplankton communities on a three year cycle. The lakes selected for monitoring in accordance with the WFD (see Section 2.7) include only 1 lake with a surface area less than 1 ha, and only a small proportion (11%) have surface areas between 1-10 ha. Lake area can have a significant influence on macrophyte communities (Free et al., in press) and therefore monitoring of smaller lakes is required for the vegetation classification of Irish lakes.

Hierarchical statistical analysis, as used by both Heuff (1984) and Free *et al.* (in press) inevitably reduces the number of lakes used to classify each type. Both projects identified 6 lake types from respective total samples of 48 and 58, meaning on average eight and 9.7 lakes per identified type. In contrast the latest JNNC classification scheme (Duigan *et al.,* 2006) identified eleven lake types from a dataset of 3447 sites, with each type based on a *n-value* of between 2 and 1067, but with only two categories based on less than 87 sites.

The information currently available on aquatic plants in Irish lakes is, therefore, quite limited, particularly so for smaller lakes (<10 ha) which account for 98% of Irish lakes.

Of the 64 sites designated as SACs for lake habitats, information on submerged aquatic plants was available for only 23 of these lakes prior to designation – 18 had been surveyed by Heuff (1984), an additional 4 lakes were surveyed by the Central Fisheries Board and 1 by the Northern Ireland Lake Survey. The recent survey of lakes by the EPA, in preparation for the implementation of the WFD lake monitoring programme, has provide macrophyte data for an additional 21 SAC lakes. Currently there is information on the aquatic macrophytes for 44 of the 64 lake SACs (Appendix 3).

2.7 The Water Framework Directive – Lake Monitoring Programme

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a lake typology (see Table 2.5), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish. Monitoring of water chemistry and hydromorphological change are also required but are stipulated as supporting, rather than driving, ecological assessment. A pilot study by the EPA sampled 201 lakes, including 61 candidate reference sites for water chemistry, phytoplankton, macrophytes and macro-invertebrates (Free *et al.,* in press). The candidiate reference lakes used in the study were selected by expert opinion using information on lake catchments including underlying geology and land-use, water chemistry and existing biological information. Subsequent palaeolimnological research, verified that 11 out of a sample of 35 of the candiadate reference lakes could be considered to be in reference condition (Leira *et al*., 2006).

The lake typology to meet the requirements of the WFD is not synonymous with lake classification required for the Habitats Directive. However, the information which was collected in order to develop the WFD typology, can contribute to the development of a system of lake classification to support the Habitats Directive. The development of a lake classification system is not a requirement of the Habitats Directive but basic ecological information required to be collected under the WFD to classify lakes is an essential part of any strategy which identifies monitoring and conservation needs of lake habitats. Furthermore, it is obvious that the descriptors used for lake habitats in the Habitat Directive are insufficient to discriminate effectively most of the freshwater habitat types (see comments below). Further development of habitat classification methods for European freshwaters are clearly required. The information collected as part of the WFD monitoring will be more relevant to assessing trends in conservation than has been the case with previous monitoring for water quality, but requires agreement and coordination to optimize relevance to statutory obligations under the Habitats Directive, and other legislation (Irvine *et al.,* 2002).

The EPA has identified a total of 805 lakes for inclusion in the WFD lake network (Table 2.6) but only a proportion (28%) of these lakes will be monitored. An expert group from the EPA, NPWS, Central Fisheries Board and the Western RBD Project selected 73 lakes for surveillance monitoring and 226 lakes for operational monitoring. All lakes selected for surveillance monitoring have also been selected for operational monitoring and therefore a total of 226 lakes will be monitored every three years. Lakes within 44 of the 64 currently designated lake SACs will be monitored as part of the WFD lake monitoring programme (Appendix 4). However the WFD monitoring of lake SACs may be very limited as many SACs contain multiple lakes, which may include several lake types, and the WFD monitoring programme may only include one lake within such an SAC.

Table 2.6. The number of lake water bodies included in the Water Framework Directive network in the Republic of Ireland (EPA 2006).

	Lake water bodies (ha)					
River Basin District	**< 50***	**50 – 100**	**100– 1,000**	**1,000 –10,000**	**>10,000**	**Total**
East	17	4	4	1	0	**26**
Neagh-Bann	0	1	1	0	0	**2**
North Western	187	25	26	2	0	**240**
Shannon	60	21	25	5	2	**113**
South East	12	0	0	0	0	**12**
South west	70	9	9	2	0	**90**
Western	249	38	27	7	1	**322**
Total	**595***	**98**	**92**	**17**	**3**	**805**

* Only includes lakes less than 50 ha located in Special Areas of Conservation or used for drinking water abstraction purposes.

Three types of monitoring, surveillance, operational and investigative, are specified and described in the WFD and Common Implementation Strategy (CIS) guidance documents. The objectives of surveillance monitoring include the assessment of long-term changes in natural conditions, and changes resulting from widespread anthropogenic activity. Operational monitoring will establish the status of those bodies identified as being at risk of failing to meet their environmental objectives and assess any changes in the status of such bodies resulting from the programmes of measures. Investigative monitoring will take place in order to ascertain the causes of a water body failing to achieve the environmental objectives or to ascertain the magnitude and impacts of accidental pollution.

The 73 lakes selected for surveillance monitoring (Fig 2.3) will be surveyed for biological parameters, phytobenthos, phytoplankton, macrophytes, macro-invertebrates and fish, on a three year cycle. The frequency of sampling has yet to be determined. Physio-chemical parameters will be surveyed on a three year cycle at a frequency of 12 times per year.

The 226 lakes selected for operational monitoring (Fig 2.4) will be surveyed for phytoplankton, macrophytes, macro-invertebrates and fish, on a three year cycle. The phasing and frequency of phytobenthos sampling has not been decided. The monitoring of physio-chemical parameters is influenced by the abstraction of water. Lakes which serve communities >30,000 will be surveyed annually at a frequency of 12 times per year while those that serve communities of 10,000 – 30,000 will be sampled 8 times per year. For the remaining lakes it is proposed that the examination of the physio-chemical parameters will be undertaken on an annual cycle at a frequency of 4 times per year.

The sampling frequency and the range of variables covered in lakes selected under the WFD lake monitoring programme will be significantly higher than exists under current monitoring programmes. The biological and chemical information collected during the lake monitoring programme will provide data that will facilitate the implementation, but will not encompass all the requirements of the Habitats Directive. The good status that is required within the WFD is based on assessing departure from a reference state. While this may present many practical challenges, it is conceptually straightforward. In contrast, the assessment of conservation status under the Habitats Directive is based on species lists and percetions of diversity. Moderately or slightly impacted lakes could very well harbour more diverse communities, or favour particular Annex II species under the Habitats Directive, or Annex I species under the Birds Directive, than *high* or *good* status waterbodies under the WFD. Increased productivity from nutrient additions could, for example, favour wading birds or diving ducks. It is, therefore, not assured that favourable conservation status is synonymous with *good* or *high* quality defined by the WFD.

3. Conservation Designation of Lakes

The designation and monitoring of sites is an essential component in the protection and conservation of habitats and species. Habitats may be recognised as being important on a national, international or global scale and are designated accordingly.

3.1 Sites of National importance

In Ireland habitats of national importance can be designated as Natural Heritage Areas (NHAs). In 1995, proposals for over 1100 NHAs were published, but the designation of sites was not possible until 2000 when the necessary legislation, the Wildlife (Amendment) Act, 2000, was introduced. To date 148 peatland sites have been designated as NHAs and therefore lakes, except those, *de facto*, dystrophic lakes within the NHAs are not currently afforded protection as NHAs.

3.2 Sites of European importance

The EU has introduced two directives, the Birds Directive and the Habitats Directive, for the protection and conservation of habitats and species throughout Europe. The Birds Directive (79/409/EEC) adopted in 1979 was the first European directive on nature conservation. The directive provides a framework for the conservation and management of wild birds within the European territory. The directive requires Member States to designate Special Protection Areas (SPAs) for the protection and conservation of bird species. Lakes are an important habitat for a number of bird species listed in Annex I of the Directive and can be designated as SPAs. Ireland has designated 128 SPAs by Statutory Instrument, and a further 22 sites have been notified as SPAs, but not yet designated. Many of the larger SPAs have numerous lakes within their boundaries.

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora requires Member States to conserve natural habitats and their species (Articles 3-11), and to protect species (Articles 12-16). Member States are obliged to designate, and protect, a network of sites identified as Special Areas of Conservation (SACs), which together with SPAs, designated under the EU Birds Directive, form the Natura 2000 network of protected sites. Habitats, whose conservation requires the designation of SACs are listed in Annex I of the Habitats Directive, while species are listed in Annex II, IV and V. The Habitats Directive requires Member States to maintain, or restore, the favourable conservation status of the habitats and species listed in its annexes.

The freshwater habitats in Annex I are divided into two groups - standing waters and running waters. There are 10 standing water habitats including lakes (Table 3.1). A reference document *Interpretation Manual of European Union Habitats*, produced by the EU, provides descriptions of each habitat and outlines characteristic elements, including vegetation.

Table 3.1. The Habitats Directive Annex I standing water habitats and the number of designated sites in the Republic of Ireland

Code	Habitat	Number of SACs
3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia* uniflorae)	32
3120	Oligotrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with *Isoetes* spp.	**
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	9
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* sp.	18
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation	9
3160	Natural dystrophic lakes and ponds	10
3170	* Mediterranean temporary ponds	**
3180	* Turloughs	43
3190	Lakes of gypsum karst	**
31A0	* Transylvanian hot-spring lotus beds	**

* Priority habitat ** Habitat not known to exist in Ireland

Article 6 of the Habitats Directive sets out the need to effect conservation measures to protect the Natura 2000 network, although relating specifically to SACs and the Annex II species present at those sites. These requirements include understanding the *ecological requirements* of habitats and species, which must be based on scientific knowledge, in order to establish "conservation measures, on a case by case basis" (EC, 2000-Managing Natura 2000 sites). Management plans are not a requirement of the Habitats Directive, but it is recognised that they can provide a framework for the protection and conservation of designated sites. The Habitats Directive does not specify the exact content of management plans but does provide a number of important considerations that can be made in view of the preparation of such plans. The objectives of a SAC management should provide a safeguard for habitats and species based, self-evidently, on their ecological requirements, so as to ensure favourable conservation status.

While there is no formal requirement for a management plan for each site under the provisions of the Directive, it is difficult to envisage how, without one, Member States can fulfill obligations relating to "appropriate statutory, administrative or contractual measures" under Article 6(1) or avoidance of deterioration of habitats or disturbance under Article 6 (2). It is also impossible to envisage how management can be effective, or the SAC network maintained without associated and appropriate monitoring. Indeed, Article 11 of the Directive requires *surveillance* of the conservation status.

It is, therefore, clear that the Habitats Directive requires that: a) Member States designate a network of sites that are effective in providing safeguards to the range and quality of listed habitats and species; b) draw up and implement management strategies for those sites and species, including conservation objectives; and c) monitor effectively those sites and the species within them. For designated sites with multiple habitat types (as identified in Annex I of the Directive) it is necessary to list all such habitats, and Annex II species, within them; and presumably to monitor in a way that take these into account.

3.3 The Habitats Directive in Ireland

In Ireland the Habitats Directive was transposed into national legislation by the European Communities (Natural Habitats) Regulations, S.I. 94/1997 and amendments SI 233/1998 & SI 378/2005. The National Parks & Wildlife Service (NPWS), part of the Department of the Environment, Heritage & Local Government (DEHLG), is responsible for the implementation of the Habitats Directive including the designation and protection of SACs. Guidance for the selection of SACs is provided in Annex III of the Habitats Directive and each member state is required to send a list of proposed SAC sites to the EU for approval. Once the proposed SACs have been approved by the EU they must be designated under national legislation within six years. To date, Ireland has proposed 423 sites and transmitted 418 to the EU for consideration. In 2004 the EU approved 408 of the the proposed SAC sites.

3.4 Designating Lakes Habitats as Special Areas of Conservation

There are 10 standing water habitats described in Annex I of the Habitats Directive. Based on the descriptions and the vegetation communities outlined in the *Interpretation Manual of European Union Habitats* it is apparent that for reasons of biogeography four of the standing water habitats are unlikely to occur in Ireland (Table 3.1). The remaining six standing water habitats comprise five lake habitats and turloughs. Turloughs are a characteristic Irish habitat and there is no disputing the occurrence of this habitat in Ireland and, for the majority of sites, identifying a turlough as such. The presence of the remaining five lake types in Ireland and the designation of corresponding sites is a more complex matter. The five Annex I lake habitats, which are believed to occur in Ireland, are:

1. Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
2. Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
3. Hard oligo-mesotrophic waters with benthic vegetation of *Chara s*p
4. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation
5. Natural dystrophic lakes and ponds

Descriptions of each of these five habitats (Appendix 5) as provided by *The Interpretation Manual of European Union Habitats* are based primarily on vegetation communities but do provide information on trophic status and subrtrate type. It is acknowledged that the ‘Standing waters’ group of habitat types is particularly complex because some habitats have similar vegetation and differ only in their substrate or trophic status and this has created difficulties for those authorities who are responsible for selecting SAC sites (Evans, 2006).

As the Directive relates to the *Conservation of natural habitats*, the reference to trophic state in the habitat descriptions should logically refer to unimpacted habitats, or those with minor impacts (equivalent, ideally, to *high* status under the WFD; or at least to *good* status). Alternatively, it is possible to envisage designation of sites that, although impacted, represent a "best available option", equivalent to the *moderate status* sites under the WFD. Such sites require restoration strategies (European Commission, 2000).

As described in Sections 2.4 and 2.6 comprehensive information on trophic status and vegetation communities of lakes is limited, and very lacking for the majority of SACs. As there has been no national lake survey there has been a reliance on information collected from a variety of sources for designation of lake SACs. Furthermore, some of the information on lake vegetation is based on surveys done more than 20 years ago. There was no systematic survey by NPWS of vegetation or water chemistry prior to, or in most cases since, the designation of lakes as SACs. The Natura 2000 forms which were compiled for all proposed SAC sites attempted to bring together the available information for each site but clearly demonstrate the variable and limited nature of the information available for many lake SAC sites.

The decision by NPWS to classify lakes, in accordance with the Habitats Directive, solely on vegetation communities has created some difficulties in the classification of lake types in Ireland. NPWS selected natural eutrophic lakes sites on the basis of the dominance of broad leaved *Potamogetons* or *Hydrochorition* spp. in the aquatic vegetation. These achieve dominance in mesotrophic to eutrophic conditions and NPWS assumed that the vegetation type was the most important factor when classifying lakes. Sites whose trophic status may have been impacted were included if it was considered that they would still have been dominated by the appropriate vegetation type in their pre-impacted state. It is unlikely that there are any natural eutrophic lakes in Ireland and the sites designated as such have been selected because of their vegetation with no reference to their trophic status. Even designated sites, which are eutrophic, would require supporting information as to why they are considered to be natural eutrophic lakes and not anthropogenically impacted ones. There are very few examples of naturally eutrophic lakes in the British Isles. The Shropshire meres stand out as a fine example, owing to phosphate rich geological seams in the catchment; although some are also impacted through nutrient run-off and inputs from waste water treatment plants. The sites designated in Ireland are, therefore, those that have been shown to require, or likely require, restoration measures. The available information of the catchments of those sites designated as naturally eutrophic (type 3150) suggest impact from anthropogenically derived nutrients. These include Lough Oughter (Irvine *et al.,* 2001), Ballyallia (Wemeare, 2005), Lough Ree (EPA reports) and Lough Gill (Lough Gill report). The site description for Lough Ballyallia, for example, refers to the proximity of intensive grassland and farmyards to the site. Lough Dromore with an alkalinity range of 130-192mg1^{-1} $CaCO_3$ recorded by Irvine *et al.* (2001) may also be better classed as a hard water lake.

Habitat type 3110 (oligotrophic waters containing very few minerals of sandy plains), also raises some questions regarding the appropriate identification of this lake type in Ireland. A number of characteristic plants of this community type are also found in Habitat type 3130 and the same phytosociological order is used to describe both habitats 3110 and 3130. Habitat type 3110 is considered rare throughout the Atlantic Biogeographic Region of Europe and in the UK is restricted to sandy plains that are acidic, low in nutrients, and typically very clear and are therefore very scarce (Jackson and McLeod, 2000). In the UK the only known high-quality examples of this habitat type occur on fluvio-glacial deposits in the New Forest and on the Cheshire Plain, and on more recent sand deposits of marine origin in the Outer Hebrides (Jackson and McLeod, 2000). Only four sites in the UK have been designated for habitat type 3110. Away from sandy plains, oligotrophic waters with similar plant assemblages, habitat type 3130, are widespread and locally abundant in the uplands of Scotland and Wales and the Lake District. The UK has designated 47 sites for habitat type 3130.

There is a possibility of misclassification of sites designated for lake habitat 3110 in Ireland owing to the limited extent of initial vegetation survey and supporting geological information combined with the decision by NPWS to place all lowland oligotrophic lakes with *Littorelletea* vegetations in this category. Sessiagh Lough, for example, classified as type 3110, appears to have little supporting geological information that would justify its inclusion in this lake type. Information in the draft management plan refers to the lake being underlain by metamorphic rocks, with a bedrock of mainly laminated quartzites, with some areas underlain by more base rich rocks and, generally the lake shore to be underlain by bare rock. This is not the description of a lake situated in a sandy plain, which is a geographical feature not present in Ireland. This anomally does, however, refect the difficulty that arises from overlapping descriptions of macrophyte communities among habitat types. Water chemistry of the lake has a pH > 7, with records of up to 8.4, and alkalinity of up to 50 mg $CaCo_3$ l^{-1} and a naturally productive fish fauna (Kennedy and Fitzmaurice, 1971; Dept Agriculture and Fisheries, 1972). Vegetation is described as comprising abundant charophytes. Very high concentration of TP recorded in summer months suggests localised pollution sources, perhaps related to intense seasonal pressure. Some of the vegetation recorded in the lake could be in response to

nutrient enrichment. Sessiagh Lough illustrates very well the difficulty of fitting a site into the habitat description provided by the Habitats Directive and its supporting interpretation manual. The lake shows characteristics of hard oligo-mesotrpohic waters (code 3140) and a plant community that could be associated with nutrient enrichment. It does not fit easily into Habitat type 3110.
Another example of the difficulty of matching a site to code 3110 is Lough Yganavan and Lough Nambrackdarric SAC. Although the lake bottom comprises sand, this is likely derived from its coastal location, and the lake also has very brown waters, likely owing to the proximity of disturbed peat bog (see comments below on dystrophic lakes). No information on water chemistry appears available. Many species of macrophyte and emergent vegetation are also typical of habitat code 3130.

Similar, but likely less contentious, problems of sites conforming to habitat descriptions apply to lake codes 3130, 3140 and 3160. As is the case for Lough Yganavan and Lough Nambrackdarric SAC, many sites designated as 3110 could without much difficulty be placed under code 3130 (Oligotrophic to mesotrophic standing waters with vegetation of the *Littoretea* and/or the *Isoëto-Nanojuccetea*). This, however, is such a broad descriptor that almost all acid waters (ca pH < 7) that are not considered dystrophic could fit into this category. Five of the eleven categories of UK lakes identified by Duigan *et al.* (2006) on the basis of their vegetation could be within this category (representing 2777 lakes, or 74% of the UK JNCC dataset).

The dystrophic lakes (code 3160) do not provide respite from the problems of interpretation. The accepted wisdom, reiterated in the Habitat Directive description of sites, is that dystrophic lakes are associated with raised or blanket bogs, and are usually highly coloured owing to high concentration of humic substances derived from peat, and have low pH (< 6). A limnological description is that these lakes obtain their carbon mainly from allochtanous souces (Wetzel, 2001). The limited data that occurs in Ireland from upland lakes, and expected to be in blanket bogs, provides a weak relationship with water colour. Common understanding would, however, consider many of those lakes as typically dystrophic. Many relatively unimpacted lakes in upland areas surrounded by bog, may in fact have relatively low amounts of colour. High concentrations of colour might, rather, reflect catchment distrurbance through e.g. overgrazing or impacts of forestry.

The remaining category to disscuss is code 3140, Hard oligo-mesotrphic waters with benthic vegetation of *Chara spp.* While this is the obvious descriptor for marl lakes, with alkalinity greater than 100 mg $CaCO_3$ l^{-1}, whose vegetation is dominated by charophytes, some species of *Chara* and species of *Nitella* and *Najas* are common on lakes of much lower alkalinities. Additionally it is well demonstrated that with nutrient enrichment charophyte communities can be replaced with species of *Potamogeton*, *Myriophyllum* and others typical of more producutive waters (Moss 1983). It is very possible that, for example, Lough Dromore (which forms part of the Dromore Woods and Lake SAC) would be more appropriately described as a moderately enriched hard water lake than a natural eutrophic lake.

The designation of SAC sites with multiple lake types also creates difficulties in the reporting, management and monitoring of such sites. For example, the Ox Mountains Bogs SAC has been designated by NPWS for lake habitat types 3110 and 3160 but not type 3140 (hard oligo-mesotrophic waters). GIS indicates that this SAC contains some 140 mapped lakes and the modelling process, outlined in Section 5, concurs with the NPWS designation for the larger lakes in the SAC. However, a significant sub-set of 76 small lakes in the North West of the SAC are predicted to be type 3140. These occur on Dinantian Pure Bedded Limestone that is classified to very calcareous and karstified. Other SACs e.g. the Owenduff/Nephin Complex have been designated for similar lake habitats (3110 and 3130) but there is no information on which lakes within the SAC belong to each habitat type. Appropriate conservation measures cannot be implemented for lakes within such SAC sites until the lakes have been assigned to the appropriate habitat category.

During the SAC site selection process a number of non-governmental organisations raised concerns that an insufficient number of sites had been selected as candidate SACs to ensure the protection of Irish habitats and species. A group of five non-governmental organisations comprising An Taisce, BirdWatch Ireland, Coastwatch Ireland, Irish Peatland Conservation Council and the Irish Wildlife Trust produced a supplementary or ‘shadow list’ of SACs (Dwyer, 2000). This list included 11 additional lakes, seven oligotrophic to mesotrophic lakes with *Littorelletae* and four hard oligo-mesotrophic lakes with benthic vegetation of *Chara* spp (Appendix 6). The NPWS considered that the lakes on the shadow list were not appropriate for designation under the proposed habitats, although some (proposed under codes 3130 and 3140) were subsequently designated under code 3110. The NGO list of lakes proposed for habitat 3130 was based on consultation with EPA and the Char Conservation Trust while the list of sites proposed for habitat 3140 was based on consultation with EPA and reference to NHA descriptions produced by NPWS.

Some of the difficulties with assigning lake types as defined by the Habitats Directive likely arise from a history of insufficient resources allocated for field survey and consultation Curtis *et al.* (2005), in a review of the process of identifying Protected Areas under Article 6 of the WFD, observed that the NPWS list of water dependent habitats and species are derived from “best expert opinion” and was of the opinion that the criteria to identify protected sites lacked the specificity of the procedures in place in the UK and Northern Ireland. However, both the Republic of Ireland and N.Ireland referred to the WFD UK Technical Advosory Group to help develop their lists of water dependent habitats and species. It is also apparent that identifying water dependent habitats has been a challenging task, set against a background of insufficient baseline data. Improved and more widespread surveys would allow the identification of areas within SACs and SPAs that are water dependent. Curtis *et al.* (2005a) also identified the lack of quantitative information on water quality and quantity available for water dependent priority sites. An earlier report by O'Riain *et al.* (2003) on the criteria for identification of water dependent habitats, has been largely superseded by more recent developments.

3.5 Designating Lakes as Special Areas of Conservation for Annex II species

Lakes may be designated as SACs if they contain species listed in Annex II of the Habitats Directive. Only a small number of Annex II species are found in freshwater and occur in lakes in Ireland (Table 3.2). In order to select and designate appropriate lakes for these species the NPWS consulted relevant experts for each species. Most of the sites that are designated for Annex II freshwater species have also been designated for their Annex I lake, river or estuarine habitats. Of the 69 lake sites designated as SACs for Annex II freshwater species only two sites are not designated for their Annex 1 habitats. It is important to note that sites designated as SACs for other habitats e.g peatland sites may also have lakes within their boundaries.

Table 3.2. The number of sites designated for Annex II freshwater species which occur in lakes in Ireland.

Species	No of SACs	No of Lake SACs	No of lake SACs also designated for their Annex 1 habitats	Lake sites designated for Annex 2 species but not Annex 1 habitats
Alosa fallax (including *Allosa fallax killarnensis*)	5	1	1	0
Austropotamobius pallipes	13	9	8	Lough Nageage
Lutra lutra	46	22	22	0
Najas flexilis	24	24	23	Lough Dahybaun
Salmo salar	26	13	13	0

3.6 Conservation Measures for Lake SACs

The Habitats Directive requires all Member States to draw up measures to maintain or restore the status of designated habitats and species to a favourable status. The favourable conservation status for a natural habitat occurs when its natural range and the area it covers within that range are stable or increasing, the specific ecological structure and functions which are necessary for its long-term

maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.
Articles 6 and 11 of the Habitats Directive outline the conservation measures required to maintain or restore favourable status including establishing:

- appropriate steps to avoid the deterioration of natural habitats and the habitats of species as well as disturbance of the species in SACs;
- ‘if need be’ appropriate management plans; and
- surveillance of designated habitats and species

<u>Management Plans</u>
In Ireland the NPWS have drafted management plans for 52 SACs that are designated for their lake habitats. Public consultation is required before any SAC management plan can be finalized but only 3 SACs designated for lake habitats, Sessiagh Lough, Owenduff/Nephin complex and Templehouse and Cloonacleigha Loughs have gone to public consultation. Over 60% of the lake habitat SAC management plans have been in draft format for over 5 years and there is no timetable for their completion and publication. No management plans, in any format, are available for 12 of the 64 sites designated for Annex I lake habitats. The management plans for the some large SAC sites, which have been designated for several lake habitat types, do not identify which lakes have been designated for each habitat type. This is an omission of detail, hindering the capacity to develop a management plan or instigate appropriate monitoring. Some draft management management plans (e.g. Lough Yganavan and Lough Nambrackdarric SAC) appear to lack reference lists.

There is a risk that management plans can lack focus, and tend towards generalities. This is the case for freshwater habitats in the Management Plan for the Wicklow Mountains National Park (NPWS, 2005), where general policies are not followed by many specific proposed actions. The five year targets for maintenance of water quality comprises only one conservation action (to continue mitigation measures to mediate heavy metal input to Glendalough Upper Lake, although details of that mitigation are not provided). Protection of spawning beds for fish does have a specific action of removing debris from one section of a river and, in general, prohibit gravel removal from river beds. Management strategies for birds dependent on aquatic habitats comprises maintaining some nest boxes for, and monitoring annually, the Goosander population. No strategies are mentioned for management or protection of birds listed in Annex I of the Birds Directive dependent on aquatic habitats.

<u>Monitoring</u>

Monitoring is required for habitats and species listed in Annex I and II of the Habitats Directive. Although lake SACs in Ireland have been designated since 1998 there has been no systematic or scientific monitoring of them. For many lake SAC sites the most recent information on the status of the habitats are site notes recorded in 1993/4 when lakes were being selected as candidate SACs.
In recent years the NPWS has monitored other designated habitats e.g. peatlands and coastal habitats. Within NPWS the need to survey a wide range of habitats with very limited resources has necessitated the prioritisation of monitoring effort. The planning of lake habitat monitoring has been influenced by a number of factors, not least, the introduction of the WFD. The possibility that designated lakes would be monitored as part of the WFD lake monitoring programme may have contributed to a delay in establishing lake monitoring programme geared specifically to the needs of the Habitats Directive. Now that the details of the WFD lake monitoring programme have been agreed, it is apparent that WFD lake monitoring will not meet the needs of the Habitats Directive in relation to the required level of habitat surveillance (see Section 2.7) because the drive to establish monitoring is firmly embedded in trying to meet the normative definitions of the WFD, and based on traditional views and practices of the EPA water quality monitoring procedures. While there has been condiderable moves towards the philosophy that monitoring is there to assess ecological quality, there has not been the focus on how this also encapsulates the requirements of the Habitats Directive. Although NPWS has been involved in steering groups of a number of WFD related activities, it still appears that liaison among agencies can be further improved. If engagement among agencies is sub-optimal, the reasons for that need to be identified and acted upon.

Currently the only regular assessment of designated lake habitats (SAC, SPA & pNHA) is undertaken in the form of a site inspection report ever three years. The site inspection reports were introduced in 1998, at a time when few sites had been designated and boundaries agreed; which provided a delay to the implementation of site inspections. Following a three-year cycle, site inspections were submitted in 2001, 2003 and 2006 by NPWS regional staff. The report requires NPWS regional staff to visit each protected area and complete a report form (Appendix 7) if they observe any activities, which they believe, are having a negative impact on the site. The NPWS monitoring team, provides the regional staff with explanatory notes regarding the completion of the site inspection report (Appendix 8). The 2006 reports are not yet available, but it is noted that guidance produced by Lynn (2006) states clearly that even if “no change” in the condition of a site is noted, it is nevertheless “important to record these “No Change” visits, because at the end of the year, you will be asked to record how many times you visited each site. Even if there is “No Change”, this Site Inspection Report stands as a record of your having visited the site to make an inspection”. From the previous reporting cycles there were only 8 reports submitted in both 2001 and 2003 (Table 3.3) although all 64 SAC sites designated for lake habitats had apparently been inspected by regional staff. Information from the NPWS monitoring team shows that on average regional staff visited each SAC seven times each year in the period 2001-2003, yet few reports of damage to sites were recorded and transmitted to the monitoring team.

Biological and chemical data from lake SACs is collected by a range of bodies, including government agencies and NGOs. Dissemination of that information back to NPWS seems, at best, to be *ad hoc*. It would be highly beneficial if for each SAC there was a comprehensive and ongoing process of data collation. This is highly feasible, as there are extensive data collections for many of the SACs, but they tend to be disparate and scattered. NPWS, and indeed other government agencies, may wish to utilize the recently established Biological Records Centre as a central repository for all biological records. In a general way the increased monitoring of lakes that will occur under the WFD will provide much greater information that will be useful for the management of conservation interests. This should not, however, be seen as a substitute to meet obligations under the Habitats Directive, and structures need to be put in place to ensure that data is transferred to, and used, by the NPWS. Monitoring for conservation status should be designed to be "fit for purpose".

Table 3.3. Site inspection reports of activities on lake SACs in 2001 and 2003.

Year	SAC site code and name	Activity	Influence
2001	00007 – Lough Outer and Associated Loughs	Urbanised areas	Negative
2001	00014 – Ballyallia Lake	Infilling of ditches, ponds and marshes	Negative
2001	00093 – Caha mountain	Human induced hydraulic changes	Neutral
2001	00304 – Lough Rea	Landfill, reclamation	Negative
2001	01342 – Clonee and Inchiquin Loughs	Overgrazing by sheep Forestry Storage of materials Leisure fishing	Negative Negative Negative Neutral
2001	001879 - Glanmore Bog	Leisure fishing Management of water levels	Neutral Neutral
2001	002034 – Connemara Bog complex	Aquaculture Water pollution	Negative
2001	002122 - Wicklow mountains	Forestry planting	Negative
2003	000304 – Lough Rea	Industrial stockage	Negative
2003	002301 – River Finn	Storage of materials Improving access to site Sport and leisure structures	Negative Negative Negative
2003	001673 – Lough Arrow	Removal of dead/dying trees Felling of native or mixed woodland Industrail or commercial areas Other tourism and leisure impacts	Negative Negative Negative Negative
2003	001312 –Ross lake and woods	Removal of scrub Removal of sediments	Negative Negative
2003	001976 – Lough Gill	Landfill, reclamation Dumping Human induced hydraulic changes	Negative Negative Negative
2003	000440 – Lough Ree	Landfill, reclamation	Negative
2003	000623 – Ben Bulben, Glenariff, and Glenade	Landfill, reclamation Removal of undergrowth	Negative Negative
2003	000297 - Lough Corrib	Sport and leisure structures	Negative

3.7 Conclusion and Recommendations.

The review of past and current practice has highlighted a number of aspects where the process for designation, the production of management plans and monitoring of sites could be improved. These perceived difficulties likely reflect a system failure within NPWS stemming, in our opinion, from two fundamental shortcomings. First, the resources to implement the Habitat Directive appear to have been inadequate, such that lake sites were designated without proper initial survey or peer review, and monitoring has not occurred to a satisfactory level. Second, while containing staff of a high calibre, there is a general sense of demoralization and a perception of a lack of support and commitment at a higher political level. This creates an ethos where operations are not conducted with the rigor, or procedural discipline, required to meet the needs of a major environmental EU directive. Specific points identified are:

- Site designation was not supported by clear and well documented criteria, or peer review;

- Sites were designated without adequate vegetation survey, sometimes none;
- Sites designated as naturally eutrophic lakes may simply be moderately impacted ones, or reflect varying perceptions of understandingof the word *eutrophic*.
- A failure to identify characteristics of individual lakes in SACs with multiple lakes;
- A delay in the production of management plans and, hence, unambiguous conservation targets;
- An inadequate monitoring regime and ethos, lacking comprehensive reporting on all SACs
- Lack of formal procedures for follow-up action if impact is detected during site inspections; and
- An over-reliance on EPA monitoring of lakes, and an uncertainty in demarcating responsibility for future monitoring among agencies.

Recognising these, it is possible to identify recommendation for the future:

- A comprehensive collation of future and past information or, as required, commissioning of new surveys of vegetation, other biota, water chemistry and catchment features of lake SACs should be a priority activity;
- The need to establish a monitoring regime with clear criteria for assessment of conservation status, including the need for, and indicators of, restoration measures;
- Improved and formal liaison, including data exchange among agencies with an interest in ecological quality of SACs;
- A recognition that the targets for the WFD are not necessary synonymous with those of the Habitats Directive; and
- An improved reporting structure, including collation of Site Inspection Reports from sites visits even when no damaging actions observed.

4. Threats and Pressures

The lack of surveying and monitoring of freshwater lakes in Ireland limits the knowledge and assessment of pressures, which may be affecting these habitats. Sources that provide some indication of the pressures on lake habitats include national water quality reports, site assessments made when lakes were being selected for designation in the early 1990s and ongoing SAC site inspection reports compiled by NPWS staff.

The EPA water quality monitoring scheme has analysed water quality in a number of lakes since the 1970s. The national water quality reports have consistently stated that eutrophication is the principal pressure on lake water quality in Ireland (eg Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005). The state of the environment reports produced by the EPA includes an assessment of the impact of the main economic sectors on the environment in Ireland. The most recent report (EPA, 2004) indicates that economic prosperity has resulted in record levels of housing development and there are serious concerns for groundwater protection as a result individual on-site wastewater treatment, particularly in rural areas.

The selection and designation of 64 lake habitat SAC sites in the early 1990s included an assessment of activities impacting on each SAC. These assessments, contained in the Natura 2000 Standard Data Forms, indicate that overgrazing, fertilization, peat cutting, afforestation, and the presence of alien species were the principal activities having a negative affect on lakes. Other activities identified as negatively affecting some of the lakes included urbanisation, dispersed habitation, tourism, leisure fishing, and human induced hydraulic changes.

The site inspection reports from SACs in 2001 and 2003 (Table 3.3) added development of sport and leisure structures, improving access to sites, aquaculture and water pollution to those activities considered to impact negatively on some SAC lakes sites.

4.1 Eutrophication/ Nutrient enrichment

The input of nutrients at concentrations in excess of natural concentrations, commonly referred to as eutrophication, is, globally, probably the most widespread impact on freshwater systems. Eutrophication leads to a gradient of impact from minor and localised effects of increased plant production to extreme degradation of habitat: typified by very dense concentrations of phytoplankton, often dominated by Cyanobacteria (blue-green algae), resulting in a much reduced light penetration and loss of submerged aquatic plants; high authochtanous (internal) production leading to high sedimentation rates and reduced concentrations of dissolved oxygen; and dramatic alterations to invertebrate and fish communities. Eutrophication can diminish the aesthetic quality of lakes and their use for leisure and water abstraction.

Eutrophication has been recognized as the principal threat to the water quality of Irish lakes since the 1970s (Downey and Ní Uid, 1977; *An Foras Forbartha,* 1983), reiterated in all of the recent EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005). The EPA *Millennium* report (Stapleton *et al.,* 2000) highlighted the continuing degradation of many inland waters and estuaries. The most recent EPA report on water quality considered that 16% of the 492 lakes surveyed were *eutrophic* (following the modified OECD (1982) scheme as discussed in Section 2.4**)** as a result of excessive inputs of phosphorus, with estimates that over 70% of phosphorus reaching inland waters emanates from agricultural sources, with waste discharges from sewage treatment plants and septic tanks possibly the main problem for enrichment of some lakes (Toner *et al.,* 2005). Long term research by Teagasc estimates that more than three quarters of all the phosphorus applied to grasslands accumulates in the soil (Culleton *et al*., 2000), and it is well established that higher soil phosphorus concentrations increase the risk of phosphorus loss to water (Tunney *et al.,* 2000). Information collated from the NATURA 2000 Standard Data Forms (NPWS) which contain a record of the assessment in the early 1990s of the 64 sites later designated as SACs, indicated that 44% were negatively affected by fertilizer application. Fertiliser application outside the SAC boundary was recorded as having a negative impact on 48% of the lakes.

Information compiled by the Central Fisheries Board showed that over 15% of reported fish kills in 2005 were caused by eutrophication (Lucey, 2006). The disappearance of the Arctic Char (*Salvelinus alpinus*) populations in several lakes including Lough Neagh, Lough Owel, Lough Ennell, Lough Corrib, Lough Conn, Lough Inchiquin, Lickeen Lough, Gortglass Lough and Cloonsnachta Lough is believed to have been influenced by eutrophication (Igoe *et al.,* 2003). Collapse of trout (*Salmo trutta)* stocks in Loughs Ennell and Sheelin have been associated with eutrophication, which also impacted charophyte distribution in those lakes (Champ 1993). Annex II species *Najas flexilis* is vulnerable to, likely relatively minor, eutrophication (Preston and Croft, 1997).

4.1.1 Eutrophication trend

Recent EPA water quality reports (Bowman *et al*., 1996, Lucey *et al.,* 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) suggest that, overall, the long-term negative trend documented since the 1970s may be abating, although there is still a threat of continued degradation of the highest quality sites. Between 1971 and 1997 the EPA recorded a 40% decline of high-quality (Class A) river channel (Lucey *et al.,* 1999). The implementation of the Phosphorus Regulations (DELG, 1978), and the Water Framework Directive will increase the pressure to modify nutrient application practices. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is designed to provide a major contribution to improved water quality. While increased storage facilities should reduce the risk of nutrient loss form land to water, in the short term, derogations on N load for intensive farms and allowance to spread chemical fertiliser to within 1.5m from surface water bodies provides a continued risk of impact on lakes and rivers. Long term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water.

4.2 Overgrazing

The EPA report on water quality in Ireland from 1991-1994 highlighted overgrazing by sheep as a serious environmental problem (Bowman *et al.,* 1996). Assessment in the early 1990s of the 64 lakes later designated as SACs indicated that overgrazing was having a negative impact on 80% of sites. Overgrazing outside the SAC boundary was recorded as having a negative impact on 43% of the sites.

Under the EEC Council Directive 75/268/EEC on less favoured areas, sheep stocks in Ireland increased 250% between 1980 and 1990 (CSO 2006), mostly in the western uplands,. Environmental consequences include increased siltation, high bacterial counts, eutrophication, increased peat staining, reduced light penetration and alterations in the water balance of catchments. Overgrazed peatlands can loose up to 250t km^{-1} of peat, which is 5 times the amount that is lost from sites that are not subject to intense overgrazing (SRA 1994). Habitat degradation in lakes can affect flora and fauna, including protected salmonids, and reduce littoral production (SRA 1994). Runoff of sheep droppings into lakes in overgrazed areas was believed to have been a factor in the increased bacterial counts and eutrophication of lakes in remote catchments during the 1990s (Bowman *et al.,* 1996).

4.2.1 Overgrazing trend

In 1994 the EU-funded Rural Environmental Protection Scheme (REPS) for environmentally sensitive farming was introduced which included incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates.

Decreased livestock numbers in recent years have been brought about by the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare. In 2005 the total number of sheep (4.257 million) in Ireland had decreased by 16% from 2000 but this is still almost double the number (2.344 million) recorded in 1980 (CSO

2006). The negative impacts of overgrazing on a range of habitats, including lakes, will likely continue until there is a significant decrease in livestock, particularly sheep, numbers. It is important to note that even with a reduction in stock numbers the impacts of overgrazing on freshwater habitats are longterm and likely to persist for many years.

4.3 Afforestation

The selection and designation of 64 lake habitat SAC sites in the early 1990s included an assessment of activities impacting on each SAC. These assessments, contained in the Natura 2000 Standard Data Forms, indicated that forestry was having a negative impact on 46% of these lakes. Afforestation of the catchments surrounding dystrophic lake SACs was noted as having a negative impact on 90% of these lakes.

Ireland is one of the least afforested States in the EU and between 1904 and 1990 the State Forest Service undertook the majority of forestry planting. Since the 1990s and as a direct result of forestry grant schemes, jointly funded by the State and the EU, afforestation by private owners has greatly increased. Afforestation can impact on water quality through acidification, siltation, pesticide pollution, eutrophication and by altering catchment hydrology.

Acidification caused by afforestation is attributed to the ability of the crowns of mature trees to filter low levels of pollutants from the atmosphere, and also ion exchange processes occurring at the roots of the trees (Kelly-Quinn *et al.*, 1997). The acidity of water is an important factor affecting aquatic organisms. Some afforestation in Ireland has occurred on soils, including peatlands, which have a low potential to buffer the run-off water. This has resulted in increased acidity in lakes and rivers receiving the run-off water from the afforested areas and negatively affected aquatic species (Allott *et al.*, 1997, Kelly-Quinn *et al.*, 1997, McGarrigle *et al.,* 2002). Increased acidity of the run-off water from acid-sensitive catchments where afforestation has occurred has resulted in an adverse impact on the biology of these waters and the elimination of fish stocks in extreme cases (EPA 2004).

Concern that afforestation may contribute to eutrophication arises from the fact that plantations have often been established on soils that have a poor capacity to hold phosphorus. In Ireland, significant losses of phosphorus from peat soils as a result of forestry activities have been found (Cummins and Farrell, 2000, Farrell 2002). Further nutrients may be released and carried into lakes on soil particles as a result of erosion after clear-felling (EPA 2004). The planting, management and eventual harvesting of forestry plantations can all result in some degree of soil disturbance. Nutrients may be released from leaf litter mulch, having not only a general impact on freshwaters, but likely decimating Annex II species such as recently documented for *Margaritifera* (McGarrigle, EPA, pers com). Siltation can affect lake ecology e.g. fish spawning and foraging grounds can be damaged.

Negative impacts on river macroinvertebrates and salmonids, arising from sediment loss after clearfelling, have been documented by Giller *et al*. (2002). Studies in Ireland and Wales have indicated that afforestation can result in a loss of water resources from the catchment (Giller *et al*., 1997). Well designed drains for embankments and roads in afforested areas can mitigate erosion.

4.3.1 Afforestation trends

EU grant aid for private forestry, which is administered by the Forest Service of the Department of Agriculture and Food, is now withheld for some designated peatlands. NHAs may also be excluded if the proposed development is incompatible with their protection (McAree, 2002). All grant-aided development in Ireland must also conform to the Forest Service Forest biodiversity guidelines which set out measures to protect existing habitats and wildlife and to maximise the biodiversity of the forest. The Forest Service has also issued guidelines on forestry and water quality, which aim to address the issue of potential eutrophication (Forest Service 2000).

Coillte Teoranta, one of the major owners of peatland in the country, has ceased planting conifers on intact peatlands in its ownership, principally on economic grounds. Coillte has has initiated a *Raised Bog Restoration Project* that will result in the felling of coniferous plantations and drain blocking on some of their raised bogs.

The afforestation of designated peatland sites is officially declining but the current trend for un-designated sites is unknown. It is, however, very likely that the legacy of afforestration and imacts from future harvesting of trees will continue to have very negative effects on freshwater ecology.

4.4 Peat cutting

In Ireland peatlands, like lakes, are primarily located in the west, northwest and central lowlands. Peat has been used as a fuel source for over 400 years and was traditionally cut by hand. The introduction of the Turf Development Act (1981) provided funding for the purchase of turf-cutting machinery, the construction of turbary roads and this drainage of turf plots. This resulted in a decline in the practice of hand-cutting peat but intensified the mechanical harvesting of peat. Peat cutting and machine cutting in particular involve drainage and the removal of vegetation which can have a very damaging effect not just on the peatland habitat but on adjacent waterbodies including lakes. Increased drainage caused by peat cutting can result in siltation of freshwater habitats which can affect the resident flora and fauna. Increased acidity, owing to the transport of excess amounts of humic and fulvic acids with the peat silt, may impact on fish egg survival (Bowman *et al,*. 1996). Research on Cuilcagh Mountain in County Fermanagh has shown that machine cutting of peat can significantly increase the runoff of water from peatland habitats and alter the hydrology of the entire catchment (Gunn *et al.,* 1997).

Information, recorded in the NATURA 2000 Standard Data Forms, from an assessment in the early 1990s of 10 dystrophic lakes which were later designated as SACs, indicated that peat cutting was having a negative impact on all of these lakes. Peat cutting was also recorded as having a negative impact on 65% of the 41 sites with oligotrophic/mesotrophic lakes which were assessed.

4.4.1 Peat cutting trend

The Conservation Assessment Report for Active Raised bog (Habitat Code 7110) estimated a 36% habitat decline in the period 1994-2005 within 43.21% of the national resource of raised bogs known to support the habitat. Foss and O'Connell (1998) estimated that approximately 45% of the blanket bog habitat has been lost or severely damaged by peat extraction. All water bodies within the areas of peatland that have been converted to other land use or degraded can be assumed to be at high risk of degradation. The flooding of some cutaway bogs by *Bord na Mona* does not provide a substitution for natural habitat, although it clearly has value for aquatic communities and for migrant birds.

4.5 Alien species introduction

A number of non-native species have invaded or been introduced into freshwaters in Ireland and have adversely affected lake habitats and species. Introductions include fish, invertebrates and plants. Some introductions, such as pike (*Esox lucius*) can be traced back to the middle ages. The recent (probably mid 1990s) introduction of zebra mussels (*Dressiena polymorpha*) is impacting on the flora and fauna of freshwater lakes. The zebra mussel colonises surfaces including the surface of native mussels preventing them from filter feeding and, also through physical colonisation, can affect the spawning of fish that require gravely substrates. Extensive filtering of the water by zebra mussels can have widespread ecological impact and suppress the chlorophyll *a* : total phosphorus relationship, invalidating a lake monitoring scheme, as used by the EPA, based on maximum concentrations of chlorophyll *a.* Zebra mussels are found in some lake SACs.

A number of fish species have been introduced into Irish lakes and rivers. The introduction of the roach (*Rutilus rutilus*) has been implicated in the reduction of populations of several fish species through competitive superiority (Johannson & Persson, 1986). Native Atlantic salmon and brown trout *Salmo trutta* may be affected (Kennedy & Strange, 1978). Roach can also have severe ecological consequences, particularly when lakes become enriched. Their ability to reach a large biomass and heavily graze zooplankton can exacerbate the algal blooms associated with nutrient enrichment in lakes (Rosell 1994).

The white-clawed crayfish (*Austropotamobius pallipes)* is a protected species listed in Annex II of the Habitats Directive. It is the only crayfish species native to Britain and Ireland, and is considered a keystone species in Irish freshwater habitats (Matthews *et al*., 1993; Reynolds 1997). Since the 1970s, several non-indigenous crayfish species from North America have become established in Britain, and have introduced a fungal disease (*Aphanomyces astaci*) known as crayfish plague (Alderman & Wickins, 1996). While the North American species of crayfish are resistant to the fungal disease the white-clawed crayfish is susceptible. To date, there have been no reports of non-indigenous crayfish species in Irish lakes and rivers but a crayfish plague outbreak in the 1980s decimated crayfish populations in the Boyne and Inny catchments (Matthews and Reynolds, 1992). There have been sporadic reports of crayfish losses from other catchments in recent years (Lyons and Kelly-Quinn, 2003).

Non-native aquatic plant species such as *Lagarosiphon major* are also having a negative impact on lakes in Ireland. *Lagarosiphon major* originated in South Africa and is believed to have been accidentally introduced into Lough Corrib from garden ponds. This is a highly competitive, rapid colonizer that can displace native submergent plant species and form a dense surface-reaching canopy. *Lagarosiphon major* is now found in several bays in Lough Corrib and is spreading rapidly throughout the lake (J. Caffery pers.comm).

4.5.1 Alien species trend

A review of invasive species in Ireland concluded that the high frequency of traffic between Great Britain and Ireland and their close proximity renders each susceptible to detrimental species introductions from the other (Stokes *et al.,* 2004). Many of the invasive alien species which are negatively affecting freshwater habitats have been introduced in recent years and there is no reason to believe that further introductions will not occur. The recent introduction of chub (*Leuciscus cephalus*) to Ireland would indicate that freshwater habitats are under continued, and possibly increasing, risk from introduced species.

5. Classifying and Mapping Lake Habitats in Ireland

With limited information available on the trophic status and vegetation communities of Irish lakes an alternative system had to be employed to classify and map lake habitats in Ireland, and to estimate parameters used to evaluate conservation status. This involved a two-step modelling procedure. The first step allocated all lakes into one of four categories (3110, 3130, 3140 and 3160). Natural eutrophic lakes (category 3150) were excluded, following reasoning provided above in Section 3.4 that this category was rare or absent in Ireland. Lakes were allocated to a category based on probability of belonging to a lake type in an unimpacted landscape, thus providing a hypothetical baseline. The second step then provided an assessment of impact based on catchment nutrient loads and existing water chemistry data. It was inevitable that this provided a relatively crude approach, but one that was considered to be the most realistic and objective, given the limited duration of the project. Outputs from this modelling process were estimates of range, area and specific structures and functions, as required for reporting under Article 17 of the Habitats Directive. For lakes (and rivers) the range and area of overall habitat are effectively constant, as these are fixed in the landscape within the timescale of human memory and records. Range and area of the lake habitat types reflect, therefore, the potential distribution assuming no anthropogenic impact. Structure and function, including typical species, are modelled from estimates of catchment nutrient loads and available data, partitioned among the four lake categories. An overall "expert opinion" of the authors was used to modulate the modelling outputs. It is clearly indicated where this is the case.

5.1 GIS Background

To date the habitat classification set out in the Habitats Directive has not been systematically applied to the freshwaters in Ireland. An important objective of this project has thus been the collation and subsequent analysis of available data in an attempt to adequately apply the specified habitat classification to the lakes of Ireland.

Primary data collection was not within the scope of this project and, therefore, collation and subsequent analysis of data has been based on available information sourced from relevant organisations including NPWS (DEHLG), EPA, Geological Survey and Teagasc. Much of this information has been set up in recent times as GIS compatible datasets for the implementation of the WFD. The availability of this GIS information is of significant benefit to the assessment of freshwaters for the Habitats Directive.

The project has made extensive use of GIS analysis. In summary this has involved 3 main stages:

- Identification and location of the freshwater features (rivers & lakes);

- Extraction of existing or development of new metrics to facilitate classification of features into the specified Habitat types (in conjunction with statistical modelling); and
- Determination of Range and Distribution and other statistical summaries and maps of the Habitat types.

5.2 Lakes Datasets

The national dataset of lakes is derived from analysis of Ordnance Survey 1;50,000 digital mapping and contains some 12,206 features (Fig 2.1). These are recorded in the EPA national lake database and range in size from 166 km^2 to less than 1 hectare. Given that the current assessment of habitat types to provide a classification for the lakes in Ireland is limited in scope, it is not possible to extract such information directly from within existing databases. Rather adequate field survey information is only available for some 350 lakes. For the purposes of this study a comprehensive GIS based analysis has been carried out to determine a suite of landscape or catchment characteristics for all lakes to facilitate a statistical modelling approach that predicts, on a probabilistic basis, the habitat class of each lake. The details of this GIS analysis are set out hereunder. Development and application of the statistical model are set out in Section 5.5.

In the absence of field survey data to ascertain the lake habitat type of all lakes in Ireland this study has set out to predict the likely habitat type based on a statistical analysis of landscape, catchment and lake morphology variables. *A priori* it is not known which variables are most useful in such a classification method. Hence, a broad range of metrics have been derived from analysis of available GIS datasets – many of which are also widely used in WFD waterbody assessments – as input variables to the statistical modelling process.

In basic terms the suite of metrics can be divided into two groups – those that pertain to the lake and adjacent features and those that describe the broad catchment that provides drainage to the lake. Each group is described below.

5.3 Local Lake Metrics

The suite of 'local' metrics refers to descriptors that pertain to the lake feature itself or landscape and hydrographic features that are adjoint to the lake, i.e. immediately adjacent or connected to the lake.

5.3.1 Hydrography

The hydrography metrics pertain to descriptors of the lake features and associated river network. The national lakes database contains information on lake size and the stream order (Strahler) value of the river. Bathymetric information on depth profiles and depth ranges is very limited. This is an important omission in the available descriptors for the lakes and the understanding of residence times and other limnological processes.

The following additional metrics have been determined for the lakes:

- Number of lakes on the river network upstream of the lake;
- Aggregate surface area of the upstream lakes;
- Number of inflowing tributaries; and
- Number of lakes within 10km, 50km and 100km (inc. lakes in N. Ireland).

5.3.2 Adjacent Topography

In the absence of specific lake bathymetric information, topographic descriptors on the inflowing and outflow rivers have been determined as indicators of local terrain:

- Lake elevation;
- Mean gradient of inflow tributaries;
- Maximum gradient within subset of inflow tributaries;
- Minimum gradient within subset of inflow tributaries;
- Gradient of ‘mainstem’ inflow tributary (this can be determined when one of the inflow tributaries has a higher stream order (Strahler) value than the others); and
- Gradient of the outflow river.

5.3.3 Adjacent Landcover

Landcover has been determined by reference to the Corine Landcover (2000) database developed by EPA. Adjacent landcover is determined as the landcover value of polygons in the Corine database that directly adjoin the lake (Note that Corine does not record (lake) features with an area < 25 ha – in these instance the Corine database is queried against the polygon feature in the national lakes database). The metric for the adjacent landcover test is recorded as a boolean type ‘yes/no’ value for specified landcover classes:

- Lake is recorded in Corine database – yes / no;
- Adjacent peat landcover classes – yes/no;
- Adjacent upland bog (peat subclass) – yes/no;
- Adjacent exploited bog (peat subclass) – yes/no;
- Adjacent urban class – yes/no;
- Adjacent conifer forestry class – yes/no;
- Adjacent arable class – yes/no; and
- Adjacent urban green (sports fields/ green urban areas) – yes/no.

5.3.4 Protected Area Designations

Under existing legislation areas of land are designated as SACs , SPAs and NHAs. GIS datasets of the boundaries of these features are maintained by NPWS.

Within each SAC, SPA and NHA an analysis has been undertaken against the national lakes database. Ergo for each lake in the national dataset the relevant SAC, SPA and/or NHA designation codes have been recorded.

5.3.5 Surveys

A subset of the national lakes database have been included in surveys and monitoring programmes. Of particular interest to the Habitats Directive classification are surveys of macrophytic plants. Descriptors have been added to the national lakes database as to their inclusion, where known, in surveys carried out by the EPA, CFB and NPWS (Heuff, 1984).

In addition the Lakes Monitoring programme for the WFD has been published. This identifies some 226 lakes within the Operational and Surveillance (subset of 73) monitoring programme. Descriptors have been added to the national lakes database to identify the lakes in the current WFD programme.

5.4 Lake Catchment Descriptors

In addition to the 'local' or 'adjoint' descriptors, analyses have been performed to derive descriptors averaged across the lake catchments. Such catchments are defined as polygons and have been derived from the EPA WFD Digital Terrain Model by other studies.

Forms of catchment used to represent lake drainage areas are:

- specific lake catchment polygons. Where available these were used, but only exist for ~350 lakes in the national dataset to date;
- 'proxy' river catchment polygons. Where lake specific catchment polygons do not yet exist proxy forms have been utilised. In most instances these are catchments to river confluences downstream of the lakes. Some 21,000 such river catchment polygons are recorded in the EPA GIS. In many instances these river catchments are at the end of the river segment that acts as the lake outflow and are adjacent to the lake. In other instances the available river catchments are further downstream and are less accurate proxies of the lake catchments area (In each instance the distance between the lake outflow and confluence point with a catchment polygon has been recorded);
- coastal zone polygons. Some lakes occur in small coastal areas that are not drained by rivers with mapped catchments. However, these coastal areas are recorded in the EPA WFD GIS and their polygon extents have been used as proxy lake catchments; and

- Some lakes occur on small first order streams that are side tributaries of larger rivers. No catchments have been derived for these rivers nor are representative downstream catchments available. Lakes on such streams together with a subset of lakes on small islands were excluded from the analysis and modelling.

5.4.1 Catchment Landcover

Lake catchment landcover is analysed on the basis of the EU Corine Landcover (EPA, 2000) dataset. This contains some 41 discrete terrestrial landcover classes, several of which are subdivisions of higher level classes. The percentage of each landcover class in the assigned catchment of each lake in the model was determined.

5.4.2 Catchment Topography

Lake catchment topography has been assessed using the national EPA WFD Digital Terrain Model (Preston and Mills 2001). Catchment topographic variables derived are mean elevation and mean slope (slope measured as percent slope).

5.4.3 Catchment Geology

Lake catchment geology has been assessed by reference to the Geological Survey of Ireland national Rock Unit dataset. This contains some 30 Rock Units that for functional analyses have been grouped by GSI into aquifer classes and calcareous water chemistry classes.

The aquifer classes comprise:

- Karstic;
- Productive Fissured;
- Poorly Productive; and
- Sand & Gravels.

The calcareous water chemistry classes comprise:

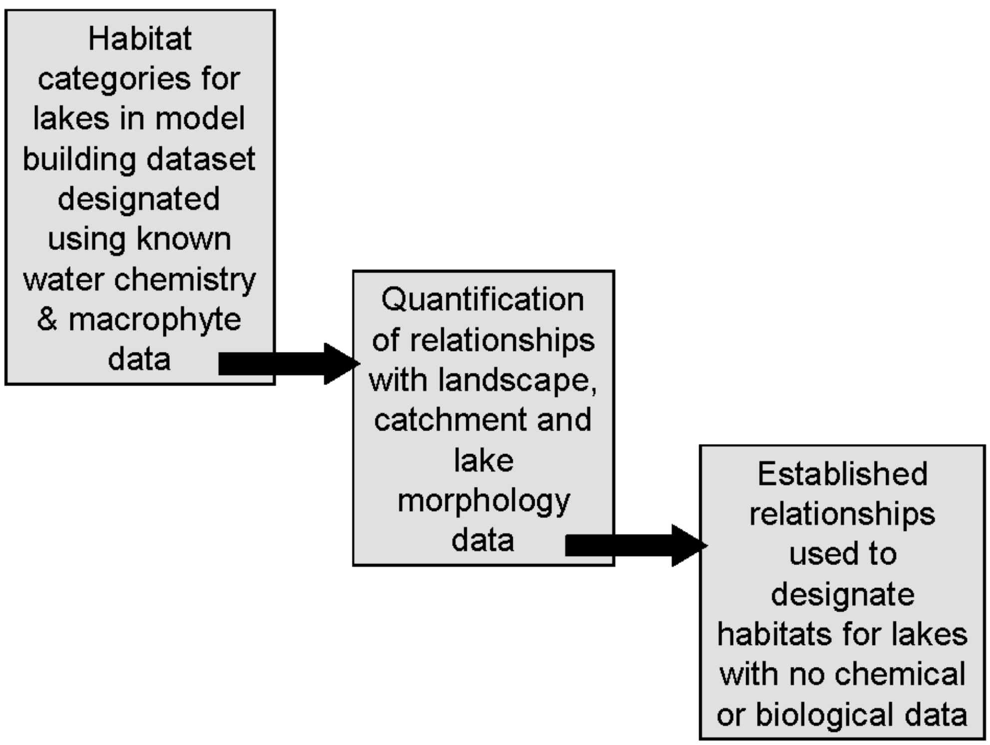
- Very Calcareous;
- Moderately Calcareous;
- Non Calcareous;

The complete set of GIS metrics derived during the GIS analysis can be provided for inclusion in the NPWS GIS.

5.5 Methods for Classifying Lakes

The probability a lake belongs to a particular habitat type described in the Habitats Directive was modelled using landscape, catchment and lake morphology data with forward stepwise binary logistic regression, using logit transformations (Fig. 5.1). All lakes were assumed *a priori* to fall into one habitat category. Models were constructed using catchment and mean water chemical data from 351 lakes contained in the database collated by TCD for the EU-INTERREG-funded NS-Share project. In addition, macrophyte data from 125 lakes, which were collected by the EPA, were used to model oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*). The effectiveness of the models is thus constrained by the types and representativity of lakes contained in the model-building database, which comprises particularly few dystrophic, upland or coastal lakes, and by the use of water chemical and macrophyte data only to designate lakes in the first instance.

Fig. 5.1. Description of the modelling process used to designate lakes to habitat types.



All models described here used a probability threshold of 0.5 for designation to a particular habitat category and take the form:

$$\text{Logit}(p) = \ln\left(\frac{p}{1-p}\right) = a + B_1 x_1 + \ldots + B_k x_k$$

Where p comprises the probability of a lake belonging to a particular habitat category, x comprises the kth independent variable incorporated in the model, and the regression coefficients a and B, which were estimated using maximum likelihood, comprise the intercept (constant) and slope of the regression line. The differing numbers of lakes with chemical, catchment and macrophyte data necessitated the development of independent models for predicting each habitat type separately.

No attempt was made to model the locations of natural eutrophic lakes as there is currently no convincing evidence to support the existence of this habitat type in Ireland. This remains an open-question that further analysis of existing palaeolimnological data may help resolve. Natural background levels of phosphorus in Irish groundwaters have, however, been found to be far below the threshold for maintaining eutrophic conditions (O'Callaghan Moran & Associates 2007).

5.5.1. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)

Hard water lakes were defined *a priori* in the model-building dataset as lakes with mean alkalinity >100 mg $CaCO_3$ L^{-1}, in agreement with the definition of high alkalinity lakes in Ireland under the typology adopted for implementing the Water Framework Directive. A highly significant logistic regression model (χ^2 = 218, *df* = 3, $p \leq 0.0001$; Table 5.1) relating landscape composition to the probability of lakes being of high alkalinity was constructed. The model (pseudo r^2 (Nagelkerke) = 0.72) incorporates the percentage of both very calcareous bedrock and karstic bedrock in the catchment as independent variables. Hosmer–Lemeshow goodness-of-fit tests found no significant differences between observed and expected frequencies (χ^2 = 13.01, *df* = 8, *p* = 0.11). The model designated high alkalinity lakes in the model-building dataset correctly 92.2% of the time.

Table 5.1. Regression coefficients (*B* ± s.e.), Wald statistics, degrees of freedom (*df*) and statistical significance (*p*) of the variables included in the logistic regression model for hard water lakes.

Variables included	***B* ± s.e.**	**Wald**	***df***	***P***
% Very calcareous	0.031 ± 0.006	27.12	1	≤0.0001
% Acidic subsoils	0.033 ± 0.006	4.46	1	0.035
% Basic subsoils	0.08 ± 0.01	16.11	1	≤0.0001
Constant	-5.818 ± 1.254	21.52	1	≤0.0001

5.5.2 Oligotrophic waters containing very few minerals of sandy plains (3110)

This waterbody type comprises lakes that are generally acidic and low in nutrients. In designating Irish lakes to this habitat type, we follow the description made by the UK Joint Nature Conservation Committee (JNCC) for lakes in this category, being characterised by the presence of *Lobelia dortmanna*, *Littorella uniflora*, or *Isoetes lacustris*. We found that the number of these species found in a lake was associated highly significantly, and inversely, with pH (ANOVA; $F_{3,122}$ = 42.17,

$p \leq 0.0001$). There was, however, no difference between lakes in which just two or all three of these species were found (Scheffé *post-hoc* test; $p = 0.99$). We, therefore, designated lakes in our model-building dataset as belonging to this habitat type if two or more of these characteristic species were found there. The difficulty in assigning this category, as described above in Section 3.4 is, however, noted.

The binary logistic regression model relating lakes of this habitat type to catchment characteristics was highly significant ($\chi^2 = 81.36$, $df = 4$, $p \leq 0.0001$; Table 5.2). The model (pseudo r^2 (Nagelkerke) = 0.78) incorporates the minimum inflow gradient, mean catchment slope and the percentage of both non-calcareous bedrock and peat bog in the catchment as independent variables. Hosmer–Lemeshow goodness-of-fit tests found no significant differences between observed and expected frequencies ($\chi^2 = 5.7$, $df = 8$, $p = 0.68$). The model designated lakes in the model-building dataset to this habitat type correctly 87.1% of the time.

Table 5.2. Regression coefficients (B ± s.e.), Wald statistics, degrees of freedom (df) and statistical significance (p) of the variables included in the logistic regression model for oligotrophic lakes containing very few minerals of sandy plains.

Variables included	***B* ± s.e.**	**Wald**	***df***	***P***
Minimum inflow gradient	-31.738 ± 14.19	5	1	0.025
Mean catchment slope	0.114 ± 0.05	4.41	1	0.036
%Non-calcareous bedrock	0.036 ± 0.02	4.62	1	0.032
%Peat bog	0.045 ± 0.02	6.5	1	0.011
Constant	-5.704 ± 1.48	14.86	1	≤0.0001

5.5.3 Natural dystrophic lakes and ponds (3160)

Owing to a low number of highly coloured lakes in the model-building dataset (range = 0-417 PtCo), which reduces the potential to make a robust and representative model, we defined lakes as dystrophic if their colour was ≥100 PtCo (25 out of 351 lakes), which could be interpreted as a relatively liberal figure. A highly significant logistic regression model ($\chi^2 = 27.41$, $df = 4$, $p \leq 0.0001$) was constructed which incorporated lake surface area, mean catchment slope and the percentage of raised bog and poorly productive bedrock aquifer in the catchment (Table 5.3). Hosmer–Lemeshow goodness-of-fit tests found no significant differences between observed and expected frequencies ($\chi^2 = 4.3$, $df = 8$, $p = 0.83$). Although the model designated lakes in the model-building dataset as dystrophic or non-dystrophic correctly 93.2% of the time, it accounted for a relatively low proportion of variability in the dependent variable (pseudo r^2 (Nagelkerke) = 0.19). The high prediction success was owing to high conservatism in the model, which designated 100% of the non-dystrophic lakes correctly. Only 4% of lakes we defined, albeit liberally, as dystrophic were, however, classified correctly as dystrophic by the model. Reduction of the colour threshold of 100 PtCo would, however, increase the likelihood that non-dystrophic lowland lakes with coloured waters would be defined as dystrophic, thus decreasing the robustness of the model still further. Owing largely to the incorporation of mean catchment slope and the percentage of raised bog in the catchment into the model, predicted dystrophic lakes were largely restricted to lower altitudes. Of the 9 lakes in the model-building dataset that are located above 300 m above sea level, however, not one had colour >100 PtCo. In addition, 6 of these lakes have catchments comprised entirely of upland and mountain bog, with the overall mean for the 9 lakes being 88% coverage of upland and mountain bog. This suggests strongly that lakes in upland areas surrounded entirely by peat bogs are not necessarily highly coloured or dystrophic. Robust modelling of naturally dystrophic upland lakes is, however, not possible at present owing to a lack of data. The model described here, therefore, remains biased against designating lakes in upland areas as naturally dystrophic. A decision was therefore taken to map the distribution of this habitat based on the range of peatlands in Ireland.

Table 5.3. Regression coefficients (B ± s.e.), Wald statistics, degrees of freedom (df) and statistical significance (p) of the variables included in the logistic regression model for dystrophic lakes.

Variables included	B ± s.e.	Wald	df	P
Log lake surface area (ha)	-0.717 ± 0.32	4.97	1	0.026
%Raised bog	0.048 ± 0.03	2.47	1	0.12
%Poorly productive bedrock	0.031 ± 0.01	5.3	1	0.021
Mean catchment slope	-0.085 ± 0.04	4.68	1	0.03
Constant	-3.734 ± 1.39	7.26	1	0.007

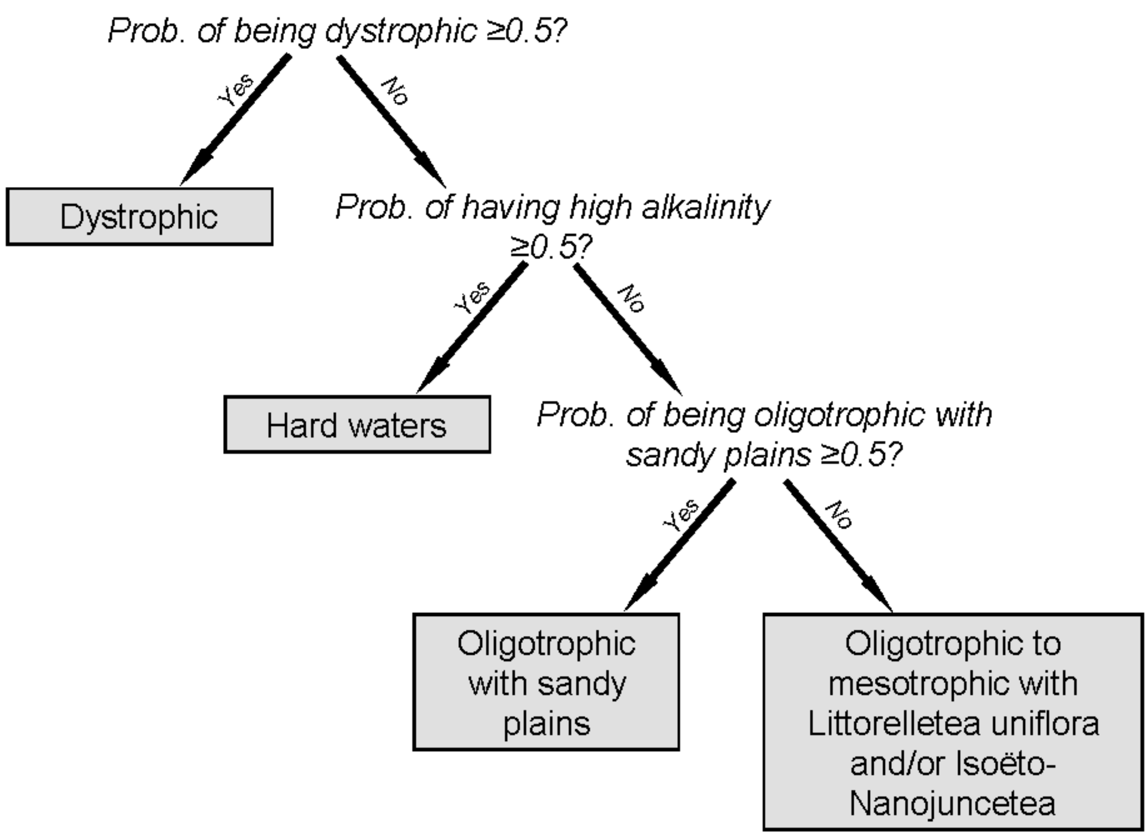
5.5.4 Oligotrophic to mesotrophic standing waters (3130)

All lakes that were not designated as high alkalinity, oligotrophic waters with sandy plains or dystrophic (32.4% of all lakes) were classified as being oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*.

5.6 Lake Classification

Lakes were assigned to specific habitat categories if their modelled probability of belonging to that habitat was ≥0.5. As the models for each habitat type were created independently, however, owing to variable data availability, it was possible for lakes to be designated as belonging to more than one habitat type. This only occurred, however, for 5% of lakes. In those cases where more than one habitat was designated, lake classification followed the decision tree illustrated in Fig. 5.2.

Fig. 5.2. Decision tree for classification of lakes where more than one habitat type was designated.



Although the JNCC characterise Habitat 3110 (Oligotrophic waters containing very few minerals of sandy plains) by the presence of *Lobelia dortmanna*, *Littorella uniflora*, or *Isoetes lacustris*, and these species were used here to designate lakes to this habitat, all three species were also identified as being characteristic of Habitat 3130 (Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*). Effective designation of lakes to Habitat 3110 requires, therefore, habitat survey data, in addition to geological, chemical and macrophyte data, which was not available. Furthermore, this habitat is described by JNNC as being very scarce in the UK. For these reasons, it has not proved possible to distinguish between Habitats 3110 and 3130 using water chemistry, macrophyte, landscape, catchment and lake morphology data, and lakes designated to both habitats have been grouped together for the remainder of this project.

5.7 Lake Modelling Results

The national lakes dataset (EPA) contains 12,206 lakes and 11,923 of these lakes were included in the habitat modelling analysis. A small number have been excluded as they are brackish (classified as Transitional Waters for the WFD) or do not have adequate catchment related information.

Summary statistics on the assignment though modelling of the lakes into the Habitat's Directive habitat types is shown in Table 5.1.

Table 5.1 Number, area and range of lake habitats as estimated using modelling process described in Section 5

Statistic	**3110 + 3130**	**3140**	**3160**
Lake Count	7730	3467	726
% of count	64.83	29.08	6.09
Habitat Area km^2	678.33	595.12	2.16
% Habitat Area	53.18	46.66	0.16
Range km^2	64,700	41,300	17,200
Clusters *	1	5	8
Grid Area km^2 **	54,300	33,800	11,300

* Clusters - groups of lakes separated by >= 2 grid cells (20km)
** Grid area - 10 x 10 km^2 in range containing lakes of specific habitat type

The modelling study indicates a common occurrence of local variation of lake habitat types within more generalised regional trends. These arise from local variation in geology or other factors. Given that field sampling has been limited to date, existing knowledge may not identify such local patterns.

6. Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)

The interpretation manual of EU habitats describes this habitat as shallow oligotrophic waters with few minerals and base poor, with an aquatic to amphibious low perennial vegetation belonging to the *Littorelletalia uniflorae* order, on oligotrophic soils of lake and pond banks (sometimes on peaty soils). This vegetation consists of one or more zones, dominated by *Littorella*, *Lobelia dortmana* or *Isoetes,* although not all zones may not be found at a given site. It is noted that a number of characteristic plants from the same phytosociological order are also found in Habitat type 3130.

In NPWS the classification and selection of lake habitats, in accordance with the Habitats Directive, was primarily based on vegetation communities. In the absence of any comprehensive survey of lakes the information available to NPWS when selecting and designating lake sites was extremely limited. The overlap between the vegetation communities associated with lake habitats 3110 and 3130 did not allow for a clear distinction between the two habitats. On the understanding that outside the Continental and Alpine regions lake type 3130 occurred in mountain areas, and in the UK it occurred particularly in high altitude lakes, NPWS decided that lake type 3130 was confined to mountains areas and that all other lowland oligotrophic lakes with *Littorelletea* vegetations would be classified as lake type 3110. This position was only modified in relation to Lough Melvin SAC, a cross-Border site, which had been classified as lake type 3130 by the Environment and Heritage Service in Northern Ireland.

Habitat type 3110 is considered rare throughout the Atlantic Biogeographic Region of Europe (Jackson & McLeod, 2000), and there is a high probability of misclassification of sites designated for this habitat type in Ireland owing to the limited extent of initial vegetation survey and supporting geological information (see Section 3.4).

6.1 Habitat Mapping [1]

There is limited information on the vegetation communities and trophic status of lakes Irish and therefore a two-step modelling process, as outlined in Section 5, was used to classify and map oligotrophic lakes of sandy soils (3110). <u>The modelling process was not able to distinguish between lake types 3110 and 3130 using the available water chemistry, macrophyte, landscape, catchment</u>

1 Some changes were made to the original file submitted by the consultant related to habitats classification (i.e. results_ 200607). These changes are illustrated in an additional field named NPWS–changes within the 3110_3130_lwseg_0207.shp shape file: Lakes IE_NW_38_59 (Kinny Lough), IE_NW_38_678 (Sannagh Lough or Magheradrumman) both part of SAC 1975 (Ballyhoorisky Point) were originally classed as 3110/3130 however are deemed to correspond to habitat 3140.

and lake morphology data and therefore range, area, and structure and function information provided in this section is for the lake types 3110 and 3130 combined.

6.2 Habitat Range

The use of range and area values to assess the conservation status of habitats was initially devised for terrestrial habitats and may not be particularly appropriate for aquatic habitats. Reporting on the Habitats Directive under Article 17 requires the provision of range and area values for all Annex 1 habitats including lakes and rivers. The *Interpretation Manual of European Union Habitats* provides guidelines for determining the range of terrestrial habitats but NPWS have advised that the EU interpretation of range, for aquatic habitats including lakes, is related to the area occupied by the waterbody. The range of aquatic habitats is unaffected by ecological changes within the habitat e.g. changes in trophic status do not affect the range or area of a lake type assuming the lake area remains unchanged. If this is the correct interpretation then the range value for lake habitats is simply an indication of the presence of a waterbody and therefore should not be used to assess the conservation status of the habitat. However, since NPWS require a range value for reporting purposes this project has used the modelling process described in Section 5 to obtain a range value for lake type 3110*. *Since the modelling process described in Section 5 was unable to separate lake types 3110 and 3130 the range value below are for lake types 3110 and 3130 combined)

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission, 2006) a preliminary range for the combined lake habitats 3110 and 3130 was established by drawing the shortest continuous boundary to encompass all known sites. "Small gaps in the distribution are considered as part of the range but larger gaps (40-50 km) are considered as breaks in the range" (European Commission, 2006). NPWS have advised that distances of 20km are sufficient to justify a break in range for freshwater habitats in Ireland. A national map showing the combined distribution of the lake habitats 3110 and 3130 on a 10 x 10 km^2 square grid was produced in a GIS format. The combined range for lake habitat 3110 and 3130 was therefore determined using the number of 10 x 10 km^2 grid squares containing lakes identified as habitat types 3110 and 3130 by the modelling process and excluding all grids > 20km which did not contain 3110 or 3130 lakes (Fig. 6.1). This range was found to be 64,700km^2.

The Favourable Reference Range of any habitat is defined as the range within which all significant ecological variations of the habitat are included for a given biogeographical region and which is sufficiently large to allow for the long term survival of the habitat (European Commission, 2006). The parameters which have been used to model and estimate the overall habitat range are those which the European Commission (2006) advise can be used to determine the Favourable Reference Range. The range which has been developed in this project, using the modelling described in Section 5, has provided an estimate of the Favourable Reference Range for oligotrophic lakes of sandy soils (3110 and 3130) which may not be synonymous with the current range of this habitat in Ireland. A comprehensive survey of lakes in Ireland is needed to distinguish between lake types 3110 and 3130 and to provide information on the current range of each habitat.

6.2.1 Conservation Status of Range

Following the guidance provided in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission 2006) the assessment of the conservation status of the habitat range can be established by assessing the variation in the habitat range in the reporting period. As outlined in Section 6.2 it appears that the EU interpretation of range for aquatic habitats is related to the area occupied by the habitat type and is unaffected by ecological changes within the habitat. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The combined range of lake habitats 3110 and 3130 is therefore regarded as Favourable - Stable.

6.3 Habitat Area

As outlined in Section 6.2 the use of range and area values to assess the conservation status of habitats was may not be particularly appropriate for aquatic habitats but are required by NPWS to comply with the reporting mechanism for the Habitats Directive.

The combined area of oligotrophic lakes of sandy soils (3110) and oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae* (3130) has been established, using a two-step modelling process as outlined in Section 5, and a national map showing the distribution was produced in a GIS format (Fig 6.1). The combined area of lake types 3110 and 3130 was determined using the area occupied by lakes identified as habitat type 3110 and 3130 by the modelling process and was found to be = 678km^2.

The Favourable Reference Area of any habitat is defined as the total surface area in a given biogeographical region considered the minimum necessary to ensure the long term viability of the habitat type (EU 2006). As with the determination of range, the habitat area that has been estimated in this project (678km^2) could be more accurately described as the Favourable Reference Area as it is based on landscape, catchment and lake morphology. A comprehensive survey of lakes in Ireland is needed to provide the information on the current area of lake habitats 3110 and 3130.

6.3.1 Conservation Status of Habitat Area

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) the assessment of the conservation status of the habitat area can be established by assessing the variation in the habitat extent in the reporting period. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The combined area of lake habitats 3110 and 3130 is therefore regarded as Favourable - Stable.

6.4 Structures and Functions

The structure and functions of all lake habitats are affected by a number of factors including lake morphology, geology, water quality and a range of anthropogenic pressures. The influence of such factors on particular lake habitats e.g. oligotrophic lakes of sandy soils (3110) have, to date, not been investigated. Utilising information developed in accordance with the WFD, an assessment of the water quality of lake types 3110 and 3130 provided an indication of the status of the structures and functions of these habitats.

Analyses of the overall pressures on water bodies, including lakes, was a requirement of WFD characterization process (EPA 2005) and in Ireland four categories of risk were developed:

1a – Water bodies at significant risk;
1b – Water bodies probably at significant risk;
2a - Water bodies probably not at significant risk; and
2b - Water bodies not at significant risk;

All lakes in the WFD network (Table 2.5) were assessed and placed into one of the four categories. The four categories are based on overall risk and do not distinguish between the different pressures which may effect a lake e.g. point and diffuse pollution, abstraction, morphology.

In order to establish what proportion of lake types 3110 and 3130 are at risk, the lakes in the WFD network were classified using the modelling process described in Section 5. A small number of lakes (29) were excluded from this modelling exercise because they are brackish and therefore classified as transitional waters. Of the lakes modeled (776) a total of 624 were identified as lake types 3110 and 3130 (Table 6.1)

Table 6.1 Risk assessment of lake types 3110 and 3130 in the WFD network of lakes

Category of risk	No of lakes	Area (km^2)	Area %
1a	134	124	32
1b	71	124	32
2a	88	80	21

2b	331	58	15

Lakes at significant risk and those probably at significant risk accounted for 64% of the total area (384 km^2) occupied by 3110 and 3130 lakes in the WFD network. Although lakes less than 1ha are not included in the WFD network, the area of lake types 3110 and 3130 included in the WFD network and assessed for risk (384km^2), accounts for 57% of the total habitat area (678km^2).

Lakes identified "at risk" are those that are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. It includes lakes known to have deteriorated in water quality, impacting negatively on structures and functions.

6.4.1 Conservation Status of Structures and Functions

Risk assessment reveals that 64% of the total area of lake types 3110 and 3130, in the WFD network of lakes, are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. The structures and functions of these lakes will be negatively affected and therefore the conservation status of the habitat structures and functions is deemed to be Unfavourable Bad.

6.4.2 Typical Species

The plants that are typically associated with oligotrophic lakes of sandy soils (3110) include *Isoetes lacustris*, *I. echinospora*, *Littorella uniflora*, *Lobelia dortmanna*, *Deschampsia setacea*, *Subularia aquatica*, *Juncus bulbosus*, *Pilularia globulifera*, *Luronium natans*, and *Potamogeton polygonifolius*

In Ireland the information currently available on lake flora and fauna has primarily been collected by the EPA, CFB and various research bodies, who have not utilized the Habitats Directive classification of lake habitats. Analysing the data collected from a variety of sources to identify the typical species associated with each of the lake habitats listed in the Habitats Directive is beyond the scope of this project. Therefore it is not possible to list any additional species, which may be typical of oligotrophic lakes of sandy plains (3110) in Ireland.

6.4.3 Conservation Status of Typical Species

In the absence of a monitoring programme the relevant information regarding typical species associated with this habitat is not available. Therefore the conservation status of typical species of oligotrophic lakes of sandy soils (3110) is unknown.

6.5 Main Pressures

The EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to lake water quality in Ireland. The selection and subsequent designation of 32 SACs for oligotrophic lakes of sandy plains (3110) in the early 1990s included an assessment of activities impacting on each SAC. The information in these assessments, contained in the NATURA 2000 standard data forms, indicate that the following pressures were negatively affecting oligotrophic lakes of sandy soils:

120 – Fertilisation;

140 – Grazing;

160 – Forestry;

180 – Burning;

220 – Leisure fishing;

230 – Hunting;

310 – Peat extraction;

403 – Dispersed habitation

420 - Discharges;

600 – Sport and leisure structures

700 – Pollution;

810 – Drainage;

900 – Erosion; and

954 – Invasive species.

Information from the Site Inspection reports (Table 3.3) indicates additional pressures on some lakes from the development of sport and leisure structures and the management of water levels.

6.6 Threats

The principal threats to oligotrophic lakes of sandy soils, as outlined in Section 4, include eutrophication, agricultural practices including overgrazing and excessive fertilization, afforestation and the introduction of invasive alien species. Waterbodies may be negatively affected by increased housing developments in rural areas and the associated wastewater treatments but it is difficult to quantify the risks associated with this. The utilization of lakes for an increasing number of sport and leisure activities may also impact on lake habitats.

6.7 Future Prospects

6.7.1 Negative Future Prospects

All the EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to water quality in Ireland.

Despite increased public awareness, resources and legislation in the last twenty years to improve lake water quality, the percentage of lakes considered to be in satisfactory condition has increased by only 4% between 1986 and 2005 (Fig 2.2). While incentives and legislation have been introduced to reduce the risk of excessive nutrient loading to freshwater bodies, the long term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water. The risk assessment of lakes has also indicated that 64% of the area of 3110 and 3130 lakes, within the WFD network, are currently at risk from a range of pressures.

The decline of peatland habitats in the west of Ireland is also likely to have a negative impact on oligotrophic lakes of sandy plains (3110). The degredation of blanket bog habitat will impact on all water bodies within and surrounding the areas of peatland. Continued afforestation of non-designated peatlands and the introduction of non-native species may also affect the future prospects of oligotrophic lakes.

6.7.2 Positive Future Prospects

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a lake typology (see Table 2.5), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish. Monitoring of water chemistry and hydromological change are also required but are stipulated as supporting, rather than driving, ecological assessment. The WFD requires "good water status" and/or "good ecological status" for lakes by 2015, to be achieved through integrated catchment management. Risk assessments for lakes to establish those at risk were required under the WFD and highlighted areas where lakes are under significant threat from pollution. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is also designed to provide a major contribution to improved water quality.

In 1998 the Government introduced the Water Quality Standards for Phosphorus Regulations, to reduce the level of pollution from phosphorus. The Regulations require that water quality in lakes be maintained or improved by reference to the biological trophic status assigned by the EPA in the 1995-97 review period or at the first occasion thereafter.

The Rural Environmental Protection Scheme (REPS), introduced in 1994, may reduce the impact of agricultural activities, especially overgrazing, on freshwater habitats. The EU-funded REPS includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with over grazing on lakes.

A reduction in livestock numbers is likely as a result of the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare. In 2006 the NPWS introduced the National Farm Plan Scheme (NFPS), which compensates landowners for losses incurred through restrictions caused by the designation of lands as SAC or SPA. The owners of designated lands can also receive payment for undertaking certain actions, which are of benefit to nature and are agreed in a farm plan. The implementation of the NFPS should reduce damage caused by agricultural activities to lakes within designated sites.

6.7.3 Conservation Status of Future Prospects

Incentives and legislation have been introduced in recent years to reduce the negative pressures on freshwater habitats but information from the EPA water quality assessments indicate that lakes are still under threat. There is little evidence of a significant decline in the primarily pressures of eutrophication, overgrazing, excessive fertilization, afforestation and the introduction of invasive alien species. A large proportion (64%) of the oligotrophic to mesotrophic within the WFD network are at risk and therefore the long term viability of this habitat cannot be assured. The conservation status of the future prospects of oligotrophic lakes of sandy soils is therefore deemed to be Unfavourable Bad.

6.8 Overall Assessment of the Habitat Conservation Status for 3110

Information on the range and area of oligotrophic lakes of sandy soils (3110) that would enable an accurate assessment of the habitat conservation status is not currently available and there is insufficient information to separate lake type 3110 from 3130 in Ireland. Information regarding the structures and functions, including typical species, is also extremely limited. A comprehensive survey of all lake habitats is urgently required to meet Ireland’s obligations under the Habitats Directive.

Based on the best available information the overall assessment of oligotrophic lakes of sandy soils (3110) is Unfavourable –Bad (Table 6.1)

Table 6.2 Conservation Status of oligotrophic lakes of sandy soils (3110) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range	X			
Area	X			
Structures and Functions			X	
Future prospects			X	
Overall Assessment			**X**	

3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

National Level	
Habitat Code	3110
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.6.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes*. An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	
Surface area	65,100km^2 (this range is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 6.1) attached
Surface area	678 km² (this area is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable .
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species

Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	65,100km^2. See map (Fig.6.1) attached
Favourable reference area	678km^2. See map (Fig.6.1) attached
Typical species	*Isoetes lacustris*, *I. echinospora*, *Littorella uniflora*, *Lobelia dortmanna*, *Deschampsia setacea*, *Subularia aquatica*, *Juncus bulbosus*, *Pilularia globulifera*, *Luronium natans*, and *Potamogeton polygonifolius*
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on species, landscape, catchment and lake morphology data. This modelling process was unable to differentiate between lake habitats 3110 and 3130 and therefore the range, area and structure and function information provided in this assessment is for the combined (3110 and 3130) habitats. The Water Framework Directive (WFD) assessment of lakes reveals that 64% of the total area of this lake type, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)

7. Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae* (3130)

The interpretation manual of EU habitats describes this habitat as - aquatic to amphibious short perennial vegetation, oligotrophic to mesotrophic, of lake, pond and pool banks and water-land interfaces belonging to the *Littorelletalia uniflorae* order and/or amphibious short annual vegetation, pioneer of land interface zones of lakes, pools and ponds with nutrient poor soils, or which grows during periodic drying of these standing waters: *Isoeto-Nanojuncetea* class. These two units can grow together in close association or separately. Characteristic plant species are generally small ephemerophytes.

In NPWS the classification and selection of lake habitats, in accordance with the Habitats Directive, was based primarily on vegetation communities. In the absence of any comprehensive survey of lakes the information available to NPWS when selecting and designating lake sites was extremely limited. The selection of 3130 lakes was further complicated by the overlap between the vegetation communities associated with lake habitats 3130 and 3110. On the understanding that outside the Continental and Alpine regions lake type 3130 occurred in mountain areas, and in the UK it occurred particularly in high altitude lakes, NPWS decided that lake type 3130 was confined to mountains areas and that all other lowland oligotrophic lakes with *Littorelletea* vegetations would be classified as lake type 3110. This position was only modified in relation to Lough Melvin SAC, a cross-Border site, which had been classified as lake type 3130 by the Environment and Heritage Service in Northern Ireland.

In Ireland this 3130 type lakes are likely to be naturally much more common than habitat 3110. The difficulty in assigning lakes to this category, as described above in Section 3.4, is however, noted.

7.1 Habitat Mapping

There is limited information on the vegetation communities and trophic status of lakes Irish and therefore a two-step modelling process, as outlined in Section 5, was used to classify and map oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae* (3130). The modelling process was not able to distinguish between lake types 3110 and 3130 using the available water chemistry, macrophyte, landscape, catchment and lake morphology data and therefore range, area, and structure and function information provided in this section is for the lake types 3110 and 3130 combined.

7.2 Habitat Range

The use of range and area values to assess the conservation status of habitats was initially devised for terrestrial habitats and may not be particularly appropriate for aquatic habitats. Reporting on the Habitats Directive under Article 17 requires the provision of range and area values for all Annex 1 habitats including lakes and rivers. The *Interpretation Manual of European Union Habitats* provides guidelines for determining the range of terrestrial habitats but NPWS have advised that the EU interpretation of range, for aquatic habitats including lakes, is related to the area occupied by the waterbody. The range of aquatic habitats is unaffected by ecological changes within the habitat e.g. changes in trophic status do not affect the range or area of a lake type assuming the lake area remains unchanged. If this is the correct interpretation then the range value for lake habitats is simply an indication of the presence of a waterbody and therefore should not be used to assess the conservation status of the habitat. However, since NPWS require a range value for reporting purposes this project has used the modelling process described in Section 5 to obtain a range value for lake type 3130*. *(Since the modelling process described in Section 5 was unable to separate lake types 3110 and 3130 the range value below is for lake types 3110 and 3130 combined)

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) a preliminary range for the combined lake habitats 3130 and 3110 was established by drawing the shortest continuous boundary to encompass all known sites. “Small gaps in the distribution are considered as part of the range but larger gaps (40-50 km) are considered as breaks in the range” (EU 2006). NPWS have advised that distances of 20km are sufficient to justify a break in range for freshwater habitats in Ireland. A national map showing the combined distribution of the lake habitats 3130 and 3110 on a 10 x 10 km^2 square grid was produced in a GIS format. The range for lake habitats 3130 and 3110 was therefore determined using the number of 10 x 10 km^2 grid squares containing lakes identified as lake type 3130 and 3110 by the modelling process and excluding all grids > 20km which did not contain 3130 or 3110 lakes (Fig. 7.1). This range was found to be 64,700km^2.

The parameters that have been used to model and estimate the overall habitat range are those that the European Commission (2006) advise can be used to determine the Favourable Reference Range. The range which has been developed in this project, using the modelling described in Section 5, has provided an estimate of the Favourable Reference Range for lake types 3130 and 3110 which may not be synonymous with the current ranges of these habitats in Ireland. A comprehensive survey of lakes in Ireland is needed to distinguish between lake types 3110 and 3130 and to provide information on the current range of each habitat.

7.2.1 Conservation Status of Range

Following the guidance provided in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission 2006) the assessment of the conservation status of the habitat range can be established by assessing the variation in the habitat range in the reporting period. As outlined in Section 7.2 it appears that the EU interpretation of range for aquatic habitats is related to the area occupied by the habitat type and is unaffected by ecological changes within the habitat. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The range of lake habitat 3130 is therefore regarded as Favourable - Stable.

7.3 Habitat Area

As outlined in Section 7.2 the use of range and area values to assess the conservation status of habitats was may not be particularly appropriate for aquatic habitats but are required by NPWS to comply with the reporting mechanism for the Habitats Directive.

The combined area of oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae* (3130) and oligotrophic lakes of sandy soils (3110) has been established, using a two-step modelling process as outlined in Section 5, and a national map showing the distribution was produced in a GIS format (Fig 7.1). The combined area of lake types 3130 and 3110 was determined using the area occupied by lakes identified as habitat type 3110 and 3130 by the modelling process and was found to be = 678km^2.

The Favourable Reference Area of any habitat is defined as the total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type (EU 2006). As with the determination of range, the habitat area that has been estimated in this project (678km^2) could be more accurately described as the Favourable Reference Area as it is based on landscape, catchment and lake morphology. A comprehensive survey of lakes in Ireland is needed to provide the information on the current area of lake habitats 3130 and 3110.

7.3.1 Conservation Status of Habitat Area

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) the assessment of the conservation status of the habitat area can be established by assessing the variation in the habitat extent in the reporting period. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The combined area of lake habitats 3130 and 3110 is therefore regarded as Favourable - Stable.

7.4 Structures and Functions

The structure and functions of all lake habitats are affected by a number of factors including lake morphology, geology, water quality and a range of anthropogenic pressures. The influence of such factors on particular lake habitats e.g. oligotrophic to mesotrophic lakes (3130) have, to date, not been investigated. Utilising information developed in accordance with the WFD, an assessment of lake type 3130 provides an indication of the status of the structures and functions of this habitat.

Analyses of the overall pressures on water bodies, including lakes, was a requirement of WFD characterization process (EPA 2005) and in Ireland four categories of risk were developed:

1a – Water bodies at significant risk;

1b – Water bodies probably at significant risk;

2a - Water bodies probably not at significant risk ; and

2b - Water bodies not at significant risk.

All lakes in the WFD network (Table 2.5) were assessed and placed into one of the four categories. The four categories are based on overall risk and do not distinguish between the different pressures which may effect a lake e.g. point and diffuse pollution, abstraction, morphology.

In order to establish what proportion lakes types 3130 and 3110 are at risk, the lakes in the WFD network were classified using the modelling process described in Section 5. A small number of lakes (29) were excluded from this modelling exercise because they are brackish and therefore classified as transitional waters. Of the lakes modeled (756) a total of 624 were identified as lake types 3110 and 3130 (Table 6.1)

Table 7.1 Risk assessment of lake types 3110 and 3130 in the WFD network of lakes

Category of risk	No of lakes	Area (km^2)	Area %
1a	134	124	32
1b	71	124	32
2a	88	80	21
2b	331	58	15

Lakes at significant risk and those probably at significant risk accounted for 64% of the total area (384 km^2) occupied by 3110 and 3130 lakes in the WFD network. Although lakes less than 1ha are not included in the WFD network, the area of lake types 3110 and 3130 included in the WFD network and assessed for risk (384km^2), accounts for 57% of the total habitat area (678km^2).

Lakes identified "at risk" are those that are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. It includes lakes known to have deteriorated in water quality, impacting negatively on structures and functions.

7.4.1 Conservation Status of Structures and Functions

Risk assessment reveals that 64% of lake types 3130 and 3110, in the WFD network of lakes, have failed to achieve good status as defined by the WFD or are suffering from deterioration in water quality status. The structures and functions of these lakes will be negatively affected and therefore the conservation status of the habitat structures and functions is deemed to be Unfavourable Bad.

7.4.2 Typical Species

The plants that are typically associated with oligotrophic to mesotrophic lakes (3130) include *Littorella uniflora*, *Luronium natans*, *Potamogeton polygonifolius*, *Pilularia globulifera*, *Juncus bulbosus* ssp. *bulbosus*, *Eleocharis acicularis*, *Sparganium minimum,*, *Elatine* spp., *Limosella aquatica*, *Scirpus setaceus*, *Juncus bufonius*, *Centaurium pulchellum*, *Centunculus minimus*, *Cicendia filiformis*

In Ireland the information currently available on lake flora and fauna has primarily been collected by the EPA, CFB and various research bodies, who have not utilized the Habitats Directive classification of lake habitats. Analysing the data collected from a variety of sources to identify the typical species associated with each of the lake habitats listed in the Habitats Directive is beyond the scope of this project. Therefore it is not possible to list any additional species, which may be typical of oligotrophic to mesotrophic (3130) in Ireland.

7.4.3 Conservation Status of Typical Species

In the absence of a monitoring programme the relevant information regarding typical species associated with this habitat is not available. Therefore the conservation status of typical species of oligotrophic to mesotrophic lakes (3130) is unknown.

7.5 Main Pressures

The EPA water quality reports (Bowman *et al.,*., 1996, Lucey *et al* 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to lake water quality in Ireland. The selection and subsequent designation of 9 SACs for oligotrophic to mesotrophic lakes (3130) in the early 1990s included an assessment of activities impacting on each SAC. The information from these assessments, contained in the NATURA 2000 standard data forms, indicate that the following pressures were negatively affecting oligotrophic to mesotrophic lakes:

120 – Fertilisation;

140 – Grazing;

160 – Forestry;

180 – Burning;

220 – Leisure fishing;

230 – Hunting;

310 – Peat extraction;

700 – Pollution;

810 – Drainage;

900 – Erosion; and

954 – Invasive species.

Information from the Site Inspection reports (Table 3.3) indicates additional pressures on some lakes from human induced hydraulic changes.

7.6 Threats

The principal threats to oligotrophic to mesotrophic lakes (3130), as outlined in Section 4, include eutrophication, agricultural practices including overgrazing and excessive fertilization, afforestation and the introduction of invasive alien species. Waterbodies may be negatively affected by increased housing developments in rural areas and the associated wastewater treatments but it is difficult to quantify the risks associated with this. The utilization of lakes for an increasing number of sport and leisure activities may also impact on lake habitats.

7.7 Future Prospects

7.7.1 Negative Future Prospects

All the EPA water quality reports (Bowman *et al*., 1996, Lucey *et al.,* 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to water quality in Ireland. Despite increased public awareness, resources and legislation in the last twenty years to improve lake water quality, the percentage of lakes considered to be in satisfactory condition has increased by only 4% between 1986 and 2005 (Fig 2.2). While incentives and legislation have been introduced to reduce the risk of excessive nutrient loading to freshwater bodies, the long term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water. The risk assessment of lakes has also indicated that 64% of the area of lake types 3130 and 3110, within the WFD network, are currently at risk from a range of pressures.

The decline of peatland habitats in the west of Ireland is also likely to have a negative impact on all waterbodies within and surrounding the areas of peatland. Continued afforestation of non-designated peatlands and the introduction of non-native species may also affect the future prospects of oligotrophic to mesotrophic lakes.

7.7.2 Positive Future Prospects

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a lake typology (see Table 2.5), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish. Monitoring of water chemistry and hydromological change are also required but are stipulated as supporting, rather than driving, ecological assessment. The WFD requires "good water status" and/or "good ecological status" for lakes by 2015, to be achieved through integrated catchment management. Risk assessments for lakes to establish those at risk were required under the WFD and highlighted areas where lakes are under significant threat from pollution. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is also designed to provide a major contribution to improved water quality.

In 1998 the Government introduced the Water Quality Standards for Phosphorus Regulations, to reduce the level of pollution from phosphorus. The Regulations require that water quality in lakes be maintained or improved by reference to the biological trophic status assigned by the EPA in the 1995-97 review period or at the first occasion thereafter.

The Rural Environmental Protection Scheme (REPS), introduced in 1994, may reduce the impact of agricultural activities, especially overgrazing, on freshwater habitats. The EU-funded REPS includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with over grazing on lakes.

A reduction in livestock numbers is likely as a result of the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare

In 2006 the NPWS introduced the National Farm Plan Scheme (NFPS) which compensates landowners for losses incurred through restrictions caused by the designation of lands as SAC or

SPA. The owners of designated lands can also receive payment for undertaking certain actions which are of benefit to nature and are agreed in a farm plan. The implementation of the NFPS should reduce damage caused by agricultural activities to lakes within designated sites.

7.7.3 Conservation Status of Future Prospects

Incentives and legislation have been introduced in recent years to reduce the negative pressures on freshwater habitats but information from the EPA water quality assessments indicate that lakes are still under threat. There is little evidence of a significant decline in the primarily pressures of eutrophication, overgrazing, excessive fertilization, afforestation and the introduction of invasive alien species. A large proportion (64%) of oligotrophic to mesotrophic lakes within the WFD network is at risk and therefore the long term viability of this habitat cannot be assured. The conservation status of the future prospects of oligotrophic to mesotrophic lakes is therefore deemed to be Unfavourable Bad

7.8 Overall Assessment of the Habitat Conservation Status for 3130

Information on the range and area of oligotrophic to mesotrophic lakes (3130) that would enable an accurate assessment of the habitat conservation status is not currently available and there is insufficient information to separate lake type 3110 from 3130 in Ireland. Information regarding the structures and functions, including typical species, is also extremely limited. A comprehensive survey of all lake habitats is urgently required to meet Ireland's obligations under the Habitats Directive.

Based on the best available information the overall assessment of oligotrophic to mesotrophic lakes (3130) is Unfavourable – Bad (Table 7.1)

Table 7.1. Conservation Status of oligotrophic to mesotrophic lakes (3130) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range	X			
Area	X			
Structures and Functions			X	
Future prospects			X	
Overall Assessment			**X**	

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae*

National Level	
Habitat Code	3130
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.7.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes.* An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R., (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	.
Surface area	65,100km^2 (this range is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 7.1) attached
Surface area	678 km² (this area is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species

Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	65,100km^2. See map (Fig.7.1) attached
Favourable reference area	678km^2 . See map (Fig.7.1) attached
Typical species	*Littorella uniflora*, *Luronium natans*, *Potamogeton polygonifolius*, *Pilularia globulifera*, *Juncus bulbosus* ssp. *bulbosus*, *Eleocharis acicularis*, *Sparganium minimum*,, *Elatine* spp., *Limosella aquatica*, , *Scirpus setaceus*, *Juncus bufonius*, *Centaurium pulchellum*, *Centunculus minimus*, *Cicendia filiformis*
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on landscape, catchment and lake morphology data. This modelling process was unable to differentiate between lake habitats 3110 and 3130 and therefore the range, area and structure and function information provided in this assessment is for the combined (3110 and 3130) habitats. The Water Framework Directive (WFD) assessment of lakes reveals that 64% of the total area of lake type 3130 and 3130, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)

8. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)

The interpretation manual of EU habitats describes this habitat as lakes and pools with waters fairly rich in dissolved bases (pH often 6-7) (21.12) or with mostly blue to greenish, very clear, waters poor (to moderate) in nutrients, base-rich (pH often >7.5) (21.15). The bottom of these unpolluted water bodies are covered with charophyte, *Chara* and *Nitella*, algal carpets.

Marl lakes in Ireland would, under natural conditions, support this community type. The NPWS site selection process did not include soft water lakes dominated by *Nitella* sp i.e. only hard water lakes were selected for this habitat in Ireland.

8.1 Habitat Mapping [2]

There is limited information on the vegetation communities and trophic status of lakes Irish and therefore a two-step modelling process, as outlined in Section 5, was used to classify and map hard oligo-mesotrophic waters with vegetation of *Chara* spp. (3140).

8.2 Habitat Range

The use of range and area values to assess the conservation status of habitats was initially devised for terrestrial habitats and may not be particularly appropriate for aquatic habitats. Reporting on the Habitats Directive under Article 17 requires the provision of range and area values for all Annex 1 habitats including lakes and rivers. The *Interpretation Manual of European Union Habitats* provides guidelines for determining the range of terrestrial habitats but NPWS have advised that the EU interpretation of range, for aquatic habitats including lakes, is related to the area occupied by the waterbody. The range of aquatic habitats is unaffected by ecological changes within the habitat e.g. changes in trophic status do not affect the range or area of a lake type assuming the lake area remains unchanged. If this is the correct interpretation then the range value for lake habitats is simply an indication of the presence of a waterbody and therefore should not be used to assess the conservation status of the habitat. However, since NPWS require a range value for reporting purposes this project has used the modelling process described in Section 5 to obtain a range value for lake type 3140.

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) a preliminary range for lake habitat 3140 was established by drawing the shortest continuous boundary to encompass all known sites. “Small gaps in the distribution are considered as part of the range but larger gaps (40-50 km) are considered as breaks in the range” (EU 2006). NPWS have advised that distances of 20km are sufficient to justify a break

[2] Some changes were made to the original file submitted by the consultant related to habitats classification (i.e. results_ 200607). These changes are illustrated in an additional field named NPWS–changes within the 3140_lwseg_0207.shp shape file: Lakes IE_NW_38_59 (Kinny Lough), IE_NW_38_678 (Sannagh Lough or Magheradrumman) both part of SAC 1975 (Ballyhoorisky Point) were originally classed as

in range for freshwater habitats in Ireland. A national map showing the distribution of the lake habitat 3140 on a 10 x 10 km^2 square grid was produced in a GIS format. The range for lake habitat 3140 was therefore determined using the number of 10 x 10 km^2 grid squares containing lakes identified as habitat type 3140 by the modelling process and excluding all grids > 20km which did not contain 3140 lakes (Fig. 8.1). This range was found to be 42,000km^2.

The Favourable Reference Range of any habitat is defined as the range within which all significant ecological variations of the habitat are included for a given biogeographical region and which is sufficiently large to allow for the long term survival of the habitat (European Commission, 2006). The parameters that have been used to model and estimate the overall habitat range are those that the European Commission (2006) advise can be used to determine the Favourable Reference Range. The range which has been developed in this project, using the modelling described in Section 5, has provided an estimate of the Favourable Reference Range for hard oligo-mesotrophic waters lakes (3140) which may not be synonymous with the current range of this habitat in Ireland until a comprehensive survey of lakes in Ireland is conducted.

8.2.1 Conservation Status of Range

Following the guidance provided in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission 2006) the assessment of the conservation status of the habitat range can be established by assessing the variation in the habitat range in the reporting period. As outlined in Section 8.2 it appears that the EU interpretation of range for aquatic habitats is related to the area occupied by the habitat type and is unaffected by ecological changes within the habitat. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The range of lake habitat 3140 is therefore regarded as Favourable - Stable.

8.3 Habitat Area

As outlined in Section 6.2 the use of range and area values to assess the conservation status of habitats was may not be particularly appropriate for aquatic habitats but are required by NPWS to comply with the reporting mechanism for the Habitats Directive.

The extent of hard oligo-mesotrophic lakes (3140) has been established, using a two-step modelling process as outlined in Section 5, and a national map showing the distribution was produced in a GIS format (Fig 8.1). The area of hard oligo-mesotrophic lakes (3140) was determined using the area occupied by lakes identified as habitat type 3140 by the modelling process and was found to be = 595km^2.

3110/3130 however are deemed to correspond to habitat 3140. IE_WE_32_528 (Fahy lough (SAC 1309 Omey Island machair)) was not assigned any habitat type (i.e. "nm") however was deemed to correspond to habitat 3140.

The Favourable Reference Area of any habitat is defined as the total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type (EU 2006). As with the determination of range, the habitat area that has been estimated in this project (595km^2) could be more accurately described as the Favourable Reference Area as it is based on landscape, catchment and lake morphology. A comprehensive survey of lakes in Ireland is needed to provide the information on the current area of lake habitat 3140.

8.3.1 Conservation Status of Habitat Area

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) the assessment of the conservation status of the habitat area can be established by assessing the variation in the habitat extent in the reporting period. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). The area of hard oligo-mesotrophic waters 3140 is therefore regarded as Favourable - Stable.

8.4 Structures and Functions

The structure and functions of all lake habitats are affected by a number of factors including lake morphology, geology, water quality and a range of anthropogenic pressures. The influence of such factors on particular lake habitats e.g. hard oligo-mesotrophic waters lakes (3140) have, to date, not been investigated. Utilising information developed in accordance with the WFD, an assessment of the water quality of hard oligo-mesotrophic waters provides an indication of the status of the structures and functions of this habitat.

Analyses of the overall pressures on water bodies, including lakes, was a requirement of WFD characterization process (EPA 2005) and in Ireland four categories of risk were developed:

1a - Water bodies at significant risk;

1b - Water bodies probably at significant risk;

2a - Water bodies probably not at significant risk; and

2b - Water bodies not at significant risk .

All lakes in the WFD network (Table 2.5) were assessed and placed into one of the four categories. The four categories are based on overall risk and do not distinguish between the different pressures that may affect a lake e.g. point and diffuse pollution, abstraction, and morphology.

In order to establish what proportion of hard oligo-mesotrophic lakes (3140) are at risk, the lakes in the WFD network were classified using the modelling process described in Section 5. A small number of lakes (29) were excluded from this modelling exercise because they are brackish and therefore classified as transitional waters. Of the lakes modeled (776) a total of 131 were identified as hard oligo-mesotrophic lakes (Table 8.1).

Lakes at significant risk and those probably at significant risk accounted for 94% of the total area (254 km^2) occupied by 3140 lakes in the WFD network. Although lakes less than 1ha are not included in the WFD network, the area of lake type 3140 included in the WFD network and assessed for risk (254km^2), accounts for 43% of the total habitat area (595km^2).

Table 8.1 Risk assessment of lake type 3140 in the WFD network of lakes

Category of risk	No of lakes	Area (km^2)	Area %
1a	25	153	60
1b	69	85	34
2a	11	11	4
2b	26	5	2

Lakes identified "at risk" are those that are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. It includes lakes known to have deterioration in water quality, impacting negatively on structures and functions.

8.4.1 Conservation Status of Structures and Functions

Risk assessment reveals that 94% of hard oligo-mesotrophic lakes (3140), in the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status. The structures and functions of these lakes will be negatively affected and therefore the conservation status of the habitat structures and functions is deemed to be Unfavourable Bad.

8.4.2 Typical Species

The plants that are typically associated with hard oligo-mesotrophic lakes (3140) include *Chara* spp. and *Nitella* spp.

In Ireland the information currently available on lake flora and fauna has primarily been collected by the EPA, CFB and various research bodies, who have not utilized the Habitats Directive classification of lake habitats. Analysing the data collected from a variety of sources to identify the typical species associated with each of the lake habitats listed in the Habitats Directive is beyond the scope of this project. Therefore it is not possible to list any additional species that may be typical of hard oligo-mesotrophic lakes (3140) in Ireland.

8.4.3 Conservation Status of Typical Species

In the absence of a monitoring programme the relevant information regarding typical species associated with this habitat is not available. Therefore, the conservation status of typical species of hard oligo-mesotrophic lakes (3140) is unknown.

8.5 Main Pressures

The EPA water quality reports (Bowman *et al*., 1996, Lucey *et al.,* 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to lake water quality in Ireland. The selection and subsequent designation of 9 SACs for hard oligo-mesotrophic lakes (3140) in the early 1990s included an assessment of activities impacting on each SAC. The information contained in these assessments, contained in the NATURA 2000 standard data forms, indicate that the following pressures were negatively affecting oligotrophic lakes of sandy soils:

120 – Fertilisation;
140 – Grazing;
160 – Forestry;
220 – Leisure fishing;
230 – Hunting;
890 – Human induced hydraulic changes;
952 – Eutrophication; and
954 – Invasive species.

Information from the Site Inspection reports (Table 3.3) indicate additional pressures on some lakes from landfill, removal of sediments, industrial or commercial areas and tourism and leisure activities

8.6 Threats

The principal threats to hard oligo-mesotrophic lakes (3140), as outlined in Section 4, include eutrophication, agricultural practices including overgrazing and excessive fertilization, afforestation and the introduction of invasive alien species. Hard water lakes are often shallow and have a natural high capacity to buffer the effects of enrichment from phosphorus, owing to a number of chemical and biotic homeostatic mechanisms (Scheffer *et al.,* 1993). Response to nutrient enrichment is, therefore, less immediate than deep water and/or circumneutral and acidic lakes. However, build up of phosphorus in the sediment of these lakes and collapse of biotic buffering systems can leads to rapid shifts in ecosystem quality. Rapid shifts in quality of hard water lakes associated with nutrient enrichment have been documented for Loughs Sheelin and Ennell (Champ, 1998), and there is good evidence of declines in ecological quality of the SAC Lough Carra associated with increasing phosphorus concentrations recorded in the sediment (Hobbs *et al.,* 2005). There is a continued threat from nutrient enrichment in these lowland lakes arising from intensification of agriculture and urban developments. Hard water lakes may also be negatively affected by increased housing developments in rural areas and the associated wastewater treatments but it is difficult to quantify the risks associated with this. The utilization of lakes for an increasing number of sport and leisure activities may also impact on lake habitats.

8.7 Future Prospects

8.7.1 Negative Future Prospects

All the EPA water quality reports (Bowman *et al*., 1996, Lucey *et al.,* 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to water quality in Ireland. Despite increased public awareness, resources and legislation in the last twenty years to improve lake water quality, the percentage of lakes considered to be in satisfactory condition has increased by only 4% between 1986 and 2005 (Fig 2.2). While incentives and legislation have been introduced to reduce the risk of excessive nutrient loading to freshwater bodies, the long-term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water.

The risk assessment of lakes has also indicated that 94% of hard oligo-mesotrophic lakes (3140), within the WFD network, are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD.

8.7.2 Positive Future Prospects

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a lake typology (see Table 2.5), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish. Monitoring of water chemistry and hydromological change are also required but are stipulated as supporting, rather than driving, ecological assessment. The WFD requires “good water status” and/or “good ecological status” for lakes by 2015, to be achieved through integrated catchment management. Risk assessments for lakes to establish those at risk were required under the WFD and highlighted areas where lakes are under significant threat from pollution. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is also designed to provide a major contribution to improved water quality.

In 1998 the Government introduced the Water Quality Standards for Phosphorus Regulations, to reduce the level of pollution from phosphorus. The Regulations require that water quality in lakes be maintained or improved by reference to the biological trophic status assigned by the EPA in the 1995-97 review period or at the first occasion thereafter

A reduction in livestock numbers is likely as a result of the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare. The Rural Environmental Protection Scheme (REPS) introduced in 1994 aimed to reduce the negative impact of agricultural activities. The EU-funded REPS includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with overgrazing on all habitats but the negative impacts associated with overgrazing are likely to persist for some time.

In 2006 the NPWS introduced the National Farm Plan Scheme (NFPS) compensates landowners for losses incurred through restrictions caused by the designation of lands as SAC or SPA. The owners of designated lands can also receive payment for undertaking certain actions, which are of benefit to nature and are agreed in a farm plan. The implementation of the NFPS should reduce damage on lakes caused by agricultural activities.

8.7.3 Conservation Status of Future Prospects

Incentives and legislation have been introduced in recent years to reduce the negative pressures on freshwater habitats but information from the EPA water quality assessments indicate that lakes are still under threat. There is little evidence of a significant decline in the primarily pressures of eutrophication, overgrazing, excessive fertilization, afforestation and the introduction of invasive alien species. Almost all (94%) of the hard oligo-mesotrophic lakes (3140) within the WFD network are at risk and therefore the long-term viability of this habitat cannot be assured. The conservation status of the future prospects of oligotrophic lakes of sandy soils is therefore deemed to be Unfavourable Bad.

8.8 Overall Assessment of the Habitat Conservation Status for 3140

Information on the range and area of hard oligo-mesotrophic lakes (3140) that would enable an accurate assessment of the habitat conservation status is not currently available. Information regarding the structures and functions, including typical species, is also extremely limited. A comprehensive survey of all lake habitats is urgently required to meet Ireland's obligations under the Habitats Directive.

Based on the best available information the overall assessment of hard oligo-mesotrophic lakes (3140) is Unfavourable –Bad (Table 8.1)

Table 8.1. Conservation Status of hard oligo-mesotrophic lakes (3140) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range	X			
Area	X			
Structures and Functions			X	
Future prospects			X	
Overall Assessment			**X**	

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

National Level	
Habitat Code	3140
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.8.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes*. An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003*. Environmental Protection Agency, Wexford.
Range	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp are found primarily in lowland areas throughout the Republic of Ireland.
Surface area	42,000km^2
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 8.2) attached
Surface area	595 km².
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species
Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species

Complementary information	
Favourable reference range	42,000km^2. See map (Fig.8.1) attached
Favourable reference area	595km^2. See map (Fig.8.1) attached
Typical species	*Chara* spp. and *Nitella* spp
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on landscape, catchment and lake morphology data. The Water Framework Directive (WFD) assessment of lakes reveals that 94% of the hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.

Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)

9. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation (3150)

The interpretation manual of EU habitats describes this habitat as lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7), with free-floating surface communities of the *Hydrocharition*or, in deep, open waters, with associations of large pondweeds (*Magnopotamion*).

The NPWS selected natural eutrophic lakes sites on the basis of the dominance of broad-leaved *Potamogetons* or *Hydrochorition* spp. in the aquatic vegetation, which achieve dominance in mesotrophic to eutrophic conditions. In selecting sites NPWS assumed that the vegetation type was the most important criterion rather than the trophic status. Lakes where the trophic status may have been impacted were included if it was considered that they would still have been dominated by the appropriate vegetation type in their pre-impacted state.

It is debatable whether *natural* eutrophic lakes occur in Ireland, as they are typically associated with phosphorus rich geological strata. The sites designated in Ireland as natural eutrophic have been selected because of their vegetation with no reference to their trophic status. Even designated sites that are eutrophic would require supporting information as to why they are considered to be natural eutrophic lakes and not anthropogenically impacted one. Many of the lakes designated as natural eutrophic in Ireland may be more appropriately classified as Habitats 3130, 3110 or, even, 3140 in their natural state. Any lake subject to anthropogenic nutrient enrichment is likely to display many of the community features listed under the description of Habitat type 3150.

9.1 Habitat Mapping

No attempt was made to model the locations of natural eutrophic lakes as there is currently no convincing evidence to support the existence of this habitat type in Ireland. This remains an open-question that further analysis of existing palaeolimnological data may help resolve. Natural background levels of phosphorus in Irish groundwaters have, however, been found to be far below the threshold for maintaining eutrophic conditions (O'Callaghan Moran & Associates 2007). The mapping and estimation of range and area of lakes in this habitat category was therefore confined to the 9 sites that are currently designated as natural eutrophic (3150) SAC sites.

9.2 Habitat Range

Irrespective of the arguments in Section 9 and 9.1, range and area values for this habitat have been calculated but are considered inappropriate.

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) a preliminary range for lake habitat 3150 was established by drawing the shortest continuous boundary to encompass all 9 designated sites. “Small gaps in the distribution are considered as part of the range but larger gaps (40-50 km) are considered as breaks in the range” (EU 2006). NPWS have advised that distances of 20km are sufficient to justify a break in range for freshwater habitats in Ireland. A national map showing the distribution of all lakes designated as habitat type 3150 on a 10 x 10 km^2 square grid was produced in a GIS format. The range for lake habitat 3150 was therefore determined using the number of 10 x 10 km^2 grid squares containing lakes designated as habitat type 3150 and excluding all grids > 20km which did not contain 3150 lakes (Fig. 9.1). This range was found to be 3,400km^2.

9.2.1 Conservation Status of Range

As outlined in Section 9.1 there is no evidence to support the existence of this habitat type in Ireland and therefore the conservation status of the habitat range is unknown.

9.3 Habitat Extent

A national map showing the distribution of all 9 lakes designated as habitat type 3150 on a 10 x 10 km^2 square grid was produced in a GIS format. The extent of natural eutrophic lakes was determined using the area occupied by the 9 designated lakes identified as habitat type 3150 by NPWS and was found to be = 401km^2.

9.3.1 Conservation Status of Habitat Extent

As outlined in Section 9.1 there is no strong evidence to support the existence of natural eutrophic lakes in Ireland and therefore the conservation status of the habitat area is unknown.

9.4 Structures and Functions including Typical Species

The typical plant species associated with this habitat include *Hydrocharition - Lemna* spp., *Spirodela* spp., *Wolffia* spp., *Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, Aldrovanda vesiculosa,* Ferns (*Azolla*), Liverworts (*Riccia* spp., *Ricciocarpus* spp.); *Magnopotamion - Potamogeton lucens, P. praelongus, P. zizii*, *P. perfoliatus*.

As outlined in Section 9.1 there is no evidence to support the existence of natural eutrophic lakes in Ireland and therefore the conservation status of the habitat structures and functions cannot be reported.

9.5 Main Pressures

The selection and subsequent designation of 9 SACs for natural eutrophic lakes (3150) in the early 1990s included an assessment of activities impacting on each SAC. The information from these assessments, contained in the NATURA 2000 Standard Data Forms, indicate that the following pressures were negatively affecting the 9 lakes designated as natural eutrophic (3150):

120 – Fertilisation;
140 – Grazing;
150 – Restructuring land holdings;
160 – Forestry;
220 – Leisure fishing;
230 – Hunting;
421 – Disposal of household waste;
621 – Nautical sports;
700 – Water pollution;
810 – Drainage; and
954 – Invasive species.

Information from the Site Inspection reports (Table 3.3) indicate additional pressures on these lakes from landfill, dumping, human induced hydraulic changes, and urbanization.

9.6 Threats

Irrespective of habitat classification, all lakes in Ireland are under threat from eutrophication, agricultural practices including overgrazing and excessive fertilization, afforestation and the introduction of invasive alien species

9.7 Future Prospects

9.7.1 Negative Future Prospects

It is likely that all lakes in catchments that comprise moderate to intensive agriculture, or those receiving industrial or domestic waste waters are impacted and will continue to be impacted. In many lakes there may be recycling of nutrient from the lakes sediments. In rural areas, unregulated or inadequately installed septic tanks may have an adverse effect, but there is a general dearth of information to quantify this. Because of the association of lake nutrient state with productive agriculture and population densities, these threats exist for all lakes, irrespective of the appropriateness of habitat designation. These conclusions are supported by national and regional monitoring, including detailed work relating water quality to landscape features in County Clare (Wemaere, 2005).

9.7.2 Positive Future Prospects

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a lake typology (see Table 2.5), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish. Monitoring of water chemistry and hydromological change are also required but are stipulated as supporting, rather than driving, ecological assessment. The WFD requires "good water status" and/or "good ecological status" for lakes by 2015, to be achieved through integrated catchment management. Risk assessments for lakes to establish those at risk were required under the WFD and highlighted areas where lakes are under significant threat from pollution. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is also designed to provide a major contribution to improved water quality.

In 1998 the Government introduced the Water Quality Standards for Phosphorus Regulations, to reduce the level of pollution from phosphorus. The Regulations require that water quality in lakes be maintained or improved by reference to the biological trophic status assigned by the EPA in the 1995-97 review period or at the first occasion thereafter.

A reduction in livestock numbers is likely as a result of the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare. The Rural Environmental Protection Scheme (REPS) introduced in 1994 aimed to reduce the negative impact of agricultural activities. The EU-funded REPS includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with overgrazing on all habitats.

9.7.3 Conservation Status of Future Prospects

The information collated for this project indicates that a range of pressures negatively affects all lake habitats, regardless of their classification. This project has assessed the future prospects of lake habitats 3110, 3130, 3140, 3160 to be Unfavourable-Bad. It is likely that any natural eutrophic lakes in Ireland would be subject to similar pressures and their future prospects would be Unfavourable-Bad.

9.8 Overall Assessment of the Habitat Conservation Status for 3150

Because there is currently no convincing evidence to support the existence of this habitat type in Ireland it is not possible to provide an accurate assessment of conservation status of this habitat. Based on the best available information the overall assessment of natural eutrophic lakes (3150) is Unfavourable - Bad (Table 9.1)

Table 9.1. Conservation Status of natural eutrophic lakes (3150) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range				X
Area				X
Structures and Functions				X
Future prospects			X	
Overall Assessment			**X**	

3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation

National Level	
Habitat Code	3150
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.9.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). A preliminary Survey of Irish Lakes. *An Foras Forbartha, Dublin.* ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	
Surface area	3,900km^2.
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 9.1) attached
Surface area	401 km².
Date	04/2007
Method used	1 = based on expert opinion
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 700 Pollution 954 Invasive species
Threats	120 Fertilisation 140 Grazing 160 General Forestry management 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	Unknown

Favourable reference area	Unknown
Typical species	*Hydrocharition – Lemna* spp., *Spirodela* spp., *Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris,* Liverworts (*Riccia* spp., *Ricciocarpus* spp.); *Magnopotamion - Potamogeton lucens, P. praelongus, P. zizii*, *P. perfoliatus*.
Other relevant information	The designation of sites as habitat type 3150 in Ireland is based on the presence of the plant communities described in the *Interpretation Manual of European Union Habitats* but these plant communities are also typical of mesotrophic lakes in Ireland. The range and area values provided are based on known lakes. These values may change in the future due to improved knowledge. There is no certainty that lakes designated as habitat type 3150 are unimpacted and therefore natural eutrophic.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Unknown (XX)
Area	Unknown (XX)
Specific structures and functions (incl. typical species)	Unknown (XX)
Future prospects	Unfavourable - Bad (U2)
Overall assessment of CS	Unfavourable - Bad (U2)

10. Natural dystrophic lakes and ponds (3160)

The interpretation manual of EU habitats describes this habitat as natural lakes and ponds with brown tinted water due to peat and humic acids, generally on peaty soils in bogs or in heaths with natural evolution toward bogs. pH is often low, 3 to 6. Plant communities belong to the order *Utricularietalia.*

NPWS selected sites containing large numbers of lakes and pools and provided a good representation of the geographic range of this habitat type. Within the blanket bogs, most of the bog pools may be classified as 3160 but many of the larger lakes could be habitat types 3110 or 3130.

It is worth noting that many upland lakes situated in raised bogs do not have high concentrations of colour (≥100 PtCo)**,** yet conform to common understanding of dystrophy (Wetzel, 2001). This anomaly affected the modelling of lake types and classified many upland lakes as habitat type 3130. Therefore the distribution of this habitat was considered to be throughout the range of peatlands in Ireland.

10.1 Habitat Mapping

The distribution of habitat 3160 is illustrated on a 10km Irish National Grid and has been produced by selecting those squares containing peatland habitats: either Raised Bog or Blanket Bog which distribution maps was produced as part of these habitat's Conservation Status Assessments (NPWS, 2007). For the purpose of mapping habitat 3160 Degraded Raised Bog habitat map also includes Secondary Degraded Raised Bog. Blanket Bog map includes three variants or sub-types: Lowland, Highland and Mountain Blanket Bog. The map produced can only be taken as indicative or approximate of the current distribution of the habitat.

10.2 Habitat Range

The use of range and area values to assess the conservation status of habitats was initially devised for terrestrial habitats and may not be particularly appropriate for aquatic habitats. Reporting on the Habitats Directive under Article 17 requires the provision of range and area values for all Annex 1 habitats including lakes and rivers. The *Interpretation Manual of European Union Habitats* provides guidelines for determining the range of terrestrial habitats but NPWS have advised that the EU interpretation of range, for aquatic habitats including lakes, is related to the area occupied by the waterbody. The range of aquatic habitats is unaffected by ecological changes within the habitat e.g. changes in trophic status do not affect the range or area of a lake type assuming the lake area remains unchanged. If this is the correct interpretation then the range value for lake habitats is simply an indication of the presence of a waterbody and therefore should not be used to assess the conservation status of the habitat.

The mapping of the habitat's current range is defined by the smallest polygon size containing all 10 km grid squares where the habitat is potentially present, acording to the peatland distribution map, drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the habitat distribution of 3 or more grid squares or oblique gaps of 2 or more squares were deemed enough as to justify a break in the range.

The resulting overall extent of dystrophic lake habitat range in Ireland is 71,700km^2.

10.2.1 Conservation Status of Range

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) the assessment of the conservation status of the habitat range can be established by assessing the extent of the current range with respect to the Favourable Reference Range. As outlined in Section 10.2 it appears that the EU interpretation of range for aquatic habitats is related to the area occupied by the habitat type and is unaffected by ecological changes within the habitat. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). Thus, the habitat's favourable reference range is considered to be similar to the habitat's current range. The range of lake habitat 3160 is therefore regarded as Favourable - Stable.

10.3 Habitat Area

As outlined in Section 10.2 the use of range and area values to assess the conservation status of habitats was may not be particularly appropriate for aquatic habitats but are required by NPWS to comply with the reporting mechanism for the Habitats Directive.

The area of natural dystrophic lakes and ponds (3160) has been established, using a two-step modelling process as outlined in Section 5, and a national map showing the distribution was produced in a GIS format (Fig 10.1). The extent of natural dystrophic lakes and ponds (3160) was determined using the area occupied by lakes identified as habitat type 3160 by the modelling process and was found to be = 2km^2*.

The extent of peatlands habitats, where dystrophic lakes primarily occur, may provide a more accurate assessment of the overall extent of dystrophic lakes in Ireland. The Conservation Assessment of Raised Bogs indicates that the area of active raised bog is 19km^2 and information from CORINE shows the area of active blanket bog is approximately 4,053 km^2. NPWS suggest that dystrophic lakes and ponds may occupy 1% of these habitats which is equal to an area of ~ 41 km^2*.

* Please note that Fig.10.1 shows the area of lake type 3160 obtained by the modelling process described in Section 5. The project team did not have access to the information required to produce a map based on the distribution of peatland habitats)

10.3.1 Conservation Status of Habitat Area

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (EU 2006) the assessment of the conservation status of the habitat area was established by assessing the variation in the habitat extent in the reporting period. The Conservation Assessment of Active Raised Bogs indicate a 36% habitat decline in the period 1994-2005 within 43.21% of the national resource of raised bogs known to support the habitat. A have negative trend in habitat area was also reported for Active Blanket Bog. Since dystrophic lakes occur within these habitats a similar pattern of decline is expected. As the decline is more than 1% per year the assessment of conservation status of dystrophic lakes is Unfavourable- Bad.

10.4 Structures and Functions

The structure and functions of all lake habitats are affected by a number of factors including lake morphology, geology, water quality and a range of anthropogenic pressures. The influence of such factors on particular lake habitats e.g. natural dystrophic lakes and ponds (3160) have, to date, not been investigated. A risk assessment of lakes, developed in accordance with the WFD, has been used to indicate the status of the structures and functions of oligotrophic and mesotrophic lakes but cannot be used for habitat type 3160 as the WFD network includes only 1 dystrophic lake. The assessment did indicate that this single site was at significant risk.

According to Fernandez *et al*. (2005) the decrease in active raised bog habitat extent has been coupled by a decline in structure and functions. Habitat quality for Active Raised Bog is mainly gauged by variations in the extent of central ecotope that is the finest quality Active Raised Bog ecotope. Twenty raised bogs have been given an Unfavourable Inadequate assessment as the extent of central ecotope decreased between 5-25% in the reporting period. Sixteen raised bogs were given an Unfavourable Bad assessment, as the central ecotope extent decrease was greater than 25%.

A decrease in the extent of central ecotope is indicated by a reduction in the bog moss (*Sphagnum*) cover; degradation in the habitat microtopography, increase in the presence of negative indicators including the presence of algae in pools, an increase of bare peat, loss of quality indicators and a reduction in water table levels. Although, the extent of central ecotope may remain unchanged in some cases, adverse changes in some of the above attributes would indicate deterioration in the structures and functions of dystrophic lakes.

10.4.1 Conservation Status of Structures and Functions

The conservation status of the structures and functions were assessed for 51.27% of the current Active Raised Bog national resource (Fernandez *et al*. 2005) and an overall Unfavourable Bad assessment was given. The results given by Fernandez *et al*. (2006) indicate that similar trend is likely to have occurred in those areas not assessed. Thus, the overall habitat structure and functions for dystrophic lakes are assessed as Unfavourable Bad

10.4.2 Typical Species

The plants that are typically associated with natural dystrophic lakes and ponds (3160) include *Utricularia* spp, *Rhynchospora alba*, *R. fusca*, *Sparganium minimum*, *Sphagnum* species.

In Ireland there is limited information currently available on dystrophic lake flora and fauna. The available information has been collected by organisations including NPWS, Irish Peatland Conservation Council (IPCC) and various research bodies, Analysing the data collected from these sources to identify the typical species associated with dystrophic lakes is beyond the scope of this project. Therefore it is not possible to list any additional species that may be typical dystrophic lakes (3160) in Ireland.

10.4.3 Conservation Status of Typical Species

In the absence of a monitoring programme the relevant information regarding typical species associated with this habitat is not available. Therefore the conservation status of typical species of natural dystrophic lakes and ponds (3160) is unknown.

10.5 Main Pressures

The selection and subsequent designation of 10 SACs for natural dystrophic lakes and ponds (3160) in the early 1990s included an assessment of activities impacting on each SAC. The information from these assessments, contained in the NATURA 2000 standard data forms, indicate that the following pressures were negatively affecting natural dystrophic lakes and ponds (3160):

120 – Fertilisation;

140 – Grazing;

160 – Forestry;

180 – Burning;

220 – Leisure fishing;

230 – Hunting;

310 – Peat extraction; and

954 – Invasive species.

10.6 Threats

The principal threat to natural dystrophic lakes and ponds (3160), as outlined in Section 4, is peat cutting, overgrazing and afforestation of peatland habitats.

10.7 Future Prospects

10.7.1 Negative Future Prospects

Deterioration of peatland habitats at current rates caused by peat cutting, drainage, forestry and burning seriously threatens the viability of dystrophic lakes and ponds. The Conservation Assessment Report estimates the extent of Active Raised Bog habitat has decreased by 36.8% in the ten year reporting period 1994-2005. Foss and O'Connell (1998) estimated that approximately 45% of the blanket bog habitat has been lost or severely damaged by peat extraction. All water bodies within the areas of peatland that have been converted to other land use or degraded can be assumed to be at high risk of degradation.

The Department of Environment, Heritage and Local Government (DEHLG) has introduced two voluntary turf cutting cessation schemes since 1999 to buy out turbary rights in NHAs and SACs. While the schemes were relatively successful in dealing with obvious commercial activity (i.e. moss peat developments), they were less successful in dealing with small scale, semi-commercial to commercial fuel peat operations and have had almost negligible impact on domestic cutting. The schemes do not appear to have significantly reduced the numbers of cutters and thus the negative effects of cutting on raised bog priority habitats (Fernandez *et al*. 2006). Thus, unless a more restrictive approach (i.e. mandatory cessation of cutting coupled by compensation packages) is taken, turf cutting is likely to continue at current levels or even escalate with increasing fuel prices.
Dystrophic lakes have been overlooked in most lake surveys and indeed the WFD lake monitoring programme, which will be initiated in 2007, includes only 1 lake with a surface area less than 1ha and therefore is unlikely to encompass few if any dystrophic lakes.

Climate change predictions of increases in temperatures accompanied by a decrease in summer rainfall would increase the summer moisture deficit of peatlands and possibly reduce dystrophic lake distribution.

10.7.2 Positive Future Prospects

In 1997 the Government introduced turbary cessation schemes for designated peatlands which requires all cutting on SAC sites to cease by the end of 2008. A similar 10-year derogation was put in place for NHAs so cutting must cease on all NHAs by the end of 2014.

Only a few examples of restoration works have been undertaken on Irish raised bogs. With assistance from the EU Cohesion Fund, NPWS commenced a *Raised Bog Restoration Project* in 1994, which ran up to the end of 1999 and included 10 sites (Ryan and Streefkerk, 1998). NPWS again carried out restoration works (i.e. blocking of drains) on three new sites in 2003 and one in 2006. The results of these restoration works are considered positive overall, as there is some expansion and new Active Raised Bog habitat formation occurring (Fernandez *et al.,* 2005).

Coillte Teoranta initiated a *Raised Bog Restoration Project* in 2004. This was funded by an EU Life - Nature Programme. This project will be completed in 2008 and forms part of Coillte's Nature Conservation Programme. The project will work towards restoring 571.2 hectares of raised bog habitat on its property in the midland counties. This project area will be managed with nature conservation as the primary management objective into the future. The project also involves the felling of 450ha of plantation forest, felling of naturally regenerated exotic trees on open bog, perimeter protection of vulnerable raised bog sites against fire, blocking of drains after felling and ongoing monitoring of vegetation and water levels on 14 sites.

A reduction in livestock numbers is likely as a result of the reform of the Common Agricultural Policy, which has changed the headage payments from an individual animal basis to payment per hectare. The EU-funded Rural Environmental Protection Scheme (REPS) introduced in 1994 aimed to reduce the negative impact of agricultural activities and includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should occur but the impacts associated with overgrazing on dystrophic lakes are likely to persist for many years.

10.7.3 Conservation Status of Future Prospects

Although certain positive management actions have been taken in recent years including peatland restoration projects, turbary cessation schemes, and land purchase, these actions seem to have only affected a small portion of the habitat resource. Negative actions such as turf cutting, drainage and burning continue impacting the peatland habitats where dystrophic lakes are primarily located.

The destruction of peatlands is having a negative affect on the future prospects of dystrophic lakes. To summarise the long-term viability of dystrophic lakes is not assured and therefore the conservation status of future prospects is deemed to be Unfavourable Bad.

10.8 Overall Assessment of the Habitat Conservation Status for 3160

Information on the range and area of natural dystrophic lakes (3160) that would enable an accurate assessment of the habitat conservation status is not currently available. Information regarding the structures and functions, including typical species, is also extremely limited. A comprehensive survey of all lake habitats is urgently required to meet Ireland's obligations under the Habitats Directive.

Based on the best available information the overall assessment of natural dystrophic lakes (3160) is Unfavourable –Bad (Table 10.1)

Table 10.1. Conservation status of natural dystrophic lakes and ponds (3160) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range	X			
Area			X	
Structures and Functions			X	
Future prospects			X	
Overall Assessment			**X**	

3160 Natural dystrophic lakes and ponds

National Level	
Habitat Code	3160
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.10.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Charles, S., (1996). *The Peat Resource of Ireland*. Global Peat Resource. Eino Lappalainen. International Peat Society. ▪ Derwin, J. & MacGowan, F., (2000). *Raised Bog Restoration Project: A Continuation of the Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland.* Unpublished report, Dúchas the Heritage Service, Dublin. ▪ Fernandez, F., Fanning, M., McCorry, M. & Crowley, W., (2005). *Raised Bog Monitoring Project 2004-05*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin. ▪ Fernandez, F., MacGowan F., Crowley, W., Farrell, M., Croal, Y., Fanning, M. & McKee, A., (2006). *Assessment of impacts of turf cutting on designated Raised Bogs 2003-06*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage Local Government, Dublin. ▪ Hammond, R.F. (1979). *The Peatlands of Ireland*. Soil and Survey Bulletin. No. 35. An Foras Taluntais (Teagasc), Dublin. ▪ Hammond, R.F. 1984. *The Classification of Irish peats as surveyed by the National Soil Survey of Ireland*. 7th International Peat Congress, Dublin. ▪ Kelly, L., Doak, M. & Dromey, M., (1995). *Raised Bog Restoration Project: An Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland.* Unpublished report, National Parks & Wildlife Service, Department of Arts, Heritage, Gaeltacht and the Islands, Dublin.
Range	
Surface area	71,700km^2
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1994 – 2005
Reasons for reported trend	3 = direct human influence
Area covered by habitat	
Distribution map	See Map (Fig 10.1) attached
Surface area	Unknown
Date	04/2007
Method used	1 = based on expert opinion
Quality of data	1 = poor
Trend	Negative
Trend-Period	1994 – 2005
Reasons for reported trend	3 = direct human influence

Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area of most lakes are considered to be stable. However most of this habitat occurs in the form of small bog pools much too small to be detected by the CORINE mapping and therefore these measurements are not reliable for this habitat type. Losses to this habitat type are still occurring due to drainage, erosion and afforestation of the bogs and wet heaths within which this habitat mainly occurs. As Dystrophic lakes can also occur on degraded areas of peat, this makes it difficult to determine the magnitude of the losses and make an appropriate assessment of the attribute.
Main pressures	140 Grazing 150 Restructuring agricultural land holding 160 General Forestry management 180 Burning 310 Peat Extraction 311 Hand-cutting of peat 312 Mechanical removal of peat 810 Drainage
Threats	140 Grazing 150 Restructuring agricultural land holding 160 General Forestry management 180 Burning 312 Mechanical removal of peat 810 Drainage
Complementary information	
Favourable reference range	71,700km^2
Favourable reference area	Unknown
Typical species	*Utricularia* spp, *Rhynchospora alba*, *R. fusca*, *Sparganium minimum*, *Sphagnum* species.
Other relevant information	The values for range and area of dystrophic lakes are based on information relating to Intact Blanket and Active Raised bogs where such lakes occur.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Area	Unknown
Specific structures and functions (incl. typical species)	Unfavourable - Bad (U2)
Future prospects	Unfavourable - Bad (U2)
Overall assessment of CS	Unfavourable - Bad (U2)

11. References

Alderman, D.J. & Wickins, J.F. 1996. Crayfish CULTURE, Laboratory Leaflet No. 76, CEFAS, Lowestoft, MAFF.

Allott, N., Brennan, M., Cooke, D.,Reynolds, J.D. and Simon, N. (1997) *Stream chemistry, hydrology and biota, Galway-Mayo Region.* Aquafor Report, Vol. 4. COFORD, Dublin.

Bowman, J.J., (1982). *The Trophic Status of Irish Lakes - Lough Ramor*. An Foras Forbartha, Dublin.

Bowman, J.J., (1985). *The Trophic Status of Irish lakes: Lough Derg.* An Foras Forbartha, Dublin.

Bowman, J.J., (1998). *The River Shannon - Results of Monitoring 1995-97.* Environmental Protection Agency.

Bowman, J.J., Clabby, K.J., Lucey, J., McGarrigle, M.L. and Toner, P.F. (1996). *Water quality in Ireland 1991- 1994.* Environmental Protection Agency, Wexford.

Bowman, J.J., McGarrigle, M.L. and Clabby K.J., 1993. *Lough Derg - An Investigation of Eutrophication and its Causes. Part 1. Water Quality Assessments, Nutrient Sources, Conclusions and Recommendations.* A Report to The Lough Derg Working Party. Environmental Research Unit.

Champ, W.S.T (1993). Lough Sheelin: a success story. In *Water of Life*, (ed. C. Mollan), 154-162. Royal Society Dublin: Dublin.

Champ, W.S.T (1998). Phosphorous/chlorophyll relationships in selected Irish lakes: ecological consequences and suggested criteria for ecosystem management. In J.G. Wilson (ed.), *Eutrophication in Irish waters*, 91–105. Dublin. Royal Irish Academy.

Cross, J.R., 1990. *The Raised Bogs of Ireland: their Ecology, Status and Conservation*. Unpublished report, Minister of State, Department of Finance.

Culleton, N., Liebhardt, W.C., Murphy,W.E., Cullen, J. and Cuddihy, A. (2000). Thirty years of phosphorus fertiliser on Irish pastures: animal–soil–water relationships. *Armis* 4231-A. Teagasc, Wexford

Cummins, T and Farrell, E, P. (2000). Effects of forest operations on acid peatland streamwater composition. *Verh. Internat. Verein. Limnol*, **27**, 1556-1559.

Curtis, T., Downes, S. and Ní Chatháin, B. (2005). North-South SHARE Project: Register of Protected Areas. *Report on and review of the relevant datasets and the nature and quality of the data included within them.* Draft report to RPS Consulting Engineers.

Curtis C.J., Evans C., Helliwell R.C. & Monteith D. (2005a) Nitrate leaching as a confounding factor in chemical recovery from acidification in UK upland waters. *Environmental Pollution* 137, 73–82.

DELG (1998). Statutory Instrument No 258 of 1998. Local Government (Water Pollution Act. 1977 (Water Quality Standards for Phosphorus) Regulations, 1998. Stationary Office, Dublin.

De Eyto, E. & Irvine, K. (2007) Assessing the status of shallow lakes using an additive model of biomass size spectra. *Aquatic Conservation: Marine and Freshwater Systems* In press

Dept Agriculture and Fisheries (1972). *National Heritage Inventory of Freshwater Habitats.*

Dillon, P.J., & Rigler, F.H. (1974). The phosphorus-chlorophyll relationship in lakes. *Limnology and Oceanography*, **19:** 767-773.

Donohue, I., Styles, D., Coxon, C.E., & Irvine, K. (2005). Importance of spatial and temporal patterns for assessment of risk of diffuse nutrient emissions to surface waters. *Journal of Hydrology* **304**: 183-192.

Downey, W.K. and Ní Uid, G. (1977). Lake pollution prevention by eutrophication control. *Proceedings of a seminar held in Killarney, Ireland.* May 10–11. National Science Council.

Duigan CA, Kovach WL, Palmer M., (2006). *Vegetation communities of British lakes: a revised classification*. Joint Nature Conservation Committee, Peterborough.

Dwyer, R B. (2000). *Protecting Nature in Ireland. The NGO Special Areas of Conservation Shadow List.* A report prepared for An Taisce, Birdwatch Ireland, Coastwatch Ireland, Irish Peatland Conservation Council, and the Irish Wildlife Trust. Published by the Irish Peatland Conservation Council.

EC, 2000, *Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*. Office for Official Publications of the European Commission, Luxembourg

EEA (2006). Corine *Land Cover 2000 – Mapping a decade of change*. European Environment Agency

EPA (2004). *Irelands Environment*. Environmental Protection Agency, Wexford

EPA (2006). *Environment in focus 2006 – Environmental Indicators for Ireland*. Environmental Protection Agency, Wexford.

Eloranta, P. (1978). Light penetration in different types of lakes in Central Finland. *Holarctic Ecology,* 1: 362-366

European Commission, (2006). *Assessment, Monitoring and reporting under Article 17 of the Habitats Directive: Explanatory Notes and Guidelines*. Draft 5, October 2006. European Commission DG XI

Evans, D. (2006). The Habitats Of The European Union Habitats Directive. *Biology And Environment: Proceedings Of The Royal Irish Academy*, Vol. 106b, No. 3, 167 - 173.

Farrell, E, P. (2002). The behaviour of nitrate and phosphate in forest soils. In: Hendrick, E. and MacLennan,L. (eds). *Forests and Water.* COFORD, Dublin

Fernandez, F., Fanning, M., Mccorry, M. & Crowley, W (2005). *Raised Bog Monitoring Project 2004-05*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Fernandez, F., MacGowan F., Crowley, W., Farrell, M., Croal, Y., Fanning, M. & McKee, A (2006). *Assessment of impacts of turf cutting on designated Raised Bogs 2003-06*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage Local Government, Dublin.

Flanagan, P.J. and Toner, P.F (1975). *A preliminary survey of Irish lakes*. Dublin. An Foras Forbartha.

Foras Forbartha, (1983). Water Quality Management Plan for the River Suir Catchment. An Foras Forbartha, Dublin

Forest Service (2000). *Forest Biodiversity Guidelines*. Forest Service, Department of the Marine and National Resources, Dublin.

Foss, P.J. and O'Connell, C.A. (1998). *The IPCC Peatland Conservation and Management Handbook*. Irish Peatland Conservation Council, Dublin.

Free, G., Bowman J., Caroni, R., Donnelly, K., Little, R., McGarrigle, M., Tierney, D., Kennedy, N., Allott, N., Irvine, K. (2005). The identification of lake types using macrophyte community composition in Ireland. *Int. Verh. Ver. Limnol.,* **29:** 296-299

Free, G., Little, R., Tierney, D., Donnelly, K., and Caroni, R (in press) - Reference based typology and ecological assessment system for Irish lakes**.**

Giller, P. S., Johnson, M. and O'Halloran, J. (2002). *Managing the impacts of forest clearfelling on stream environments*. COFORD, Dublin.

Giller, P., O'Halloran, J., Kiely, G., Evans, J., Clenaghan, C., Hernan, R., Roche, N. and Morris, P. (1997). *An evaluation of the effects of forestry on surface water quality and ecology in Munster.* Aquafor Report, Vol. 2.COFORD, Dublin.

Gunn, J., Walker, C. & Watson, R. (1997). Degradation and Restoration of Blanket Bog on Cuilcagh Mountain, County Fermanagh. *In:* Tallis, J.H., Meade, R & Hulme, P.D. (Eds.) *Blanket Mire Degradation: Proceedings of Conference, Manchester* British Ecological Society , 83-84

Hammond, R.F. (1979). *The Peatlands of Ireland*. Soil and Survey Bulletin. No. 35. An Foras Taluntais (Teagasc), Dublin.

Heuff, H. (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin.

Hobbs, W., Irvine, K. and Donohue, I. (2005). Using sediments to assess the resistance of a calcareous lake to diffuse nutrient loading. *Archive fur Hydrobiologia,* 164**:** 109-125

Horkan, J. P.K. & Toner, P.F. (1984*). The trophic status of Irish lakes: Lake Muckno.* An Foras Forbartha, Dublin.

Igoe, F., O'Grady, M.F., Tierney, D. and Fitzmaurice,P. (2003) Arctic char Salvelinus alpinus (L.) in Ireland - A millennium review of their distribution and status with conservation recommendations. *Biology and Environment: Proceedings of the Royal Irish Academy* 103B, 9-22.

Irvine, K., N. Allott, E. De Eyto, G. Free, J. White, R. Caroni, C. Kennelly, J. Keaney, C. Lennon, A. Kemp, E. Barry, S. Day, P. Mills, G. O' Ríain, B. Quirke, H. Twomey & P. Sweeney (2001)**.** *Ecological Assessment of Irish Lakes: The development of a new methodology suited to the needs of the EU Directive for Surface Waters*. Environmental Protection Agency, Ireland, 501 pp

Irvine, K., R. Boelens, J. Fitzsimmons, A. Kemp and P. Johnston (2002). *Review of monitoring and Research to meet the needs of the EU Water Framework Directive*. Environmental Protection Agency, Ireland, 147 pp.

Irvine, K., G. Free, E. de Eyto, J. White, N. Allott & P. Mills (2001). The EC Water Framework Directive and Monitoring lakes in the Republic of Ireland. *Freshwater Forum,* **16***:* 48-64.

Irvine, K., Moss B. & Balls H. (1989). The loss of submerged aquatic plants with eutrophication. II. Relationships between fish and zooplankton in experimental ponds. Conclusions. *Freshwater Biology* **22**: 89-107.

Jackson, D.L. & McLeod, C.R. (Editors), (2000). *Handbook on the UK status of EC Habitats Directive interest features: provisional data on the UK distribution and extent of Annex I habitats and the UK distribution and population size of Annex II species*, Revised 2002, JNCC Report 312.

Johannson, L. & Persson, L., (1986). Planktivorous fish. In *Carbon dynamics in eutrophic temperate lakes.* (eds. Riemann, B. & Sondergaard, M.) 237-266.

John, D.M., Champ, W.S.T. and Moore, J.A. (1982). The changing status of *Characeae* in four marl lakes in the Irish midlands. *Journal of Life Sciences of the Royal Dublin Society* **4**, 47–71.

Johnes P., Moss, B. & Phillips, G. (1994). *Lakes-classification and monitoring. A strategy for the classification of lakes*. National Rivers Authority, R&D Project Record 286/6/A.

Kelly-Quinn, M., Tierney, D., Coyle, S. and Bracken, J.J. (1997) *Stream chemistry, hydrology and biota, Wicklow Region.* Aquafor Report, Vol. 3. COFORD, Dublin.

Kennedy, G.J.A. & Strange, C.D., 1978. Seven years on – a continuing investigation of salmonid stocks in Lough Erne tributaries. *Journal of Fish Biology*, **12**; 325-330.

Kennedy, M and Fitzmaurice, P. (1971). Growth and food of brown trout, *Salmo trutta,* in Irish waters. *Royal Irish Academy,* 71: Sect B, (18).

King, J. J. and Caffrey, J. M. (1998). Macrophytes in Irish lakes and rivers: an overview of investigations and current knowledge. *In:* Giller, P.S. (ed) *Studies in Irish Limnology.* Marine Institute, Dublin, pp 101-124.

King, J.J. and Champ, W.S.T. (1997). *Macrophytes of L. Corrib and L. Carra. An interim report.* Central Fisheries Board, Dublin.

Krause, W. and King, J.J. (1994). The ecological status of Lough Corrib, Ireland, as indicated by physiographic factors, water chemistry and macrophyte flora. *Vegetatio* **110**, 149–61.

Leira, M., Jordan, P., Taylor, D. Dalton, C., Bennion, H., Rose, N and Irvine, K. (2006). Assessing the biological status of candidate reference lakes in Ireland using palaeolimnology. *Journal of Applied Ecology,* **43**: 816-827.

Lucey, J. (2006). Water Quality in Ireland 2005 – key Indicators of the Aquatic Environment. Environmental Protection Agency, Wexford.

Lucey, J., Bowman, J.J., Clabby, K.J., Cunningham, P.,Lehane, M., MacCarthaigh, M., McGarrigle, M.L.and Toner, P.F. (1999). *Water Quality in Ireland 1995 –1997*. Environmental Protection Agency, Wexford.

Lucy, F., Sullivan, M., & Minchin, D (2005). *Nutrient levels and the zebra mussel population in Lough Key*. Environmental Protection Agency, Wexford

Lynn, D. (2006). Site Monitoring: Monitoring Impacts and Activities. Guidelines for form completion: Site Inspection Report. Internal memo, Monitoring Section Research Branch. NPWS.

Lyons, R., Kelly-Quinn, M. (2003) An investigation into the disappearance of *Austropotamobius pallipes* (Lereboullet) populations in the headwaters of the Nore River, Ireland, and the correlation to water quality. *Bulletin Français de la Pêche et de la Pisciculture* 370–371: 139-150

Maguire, C., Rosell, R., & Roberts, D (2005). *Management of the Impacts of Zebra Mussels in Northern Ireland and Determination of Effects on Fish Populations in Lough Erne through Alterations of the Food Web*. Environment and heritage Service, Belfast.

Matthews, M. & Reynolds, J.D., (1992). Ecological impact of crayfish plague in Ireland. *Hydrobiologia*, **234**; 1-6.

Matthews, M.A., Reynolds, J.D. & Keatinge, M.J., (1993). Macrophyte reduction and benthic community alteration by the crayfish *Austropotamobius pallipes* (Lereboullet). *Freshwater Crayfish*, 9, 289-299.

Monahan C, and Caffrey J.M. (1997) *Aquatic plant management in the Shannon-Erne Fisheries Development Programme 1996-1999*: Annual report for 1996. Central Fisheries Board, Dublin

Moss, B. (1983). The Norfolk Broadland: Experiments in the restoration of a complex wetland. *Biological Reviews,* 58**:** 521-561.

Moss, B., Johnes, P. & Phillips, G. (1996). The monitoring of ecological quality and the classification of standing waters in temperate regions: a review and proposal based on a worked scheme for British waters. *Biological Review,***71:** 301-339.

McAree, D. (2002). *The Forest Service Biodiversity Plan*. Biology and Environment: Proceedings of the Royal Irish Academy, Vol.102B, No.3, 183-184.

McCarthy, V., Donohue, I., and Irvine (2006). Field evidence for stoichiometric relationships between zooplankton and N and P availability in a shallow calcareous lake. *Freshwater Biology.* **51:** 1589-1604

McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucey, J., Cunningham, P., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C. and Toner, P.F. (2002) Water quality in Ireland 1998- - 2000. Environmental Protection Agency, Wexford.

McGarrigle, M L, Champ, W. S. T.., Norton, R., Larkin, P. and Moore, M., (1994). *The Trophic Status of Lough Conn. An investigation into the causes of recent accelerated eutrophication.* Mayo County Council

NPWS (2005). Management Plan for the Wicklow Mountains National Park.

O.E.C.D. (1982). *Eutrophication of waters. Monitoring, assessment and control*. O.E.C.D. Publication N° 42077, Paris: 154 pp.

O'Callaghan Moran & Associates (2007). *Establishing natural background levels for groundwater in Ireland.* Southeastern River Basin District Project. Draft document, February 26, 2007

O,Riain, G., Duff, K. and Long, M. (2003). *Identification and ranking of nature conservation Designated Area, where the status of water is an important factor*. Environmental Proteection Agency, Wexford. Environmental RTDI Programme 2000-2006.

Palmer, M (1992). *A botanical classification of standing waters in Great Britain and a method for the use of macrophyte flora in assessing changes in water quality incorporating a reworking of data*. Joint Nature Conservation Committee, Peterborough.

Premazzi, G. & Chiaudani, G. (1992). *Ecological Quality of Surface Waters. Quality assessment schemes for European Community lakes.* Joint Research Centre, European Commission, Brussels. 124 pp.

Preston, C. D. & J. M. Croft, (1997). *Aquatic plants in Britain and Ireland*. Harley Books, Colchester, U.K: 365 pp.

Reynolds, J.D., (1988). Crayfish extinctions and crayfish plague in Ireland. *Biological Conservation*, **45**; 279-285.

Rosell, R. S., (1994). Changes in fish populations in Lower Lough Erne: a comparison of 1972-3 and 1991-2 gill net survey data. *Biology and Environment: Proceedings of the Royal Irish Academy*, **94B**, 275-283.

Ryan, J. & Cross, J., (1984). *The Conservation of Peatlands in Ireland*. Proceedings of the 7th International Peat Congress, Dublin, 389-406.

Ryan, J. & Streefkerk, J. (1998). Raised Bogs – Conservation problems and solutions. In O'Leary, G. and Gormley, F. (eds) *Towards a Conservation Strategy for the Bogs of Ireland*, pp. 127-136. Irish Peatland Conservation Council, Dublin.

Salmon Research Agency (SRA) of Ireland (1994). Annual Report No 38. Newport, Mayo

Scheffer, M., Hosper, S. H., Meijer, M. L., Moss, B. and Jeppesen, E. (1993). *Alternative Equilibria in Shallow Lakes.* Trends in Ecology & Evolution, 8: 275-279

Stapleton L., Lehane M., Toner P. (eds.) (2000). *Ireland's Environment. A millennium report*. Environmental Protection Agency, Wexford.

Stokes, K., O'Neill, K. & McDonald, R.A. (2004). *Invasive species in Ireland*. Unpublished report to Environment & Heritage Service and National Parks & Wildlife Service. Quercus, Queens University Belfast, Belfast.

Toner, P.F., (1979). *The Trophic Status of Irish Lakes, Lough Key*. An Foras Forbatha, Dublin.

Toner P., Bowman J., Clabby K., Lucey J., McGarrigle M., Clenaghan C., Cunningham P., Delaney J., O'Boyle S., MacCárthaigh M., Craig M. and Quinn R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford

Tunney, H., Coulter, B., Daly, K., Kurz, I., Coxon, C., Jeffrey, D., Mills, P., Kiely, G. and Morgan, G. (2000). *Quantification of phosphorus loss to water due to soil P desorption. Final Report.* Environmental Monitoring R&D Report Series No. 6. Environmental Protection Agency, Wexford.

Vollenweider, R. A. (1968). Scientific fundamentals of stream and lake eutrophication with particular reference to nitrogen and phosphorus. *OECD Technical Report DAF/DST/88.* Organisation for Economic Cooperation and Development, Paris

Wemeare, A. (2005) *Influence of catchment characteristics on the relationship between land use and lake water quality in County Clare.* Ph D thesis, University of Dublin

Wetzel, R. (2001). *Limnology. Lake and River Ecosytems.* Third Edition Academic Press.

Wolfe-Murphy, S.A., Lawrie, E.W., Smith, S.J. and Gibson, C.E. (1992). *The Northern Ireland Lakes Survey*. Report for Countryside and Wildlife Branch, DoE (Northern Ireland).

Appendix 1. Trophic classification scheme for lake waters proposed by the OECD (OECD, 1982).

Lake Category	Total Phosphorus (mg/m^3)	Chlorophyll (mg/m^3)		Transparency (m)	
	Mean	Mean	Max	Mean	Min
Ultra - Oligotrophic	<4	<1.0	<2.5	>12	>6
Oligotrophic	<10	<2.5	<8	>6	>3
Mesotrophic	10-35	2.5-8	8-25	3-6	1.5-3
Eutrophic	35-100	8-25	25- 75	1.5-3	1.5-0.7
Hypertrophic	>100	>25	>75	<1.5	<0.7

Appendix 2. EPA modified version of the OECD scheme based on values of annual maximum chlorophyll concentration.

Classification Scheme		Category Description			
Lake Trophic category	**Annual Max. Chlorophyll mg/m3**	**Algal Growth**	**Deoxygenation in Hypolimnion**	**Level of Pollution**	**Impairment of Use of Lake**
Oligotrophic	<8	Low	Low	Very low	Probably none
Mesotrophic	8-25	Moderate	Moderate	Low	Very little
Moderately Eutrophic	25-35	Substantial	May be high	Significant	May be appreciable
Strongly Eutrophic	35-55	High	High	Strong	Appreciable
Highly Eutrophic	55-75	High	Probably total	High	High
Hypertrophic	>75	Very high	Probably total	Very high	Very high

Appendix 3. Macrophyte surveys of the 64 lake SACs

Site code	Site name	3110	3130	3140	3150	3160	Macrophyte data collected by
000007	Lough Oughter and Associated Loughs SAC				√		Heuff + CFB
000014	Ballyallia Lake SAC				√		Heuff
000032	Dromore Woods and Loughs SAC				√		Heuff + EPA
000093	Caha Mountains SAC		√			√	
000142	Gannivegil Bog SAC	√					
000158	Lough Akibbon and Gartan Lough SAC	√					Heuff
000163	Lough Eske and Ardnamona Wood SAC	√					
000165	Lough Nillan Bog (Carrickatlieve) SAC	√					
000185	Sessiagh Lough SAC	√					CFB
000194	Tranarossan and Melmore Lough SAC			√			
000197	West of Ardara/Maas Road SAC	√					EPA
000252	Coole-Garryland Complex SAC				√		
000297	Lough Corrib SAC	√		√			Heuff + CFB
000304	Lough Rea SAC			√			EPA
000365	Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC	√	√				Heuff + EPA
000370	Lough Yganavan and Lough Nambrackdarrig SAC	√					Heuff
000375	Mount Brandon SAC		√				
000428	Lough Melvin SAC		√				EHS + EPA
000440	Lough Ree SAC				√		CFB
000470	Mullet / Blacksod Bay Complex SAC				√		EPA
000500	Glenamoy Bog Complex SAC					√	
000534	Owenduff/Nephin Complex SAC	√	√		√	√	EPA
000584	Cuilcagh-Anierin Uplands SAC		√			√	
000607	Errit Lough SAC			√			Heuff
000633	Lough Hoe Bog SAC	√					EPA
000636	Templehouse and Cloonacleigha Loughs SAC			√			EPA
000688	Lough Owel SAC			√			Heuff + EPA
000708	Screen Hills SAC	√					Heuff
001141	Gweedore Bay and Islands SAC	√					Heuff + EPA
001151	Kindrum Lough SAC	√					EPA
001228	Aughrusbeg Machair and Lake SAC	√					EPA
001309	Omey Island Machair SAC			√			
001311	Rusheenduff Lough SAC	√					
001312	Ross Lake and Woods SAC			√			EPA
001342	Cloonee and Inchiquin Loughs, Uragh Wood SAC	√					Heuff +EPA
001571	Urlaur Lakes SAC			√			EPA
001673	Lough Arrow SAC			√			CFB
001774	Lough Carra/Mask Complex SAC	√		√			CFB
001786	Kilroosky Lough Cluster SAC			√			
001810	White Lough, Ben Loughs and Lough Doo SAC			√			
001818	Lough Forbes Complex SAC				√		EPA
001879	Glanmore Bog SAC	√					EPA
001919	Glenade Lough SAC				√		Heuff
001922	Bellacorick Bog Complex SAC					√	
001926	East Burren Complex SAC			√			Heuff + EPA
001932	Mweelrea/Sheeffry/Erriff Complex SAC	√	√			√	EPA
001952	Comeragh Mountains SAC		√				Heuff
001975	Ballyhoorisky Point to Fanad Head SAC	√		√			

Site code	Site name	3110	3130	3140	3150	3160	Macrophyte data collected by
001976	Lough Gill SAC				√		
002006	Ox Mountains Bogs SAC	√				√	EPA
002008	Maumturk Mountains SAC	√					EPA
002031	The Twelve Bens/Garraun Complex SAC	√					EPA
002032	Boleybrack Mountain SAC					√	
002034	Connemara Bog Complex SAC	√			√	√	Heuff + EPA
002047	Cloghernagore Bog and Glenveagh National Park SAC	√					Heuff + EPA
002074	Slyne Head Peninsula SAC	√		√			EPA
002118	Barnahallia Lough SAC	√					
002119	Lough Nageeron SAC	√					
002120	Lough Bane and Lough Glass SAC			√			EPA
002121	Lough Lene SAC			√			EPA
002122	Wicklow Mountains SAC		√			√	Heuff + EPA
002130	Tully Lough SAC	√					
002176	Leannan River SAC	√					EPA
002301	River Finn SAC	√					EPA

CFB - Central Fisheries Board

EPA - Environmental Protection Agency

Heuff, H. (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin

Appendix 4. EPA Lake Monitoring Programme

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Abisdealy	SW_20_148	Cork		1		
Acoose	SW_22_208	Kerry	1	1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Acorrymore	WE_33_1892	Mayo		1	001955	CROAGHAUN/SLIEVEMORE
Acres	SH_26_681	Leitrim		1		
Acurry	EA_07_242	Cavan		1		
Agannive	NW_38_665	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
Aille	WE_30_532	Mayo		1		
Akibbon	NW_39_11	Donegal		1		
Alewnaghta	SH_25_189	Clare	1	1		
Allen	SH_26_716	Leitrim		1		
Allua	SW_19_4	Cork	1	1		
an tSeisigh	NW_38_61	Donegal	1	1	000185	SESSIAGH LOUGH
Anaserd	WE_31_211	Galway		1	002074	SLYNE HEAD PENINSULA
Anillaun	WE_30_348	Galway		1		
Annagh	NW_36_517	Cavan		1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Annagh or White Lough	EA_07_258	Meath	1	1	001810	WHITE LOUGH, BEN LOUGHS AND LOUGH DOO
Annaghmore	SH_26_669	Roscommon	1	1	001626	ANNAGHMORE LOUGH (ROSCOMMON)
Annary	WE_35_131	Leitrim		1		
Anure	NW_38_83	Donegal	1	1		
Ardan	NW_36_432	Cavan		1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Ardderry	WE_31_76	Galway	1	1	002034	CONNEMARA BOG COMPLEX
Arrow	WE_35_159	Roscommon	1	1	001673	LOUGH ARROW
Atedaun	SH_27_108	Clare	1	1	001926	EAST BURREN COMPLEX
Atrain	NW_36_618	Cavan		1		LOUGH OUGHTER AND ASSOCIATED LOUGHS
Aughrusbeg	WE_32_436	Galway	1	1	001228	AUGHRUSBEG MACHAIR AND LAKE
Aunwillan	WE_31_120	Galway		1		
Avaghon	NW_36_638	Monaghan		1		
Awallia	WE_31_1	Galway		1	002034	CONNEMARA BOG COMPLEX
Ballin	SW_20_150	Cork		1		

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Ballin	WE_32_364	Mayo		1		
Ballybeg	SH_27_123	Clare		1		NEWHALL AND EDENVALE COMPLEX
Ballycar	SH_27_193	Clare		1		
Ballynahinch Lake	WE_31_228	Galway		1	0020	CONNEMARA BOG COMPLEX AND THE TWELVE BENS/GARRAUN COMPLEX
Ballynakill	WE_32_479	Galway		1		
Ballyquirke	WE_30_340	Galway		1		
Ballyscanlan	SE_16_460	Waterford		1		
Ballyshunnock	SE_16_463	Waterford		1		
Bane	EA_07_270	Meath	1	1	IE0002120	LOUGH BANE AND LOUGH GLASS
Barra	NW_38_84	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
Bawn	NW_36_573	Cavan		1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Beaghcauneen	WE_32_402	Galway		1	002034	CONNEMARA BOG COMPLEX
Bekan	WE_30_341	Mayo		1		
Belhavel	WE_35_155	Leitrim		1		
Belle	SE_17_5	Waterford		1		
Birroge	NW_38_57	Donegal		1	000197	WEST OF ARDARA/MAAS ROAD
Black Lough	NW_36_278	Monaghan		1		
Bleach	SH_24_90	Limerick		1		
Boderg	SH_26_747b	Leitrim		1		
Bofin	WE_30_335	Galway		1		
Bofin	SH_26_747a	Leitrim		1		
Bofinna	SW_21_448	Cork		1		
Bray Lower	EA_10_28	Wicklow		1	IE0002122	WICKLOW MOUNTAINS
Bridget	SH_27_117	Clare		1		
Brin	SW_21_402	Kerry	1	1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Bunerky	NW_36_624	Cavan		1		
Bunny	WE_27_114	Clare	1	1	001926	EAST BURREN COMPLEX
Caherglassaun	WE_29_190	galway		1		
Cam	SH_23_74	Kerry	1	1	000375	MOUNT BRANDON
Caragh	SW_22_207	Kerry	1	1		KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Carra	WE_30_347	Mayo	1	1	001774	LOUGH CARRA/MASK COMPLEX
Carrigavantry Reservoir	SE_17_8	Waterford		1		
Carrigdrohid Reservoir	SW_19_139	Cork		1		THE GEARAGH

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Carrowmore	WE_33_1914	Mayo	1	1	000476	CARROWMORE LAKE COMPLEX
Castle	SH_27_74	Clare		1		
Cavetown	SH_26_705	Roscommon	1	1		
Cloonaghlin	SW_21_443	Kerry		1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Conn	WE_34_406b	Mayo		1	002298	RIVER MOY
Coole Lough	WE_29_196á	galway		1		
Coolkellure	SW_20_153	Cork		1		
Coosan	SH_26_750b	Westmeath		1		
Corcaghan	NB_03_71	Monaghan		1		
Corglass	NW_36_655	Cavan	1	1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Corrib Lower	WE_30_666a	Galway Co. Borough	1	1	000297	LOUGH CORRIB
Corrib Upper	WE_30_666b	Galway	1	1	000297	LOUGH CORRIB
Cross	WE_33_1889	Mayo		1	000470	MULLET/BLACKSOD BAY COMPLEX
Cullaun	SH_27_115	Clare	1	1	001926	EAST BURREN COMPLEX
Cullaunyheeda	SH_27_128	Clare		1		
Cullin	WE_34_406a	Mayo	1	1	002298	RIVER MOY
Cullinaghan	NW_36_385	Cavan		1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Cummernamuck	SW_22_199	Kerry		1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Curraghalicky	SW_20_158	Cork		1		
Currane	SW_21_457	Kerry		1		KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Dan	EA_10_29	Wicklow	1	1	IE0002122	WICKLOW MOUNTAINS
Derg	NW_01_115	Donegal		1	002301	RIVER FINN
Derg	SH_25_191a	Tipperary N.R.& Clare	1	1	002241	LOUGH DERG, NORTH-EAST SHORE
Derg pHMWB	SH_25_191b	Tipperary N.R.& Clare		1		LOWER RIVER SHANNON
Derravaragh	SH_26_708	Westmeath		1		
Derrybrick	NW_36_400	Cavan	1	1		LOUGH OUGHTER AND ASSOCIATED LOUGHS
Derrycassan	NW_36_514	Cavan		1		
Derryclare	WE_31_227	Galway		1	002031	THE TWELVE BENS/GARRAUN COMPLEX/CONNEMARA BOG COMPLEX
Doo	SH_28_82	Clare		1	001932	MWEELREA/SHEEFFRY/ERRIFF COMPLEX
Doo	WE_32_490	Mayo	1	1		
Dromore	SH_27_82	Clare	1	1	000032	DROMORE WOODS AND LOUGHS
Drumkeery	EA_07_268	Cavan		1		

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Drumlaheen	NW_36_614	Leitrim		1		
Drumlona	NW_36_525b	Monaghan		1		
Drumore	NW_36_525a	Monaghan		1		
Dunglow	NW_38_692	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
Easky	WE_35_136	Sligo	1	1	002006	OX MOUNTAINS BOGS
Egish	NW_36_671	Monaghan	1	1		
Emy	NB_03_102	Monaghan		1		
Enask	WE_32_333	Galway		1	002034	CONNEMARA BOG COMPLEX
Ennell	SH_25_188	Westmeath		1	000685	LOUGH ENNELL
Eske	NW_37_188	Donegal		1	000163	LOUGH ESKE AND ARDNAMONA WOOD
Fad	NW_40_2	Donegal		1		
Fadda	WE_32_501	Galway		1	002034	CONNEMARA BOG COMPLEX
Fallaneas	NW_38_194	Donegal		1	001151	KINDRUM LOUGH
Feeagh	WE_32_510	Mayo		1	000534	OWENDUFF/NEPHIN COMPLEX
Fern	NW_39_13	Donegal	1	1		
Finn	NW_01_102	Donegal		1	002301	RIVER FINN
Forbes	SH_26_723	Longford		1	001818	LOUGH FORBES COMPLEX
Funshinagh	SH_26_701	Roscommon		1	000611	LOUGH FUNSHINAGH
Gara	SH_26_728	Roscommon		1		CALLOW BOG
Garadice	NW_36_648	Leitrim		1		
Gartan	NW_39_12	Donegal		1	0001	LOUGH AKIBBON AND GARTAN LOUGH
Garty	NW_36_430	Cavan		1		
Gill	SW_23_72	Kerry		1	002070	TRALEE BAY AND MAGHAREES PENINSULA, WEST TO CLOGHANE
Gill	WE_35_158	Sligo	1	1	001976	LOUGH GILL
Glasshouse	NW_36_615	Cavan		1		
Glen	NW_38_22	Donegal		1		
Glenade	WE_35_156	Leitrim	1	1	001919	GLENADE LOUGH
Glenasmole Reservoirs	EA_09_68	South Dublin		1		GLENASMOLE VALLEY
Glenasmole Reservoirs	EA_09_70	South Dublin		1		GLENASMOLE VALLEY
Glenbeg	SW_21_444	Cork	1	1		GLANMORE BOG
Glencar	WE_35_139	Leitrim	1	1	000623	BEN BULBEN, GLENIFF AND GLENADE COMPLEX
Glencullin	WE_32_487	Mayo	1	1	001932	MWEELREA/SHEEFFRY/ERRIFF COMPLEX
Glinn	SH_26_661	Roscommon		1		

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Golagh	NW_36_715	Donegal		1	002164	LOUGH GOLAGH AND BREESY HILL
Gortglass	SH_27_122	Clare		1		
Gowna	NW_36_524	Cavan		1		
Graney	SH_25_190	Clare		1		
Grange	SH_26_706	Roscommon		1		
Guitane	SW_22_172	Kerry		1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Gur	SH_24_99	Limerick	1	1		
Holan	WE_34_458	Mayo		1		
Illauntrasna	WE_99_102	Galway		1		
Inchicronan	SH_27_126	Clare	1	1		
Inchiquin	SH_27_130	Clare		1	001926	EAST BURREN COMPLEX
Inchiquin	SW_21_452	Kerry		1		CLOONEE AND INCHIQUIN LOUGHS, URAGH WOOD
Inner	NW_36_526	Monaghan		1		
Inniscarra Reservoir	SW_19_138	Cork		1		
Keagh	SH_28_64	Clare		1		
Keel	NW_38_576	Donegal		1		CLOGHERNBAGORE BOG AND GLENVEAGH NATIONAL PARK
Keel	NW_38_75	Donegal		1		
Keel	WE_33_1895	Mayo		1	001513	KEEL MACHAIR/MENAUN CLIFFS
Key	SH_26_724	Roscommon		1		
Killinure	SH_26_750c	Westmeath		1	000440	LOUGH REE
Killinure	SH_26_750d	Westmeath		1	000440	LOUGH REE
Kilsellagh	WE_35_17	Sligo		1		
Kiltooris	NW_38_47	Donegal	1	1		WEST OF ARDARA/MAAS ROAD
Kinale	SH_26_678	Cavan		1		
Kindrum	NW_38_670	Donegal	1	1	001151	KINDRUM LOUGH
Kinny	NW_38_59	Donegal		1		BALLYHOORISKY POINT TO FANAD HEAD
Knappabeg	WE_32_483	Mayo		1		
Knockaderry Reservoir	SE_16_294	Waterford		1		
Kylemore	WE_32_509b	Galway	1	1	002031	THE TWELVE BENS/GARRAUN COMPLEX
Lannagh	WE_34_403	Mayo		1		
Lattone Lough	NW_35_143	Leitrim	1	1		
Leane	SW_22_185	Kerry	1	1		KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Lene	EA_07_274	Westmeath	1	1	IE0002121	LOUGH LENE

Lettercraffoe	WE_30_344	Galway	1	1	002034	CONNEMARA BOG COMPLEX
LAKE	**WFD Code**	**Local Authority**	**Surveillance Monitoring**	**Operational Monitoring**	**SAC Code**	**SAC Name**
Levally	WE_34_368	Mayo		1	002298	RIVER MOY
Lickeen	SH_28_85	Clare	1	1		
Loughaunore	WE_31_177	Galway		1		
Macnean Lower	NW_36_445	Cavan	1	1		
Macnean Upper	NW_36_673	Cavan	1	1		
Mask	WE_30_665	Mayo		1	001774	LOUGH CARRA/MASK COMPLEX
Maumwee	WE_30_343	Galway	1	1	002008	MAUMTURK MOUNTAINS
Meelagh	SH_26_711	Roscommon	1	1		
Melvin	NW_35_160	Leitrim	1	1	000428	LOUGH MELVIN
Mill	NW_36_597	Cavan		1		LOUGH OUGHTER AND ASSOCIATED LOUGHS
Moher	WE_32_406	Mayo		1		
Monalty	NB_06_234	Monaghan		1		
Mourne	NW_01_104	Donegal		1		CROAGHONAGH BOG
Muckanagh	SH_27_94	Clare	1	1	001926	EAST BURREN COMPLEX
Muckno or Blayney	NB_06_56	Monaghan	1	1		
Muckross	SW_22_184	Kerry		1		KILLARNEY NATIONAL PARK, MAGILLACUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Nacarriga	WE_29_181	Clare	1	1	001926	EAST BURREN COMPLEX
Nadreegeal	EA_07_273	Cavan		1		
Naglack	NB_06_55	Monaghan		1		
Nahasleam	WE_31_208	Galway		1		
Nambrackkeagh	WE_32_422	Galway		1		
Nambrackmore	WE_32_500	Galway	1	1	002034	CONNEMARA BOG COMPLEX
Naminna	SH_28_87	Clare		1		
Namona	SW_21_421	Kerry		1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Nanoge	SH_26_580	Mayo	1	1	001571	URLAUR LAKES
Nasnanida	NW_38_67	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
O'Flynn	SH_26_693	Roscommon	1	1		
Oughter	NW_36_657	Cavan		1	000007	LOUGH OUGHTER AND ASSOCIATED LOUGHS
Owel	SH_26_703	Westmeath	1	1	000688	LOUGH OWEL
Pollacappul	WE_32_509a	Galway		1	002031	THE TWELVE BENS/GARRAUN COMPLEX/CONNEMARA BOG COMPLEX
Pollaphuca Reservoir	EA_09_71	Wicklow		1		

LAKE	WFD Code	Local Authority	Surveillance Monitoring	Operational Monitoring	SAC Code	SAC Name
Ramor	EA_07_275	Cavan		1		RIVER BOYNE AND RIVER BLACKWATER
Rea	WE_29_194	Galway	1	1	000304	LOUGH REA
Ree	SH_26_750a	Longford		1	000440	LOUGH REE
Reelan	NW_38_514	Donegal		1		
Rinn	SH_26_700	Leitrim		1		
Rosroe	SH_27_120	Clare		1		
Ross	WE_30_345	Galway	1	1	001312	ROSS LAKE AND WOODS
Rowan	SH_26_738	Leitrim		1		
Salt	NW_38_649	Donegal		1		
Scur	NW_36_665	Leitrim		1		
Shannagh	NW_38_678	Donegal		1		BALLYHOORISKEY POINT TO FANAD HEAD
Sheelin	SH_26_709	Cavan	1	1	002340	MONEYBEG AND CLAREISLAND BOGS
Shindilla	WE_31_171	Galway	1	1	002008	MAUMTURK MOUNTAINS
Sillan	NW_36_528	Cavan		1		
Skeagh (Schull Reservoir)	SW_20_53	Cork		1		
Summerhill Lough		Donegal		1		
Tacker	NW_36_363	Cavan		1		
Talt	WE_34_405	Sligo	1	1	000633	LOUGH HOE BOG
Tay	EA_10_25	Wicklow	1	1	002122	WICKLOW MOUNTAINS
Templehouse	WE_35_157	Sligo	1	1	000636	TEMPLEHOUSE AND CLOONACLEIGHA LOUGHS
Tooreen	SW_20_133	Cork		1	001040	BARLEY COVE TO BALLYRISODE POINT
Tully	WE_32_474	Galway		1	002130	TULLY LOUGH
Tullynasiddagh Lough	NW_36_651	Donegal		1		
Unshin	NW_36_712	Donegal		1		LOUGH GOLAGH AND BREESY HILL
Upper	SW_22_186	Kerry	1	1		
Upper Lake Glendalough	EA_10_32	Wicklow		1	000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT
Upper Lough Erne	NW_36_672	Cavan	1	1		
Upper Lough Skeagh	EA_07_267	Cavan	1	1		
Vartry	EA_10_10	Wicklow		1		
Veagh Lower	NW_38_80a	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
Veagh Upper	NW_38_80b	Donegal	1	1	002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK
Vearty	NW_36_711	Donegal		1		TAMUR BOG

Washpool	WE_34_402	Mayo		1		
White	NW_36_647	Monaghan	1	1		

Appendix 5. Descriptions of five freshwater habitats as provided by The Interpretation Manual of European Union Habitats

3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae)*

1) Shallow oligotrophic waters with few minerals and base poor, with an aquatic to amphibious low perennial vegetation belonging to the *Littorelletalia uniflorae* order, on oligotrophic soils of lake and pond banks (sometimes on peaty soils). This vegetation consists of one or more zones, dominated by *Littorella*, *Lobelia dortmana* or *Isoetes,* although not all zones may not be found at a given site.

2) Plants: *Isoetes lacustris*, *I. echinospora*, *Littorella uniflora*, *Lobelia dortmanna*, *Deschampsia setacea*, *Subularia aquatica*, *Juncus bulbosus*, *Pilularia globulifera*, #*Luronium natans*, *Potamogeton polygonifolius*; in the Boreal region also *Myriophyllum alterniflorum*, *Drepanocladus* spp., *Warnstorfia* spp. and *Fontinalis* spp.

3) Corresponding categories
German classification : "24020201 kalkarmer, oligotropher See des Tief- und Hügellands", "24020301 kalkarmes, oligotrophes, sich selbst überlassenes Abbaugewässer".
Nordic classification: "6413 *Lobelia dortmanna-Isoetes* spp.typ", "6414 *Littorella uniflora-Lobelia dortmanna*-typ". In the Boreal region this habitat is particularly found on glacio fluvial soil and with usually dense isoetid vegetation, sparse reedbeds, helophytic vegetation and carpets of submerged bryophytes.

4) This habitat is found in association with heath (31.1) and *Nanocyperion* (22.32) communities. In France and Ireland this habitat occurs, in particular, in heathland of sandy plains on podzols, where the water table occurs at the surface

5) Mäkirinta, U. (1978). *Die Pflanzensoziologische Gliederung der Wasservegetation im See Kukkia, Südfinnland*. Acta Univ. Ouluensis Ser. A. Scientiae Rerum Naturalium Nr. 75, biologica Nr.5.
Thunmark, S. (1931). Der See Fiolen und seine Vegetation. *Acta Phytogeogr. Suecica*. II:1-198.

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto- Nanojuncetea*

1) 22.12 x 22.31 - aquatic to amphibious short perennial vegetation, oligotrophic to mesotrophic, of lake, pond and pool banks and water-land interfaces belonging to the *Littorelletalia uniflorae* order.
22.12 x 22.32 - amphibious short annual vegetation, pioneer of land interface zones of lakes, pools and ponds with nutrient poor soils, or which grows during periodic drying of these standing waters: *Isoeto- Nanojuncetea* class.
These two units can grow together in close association or separately. Characteristic plant species are generally small ephemerophytes.

2) Plants: 22.12 x 22.31: *Littorella uniflora*, #*Luronium natans*, *Potamogeton polygonifolius*, *Pilularia globulifera*, *Juncus bulbosus* ssp. *bulbosus*, *Eleocharis acicularis*, *Sparganium minimum*.
22.12 X 22.32 : #*Lindernia procumbens*, *Elatine* spp., *Eleocharis ovata*, *Juncus tenageia*, *Cyperus fuscus*, *C.flavescens*, *C.michelianus*, *Limosella aquatica*, *Schoenoplectus supinus, Scirpus setaceus*, *Juncus bufonius*, *Centaurium pulchellum*, *Centunculus minimus*, *Cicendia filiformis*.

3) Corresponding categories

German classification : "240301 mesotropher See (Bleisee) (mit Zwergbinsenfluren -wechselnass-,P143)", "240306 meso- bis eutrophes, sich selbst überlassenes Abbaugewässer (mit Zwergbinsenfluren -wechselnass-, P143)".
Nordic classification : "6411 *Eleocharis acicularis*-typ", "6412 *Ranunculus reptans-Subularia aquatica*-typ".
in the Azores the corresponding association is *Isoetetum azorica* Lüp.

4) This habitat type could also develop in wet dune slacks (see 16.32 in 2190, included in Annex I). In the Atlantic region, such lakes can shelter glacial relict species, e.g. fish such as *Selvelinus alpinus*. Areas with a variable hydrological system, periodically lacking vegetation due to trampling, should not be included.

5) Jenssen, S. (1979). Classification of lakes in southern Sweden on the basis of their macrophyte composition by means of multivariate methods. *Vegetatio* 39:129-146.

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

1) Lakes and pools with waters fairly rich in dissolved bases (pH often 6-7) (21.12) or with mostly blue to greenish, very clear, waters poor (to moderate) in nutrients, base-rich (pH often >7.5) (21.15). The bottom of these unpolluted water bodies are covered with charophyte, *Chara* and *Nitella*, algalcarpets. In the Boreal region this habitat type includes small calcareous-rich oligo-mesotrophic gyttja pools with dense *Chara* (dominating species is *C. strigosa*) carpets, often surrounded by various eutrophic fens and pine bogs.

2) Plants: *Chara* spp., *Nitella* spp.

3) Corresponding categories
Nordic classification : "633 Långskottsvegetation med kransalger", "6421 *Littorella uniflora-Chara* spp. -typ"

5) Lundh, A. (1951). Studies on the vegetation and hydrochemistry of Scanian lakes. III. Distribution of macrophytes and some algal groups. *Bot. Not. Suppl*. 3(1):1-138.

Rintanen, T. (1982). Botanical lake types in Finnish Lappland. *Ann. Bot. Fennici* 19:247-274.

3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation

1) Lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7), with free-floating surface communities of the *Hydrocharition* or, in deep, open waters, with associations of large pondweeds (*Magnopotamion*).

2) Plants: *Hydrocharition - Lemna* spp., *Spirodela* spp., *Wolffia* spp., *Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, #Aldrovanda vesiculosa,* Ferns (*Azolla*), Liverworts (*Riccia* spp., *Ricciocarpus* spp.); *Magnopotamion - Potamogeton lucens, P. praelongus, P. zizii*, *P. perfoliatus*.

3) Corresponding categories
Nordic classification : "632 *Potamogeton* spp.-huvudtyp", "6511 *Lemna minor-Spirodela polyrrhiza*typ".

5) Dahl, E., Kalliola, R., Marker, E. & Persson, Å. (1971). Nordisk vegetationsklassificering för kartläggning. In: *IBP i Norden 7.* Universitetsforlaget, Oslo, pp. 3-12.

3160 Natural dystrophic lakes and ponds

1) Natural lakes and ponds with brown tinted water due to peat and humic acids, generally on peaty soils in bogs or in heaths with natural evolution toward bogs. pH is often low, 3 to 6. Plant communities belong to the order *Utricularietalia*.

2) Plants: *Utricularia* spp, *Rhynchospora alba*, *R. fusca*, *Sparganium minimum*, *Sphagnum* species. In the Boreal region also *Nuphar lutea*, *N. pumila*, *Carex lasiocarpa*, *C. rostrata*, *Nymphaea candida*, *Drepanocladus* spp., *Warnstorfia trichophylla*, *W. procera*. Animals: Odonata (dragonflies and damselflies)

3) Corresponding categories
German classification: "240101 natürliches, distrophes Gewässer (z. B. Kolk, Moorauge, Randlagg).
Nordic classification : "6211 *Nuphar*-typ", "652 Vattenmossvegetation".

Appendix 6. List of lakes proposed by NGOs for designation as SACs (Dwyer 2000).

Site	Qualifying Habitat (proposed by NGOs)	Current designation
Lough Finn	3130	No
Bluestack mountains	3130	No
Slieve Beagh	3130	No
Barleart and Lackagh Bog	3130	Part of Boleybrack cSAC (qualifying habitat 3160)
Cloghernagore and Glenveagh	3130	Designated SAC for 3110 and 3260 freshwater habitats
Lough Nalughraman, Lough Nafooey	3130	No
Ox Mountains	3130	Designated for 3110
Garrycloonagh	3140	Part of Moy cSAC (qualifying freshwater habitat 3260)
Kilcorran Lough	3140	cNHA
Pallas Lough	3140	cNHA
Lough Ennell	3140	Designated SAC for fen habitat

Appendix 7. Site Inspection Report Form 2004-2006

PART 1 - SITE DETAILS

Site Name and Designation Status:

NHA ☐ **Site Name** ______________________________ **Site Code** __________

SAC ☐ **Site Name** ______________________________ **Site Code** __________

SPA ☐ **Site Name** ______________________________ **Site Code** __________

Other ☐ **Specify** ______________________________

County/ies ____________________ **6" Map No.** ____________ **Management Zone** ____________

Part of Site Visited (Townland/s) ______________________________

Visited by ____________________ **Date** ____________ **Date of last visit** ________

PART 2 - REPORT DETAILS

Map Attached: **Scale** ____________ **Photograph Ref. No's**: ____________

Reporting: **Damage** ☐ **Improvement** ☐ **No Change** ☐

Reported Activity is: **Inside** ☐ **Outside** ☐ **the Site**

PART 3 - DESCRIPTION OF IMPACT OR ACTIVITY

Description

Impact/Activity Code ☐ ☐ ☐

Intensity A B C

Influence ☐ ☐ ☐ ☐ ☐

Grid Ref. ☐ ☐☐☐☐ ☐☐☐☐

SAC (ha/m) ☐☐☐☐☐.☐☐

SPA (ha/m) ☐☐☐☐☐.☐☐

NHA (ha/m) ☐☐☐☐☐.☐☐

TOTAL (ha) ☐☐☐☐☐.☐☐

TOTAL (m) ☐☐☐☐☐.☐☐

NATURA 2000 Sites / Fossit Habitat / SPA Species
E.U. Habitats and Species Affected
Qualifying Interests - see Guidelines)

Area of each qualifying interest where applicable (ha/m)

____________________ ☐☐☐☐ ☐☐☐☐☐.☐☐

____________________ ☐☐☐☐ ☐☐☐☐☐.☐☐

____________________ ☐☐☐☐ ☐☐☐☐☐.☐☐

____________________ ☐☐☐☐ ☐☐☐☐☐.☐☐

____________________ ☐☐☐☐ ☐☐☐☐☐.☐☐

PART 4 - REGULATION OF ACTIVITY

Is the reported activity: **A) a Notifiable Action?** **Y☐** **N☐** **If Yes, N.A. Number** ______________

B) subject to licence from another Statutory Body? **Y☐** **N☐**

Is the area in question in REPS? **Y☐** **N☐** **Don't Know☐**

PART 5

Contact Name & Address

Third Party ☐ **Owner/Occupier☐**
Statutory Body☐ **Unknown☐**
Other☐ ___________________

PART 6

Action Taken/Recommended

PART 7

Comments by DWO/DRM/RM

Signature ___________________________

Appendix 8. Npws Guidelines For Form Completion : Site Inspection Report

SITE MONITORING: MONITORING IMPACTS AND ACTIVITIES

GUIDELINES FOR FORM COMPLETION:
SITE INSPECTION REPORT

Document Version SIR.4, September 2006
Deirdre Lynn
Monitoring Section Research Branch

1. INTRODUCTION

1.1 Objectives

It is a national and EU requirement, and a Management responsibility, to regularly visit designated sites and those proposed for designation, to record and report all activities (Appendix 1) and their impacts. Monitoring Section is required to prepare a national summary of physical changes, resulting from the range of activities recorded. The next summary for the 2004-2006 cycle is due in February 2007. The summary will be compiled from information gathered through regular, standardised site visits and the completion of Site Inspection Reports, which should become a permanent record stored within each Region.

The format of the Site Inspection Report has evolved through a number of versions since it was first introduced over 8 years ago. It was designed primarily with the needs of management in mind and can be applied to all site designations. Since then, more fields have been added, asking for some detailed information on each activity or impact reported. The current version of the forms are shown in Appendices 2 and 3. In our view, the information which is requested in these forms is the minimum required in order to report effectively on the integrity of the national network of Natura 2000 sites.

1.2 Priorities

1.2.1 Which sites to visit and how often to visit them

For monitoring and reporting purposes, visits should prioritise SACs and designated SPAs. Where time and resources permit, NHAs should be visited also. The Wildlife Act (2000) Amendment Bill gives NHAs equal status as SACs and SPAs, to harmonise REPS payments.

By and large, the frequency of site visits will depend on the levels of activity associated with different habitats at different times of the year. For example, a coastal area which experiences sand removal and pressure from tourism will require more visits than an isolated mountain top. Nonetheless, you should feel confident of being able to report on each site in its entirety every 3 years.

1.2.2 Areas to keep a "special eye" on within each site

You should ensure that all relevant information is provided <u>at least on activities which affect the “qualifying interests”</u> of the site, i.e. those habitats and species for which the site was selected as SAC or SPA (See Section 2, below, and Appendix 4). These are the features which must be reported on in a national context. Activities which affect other habitats or species can also be reported, but this reporting system asks for specific detail to be provided on the "qualifying interest" of Natura 2000 sites. Particular note should also be given to Annexed habitats and species present but which may not be "qualifying interests" within that particular site.

1.2.3 What kinds of changes to report for each site

You are being asked to account for physical impacts of particular activities on the habitats and species on the site during the year. It is best to keep accounts factual, and to avoid speculation on what the impact might be in the future. However, if you suspect that a subtle change is developing over time, you can highlight this in your Site Inspection Reports, using photographic records, for example, to supplement your reports and to gather evidence of the change (see Section 3, Part 2). In some cases, scientific experimentation may be warranted to establish the precise nature and rate of the change occurring.

You will be asked to categorise the activities you are reporting using a list of "Impacts and Activities" and a coding system, which is introduced later in the Guidelines (see Section 3, Part 3 and Appendix 1). This list of "Impacts and Activities" was developed in Brussels (M. OBriain, pers. comm.), and is the current system in use at EU level in the Natura 2000 reporting network. We have adopted this system rather than the NHA categories of Landuse and Damaging Operations because:

- it is more comprehensive (lists more activities)
- it includes natural processes
- it allows a means of recording positive impacts
- it allows you to report activities occurring both within and outside the site
- it is the system already used in Brussels for reporting Natura 2000 sites

1.3 Limitations

Because of the need to prioritise, there are inevitably some limitations to this system.

1.3.1 Mapping of habitats, landuse and impacts for each site

Site habitat maps for many sites are available from the Management Planning Support Unit, these are however rarely based on field surveys. Monitoring section have mapped several Annexed habitats from field-based surveys, many of which occur within designated areas. Areas of impacting activities have been mapped onto these maps. Habitat maps are still not available for many sites apart from the hand drawn maps in the Natura 2000 site files.
We require you to maintain and store maps, hand-drawn at 6" scale or in a suitable digital format, showing the mapped location of activities reported, where they occur within the site, and (where relevant) around the site. Such maps (and photographs) should always accompany Site Inspection Reports. Mapping is an essential part of monitoring, and we hope that maps of habitats and landuse can be more readily stored on an accessible computer system in the future.

1.3.2 What this system does not record

This system does not adequately monitor changes in habitat condition or the well-being of the population of a selected species. Monitoring of these requires methodologies which should be as objective as possible, such as those which already exist for certain species, e.g. Pearl Mussel and habitats e.g. coastal dune and saltmarsh habitats. These monitoring surveys will have to be developed over time for all habitats and species listed as qualifying interests. However, the Site Inspection Reports can be used to highlight changes which you observe over time, and which you think might merit further investigation (see Section 1.2.3).

1.4 Baseline

A decision has been taken to use the NHA survey as the baseline for this monitoring programme. The NHA survey was carried out mostly during 1993/94 and 1995/96, and is ongoing on a limited scale. In that survey, habitats, landuse and damage were described and, to some extent, mapped. It must be stated at this point that the NHA survey was in essence a boundary survey, and that the extent to which habitats and damage were actually mapped was necessarily very limited. Thus, the NHA survey does not provide adequate habitat or landuse mapping - this still needs to be done for all sites. More detailed maps for certain sites or for Annexed habitats and species within a site have been produced by MPSU and Monitoring Section respectively.

The Site Inspection Report procedure will bring the survey information up to date, particularly with respect to landuse and impacting activities.

2. GETTING STARTED

A site visit usually occurs either as a response to notification of a specific activity, or as a routine site inspection. In either case, a Site Inspection Report should be filled in (Appendix 2). The form is designed in such a way that one Site Inspection Report should be completed for each activity reported. You will notice that some quite specific information is asked for on the form, and so you will need to gather some background documentation to help you complete the form. Some suggestions as to what you might need are given below.

2.1 Preparation

A good starting point is familiarising yourself with the information available for each site. At this stage, quite a lot of ecological information has been compiled for SACs and SPAs. A brief step-by-step guide to the plethora of information available is given in Appendix 5.

As you assemble the information you need, it would probably be helpful to establish a paper file for each of the sites in your area, beginning with the Natura 2000 sites (i.e. the SPAs and SACs). In this file, you can store the background information and Site Inspection Reports, in date order, with maps and photographs, which pertain to that site. Thus, you are building up a record of the site over time, and one which may make it easier for you to report on progress on a site-by-site basis.

2.2 Equipment

In order to complete this exercise, you will need to have a number of items to hand.

- camera, preferably a model which prints the date on your photographs

- a ROMER, or Grid Square, to help in the calculation of area estimates
- the current <u>official</u> version of the site boundary, i.e. the version <u>digitised</u> at scale 1:15,000
- Discovery Series maps covering your area
- GPS (Global Positioning System).
- NHA survey report, with the Site Map (hand-drawn at scale 6”:1 mile), with the locations of note numbers
- SAC Management Plan, with habitat map, where available
- any monitoring or species surveys that provide more detailed information about the site
- Natura 2000 form, with habitat map and Explanatory Notes, where available
- recent aerial photographs of the site.
- copy of “Habitats Directive Regulations” and “Notice of Notifiable Actions”

3. GUIDE TO THE SITE INSPECTION REPORT

Asterisks in the margin indicate the information which should be collected at all times and which will have to be conveyed to Monitoring. The items without asterisks in the margin are items of information which are of use to Regional Management. Monitoring Section will <u>not</u> be collecting this information for the present.

PART 1 - SITE DETAILS

* **Site Name and Designation Status**: Two situations can arise here:

<u>*CASE 1: Reporting an impact or activity in an area covered by two or more designations with the SAME boundary*</u>
In the boxes down the left-hand-side, tick the boxes which apply to the area you are reporting on. For example, if the area you are reporting on lies within an SAC and an NHA, and both these sites have the same boundaries, then tick the boxes for NHA and SAC, and fill out one name and site code in the top line provided. Likewise, if the area you are reporting on lies outside (see below) or adjacent to an SAC and a NHA, and both sites have the same boundary, tick both boxes and give the name and site code common to both sites.

<u>*CASE 2: Reporting an impact or activity in an area covered by two or more designations with DIFFERENT boundaries*</u>
There may be situations where you will be reporting on a particular activity occurring in an area which lies, say, within an SPA and a NHA, but those two sites have different boundaries. If they have different boundaries, they will also have different names and site codes. In cases such as these, tick the NHA box and give the name and code for the NHA in the adjacent lines provided. Then tick the SPA box, and fill in the name and code for the SPA on the lines opposite the SPA box.

<u>*Note*</u> Use the official version of the site name and its correct code.

* **County/ies**: The county(ies) in which lies the area being reported.

* **6” Map No.**: The 6” map number(s) covering the area being reported. The NPW system for listing 6" map numbers follows that used by the Ordnance Survey, i.e. the name of the county abbreviated to two letters, followed by the map number. The format is as follows: **KE026**, for 6" map number 26 in Kerry. Note: a) that the county abbreviation is <u>not</u> the same as that used in car registrations; b) the map number is given in three digits, with the first digit being zero for numbers less than one hundred.

Management Zone: Record the Management Zone covering the area being reported, from the SAC Management Plan. This is not relevant to sites for which no SAC Management Plan exists.

Part of Site Visited (Townland/s): Townlands which you have visited on the day. This is mainly for your own reference and can be very useful if you are reporting on a large site, to record quickly which part of the site you visited. Townland names are given on the 6" Ordnance Survey maps. For a more complete record, you can sketch in on the 6" map the area covered by your visit on the day.

* **Visited by**: List the names of the persons present during the site visit on the date specified.

* **Date**: Date of site visit.

Date of last visit: Date at which you last visited this site It can help you keep tabs on the sequence of visits to any particular area.

PART 2 - REPORT DETAILS

Map Attached: Outline clearly and accurately the location and extent of the activity reported on a 6":1 mile O.S. map (the metric scale of these maps is 1:10,560). Note that the official maps for SACs are provided at 1:15,000 scale, which is not quite 6" scale. Make sure you are keeping map records at 6" scale. For the moment, Monitoring Section will not be collecting maps with Site Inspection Reports, but it is essential to maintain a geographical record of events on each site.

Photograph Ref. No.'s: Photograph the event being reported. It is a good idea here to include in the photo., if you can, a recognisable feature, for example a building or unusual hill, which proves the location of the scene photographed. Also, use a camera which prints the date on the photos. This space on the Site Inspection Report allows you to set up a reference number system, if required, for keeping track of photos. The photographs should be placed in plastic photo. holders and stored with the Site Inspection Report in your site file.

Photographs can have many uses in Monitoring. For example, there may be one part of a site which you feel is changing in some way but the change is hard to pinpoint at any one time. Examples might be scrub spreading on grassland, or vegetation improving after having been fenced from grazers. It might be an idea here to choose a fixed point and photograph it over time. This may illustrate the nature of the change occurring. Monitoring Section will not be collecting photographs with Site Inspection Reports, but we encourage the use of photography generally in site monitoring.

Reporting: These boxes allow you to summarise the nature of the impact and activity, if any, which you observed on the day. Tick a box to indicate whether the activity being reported in your view constitutes damage or improvement to the site. If you have noticed no readily visible changes in the site since your last visit, then tick the "No Change" box. If there is no change, you need not proceed any further than this with completing the Site Inspection Report. However, it is important to record these "No Change" visits, because at the end of the year, you will be asked to record how many times you visited each site. Even if there is "No Change", this Site Inspection Report stands as a record of your having visited the site to make an inspection.

* **Reported Activity is Inside or Outside the Site**: There may be instances where an activity occurring adjacent to a site is clearly going to impact on the habitats within the site. It is important to report these events. An example might be digging a large drain just outside the boundary of a wetland site, or erecting a fence just outside the boundary, which will exclude grazers from the site. This reporting system allows you to record activities which occur outside the site but which may, nonetheless, impact on habitats and species inside the boundary. On the Form, in Parts 3 to 8 (see

below), the manner in which you report an impact or activity is the same whether it occurs inside or outside the site.

PART 3 - DESCRIPTION OF IMPACT OR ACTIVITY

* **Description of Damage, Improvement, Threat or Natural Event**: This space allows you to write about the event you are reporting. It is "free text box" - it is for you to put down, in your own words, a description of a particular incident or activity which was happening on the site on the date of your visit, or a change which had happened since your last visit.
To the right of this, we have provided a series of boxes for you to summarise what you have written (see below). The reason for doing this is that when this Site Inspection Report system is computerised, it is easier to work with tick boxes and codes than with text descriptions.

* **Impact/Activity Code**: Consult the list of Impacts and Activities given in Appendix 1. Choose the one which describes the event you are reporting. In Appendix 1, each Impact and Activity is given a three-digit code. Enter the appropriate code number here, in the boxes provided.

You will notice, while reading Appendix 1, that this is a very long list of potential impacts and activities. Also, that the list contains some oddities, for example “off-piste” activities, which you are unlikely to encounter in Ireland (but then again....). This is because this list was devised for use across the EU in preparing Natura 2000 forms (see Section 1.2.3). However, we can adapt this list to our own use - we have been informed from Brussels that we can add categories to suit our needs (M. OBriain, pers. comm.).

* **Intensity**: Indicate the intensity of the influence of the activity reported on the area affected, whether it is:
A - high influence
B - medium influence
C - low influence

For example, if you are reporting a drain being dug in or adjacent to a wetland habitat, you should place an “**X**” in the box marked “A” on the Form, to indicate that the drain will significantly impact on that part of the wetland, and will therefore have a “high influence”. Light fertiliser application, as part of traditional or extensive farming practice has a “low influence”, and so you should place an “**X**” in the box marked “C”. An “unknown” option is included where it is not possible to determine the intensity of the activity

* **Influence**: Indicate whether the influence is positive (+), neutral (0) or negative (-). In the example of the drain referred to above, its influence will be “negative”, so place an “**X**” in the box marked with the “-” sign on the Form. On the other hand, fertiliser application in sites important for grazing birds will have a “positive” influence, while controlled burning of heaths can, as a management tool in certain circumstances, have a positive influence. In these situations, place an “**X**” in the box marked with a “+” on the Form.

The influence scale was expanded in the last cycle to a 5 point scale (-2, -1, 0, +1, +2). This was an attempt to report on recovery or permanent damage. However the analysis becomes far too complex when tracking changing influences of different intensities over time. Therefore we will return to the original influence categories of -1, 0, +1. Any forms already filled out with -2 or +2 can be adjusted to -1 or +1 respectively so don’t be concerned if you have already filled out forms for this cycle.

The neutral category is for activities that are occurring which have no apparent impact. Activities may have no effect in isolation but when combined, they may start to have an impact e.g. rock climbing plus paragliding plus mountaineering may indicate an increase in the amount of people coming to an area and have knock on effects. An "unknown" option is included where it is not possible to determine the influence of the activity.

* **Area (ha) or length (m)**: In Part 2, you were asked to outline clearly on a 6" map the area of the impact or activity being reported. When you have done this, use a grid square or ROMER to calculate the actual area affected in hectares. Once you have obtained an estimate of the area affected by the activity reported, enter the figure here, placing one digit in each box provided. Note that there is a decimal point with two boxes to the right of it, which allows you to enter values less than 1 hectare. This does not mean that you are expected to calculate the area affected by each activity correct to two places of decimals, but instead these boxes are there to allow you to record activities which impinge on very small areas. The smallest area you can enter in here is 0.01 hectares, which equals $100m^2$, or an area measuring 10m x 10m on the ground. Length has also been included to account for impacts on linear features such as rivers or activities which are linear in nature e.g. drains.

Important Note

Please read the paragraph marked important in Section 3 page 8 to understand how the area impacted has to be summarised for the whole reporting cycle.

* **Grid Ref.**: This space is for you to record the location of the activity you are reporting. To do this, you need an O.S. map - either 1/2":1 mile or Discovery Series (1:50,000). The approach we advocate is to locate approximately on the map the central point of the area which is affected by the activity you are reporting. Then use the procedure detailed below to give a six-figure grid reference for that spot. A six-figure grid reference is accurate to within 100m x 100m on the ground.

In the National Grid, Ireland is divided into a series of squares. You can pin-point any location in the country by using letters and numbers to define a specific part of the National Grid, using an established format. First, you use a letter to define which part of the country you are concerned with. These letters are shown on the O.S. 1/2":1 mile and Discovery Series maps. On the Form, record this letter in the box which is slightly separated from the others, and to the left of them. Next, you read gridline numbers off the top or bottom of the map to give easting co-ordinates. These should be filled in the first group of four boxes on the Form. Finally, you read gridline numbers off either side of the map to give northing co-ordinates. These numbers should be filled in the last group of four boxes on the Form.

The Form allows you to record eight-figure grid references (accurate to within 10m x 10m on the ground). Please note that you are not required to provide this detail, in fact, unless you are using a GPS, you will not be obtaining eight-figure grid references.

* **Natura 2000 Sites – Fossitt or E.U. Habitats and Species Affected**: At the bottom of the sheet the boxes have been included to detail whether the activity impacted specific habitats or species, for example a high intensity burn may negatively affect 100ha of a site but more specifically affect 50 ha of blanket bog, 10 hectares of wet heath and 0.2 ha of *Saxifraga hirculus* habitat with the rest of the area made up of WS1 scrub (Fossitt classification http://www.heritagecouncil.ie/publications/habitats/index.html).

For qualifying interests which have been affected by a particular activity, write the name of the habitat or species in the line provided. To the left of this are boxes, which are provided for recording code numbers. Appendix 4 lists the names and four-digit Natura code numbers for all habitats and species which are SAC qualifying interests in Irish SACs. For habitats not listed in the Appendix use Fossitt (2000) Level 3 habitats http://www.heritagecouncil.ie/publications/habitats/index.html.

* **PART 4 - REGULATION OF ACTIVITY**

Is the reported activity a Notifiable Action?: At present, this is relevant only for SACs, When these sites were notified to the public, lists of Notifiable Actions were provided to each landowner, on a series of numbered pages. If the activity reported is among those listed for the site, tick the "Y" box and record the page number on the line provided. (Note: N.A. = Notifiable Action.) A revised list has recently been drawn up for SPAs.

Is the reported activity subject to licence from another Statutory Body?: Tick the "Y" box if you are reporting activities which come under the jurisdiction of other public bodies, for example, activities which are subject to Planning Permission from the local authority. Apparently, this has a bearing on our powers under the Habitats Directive Regulation.

Is the area in question in REPS?: Tick the "Y"box if you know that the activity reported is occurring on land which is in REPS, the "N" box if you know the land in question is not in REPS, and "Don't Know" if you don't have the information.

PART 5

In this section, you can record details of the persons associated with the impact or activity being reported.

Contact Name and Address: Provide the name and address of the person or agency who is responsible for the reported activity. You should ensure that you know for certain who is actually responsible before you commit someone’s name to paper here. Bear in mind that all of these records can be made available to the public if requested under the Freedom of Information Act. Note that Monitoring Section will <u>not</u> be collecting any names or addresses - this is for Management to record information for follow-up activity if required. However, Monitoring Section does ask you to indicate whether the person is:

* **Owner/Occupier**: Tick this box whether the person who owns or is leasing the land carried out the activity themselves, or hired contractors to do it on their behalf.

* **Third Party**: The party responsible does not own or lease the land in question.

* **Statutory Body**: This includes any activity carried out by, for example, a local authority.

* **Unknown**: If you don’t know the person/agency responsible, tick this box.

* **Other**: If you do know the person/agency responsible, but they don’t fall into the above categories, tick this box and specify further in the space provided.

PARTS 6 & 7

These sections are for recording follow-up activity by Regional Management. Information here will not be collected by Monitoring Section.

Note

The "Purpose" section (ie, Agriculture, Forestry etc) has been removed as it is already implied through the activity code.

3. SUMMARY FORM

The purpose of the summary form (Appendix 3) is to collate all information to give a full account of what happened to the site over the reporting cycle.

The form details the amount of visits to a site over the cycle and the proportion of the site visited and whether you consider it to be representative of the site as a whole. For example, if 50% of a site is checked but there are no known major threats to the site, the area checked is therefore considered to be representative of the site as a whole. If however only 5% of a site is continually visited for some reason (e.g. planning), but pressures on the rest of the site is not known this coverage cannot be considered to be representative of the site as a whole.

The SIR summary form also combines the information from all SIR forms filled in during the cycle to give a total area of impacting activities affecting the site overall. The area of impacting activities affecting habitats and species are filled out on in Appendix 3A.

Important - Reporting on the changes in the area impacted over time

The original guidelines did not account for how to track the changes in the area impacted over time. This is very difficult to quantify, particularly where overlapping activities occur, the effects of which may change at different rates over time. If an area, e.g. 10 ha, is reported as damaged in reporting period 1 and is still there in reporting period 2 then the area should be reported again, i.e. **the absolute area of each impact is reported in each reporting period.** In an ideal world active management should commence in this damaged area and therefore an area of +ve influence reported would also 10 ha. When the area is restored the negative and positive areas of influence would be 0 (and therefore no longer recorded). Therefore, the area of active management should be mirroring damaged areas. For management to be at its optimum the area of positive influence should be larger than the area of negative influence therefore indicating enhancement of the site and not just reactionary management to damage. It is important not to forget that the monitoring section has to amalgamate all the data to give a national picture.

There is a option of reporting on impacting activities that occur outside the site but which affect habitats and species within the site, this may be very important for species such as Pearl Mussel that is affected by silt loading that occurs outside the SAC boundaries.

Grid reference and extra management information have been added to the summary form. This is not extra information but it is requested on the main SIR forms but was not previously collated by the monitoring section. This type of information will be required by the EU on a national level.

The “Purpose” section (ie, Agriculture, Forestry etc) has been removed as it is already implied through the activity code.

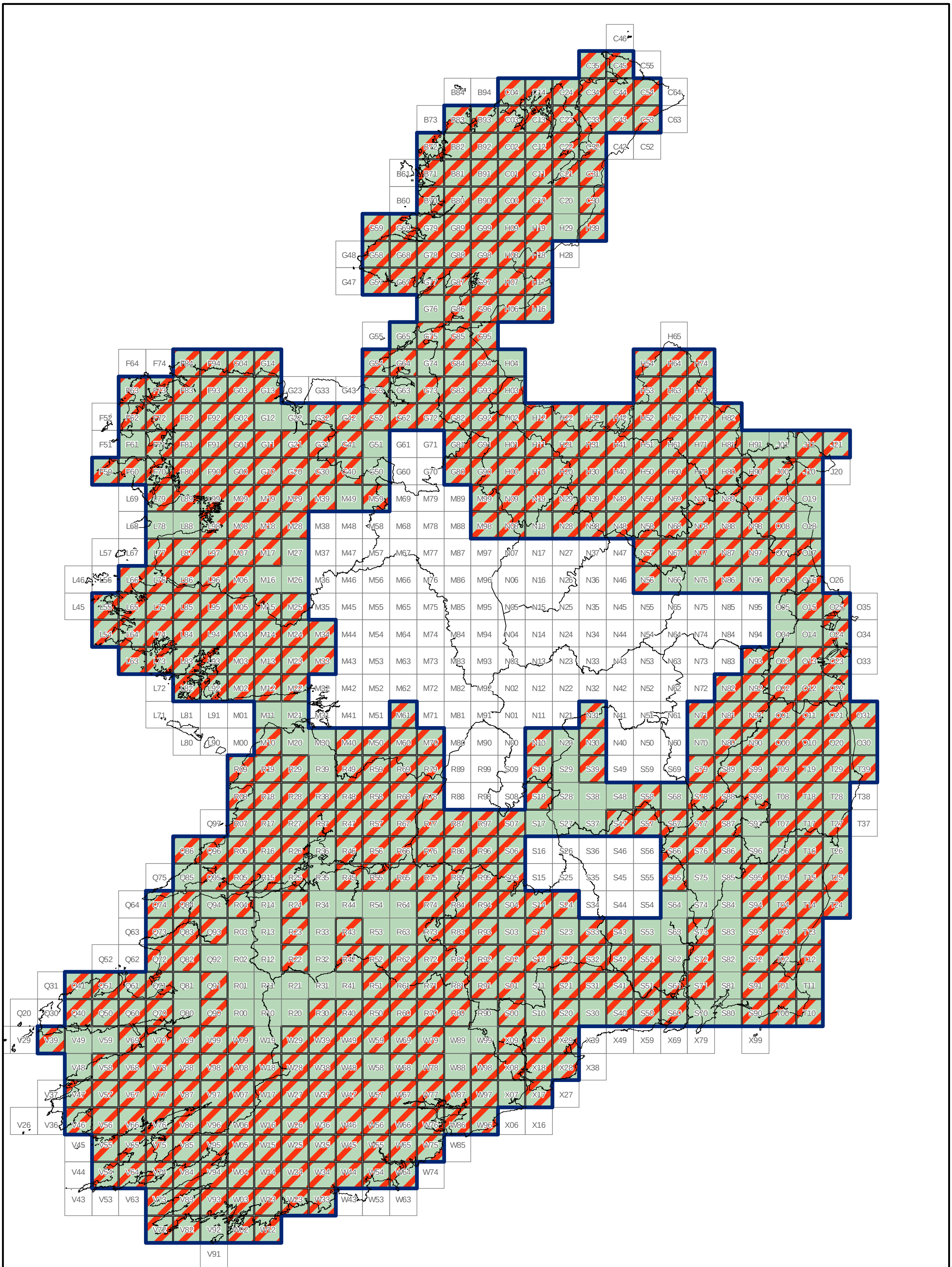
The calculation of the overlapping areas has also been removed as it can be very difficult to quantify changes in the effects of several activities on overlapping areas of habitat mosaics over time (!) The grid reference will give us some idea of the vicinity of impacts and whether hotspots occur. We are hoping to move towards using hand held computer mappers in the field in the future.

3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

National Level	
Habitat Code	3110
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.6.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes*. An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	
Surface area	65,100km^2 (this range is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970 – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 6.1) attached
Surface area	678 km² (this area is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable .
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species

Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	65,100km^2. See map (Fig.6.1) attached
Favourable reference area	678km^2. See map (Fig.6.1) attached
Typical species	*Isoetes lacustris*, *I. echinospora*, *Littorella uniflora*, *Lobelia dortmanna*, *Deschampsia setacea*, *Subularia aquatica*, *Juncus bulbosus*, *Pilularia globulifera* and *Potamogeton polygonifolius.* The list of typical species submitted was derived using best expert judgement. Species lists may be compiled during field-based surveys, however all surveys that assess habitat condition focus on changes in or presence/absence of indicator species. Therefore the conservation status of all typical species is rarely assessed apart from assessments derived from best expert judgement.
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on species, landscape, catchment and lake morphology data. This modelling process was unable to differentiate between lake habitats 3110 and 3130 and therefore the range, area and structure and function information provided in this assessment is for the combined (3110 and 3130) habitats. The Water Framework Directive (WFD) assessment of lakes reveals that 64% of the total area of this lake type, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Oligotrophic waters containing very few minerals of sandy plains: *Littorelletalia uniflorae* 3110

- Current Distribution (543 cells)
- Current Range (651 cells)
- Favourable Reference Range (651 cells)
- W48 10km grid cells

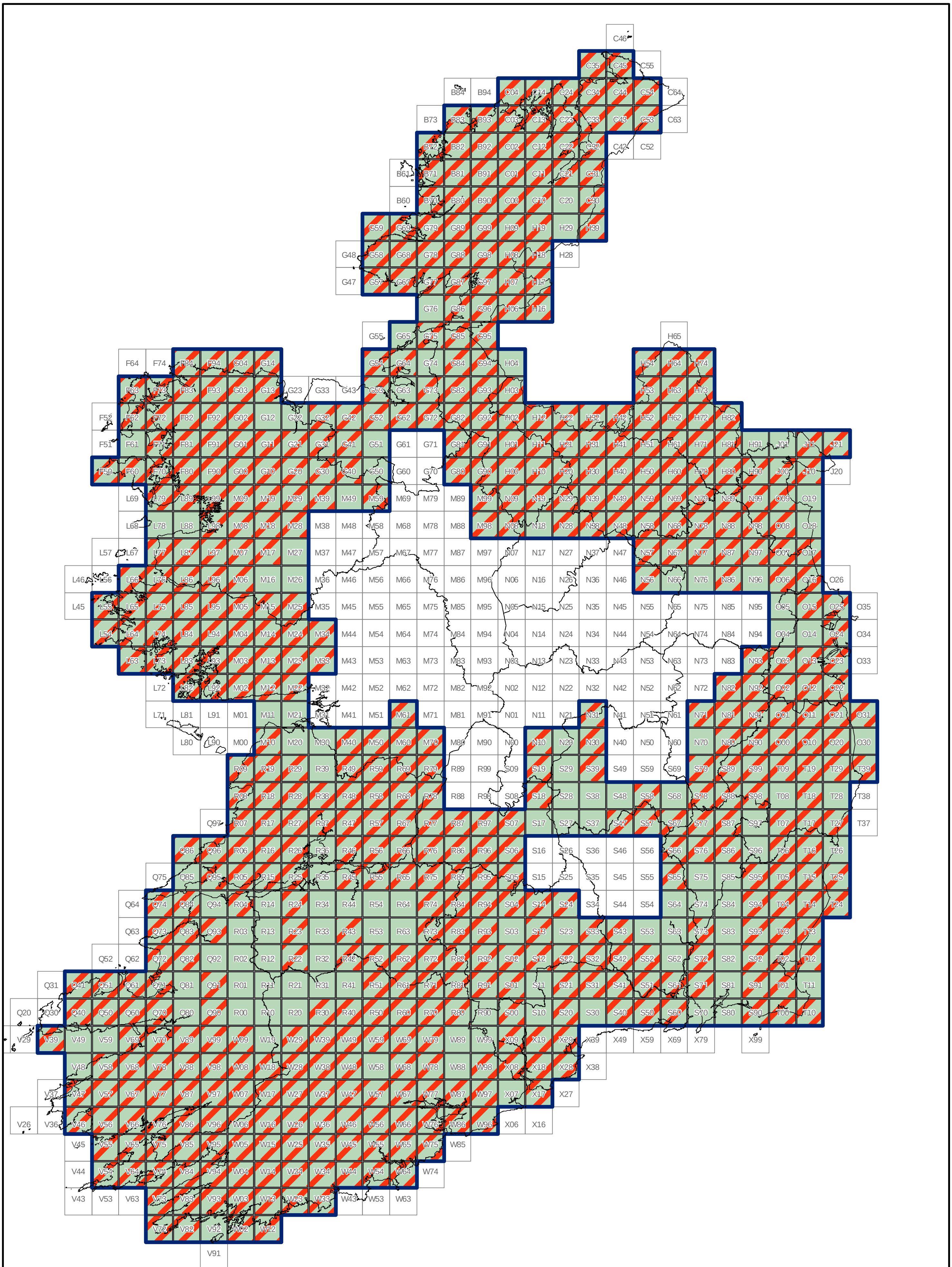
Date: August 2007

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and or *Isoeto- Nanojuncetae*

National Level	
Habitat Code	3130
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.7.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes.* An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R., (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	.
Surface area	65,100km^2 (this range is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 7.1) attached
Surface area	678 km² (this area is a combined value for lake types 3110 and 3130 because there is currently insufficient information available to separate these two habitats in Ireland)
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species

Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	65,100km^2. See map (Fig.7.1) attached
Favourable reference area	678km$^{2.}$ See map (Fig.7.1) attached
Typical species	*Littorella uniflora*, *Potamogeton polygonifolius*, *Pilularia globulifera*, *Juncus bulbosus* ssp. *bulbosus*, *Eleocharis acicularis*, *Sparganium minimum, Elatine* spp., *Limosella aquatica*, *Scirpus setaceus*, *Juncus bufonius*, *Centaurium pulchellum*, *Centunculus minimus*, *Cicendia filiformis*
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on landscape, catchment and lake morphology data. This modelling process was unable to differentiate between lake habitats 3110 and 3130 and therefore the range, area and structure and function information provided in this assessment is for the combined (3110 and 3130) habitats. The Water Framework Directive (WFD) assessment of lakes reveals that 64% of the total area of lake type 3130 and 3130, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* 3130

Current Distribution (543 cells)
Current Range (651 cells)
Favourable Reference Range (651 cells)
W48 10km grid cells

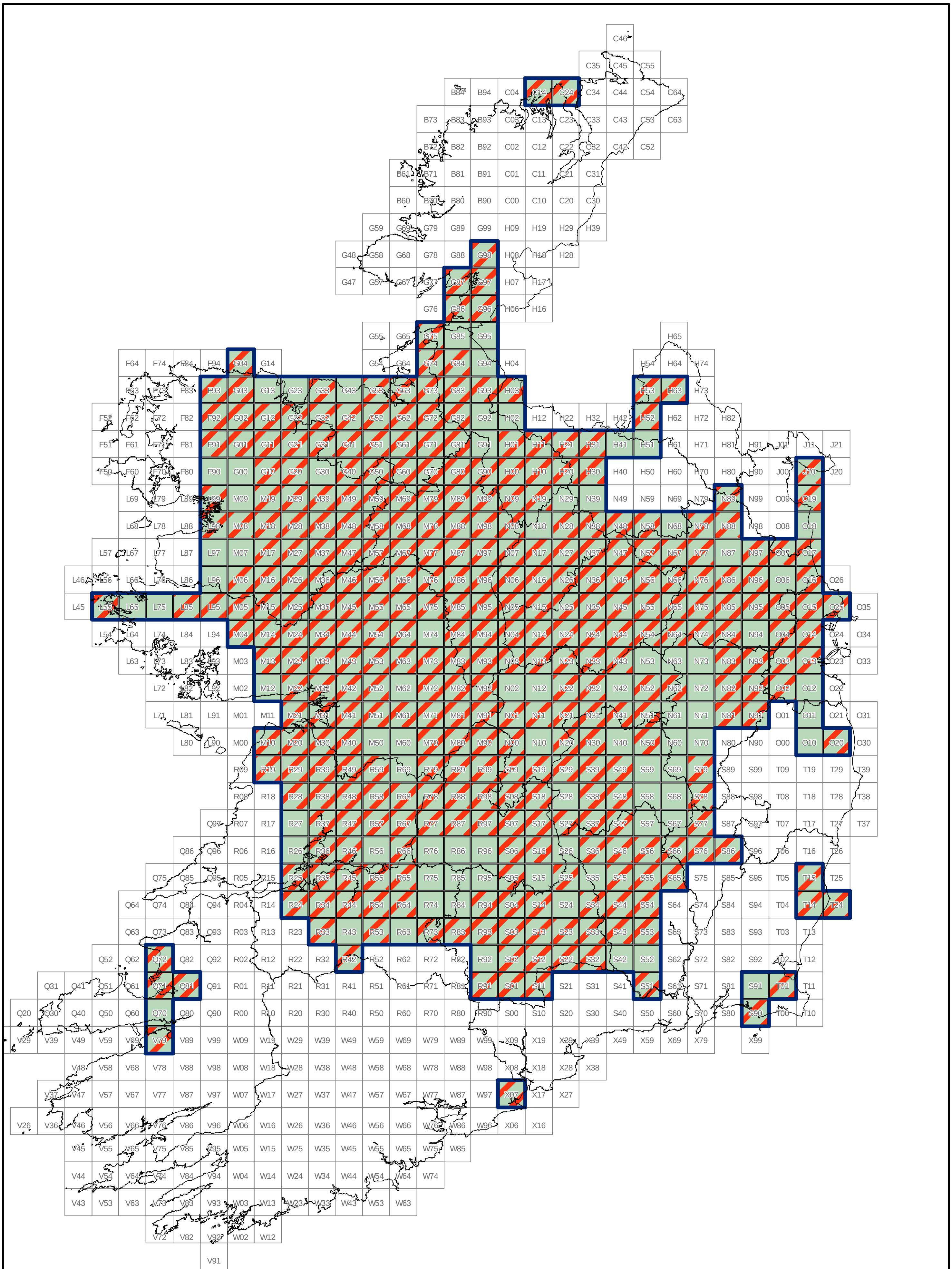
Date: August 2007

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

National Level	
Habitat Code	3140
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.8.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). *A preliminary Survey of Irish Lakes*. An Foras Forbartha, Dublin. ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp are found primarily in lowland areas throughout the Republic of Ireland.
Surface area	42,000km^2
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 8.2) attached
Surface area	595 km².
Date	04/2007
Method used	1 = based on expert opinion and modelling
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 700 Pollution 954 Invasive species

Threats	120 Fertilisation 140 Grazing 160 General Forestry management 310 Peat Extraction 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species
Complementary information	
Favourable reference range	42,000km^2. See map (Fig.8.1) attached
Favourable reference area	595km^2. See map (Fig.8.1) attached
Typical species	*Chara* spp. and *Nitella* spp
Other relevant information	Estimates of the Favourable Reference Range and Favourable Reference Area have been determined using a modelling process based on landscape, catchment and lake morphology data. The Water Framework Directive (WFD) assessment of lakes reveals that 94% of the hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp, within the WFD network of lakes, are unlikely to meet their environmental objectives of achieving good status, or are suffering from deterioration in water quality status.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.* 3140

Current Distribution (341 cells)
Current Range (420 cells)
Favourable Reference Range (420 cells)
W48 10km grid cells

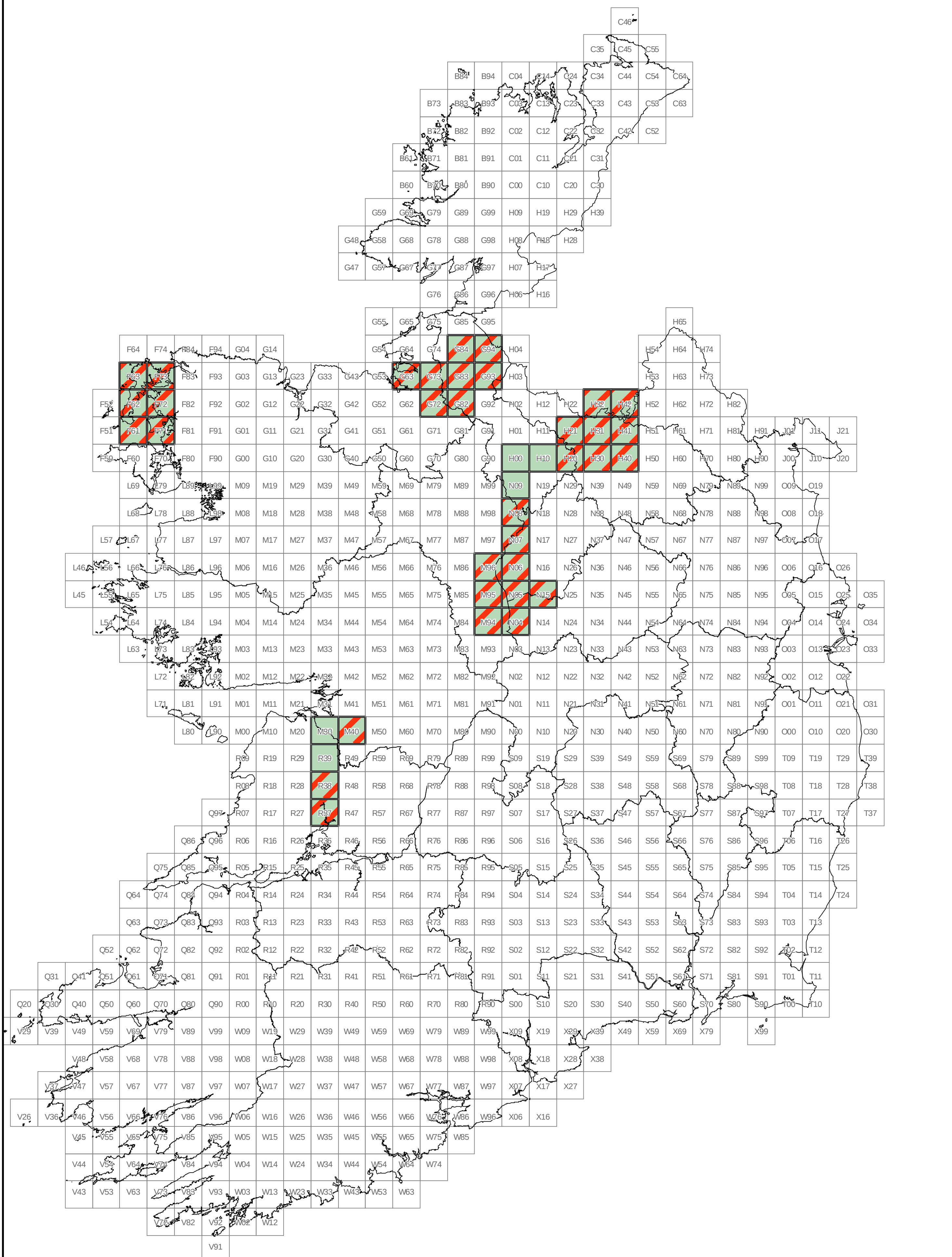
Date: January 2008

3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation

National Level	
Habitat Code	3150
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.9.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Flanagan, P.J. and Toner, P.F., (1975). A preliminary Survey of Irish Lakes. *An Foras Forbartha, Dublin.* ▪ Heuff, H., (1984). *The vegetation of Irish lakes*. Wildlife Service, Office of Public Works, Dublin. ▪ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCárthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	
Surface area	3,900km^2.
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Area covered by habitat	
Distribution map	See Map (Fig 9.1) attached
Surface area	401 km^2.
Date	04/2007
Method used	1 = based on expert opinion
Quality of data	1 = poor
Trend	Stable
Trend-Period	1970s – 2007
Reasons for reported trend	
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.
Main pressures	120 Fertilisation 140 Grazing 160 General Forestry management 700 Pollution 954 Invasive species
Threats	120 Fertilisation 140 Grazing 160 General Forestry management 403 Dispersed habitation 600 Sport and leisure structures 700 Pollution 954 Invasive species

Complementary information	
Favourable reference range	Unknown
Favourable reference area	Unknown
Typical species	*Hydrocharition – Lemna* spp., *Spirodela* spp., *Stratiotes aloides, Utricularia australis, U. vulgaris,* Liverworts (*Riccia* spp., *Ricciocarpus* spp.); *Magnopotamion - Potamogeton lucens, P. praelongus, P. zizii*, *P. perfoliatus*.
Other relevant information	The designation of sites as habitat type 3150 in Ireland is based on the presence of the plant communities described in the *Interpretation Manual of European Union Habitats* but these plant communities are also typical of mesotrophic lakes in Ireland. The range and area values provided are based on known lakes. These values may change in the future due to improved knowledge. There is no certainty that lakes designated as habitat type 3150 are unimpacted and therefore natural eutrophic.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Area	Unknown (XX)
Specific structures and functions (incl. typical species)	Unknown (XX)
Future prospects	Unfavourable - Bad (U2)
Overall assessment of CS	Unfavourable - Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation 3150

Current Distribution (34 cells)
Current Range (39 cells)
W48 10km grid cells

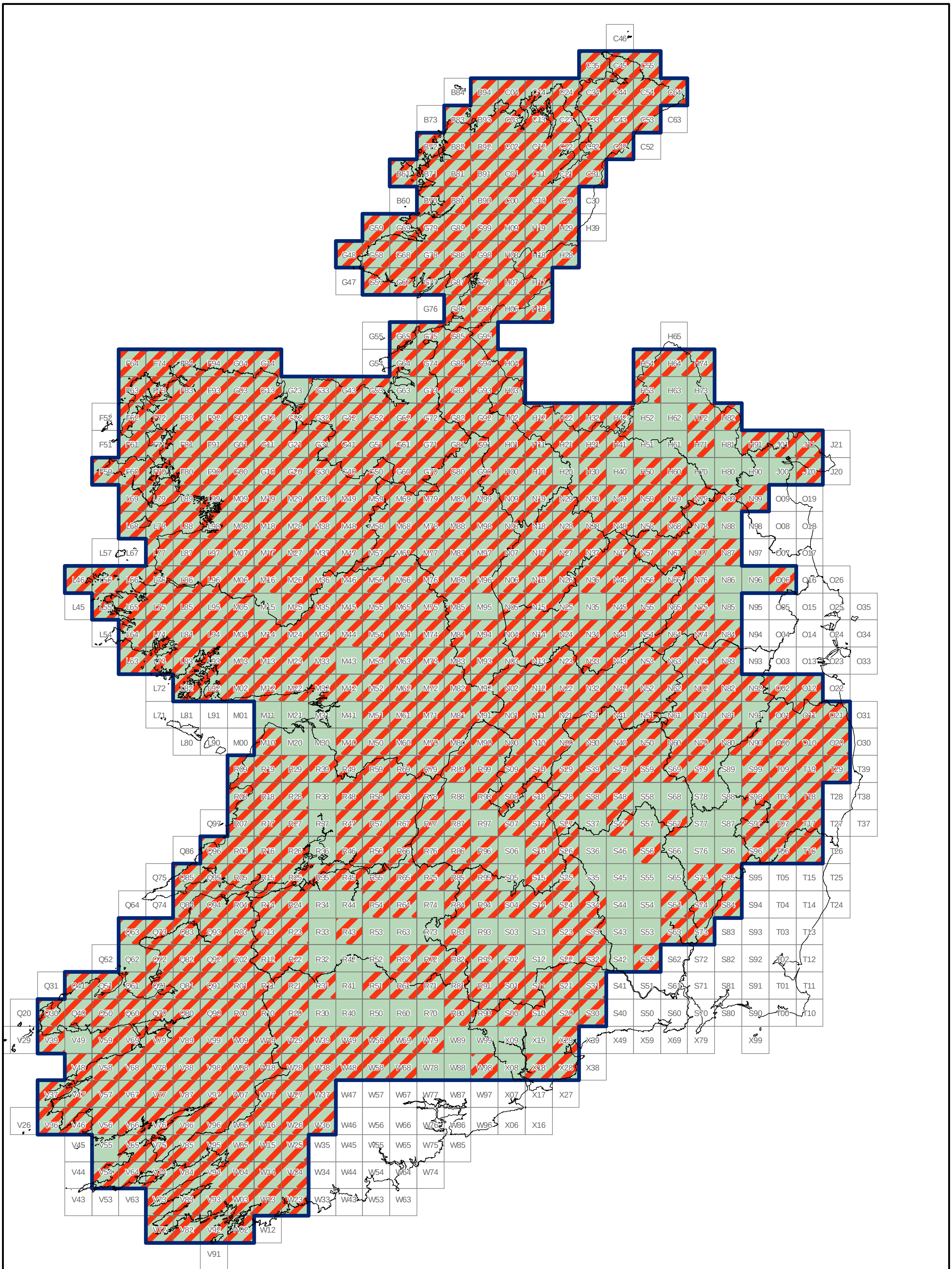
Date: August 2007

3160 Natural dystrophic lakes and ponds

National Level	
Habitat Code	3160
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	**See attached map – Fig.10.1**

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Charles, S., (1996). *The Peat Resource of Ireland***.** Global Peat Resource. Eino Lappalainen. International Peat Society. ▪ Derwin, J. & MacGowan, F., (2000). *Raised Bog Restoration Project: A Continuation of the Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland.* Unpublished report, Dúchas the Heritage Service, Dublin. ▪ Fernandez, F., Fanning, M., McCorry, M. & Crowley, W., (2005). *Raised Bog Monitoring Project 2004-05*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin. ▪ Fernandez, F., MacGowan F., Crowley, W., Farrell, M., Croal, Y., Fanning, M. & McKee, A., (2006). *Assessment of impacts of turf cutting on designated Raised Bogs 2003-06*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage Local Government, Dublin. ▪ Hammond, R.F. (1979). *The Peatlands of Ireland*. Soil and Survey Bulletin. No. 35. An Foras Taluntais (Teagasc), Dublin. ▪ Hammond, R.F. 1984. *The Classification of Irish peats as surveyed by the National Soil Survey of Ireland*. 7th International Peat Congress, Dublin. ▪ Kelly, L., Doak, M. & Dromey, M., (1995). *Raised Bog Restoration Project: An Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland.* Unpublished report, National Parks & Wildlife Service, Department of Arts, Heritage, Gaeltacht and the Islands, Dublin.
Range	
Surface area	71,700km^2
Date	04/2007
Quality of data	1 = poor
Trend	Stable
Trend-Period	1994 – 2005
Reasons for reported trend	N/A
Area covered by habitat	
Distribution map	See Map (Fig 10.1) attached
Surface area	Unknown
Date	04/2007
Method used	1 = based on expert opinion
Quality of data	1 = poor
Trend	Negative
Trend-Period	1994 – 2005
Reasons for reported trend	3 = direct human influence

Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area of most lakes are considered to be stable. However most of this habitat occurs in the form of small bog pools much too small to be detected by the CORINE mapping and therefore these measurements are not reliable for this habitat type. Losses to this habitat type are still occurring due to drainage, erosion and afforestation of the bogs and wet heaths within which this habitat mainly occurs. As Dystrophic lakes can also occur on degraded areas of peat, this makes it difficult to determine the magnitude of the losses and make an appropriate assessment of the attribute.
Main pressures	140 Grazing 150 Restructuring agricultural land holding 160 General Forestry management 180 Burning 310 Peat Extraction 311 Hand-cutting of peat 312 Mechanical removal of peat 810 Drainage
Threats	140 Grazing 150 Restructuring agricultural land holding 160 General Forestry management 180 Burning 312 Mechanical removal of peat 810 Drainage
Complementary information	
Favourable reference range	71,700km^2
Favourable reference area	Unknown
Typical species	*Utricularia* spp, *Rhynchospora alba*, *R. fusca*, *Sparganium minimum*, *Sphagnum* species.
Other relevant information	The values for range and area of dystrophic lakes are based on information relating to Intact Blanket and Active Raised bogs where such lakes occur.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Area	Unknown
Specific structures and functions (incl. typical species)	Unfavourable - Bad (U2)
Future prospects	Unfavourable - Bad (U2)
Overall assessment of CS	Unfavourable - Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Natural dystrophic lakes and ponds

3160

- Current Distribution (627 cells)
- Current Range (717 cells)
- Favourable Reference Range (717 cells)
- W48 10km grid cells

Date: August 2007

Turloughs

Draft backing document 2007

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. **Habitat characteristics in Ireland**
2. **Habitat mapping**
3. **Habitat Range**
   - **3.1. Conservation Status of Habitat Range**
4. **Habitat Extent**
   - **4.1. Conservation Status of Habitat Extent**
5. **Structures and Functions**
   - **5.1. Habitat Structures and Functions**
     - **5.1.1. Conservation Status of Habitat Structures and Functions**
   - **5.2. Typical Species**
     - **5.2.1. Conservation Status of Habitat Typical Species**
6. **Main pressures**
   - **6.1. Drainage**
   - **6.2. Over- and under-grazing**
   - **6.3. Eutrophication**
   - **6.4. Peat Cutting, marl extraction and quarrying**
7. **Threats**
   - **7.1. Climate change**
   - **7.2. Eutrophication**
   - **7.3. Over- and under-grazing**
   - **7.4. Groundwater abstraction**
8. **Future Prospects**
   - **8.1. Negative Future Prospects**
   - **8.2. Positive Future Prospects**
9. **Overall Assessment of the Habitat Conservation Status**
10. **References**

1. Habitat characteristics in Ireland

Irish turloughs can be defined as topographic depressions in karst which are intermittently inundated on an annual basis, mainly from ground water, and have a substrate and/or ecological communities characteristic of wetlands (Working Group on Groundwater, 2004). Reynolds (1996) described turloughs as ecotones, since they are transitional between aquatic and terrestrial systems and constitute ecosystems in a temporary sense. The majority of turloughs occur in areas of thin glacial drift, in gentle relief on well-bedded, pure, grey calcerenite, that has a greater degree of karstification than other limestones as a result of its purity and well-developed bedding (Coxon, 1987a).

All turloughs are characterised by the fact that they chiefly flood and drain via connections with groundwater, such as springs, swallow-holes and estavelles. Coxon (1986) investigated the geomorphology of turloughs >10 ha and identified swallow holes as present in 80 out of 90 sites studied. Swallow holes are mostly located around the periphery of turloughs, where bedrock is at or close to the ground surface, and at the edge of the unconsolidated deposits, such as peat and marl, which occupy the turlough floor. Occasionally, turloughs act as sinks for a stream or river (Coxon, 1986; Goodwillie, 1992; Goodwillie and Reynolds, 2003). The majority of the volume of turlough floodwaters results from the surface expression of ground water, the changing levels of which reflect relatively local weather patterns. Generally turloughs flood to maximum levels between October and April, are often dry in May and June, and may be variably wet from July through to September (Coxon 1986, Goodwillie and Reynolds, 2003).

Characteristic turlough substrates, indicative of their wetland environment, include marls, peats and gleys. Studies of the pedology of 16 turloughs found characteristic substrate profiles of peat or sand/silt/clay mixtures underlain by marl (MacGowran, 1985). MacGowran (1985) also identified gleys and gleyed rendzinas as the most common turlough soil types. Coxon (1986, 1987b) investigated the unconsolidated deposits within 90 turloughs to a depth of one m or greater, and identified six substrate categories: peat, marl, peat-marl, silt/clay, sand/silt and diamicton, and noted that a given turlough can contain several of these categories. The majority of turloughs studied were found to contain at least one of the deposits peat, marl or peat-marl.

Turloughs are considered of high conservation value for their plant, invertebrate (both terrestrial and aquatic) and bird communities. They are grass- or sedge-dominated habitats, which often have areas of fen, marsh or permanent pond (Goodwillie and Reynolds, 2003; Sheehy Skeffington et al. 2006). The presence of the moss *Cinclidotus foninaloides* on walls and trees is considered typical of turloughs (Praeger, 1932; Coxon, 1986, 1987b; Coker, 1993; Goodwilie, 2003; Sheehy Skeffington, 2006). Many turloughs show distinctive zonation of herbaceous perennials (Praeger, 1932, 1950; Ivimey-Cook and Proctor, 1966, O'Connell *et al.*, 1984; Webb and Scannell, 1983; Goodwillie 1992, 2003). The typical vegetation communities of turloughs, however, are not generally unique to these habitats, being also found on lake-shores, fens or marshes, although two sub-communities may be confined to turloughs (Sheehy Skeffington *et al*., 2006).

Ivimey-Cook and Proctor (1966) and O'Connell et al. (1984) described the phytosociology of turlough vegetation as part of vegetation studies of the Burren and Irish wetlands, respectively. Most turlough wetland communities were classified into two main phytosociological classes: *Scheuchzerio-Caricetea fuscae*, dominated by small sedges, and *Plantaginetea majoris*, closely grazed sward dominated by *Potentilla anserina* and *Agrostis stolonifera* (O'Connell *et al*., 1984). O'Connell *et al*. (1984) described two turlough variants within the *Scheuchzerio-Caricetea fuscae* and eight turlough communities or variants within the *Plantaginetea majoris*. Communities of class *Littorelletea* are also found on the margins of more permanent ponds in turloughs (Ivimey-Cook and Proctor, 1966; O'Connell *et al*., 1984).

Goodwillie (1992) conducted a comprehensive survey of the vegetation of 61 turloughs and identified and mapped 32 distinct vegetation units. Subsequently, Goodwillie *et al*. (1997) mapped additional turloughs in the Gort Lowlands. The vegetation units described in these two studies were subjectively identified by the author in the field and later summarised into 24 main communities (Goodwillie, 2003).

Regan et al. (2007) investigated the vegetation communities of 30 turloughs in south-east Galway and Clare. She sampled 18 Goodwillie (1992, 1997) vegetation units and identified nine communities. There was large overlap and distinct gradation among these nine communities, which formed two main groups: sedge-dominated and grass/forb-dominated, equivalent to those identified by Ivimey-Cook and Proctor (1966) and O'Connell et al. (1984) (Regan *et al*., 2007).

The vascular plant flora of turloughs includes several rare wetland species that are strongly associated with the habitat, such as *Rorippa islandica*, *Frangula alnus*, *Viola persicifolia*, *Callitriche palustris* and *Limosella aquatica* (Scannell, 1973; MacGowran, 1979; Webb and Scannell, 1983; Goodwillie, 1995, 2003; Conaghan *et al*., 2006; Roden *et al*., 2006; Sheehy Skeffington *et al*., 2006). Other rare/scarce vascular plants recorded from turloughs, amongst other wetland habitats, include *Alopecurus aequalis*, *Campanula trachelium*, *Potentilla fruticosa*, *Tarxacum palustre* and *Teucrium scordium* (NPWS Rare/Threatened/Scarce Vascular Plant Database). A number of other species of note found in local abundance in turloughs are listed in Goodwillie (2003).

Some plant species can exhibit different growth forms in turloughs, e.g. *Ranunculus repens*, *Potentilla reptans* and *Mentha aquatica* (Lynn, 1998; Sheehy Skeffington, 2006). *Ranunculus repens* exhibits morphological variation in leaves and root aerenchyma, and physiological differences in response to flooding (White, 1984; Lynn, 1998; Lynn and Waldren, 2001, 2002, 2003; Goodwillie, 2003).

Turlough aquatic fauna is highly spatially variable, in terms of both species diversity and abundance (Reynolds, 1997, 2000). Many of the aquatic invertebrates found in turloughs are widespread and common elsewhere (Lansbury, 1965), but are well adapted to the temporary nature of turloughs (Reynolds, 1982). Typical groups include flatworms, gastropod molluscs, cladocerans, copepods, ostracods, mayfly nymphs and beetles (Reynolds, 1982, 1985a, 1996a, 1997, 2003) most of which are commonly found in small ponds (Reynolds, 2000). The groups with the highest diversity in turloughs are Cladocera, Copepoda and Coleoptera, although the species richness at individual sites may be low (Duigan, 1988, 1992; Reynolds, 1997; Reynolds and Marnell, 1999). Reynolds (1985b) recorded 20 cladoceran species in two turloughs in County Clare, and 15 in a larger series of 28 turloughs sampled in early spring (Reynolds *et al*., 2004). Coleopteran diversity in turloughs is reasonably well studied (Bilton. 1988; Bilton and Lott, 1991; Foster *et al*., 1992) and O Connor *et al*. (2004) found 31 species in three turloughs in south-east Galway.

A number of rare aquatic invertebrate species are found, some exclusively, in turloughs, including the glacial relict cladoceran *Eurycercus glacialis* (Duigan and Frey, 1987a, 1987b; Reynolds 1997, 2000; Reynolds and Marnell, 1999; Reynolds *et al*., 2004), the copepod *Daptomus castor* (Ali *et al*., 1987; Reynolds, 1997) and the damselfly *Lestes dryas* (Nelson and Thompson, 2004). A characteristic turlough water's-edge, moss-dwelling aquatic beetle assemblage, that includes some rare species, has been identified: *Hygrotus quinquelineatus, Coelambus impressopunctatus, Graptodytes bilineatus, Agabus labiatus, A.* nebulosus, *Helophorus* spp., *Berosus signaticollis* and *Dryops similaris* (Bilton. 1988; Bilton and Lott, 1991; Foster, 1992, Bradish *et al*., 2002).

The terrestrial invertebrate fauna of turloughs also includes several rare species, but has in general been poorly documented (Sheehy Skeffinton *et al*., 2006). Beetles, particularly carabids, have been investigated and a number of species new to Ireland recorded (Speight, 1976, 1977; Lott and Foster, 1990; Anderson, 1997; Good, 1997; Owen, 1997; Good and Butler, 2001; Ní Bhriain *et al*., 2002; Moran et al., 2003; Regan and Anderson, 2004; Regan, 2005a; Regan and Moran, 2005). Some of these, notably *Agonum lugens* and *Philonthus furcifer* are not found in Great Britain (Anderson *et al*., 2000; Owen, 1997). Good and Butler (2001) described the carabid and staphylinid fauna of turloughs indicative of an ecosystem sufficiently undisturbed by human activity to retain many local or rare characteristic species. New dipteran species have also been recorded from turloughs (Speight and Cogan, 1979; Speight *et al*., 1979; Ryder *et al*., 2003). Bond (1997) recorded 240 species of Lepidoptera from sites including turloughs in the Gort Lowlands.

Turloughs are considered good sites for over-wintering wildfowl and waders (Ruttledge, 1989; Cabot, 1999), although birds tend to use clusters of sites rather than individual turloughs. The seasonality of these bird species coincides with the flooded phase of turloughs, with turloughs providing good feeding grounds (Madden and Heery, 1997). Dabbling and grazing species, such as whooper swan, Greenland white-fronted goose, pintail, wigeon and teal, are typical species (Ruttledge, 1989). Rahasane turlough is perhaps the most famous for its wildfowl and waders, which includes significant numbers of whooper swans, Greenland white fronted geese, pintail, shoveler, wigeon, golden plover, lapwing, dunlin and black-tailed godwit (Crowe, 2005). Rahasane and Coole-Garryland are considered of international importance for wildfowl and waders (Crowe, 2005). Turloughs that do not dry out completely can be important breeding sites (Madden and Heery, 1996) and lapwing, snipe and meadow pipit have been recorded breeding in turloughs (Buckley and McCarthy, 1987; Buckley, 1993).

Turloughs are a highly variable habitat, as is reflected by the fact that they can range in area from small, compact basins <10 ha to sprawling complexes of up to 280 ha. Turloughs also vary with regard to depth, topography, groundwater connections and inundation patterns. As is clear from the above paragraphs, these physical and chemical variations lead to similarly significant variations in biological communities.

44 sites have been designated as Special Areas of Conservation (SACs) for turloughs in the Republic of Ireland, containing more than 70 individual turloughs. Three of the sites selected as turlough SACs also have overlapping Special Protection Areas (SPAs) designation. Several other proposed and designated SPAs include turloughs, however as the designation process under the Birds Directive is incomplete, a precise figure cannot be given at this time. Only one site containing a turlough, Cregganna Marsh, has been formally designated as a Natural Heritage Area (NHA). Turloughs are present within the boundaries of c. 67 proposed NHAs (pNHAs), although 38 of these are already SACs for the habitat.

2. Habitat mapping

A number of disparate lists of turlough sites have been collated for different purposes, although there has never been a comprehensive survey of the habitat. The main sources of turlough distribution data are:

- Coxon ,1986 – 90 turloughs investigated as part of a PhD study,
- Goodwillie, 1992 – 61 turloughs surveyed as part of a NPWS funded vegetation study,
- Goodwillie *et al.*, 1997 – X turloughs studied as part of an investigation of flooding in the Gort lowlands,

- NPWS Sites Database – a list of known sites of nature conservation interest,
- Geological Survey of Ireland (GSI), Karst database – list of known karst limestone features collated from all available sources,
- Sheehy Skeffington *et al*. (2006) – modified version of GSI, Karst database.

A new database (the turlough conservation assessment database), based primarily upon the GSI, karst database, was created for the purpose of this conservation assessment. The distribution map produced for this conservation assessment was based upon the turlough conservation assessment database).

The GSI database of karst features includes turloughs, caves, springs and limestone pavements as well as other geological phenomenon. Overall it contains 308 turloughs, giving their townland names, with six figure grid references. The database does not distinguish between active and inactive sites or give turlough area, not all sites on the GSI karst database have been formally verified as turloughs by site visits. The database gives the source (generally published and grey literature) of the information on each site, however sources were not provided for 15 turloughs. In this instance the grid references were checked against six inch maps and aerial photographs in an attempt to confirm the presence of a turlough. If a "liable to flood" zone was apparent on the six inch map and flooding or evidence of flooding was apparent on the year 2000 aerial photos, it was taken as preliminary confirmation of the existence of a turlough.

Nine turloughs were added to the GSI karst database based on information contained in Coxon (1986); Goodwillie (1992); Ecosystem Research Group, Sheehy Skeffington *et al*. (2006), Southern Water Global (1997) and the NPWS Natura 2000 databases. The database was also supplemented with ID numbers and turlough area information from these sources. The locations and names of the turloughs were validated and cross checked across the individual databases.

Coxon (1986) conducted a survey of 90 turloughs greater than 10 ha and divided her turlough sites into drained and undrained sites on the basis of a field visit in which drainage channels and the distribution of the moss *Cinclidotus fontinaloides* were taken into account. If the moss indicated a flooding depth of less than 50 cm or if the lateral extent of the moss showed flooding to occur over less than 50% of the area noted on the O.S. maps, she categorised the site as drained category. These sites were excluded from the conservation assessment. Future site visits should be conducted to confirm whether or not these sites function as turloughs.

Sites within the conservation assessment database were assigned a level of confidence in their classification as turloughs:

1. HIGH: Definite turloughs (these included SACs, SPAs, NHAs, other sites from NPWS files or sourced from the literature and experienced personnel.);

2. MEDIUM: Probable turloughs (sites that are likely to be turloughs, based on the available information, but require field verification of turlough characteristics);
3. LOW: Classification as turlough based on maps alone (no site visit or supporting sources listed in GSI karst database).

The final turlough conservation assessment database contained 307 turloughs. Mapping was conducted using the grid reference for the centroid of each turlough. Since polygons were not available for most turloughs, they were not used to map the habitat. Site visits will be required to map turlough boundaries, which are generally indistinguishable from aerial photographs and six inch maps. Sites with centroid points close to the borders of 10 km^2 cells were checked using aerial photographs for evidence of the turlough extending into an adjacent grid square, and maps were adjusted accordingly.

3. Habitat Range

Turloughs are largely restricted to west of the River Shannon, where karstified limestone and areas of thin glacial drift are extensive (Map 1). As detained above (Section 2), a national map of turlough distribution, on a 10 km^2 grid basis, was produced using the turlough conservation assessment database. The habitat range was then defined as the smallest polygon that could be drawn to contain all turlough grid squares, using a minimum number of 90 degree angles. Horizontal or vertical gaps in the habitat distribution of three or more grid squares or oblique gaps of two or more squares were deemed enough to justify a break in the range. The map was produced in a GIS format (ArcGIS 9). The surface area of the range was taken as the number of 10 km^2 grid cells within the range polygon, which in this case was 119 (11,900 $km^{2)}$. It should be noted that the range of turloughs may change in future as more accurate data becomes available, particularly following field survey of sites that have not yet been confirmed as turloughs.

Favourable Reference Range

This current range of 11,800 km^2 was taken as the favourable reference range (FRR) as it is thought to include all geographical, hydrogeological, morphological and ecological variants of the habitat and also covers the known natural range of turloughs in Ireland. Expert opinion concluded that the current geographical range is very unlikely to have declined from the historical range of the habitat.

3.1. Conservation Status of Habitat Range

The conservation status of the range was assessed using the method based on the relationship between current habitat range and the favourable reference range (FRR):

- If current range of the habitat range is not smaller than the FRR, it is considered in favourable conservation status.
- Any combination other than for favourable and unfavourable - bad
- If the current range is >10% below the FRR, it is considered unfavourable-bad.

Although turloughs have been lost historically, the overall range for the habitat is not thought to have declined. These site losses were caused by arterial drainage and, therefore, sites cannot now be re-instated. Large scale drainaged has ceased and the range of turloughs is thought to have been stable throughout the trend period of 1986-2007. The assertion that the current habitat range is equal to the favourable reference range indicates that the conservation status of the habitat is favourable.

Table 1 The conservation assessment for turlough range in the Republic of Ireland.

Range Parameter	Value
Current Range	11,800 km^2
Trend (1986-2007)	stable
Favourable Reference Range	11,800 km^2
Range Conservation Assessment	Favourable

4. Habitat Area

Areas were available for 84 turloughs from NPWS files, Coxon (1986), Goodwillie (1992) and Sheehy Skeffington *et al.*, (2006). The sources for all areas are listed in the Turlough Conservation Assessment database. For 19 confirmed turloughs (HIGH site confidence) that lacked area estimates in the literature, polygons were drawn on aerial photographs using ArcGIS 9, and their areas calculated. The areas for these 103 turloughs) were summed, giving a total of 44.7 km^2.

The area of the remaining 204 turloughs on the Turlough Conservation Assessment database was estimated, based upon the average area of a randomly chosen subset of 25 turloughs. The areas of these 25 turloughs were measured using ArcGIS 9, giving an average area of 0.18 km^2. By extrapolation, the total area for the remaining 204 turloughs was, therefore, 36.9 km^2. This figure is considered likely to be a significant overestimate, as it appears that the Turlough Conservation Assessment database may contain multiple records for single sites or interconnected sites (i.e. complexes of smaller sites). The average area of 0.18 km^2 or 18 ha is also thought likely to be an overestimate, with the majority of the 204 turloughs probably < 10 ha.

With the caveat that it is considered an overestimate, the final estimate for the total surface area of turloughs in Ireland is 81.6 km^2.

Coxon (1986) stated that thirty out of the 90 turloughs she surveyed were drained, amounting to an area of 2,281 ha or 51% of the total area of turloughs surveyed. Goodwillie (1992) noted four additional sites that were damaged by drainage (Attishane, Scardaun, Fearagha and Liskeenan). He also stated that one of the turloughs considered drained by Coxon (1986) (The Loughans) was not, in fact, drained. Further investigation is necessary to determine if other sites considered drained by Coxon (1986) have ceased to function as turloughs.

Most of the turloughs lost through drainage were within the catchment of the Clare River and Lough Carra. Turloughmore at 790 ha was the largest known turlough and formed a sink for Clare river system, before an overland channel was opened to Lough Corrib. D'Arcy (1983) stated that an original area of 2,025 ha flooded within the Clare catchment, inlcuding the semi-permanent Clonkeen Lough and the large neighbouring turloughs (Turloughcor, Killower, Turloughmore etc.). More details of the influence of drainage on turlough extent are presented in Section 6.1.

Favourable Reference Area

The FRA was taken as the current total area of turloughs as this is considered the minimum necessary to ensure the long-tern conservation of the habitat. Given the difficulties in estimating the current total area, however, this value should be treated with caution.

4.1. Conservation status of the habitat area

The conservation status of the turlough habitat area was also based on the relationship between current habitat area and the favourable reference area (FRA). Extensive loss of turlough habitat area owing to drainage occurred from the 1840s. Over the conservation assessment trend period (1986-2007) drainage trends have, however, stablised. The assertion that the current habitat extent and FRA are equal, and that further extensive loss of turlough habitat as a result of drainage is unlikely, yields as **favourable** the conservation status for the habitat area.

Table 2 The conservation assessment for turlough area in the Republic of Ireland.

Area Parameter	Value
Current Area	81.6 km^2
Trend (1986-2007)	stable
Favourable Reference Area	81.6 km^2
Area Conservation Assessment	Favourable

5. Turlough Habitat Structures and Functions

5.1 Turlough structures and functions

Turlough structures and functions are physical, chemical and biological in nature, however, their inter-relationships are not currently well understood. As a result, no monitoring programme for turlough structure and function is yet in place. These issues are being addressed, however, in an ongoing NPWS-funded project.

This section attempts to set out a hypothesis of how turloughs are structured and function and, therefore, how the main pressures identified in section 6 impact upon them.

Turlough ecology is probably largely driven by disturbance. The disturbance factor is the cycle of flooding and drying and its effects, and this exerts a very strong directional selection pressure, on both aquatic and terrestrial components. The effect of the disturbance is probably to decrease competition and, for some groups, increase the randomness of colonisation. This suggests that, even if all turloughs were similar in terms of their geology, morphology and hydrological regime, the ecological communities would naturally be variable. While there are core groups of species that are better adapted to turlough conditions and tend to be widespread, disturbance is likely to create gaps or niches in which rare/less common species can survive, and provide refugia for certain species. A large number of factors determine where turloughs are found and what ecological communities they contain. These can be considered under the following headings:

1. Geology
2. Morphology
3. Climate
4. Hydrology
5. Soils
6. Nutrient cycling
7. Land management

1. <u>Geology</u>

<u>Bedrock</u>: Turloughs are only found on well-bedded limestone that has been karstified. The degree and type of karstification appears to have a significant influence over the ecology, leading to the typology based on conduit and/or epikarstic flow paths. The degree and type of karstification influences hydrological regime and hydrochemistry.

<u>Deposits/sub-soils</u> are generally thin, especially at the margins of the depression, allowing direct contact with the groundwater. The depth and permeability of sub-soils over the wider turlough catchment will influence the rate of recharge and, therefore, groundwater level fluctuations. Less permeable deposits towards the centre of turlough depressions could also influence the hydroperiod.

Karst features: Sinks, springs and estavelles are regular features of turloughs (references). In most turloughs, separate springs and swallow holes act as the sources and sinks of groundwater.

2. Morphology

Turloughs are found in low-lying, topographic depressions. As low points in the landscape, the fluctuating groundwater level can rise above the surface. The shape of the depression influences the depth and area of flooding, as well as hydroperiod and rate of change of water level.

3. Climate

Significant karstification will only occur in areas of relatively high rainfall and recharge, as present throughout Ireland. High rainfall and a variable annual rainfall pattern drive the fluctuations in the groundwater level.

4. Hydrology

Hydrology is considered to be the main driver of turlough ecology. Turloughs only form where the groundwater level fluctuates significantly over the annual cycle, as a result of the karst geology and precipitation. The depth, duration and timing of flooding are all likely to be important determinants of plant and animal communities, and it has been shown that vegetation communities differ significantly along a gradient of flooding intensity (Praeger, 1932; Goodwillie, 2003; Caffara, 2002; Roe, 2005). Many turlough species show particular adaptations to temporary inundation (e.g. Lynn & Waldren, 2001, 2002, 2003).

Although hydrology is considered the main driver, the specific mechanisms by which it determines turlough ecology are not fully understood. Various authors, however, have noted different hydrological aspects influencing biological communities. These can be divided into two main aspects of hydrology: **hydrological regime** and **hydrochemistry**.

Hydrological regime includes the following factors which have very important effects on turlough ecology:

Water levels. The magnitude of the water level fluctuations, in combination with morphology, determines the depth and duration of flooding (hydroperiod, see below), which will have a significant effect on biota present. Water depth determines light penetration and water pressure, which can influence both terrestrial and aquatic ecology.

Timing/Seasonality. When a turlough floods and recedes can determine what species can survive. In turloughs that flood in late summer/ early autumn, some insects can deposit eggs into the flood water allowing survival over winter as aquatic eggs or larvae. Some aquatic invertebrates, e.g. Corixidae, are found only as aquatic nymphs during the summer, and these are incapable of flight and cannot tolerate desiccation. Corixid nymphs can only survive if there is open water throughout the summer. The availability of water is summer is important for aquatic invertebrate and vertebrate communities, as well as allowing survival of aquatic plant species. Plants show a variety of adapations to the turlough environment, through avoidance mechanisms (dormancy, annual life cycle etc.) through morphological adjustment to full physiological tolerance.

Hydroperiod. The duration of the flood period influences whether a species (aquatic or terrestrial) can complete its life-cycle, or tolerate the extreme selective effect of flooding. As the hydroperiod varies along the slope of the turlough depression, it influences the characteristic turlough vegetation zonation. It has been shown that vegetation communities differ significantly along a gradient of flooding intensity (Praeger, 1932; Goodwillie, 2003; Caffara, 2002; Roe, 2005).

Frequency. How often a turlough floods or dries out on an annual (or sometimes longer) time scale, will also influence the species that can survive.

Rate of change. How quickly a turlough fills or empties may have a particular influence over the invertebrate species, determining whether they can avoid drowning/desiccation. It may also influence the pattern of colonisation of plant species, possibly by creating or restricting niches available for colonisation.

It appears that different biological communities are preferentially influenced by the above factors. However, it is not yet apparent which; depth, duration, frequency, rate of change or timing of flooding, or a combination, is most important for each community. Current resaerch is attempting to address this knowledge gap.

Hydrochemistry has a very significant influence on turlough soils and ecology. The two main factors are probably:
Mineralisation. This is the alkalinity or the concentration of base ions in the groundwater. Generally the higher the concentration of ions such as Ca or Mg, the lower the productivity of the turlough. Some authors have suggested that the lower the turlough productivity, the higher the diversity.

Productivity The groundwater feeding turloughs will be naturally variable in terms of its trophic status. Larger catchments dominated by conduit flow-paths are likely to have higher trophic status, whilst smaller catchments with epikarstic flow-paths are likely to be extremely oligotrophic.

Both mineralisation and productivity of the groundwater are influenced by the size and characteristics of the groundwater zone of contribution and the catchment. Variation in the degree of mineralisation and productivity appears to be instrumental in the ecological variation among turloughs, though the exact details are not known. Ongoing research is attempting to define links between productivity and diversity.

Turlough typology. Tynan et al. (2006) put forward an indicative turlough typology based upon karstic flow systems, which identified five natural turlough types. These are:

- Type 1: Conduit/conduit type flow system turloughs, with relatively high trophic status.
  These turloughs are situated in systems comprising deep conduit, fracture/conduit and/or deep epikarst conduit flow:
  a. Conduit flow systems – flow is in major conduits/ cave systems at depths of up to 45 m. These conduits are often several meters in diameter and represent linear flow routes that can carry very large flows.
  b. Fracture/conduit (conduit type) flow systems – flow is at depth in smaller more distributed fractures and/or conduits, but can be represented by the concept of a single conduit. These can carry minor to very large flows.
  c. Deep epikarst conduit flow systems – flow is normally in the top 10-15 m, in large conduits, collapses and, at high level, areas of broken limestone, zones of solution opened fissures and joints and bedding plane karst. Very large flows are supported.

  These are high storage systems that can support large volumes and high velocities of flow. Turloughs receive water through discrete, interconnected pathwasy when there is sufficient hydraulic head to force it into the turlough. The hydrological indicator stage recession is relatively rapid, and will probably have values in the range 10.25-11.67. A higher recession constant in this range will give greater confidence in the presence of this flow system type. The large storage capacity of these systems allows rapid discharge froma turlough once the hydraulic head has dropped in reponse to dropping groundwater levels. Recharge to these systems can be from shallow epikarst, indirect recharge from losing and/or sinking streams (including indirect recharge from surface waters generated on non-karstic aquifers). Productivity will be relatively high for a turlough, although in comparison to other ecosystems, these can be considered mesotrophic as a maximum.

- Type 2: Shallow epikarst type flow system turloughs, with low trophic status.
  These turloughs are situated in shallow epikarst flow systems with water flowing in the upper 2-5 m. The karst is characterised by fluted clints, grikes, small deflation structures, solution opened joints and fissures and bedding planes. These are low storage systems that support low volumes of flow in a relatively dispersed system and unconfined. Effectively, discontinuous water table exists. The hydrological indicator stage recession, will probably have values in the range range 8.89 to 10.72, a lower recession constant in this range will give greater confidence in the presence of this flow system type. This is a result of the low storage capacity of the receiving system. Recharge to these systems is direct, via the epikarst, and

relatively local, probably from within the local topographic catchment. Turlough productivity, including the trophic status of the water, will be low.

- Type 3: Combined conduit/conduit type, shallow epikarst type flow system turloughs, with relatively high trophic status.
  These turloughs have flow occurring from and to both shallow, low volume, low flow epikarst and are also connected to a conduit/conduit type flow network, possibly via the epikarst. The conduit/conduit flow appears in general to dominate the trophic status response of the turlough. Examples include Tulla (trophic status 2), which according to the GFS appears to be located in a shallow epikarst flow system (KFS1), which possibly has links with a conduit/fracture flow system, and Hawkhill turloughs. Hawkhill (trophic status 3), has both shallow epikarst, and deep epikarst conduit flow components to its flow system. Insufficient stage recession data is available to assess the likely recession constant for these turloughs.

- Type 4: Turloughs with riverine input, with high trophic status.
  These are a small number of turloughs which have inflow, and in some cases also outflow, via rivers. The karstic flow system may be any of shallow epikarst, conduit/conduit type flow or a combination of both. In the case of turloughs situated in shallow epikarst flow systems, a low stage recession constant, as is typical of such systems can be expected, and a relatively high productivity (e.g. Rahasane). In the case of combination or conduit/conduit type flow system turloughs, with typically high stage recession rates, high productivity will be caused by the conduit flow component as well as by the riverine input. Coole turlough is an example.

- Type 5: Turloughs receiving distributed flow from certain types of sediment.
  There is a small number of turloughs which, in addition to inputs from shallow epikarst, conduit/conduit type flow or a combination of both, receive distributed flow from sediments whose composition will increase the nutrient load of the groundwater. Productivity may be moderate/high. These turloughs include Ballinduff, which is situated in a shallow epikarst flow system, but is also noted as receiving substantial flow from sands, gravels and sandy tills. Such deposits would be expected to increase the trophic status of water flowing through them. Water from sandy till deposits also contributes to Coy and Blackrock turloughs, these turloughs have a relatively high productivity, and are situated in conduit/conduit type flow systems.

The majority of turloughs studied to date fall into two of these types (types 1 and 2) (Tynan *et al.*, 2006). Visser *et al.* (2006) however challenged the use of a turlough typology and promoted an alternative dry-wet continuum concept. Their exploration of published data for variables affecting turlough ecology suggested that turloughs cannot easily be assigned to distinct types and that there is one continuum from dry to wet sites, which affects all aspects of turlough ecology. These authors also highlight the pitfalls of trying to fit turloughs to types that are weakly supported by the data on which they are based and the scope that the dry-wet continuum provides for a more flexible approach to turlough conservation. Further research on relationships between the hydrological signatures of turloughs and biological communities is required to test current turlough typology and dry-continuum hypotheses.

5. Soils

Coxon (1986) studied the main soil and concluded that turloughs occur on, or partly on, twelve of the 44 soil associations on the Soil Map of Ireland (Gardiner and Radford, 1980). The association on which turloughs are most common, number 33, has shallow brown earths and rendzinas and the parent material of limestone till is shallow in places. Turloughs are less common in the drumlin areas where the principal soils are gleys and grey brown podzolics.

Although geological processes determine the soil's parent material, turlough soils are heavily influenced by the hydrology. Marl precipitates out from the calcium rich groundwater and peat forms where there is constant saturation. Flooding increases the organic content of most wetland soils and turlough soils have been found to be highly organic, most likely as a result of reduced decomposition rate induced by regular inundation (S. Kimberley, unpublished data). Soil type varies within and among turloughs, with turlough soils ranging through shallow rendzinas, inorganic gleys, peaty gleys, peats and thick deposits of marl. Turlough soils are often extremely shallow and are prone to dessication and, therefore, present an unusual wetland soil situation with saturated and dessicated soils occurring in close proximity to one another. Turlough soils typically have different vegetation types, and may partly reflect the strong influence of hydrology on soil development, but also variation in nutrient content. Nutrient status in turlough soils has been shown to vary with soil type along flooding gradients, to vary among turloughs within a catchment, and to show catchment specific variation (S. Kimberley, unpublished data). Soil types affect nutrient availability and hence plant (and possibly some animal, see Ryder *et al.*, 2005) community development; however, nutrient availability is strongly influenced by landuse at the microsite level (e.g. through localised dunging), at the turlough level, and at the catchment level.

6. Nutrient-cycling

The process of nutrient-cycling in turloughs is currently not fully understood and is likely to vary among sites. For many turloughs (especially the most oligotrophic ones), it is likely that there is very tight nutrient-cycling within the site, with terrestrial vegetation decomposing upon flooding and driving productivity during the aquatic phase, and aquatic vegetation (particularly epiphytic algae) decomposing upon flood recession and enriching the terrestrial phase. Strong terrestrial vegetation growth is often observed immediately after flood recession. Some terrestrial species have been observed to continue to grow under water. Turloughs fed by conduit systems and large catchments may naturally receive nutrients from external sources via the groundwater, i.e. act as nutrient sinks. It is also possible that some turloughs that form part of a chain of sites along a conduit system (e.g. Peterswell, Coy, Coole and Caherglassaun) are sources of nutrients for downgradient (i.e. downstream) sites. The exchanges of nutrients between water, soils and vegetation are clearly very important, but as yet poorly understood.

The highly calcareous nature of many turloughs, particularly those on epikarst, may lead to depletion of available phosphorus. Nitrogen may also be lost by denitrification, and surprisingly, potassium is very low in some turlough soils. The most oligotrophic turloughs are thus likely to be very nutrient deficient; they have different plant communities to more meso- and eutrophic turloughs. Although turlough trophic status has largely been determined by proxy using Ellenberg indicator values for the plant communities mapped by Goodwillie (1992, 1997), the limited direct quantitative studies to date support the contention that turloughs that differ in soil nutrient status have very different plant communities (S. Kimberley, unpublished data). However, detailed ecological understanding of turlough nutrient status is hampered by the complexity of processes involving soil and water nutrients, direct nutrient inputs from grazing animals, local inputs from landuse activities in the vicinity of a given turlough, and catchment based inputs from groundwater. The integrated studies required to understand these complex processes are only just beginning.

7. <u>Land management</u>

Almost all turloughs are grazed. Grazing can have a direct impact on the diversity and structure of vegetation. Vegetation structure is important for many invertebrate communities, e.g. many of characteristic turlough water beetles are associated with mossy, shallow, littoral zones, some of the rare terrestrial beetles require open mud in summer, rare dipteran species have been recorded from long turlough vegetation in summer and some of the characteristic turlough terrestrial beetles require fringing woodland or scrub for over-wintering. Structural heterogeneity is likely to be a key determinant of turlough diversity. Poaching by grazing animals can create niches that allow colonisation by certain plant species. Short vegetation and open muddy areas will favour some terrestrial invertebrate species, e.g. ground beetles, while long vegetation will favour others, e.g. scyomyzid flies. Overgrazing leads to increased poaching and vegetation disturbance, while under-grazing may favour the establishment of taller wetland and woody species, particularly in more marginal areas of the turlough. In addition, grazing animals redistribute nutrients, providing localised concentrations, and supplemental feeding of stock (as happens in some turloughs) leads to nutrient enrichment.

CONSERVATION ASSESSMENT OF TURLOUGH FUNCTIONS

1. Geology

Bedrock and subsoils are unlikely to be significantly impacted by anthropogenic activity, except by local quarrying.

2. Morphology

Turlough morphology can be altered through excavation and in-filling. Excavation, in the form of peat-cutting and quarrying has occurred in turloughs. In-filling has also been recorded, particularly with the construction of causeways.

3. Climate

Climate change could possibly change the flooding regime by altering annual precipitation patterns. Climate change scenarios for the west of Ireland predict increased winter precipitation, which could increase the area depth and frequency of flooding. It may also lead to further efforts to ameliorate flooding, with consequent effects on turlough ecology. Increased precipitation in summer could increase the frequency of summer floods and lead to longer or more variable hydroperiods.

4. Hydrology

Turloughs are most at risk from impacts upon their hydrolog;. 30% of turloughs examined by Coxon were damaged by drainage, although arterial drainage now seems to have largely stopped. Extensive flooding in the Gort area in the late 1980s produced calls for efforts to increase arterial drainage.

Hydrological regime:

Water levels. These could be altered through drainage, both large-scale, external (i.e. arterial) and internal drainage (i.e. excavation of drains within the turlough depression). These could also be impacted through morphological changes, as noted above. Other considerations are abstractions and climate change as mentioned above.

Timing/Seasonalility. The same factors apply as for water levels, however internal drainage is one of the most significant risks, often leading to earlier release dates and sometimes also delaying the onset of flooding.

Hydroperiod. Again, the same factors apply, with internal drainage one of the most significant threats.

Frequency. Again, the same factors apply as for water levels. The potential for impacts arising from climate change should be considered, in particular.

Rate of change. Climate change has potential to significantly alter this parameter.

Hydrochemistry:

Mineralisation. Changes in the mineral composition of groundwater is unlikely to occur, unless factors such as drainage or abstraction shorten or increase the flow path length.

Productivity Eutrophication is one of the most significant pressures on turloughs. Nutrient inputs can come from within the turlough depression and from the wider catchment. The nutrient sources that present a risk to turloughs include:

- On-site wastewater systems, i.e. septic tanks etc.
- Farmyards
- Slurry spreading
- Fertilisation of grasslands and crops
- Manuring by grazing animals
- Supplementary feeders and silage stores
- Forestry fertilisation

There is also potential for sediment to be carried within conduit flows, which could be an additional nutrient source and alter light penetration during the flooded phase.

5. Soils

Land management within a turlough, particularly grazing and fertilisation, can have a significant influence on the soils. The timing of grazing is an important factor in maintaining turlough soil quality. When stock is put out to pasture after the winter flood season, before vegetation has regenerated, the soil surface is broken up, encouraging the proliferation of weedy species (Goodwillie, 1992). If this practice is widespread within a turlough it could impact negatively on turlough biodiversity. Areas around pools of water which remain in some turloughs over the summer months often become heavily poached and compacted resulting in soil structural degradation and loss of soil quality, however areas of bare soil can be important for rare annuals and terrestrial invertebrates. Application of inorganic fertiliser has occurred in turloughs. The application of fertiliser and animal waste deposits influence soil nutrient status but different soil types have different capacities to adsorb phosphorus and associated desorption dynamics (Daly *et al.,* 2001). High organic matter soils exhibit low P sorption capacities and poor P reserves compared with mineral soils. Daly *et al.,* (2001) suggest that peat and high organic matter soils have a particularly low capacity to absorb phosphorus, therefore, they are highly susceptible to P-loss, even at low nutrient loading rates. Study is necessary to determine if and when soil-bound phosphorus is lost with run-off during the dry phase of the turlough. This P loss from soil to water may be most relevant within heavily managed turloughs retaining some water during the summer months, particularly after sustained periods of rainfall.

6. Nutrient-cycling

The effect of nutrient enrichment on turloughs has received relatively little direct study. Adding fertilizer to swards in two turloughs increased the cover of some species, but the cover and abundance of others declined progressively (Waldren, Lynn & Murphy, 2002). The authors suggest that, with time, species may be completely eliminated. However, the extent of natural variation in the trophic status of turlough waters is not well understood, as a result of the lack of water sampling. Trophic status is also complicated by the fact that, turloughs have long been managed (primarily for grazing) and because of the possibility that they are impacted upon by groundwater enrichment at the catchment level. The pressures noted above as impacting on groundwater productivity will also impact on nutrient-cycling. Nutrient cycling could also be impacted through changes in the hydrological regime, particularly changes in hydroperiod and timing, and through changes in soil processes. Changes in land management, for example supplementary feeding of stock, is also likely to impact on nutrient cycling in certain turloughs.

The productivity of turlough terrestrial vegetation and its sensitivity to nutrient enrichment was estimated using Ellenberg fertility indices (Working Group on Groundwater, 2004). 28 (27%) of the turloughs analysed had vegetation indicative of very low productivity, or ultra-oligotrophic conditions, and an extreme sensitivity to enrichment. 28 turloughs (27%) had an intermediate status, indicative of low productivity and were determined as being highly sensitive to enrichment and 48 (46%) had vegetation communities indicative of medium productivity, or mesotrophic conditions, and had moderate sensitivity to enrichment. This work also identified, through expert judgement, the natural versus impacted productivity of all turloughs examined.

It can be assumed that highly eutrophic conditions are not favourable, and have a diverse impact on conservation status. Equally, it can be assumed that oligotrophic conditions suggest favourable conservation status (though at high risk). What is not clear is how mesotrophic conditions should be interpreted. Turloughs surrounded by limestone pavement with thin organic substrates, as for example in the East Burren complex, are often highly oligotrophic and may represent relatively undisturbed conditions. However, turloughs surrounded by woodland, or with higher proportions of soils derived from drift may have naturally had a much higher nutrient status to the extent that they *may* have been mesotrophic prior to human disturbance. Thus while it is possible to claim that eutrophic turloughs have suffered significant impact, the degree of impact of mesotrophic turloughs is uncertain.

Rural development, particularly in north-east Clare and east Galway, may have significant future impacts on turloughs. For example, Caranavoodaun is currently considered to be a very oligotrophic turlough, based on the Ellenberg indicator species analysis and supported by quantitative assessment of soil nutrient status. Extensive building of new houses along road surrounding this turlough are likely to result in significantly increased nutrient inputs in the near future.

7. Land management

As noted under the turlough structures section above, the main pressures on turlough ecological functions are probably inappropriate grazing – both under-grazing and more likely over-grazing, scrub removal around margins and homogenous management throughout a site. Landuse, primarily through grazing regime within turloughs, and other forms of landuse within the wider catchment, have pronounced effects on turlough biota. Current landuse of turloughs is primarily as grazing pasture. Selective grazing is likely to alter sward composition, and grazing intensity is known to influence vegetation and arthropod communities (Ní Bhriain *et al.*, 2002, 2003; Ryder *et al.,* 2005). Over-grazing may alter sward composition, provide local nutrient inputs, and when very severe cause poaching of the substrate (e.g. Ní Bhriain *et al.*, 2002). This can be particularly acute around permanently wet areas and pools, which often show significant local damage. The impact of grazing on plant diversity has been shown to be more pronounced in the lower, more flood-prone parts of turloughs (Waldren, Lynn & Murphy, 2002). The localised movement and behaviour of agricultural grazing animals (mainly cattle, but also sheep, horses and geese- see Sheehy Skeffington *et al.*, 2006) has important local effects on plant and animal communities (Galway group's work); different landowners within a given turlough may have very different grazing regimes, including the use of fertilizer to promote forage (e.g. Ní Bhriain *et al.*, 2003). Additionally, some grazing practices have been shown to have minimal effects on plant diversity, but large effects on communities of diptera. Management prescriptions to support turlough conservation may therefore need to be complex and flexible (Ní Bhriain *et al.,* 2003): the current recommended stocking rate of 1.5 livestock units per hectare may be both too high, and too simplistic a measure (Sheehy Skeffington *et al.*, 2006). Wild or feral animals also graze turloughs, and there have been reports of locally excessive grazing by herds of whooper swans (*Cygnus cygnus*) which appear to forage on carbohydrate-rich rhizomes and roots (e.g. *Potentilla anserina*). Other overwintering wildfowl, including widgeon, teal, pintail, may have important effects by grazing vegetation in those turloughs where large number build up. However, there has been no published work on the grazing effects of wild or feral animals in turloughs. Undergrazing has been implicated in limiting shrub growth (Sheehy Skeffington *et al.*, 2006), although regular inundation is much more likely to the main factor limiting the growth of woody plants. Heavy grazing may have locally detrimental impacts on the shrub communities that occur typically at the upper flooding zones of turloughs. Only limited data exist on the level and impact of grazing in turloughs, derived from a number of intensive studies (Ní Bhriain *et al.,* 2002, 2003; Ryder *et al.,* 2005; Waldren, Lynn & Murphy, 2002). It has been argued that both undergrazing and overgrazing provide threat to turloughs (Sheehy Skeffington *et al.*, 2006), and that balancing the grazing regime to local conditions is of key importance. However, undergrazing is unlikely to be responsible for controlling scrub and tree growth in turlough basins, as has been reported; more likely is a physiological constraint on the growth of woody vegetation in areas that are seasonally submerged.

Many turloughs were formerly cultivated, perhaps extensively so in famine times, and evidence of former cultivation ridges can be seen in some turloughs (see Sheehy Skeffington *et al.*, 2006). There is currently very little cultivation in turloughs, and it is of little current ecological significance, although the effects of previous cultivation on current biota has not been investigated. Cultivation adjacent to turloughs may influence nutrient status through run off down slope into turlough basins, and cultivation throughout the catchment may act as sources of nutrient enrichment to groundwater.

Woodland Clearance

It is likely that many turloughs were formerly surrounded by a wet woodland of *Rhamnus catharticus*, *Frangula alnus* and *Fraxinus excelsior*, among other species. Such woodland still exists around some turloughs, though the exact extent is unknown. Its possible clearance from the upper zones of many turloughs seems likely, though the ecological consequences of this are uncertain.

5.1. Typical Species

ANNEX G outlines that typical species chosen for conservation assessment should indicate the amount of good and characteristic variants/subtypes of the habitat type. Applying this concept to the turlough situation is complex as turlough classification is undefined. This ANNEX also highlights that typical species are not necessarily the same as indicator species regarding the structure and functions of a habitat and when defining a list of typical species characteristic, dominant and frequent species should be taken into account. Defining a list of turlough typical species is complicated by the fact that turloughs are landforms which contain common wetland/wetground species, a low number of specialist species and the fact that the relationships between turlough specialist species and turlough structures and functions are poorly understood. These lists of points from ANNEX G should be taken into account when providing comment on which typical species to include:

- Typical species need to be chosen for conservation assessment of the habitat and not for the purpose of defining it.
- Typical species chosen for the purpose of assessing conservation status should remain stable over the middle to longterm. Regionally rare species of unstable occurrence should be excluded if they are non-typical of the region.
- Species occurring in a wide variety of habitat types other than turloughs should be excluded and typical species should be largely dependent on turloughs for their survival and responsive to management.
- Indicator species for the evaluation of the structure and function of turloughs should be included.

According to Fossitt (2000), turloughs support a range of different plant communities that comprise a mixture of aquatic, amphibious and terrestrial species. Plant communities typically form a concentric pattern around the basin, the different zones reflecting differences in the extent and duration of flooding. Jackson (2000) notes that the vegetation mainly belongs to the alliances *Lolio-Potentillion anserinae* and *Caricion davallianae*. A list of typical turlough taxa (Reynolds 2003; Fossitt, 2000; www.eea.europa.uk) is presented in Table 1. Based on the guidelines above, frequently occurring turlough specialist plant species are included in the table 1.

List of taxa typical of turloughs in Ireland, although not necessarily restricted to these ecotones:
Bryophytes and algae:
Cinclidotus fontinaloides, Drepanocladus revolvens, Fontinalis antipyretica, *Oedogonium* sp.

Angiosperms:
Dicots: (*Salix repens, Polygonum amphibium, Polygonum persicaria, Rumex crispus, Ranunculus flammula, Ranunculus repens, Rorippa amphibia, * Rorippa islandica, Rorippa palustris, Filipendula ulmaria, Potentilla anserina, Potentilla reptans, Trifolium repens. Lotus corniculatus, Rhamnus cathartica, Frangula alnus, * Viola persicifolia, Hydrocotyle vulgaris, Apium inundatum, Menyanthes trifoliata, Galium boreale, Galium palustre, Myosotis scorpioides, * Callitriche palustris, Mentha aquatica, Mentha arvensis, * Limosella aquatica, Veronica scutellata, Littorella uniflora, Achillea ptarmica, Cirsium dissectum, Leontodon autumnalis, Taraxacum palustre).*
Monocots: (*Baldellia ranunculoides, Alisma plantago-aquatica, Potamogeton natans, Potamogeton polygonifolius, Juncus bulbosu, Glyceria fluitans, Agrostis stolonifera, Phalaris arundinacea, Molinia caerulea, Eleocharis palustris, Schoenus nigricans, Carex flacca, Carex viridula, Carex hirta, Carex hostiana, Carex nigra, Carex panicea).*

Aquatic invertebrates:
Plathyhelminthes, Turbellaria: (*Polycelis nigra);* **Mollusca** *(Lymnaea palustris, Lymnaea peregra, Bithynia tentaculata);* **Crustacea, Cladocera** *(Alona affinis, Chydorus sphaericus, Daphnia spp. (D. obtusa, D. longispina, D. pulex, and D. magna) * Eurycercus glacialis, Simocephalus vetulus);* **Crustacea Copepoda; Crustacea Ostracoda; Crustacea, Amphipoda** *(Gammarus spp., Asellus aquaticu)s;* **Insecta, Ephemeroptera** (*Cloeon simile*); **Insecta, Odonata** (**Lestes dryas, Sympetrum sanguineum*); **Insecta, Heteroptera** (*Notonecta* spp.); **Insecta, Trichoptera** (Family Limnephilidae); **Insecta, Coleoptera** (*Colymbetes fuscus, Rhantus frontalis; IIybius fuliginosus Agabus bipustulatus, Agabus labiatus, Agabus nebulosus, Laccophilus minutus, Porhydrus lineatus, Hygrotus impressopunctatus, Hygrotus inaequalis, Hygrotus quinquelineatus, * Graptodytes bilineatus, Hydroporus erythrocephalus, Hydroporus palustris, Hydroporus planus, Hydrobius fuscipes, Helophorus brevipalpis, Helophorus flavipes, Helophorus grandis, Helophorus minutus, Anacaena lutescens, Ochthebius minimus, Dryops spp. (D. luridus and D. similaris).*

Terrrestrial invertebrates:

Diptera (*Clusiodes caledonica, Zabrachia minutissima*); **Diptera, Sciomyzidae** (*Pherbellia nana, Colobaea distincta, Ilione albiceta, Pherbina coryleti*); Lepidoptera (*Paraponyx stratiotata, Bactra furfurana, Deltote uncula, Blethisa multipunctata, Chlaenius nigricornis, Pelophila borealis*); **Coleoptera, Carabidae** (*Philonthus furcifer, Blethisa multipunctata, Chlaenius nigricornis, Pelophila borealis, Agonum piceum, Carabus granulatus, Loricera pilicornis, Pterostichus nigrita, Bembidion clarkii, Agonum muelleri, Bembidion aeneum, *Agonum lugens, *Platynus livens, *Badister meridionalis, *Badister peltatus*; Silphidae: *Thanatophilus dispar.*

5.1.1. Conservation Status of Habitat Typical Species

An accurate assessment of the conditions of typical habitat species can not be carried out in the absence of a specific monitoring programme and an assessment is made here on the basis of best available information in the literature. Growth of the algal *Oedogonium* species is encouraged by warm weather and a gradually decreasing water level, and forms felts known as algal paper that bleach white on drying (Reynolds, 1996). Algal paper is commonly found in turloughs during the summer months in turloughs where water levels fluctuate and it is thought that large abundances indicate nutrient enrichment.

The mosses *Cinclidotus fontinaloides*, *Fontinalis antipyretica* have been used previously by Coxon (1986) as indicators of hydrological regime and their distribution within turloughs are determined by the depth and duration of flooding. Of the plant species listed above *Viola persicifolia* and *Potentilla fruticosa* are listed in The Irish Red Data Book (Curtis and McGough, 1998) and were assigned to the rare category which means that these species occurred in ten or less than ten kilometre squares on the basis of their distribution on the Irish National Grid. Their presence in a turlough adds to their conservation value.

CONSERVATION ASSESSMENT OF SPECIFIC STRUCTURES AND FUNCTIONS (INCLUDING TYPICAL SPECIES): UNFAVOURABLE-INADEQUATE (AMBER)

The ecological processes (structures and functions) of turloughs are poorly understood due to a lack of integrated studies and monitoring. Section 5.1.1 highlights, based on the current understanding of turlough structures and functions, that they have significant pressures acting on them. There is a lack of information on the relationship between turlough habitat area and specific structures and functions and the conservation assessment is therefore Unfavourable-Inadequate.

6. Main Pressures

6.1. Drainage

Arterial drainage, or drainage of river systems to dry out land within the catchment, of karst lowlands in Ireland since the mid-19th century has resulted in losses of recharge, lowering of water tables, drying up of turloughs, alteration of underground flow routes and periodic groundwater contamination (Drew and Coxon, 1988). As cited in Reynolds (1996), wetland drainage has been a feature of Ireland since the Famine (1841), with up to 40,000 employed following the Drainage Act of 1842, resulting in the rapid drainage of 1000,000ha (Baldock, 1984; Bruton and Convery, 1982). Drainage in the nineteenth century eliminated many of the large turloughs of East Galway in the creation of the Clare River as it is today. A second burst of activity followed the Arterial Drainage Act of 1945. More recent schemes most affecting turloughs have been the Corrib-Clare drainage (1954-64), draining over 21,000ha of farmland, and the smaller Corrib-Headford and Corrib-Mask-Robe schemes (Baldock, 1984; Bruton and Convery, 1982). Seven sites of importance for Greenland white-fronted geese and Bewick and whooper swans were drastically affected (Scott, 1980; Ruttledge and Ogilvie, 1979), and drainage may also have curtailed the numbers of breeding black-necked grebe. Reynolds (1996) noted that the 40,000ha Dunkellin catchment was under threat of drainage into the 1990s (Baldock, 1984) and the portion of the Dunkellin River that leaves Rahasane turlough (SAC) was partly drained in 1992. At Rahasane turlough the clearance of the lower part of the river channel has increased run-off in summer by allowing the water to avoid the main swallow hole. This has reduced the area of wetland vegetation in a former river channel in the northern part of the basin though it has probably not affected the wintering birdlife. The actual operation also wiped out an oyster bed in the bay below, because of suspended silt. Several turloughs dried out during the drainage of the Clare River catchment and farmers found that although this resulted in more land being available for grazing for a longer season, fertiliser was now needed and the shallower soils were susceptible to poaching (D`Arcy, 1983). Elsewhere, drainage has been seen as of benefit to the land-owners, though completely altering the ecology and species composition of the turlough basin (Tenthorey, 1994).

Arterial drainage ceased for practical purposes in the 1980s with the last completed scheme in the Robe catchment. In recent years there has been damage to individual sites from local drainage. Turloughs have had overland drains dug into them for many years in an effort to speed the run-off of water, mainly in spring. Swallow holes have frequently been dug out in an attempt to improve the escape of water - on the principle of the domestic sink. However the control on the water level is the groundwater so these works are seldom significant. They will make little difference to a turlough on a line of high permeability though they could add a few days to the growing season for a more stable one.

6.2. Over-grazing

Grazing is a major ecological factor in turloughs, either as commonage or in privately owned fields. They are grazed, sometimes heavily by cattle, sheep and even horses and domestic geese (MacGowran, 1985; Goodwillie, 1992, 2003; Feehan, 1998; Aughney and Gormally, 1999; NiBhriain *et al.,* 2003). Grazing determines the height and character of turlough vegetation in summer and the presence of certain species. Apart from limiting shrub growth, the sward is directly affected by grazing through the removal of the more palatable species and by physical damage and manuring (Goodwillie, 2003). When stock is put out to pasture before the vegetation has regenerated following water subsidence, the soil surface is broken up encouraging the proliferation of weedy species (Goodwillie, 2001). If not widespread, this is not detrimental and is an intrinsic part of turlough biodiversity. The stocking density for turloughs recommended by the National Parks and Wildlife Service is 1.5 livestock units per hectare (LU ha-1) (reference). Research on past and present agricultural practices on turloughs so far suggests and upper limit of 1LU ha-1 (Aughney and Gormally, 1999; Ni Bhriain *et al.,* 2002, 2003) referring mostly to cattle. However, large variation in times and rates of stocking occurs between sites, even on one turlough (Ni Bhriain *et al.,* 2003). No research is published to date on behaviour of animal type and breed, or on effects on sward height and composition in turloughs. It has been shown above that different sward heights favour different plant and invertebrate species and thus management diversity within a turlough is important for its biodiversity. Some turloughs have become permanently flooded, owing to compaction of the soil by the heavier breeds of cattle that have replaced sheep (see Grainger in Reynolds, 1996). Stocking density is difficult to measure in the open conditions of the turlough basin, particularly when it is held as commonage. It is logical to express it as livestock units per 6-month (dry) period rather than over the whole year. (Period of agricultural intensity) Ni Bhriain et al., (1999) provides data which shows that modern stocking rates are significantly higher than they were formerly. Aughney and Gormally (1999) give a usage of turlough lands near Annaghdown, Co. Galway in the 1940s of 0.72 LU/ha for five months (April-August). This compares with figures of 0.85 LU/ha in Caranavoudaun and 1.07 LU/ha in Caherglassaun when the present farmers took over their land in 1960-1970. Currently these sites support 1.27 LU/ha and 1.84 LU/ha respectively. Such increases in stocking rates could reflect a general increase in stocking rates, the use of supplementary feeding and/or the application of phosphorus to turlough soils. The latter figure for Caherglassaun represents a 172% increase in grazing pressure over the last 30years. Over-grazing will negatively impact on soil quality by promoting soil compaction, poaching and soil erosion and the elimination of palatable species.

6.3. Eutrophication

The complex hydrology, thin patchy soils and lack of filtration of water within the limestone aquifer make karst groundwater particularly vulnerable to contamination (Drew, 1990; 1992). For example, Reynolds (1996) notes that parts of the East Burren lie in the headwaters of the Fergus River, and silage effluent septic tank overflow anywhere in the catchment upstream of Mullach Mor could have negative effects on turloughs within the Burren National Park. The evaluation of turloughs with respect to nutrient status is complex and, in the absence of a monitoring programme, past assessments of the influence of eutrophication on turloughs are based on localised, small-scale studies. Plant nutrient analyses have been carried out in Rahasane turlough, showing the vegetation there to have nitrogen levels comparable to those of fertilised grassland (soil and plant P were relatively low) (Sheehy Skeffington, 1985). Elsewhere, preliminary turlough water sampling in SE Galway showed nitrate levels were highest at those turloughs that were most strongly grazed, indicting manure effects or possible fertliser addition (Southern Water Global, 1998). They have been ranked according to the trophic status of their vegetation and Ellenberg Fertility Scores for the dominant plant species (Goodwillie, 1992; Working Group on Groundwater, 2004). The vegetation has been classified into mesotrophic, disturbance-indicator, grassy plant communities, or oligotrophic sedge-dominated communities (Ivimey-Cook and Proctor, 1966; O`Connell et al. 1984). However the extent to which these are influenced by anthropogenic factors such as water pollution and fertiliser addition is not clear. Therefore it is assumed for the purposes of this conservation assessment that some turloughs have been negatively impacted by eutrophication.

6.4. Peat cutting, marl extraction and quarrying

Peat accumulates on the turlough floor under the influence of waterlogging which deprives organic matter of air and prevents aerobic decay. Coxon (1986) recorded peat in the bottom deposits of 44% of her sites. In the turlough situation the peat forms as fen peat, probably a mixture of the remains of tall sedges including *Cladium mariscus*, *Schoenus nigricans*, *Molinia caerulea* and *Scorpidium* and *Drepanocladus* mosses (Sheehy Skeffington *et al.*, 2006). Goodwillie (1992) provided an assessment of landuse within 61 turloughs > 10ha and noted traces of past peat cutting in 17 of the 61 turloughs. In all instances it was noted that peat cutting has long ceased. Such peat cutting was localised and for domestic use but has influenced the mosaic of vegetation within turloughs where it occurred and should be taken into account during turlough vegetation surveys. Evidence of past marl extraction was recorded in two turlough sites by Goodwillie (1992) which has produced a similar influence on the vegetation as peat cutting.

Quarrying was recorded adjacent to one turlough however as assessment of its impact on the turlough was not given. Some of this quarrying is very small scale and local, appears to have stopped, and is probably of limited ecological consequence. Infill of turlough edges occurs quite often (e.g. Termon North) and while this may not be very significant in reducing the area of the habitat it destroys the edge vegetation and any zonation that is present. The source of such material is often the clearance of pavement or loose blocks which is now so common in the agricultural limestone regions. As well as adding to existing grazing land, roadways or farm buildings there are instances of such material being dumped on existing low level pavement (Cregaclare South, Kilmaine) covering the woodland and scrub that naturally occurs in such places.

7. Threats

7.1. Climate change

Habitats on the interface between land and water constitute a sensitive measure of environmental and climatic change. Turloughs are particularly useful in this regard as they are perennially on the interface as ecotones, but the turlough habitat will also respond to anthropogenic influences of all sorts, from changes in nutrient cycling to variations in temperature and rainfall, especially its timing, intensity and overall level. Warmer winters caused by global warming could lead to some perennial rhizomatous species respiring too much and running out of the food reserves necessary to maintain themselves until exposed by the falling waters. The persistence of some of the coolwater Crustacea may also be threatened (Grainger, 1996) and the regular monitoring of the commonest species *Eurycercus glacialis* might be a useful check on the ecosystem. Increased winter precipitation (see McElwain & Sweeney, 2006) may lead to increased flooding in karst areas, which could result in new demands for drainage schemes in response to local pressure from the community. This last point may be exacerbated by local increases in rural development, with an increasing number of private dwellings being built in rural areas, particularly those within relatively easy commuting distance from Galway. In some cases this may also lead to increased inputs to groundwater adjacent to sensitive (currently oligotrophic) turloughs.

7.2. Eutrophication

Catchment water is thought to be the main factor determining nutrient input into turlough systems (Southern Water Global, 1998). Article 5 of the WFD required the identification of groundwater bodies at risk of failing ot meet the environmental objectives set out in Article 4 (Working Group on Groundwater, 2004). The objective was to identify groundwater bodies at risk and allow for prioritisation in the programme of measures and river basin management plan (Kilroy *et al.,* 2006) by collecting information on the magnitude of pressures, pathway susceptibility and receptor sensitivity. 19 of the 70 turloughs designated as SACs were identified as occurring within groundwater bodies probably at significant risk from abstraction and eutrophication pressures. Increased rural development, particularly in SE Galway, may lead to increased local risks from eutrophication.

7.3. Over-and under-grazing

In fact, it is likely that the major threat to turlough biodiversity, given that turloughs are considered marginal land, is the abandonment of land. An absence of grazing, if extensive over a whole turlough is likely to be detrimental to both vegetation and invertebrate diversity. Management plans for turloughs must therefore be cognisant of national trends in farming and include incentives to retain farming systems on the turloughs, as well as incorporating the experiences of farmers managing these habitats.

8. Future Prospects

8.1. Negative Future Prospects

If formal verification of turlough sites is not deemed a priority and conservation focus is placed solely on sites designated as SACs information on the range, extent and quality of turlough habitats will continue to be inadequate. If the threats outlined in Section 7 are not addressed in the context of between-site and within-site turlough variation the implications of threats will not be fully understood. If studies on turloughs do not fully integrate the landowners associated with turloughs the risk is that participation in national conservation initiatives (Sections 8.2.1 and 8.2.2) will be less than ideal.

8.2. Positive Future Prospects

8.2.1. The Rural Environment Protection Scheme (REPS)

REPS is a 5 year EU funded scheme for environmentally sensitive farming, introduced in 1994, which includes incentives to reduce stocking densities within proposed NHAs, SACs and on those lands designated as degraded (overgrazed) by the Department of Agriculture, Food and Forestry. Phase 3 of REPS is currently operating, with a fourth phase under consideration. The positive impact of this scheme for turloughs is dependent on several factors such as the uptake of REPS by farmers with large stock numbers in overgrazed areas. A reduction in the stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with over grazing in turloughs.

8.2.2. National Farm Plan Scheme (NFPS)

In February 2006 the NPWS launched a new 5 year National Farm Plan Scheme for designated areas (SACs, SPAs) and commonage. This follows on from the requirements of the EU Natural Regulations and Wildlife (Ammendment) Act, 2000. The scheme allows the Department to pay farmers and landowners for losses incurred through restrictions caused by the designation of lands as SAC or SPA, or to pay for certain actions which are of benefit to nature and are agreed in a farm plan. The implementation of the plan should reduce damage on turloughs caused by farming activities, particularly grazing. Its success obviously depends on the farmers` participation. However the NFPS should be taken as an action addressed to benefit the habitat protection.

8.2.3. Water Framework Directive (2000/60/EC)

The European Water Framework Directive (WFD) is the first piece of legislation that encompasses groundwater, rivers, lakes, estuarine and coastal waters. Whilst turloughs are important for both their aquatic and terrestrial ecologies, they were classified as Groundwater Dependent Terrestrial Ecosystems for the purpose of the WFD because their aquatic phase is not permanent (Kilroy et al. 2006). The WFD requires “good water status” and/or “good ecological status” for turloughs by 2015, to be achieved through integrated catchment management. Risk assessments for turlough nutrient pollution were required under the WFD as part of the characterisation reports for each of the eight River Basin Districts in Ireland and these highlighted areas where turloughs are under significant threat from pollution. Consideration of the complexities of integrating turloughs into river basin management planning was presented by Kilroy *et al.,* (2006) and a wider appreciation and understanding of such complexities is vital if the WFD objectives for turloughs are to be achieved.

8.2.4. Assessing the Conservation Status of Turloughs

Details of turlough habitat quality are of fundamental importance in assessing the conservation status of turlough structures. However, there has been little if any monitoring of the condition of the turlough habitat over time. Various studies have described particular sites but there has never been a repeat study done by the same personnel. This is a vital factor in monitoring (Oredsson, 2000). At some sites there are regular bird counts but the relationship of most birds to the habitat is an opportunistic one depending on the extent of flooding in a region, the state of the bird population and, for some species, adjacent land use (Madden & Heery, 1997). Goodwillie (2003) notes that biological methods should play the largest part in site monitoring as species are permanently exposed to all variations in hydrology and nutrient inputs and their response is an integrated one. In some instances they respond to highs and lows as well as sustained levels of quality. The response of some small animal species is probably the most sensitive to change. However, turlough inhabitants are adapted to natural stresses and may be somewhat resistant to change (Reynolds, 1996). Vegetation will also change but it has considerable inertia caused by an ability to survive natural periods of unfavourable extremes.

The lack of comprehensive turlough monitoring is being addressed by a multidisciplinary project entitled “Assessing the Conservation Status of Turloughs” is being funded by the National Parks and Wildlife Service and is being conducted by group from the School of Natural Sciences, Trinity College, Dublin, Ireland. This project was born out of Habitats Directive and Water Framework Directive requirements. These requirements include an improved understanding of the sum of influences acting on turloughs that may affect their distribution, structure and functions and typical species and turlough characterisation based on an assessment of ecological elements including the chemical and hydromorphological conditions that support those elements. The primary aim of this project is to devise an appropriate monitoring programme for turloughs based on an improved understanding of turlough structures and functions.

It is aimed to:

- Test the use biological, hydrological and hydrochemical elements as indicators of turlough habitat quality, where habitat quality is indicated by within-site and catchment scale pressures.
- Test the use of biological elements as indicators of potentially damaging future changes in hydrological regime and/or nutrient inputs.
- Test the hypothesis that turloughs with similar hydro-geomorphological characteristics have a typical range of ecologies and management pressures.

CONSERVATION ASSESSMENT OF FUTURE PROSPECTS: UNFAVOURABLE-INADEQUATE

The conservation assessment of the future prospects for turloughs should take into account the prospects affecting their range, area covered and specific structures and functions. Maintaining the hydrology of turloughs is of primary importance for each of these aspects. The cessation of large-scale drainage and current legislation/research projects aimed at protecting the quality of turlough habitats present a favourable future prospect for the habitat. The current absence of a monitoring programme for turlough habitat quality based on an improved understanding of turlough eco-hydrology however results in an unfavourable-inadequate conservation assessment of future prospects. Application of the precautionary principle in the absence of comprehensive monitoring in the short-term is advised.

9. OVERALL CONSERVATION ASSESSMENT: UNFAVOURABLE-INADEQUATE

Based on the General Evaluation Matrix the combination of two Favourable and two Unfavourable-Inadequate sub-conservation assessments yields an overall Unfavourable-Inadequate conservation status for the turlough habitat.

References-INCOMPLETE

Ali, T.H., Holmes, J.M.C., Grainger, J.N.R. 1987. *Diaptomus cyaneus* Gurney, a freshwater copepod new to Britain and Ireland. *Irish Naturalists' Journal*, **22** (6): 240-241.

Anderson, R. 1997. A second Irish locality for *Agonum livens* (Gyllenhal) (Carabidae). *The Coleopterist*, **5** (3): 76.

Anderson, R., McFerran, D. and Cameron, A. 2000. *The ground beetles of Northern Ireland*. Ulster Museum, Belfast.

Aughney, T.C. and Gormally, M.J. 1999. *Farm Habitats in Annaghdown, County Galway: Management Practices in the 1940s.* Environmental Science Unit, National University of Ireland, Galway.

Bilton, D.T. 1988. A survey of aquatic Coleoptera in central Ireland and the Burren. *Bulletin of the Irish Biogeographical Society*, **11**: 77-94.

Bilton, D.T. and Lott, D.A. 1991. Further records of aquatic Coleoptera from Ireland. *Irish Naturalists' Journal*, **23** (10): 389-397.

Bond, K.G.M. 1997. Insect survey: Lepidoptera. In: *An Investigation of the Flooding Problems in the Gort–Ardrahan Area of South Galway*. Ecology Baseline Study Vol. II (Southern Water Global and Jennings O'Donovan and Partners eds.). The Office of Public Works, Dublin. pp. 1–86.

Buckley, P. 1993. *The bird communities and general ecology of Rahasane turlough and the Dunkellin/Lavally river system*. Unpublished Ph.D. Thesis, Department of Zoology, NUI, Galway.

Buckley, P. and McCarthy, T.K. 1987. *Bird communities in the Dunkellin/Lavally catchments*. A pre-drainage survey and Environmental Impact Assessment. Report to the National Parks and Wildlife Service, Dublin.

Cabot, D. 1999. *Ireland. A natural history*. The New Naturalists, Harper Collins, London.

Bradish, S., O Connor, Á and Reed, T. 2002. New records of the water beetles *Berosus signaticollis* (Charpentier) and *Graptodytes bilineatus* (Sturm) in turloughs. *Irish Naturalists' Journal*, **27**: 83-84.

Caffarra, A. 2002. Vegetation patterns along the flooding gradient in turlough basins. Unpublished MSc. Thesis, Dublin University, Ireland.

Conaghan, J., Roden, C. and Fuller, J. 2006. *A survey of rare and scarce vascular plants in County Galway*. Unpublished report to National Parks and Wildlife Service, Dublin.

Coxon, C. 1986. *A study of the geologyhydrology and geomorphology of turloughs*. Unpublished Ph.D. thesis, University of Dublin, Ireland.

Coxon, C.E. 1987a. The spatial distribution of turloughs. *Irish Geography*, **20**: 11-23.

Coxon, C.E. 1987b. Examination of the characteristics of turloughs, using multivariate statistical techniques. *Irish Geography*, **20**: 24-42.

Crowe, O. 2005. *Ireland's wetlands and their waterbirds: status and distribution*. BirdWatch Ireland, Dublin.

Curtis, T.G.F. and McGough, H.N. 1988. The Irish Red Data Book 1, Vascular Plants. The Stationery Office, Dublin.

D'Arcy, G.H. 1983. Post-drainage Assessments of Impacts on a Part of the River Clare Catchment, County Galway. Unpublished M.Sc. Thesis, University of Dublin, Ireland.

Drew, D.P., and Coxon, C.E. 1988. The effects of land drainage on groundwater resources in karstic areas of Ireland. In: *Proceedings of the 21st I.A.H. Congress* (Yuan Daoxian, ed.). Geological Publishing House, Beijing, China. pp. 204–209.

Duigan, C. 1988. The Cladocera (Crustacea) of Lough Ree and neighbouring waterbodies in Ireland. *Bulletin of the Irish Biogeographical Society*, **11**: 100-113.

Duigan, C.A. 1992. The ecology and distribution of the littoral freshwater Chydoridae (Branchiopoda, Anomopoda) of Ireland, with taxonomic comments on some species. *Hydrobiologia*, **241**: 1-70.

Duigan, C.A. and Frey, D.G. 1987a. *Eurycercus glacialis*, a chydorid cladoceran new to Ireland. *Irish Naturalists' Journal*, **22** (5): 180-183.

Duigan, C.A. and Frey, D.G. 1987b. *Eurycercus glacialis* in Ireland (Cladocera, Chydoridae). *Internationale Revue der Gesampten Hydrobiologie*, **72** (2): 235-249.

Duigan, C.A. and Kovach, W.L. 1991. A study of the distribution and ecology of littoral freshwater chydorid (Crustacea, Cladocera) communities in Ireland using multivariate analyses. *Journal of Biogeography*, **18**: 267-280.

Ellenberg, H. 1988. *Vegetation ecology of Central Europe.* 4th ed. Cambridge University Press.

Feehan, J. 1998. *Traditional Management of Selected Turlough and Machair Sites*. Report to National Parks and Wildlife Service, Dublin.

Good, J.A. 1997. Soil/Ecotonal invertebrates. In: *An Investigation of the Flooding Problems in the Gort–Ardrahan Area of South Galway*. Ecology Baseline Study Vol. I (Southern Water Global and Jennings O'Donovan and Partners eds.). The Office of Public Works, Dublin. pp. 221–249.

Good, J.A. and Butler, F.T. 2001. Turlough pastures as a habitat for Staphylinidae and Carabidae (Coleoptera) in south-east Galway and north Clare, Ireland. *Bulletin of the Irish Biogeographical Society*, **25**: 74-88.

Goodwillie, R. 1992. *Turloughs over 10 hectares: Vegetation survey and evaluation.* Report to the National Parks and Wildlife Service, Dublin.

Goodwillie, R. 1995. Additions to the range of *Rorippa islandica* (Oeder ex Murray) Bórbas in Ireland. *Irish Naturalists' Journal*, **25**: 57-59.

Goodwillie, R. 2001. *Materials for an Action Plan for the priority habitat, Turloughs.* Draft Report for National Parks and Wildlife Service, Dublin.

Goodwillie, R. 2003. Vegetation of turloughs. In: *Wetlands of Ireland: Distribution, ecology, uses and economic value* (M. L. Otte, ed.). University College Dublin Press, Dublin. pp. 135-144.

Goodwillie, R., Heery, S. and Keane, S. 1997. Wetland vegetation on the Gort lowlands. In: *An Investigation of the Flooding Problems in the Gort–Ardrahan Area of South Galway*. Ecology Baseline Study Vol. I (Southern Water Global and Jennings O'Donovan and Partners eds.). The Office of Public Works, Dublin. pp. 1–131.

Goodwillie, R., and Reynolds, J.D. 2003. Turloughs. In: *Wetlands of Ireland: Distribution, ecology, uses and economic value* (M. L. Otte, ed.). University College Dublin Press, Dublin. pp. 130-134.

Foster, G.N., Nelson, B.H., Bilton, D.T., Lott, D.A., Merrit, R., Weyl, R.S. and Eyre, M.D. 1992. A classification and evaluation of Irish water beetle assemblages. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **2**: 185-208.

Hill, M.O., Mountford, J.O., Roy, D.B. and Bunce, R.G.H. 1999. Ellenberg's indicator values for British Plants, ECOFACT 2a Technical Annex. Centre for Ecology and Hydrology, Huntingdon, Cambridgeshire, U.K.

Ivimey-Cook, R.B., and Proctor, M.C.F. 1966. The plant communities of the Burren Co. Clare. *Proceedings of the Royal Irish Academy*, **64**: 211-301.

Lansbury, I. 1965. Notes on the Hemiptera, Coloeptera, Diptera and other invertebrates of the Burren, Co. Clare and Inishmore, Aran Islands. *Proceedings of the Royal Irish Academy*, **64B**: 89-111.

Lott, D.A. and Foster, G.N. 1990. Records of terrestrial Coleoptera from wetland sites in 1987, including *Stenus glabellus* Thomson (Staphylinidae) new to the British Isles. *Irish Naturalists' Journal*, **23**: 280-282.

Lynn, D. 1998. *Morphological and physiological variation in the turlough form of* <u>Ranunculus</u> repens. Unpublished Ph.D. Thesis, Department of Botany, University of Dublin.

Lynn, D.E. and Waldren, S. 2001. Morphological variation in populations of *Ranunculus repens* from the temporary limestone lakes (Turloughs) in the west of Ireland. *Annals of Botany*, **87**: 9-17.

Lynn, D.E. and Waldren, S. 2002. Physiological variation in populations of *Ranunculus repens* L. (Creeping Buttercup) from the temporary limestone lakes (turloughs) in the west of Ireland. *Annals of Botany,* **89**: 707-714.

Lynn, D.E. and Waldren, S. 2003a. Survival of *Ranunculus repens* L. (Creeping Buttercup) in an amphibious habitat. *Annals of Botany*, **91**: 75-84.

Lynn, D.E., and Waldren, S. 2003b. The turlough form of *Ranunculus repens*, In: *Wetlands of Ireland. Distribution, ecology, uses and economic value* (M. L. Otte, ed.). University College Dublin Press, Dublin. pp. 157-159.

Madden, B. and Heery, S. 1996. Breeding waterfowl in south Galway area. In: An Investigation of the Flooding Problems in the Gort–Ardrahan Area of South Galway. Ecology Baseline Study Vol. I (Southern Water Global and Jennings O'Donovan and Partners eds.). The Office of Public Works, Dublin. pp. 132–208.

MacGowran, B. 1985. *Phytosociological and ecological studies on turloughs in the west of Ireland*. Unpublished Ph.D. Thesis, Department of Botany, University College, Galway, Ireland.

MacGowran, B. 1979. *Rorippa islandica* (Oeder ex Murray) Bórbas in turloughs of southeast Galway (H15). *Irish Naturalists' Journal,* **19**:326.

McElwain, L. and Sweeney, J. 2006. *Implications of the EU Climate Protection Target for Ireland*.. Environmental Protection Agency, Wexford, Ireland. 25pp.

Moran, J., Gormally, M.J. and Sheehy Skeffington, M. 2003. Records of *Panagaeus crux-major* (Linnaeus) and *Pterostichus aterrimus* (Herbst) recorded on turloughs in Couties Clare and Mayo. *Irish Naturalists' Journal,* **27** (8): 309-311.

Nelson, B. and Thompson, R. 2004. *The natural history of Ireland's dragonflies*. Ulster Museum, Belfast.

Ní Bhriain, B., Gormally, M. and Sheehy Skeffington, M.. 2003. Changes in land use practices at two turloughs, on the east Burren limestones, Co. Galway, with reference to nature conservation. *Biology and Environment, Proceedings of the Royal Irish Academy,* **103B**:169-176.

Ni Briain, B., Sheehy Skeffington, M. and Gormally, M. 2002. Conservation implications of land use practices on the plant and carabid beelt communities of two turloughs in Co. Galway, Ireland. *Biological Conservation*, **105**: 81-92.

O'Connell, M.,. Ryan, J.B and MacGowran, B.A. 1984. Wetland communities in Ireland: a phytosociological review. In: *European Mires* (P. D. Moore, ed.). Academic Press, London. pp. 303-364.

O Connor, Á., Bradish, S., Reed, T., Moran, J., Regan, E., Visser, M., Gormally, M. and Sheehy Skeffington, M. 2004. A comparison of the efficacy of pond-net and box sampling methods in turloughs – Irish ephemeral aquatic systems. *Hydrobiologia*, **524**: 133-144.

Owen, J.A. 1997. Beetles (Coleoptera) recorded from various Irish sites in 1993, 1994 and 1996. *Bulletin of Irish Biogeographical Society,* **20**: 136-154.

Praeger, R.L. 1932. The flora of the turloughs: a preliminary note. *Proceedings of the Royal Irish Academy*, **41B**: 37-45.

Praeger, R.L. 1950. Natural history of Ireland. Collins, London.

Regan, E. 2005a. Further records of carabid beetles from turloughs. *Irish Naturalists' Journal*, **28** (2): 59-61.

Regan, E. 2005b. An Investigation of the plant, carabid and staphylinid communities of turloughs in southeast Galway/ north Clare, Ireland. Unpublished Ph.D. Thesis, NUI Galway, Ireland.

Regan, E.C. and Anderson, R. 2004. Terrestrial Coleoptera recorded in Ireland, May 2003. *Bulletin of the Irish Biogeographical Societ*y, **28**: 85-132.

Regan, E.C. and Moran, J. 2005. *Thanatophilus dispar* (Herbst) (Silphidae) in turloughs in the west of Ireland. *The Coleopteris*t, **14** (2): 89-91.

Regan, E., Sheehy Skeffington, M. and Gormally, M.J. 2007. Wetland plant communities of turloughs in southeast Galway/north Clare, Ireland in relation to environmental factors. *Aquatic Botany*, **87**: 22-30.

Reynolds, J.D. 1982. Ecology of Turloughs (Vanishing Lakes) in the Burren, Western Ireland. *Transactions of the 14th International Congress of Game Biologists*, **14**: 183–188.

Reynolds, J.D. 1985a. Karstic freshwater habitats on the Aran Islands, Co. Galway, with preliminary notes on their fauna. *Irish Naturalists' Journal*, **21** (10): 430-435.

Reynolds, J.D. 1985b. Cladocera from Burren Turloughs at Mullagh More, Co. Clare. *Bulletin of the Irish Biogeographical Society,* **9**: 51-54.

Reynolds, J.D. 1996. Turloughs, their significance and possibilities for conservation. In: *The conservation of Aquatic Systems* (J. D. Reynolds, ed.). Royal Irish Academy, Dublin. pp. 38-46.

Reynolds, J.D. 1998. Invertebrate surveys of S.E. Galway turloughs. Baseline Report. In: An Investigation of the Flooding Problems in the Gort–Ardrahan Area of South Galway. Ecology Baseline Study Vol. II (Southern Water Global and Jennings O'Donovan and Partners eds.). The Office of Public Works, Dublin. pp. 126–141.

Reynolds, J.D. 2000. Invertebrate communities of turloughs (temporary lakes) in south-east Galway, Ireland. *Verhandlungen Internationale Vereinigung für Thoretische und Angewandte Limnologie,* **27** (3): 1679-1684.

Reynolds, J.D. 2003. Fauna of turloughs and other wetlands. In: *Wetlands of Ireland: Distribution, ecology, uses and economic value* (M. L. Otte, ed.). University College Dublin Press, Dublin. pp. 145-156.

Reynolds, J.D. and Marnell, F. 1999. New records o*f Eurycercus glacialis* (Cladocera: Chydoridae) in turloughs in south-east Galway. *Irish Naturalists' Journal*, **26** (5/6): 177-180.

Reynolds, J., Murphy, M. and O Connor, Á. 2004. Early season cladoceran diversity of Atlantic temporary pools (turloughs). *Archives des Sciences*, **57**: 97-104.

Roden, C., Conaghan, J., Fuller, J. and Reynolds, S. 2006. *A survey of rare/threatened and scarce vascular plants in County Clare*. Unpublished report to National Parks and Wildlife Service, Dublin.

Roe, C. 2005. *Vegetation differentiation along flooding gradients in relation to incidence of flooding in Turlough*s. Unpublished B.A. Moderatorship thesis, University of Dublin, Ireland.

Ruttledge, R.F. 1989. *Birds in counties Galway and Mayo*. Irish Wildbird Conservancy, Dublin.

Ruttledge, R.F. and Ogilvie, M.A. 1979. The past and current status of the Greenland white-fronted goose in Ireland and Britain. *Irish Birds*, **1**: 293-363.

Ryder, C., McDonnell, R.J., Gormally, M.J. and Knutson, L. 2003. *Colobaea distincta* (Meigen): a sciomyzid (Diptera) new to Ireland with a key to the Irish species of the genus. *Irish Naturalists' Journal*, **27**: 184-186.

Ryder, C., Moran, J., McDonnell, R. and Gormally, M. 2005. Conservation implications of grazing practices on the plant and dipteran communities of a turlough in Co. Mayo, Ireland. *Biodiveristy and Conservation*, **14**: 186-187.

Scannell, M.J.P. 1973. *Rorippa islandica* (Oeder ex Murray) Bórbas in Ireland. *Irish Naturalists' Journal*, **17**: 348-349.

Sheehy Skeffington, M., Moran, J., O Connor, Á. Regan, E., Coxon, C.E., Scott, N.E. and Gormally, M. 2006. Turloughs - Ireland`s unique wetland habitat. *Biological Conservation*, **133**: 265-290.

Sheehy Skeffington, M.J. 1985. Vegetation productivity in Rahasane turlough, County Galway. *British Ecological Society Bulletin*, **XVI**: 20-23.

Southern Water Globaland Jennings O'Donnovan and Partners. 1998. *An investigation of the flooding problems in the Gort-Ardrahan area of South Galway*. Final Report. Office of Public Works, Dublin.

Speight, M.C.D. 1976. *Agonum livens, Aenum striatum* and *Xyolta coeruliventris*: insects new to Ireland. *Irish Naturalists' Journal*, **18**: 274-275.

Speight, M.C.D. 1977. Notes on three ground beetles (Coleoptera: Carabidae) *Dyschirius luedersi* new to Ireland, *Badister peltatus* and *Chlaenius tristis* reinstated as Irish. *Irish Naturalists' Journal*, **19** (4): 116-118.

Speight, M.C.D. and Cogan, B. 1979. *Arcometopia wahlbergi*, *Clusiodes caledonica* and *Stigmella cathaticella*: insects new to Ireland. *Irish Naturalists' Journal*, **19** (11): 401-402.

Speight, M.C.D., Williams, M.D.C. and Withers, P. 1979. *Pachygaser minutissima*, *Psacadina zernyi* and *Xylota tarda*: insects new to Ireland. *Irish Naturalists' Journal*, **19** (10): 354-355.

Tenthorey, G. 1994. *Changes in the Landscape and Sustainable Development: the Case of the Turloughs*. Report to Landscape and Life: Appropriate Scales for Sustainable Development (LLASS) project, Department of Geography, University College, Dublin.

Tynan, S., Gill, M. and Johnston, P. 2006. *Development of a methodology for the characterisation of a karstic groundwater body with particular emphasis on the linkage with associated ecosystems such as the turlough ecosystem.* Report on ERTDI project 2002-W-DS-08-M1. EPA, Wexford, Ireland.

Visser, M., Regan, E., Moran, J., Gormally, M., and Sheehy Skeffington, M. 2006. The rise and fall of turlough typologies: a call for a continuum concept. . *Wetlands*, **26**: 745-764.

Waldren, S., Lynn, D.E. and Murphy, S. 2002. *The Effects of Management Practices on the Dynamics and Conservation Status of Turlough Plant Communities*. Final Scientific and Technical Report to Enterprise Ireland.

Webb, D.A. and Scannel, M.J.P. 1983. *Flora of Connemara and the Burren*. Cambridge University Press.

White, P. 1984. *The effect of submergence on plants from a turlough and non-turlough population of* Ranunculus repens *L*. Unpublished B.Sc. Thesis, Department of Botany, NUI, Galway.

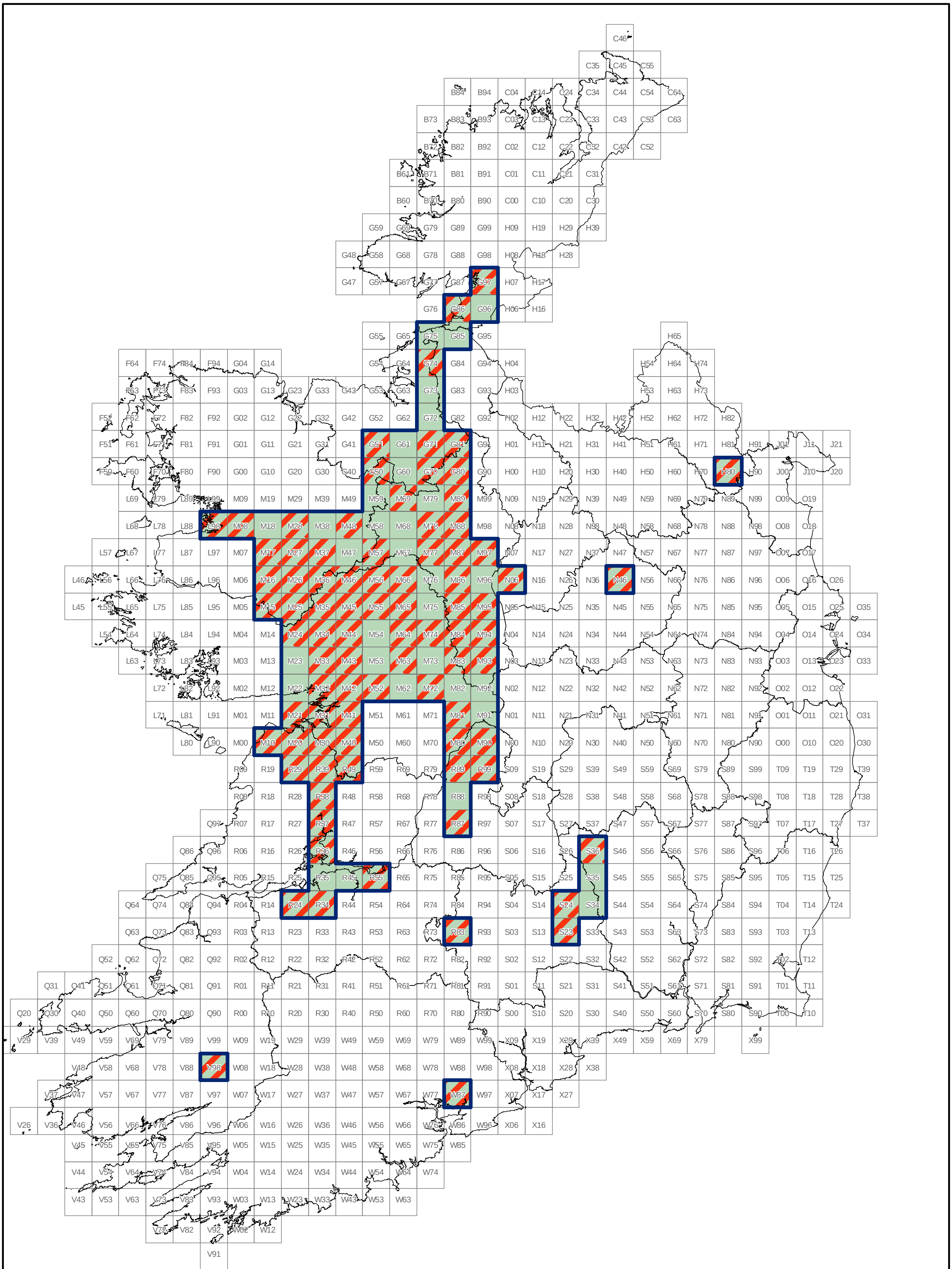
Working Group on Groundwater. 2004. Guidance on the assessment of pressures and impacts on groundwater dependent terrestrial ecosystems, Risk Assessment Sheet GWDTERA2a – Turloughs. WFD Pressures and Impacts Assessment Methodology, Guidance Document no. GW9. Working Group on Groundwater, Sub-committee on Turloughs. www.wfdireland.ie

3180 Turlough

National Level	
Habitat Code	3180
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Range Map	See attached map
Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	Coxon, C.E. 1987. The spatial distribution of turloughs. *Irish Geography*, **20**:11-23. Geological Survey of Ireland (Date) Karst Database. Geological Survey of Ireland, Beggars Bush, Haddington Rd., Dublin 4. Goodwillie, R. 1992. *Turloughs over 10 hectares: Vegetation survey and evaluation.* Report to the National Parks and Wildlife Service, Dublin. Goodwillie, R. 2001. *Materials for an Action Plan for the priority habitat Turloughs.* Draft Report for National Parks and Wildlife Service, Dublin. Ní Bhriain, B., Gormally, M. and Sheehy Skeffington., M. 2003. Changes in land use practices at two turloughs, on the east Burren limestones, Co. Galway, with reference to nature conservation *Biology and Environment, Proceedings of the Royal Irish Academy*, **103B**: 169-176. Ni Briain, B., Sheehy Skeffington, M. and Gormally., M. 2002. Conservation implications of land use practices on the plant and carabid beelt communities of two turloughs in Co. Galway, Ireland. *Biological Conservation*, **105**:81-92. O`Connell, M., Ryan, J.B. and MacGowran, B.A. 1984. Wetland communities in Ireland: a phytosociological review. In: *European Mires*, (P. Moore, ed.). Academic Press, London. pp. 303-364. Regan, E. 2005. An Investigation of the plant, carabid and staphylinid communities of turloughs in southeast Galway/ north Clare, Ireland. Unpublished Ph.D. Thesis, NUI Galway, Ireland. Reynolds, J.D. 1996. Turloughs, their significance and possibilities for conservation. In:. *The conservation of Aquatic Systems* (J. D. Reynolds, ed). Royal Irish Academy, Dublin. p. 38-46. Reynolds, J.D. 1998. Invertebrate Surveys of S.E. Galway Turloughs. Baseline Report. In: *An investigation of the flooding problems in the Gort Ardrahan area of South Galway* (Jennings O`Donovan and Partners and Southern Water Global). Final Report:Office of Public Works, Dublin. Reynolds, J.D. 2000. Invertbebrate communities of turloughs (limestone lakes) in south-east Galway, Ireland. *Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie*, **27** (3): 1679-1684. Sheehy Skeffington, M., Moran, J., O Connor, Á., Regan, E., Coxon, C.E., Scott, N.E., Gormally, M. 2006. Turloughs - Ireland`s unique wetland habitat. *Biological Conservation*, **133**: 265-290. Southern Water Global and Jennings O`Donovan and Partners . 1998. An investigation of the flooding problems in the Gort-Ardrahan area of South Galway. Final Report. Office of Public Works, Dublin.
Range	Turloughs are largely restricted to the area west of the River Shannon
Surface area of range	11,800 km^2 (118 grid cells x 100 km^2).
Date	1986 - 2007

Quality of data	3 = Good
Trend	0 = Stable
Trend-Period	1986- 2007
Reasons for reported trend	
Distribution map	See attached map
Surface area of habitat	The total area of turloughs in Ireland was estimated as 81.6 km^2
Date	1986 - 2007
Method used	2 = based on remote sensing
Quality of data	2 = moderate
Trend	0 = Stable
Trend-Period	1986- 2007
Reasons for reported trend	
Justification of % thresholds for trends	
Main pressures	810 Drainage 148 Overgrazing 709 Eutrophication 311 Peat cutting and marl extraction 301 Quarrying 403 Dispersed habitation
Threats	850 Climate change 709 Eutrophication 142 Overgrazing by sheep 143 Overgrazing by cattle 149 Undergrazing 301 Quarrying 890 Other human induced changes in hydraulic conditions (Groundwater abstraction). 403 Dispersed habitation
Complementary information	
Favourable reference range	11,800 km^2 (118 grid cells x 100 km^2).
Favourable reference area	71 81.6 km^2
Typical species	**Bryophytes and algae:** *Cinclidotus fontinaloides, Drepanocladus revolvens, Fontinalis antipyretica***,** *Oedogonium* sp. **Angiosperms:** **Dicots:** *Salix repens, Polygonum amphibium, Polygonum persicaria, Rumex crispus, Ranunculus flammula, Ranunculus repens, Rorippa amphibia, *Rorippa islandica, Rorippa palustris, Filipendula ulmaria, Potentilla anserina, Potentilla reptans, Trifolium repens. Lotus corniculatus, Rhamnus cathartica, Frangula alnus, *Viola persicifolia, Hydrocotyle vulgaris, Apium inundatum, Menyanthes trifoliata, Galium boreale, Galium palustre, Myosotis scorpioides, *Callitriche palustris, Mentha aquatica, Mentha arvensis, *Limosella aquatica, Veronica scutellata, Littorella uniflora, Achillea ptarmica, Cirsium dissectum, Leontodon autumnalis, Taraxacum palustre.* **Monocots**: *Baldellia ranunculoides, Alisma plantago-aquatica, Potamogeton natans, Potamogeton polygonifolius, Juncus bulbosu, Glyceria fluitans, Agrostis stolonifera, Phalaris arundinacea, Molinia caerulea, Eleocharis palustris, Schoenus nigricans, Carex flacca, Carex viridula, Carex hirta, Carex hostiana, Carex nigra, Carex panicea.* **Aquatic invertebrates:**

	Plathyhelminthes, Turbellaria: *Polycelis nigra;* **Mollusca:** *Lymnaea palustris, Lymnaea peregra, Bithynia tentaculata;* **Crustacea, Cladocera:** *Alona affinis, Chydorus sphaericus, Daphnia spp. (D. obtusa, D.longispina, D. pulex, and D. magna), *Eurycercus glacialis, Simocephalus vetulus;* **Crustacea, Copepoda; Crustacea, Ostracoda; Crustacea, Amphipoda:** *Gammarus spp., Asellus aquaticus;* **Insecta, Ephemeroptera:** *Cloeon simile*; **Insecta, Odonata:** **Lestes dryas, Sympetrum sanguineum*; **Insecta, Heteroptera:** *Notonecta* spp.; **Insecta, Trichoptera:** Family Limnephilidae; **Insecta, Coleoptera:** *Colymbetes fuscus, Rhantus frontalis; Ilybius fuliginosus, Agabus bipustulatus, Agabus labiatus, Agabus nebulosus, Laccophilus minutus, Porhydrus lineatus, Hygrotus impressopunctatus, Hygrotus inaequalis, Hygrotus quinquelineatus, *Graptodytes bilineatus, Hydroporus erythrocephalus, Hydroporus palustris, Hydroporus planus, Hydrobius fuscipes, Helophorus brevipalpis, Helophorus flavipes, Helophorus grandis, Helophorus minutus, Anacaena lutescens, Ochthebius minimus, Dryops spp. (D. luridus and D. similaris).* **Terrrestrial invertebrates:** **Lepidoptera:** *Paraponyx stratiotata, Bactra furfurana, Deltote uncula*; **Coleoptera, Staphylinidae:** *Platystethus nodifrons,Philonthus furcifer* , **Colopetera, Carabidae:** *Pterostichus crenatus, Pterostichus strenuus, Pelophila borealis and Chlaenius nigricornis;* **Diptera:** *Clusiodes caledonica, Zabrachia minutissima*, *Pherbellia nana, Colobaea distincta*.
Other relevant information	Turlough Habitat Surface Area: • Not all of the 307 sites within the turlough Conservation Assessment database have been surveyed and, as a result sites were assigned a level of confidence in their classification as turloughs: HIGH: Definite turloughs (SACs, SPAs, NHAs, NPWS files, sources from experienced personnel.); MEDIUM: Probable turloughs (require field verification of habitat characteristics); LOW: Classification as turlough based on desk survey alone (no site visit or supporting sources listed). • All turlough areas available from literature or GIS sources were summed, giving an area of 44.7 km^2 for 103 of the 307 turloughs. An average area was then calculated for the remaining 204 turloughs, based on measurement of the area of a randomly chosen subset of 25 sites (average of 0.18 km^2) was 0.16 km^2. The extrapolated area for the 204 turloughs was 36.9 km^2. The total turlough surface area, therefore, was estimated as 81.6 km^2. • The total area of 81.6 km^2 is considered likely to be a significant overestimate, as it appears that the Turlough Conservation Assessment database may contain multiple records for single sites or interconnected sites (i.e. complexes of smaller sites). The average area of 0.18 km^2 or 18 ha is also thought likely to be an overestimate, with the majority of the 204 turloughs probably < 10 ha. Typical Species: • Species indicated by * have a strong association with turloughs, i.e. most/all records for that species in Ireland are from turloughs. • Plant species names and taxonomic order follow Webb (1996).
Conclusions	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable – Inadequate
Future prospects	Unfavourable – Inadequate
Overall assessment of CS	Unfavourable – Inadequate



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Turloughs

3180

- Current Distribution (86 cells)
- Current Range (118 cells)
- Favourable Reference Range (118 cells)
- W48 10km grid cells

Date: August 2007

CONSERVATION ASSESSMENT OF FRESHWATER RIVER HABITATS IN THE REPUBLIC OF IRELAND

BY

THE FRESHWATER ECOLOGY GROUP, TRINITY COLLEGE DUBLIN

AND

COMPASS INFORMATICS

FOR

THE NATIONAL PARKS AND WILDLIFE SERVICE, DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

APRIL 2007

TABLE OF CONTENTS

1. Habitat Characteristics **3**
1.1 The Water Framework Directive – River Typology 3
1.2 The Water Framework Directive – River Monitoring Programme 4
1.3 Habitats Directive Classification of Running Waters 5

2. Habitat Mapping **7**

3. Habitat Range **7**
3.1 Conservation Status of Range 7

4. Habitat Extent **8**
4.1 Conservation Status of Habitat Extent 8

5. Structures and Functions **8**
5.1 Water Quality of Rivers 9
5.1.1 River Water Quality Trends 10
5.2 WFD Risk Assessment of Rivers 11
5.3 Conservation Status of Structures and Functions 12
5.4 Typical Species 12
5.4.1 Conservation Status of Typical Species 13

6 Main Pressures **13**
6.1 Eutrophication/ Nutrient enrichment 15
6.2 Overgrazing 17
6.3 Afforestation 18
6.4 Peat cutting 19

7. Threats **22**

8. Future Prospects **22**
8.1 Negative Future Prospects 22
8.2 Positive Future Prospects 23
8.3 Conservation Status of Future Prospects 24

9. Overall Assessment of the Habitat Conservation Status for 3260 **24**

10. References **25**

11. Appendix 1. **29**

1. Habitat Characteristics

Ireland has an abundant freshwater resource, including lakes, rivers and canals, which accounts for 2.3% of the land cover (approx: 161,660km^2) (EPA 2004). This is significantly higher than the EU average of 1.3% (EEA 2006). Based on the 1:50000 series of Ordnance survey maps, there are 93,500km of river and stream channels but more than 50% are small first order channel. Almost half of the land area in Ireland is drained by just nine river systems including the large Shannon catchment, which alone drains 17% of the State (Fig.1.1).

The first national biological and chemical survey of river water quality was carried out by An Foras Forbatha in 1971 when monitoring was done to cover an estimated 2,900km of river channel (Flanagan and Toner, 1972). The rivers surveyed in this initial monitoring have been re-surveyed seven times since 1971 and provide information on long-term trends in river water quality. The rivers included in the initial survey were selected because they had, or were susceptible to, pollution; they did not therefore provide an overall representation of rivers throughout the country. Rivers in remote areas and smaller streams were under-represented in the survey. A more extensive baseline of rivers was established in 1987 and includes 1,132 rivers and streams which are biologically monitored on a three year cycle. River water quality in Ireland is largely based on biological surveys as the chemical monitoring programme of baseline rivers has been less extensive and the frequency of sampling is often low (Toner *et al.,* 2005). The channel length of the baseline rivers, 13,200km, is considered to be representative of river quality conditions nationally and to be capable of reflecting changes within a reasonable time-frame.

1.1 The Water Framework Directive – River Typology

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a river typology and reference sites and the implementation of monitoring that allows classification of sites relative to a reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state).

The RIVTYPE project (Kelly-Quinn *et al.,* 2004) funded by the EPA studied 50 sites to identify reference sites and develop a river typology. Based on geology, water hardness and slope, twelve river types were identified within the Republic of Ireland (Table 1.1).

The river typology proposed to meet the requirements of the WFD is not synonymous with the river classification used in the Habitats Directive.

Table 1.1 River typology proposed for the Water Framework Directive (Kelly-Quinn *et al.,* 2004)

River Type	Geology	Slope	Water chemistry	River channel (km)	River channel (%)
1	Siliceous 100% Siliceous	<0.05	Soft Water <35 mg $CaCO^3$/l	1,547	7.6
2		0.05-0.02		2,767	13.5
3		0.02 – 0.04		849	4.2
4		> 0.04		507	2.5
5	Mixed 1-25% Calcareous	<0.05	Medium 35-100 mg$CaCO^3$/l	1,008	4.9
6		0.05-0.02		1,271	6.2
7		0.02 – 0.04		326	1.6
8		> 0.04		161	0.8
9	Calcareous >25% Calcareous	<0.05	Hard Water >100 mg $CaCO^3$/l	8,530	41.7
10		0.05-0.02		3,076	15.0
11		0.02 – 0.04		291	1.4
12		> 0.04		113	0.6

1.2 The Water Framework Directive – River Monitoring Programme

Although rivers in Ireland have been surveyed since the 1970s, the WFD requires a more comprehensive monitoring programme than has previously existed. Biological elements including macrophytes, phytobenthos, macro-invertebrates and fish will be monitored once every three years at selected sites. Measurements of a range of physico-chemical elements are also required to support the biological elements. It is likely that a core range of physico-chemical variables will be monitored at each site, with an additional selection inserted where appropriate to be representative of the specific dominant pressure at that sample location. The generic list of physico-chemical variables includes temperature, dissolved oxygen, BOD, salinity, conductivity, hardness, chloride, phosphorus, nitrogen, silicon, pH and alkalinity.

Three types of monitoring, surveillance, operational and investigative, are specified and described in the WFD and Common Implementation Strategy (CIS) guidance documents. The objectives of surveillance monitoring include the assessment of long-term changes in natural conditions, and changes resulting from widespread anthropogenic activity. Operational monitoring will establish the status of those bodies identified as being *at risk of failing to meet their environmental objectives and assess any changes in the status of such bodies resulting from the programmes of measures*. Investigative monitoring will take place in order to ascertain the causes of a water body failing to achieve the environmental objectives or to ascertain the magnitude and impacts of accidental pollution.

The EPA has identified a total of 2676 sites for operational monitoring and 181 for surveillance monitoring as part of the WFD river monitoring programme. All surveillance monitoring sites are included in the operational monitoring programme and therefore the total number of sites included in the WFD river monitoring programme is 2676. Of the rivers sites included in the operational monitoring programme:

- 1014 will be monitored for both physico-chemical and biological parameters;
- 1218 sites monitored will be monitored for biological parameters only; and
- 444 sites will be monitored for physico-chemical parameters only.

The WFD river monitoring programme will monitor river sites within all 21 SACs designated for river habitat 3260. The information collected as part of the WFD monitoring will be more relevant to assessing trends in conservation than has been the case with previous monitoring for water quality, but requires agreement and coordination to optimize relevance to statutory obligations under the Habitats Directive, and other legislation (Irvine *et al.,* 2002).

1.3 Habitats Directive Classification of Running Waters

There are 9 running water habitats described in Annex I of the Habitats Directive. Based on the descriptions and the vegetation communities outlined in the *Interpretation Manual of European Union Habitats* it is apparent that for reasons of biogeography seven of the standing water habitats are unlikely to occur in Ireland (Table 1.2). Of the two remaining habitats, the occurrence of river habitat 3260 is confirmed by the presence of the associated plant communities (Appendix 1) at many river sites in Ireland. However, the identification and designation of river habitat 3270 presents some difficulties in Ireland. Two of the plant species associated with rivers with muddy banks (*Chenopodium rubrum*, and *Polygonum lapathifolium*) have been recorded at turlough sites in Ireland and one site, the Coole-Garyland complex, has been designated for this habitat type. There is an issue in determining if turloughs that have some of the characteristic plant species for this habitat type should be classified as habitat type (3270) which is a running water-river habitat. NPWS will therefore undertake the assessment of the conservation status of habitat type 3270 and this report will deal with river habitat 3260 only.

Rivers may be designated as SACs if they contain species listed in Annex II of the Habitats Directive. Only a small number of Annex II species are found in freshwater and occur in Ireland (Table 1.3). In order to select and designate appropriate rivers for these species the

NPWS consulted relevant experts for each species. Most of the sites that are designated for Annex II freshwater species have also been designated for their Annex I lake, river or estuarine habitats. The designation of rivers for Annex II species adds an additional 2 rivers to the list of 22 rivers designated for Annex I habitats and makes a total of 24 designated river SACs in the Republic of Ireland.

Table 1.2 The Habitats Directive Annex I running water habitats and the number of designated sites in the Republic of Ireland

Code	Habitat	Number of SACs
3210	Fennoscandian natural rivers	*
3220	Alpine rivers and the herbaceous vegetation along their banks	*
3230	Alpine rivers and their ligneous vegetation with *Myricaria germanica*	*
3240	Alpine rivers and their ligneous vegetation with *Salix elaeagnos*	*
3250	Constantly flowing Mediterranean rivers with *Glaucium flavum*	*
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	21
3270	Rivers with muddy banks with C*henopodion rubri* p.p. and *Bidention* p.p. vegetation	1
3280	Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba*	*
3290	Intermittently flowing Mediterranean rivers of the *Paspalo-Agrostidion*	*

Table 1.3 The number of sites designated for Annex II freshwater species in Ireland.

Species	No of SACs	No of River SACs	No of river SACs also designated for their Annex 1 habitats
Alosa alosa	4	4	4
Alosa fallax (including A. f. killarnensis)	5	5	5
Austropotamobius pallipes	13	5	4
Lampetra planeri	10	8	8
Lampetra fluviatilis	9	7	7
Lutra lutra	46	21	20
Margaritifera margaritifera	19	16	14
Petromyzon marinus	10	8	8
Salmo salar	26	18	16

2. Habitat Mapping

The rivers of Ireland are recorded in a national rivers GIS dataset (EPA) that is widely used for interpretation of the Water Framework Directive (WFD) and other directives. It contains some 92,600 individual river segments with a combined length of 73,500 km. The range and distribution of river habitat type 3260 is considered to be very widespread within Ireland. However, it is thought likely that the habitat does not include channels with a gradient in excess of 4% that typically are cascade type channels. These high gradient channels comprise some 33,885 individual river segments with a combined length of 19,680 km

All other river channels not subject to saline intrusion in Ireland were classified as "Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation". This is based on the very widespread distribution of this plant association, but with limited survey to make a more detailed assessment. It, therefore, represents a conservative approach.

3. Habitat Range

Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation are found throughout the Republic of Ireland (Fig 3.1). The range of this habitat, as outlined in Section 2, is based on the range of all rivers excluding the high gradient channels (19,680km) where the associated vegetation communities are not likely to occur. River habitat 3260 is therefore found within 58,721 river segments with a total length of 53,876 km.

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission, 2006) a national map showing the distribution of the river habitat 3260 on a 10 x 10 km^2 square grid was produced in a GIS format. The range for river habitat 3260 was therefore determined using the number of 10 x 10 km^2 grid squares containing rivers and was found to be = 81,900 km^2 which is 96.97% of the range value for the Republic of Ireland.

3.1 Conservation Status of Range

Following the guidance provided in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission, 2006) the assessment of the conservation status of habitat range is established by assessing the variation in the reporting period. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies In Ireland (EPA 2006). This indicates that the overall range of rivers has not altered significantly between 1990 and 2000 and therefore the current range of habitat 3260 is unlikely to have changed during the reporting period. The range of habitat 3260 is therefore assessed as stable and the conservation status of the habitat range is deemed to be Favourable.

4. Habitat Extent

The extent of river habitat (3260) is based on the extent of all rivers excluding the high gradient channels (19,680km) where the associated vegetation communities are not likely to occur. The exact width of the river channels is not systematically recorded, however, the Central Fisheries Board (2002 and unpublished revision 2006) has estimated the width of the channels on the basis of a statistical model that relates channel width to catchment area and stream network metrics. This model does not estimate width of first order (Strahler stream order) streams but on the basis of streams with a stream order >= 2 the CFB model indicates an approximate habitat area for 3260 of 213 km^2.

4.1 Conservation Status of Habitat Extent

Following the guidance provide in the explanatory notes and guidelines for reporting under Article 17 of the Habitats Directive (European Commission, 2006) the assessment of the conservation status of habitat extent is established by assessing the variation in the habitat area in the reporting period. The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006). This indicates that the overall extent of rivers has not altered significantly between 1990 and 2000 and therefore the current extent of habitat 3260 is unlikely to have changed during the reporting period. The current extent of habitat 3260 is therefore assessed as stable and the conservation status of the habitat extent is deemed to be Favourable.

5. Structures and Functions

The structure and functions of all freshwater habitats are affected by a number of factors including geology, water quality and a range of anthropogenic pressures. Information on water quality and pressures affecting rivers, collated for the implementation of the WFD, provide a mechanism for assessment of status of the structures and functions of river habitats.

5.1 Water Quality of Rivers

The flora and fauna or rivers and streams are affected by the presence of pollutants and, therefore, can be used to assess the water quality and the extent of pollution. The impacts of pollution on macroinvertebrates such as aquatic insects, Crustaca, Mollusca, and Oligochaeta are well documented in the scientific literature (Rosenberg and Resh, 1993) and are regarded as satisfactory for routine water quality monitoring purposes (Toner *et al.,* 2005). The relationship between water quality and macroinvertebrate community structure is described by means of a numerical scale of values know as a biotic index. The biotic index employed by the EPA to assess the water quality of rivers relates the diversity and relative abundance of key groups of macroinvertebrate benthic communities (see Section 5.4) to five basic water quality (Q) values (Table 5.1). The scheme is further simplified to include those rivers and streams with transitional conditions e.g. Q1-2, Q2-3, Q3-4, Q4-5 and identifies four water quality classes (Table 5.2).

Table 5.1 The EPA Biotic Indices for river water quality (Toner *et al*., 2005)

'Q' Value	Community Diversity	Water Quality	Condition *
Q5	High	Good	Satisfactory
Q4	Reduced	Fair	Satisfactory
Q3	Low	Doubtful	Unsatisfactory
Q2	Very Low	Poor	Unsatisfactory
Q1	Little/None	Bad	Unsatisfactory

* refers to the likelihood of interference with beneficial or potential beneficial uses.

Table 5.2 The EPA biological classification of river water quality (Toner *et al*., 2005).

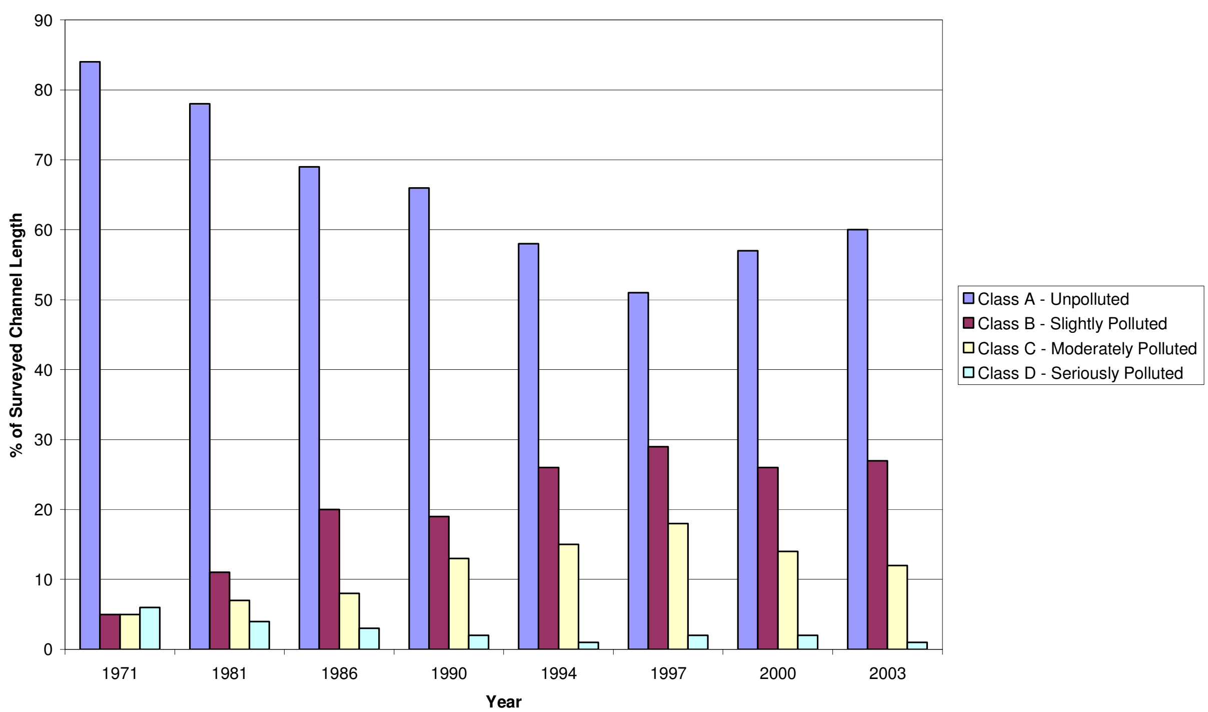
Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly Polluted	Class B
Q3, Q2-3	Moderately Polluted	Class C
Q2, Q1-2, Q1	Seriously Polluted	Class D

Class A waters are those in which problems relating to existing or potential beneficial uses are unlikely to arise and are therefore regarded as being in a satisfactory condition. Such waters typically support healthy natural populations of trout and salmon and are suitable for amenity use and water abstraction purposes. Class B waters are characterised by eutrophication and frequently have excessive deposition of silt. The excessive plant growth can deplete dissolved oxygen levels, which can kill fish in extreme circumstances. Class C waters are typically extremely eutrophic and are frequently impacted by other influences such as organic pollution. Class D waters are characterised by very high concentrations of biodegradable organic waste causing deoxygenation and the growth of bacterial and fungal slimes. Only the most tolerant invertebrates to organic enrichment, and likely, other pollutants, are found in such waters.

5.1.1 River Water Quality Trends

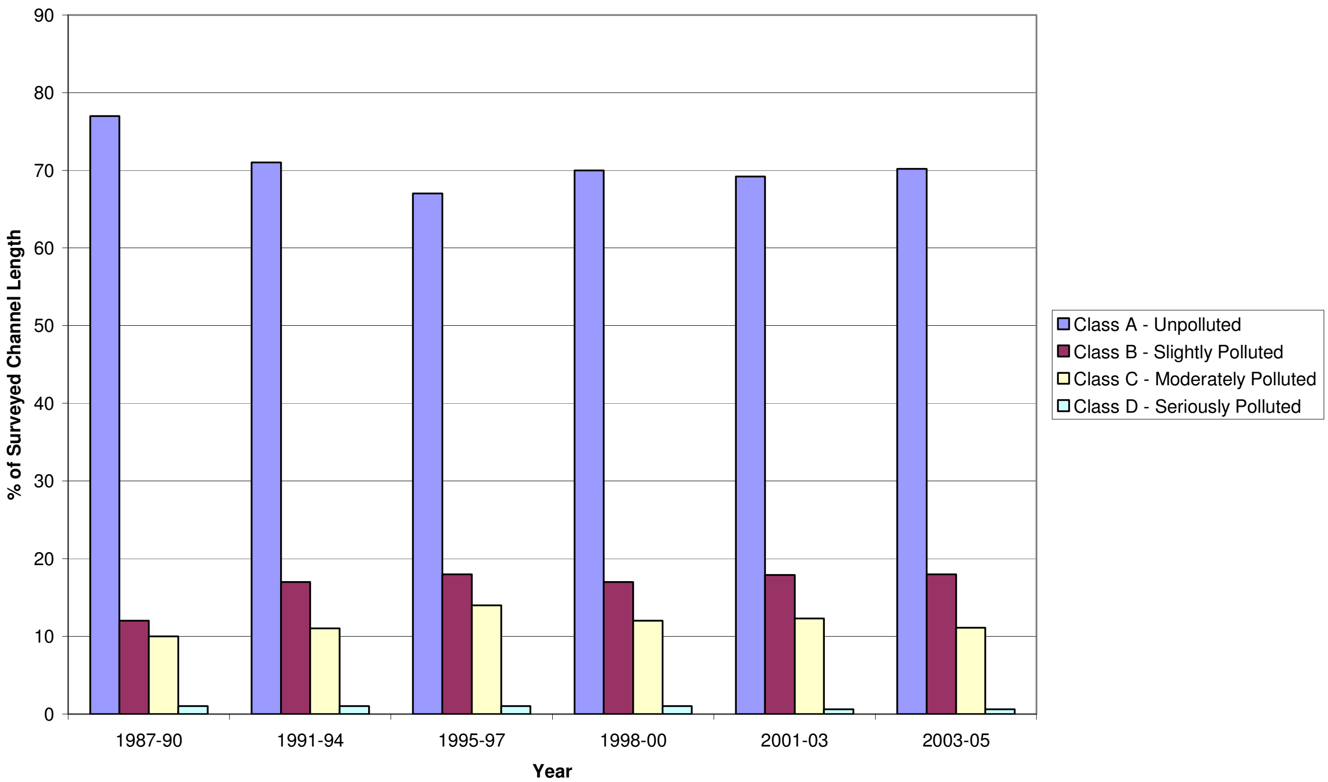
River water quality trends in Ireland are based on either the long-term trends from the 1971 baseline survey or the recent trends from the 1987 baseline. The 2,900km of river and stream channel surveyed in 1971 has been re-surveyed seven times. The information collected shows that the proportion of unpolluted channel had decreased by 39% between 1971-1997 (Fig 5.1). During this period there was also a substantial increase in slight pollution from 5% in 1971 to 29% in 1997. An increase from 5% to 18% in moderate pollution was also recorded during this period. The most recent surveys in 2000 and 2003 show a slight improvement with an increase in the proportion of unpolluted (Class A) waters and a decrease in moderately (Class C) and seriously polluted waters (Class D).

Fig 5.1 Long-term water quality trends based on 2,900km baseline (Toner *et al.,* 2005)



As the 1971 survey had a bias towards rivers and streams with potential pollution problems the baseline of 13,200km, established in 1987, gives a more accurate reflection of river water quality nationally (Fig 5.2). The trends are however similar to the 1971 baseline with a decrease in the proportion of unpolluted (Class A) rivers throughout the 1990s and an increase in proportion of slightly (Class B) and moderately (Class C) polluted rivers. The most recent surveys in 2000, 2003 and 2005 have also indicated that the situation appears to be improving slightly with an increase in the proportion of channel in Class A and a decrease in the proportion of Class D channel.

Fig 5.2 Recent water quality trends based on 13,200km baseline (Toner *et al.,* 2005)



5.2 WFD Risk Assessment of Rivers

An assessment for the WFD of the rivers at risk from pressures including abstraction, alterations to the river morphology and both point and diffuse pollution, provides an indication of the status of the structures and functions of river habitats.

Analyses of the overall pressures on water bodies, including rivers, was a requirement of WFD characterization process (EPA 2005) and in Ireland four categories of risk were developed:

1a – Water bodies at significant risk;

1b – Water bodies probably at significant risk;

2a - Water bodies probably not at significant risk; and

2b - Water bodies not at significant risk;

A total of 4464 river sites were assessed and placed into one of the four categories. The four categories are based on the assessment of risk from abstraction, alterations in morphology and point and diffuse pollution (Table 5.3).

Of the rivers included in the assessment 63.9% or 17,492.5km were categorised as "at risk" (i.e. they were in category 1a or 1b) by the WFD assessment. Rivers identified "at risk" are those which are unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. It includes rivers known to have deterioration in water quality, impacting negatively on structures and functions.

Table 5.3 The number, percentage and length of rivers, assessed for the WFD, likely to be at risk from abstraction, morphology and point and diffuse pollution

Pressure	Number of rivers at risk (1a + 1b)	% of rivers assessed at risk	Km affected
Abstraction and flow regulation	201	4.5	1,648
Morphology	1720	38.5	10,776
Point pollution	602	13.5	7,240
Diffuse pollution	2021	45.2	12,790
Total*	2854*	63.9*	17,492*

*Some rivers may be affected by more than one pressure and therefore the total number of rivers at risk is not equal to the sum of the rivers at risk from individual pressures

5.3 Conservation Status of Structures and Functions

Analysis of a range of pressures affecting rivers indicated that almost two-thirds of rivers assessed were unlikely to meet their environmental objectives, of achieving good status as defined by the WFD. The long-term trends in river water quality show that the proportion of unpolluted river channel has declined by 29% since 1971 (Fig 5.1) while the recent trends indicate a decline of 10% since 1987 (Fig 5.2). The latest report on water quality (Lucey, 2006) indicated that almost 30% of rivers surveyed were polluted. Pollution will negatively affect the ecological structures and functions of river habitats and therefore the conservation status is deemed to be Unfavourable – Bad.

5.4 Typical Species

The biotic index employed by the EPA and described in Section 5.1 has a number of associated macroinvertebrate communities related to each Q value. In the EPA assessment of

Q values, benthic macroinvertebrates have been divided into 5 groups:

Group A – sensitive forms;

Group B – less sensitive forms;

Group C – tolerant forms;

Group D – very tolerant forms; and

Group E – most tolerant forms.

Unpolluted (Class A) rivers will have at least one Group A taxon present in fair numbers i.e the approximate frequency of occurrence is 5-10%. Group B taxa may be common (10-20% frequency of occurrence), scare (< 1% frequency of occurrence) or absent.

Macroinvertebrate taxa and species listed in Group A include:

Plecoptera – All species except *Leuctra* spp.;

Ephemoptera – Heptageniidae, Siphlonuriidae, *Ephemera danica;* and

Lamellibranchiata – *Margaritifera margaritifera.*

5.4.1 Conservation Status of Typical Species

An assessment of the status of the freshwater pearl mussel (*Margaritifera margaritifera*) in Ireland concluded that the species was negatively affected by a range of pressures including eutrophication, pollution, overgrazing, river modification and introduced species (Moorkens, 1999). The increase in nitrate values recorded in the last 30 years rivers has coincided with the extinction of the pollution-sensitive freshwater pearl mussel (*Margaritifera margaritifera*) in the Barrow and the Suir and the decline of populations in the Nore, Slaney and Blackwater (Lucey, 2006).

The status of other macroinvertebrate species that are typical of habitat 3260 have not been assessed but they are likely to similarly affected by these pressures. The conservation status of the typical species of river habitat 3260 is therefore deemed to be Unfavourable – Bad.

6 Main Pressures

Arterial drainage schemes, introduced in the late 19th century and operational until the 1960s, had a major impact on freshwaters in Ireland. There were successive government Acts on river drainage including :

The Drainage and Navigation (Ireland) Acts, 1842 to 1857;

The Drainage and Improvement of Lands (Ireland) Acts, 1863 to 1892;

The Arterial Drainage Acts, 1925 and 1929; and

The Arterial Drainage Act, 1945.

The Arterial Drainage Act in 1945 recommended the drainage of all major river basins except the Shannon and resulted in the drainage of 250,000ha and a further 1,500,000ha were provided with field drains (Reynolds, 1998). Arterial drainage can alter the stream flow, increase flow velocity and reduce the heterogeneity of river structures, such as substrates and aquatic weed which can negatively affect invertebrates and important salmonids species.

The damming of several of the largest rivers in Ireland including the Shannon, Erne, Lee and the Liffey for the development of hydroelectric power stations has impacted on freshwater species including protected salmonids species. Although salmon still frequent these systems, they no longer do so in their former abundance and are maintained artificially through extensive hatchery programmes (Mathers *et al.,* 2002)

The EPA water quality monitoring scheme has analysed water quality in a number of river since the 1970s. The national water quality reports have consistently stated that eutrophication is the principal pressure to river water quality in Ireland (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005).

The selection and designation of 21 river habitat SAC sites in the early 1990s included an assessment of activities impacting on each SAC. The selection and subsequent designation of 21 SACs for river habitat (3260) in the early 1990s included an assessment of activities impacting on each SAC. The assessment information, contained in the NATURA 2000 Standard Data Forms (NPWS), indicate that the following pressures were negatively affecting river habitats:

120 – Fertilisation;
140 – Grazing;
160 – Forestry;
180 – Burning;
220 – Leisure fishing;
230 – Hunting;
310 – Peat extraction;
420 - Discharges
700 – Water Pollution;
810 – Drainage;
900 – Erosion; and

954 – Invasive species.

Information from the Site Inspection reports in 2001 and 2003 indicate additional pressures on one river SAC (Glanmore Bog) from management of water levels.

6.1 Eutrophication/ Nutrient enrichment

The input of nutrients at concentrations in excess of natural concentrations, commonly referred to as eutrophication, is, globally, probably the most widespread impact on freshwater systems. Eutrophication leads to a gradient of impact from minor and localised effects of increased plant production to extreme degradation of habitat: typified by very dense concentrations of phytoplankton, often dominated by cyanobacteria (blue-green algae), resulting in a much reduced light penetration and loss of submerged aquatic plants; high authochtanous (internal) production leading to high sedimentation rates and reduced concentrations of dissolved oxygen; and dramatic alterations to invertebrate and fish communities. Eutrophication can diminish the aesthetic quality of rivers and their use for leisure and water abstraction.

Eutrophication has been recognized as the principal threat to the water quality of Irish rivers since the 1970s (Flanagan and Toner, 1972) and reiterated in all the recent EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005). The EPA *Millennium* report (Stapleton *et al.,* 2000) highlighted the continuing degradation of many inland waters and estuaries. The most recent EPA report on water quality (Lucey, 2006) indicated that almost 30% of the rivers surveyed are in an unsatisfactory condition. The suspected causes of river pollution are primarily municipal and agricultural discharges. In the reporting period 2001-2003 municipal discharges, which includes sewage, water treatment plant effluent and urban runoff, was the suspected source of 29%, 36% and 49% of slight, moderate and serious river pollution respectively (Toner *et al.,* 2005).

Observations based on research and on monitoring suggest that the contribution of farming activities to nutrient enrichment of waters is greater than that of point sources (Allott *et al.,* 1998; Toner *et al.,* 2005). In the 2001-2003 reporting period agriculture was the suspected source of 33% of both slight and moderate river pollution and 14% of serious river pollution (Toner *et al.,* 2005). Long term research by *Teagasc* estimates that more than three quarters of all the phosphorus applied to grasslands accumulates in the soil (Culleton *et al*., 2000), and it is well established that higher soil phosphorus concentrations increase the risk of phosphorus loss to water (Tunney *et al.,* 2000). Information collated from the NATURA 2000

Standard Data Forms (NPWS) which contain a record of the assessment in the early 1990s of the 21 rivers later designated as SACs, indicated that 48% were negatively affected by fertilizer application. Fertiliser application outside the SAC boundary was recorded as having a negative impact on 48% of the lakes.

Enrichment and deoxygenation as a result of sewage, agricultural and industrial discharges is suspected of causing 58% of all the fish kills (147) reported between 2003-2005 (Toner *et al.,* 2005).

The concentration of nitrate, along with phosphorus, in rivers is a key quality indicator because of its enriching effect. In 2005 the nitrate levels recorded at 9 of the 11 designated salmonids rivers surveyed had increased significantly compared with initial sampling in the late 1970s (Lucey, 2006). A positive correlation between nitrate levels and the proportion of ploughed land in the catchment has been established for rivers in the south-east (Neill, 1989). The increase in nitrate values recorded in the last 30 years rivers has coincided with the extinction of the pollution-sensitive freshwater pearl mussel (*Margaritifera margaritifera*) in the Barrow and the Suir and the decline of populations in the Nore, Slaney and Blackwater (Lucey, 2006). Increases in nitrate are likely associated with increases in phosphorus.

6.1.1 Eutrophication trend

Recent EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) suggest that, overall, the long-term negative trend documented since the 1970s may be abating, although there is still a threat to continued degradation of the highest quality sites. Between 1971 and 1997 the EPA recorded a 39% decline of high-quality (Class A) river channel (Lucey *et al.,* 1999). The implementation of the Phosphorus Regulations (DELG, 1978), and the Water Framework Directive will increase pressure to modify nutrient application practices.

The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) is designed to provide a major contribution to improved water quality. Information collected in compliance with the Freshwater Fish Directive indicates that nitrite levels in designated salmonids rivers have increased significantly during the last 25 years (Lucey, 2006). In the reporting period 2001-2003, 19 of the 34 designated salmonids rivers in Ireland recorded nitrite values in excess of the Regulation (Quality of Salmonid Waters) value which is = 0.05mg/l NO_2 (Lucey, 2006).

While increased storage facilities should reduce the risk of nutrient loss from land to water, in the short term derogations on N load for intensive farms and allowance to spread chemical fertiliser to within 1.5m from surface water bodies provides a continued risk of impact on lakes and rivers. Long-term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water.

6.2 Overgrazing

The EPA report on water quality in Ireland from 1991-1994 highlighted overgrazing by sheep as a serious environmental problem (Bowman *et al.,* 1996). Information collated from the NATURA 2000 Standard Data Forms (NPWS), which contain a record of the assessment in the early 1990s of the 21 rivers later designated as SACs, indicate that overgrazing was having a negative impact on 62% of sites. Overgrazing outside the SAC boundary was recorded as having a negative impact on 43% of the sites.

Under the EEC Council Directive 75/268/EEC on less favoured areas, sheep stocks in Ireland increased 250% between 1980 and 1990 (CSO 2006), mostly in the western uplands, with consequence increased sediment loss into lakes and rivers. Environmental consequences include increased siltation, high bacterial counts, eutrophication, increased peat staining, reduced light penetration and alterations in the water balance of catchments. Overgrazed peatlands can lose up to 250t km^{-1} of peat, which is five times the amount that is lost from sites that are not subject to intense overgrazing (SRA 1994). Habitat degradation in rivers can affect flora and fauna, including protected salmonids, and reduce littoral production (SRA 1994; McGinnity *et al.,* 2003).

6.2.1 Overgrazing trend

In 1994 the EU-funded Rural Environmental Protection Scheme (REPS) for environmentally sensitive farming was introduced which included incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates.

Decreased livestock numbers in recent years have been brought about by the reform of the Common Agricultural Policy which has changed the headage payments from an individual animal basis to payment per hectare. In 2005 the total number of sheep (4.257 million) in

Ireland had decreased by 16% from 2000 but this is still almost double the number (2.344 million) recorded in 1980 (CSO 2006). The negative impacts of overgrazing on a range of habitats, including rivers, will likely continue until there is a significant decrease in livestock numbers.

6.3 Afforestation

The selection and designation of 21 river habitat SAC sites in the early 1990s included an assessment of activities impacting on each SAC. These assessments, contained in the NATURA 2000 Standard Data Forms (NPWS), indicated that forestry was having a negative impact on 43% of these rivers. Afforestation of the catchments surrounding river SACs was noted as having a negative impact on 62% of these rivers.

Ireland is one of the least afforested States in the EU and between 1904 and 1990 the State Forest Service undertook the majority of forestry planting. Since the 1990s and as a direct result of forestry grant schemes, jointly funded by the State and the EU, afforestation by private owners has greatly increased. Afforestation can impact on water quality through acidification, siltation, pesticide pollution, eutrophication and by altering catchment hydrology.

Acidification caused by afforestation is attributed to the ability of the crowns of mature trees to filter low levels of pollutants from the atmosphere, and also ion exchange processes occurring at the roots of the trees (Kelly-Quinn *et al*., 1997). The acidity of water is an important factor affecting aquatic organisms. Some afforestation in Ireland has occurred on soils, including peatlands, which have a low potential to buffer the run-off water. This has resulted in increased acidity in lakes and rivers receiving the run-off water from the afforested areas and negatively affected aquatic species (Allott *et al*., 1997, Kelly-Quinn *et al*., 1997, McGarrigle *et al.,* 2002). Increased acidity of the run-off water from acid-sensitive catchments where afforestation has occurred has resulted in an adverse impact on the biology of these waters and the elimination of fish stocks in extreme cases (EPA 2004).

Concern that afforestation may contribute to eutrophication arises from the fact that plantations have often been established on soils that have a poor capacity to hold phosphorus and in the early stages of forest establishment (0-7 years) nutrients are typically added from the air. In Ireland, significant losses of phosphorus from peat soils as a result of forestry activities have been found (Cummins and Farrell, 2003). Further nutrients may be released and carried into rivers on soil particles as a result of erosion after clear-felling (EPA, 2004). The planting, management and eventual harvesting of forestry plantations can all result in some degree of soil disturbance. Siltation can affect lake ecology e.g. fish spawning and foraging grounds can be damaged. Negative impacts on river macroinvertebrates and salmonids, arising from sediment loss after clear-felling, have been documented by Giller *et al*. (2002). Studies in Ireland and Wales have indicated that afforestation can result in a loss of water resources from the catchment (Giller *et al*., 1997).

6.3.1 Afforestation trends

EU grant aid for private forestry, which is administered by the Forest Service of the Department of Agriculture and Food, is now withheld for some designated peatlands. NHAs may also be excluded if the proposed development is incompatible with their protection (McAree, 2002). All grant-aided development in Ireland must also conform to the Forest Service Forest biodiversity guidelines, which set out measures to protect existing habitats and wildlife and to maximise the biodiversity of forest. The Forest Service has also issued guidelines on forestry and water quality, which aim to address the issue of potential eutrophication (Forest Service 2000).

Coillte Teoranta, one of the major owners of peatland in the country, has ceased planting conifers on intact peatlands on its ownership, principally on economic grounds. Coillte has initiated a *Raised Bog Restoration Project* that will result in the felling of coniferous plantations and drain blocking on some of their raised bogs. The afforestation of designated peatland sites is officially declining but the current trend for un-designated sites is unknown.

A recent water quality report (Toner *et al.,* 2005) indicated that forestry was suspected as the cause of 4% of slight pollution and 2% of moderate pollution incidents in rivers

6.4 Peat cutting

Peat has been used as a fuel source for over 400 years and was traditionally cut by hand. The introduction of the Turf Development Act (1981) provided funding for the purchase of turf-cutting machinery, the construction of turbary roads and this drainage of turf plots. This resulted in a decline in the practice of hand-cutting peat but intensified the mechanical harvesting of peat. Peat cutting and machine cutting in particular involve drainage and the removal of vegetation which can have a very damaging effect not just on the peatland habitat but on adjacent waterbodies including lakes and rivers. Increased drainage caused by peat cutting can result in siltation of freshwater habitats, which can affect the resident flora and fauna. Increased acidity, owing to the transport of excess amounts of humic and fulvic acids with the peat silt, may impact on fish egg survival (Bowman *et al,*. 1996). Research on Cuilcagh Mountain in County Fermanagh has shown that machine cutting of peat can significantly increase the runoff of water from peatland habitats and alter the hydrology of the entire catchment (Gunn *et al.,* 1997).

Information, recorded in the NATURA 2000 Standard Data Forms, from an assessment in the early 1990s of 21 rivers which were later designated as SACs, indicates that peat cutting was having a negative impact on 52% of these rivers.

6.4.1 Peat cutting trend

The Conservation Assessment Report for Active Raised bog (Habitat Code 7110) estimates a 72% decline from *Favourable Reference Range,* with 68% of the extent of raised bogs cut away over the last 400 years (Hammond, 1979; Ryan and Cross, 1984; Cross, 1990). The Conservation Assessment Report estimates the extent of Active Raised Bog habitat has decreased by 36% in the ten year reporting period 1994-2005. Foss and O'Connell (1998) estimated that approximately 45% of the blanket bog habitat has been lost or severely damaged by peat extraction. All water bodies within the areas of peatland that have been converted to other land use or degraded can be assumed to be at high risk of degradation.

6.5 Alien species introduction

A number of non-native species have invaded or been introduced into freshwaters in Ireland and have adversely affected river habitats and species. Introductions include fish, invertebrates and plants. Some introductions, such as pike (*Esox lucius*), a predator of native salmonid species, can be traced back to the middle ages. A number of fish species have been introduced into Irish lakes and rivers. The introduction of the roach (*Rutilus rutilus*) has been implicated in the reduction of populations of several fish species through competitive superiority (Johannson & Persson, 1986) including native Atlantic salmon and brown trout *Salmo trutta* (Fitzmaurice, 1984).

The recent (probably mid 1990s) introduction of zebra mussels (*Dressiena polymorpha*) is impacting on the flora and fauna of freshwater lakes and rivers. The zebra mussel colonises surfaces including the surface of native mussels preventing them from filter feeding and, also through physical colonisation, can affect the spawning of fish that require gravely substrates.

The introduction of a non-native freshwater shrimp species (*Gammarus pulex*) has resulted in the decline of the native shrimp species (*Gammarus duebeni celticus*) and a decrease in invertebrate community diversity through competition and predation mechanisms (Dick, 1996; MacNeil *et al.*, 2000). The impact on the diet of native fish species is not known.

The white-clawed crayfish (*Austropotamobius pallipes)* is a protected species listed in Annex II of the Habitats Directive. It is the only crayfish species native to Britain and Ireland, and is considered a keystone species in Irish freshwater habitats (Matthews *et al*., 1993; Reynolds 1997). Since the 1970s, several non-indigenous crayfish species from North America have become established in Britain, and have introduced a fungal disease (*Aphanomyces astaci*) known as crayfish plague (Alderman 1996). While the North American species of crayfish are resistant to the fungal disease the white-clawed crayfish is susceptible. To date, there have been no reports of non-indigenous crayfish species in Irish lakes and rivers but a crayfish plague outbreak in the 1980s decimated crayfish populations in the Boyne and Inny catchments (Matthews and Reynolds, 1992). There have been sporadic reports of crayfish losses from other catchments in recent years (Lyons and Kelly-Quinn, 2003).

Giant Hogweed (*Heracleum mantegazzianum*) was first recorded in Ireland in the late 19th century and has since spread a spread throughout the country, primarily along river corridors (Caffrey, 1994). On some sections of Ireland's more popular salmonid and coarse fishery rivers (e.g. Newport in County Tipperary, Mulkear in County Limmerick, Bride in County Cork and Dee in County Louth) dense bankside infestations have developed restricting access to the water (Stokes *et al.,* 2004). In winter the plant dies back, exposing the soil which may be eroded into rivers, altering substrate characteristics and providing favourable conditions for abundant aquatic plant growth, whilst rendering river substrates unsuitable for salmon spawning. Giant hogweed also poses a health hazard to humans as skin contact with the sap of the plant causes irritation, particularly in direct sunlight.

6.5.1 Alien species trend

A review of invasive species in Ireland concluded that the high frequency of traffic between Great Britain and Ireland and their close proximity renders each susceptible to detrimental species introductions from the other (Stokes *et al.,* 2004). Many of the invasive alien species which are negatively affecting freshwater habitats have been introduced in recent years and there is no reason to believe that further introductions will not occur. Improved links between major waterways e.g. the Shannon and Erne systems facilitate the spread of some alien species such as the zebra mussel. The proposal to pipe water from the Shannon system to supply water for the Greater Dublin Area has a risk for negative impacts from the translocation of species. The recent introduction of chub (*Leuciscus cephalus*) to Ireland would indicate that freshwater habitats are under continued, and possibly increasing, risk from introduced species.

7. Threats

The EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*., 1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to river water quality in Ireland. Risk analysis of a over 4,400 river sites indicated that a significant proportion (63.9%) of rivers are likely at risk because of pressures abstraction, alterations to river morphology and point and diffuse pollution (Table 5.3). As discussed in Section 6 afforestation and the introduction of new species also threaten freshwater habitats.

8. Future Prospects

8.1 Negative Future Prospects

All the EPA water quality reports (Bowman *et al.,* 1996, Lucey *et al*.,1999, McGarrigle *et al*., 2002, Toner *et al*., 2005) indicate that eutrophication is the principal threat to water quality in Ireland. The long-term trends in river water quality show that the proportion of unpolluted river channel has declined by 29% since 1971 (Fig 5.1) while the recent trends indicate a decline of 10% since 1987 (Fig 5.2). While incentives and legislation have been introduced to reduce the risk of excessive nutrient loading to freshwater bodies, the long-term storage of phosphorus in soils may, irrespective of current nutrient regimes, provide continued diffuse loss of phosphorus to water. The risk assessment of rivers has also indicated that 63.9% of the rivers assessed were unlikely to meet their environmental objectives, of achieving good status as defined by the WFD.

Several local authorities have upgraded their sewage treatment plants to reduce or eliminate pollution from municipal sources as required by the Urban Waste Water Treatment Directive. However, the latest report for the period 2002-2003 (Smith *et al.,* 2004) found that the basic parameters for effluent, as stipulated by the directive, are being exceeded at several treatment plants.

The decline of peatland habitats in the west of Ireland is also likely to have a negative impact on river habitats. The decreased by 36% of Active Raised Bog habitat between 1994-2005 will impact on all water bodies within and surrounding the areas of peatland that have been converted to other land use or degraded. Continued afforestation of non-designated peatlands and the introduction of non-native species may also affect the future prospects of freshwater lakes and rivers.

8.2 Positive Future Prospects

The publication of the EU Water Framework Directive (WFD) in 2000 has altered the approach to water quality monitoring and assessment by Member States. It has required the identification of a river typology (see Table 1.1), the identification of reference sites and implementation of monitoring that allows classification of sites relative to reference state (as defined by an Ecological Quality Ratio as a measure of departure from reference state). The WFD requires monitoring of biological elements including macrophytes, phytobenthos, macroinvertebrates and fish. Monitoring of water chemistry and hydromological change are also required but are stipulated as supporting, rather than driving, ecological assessment. The WFD requires "good water status" and/or "good ecological status" for rivers by 2015, to be achieved through integrated catchment management. The agreement with the EU over a Nitrates Action Plan under the Nitrates Directive, (91/676/EEC) and the introduction of Water Quality Standards for Phosphorus in 1998 are designed to provide a major contribution to improved water quality; but allowance of chemical fertiliser delivery close to water bodies may limit the potential of the Nitrates Action Plan and the Phosphorus Regulations to reduce water pollution.

The introduction of the Rural Environmental Protection Scheme (REPS) in 1994 may reduce the impact of agricultural activities, especially overgrazing, on freshwater habitats. The EU-funded REPS includes incentives to reduce stocking densities within proposed NHAs, SACs and lands designated as overgrazed by the Department of Agriculture, Food and Forestry. A revision of the REPS in 1999 resulted in the introduction of the Commonage Framework Plan (CFP). The aim of the CFP is to survey and assess the condition of most commonage areas and SACs, NHAs and SPAs and recommend reduced stocking rates. A reduction in stocking density as a result of the implementation of the CFP recommendations should reduce the impact associated with over grazing on rivers. The reform of the EU Common Agricultural Policy, which has changed the headage payments from an individual animal basis to payment per hectare, should also result in decreased livestock numbers.

In 2006 the NPWS introduced the National Farm Plan Scheme (NFPS) that compensates landowners for losses incurred through restrictions caused by the designation of lands as an SAC or SPA. The owners of designated lands can also receive payment for undertaking certain actions, which are of benefit to nature and are agreed in a farm plan. The implementation of the NFPS should reduce damage to rivers caused by agricultural activities.

8.3 Conservation Status of Future Prospects

Incentives and legislation have been introduced in recent years to reduce the negative pressures on freshwater habitats but information from the EPA water quality assessments indicate that rivers are still under threat. There is little evidence of a significant decline in the primarily pressures of eutrophication, overgrazing, excessive fertilization, afforestation and the introduction of invasive alien species. Almost two thirds of the rivers assessed by the EPA were at risk of meeting their environmental objectives as defined by the WFD. The conservation status of the future prospects of river habitat 3260 is therefore deemed to be Unfavourable-Bad.

9. Overall Assessment of the Habitat Conservation Status for 3260

Information on the range, extent, structures and functions, and future prospects of river habitat 3260 have been used to determine the overall conservation status of the habitat. Based on the best available information the overall assessment of (3260) is Unfavourable – Bad (Table 9.1)

Table 9.1 Conservation Status of river habitat (3260) based on range, area, structures and functions and future prospects.

Parameter	Favourable	Unfavourable - Inadequate	Unfavourable - Bad	Unknown
Range	X			
Area	X			
Structures and Functions			X	
Future prospects			X	
Overall Assessment			**X**	

10. References

Alderman, D.J. (1996). Geographical spread of bacterial and fungal diseases of crustaceans. *Revue scientifique et technique de l'Office international des e´pizooties,* **15 (2),**603 - 32.

Allott, N., Brennan, M., Cooke, D.,Reynolds, J.D. and Simon, N. (1997) *Stream chemistry, hydrology and biota, Galway-Mayo Region.* Aquafor Report, Vol. 4. COFORD, Dublin.

Allott, N., Free, G., Irvine, K., Mills, P., Mullins, T.E., Bowman, J.J., Champ, W.S.T., Clabby, K.J., McGarrigle, M.L., (1998). Land use and aquatic systems in the Republic of Ireland. In: Giller, P.S. (Ed.), *Studies in Irish Limnology*. The Marine Institute. Ireland, pp. 1–18.

Bowman, J.J., Clabby, K.J., Lucey, J., McGarrigle, M.L. and Toner, P.F. (1996). *Water quality in Ireland 1991- 1994.* Environmental Protection Agency, Wexford.

Caffrey, J.M. (1994). Spread and management of *Heracleum mantegazzianum* (Giant Hogweed) along Irish River Corridors. In: *Ecology and management of riverside plants*. DeWaal, L.C., Child, L.E., Wade, M. & Brock, J.H. (eds); 67-76. John Wiley & Sons Ltd, England**.**

Cross, J.R., 1990. *The Raised Bogs of Ireland: their Ecology, Status and Conservation*. Unpublished report, Minister of State, Department of Finance.

Culleton, N., Liebhardt, W.C., Murphy,W.E., Cullen, J. and Cuddihy, A. (2000). Thirty years of phosphorus fertiliser on Irish pastures: animal–soil–water relationships*. Armis* 4231-A. Teagasc, Wexford

Cummins, T. and Farrell, E.P. 2003. Biogeochemical impacts of clearfelling and reforestation on blanket peatland streams. I - phosphorus. *Forest Ecology and Management*, **180**:545-555.

DELG Statutory Instrument No 258 of 1998. Local Government (Water Pollution Act. 1977 (Water Quality Standards for Phosphorus) Regulations, 1998. Stationary Office, Dublin.

Dick, J. T. A (1996). Post-invasion amphipod communities of Lough Neagh, N. Ireland: influences of habitat selection and mutual predation. *Journal of Animal Ecology*, **65**: 756–767.

EEA (2006). Corine *Land Cover 2000 – Mapping a decade of change*. European Environment Agency

EPA (2004). *Irelands Environment*. Environmental Protection Agency, Wexford

EPA (2005). Submission in accordance with Article 5 of Directive 2000/60/EC of the European parliament and of the Council of 23 October 2000 establishing a framework for Community Action in the field of water policy, and in accordance with EC-DG Environment D.2 document "Reporting Sheets for 2005 Reporting". Environmental Protection Agency, Wexford.

EPA (2006). *Environment in focus 2006 – Environmental Indicators for Ireland.*

Environmental Protection Agency, Wexford.

European Commission, (2006). *Assessment, Monitoring and reporting under Article 17 of the Habitats Directive: Explanatory Notes and Guidelines*. Draft 5, October 2006. European Commission DG XI

Fitzmaurice, P (1984). The effects of freshwater fish introductions into Ireland. EIFAC Technical Paper No. 42 suppl. 2, 449–57.

Forest Service (2000). *Forest Biodiversity Guidelines*. Forest Service, Department of the Marine and National Resources, Dublin.

Flanagan, P.J. and Toner, P.F (1972). *The National Survey of Irish rivers – A report on water Quality*. Dublin. An Foras Forbartha.

Foss, P.J. and O'Connell, C.A. (1998). *The IPCC Peatland Conservation and Management Handbook*. Irish Peatland Conservation Council, Dublin.

Giller, P.S., O'Halloran, J. and Kiely, G. (1997). *A study of the effects of stream hydrology and water quality in forested catchments on fish and invertebrates*: AQUAFOR report Vol. 2 - An evaluation of the effects of forestry on surface water quality and ecology in Munster. National Council for Forest Research and Development, Dublin.

Giller, P. S.**,** Johnson, M. and O'Halloran, J. (2002). *Managing the impacts of forest clearfelling on stream environments*. COFORD, Dublin. pp 49.

Gunn, J., Walker, C. & Watson, R. (1997). Degradation and Restoration of Blanket Bog on Cuilcagh Mountain, County Fermanagh. *In:* Tallis, J.H., Meade, R & Hulme, P.D. (Eds.) *Blanket Mire Degradation: Proceedings of Conference, Manchester* British Ecological Society , 83-84.

Hammond, R.F. (1979). *The Peatlands of Ireland*. Soil and Survey Bulletin. No. 35. An Foras Taluntais (Teagasc), Dublin.

Irvine, K., R. Boelens, J. Fitzsimmons, A. Kemp and P. Johnston (2002). *Review of monitoring and Research to meet the needs of the EU Water Framework Directive*. Environmental Protection Agency, Wexford.

Johannson, L. & Persson, L., (1986). Planktivorous fish. In *Carbon dynamics in eutrophic temperate lakes.* (eds. Riemann, B. & Sondergaard, M.) 237-266.

Kelly-Quinn, M., Dodkins, I., Bradley, C., Baars, J.-R., Harrington, T., Ní Cathain, B., Rippey, B., O'Connor, M. and Trigg, D (2004). *Characterisation of Reference Conditions and Testing of Typology of Rivers (RIVTYPE).* Environmental Protection Agency, Wexford.

Kelly-Quinn, M., Tierney, D., Coyle, S. and Bracken, J.J. (1997) *Stream chemistry, hydrology and biota, Wicklow Region.* Aquafor Report, Vol. 3. COFORD, Dublin.

Lucey, J., Bowman, J.J., Clabby, K.J., Cunningham, P.,Lehane, M., MacCarthaigh, M., McGarrigle, M.L.and Toner, P.F. (1999). *Water Quality in Ireland 1995 –1997*. Environmental Protection Agency, Wexford.

Lucey, J (2006). *Water Quality in Ireland 2005. Key Indicators of the Aquatic Environment*. Environmental Protection Agency, Wexford.

Lyons, R. & Kelly-Quinn, M. (2003). An investigation into the disappearance of *Austropotamobius pallipes* (Lereboullet) populations in the headwaters of the Nore River, Ireland, and the correlation to water quality. *Bull. Franc. Pêche Piscic*. **370-371**: 139-150.

Mathers, R.G., Carlos, De, M., Crowley, K. and Teangana, O. D. (2002). A review of the potential effect of Irish hydroelectric installations on Atlantic salmon (*Salmo salar*) populations, with particular reference to the River Erne. *Biology And Environment: Proceedings Of The Royal Irish Academy*, Vol. 102b, No. 2.

Mathews, M. & Reynolds, J.D., (1992). Ecological impact of crayfish plague in Ireland. *Hydrobiologia*, **234**; 1-6.

Matthews, M.A., Reynolds, J.D. and Keatinge, M.J. (1993). Macrophyte reduction and benthic community alteration by the crayfish, *Austropotamobius pallipes* (Lereboullet). *Freshwater Crayfish,* **9**, 289- 99.

MacNeil, C., Elwood, R. W. and Dick, J. T. A (2000). Factors influencing the importance of *Gammarus* spp. (Crustacea: Amphipoda) in riverine salmonid diets. *Arch. Hydrobiol*. **149**: 87–107.

McAree, D. (2002). The Forest Service Biodiversity Plan. Biology and Environment: Proceedings of the Royal Irish Academy 102B, 183-184.

McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucey, J., Cunningham, P., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C. and Toner, P.F. (2002) *Water Quality in Ireland 1998 - 2000*. Environmental Protection Agency, Wexford.

McGinnity, P., Gargan, P., Roche W., Mills, P., and McGarrigle M. (2003). Quantification of the freshwater salmon habitat asset in Ireland using data interpreted in a GIS platform. *Irish Freshwater Fisheries Ecology and Management Series*.Central Fisheries Board, Dublin.

Moorkens, E. A (1999). Conservation Management of the Freshwater Pearl Mussel *Margaritifera margaritifera*. Part 1: Biology of the species and its present situation in Ireland. *Irish Wildlife Manuals*. Duchas, Dublin

Neill, M. (1989). Nitrate concentrations in river waters in the southeast of Ireland and their relationship with agricultural practice. *Water Research*, **23**, 1339–1355.

Reynolds, J.D (1998). *Ireland's Freshwaters*. Marine Institute, Dublin.

Reynolds, J.D. (1997). The present status of freshwater crayfish in Ireland. *Bulletin Francais de la Peche et de la Pisciculture*, **347**, 693- 700.

Reynolds, J.D (1988). Crayfish extinctions and crayfish plague in Ireland. *Biological Conservation*, **45**; 279-285.

Rosenberg, D. M. and. Resh, V. H (Eds) (1993). *Freshwater Biomonitoring and Benthic Macroinvertebrates.* Chapman and Hall, New York.

Ryan, J. & Cross, J., (1984). *The Conservation of Peatlands in Ireland*. Proceedings of the 7th International Peat Congress, Dublin, 389-406.

Salmon Research Agency (SRA) of Ireland (1994). Annual Report No 38. Newport, Mayo

Smith, D., O'Neill, N., Doris, Y., and Moriarty, J. (2004) *Urban Waste Water Discharges in Ireland with Population Equivalents greater than 500 Persons. A report for the Years 2002 and 2003.* Environmental Protection Agency, Wexford

Stapelton, L., Lehane, M. and Toner, P (Eds.) (2000). *Ireland's Environment – A Millennium Report*. Environmental Protection Agency, Wexford

Stokes, K., O'Neill, K. & McDonald, R.A. (2004). *Invasive species in Ireland*. Unpublished report to Environment & Heritage Service and National Parks & Wildlife Service. Quercus, Queens University Belfast, Belfast.

Toner P., Bowman J., Clabby K., Lucey J., McGarrigle M., Clenaghan C., Cunningham P., Delaney J., O'Boyle S., MacCárthaigh M., Craig M. and Quinn R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford

Tunney, H., Coulter, B., Daly, K., Kurz, I., Coxon, C., Jeffrey, D., Mills, P., Kiely, G. and Morgan, G. (2000). *Quantification of phosphorus loss to water due to soil P desorption. Final Report.* Environmental Monitoring R&D Report Series No. 6. Environmental Protection Agency, Wexford.

11. Appendix 1. Description of Habitat (3260), as outlined in the Interpretation Manual of European Union Habitats

Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

1) Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses.

2) Plants: *Ranunculus saniculifolius*, *R. trichophyllus*, *R. fluitans*, *R. peltatus*, *R. penicillatus* ssp. *penicillatus*, *R. penicillatus* ssp. *pseudofluitantis*, *R. aquatilis*, *Myriophyllum* spp., *Callitriche* spp., *Sium erectum*, *Zannichellia palustris*, *Potamogeton* spp., *Fontinalis antipyretica*.

3) Corresponding categories

German classification : "23010101 naturnahes, kalkreiches Epi-/Metarhithral", "23010201 naturnahes, kalkarmes Epi-/Metarhithral", "23010301 naturnahes, kalkreiches Hyporhithral", "23010401 naturnahes, kalkarmes Hyporhithral", "23020101 naturnahes Epipotamal", "23010201 naturnahes Metapotamal", "23010301 naturnahes Hypopotamal" (mit flutenden Macrophyten, P138).

Nordic classification : "6621 *Myriophyllum alterniflorum-Potamogeton alpinus-Fontinalis antipyretica-*typ".

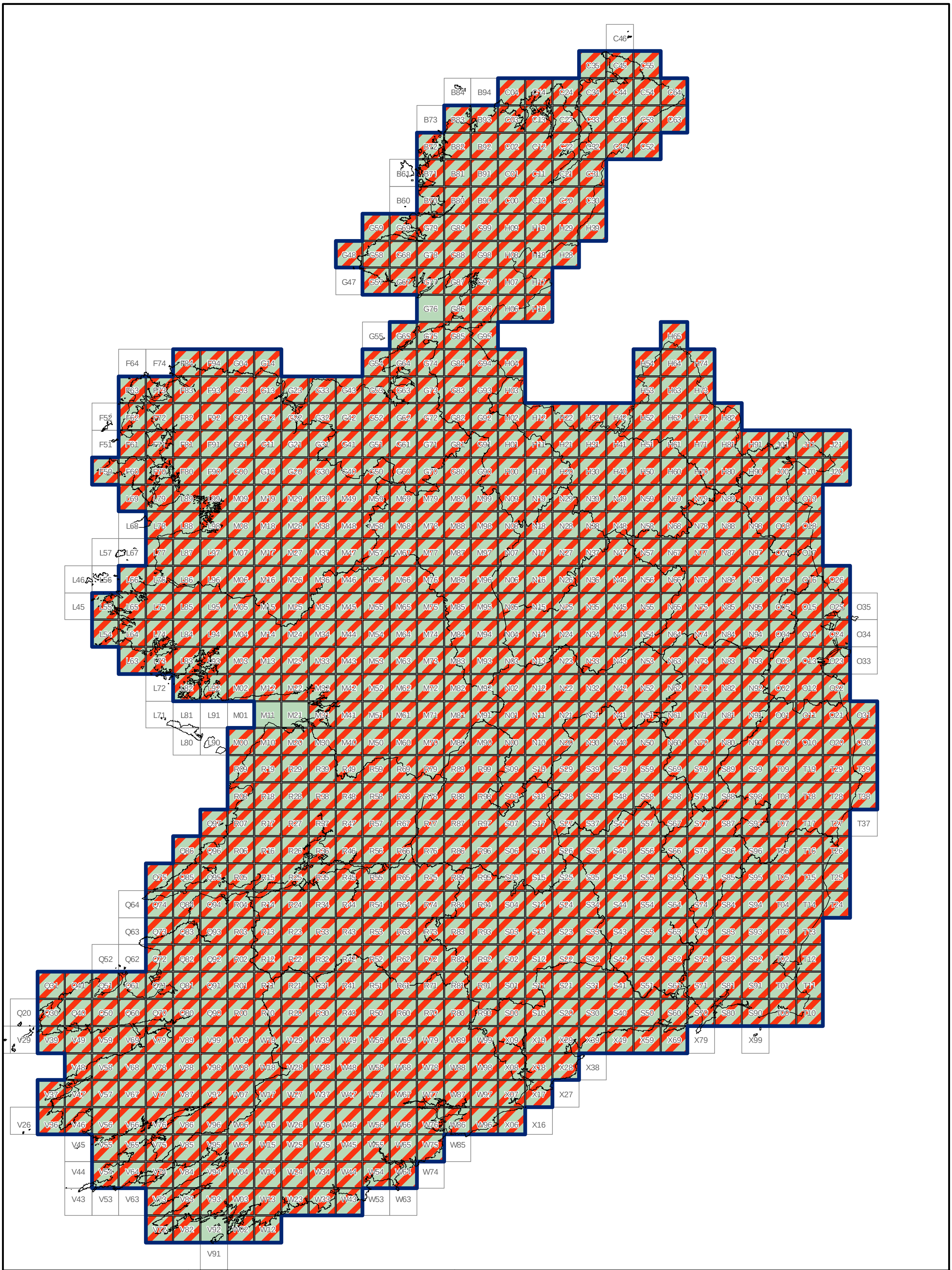
4) This habitat is sometimes associated with *Butomus umbellatus* bank communities. It is important to take this point into account in the process of site selection.

3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

National Level	
Habitat Code	3260
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Environmental Protection Agency (2006). *Environment in Focus – Environmental Indicators for Ireland*. Environment Protection Agency, Wexford. ▪ Flanagan, P.J. and Toner, P.F., 1972. *Notes on the chemical and biological analysis of Irish waters.* An Foras Forbartha, Dublin. ▪ Kelly-Quinn, M., Baars, J-R., Bradley, C., Dodkins I., Harrington, T.J., Ní Catháin, B., O'Connor, Mm., Rippey, B., Trigg, D. 2004. *Characterisation of reference conditions and testing of typology of rivers (RIVTYPE)*. Environment Protection Agency, Wexford. ▪ Lucey, J. (2006) *Water Quality in Ireland 2005 – Key Indicators of the Aquatic Environment.* Environmental Protection Agency, Wexford. ▪ Toner P., Bowman J., Clabby K., Lucey J., McGarrigle M., Clenaghan C., Cunningham P., Delaney J., O'Boyle S., MacCárthaigh M., Craig M. and Quinn R. (2005). *Water Quality in Ireland 2001–2003.* Environmental Protection Agency, Wexford.
Range	
Surface area	81,500km^2 81,900km^2
Date	04/2007
Quality of data	1= poor
Trend	stable
Trend-Period	1970s - 2006
Reasons for reported trend	No change
Area covered by habitat	
Distribution map	See attached map
Surface area	213 km²
Date	04/2007
Method used	1 = expert opinion
Quality of data	1= poor
Trend	Stable
Trend-Period	1970s - 2006
Reasons for reported trend	No Change
Justification of % thresholds for trends	The CORINE Land Cover (CLC) project assessed land cover changes between 1990 and 2000 and recorded only a very small change (<1 % increase) in the area covered by water bodies (EPA 2006) and therefore the range and area are assessed as stable.

Main pressures	120 – Fertilisation; 140 – Grazing; 160 – Forestry; 180 – Burning; 220 – Leisure fishing; 310 – Peat extraction; 420 - Discharges; 700 – Water Pollution; 810 – Drainage; 900 – Erosion; 954 – Invasive species.
Threats	120 - Fertilisation 140 - Grazing 160 - General Forestry management 310 - Peat Extraction 700 - Pollution 954 - Invasive species
Complementary information	
Favourable reference range	81,500km^2 81,900km^2
Favourable reference area	213km^2
Typical species	*R. trichophyllus*, *R. peltatus*, *R. penicillatus, R. aquatilis*, *Myriophyllum* spp., *Callitriche* spp., *Sium erectum*, *Zannichellia palustris*, *Potamogeton* spp., *Fontinalis antipyretica*.
Other relevant information	
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable
Area	Favourable
Specific structures and functions (incl. typical species)	Unfavourable –Bad (U2)
Future prospects	Unfavourable –Bad (U2)
Overall assessment of CS	Unfavourable –Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
3260

Current Distribution (815 cells)
Current Range (819 cells)
Favourable Reference Range (819 cells)
W48 10km grid cells

Date: August 2007

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland
2. Habitat mapping
3. Habitat Range
    3.1. Conservation Status of Habitat Range
4. Habitat Extent
    4.1. Conservation Status of Habitat Extent
5. Structures and Functions
    5.1. Habitat Structures and Functions
        5.1.1. Conservation Status of Habitat Structures and Functions
    5.2. Typical Species
        5.2.2 Conservation Status of Habitat Typical Species
6. Impacts and Threats
7. Future Prospects
    7.1. Negative Future Prospects
    7.2. Positive Future Prospects
8. Overall Assessment of the Habitat Conservation Status
9. References

1. Habitat characteristics in Ireland

The **Chenopodion rubri** and **Bidention** vegetation require damp, nutrient-rich soils where the vegetation is kept open by some means and is dominated by annual plants. The conditions are produced naturally by flooding which extends into the spring months (April/May). In Ireland river flows decline earlier than in continental Europe because of the absence of snow melt and the specific habitat does not develop by rivers except in one case where a river feeds a reservoir. The only natural habitats with late flooding are turloughs – fluctuating lakes whose level is controlled by groundwater but which may have channels of water flow on their floors during summer. The **Chenopodietum rubri** is only found in nutrient-rich turloughs and usually where animal treading and dunging (or occasionally waste disposal) add to the waterborne nutrients. Its main sites are at riverine turloughs (those in the path of drainage from a large catchment) which are naturally eutrophic. Minor anthropogenic sites occur in smaller turloughs and sometimes at higher levels where high animal numbers or sewage discharge occurs.

Since turloughs may be seen as the floodplains of underground rivers – the occasional surface exposure of a high watertable which is moving seawards through karst limestone – there are obvious parallels with submontane rivers, as in the Interpretation Manual.

The habitat is also recorded sporadically on the beds of reservoirs where drawdown occurs in the summer. The only regular example is at the Gearagh in Cork (River Lee), where the vegetation develops on the mud of former islands of the braided river channel. Occasional records have also been made at several reservoirs in Dublin (Doogue *et al* 1998).

Species from the association do occur on riverbanks but usually in small patches amongst perennial vegetation The usual river community is better thought of as based on *Persicaria hydropiper* with *Bidens tripartita* sporadic and *Chenopodium rubrum* almost absent. The introduced *Impatiens glandulifera* is a negative factor on riverbanks as its shade eliminates many smaller annuals.

The substrate consists of silt or clay and develops a skin of algae during the flooded phase. The sites may be rewetted at any time by prolonged rainfall and the watertable is always close to the surface. Some of them remain too soft to walk on through the summer and two (Lough Funshinagh and the Gearagh) do not dry out every year.

2. Habitat mapping

No countrywide mapping of habitats has been done as yet in Ireland but even if it had been, the small-sized patches of this habitat would be scarcely visible. In the absence of this the ‘parent’ habitat of turloughs has been used, augmented by the paper of White (1985) for the Cork site.

The main mapping of turloughs in Ireland was carried out by Coxon (1987) who concentrated on large examples (over 10ha). This scheme was followed by Goodwillie (1992) who described their vegetation. Some additional ones are recorded with vegetation details in Peach *et al* (1997) and also in the databases of the National Parks & Wildlife Service and the Geological Survey of Ireland.

To examine the likelihood of additional sites a potential distribution map was produced based on the co-occurrence of several indicator species in all habitats. This was created from existing botanical sources and the resulting information discussed with the appropriate local botanists and other experts.

3. Habitat Range

The only map of turlough sites is that of Coxon (1987) which shows all large turloughs (over 10ha), both drained and undrained. Additional sites have been added since that date but they all have been within the known range except for Donegal which has 1-3 small examples (see Turlough Conservation Assessment maps).

Turloughs are only found in karstic limestone areas which in Ireland are predominantly west of the Shannon in Clare, east Galway, east Mayo, Roscommon and Sligo. A few outliers occur in Tipperary, Donegal and Kilkenny but only the latter is separated by a geological discontinuity.

The habitat range inferred from this information was adjusted for the drained turlough sites which are currently in agricultural use. The current range (Map 1) can then be compared with the protected range to ensure that an adequate network of sites is recognised for the conservation of this habitat in Ireland

Map 1 (Current range map for **Chenopodietum rubri**) indicates that the habitat has a range of 1200km^2. Expert opinion indicates that the current range of the habitat, based on the known sites listed within the NPWS database, is sufficient to represent the ecological variation of the habitat across its distribution and range in Ireland. There is a possibility that truly riverine examples of the habitat occur along the Munster Blackwater which drains eastwards from the Cork/Kerry mountains. Seasonal fluctuations are higher here than in most rivers and there is one 10km square in the lower part of the Blackwater catchment with *Bidens tripartita*, *Chenopodium rubrum* (and *Persicaria lapathifolia*).

3.1 Conservation Status of Habitat Range

The range of major sites stretches from Galway/Mayo to Cork and Kilkenny. Examples from all of these areas are listed as cSAC's, representing 88% of the whole habitat area.

The assessment of the conservation status of this range can be carried out either by reviewing the annual variation in the habitat range in the reporting period or by examining the relationship between the current habitat range and the Favourable Reference Range (FRR)

No specific studies have been undertaken on the range of the habitat in Ireland during the reporting period, making any assessment of the annual change impossible. However there is no evidence of any decline within the protected sites which cover the greater part of the range. Some ecological connection seems to exist throughout the range as the major isolated site (in Kilkenny) shares two of the indicator species of the habitat (*Chenopodium rubrum* and *Rorippa islandica*) with the rest of the range.

Since the current range is the same as the **Favourable Reference Range** (FRR) the conservation status of the range is considered to be good.

4. Habitat Extent

The extent of **Chenopodietum rubri** in Ireland in the past is a matter for conjecture. As a community it is fleeting and non-permanent and will only occupy 1-10% of a given turlough area depending on site history and annual weather (watertable). Two historical factors also play a part. Animal numbers were generally lower on turloughs in the past (Augney & Gormally 1999) and therefore nutrient enrichment less widespread. By contrast there were more available sites which have since been drained, particularly in east Galway/Mayo (by 1950).

The artificial nature of reservoirs implies that the community at the Gearagh and possibly elsewhere is of historically recent appearance. The Gearagh reservoir was created in 1954.

Since the habitat fluctuates considerably from year to year, monitoring would have to be carried out over an extended period to assess real change. As an example Lough Funshinagh had a major extent of the community in the year sampled (September 2004) as shown in Table 1. However the waterbody does not dry out sufficiently in every year for this to happen – it was not even recognised as a turlough in the past – so that the habitat would be almost non-existent at times.

It is considered that a very wet summer may reduce the overall extent of the habitat in the country by as much as 60%.

Table 1. Distribution of ***Chenopodietum rubri*** *in Ireland*

County	*Site*	*Overall Site Area*	*Area of habitat*
Mayo	Greaghans turlough	37	6.0
Mayo	Slishmeen turlough	20	0.8
Mayo	Ballyglass turlough	26	2.1
Galway/Mayo	Rathbaun turlough	67	2.3
Galway	Kilkerrin turlough	17	0.2
Galway	Coole Lough	280	20.0
Roscommon	Lough Croan turlough	107	4.6
Roscommon	Lough Funshinagh turlough	362	33.0
Clare	Lough Gash turlough	22	5.8
Kilkenny	Loughans turlough	22	0.2
Cork	The Gearagh	200	20.0
TOTAL			95.0

The current area of the habitat, based on the known sites listed within the NPWS database, is thought to be sufficient to represent the ecological variation of the habitat across its distribution and range in Ireland. The area of 73ha should be considered the **Favourable Reference Area** (FRA) for the habitat in Ireland, the same as the current known area.

4.1 Conservation Status of Habitat Extent

No studies have been undertaken on the conservation status or quality of the habitat in Ireland. However since it mainly occurs in turloughs it is considered that the assessment of these major habitats will incorporate the **Chenopodietum rubri**.

Table 2. Conservation status of known sites

Site	*Designation*	*Site Code*	*Area of habitat (ha)*
Greaghans turlough	pNHA	0503	6.0
Slishmeen turlough	pNHA	1559	0.8
Ballyglass turlough			2.1
Rathbaun turlough	pNHA	0215	2.3
Kilkerrin turlough	pNHA	1279	0.2
Coole Lough	cSAC	0252	20.0
Lough Croan turlough	cSAC	0610	4.6
Lough Funshinagh turlough	cSAC	0611	33.0
Lough Gash turlough	cSAC	0051	5.8
Loughans turlough	cSAC	0407	0.2
The Gearagh	cSAC	0108	20.0

TOTAL			95.0

The current habitat area in Ireland, based on known sites, is 0.95km^2 in a total of 11 sites. This is considered the **Favourable Reference Area** (FRA)

According to the General Evaluation Matrix (Annex E Explanatory notes Article 17 Habitat Directive) the area covered by the habitat type within the range is **Favourable**.

5. Structures and Functions

5.1 Habitat structure and function

The link between the ecology of the sites, their hydrogeological characteristics and management, has not yet been quantified adequately. This is partly a result of the absence of co-incident data for both aspects. On-going turlough work sponsored by the NPWS is seeking to improve the knowledge of these connections. Because of the current lack of data there is a high degree of uncertainty associated with predicting impacts from pressures on these sites. Useful data on the functioning of the **Chenopodietum rubri** in Ireland would be difficult to produce because of its transient nature. The existing risk assessments (Water Framework Directive working group 2005) have been with regard to eutrophication – which would obviously favour this community type.

5.1.1 Conservation Status of Habitat Structures and Functions

Satisfactory data on habitat quality, and habitat change or species trends are lacking. Based on available information and expert opinion it is likely that more than 95% of the area of the habitat in Ireland is favourably conserved as regards its specific structures and functions (including typical species). Conservation status of habitat structures and functions is therefore regarded as **Favourable**.

5.2 Typical Species

In Ireland White & Doyle (1982) recognise only the **Bidention** alliance in the order BIDENTALIA TRIPARTITAE. They describe the community as ‘natural vegetation of trampled places along shallow, still or slowly-running water on the floodmark litter: also in damp places influenced by human activities. Their nearest association is the **Polygono-Bidentetum** with character species of *Persicaria hydropiper*, *P.mite* (rare in Ireland) and *P.minus*.

Schaminée *et al* 1998 divide the **Bidention tripartitae** in the Netherlands into the **Polygono-Bidentetum** (3-110 days of inundation), the **Chenopodietum rubri** (50-250 days) and the **Eleocharito acicularis – Limoselletum** (130-300). This system has definite parallels in Ireland. All three communities may be recognized in turloughs and at the Gearagh though the last (with *Limosella*) depends on slightly wetter situations and occurs either deeper in the basin or near to springs and to more permanent runnels of water. *Callitriche palustris* is a rare addition in the Coole area and also at Glenamaddy, Co Galway (Conaghan *et al* 2006). The vegetation at the Gearagh is classified as **Bidentiti-Polygonetum hydropiperis**, a synonym of the **Polygono-Bidentetum** (White 1985).

Though *Bidens tripartita* itself is only common at the Gearagh (and at Lough Gash) there is a group of *Persicaria* species that commonly occur on newly exposed mud, often with *Rorippa islandica* or *R.palustris*, *Gnaphalium uliginosum* and *Juncus bufonius*. Where the substrate is rich enough in nutrients, *Chenopodium rubrum* becomes abundant. Dawson & Szoszkiewicz (1999) found a high phosphate level (216µg total P) in the water of adjoining rivers for this community in Britain. The relative rarity of the **Bidention** in turloughs may be caused by the high alkalinity which makes phosphate unavailable.

The **Chenopodietum rubri** in Ireland is usually based on *Persicaria* and *Polygonum* species which spring up on newly exposed mud or other bare places in turloughs and some reservoirs in summer. *Persicaria maculosa*, *P.hydropiper* and *Polygonum aviculare* are frequent, with *Persicaria minor* in wetter places and *Polygonum arenastrum* in drier ones. The characteristic species of *Gnaphalium uliginosum*, *Rorippa islandica*, *R.palustris*, *Ranunculus trichophyllus*, *Chenopodium rubrum* and *Juncus bufonius* are found throughout but *Bidens tripartita* is quite rare except at the Gearagh. Since the turlough habitat usually dries out in summer and is favoured by animals, various other ruderals may also occur, for example *Capsella bursa-pastoris*, *Stellaria media*, *Atriplex patula* and *Matricaria discoidea*. At wetter sites, e.g. Lough Funshinagh, perennial aquatic species are scattered over the surface, particularly *Oenanthe aquatica* and *Mentha aquatica*.

The interpretation manual lists *Persicaria lapathifolia* as one of the plants that occurs in the habitat. However in Ireland the species is associated more with arable land than turloughs and is not often found. Neither Louman (1984) or Goodwillie (1992) record it though it does occur at the Gearagh (White 1985).

5.2.1 Conservation Status of Habitat Typical Species

Most species are widespread in other habitats in Ireland, often in association with farm animals. *Rorippa islandica* seems the most restricted though its full distribution is probably not yet known. It was recorded first on a lakeshore in western Ireland before being found quite widely in turloughs (Mayo, Roscommon, Galway, Kilkenny). Judging by its appearance in waste ground and stream sides elsewhere it is likely to be more widespread.

Persicaria minor is uncommon in Ireland but occurs on lakeshores and other flooded places, not necessarily with the other species.

Callitriche palustris, *Limosella aquatica* and *Alopecurus aequale* are all rare turlough species in Ireland and while they may co-occur in the present habitat, they seem to be favoured by slightly wetter conditions, deeper in the basin or beside water. Irish records of all three species are currently increasing because of targeted fieldwork and there is no evidence of decline. The Gearagh site contains both *Limosella aquatica* and *Elatine hexandra*, further distinguishing it from turloughs.

5.2.2 Conservation Status of Habitat Typical Species

Although no specific studies have been undertaken on conservation status of the habitat typical species in Ireland, expert opinion is that they are stable or increasing and therefore that the conservation status is **Favourable**.

6. Impacts and Threats

The habitat type depends on high nutrient levels and on bare soil produced by late flooding (May/June) or disturbance. It thus requires a naturally eutrophic system or alternatively a nutrient input from animal dung or other source. It is likely that in many meso- or oligotrophic basins natural recycling proceeds too slowly to release sufficient nutrients in the waterlogged surroundings, perhaps from the lack of available phosphate. Organic material then builds up in the soil as peat, making the habitat unsuitable for Bidention species.

Impacts to this system may therefore come from changes in the flooding regime, a decline in nutrient inputs or the removal of farm animals. One of the small sites above (Ballyglass turlough) was subject to some drainage in the 1970’s and two others (Slishmeen and Rathbaun) are within range of arterial drainage measures. The presence of the **Chenopodietum rubri** was discovered after these impacts had occurred however and there has been no change in the last 15 years.

A decline in the suitability of the habitat may be brought about by changes in grazing management. In general sheep seem to produce the required local conditions more readily than cattle since they have regular paths and resting places with high nutrient status. Cattle graze more widely and cover the area uniformly. This is a factor at all Mayo sites where sheep have been commoner in the last decade. Only cattle (and a few horses) graze the major sites of Lough Funshinagh and Coole Lough. Although they must have a nutrient input to the overall system, their use of the wet, low-lying areas where the habitat occurs is low.

Grazing by domestic herbivores prevents the establishment of trees in turloughs where *Salix* sp would naturally grow over the upper parts of the basins. However it is unlikely that any woody species would occur at the deep levels of the present habitat to endanger the future of **Chenopodietum rubri**.

In ungrazed situations the habitat occurs in one turlough which receives outflows from a sewage treatment works (Lough Gash). This is the only turlough site where *Bidens tripartita* achieves a high frequency and grows, with *Chenopodium rubrum*, as a canopy over *Rorippa islandica*. Any impact from changes in sewage treatment would be slow to have an influence on the habitat as the substrate is extremely nutrient-rich.

The Gearagh habitat is not grazed at all and the only threat here would be climatic if summer rainfall was to increase and prevent the annual drying out of the upper reservoir.

A review of damaging activities and threats reported on sites from 1993 to-date was undertaken as part of this conservation assessment. Data on activities affecting or likely to affect sites were collated against individual sites from two sources:

- Damage assessment section of the NHA standard data forms held by NPWS created as part of the NHA surveys of the mid to late 1990's.

- Site Inspection Reporting (SIR) programme. Reporting under SIR is carried out on a three yearly cycle that began in 1998 (i.e. 1998-2000; 2001-2003; 2004-2006). The Research Branch Monitoring Section (NPWS) developed the SIR programme to be used as a monitoring tool. Local NPWS staff collect information on activities occurring on the site and their effects on the site's integrity. Any follow-up actions including all outcomes such as prosecutions, notifiable actions and positive management undertaken are also recorded.

Analysis showed that of the 10 designated sites listed here none had been affected by significant damaging operations or were threatened by such activities. Minor agricultural activities were noted in a few turloughs but these had affected the drier parts of the sites, not the lower levels where the **Chenopodietum rubri** is found.

Although the regular monitoring of the cSAC areas is carried out, visits have not been timed so as to coincide with the growth of the vegetation (in late summer). Specific information on it therefore is lacking.

None of the sites has been drained or had major physical interference in the reporting period and it may be presumed that the nutrient status of the few smaller ones subject to agricultural use or effluent disposal has slightly increased since the Directive came into force. Therefore any ecological changes have been to favour a nitrophilous vegetation such as the **Chenopodietum rubri.**

7. Future Prospects

The persistence of the habitat at its major sites is probable because external impacts are either small or likely to remain the same in future years. Changes are most likely at the minor sites but if the habitat disappears from some it is as likely to appear at others.

7.1 Negative prospects

A general decline of livestock keeping may lead to some loss of area but only in the minor sites.

7.2 Positive Future Prospects

Drier summers in future may significantly reduce summer water levels in some sites which are currently too wet (e.g. Levally Lough, Termon Lough) and create further expanses of ground to be colonised each year by the **Chenopodietum rubri**. While this would be offset by the disappearance of the habitat from some of the smaller drier sites it is probable that overall the area of habitat would remain stable or increase.

8. Overall Assessment of the Habitat Conservation Status

The habitat conservation status of the four main attributes has been assessed as follows:

- The **Favourable Reference Range (FRR)** is estimated to be 100% of the current habitat range and thus be **Favourable**.
- The extent of **Chenopodietum rubri** habitat is thought to have remained stable (with annual fluctuations). The extent of the **Favourable Reference Area** of the habitat is the same as the current extent and therefore deemed **Favourable**.
- A **Favourable** assessment is given to the **habitat structures and functions** as there has been no decline in habitat quality.
- The future prospects of the habitat are overall considered to be **Favourable**. It is resilient to likely environmental changes, both those with anthropogenic and natural origins.

The overall conservation status for **Chenopodietum rubri** in Ireland is **Favourable**.

References

Aughney, T.C. & Gormally, M.J. 1999. Farm habitats in Annaghdown, County Galway: management practices in the 1940's. Environmental Science Unit, National University of Ireland, Galway.

Conaghan, J., Roden, C. & Reynolds, S. 2006. *Rare plants in Galway*. Unpub, Report to the National Parks & Wildlife Service, Dept of Environment, Heritage and Local Government, Dublin

Coxon, C. E. (1987) The spatial distribution of turloughs. *Irish Geography*, 20, 11-23.

Dawson, F.H. & Szoszkiewicz, K. 1999.Relationships of some ecological factors with the associations of vegetation in British rivers *Hydrobiologia* 415: 117–122,

Doogue, D., Nash, D., Parnell, J., Reynolds, S. and Wyse Jackson, P. 1998. *Flora of County Dublin*. Dublin Naturalists' Field Club, Dublin.

Goodwillie, R.N. 1992.*Turloughs over 10ha: Vegetation survey and evaluation*. Unpub. Report to National Parks & Wildlife Service, Office of Public Works.

Louman, E. 1984. The vegetation of the Coole turlough area (Western Ireland). Interne Rapporten Hugo de Vries Laboratorium Nr 184. University of Amsterdam.

Peach, D.W., Moore, I., Watson, S.J., Carpenter, C.R.L., Price, N., Dance, L., Goodwillie, R. & McCarthy, C. 1997 An investigation of the flooding problems in the Gort-Ardrahan area of south Galway. Unpub. Report to the Office of Public Works.

Water Framework Directive Working Group on Groundwater - Sub-committee on Turloughs 2005. Guidance document No. GW9. Impacts on groundwater dependent terrestrial ecosystems. Risk Assessment Sheet GWDTERA2a – Turloughs

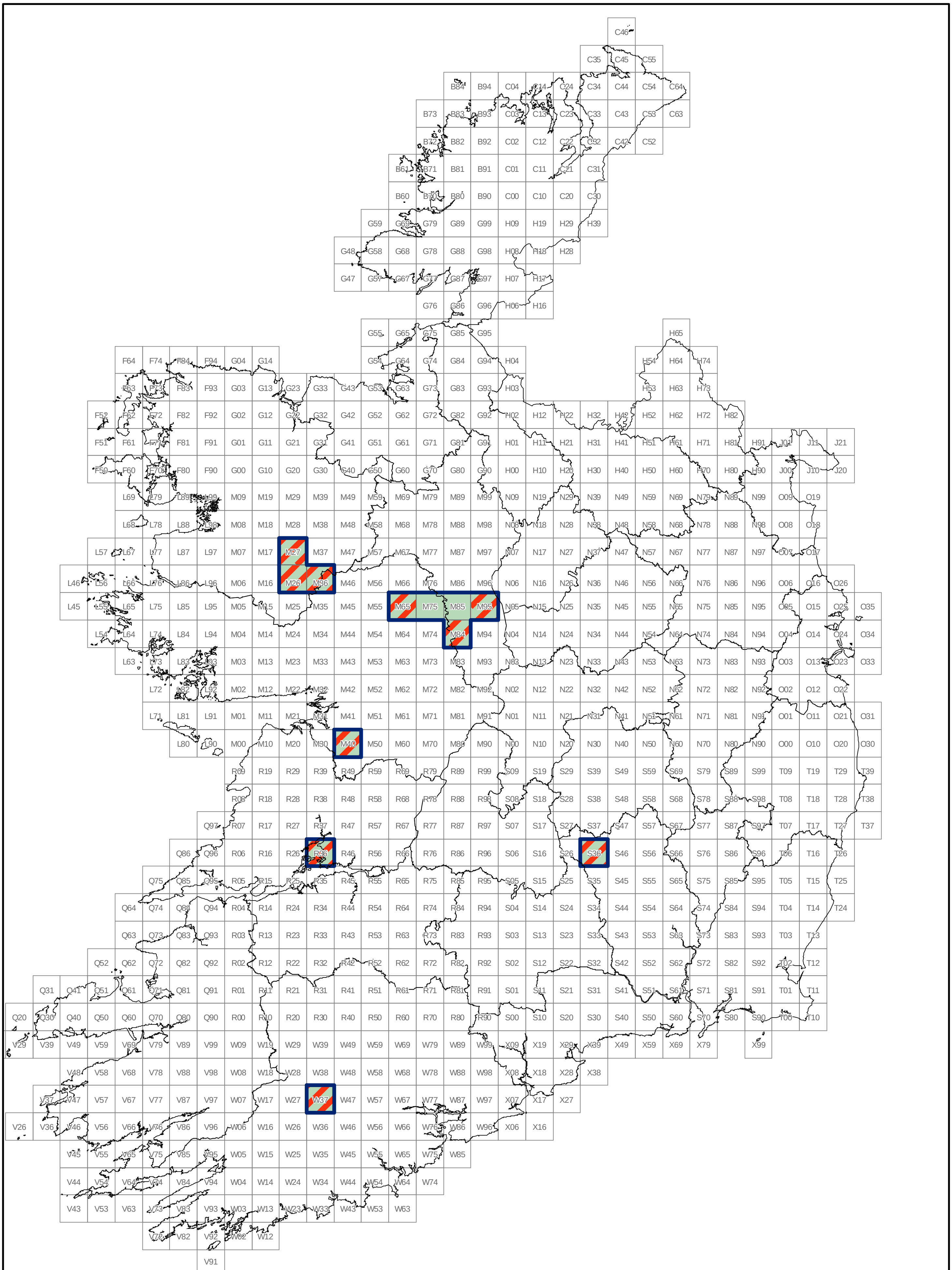
White, J. 1985. *Limosella aquatica* L. and the vegetation of exposed mud at the Gearagh, Co Cork (H11). *Irish Naturalists' Journal* 21, 509-515.

3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation

National Level	
Habitat Code	3270
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map (See Map I attached)	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Goodwillie, R.N. 1992.Turloughs over 10ha: Vegetation survey and evaluation. Unpub. Report to National Parks & Wildlife Service, Office of Public Works. ▪ Coxon C. E. (1987) The spatial distribution of turloughs. *Irish Geography*, 20, 11-23. ▪ Peach, D.W., Moore, I., Watson, S.J., Carpenter, C.R.L., Price, N., Dance, L., Goodwillie, R. & McCarthy, C. 1997 An investigation of the flooding problems in the Gort-Ardrahan area of south Galway. Unpub. Report to the Office of Public Works. ▪ Water Framework Directive Working Group on Groundwater - Sub-committee on Turloughs 2005. Guidance document No. GW9. Impacts on groundwater dependent terrestrial ecosystems. Risk Assessment Sheet GWDTERA2a – Turloughs
Range	In turloughs on karstic limestone in (western) Ireland. Also in one on-river reservoir.
Surface area	1200 km² see Map 1
Date	05/2007 Data for habitat distribution and range covers data collection period from special turlough surveys in 1987, 1992 and 1997; and vegetation mapping for the Water Framework Directive Study 2004.
Quality of data	2 = moderate (based on incomplete data and on expert judgement)
Trend	Stable
Trend-Period	1992 - 2006
Area covered by habitat	
Distribution map	See attached map
Surface area	0.95 km²
Date	05/2007 Data for habitat area covers data collection period from special surveys in 1987, 1992; also the NHA surveys of the 1990's to Water Framework Directive Study 2004.
Method used	3=ground-based survey
Quality of data	Moderate
Trend	Stable
Trend-Period	1992- 2006
Main pressures	810 Drainage 890 Other human induced changes in hydraulic conditions
Threats	803 Infilling ditches, dykes, ponds, marshes and pits 810 Drainage 890 Other human induced changes in hydraulic conditions
Complementary information	
Favourable reference range	1200km² See attached map
Favourable reference area	0.95 km²
Typical species	**Vascular plants:** *Persicaria maculosa, P.hydropiper, P.minor, Gnaphalium uliginosum, Rorippa islandica, R.palustris, Ranunculus trichophyllus, Chenopodium rubrum, Bidens tripartita, Juncus bufonius* The list of typical species submitted was derived using best expert judgement. Species lists may be compiled during field-based surveys, however all surveys that assess habitat condition focus on changes in or presence/absence of indicator species. Therefore the

	conservation status of all typical species is rarely assessed apart from assessments derived from best expert judgement. Typical species were assessed as favourable using best export judgement.
Other relevant information	
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Favourable (FV)
Specific structures and functions (incl. typical species)	Favourable (FV)
Future prospects	Favourable (FV)
Overall assessment of CS	Favourable (FV)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation 3270

Current Distribution (10 cells)

Current Range (12 cells)

Favourable Reference Range (12 cells)

W48 10km grid cells

Date: October 2007

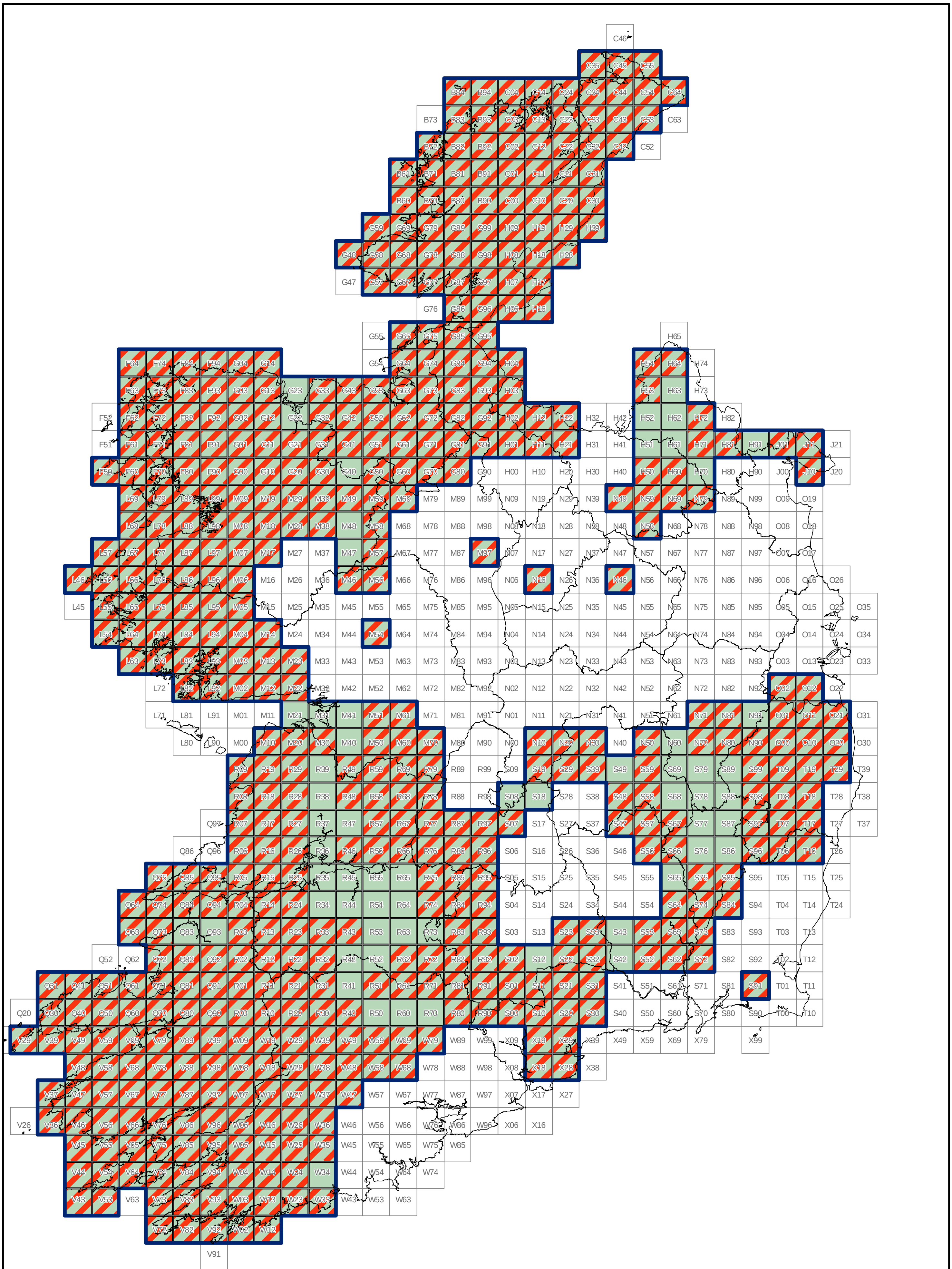
4010 North Atlantic Wet Heaths with *Erica tetralix*

National Level	
Habitat Code	4010
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Conaghan, J., (2001). *A Review Studyof Heathlands in Ireland*. The Heritage Council. ▪ Hammond, R.F. 1979. *The Peatlands of Ireland*. Soil and Survey Bulletin. No. 35. An Foras Taluntais (Teagasc), Dublin. ▪ Hammond, R.F. 1984. *The Classification of Irish Peats as surveyed by the National Soil Survey of Ireland*. 7th International Peat Congress, Dublin. ▪ O'Connor, M., 2000. *Action Plan for Blanket Bog and Wet Heath*: Technical Aspects. Draft Report for The Heritage Service, Dublin. ▪ Moore, J.J. (1968). *A Classification of the Bogs and Wet Heaths of Northern Europe*. In: Tüxen, R. (ed.) *Pflanzensoziologische Systematik*, pp. 306-320. ▪ Conaghan, J. (2001). *The Distribution, on a ten-kilometre-square basis, of Selected Habitats in the Republic of Ireland*. A report to National Parks and Wildlife – Dúchas The Heritage Service, Dublin. ▪ Bleasdale, A.J., 1995. *The Vegetation and Ecology of the Connemara uplands, with particular reference to Sheep Grazing.* Unpublished Ph.D. Thesis, National University of Ireland, Galway, p 229. ▪ Kirkpatrick, Alexandra, Hillary, 1988. A Vegetation Survey of Heath and Moorland in Northern Ireland and Co. Donegal. Unpublished Ph. D thesis, University of Ulster.
Range	
Surface area	Estimated to be 55,400km2 (554 grid cells x 100 km²).
Date	07/2007
Quality of data	2 = moderate
Trend	Stable
Trend-Period	1994 - 2007
Reasons for reported trend	The range includes large areas of poor-quality habitat as a result of direct human impact. Some of the typical species have been seriously impacted for example Ling Heather (*Calluna vulgaris*) etc. however at the resolution of 10 km² there would still be areas with typical wet heath vegetation occurring within the degraded areas.
Area covered by habitat	
Distribution map	See attached map
Surface area	Unknown -
Date	07/2007
Method used	2
Quality of data	Poor
Trend	- (magnitude unknown)
Trend-Period	1994 - 2006
Reasons for reported trend	3 = direct human impact
Justification of % thresholds for trends	It is difficult to quantify the area of wet heath or the magnitude of decline as there has been no comprehensive assessment of the extent, distribution or condition of the wet heath habitat resource in Ireland.

Main pressures	142 Overgrazing by sheep 900 Erosion 810 Drainage 800 Land Reclamation 161 Forestry Planting 160 General Forestry Management 180 Burning 512 Windfarm development 954 Invasion by a species 502 Roadway, motorways
Threats	810 Drainage 180 Burning 800 Land Reclamation 900 Erosion 142 Overgrazing by sheep 791Climate change 160 General Forestry Management 512 Windfarm Development 161 Forestry Planting 502 Roadway, motorways 954 Invasion by a species 410 Large scale industrial development
Complementary information	
Favourable reference range	Estimated to be 55,400km2 (554 grid cells x 100 km²). Favourable range is considered to be similar to the habitat current range.
Favourable reference area	Unknown
Typical species	*Molinia caerulea, Trichophorum cespitosum, Calluna vulgaris Erica tetralix, Narthecium ossifragum, Potentilla erecta, Carex panicea Eriophorum angustifolium,* Sphagnum *capillifolium, Hypnum cupressiforme, Cladonia portentosa, Sphagnum tenellum*.
Typical species assessment	The list of typical species submitted was derived using best expert judgement. Species lists may be compiled during field-based surveys, however all surveys that assess habitat condition focus on changes in or presence/absence of indicator species. Therefore the conservation status of all typical species is rarely assessed apart from assessments derived from best expert judgement.
Other relevant information	Wet heath is extensively developed, on areas of relatively shallow, peat which generally vary between 30 cm and 80 cm in depth, in uplands and in western Ireland. They are found on areas of damp-moist rather than waterlogged peats, where the hydrological regime usually involves a fluctuating water table. Wet heath can cover extensive areas at low levels, especially in the west of Ireland. It lies below the alpine or montane zone, which occurs above c. 600 m. The location of Ireland, positioned on the coastal fringe of Europe mean many wet heath areas are under an extreme oceanic influence. Throughout the western half of Ireland areas of heath are frequently observed to occur as a mosaic within more extensive areas of blanket bog, In addition to the occurrence of wet heath on naturally occurring, relatively shallow peats in blanket bog areas it must also be noted that cutover/disturbed areas of blanket bog and cutover margins of raised bogs in midland counties may also support pockets of secondary wet heath vegetation. The depth of peat present implies that the habitat occupies the transition between dry heath and blanket bog and this transitional nature is also reflected in the vegetation composition of the habitat. Most of the wet heath vegetation occurring in Ireland is ascribable to *the Narthecio-Ericetum tetralicis* and this vegetation is dominated by varying mixtures *of Molinia caerulea, Trichophorum cespitosum, Calluna vulgaris* and *Erica tetralix.* Other frequent vascular plant species may include *Narthecium ossifragum, Potentilla erecta, Carex panicea* and *Eriophorum angustifolium.* The most frequent cryptogamic species are *Sphagnum capillifolium, Hypnum cupressiforme, Cladonia portentosa,* and *Sphagnum tenellum*. As wet heaths occurs on deeper, wetter peats the vegetation contains some elements of deeper bog vegetation such as *Narthecium ossifragum* and *Trichophorum cespitosum* and some *Sphagnum* species. (Wet heath dominated *Erica ciliaris* also occurs but is confined to one small location near Roundstone, Connemara).

	A high proportion of high-quality examples of heathland habitat occur within SACs proposed NHAs and National Parks and to a lesser extent Nature Reserves. SPAs scheduled for designation for Hen Harrier contain extensive areas of wet heath. In addition, there are large areas of high-quality intact heath habitat throughout the country that are not protected in any way. It is difficult to accurately quantify the extent of wet heath however as there has been no comprehensive assessment of the extent, distribution or condition of the wet heath habitat resource in Ireland. Wet heaths are protected through designation, the EIA Directive and national planning law. Management plans for wet heath habitats have been drawn up and more are in preparation and consultation. Local authority biodiversity plans, now being formulated, may increase the status of wet heaths and list them for protection in Development Plans. Guidelines on forestry developments may also limit damage to non-designated heath. Stocking rates of livestock in Ireland, particularly in more remote areas, are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (SFP). As long as the market value of hill sheep remains low, there is little incentive for farmers to maintain large flocks in the uplands. Payment under the SFP requires the farmer to keep lands in “Good Agricultural and Environmental Condition”. The application of commonage framework plans under the REPS and National Farm Plan Schemes will further promote recovery of overgrazed areas. However, on badly degraded upland areas, e.g. where peat erosion is actively occurring, recovery of vegetation may not readily occur such that erosion of significant areas of wet heath will continue. Climate changes are likely to significantly accelerate degradation via alternation of drought period with more extreme weather events that increase the rate of erosion and that can trigger peat slides. Forest Service policy of refusing grant-aid for proposals for new afforestation on wet heath SACs and NHAs has reduced pressure from afforestation on designated sites. However areas of this habitat outside the designated sites continue to be a strong focus of afforestation. In addition general forestry management and reforestation of felled plantations on wet heath areas will continue to degrade these areas and the intact areas occurring along their extensive margins. Conifers may spread from plantations to colonise wet heath areas and this may be accelerated if the surface dries out for any reason including as a result of longer dry periods resulting from climate change. Abandonment of traditional farming on wet heath areas currently in favourable condition would eventually result in scrub invasion. However wet heath vegetation may colonise blanket bogs as a result of drainage or other factors causing desiccation although this is a secondary or new habitat and is likely to have significant differences in biodiversity to the long established or primary wet heath areas.
Conclusions* *(assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unknown
Specific structures and functions (incl. typical species)	Unfavourable – Bad (U2)
Future prospects	Unfavourable – Bad (U2)
Overall assessment of CS	Unfavourable – Bad (U2)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Northern Atlantic wet heaths with *Erica tetralix*

4010

Current Distribution (494 cells)
Current Range (554 cells)
Favourable Reference Range (554cells)
W48 10km grid cells

Date: September 2007

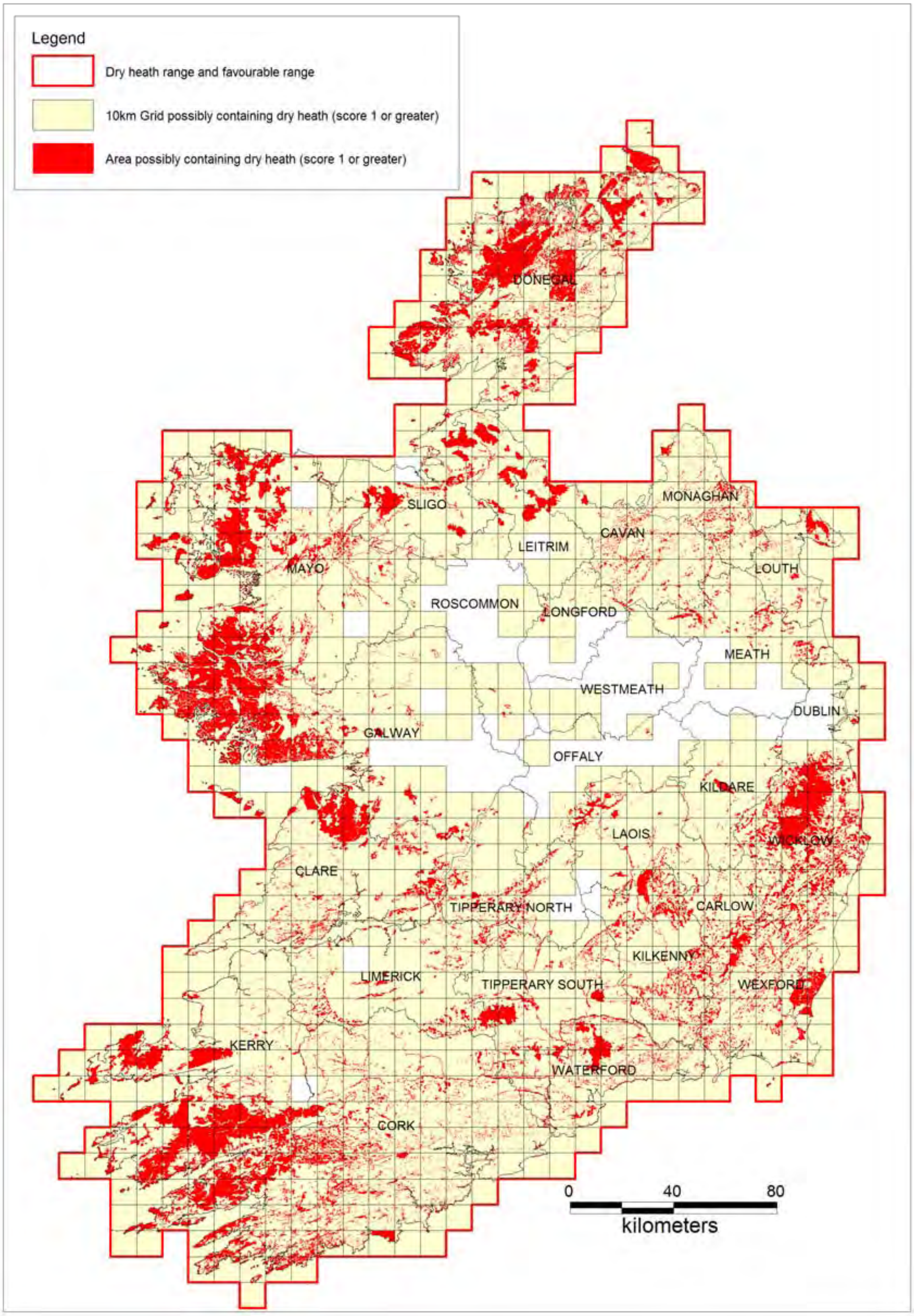
4030 **European dry heath**

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

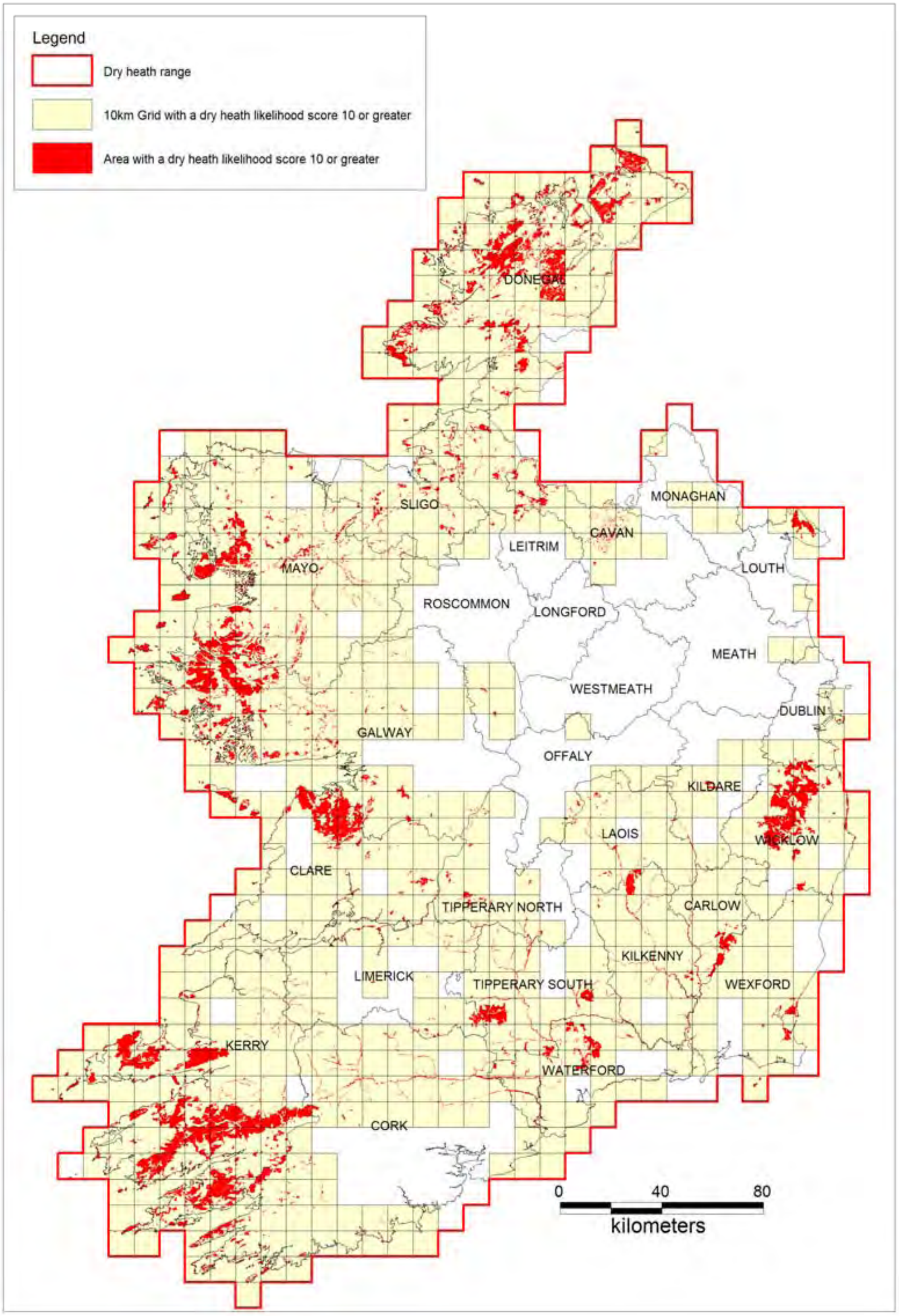
1 Maps 2
2 Habitat characteristics in Ireland 5
3 Habitat mapping 5
4 Habitat Range 8
4.1 Conservation Status of Habitat Range 9
5 Habitat Area 9
5.1 Conservation Status of Habitat Extent 11
6 Structures and Functions 12
6.1 Habitat Structures and Functions 12
6.1.1 Conservation Status of Habitat Structures and Functions 14
6.2 Typical Species 14
6.2.1 Conservation Status of Habitat Typical Species 15
7 Impacts and Threats 15
8 Future Prospects 17
8.1 Negative Future Prospects 17
8.2 Positive Future Prospects 17
8.2.1 The Rural Environment Protection Scheme (REPS) 17
8.2.2 National Farm Plan Scheme (NFPS) 17
8.2.3 International projects 18
8.2.4 Notifiable actions 18
8.2.5 Forestry Policy 18
8.2.6 Protection of individual species 18
8.2.7 Overall Habitat Future Prospects 18
9 Overall Assessment of the Habitat Conservation Status 19
10 References 20
Appendix 1: Dataset review 22
Appendix 2: Dataset scoring system 27

1 Maps



Reproduced from Ordnance Survey material by permission of the Government (Permit No 5953).

Map 1. Favourable reference range, current range and maximum favourable reference area (11,663 km^2) (see backing document Section 5) of European Dry Heaths (4030). The entire country is included for Range. Both favourable reference values are based upon polygons with a likelihood score of >0; i.e. those that have at least one dataset suggesting that the polygon has the potential to support Dry Heath.



Reproduced from Ordnance Survey material by permission of the Government (Permit No 5953).

Map 2. Current estimated range and extent (score>9) of European Dry Heaths (4030). Range is based upon grid squares containing polygons with a likelihood score of >0, whereas the estimate of extent (shown as polygons and shaded grid squares) is based on those with a likelihood score of >9 (4,825 km^2). (Polygons with a likelihood score of >0 would be similar to Map 1 - 11,663 km^2). It should be noted that this map is indicative only and the true extent of the habitat is not known.

2 Habitat characteristics in Ireland

European Dry Heaths (4030) are mesophile or xerophile heaths on siliceous, podsol soils in moist Atlantic and sub-Atlantic climates (EC, 2003). Heath includes areas where the vegetation comprises at least 25% dwarf shrubs (Fossitt, 2000). In Ireland, dry siliceous heaths occur on a range of slopes, in both upland and lowland areas, though most usually on slopes of 5-20° or more, often on upper slopes of hills and mountains, and are usually reported as being concentrated towards the drier south and east of the country, for example in the Comeraghs, Blackstairs and Dublin/Wicklow mountains Commonage Framework Plan (CFP), but occurring along the western seaboard, particularly in mountainous areas. Soils are usually acidic, nutrient poor and relative dry and free-draining; usually mineral-rich or peaty podzols (particularly Brown Podzolic and Podzol soils). However dry heaths can also occur on very shallow peats of less than 15cm or 30cm, depending on authority (Fossitt, 2000; Conaghan, 2000).

Dry calcareous heaths on base-rich substrates, are included within the habitat (Fossitt, 2000), and occur on either exposed limestones or where soil surfaces have been leached.

Dry heathland plant communities sometimes occur in cutaway areas adjacent to blanket bog, raised bog or wet heath. Such areas may be generally considered as heavily degraded bog, and are not included within the Annex 1 habitat.

Note that in Ireland, a number of restricted distribution, species-rich acid grasslands have historically been included in the heathland category, in terms of conservation procedures. One such cSAC is Screen Hills. TheCurragh is a Natural Heritage Area (NHA). The former has heath as a qualifying feature. In order to remain consistent with earlier work, these sites have remained within the heathland sites lists used for habitat mapping within this conservation status assessment.

3 Habitat mapping

There is no national inventory of dry heaths, and survey data for the habitat is extremely patchy. Therefore a best estimate was made of the extent of the habitat, based on a number of different data sources, none of which was alone able to accurately depict the national resource of dry heath. Therefore, the maps produced should be taken as indicative only.

Figure 1 is a schematic representation of the approach taken for mapping dry heath. This was essentially a 'top down' approach, with the following stages:

- Identification of previously defined sites for which available datasets indicate the presence of dry heath, using spreadsheet and paper-based data;
- Use of existing GIS datasets to identify areas with different likelihood of supporting dry heath habitat;
- Use of the above to develop range and extent maps.

The following datasets were used; key datasets are discussed in more depth in Appendix 1:

Site data, attributed to site polygons or point location:

- National Parks and Wildlife Service (NPWS) Habitat Assignment Project Database;
- Habitat Assignment Project updates December 2006;
- Browne (2005);
- 'Old' CORINE database;
- NGOs (2002);
- Derwin (2003/04) and Conaghan (2000);
- NPWS staff knowledge of which designated sites are entirely raised bog;
- CORINE implementation document;
- NHA and cSAC site synopsis;
- cSAC Natura 2000 site files;
- NHA site files.

GIS data:

- Forest Inventory Planning System (FIPS);
- Management Planning Support Unit (MPSU);
- Commonage Framework Plan (CFP);
- CORINE Land Cover (CLC) Map;
- OS Inland Water data;
- Digitised Peatland Map of Ireland (Hammond, 1979);
- Raised bogs habitat map (Kelly *et al.*, 1995; Derwin & MacGowan, 2000; Fernandez *et al.*, 2005; Fernandez *et al.*, 2006)
- National Soils and Parent Material Map (Teagasc, 2006). 21: shallow well-drained mineral soils derived mainly from acidic parent material, and 43: mineral podsolised soils and peaty topsoil with occasional iron pan layers.

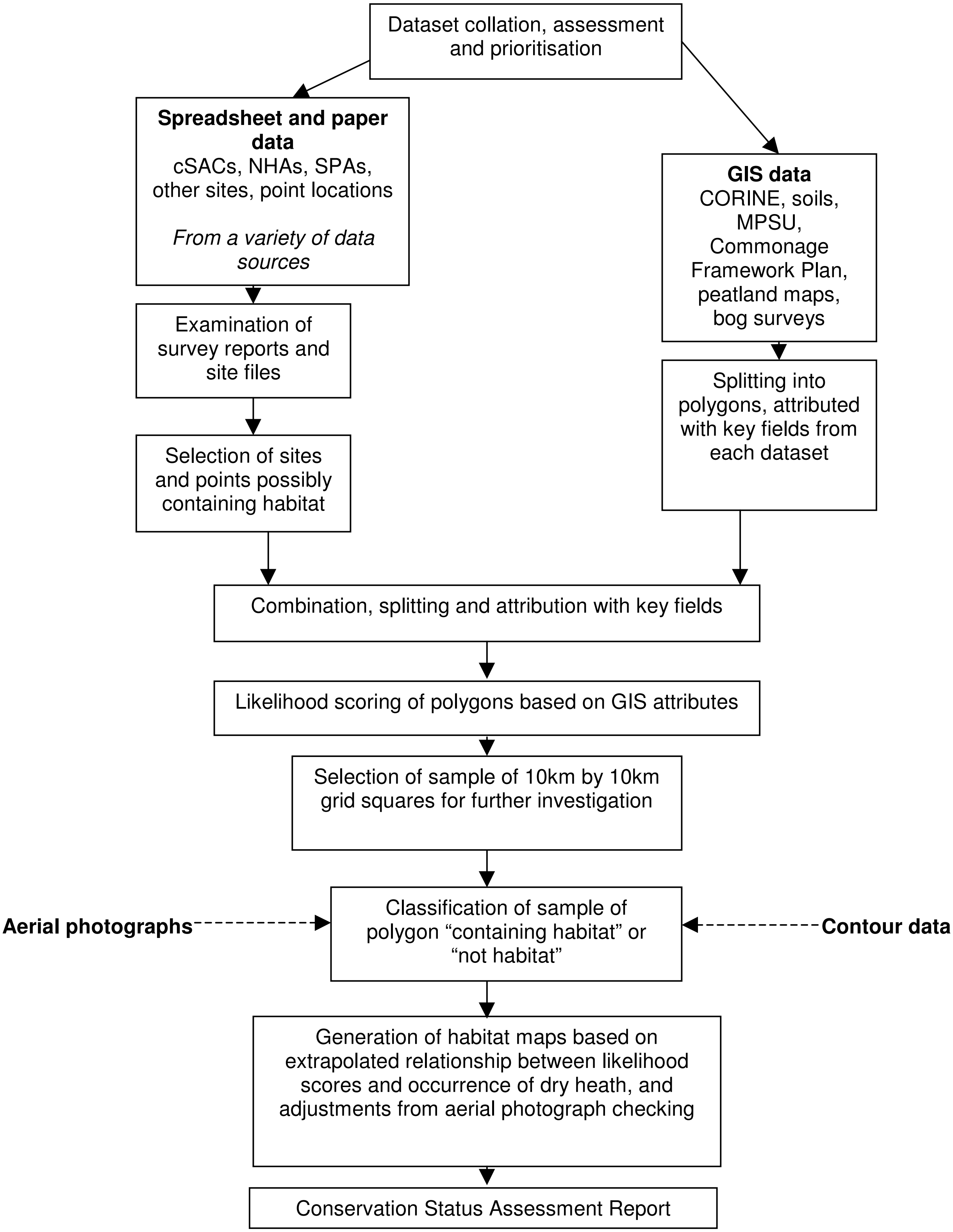


Figure 1: Flow of work for European Dry Heath (4030)

All of the datasets were combined, and a ‘base layer’ of individual intersect polygons created, with the arising polygons attributed with information from all layers. It was then possible to assess how likely any particular polygon was to contain heathland, as indicated by the attributes from the available datasets. This was done by scoring key dataset attributes, positively where it indicated heath may be present, and negatively where it suggested heath would not be present. These scores were then summed to indicate the overall likelihood of each polygon containing heathland (see Appendix 2).

Scores were calibrated with aerial photograph checking in 16 10km x 10km grid squares. This process was also used to adjust (/correct) scores where checked polygons were found to contain or not contain dry heath. Polygons with scores of 10 or greater were mapped as assumed to be containing dry heath (hence a single highly weighted attribute was able to confirm that a polygon was at least parented by an area that contained heath). However, the limited aerial photograph checking showed that this method was not completely accurate, and arising maps should be considered to be indicative only; the true extent of the habitat is not known. Though expert knowledge suggests that smaller/undetected patches of habitat may exist beyond those shown here, Dry Heath in other areas may be over-estimated as whole sites scored highly, even where the heath was restricted to only part of the site. This uncertainty, combined with anecdotal information led to the current range, being based on all areas scoring >0, i.e. those that had some data suggesting that the polygon has the potential to support Dry Heath. The Favourable Reference Range was also based on the same score threshold. Different estimates of habitat extent were based on both cut-off scores, the score following aerial photography adjustment and also on PEENHAB based area (see Section 5). The median value taken as the estimated value, though obviously there is uncertainty associated with this estimate.

Habitat ranges for many other habitats were drawn as the smallest polygon containing all grid squares containing polygons above a threshold score, drawn using a minimum of 90 degree angles. Gaps in the habitat distribution of greater than 2 grid squares, or as a result of unsuitable ecological conditions for the development of the habitat, were deemed enough to justify a break in the range. In the case of Dry Heath, the Range is taken as the entire country.

4 Habitat Range

According to the Commonage Framework Plan (CFP) documentation, Dry Heaths are concentrated towards the drier south and east of the country, for example in the Comeraghs, Blackstairs and Dublin/Wicklow mountains (CFPs). The range shown in Maps 1 and 2 encompasses the whole country, a total of 865 grid squares (86,500 km^2).

4.1 Conservation Status of Habitat Range

According to the General Evaluation Matrix (Annex E – Explanatory notes Article 17 Habitats Directive), the assessment of the conservation status of the habitat range can be carried out in two different ways. The first method consists of assessing the annual variation in the habitat range extent in the reporting period. However, because of lack of time-series data, it was not possible to assess the conservation status of habitat range in this way. Therefore, the second method was used, which examines the relationship between current habitat range and the favourable reference range.

The Favourable Reference Range may be taken as all appropriately linked 10km x 10km grid squares, containing polygons scoring >0, *i.e.* as current range, the whole country (86,500 km^2; Map 1). The Favourable Reference Range would hence equal the estimate of current range, giving a Favourable (FV) conservation status. However, if estimate of current range is more conservatively estimated to be that of appropriately linked grid squares containing polygons scoring >9 (not illustrated), the same Favourable Reference Range is >12% above this refined estimate of current range (70,900 km^2). This equates to Unfavourable Bad (U2) conservation status (as this estimate of current range is more than 10% below the favourable reference range).

In reality, with currently available datasets, it is extremely difficult to assess which of these two measures of conservation status is most appropriate, and hence, following guidance from NPWS, an overall assessment of Favourable (FV) has been made.

5 Habitat Area

The total area of Dry Heath could be estimated in three ways:

1. Application of a simple cut-off score of >9 to all polygons in the country, including those corrected by the limited aerial photograph checking which took place (as shown in Map 2). The area of all polygons in Ireland with a likelihood score of 10 or more is approximately **4,828 km^2**.

2. Application of a simple cut-off score of >0 to all polygons in the country, including those corrected by the limited aerial photograph checking which took place (as shown in Map 1). The area of all polygons in Ireland with a likelihood score of 1 or more is approximately **11,663 km^2**.

3. Application of the equation of the best-fit line of the relationship between polygon score and the percentage of polygons (by area) with this score that contain heath, based on a 16 grid square aerial photograph checked sample was applied to (non-API-corrected) polygons in the whole country (those with scores greater than zero only). This gives an estimate of dry heath in Ireland of **1,950 km^2**. Note that this estimate does not produce a mappable area as it is based on extrapolation. More details may be found in the supporting report (Hewins & Lush, 2007). Check this report and where it is

Other estimates of Dry Heath extent are available from CORINE Land Cover Map 2000 and PEENHAB. CORINE (2000) estimates the extent of "moors and heath" Ireland, as 588 km^2. PEENHAB estimates the cover of Dry Heath to be **3,730 km^2**. It is highly probable that CORINE under-estimates the extent of moors and heaths. The PEENHAB value is possibly an over-estimation, this theory being supported by brief aerial photograph checking. Unfortunately it was not easily possible to gain a countrywide estimate of heathland from the EPA soil and subsoil mapping project (which includes land cover) as supplied data available does not have full coverage (Fealy *et al.,* 2006).

Note that all estimates may over estimate the actual area of dry heathland, as polygons may not be entirely heathland and polygons are scored according to their parent polygon. Therefore, all parts of a large designated site will be scored highly for dry heath, even though this heath may be very restricted within the site. Estimates 1 and 3 may, however, also under-estimate the area of dry heath, as only designated sites and other areas with good data coverage may reach likelihood scores of 10 or above.

The true estimate of Dry Heath area probably lies in the range **1,950 to 11,663 km^2 (*i.e.* 6,807 ± 4,857 km^2)**, and NPWS staff experience supports this estimate. However the accuracy of this estimate is severely limited by the availability of suitably accurate and high resolution datasets.

5.1 Conservation Status of Habitat Extent

According to the General Evaluation Matrix (Annex E – Explanatory notes Article 17 Habitats Directive), the assessment of the conservation status of the habitat extent can be carried out in two different ways. The first method consists of assessing the annual variation in the habitat extent in the reporting period.

There is very little time-series data on the extent of Dry Heath in Ireland, though there is anecdotal evidence for the loss of the habitat through such activities as over-grazing, intensive burning, agricultural improvement, tree planting and forestry, bracken invasion, quarrying and other such activities. Sheep numbers in Ireland nearly trebled between 1980 and 1991 (Corbet *et al*., 1999), and this has had large impacts on heathlands and moorlands. Additionally, an ambitious government afforestation programme over recent decades has resulted in past loses of valuable moorland and bogland habitats to forest plantations (Corbet *et al*., 1999).

However, there is little available data to support the perceived change in Dry Heath extent. The CORINE Land Cover dataset shows changes in 'moors and heath' between 1990 and 2000. In that decade, the total area of the land category fell from 59,483 ha to 58,810 ha, a change of only -673ha (-1.13%). This change could be attributed to loss to broad-leaved forest (5%), coniferous forest (17%), transitional scrub woodland (71%), pastures (6%) and water bodies (1%). Of course this estimate is heavily restricted by the low-resolution of the CORINE dataset, and the difficultly in separating out moorland-type land classes.

The extent of heathland bracken invasion was investigated by examination of sites within NPWS's Habitat Assignment Database. Of the 626 sites which have some type of heathland listed, as many as 140 (22%) were listed only for dense bracken. These figures may perhaps overestimate cover of bracken, as some sites were surveyed only from the boundary. Contrarily, other sites may also contain dense bracken, but are not included in the 22% as other heathland habitats were also present.

Due to the lack of detailed time-series data, analysis of the conservation status of habitat extent with this first method is not possible. Therefore, the conservation assessment of the habitat extent was based on the relationship between current habitat extent and the Favourable Reference Area.

The exact Favourable Reference Area for this habitat is very uncertain. It could be estimated as all areas scoring >0, i.e. those that had some datasets suggesting they *may* be suitable areas to contain heathland, equating to 11,663 km^2 (Map 1). However, this is almost certainly a large over-estimate, as not all areas would ever have supported heathland. Possibly not even all parts of polygons scoring >9 (4,828 km^2) would ever have had heathland potential, though some additional polygons with lower scores may have. Therefore, NPWS staff advised that the same range of area values should be used for Favourable Reference Area as were used for current extent, *i.e.* **6,807 ± 4,857 km^2**.

This favourable reference value can be used to assess conservation status through comparison with current habitat extent. However, as shown above, which estimate of current extent and Favourable Reference Area is most appropriate is not clear.

The median of the various estimated values of habitat extent (6, 807 km^2) is 42% below the maximum Favourable Reference Area. Theoretically this could correspond to Unfavourable Bad (U2) (*i.e.* current estimated area is more than 10% below the favourable reference area). However, knowledge of NPWS staff suggests that though there is anecdotal evidence of a decline in the habitat's condition, and though Corine reports a negligible decline in the habitat class of "moors and heaths," there is little to support any recent decline in its area. In addition, there are many marginal areas on hill slopes which are now becoming heathland due to abandonment and they may be counteracting losses in other areas. It is felt that the current area of the habitat is sufficient enough and includes large enough patches to ensure its viability. Hence the overall assessment is Favourable (FV).

However, it should be noted that, with current datasets, if it is extremely difficult to say which of the estimates of current extent is closest to the real extent of the habitat on the ground. It is hoped that the accuracy of this estimate of conservation status might be improved in future as further research is carried out.

6 Structures and Functions

6.1 Habitat Structures and Functions

Dry Heaths usually have a history of grazing and/or burning, and it is such low intensity management which has maintained them over hundreds of years (Webb, 1998; Ostermann, 1998). Continued management is necessary to prevent reversion to scrubby woodland dominated by *Betula*, *Quercus* and *Ilex* spp (Cross, 2006). In some places, wind exposure or natural herbivore populations may be sufficient to maintain the sub-climax vegetation. However, when the grazing/burning management is particularly intensive this may result in replacement of ericaceous species by grasses, together with a decrease in structural diversity, vegetation height, and increased incidence of 'damaged' forms of heather growth. Dry heaths can also be damaged by such activities as agricultural improvement, tree planting and forestry, bracken invasion, quarrying and recreational activities.

There is very limited actual data available by which the 'condition' or 'quality' of the habitat can be objectively assessed. Information from a brief review of data held within cSAC Natura 2000 paper files for a sub-sample of 38 designated Dry Heaths within cSACs, showed that cSACs contain heathland that is usually in good condition, but which in approximately a third of cases is subject to more than very localised overgrazing (unfortunately size of damaged areas are not detailed). Undergrazing was an issue on only one of the 38 cSACs examined.

Another dataset which may be useful in attempting to quantify the condition of heaths is that provided in the Commonage Framework Plan (CFP) dataset, which contains a vegetation damage condition code, ranging from undamaged to severely damaged. This dataset contains a variety of habitats, so polygons containing heath (both wet and dry, and often with other habitats) were extracted and the total areas for each vegetation condition code calculated. This is shown in Table 1 below. This shows that approximately half of the polygons containing heath were damaged in some way, with 24.7% experiencing moderate or worse damage. This information is based on a total area of 1,845 km^2 of polygons containing heath (i.e. approximately a third of the area of the average estimate of habitat extent). When only the 304 km^2 of polygons containing heath not in mosaic with other habitats are examined, a similar incidence of damage was found. However it should be noted that though not all of this may refer to dry heath, wet heath may also be included.

Table 1: Damage to polygons containing heath (wet and dry), according to the Commonage Framework Plan (CFP) dataset

Vegetation condition type	**Vegetation condition code**	**Total (ha)**	%
Very severely damaged	s*	8,034	4.4
Severely damaged	s	6,271	3.4
Moderate damage	m	794	0.4
Moderately to severely damaged	ms	11,032	6.0
Moderately damaged	mm	19,355	10.5
Moderate to undamaged	mu	39,586	21.5
Undamaged	u	99,420	53.9
Rank	u*	21	0.0
	Grand Total	184,513	100.0

6.1.1 Conservation Status of Habitat Structures and Functions

All of the above activities are believed to have altered the habitat quality. CFP data (see section 6.1) suggests that just under 25% of the Dry Heath resource is in at least a moderately damaged condition, and hence a conservation status of Inadequate (U1) has been allocated. This conservation status was supported by the expert opinion of NPWS staff.

6.2 Typical Species

The habitat contains a large proportion of dwarf shrubs species, commonly *Calluna vulgaris* or *Vaccinium myrtillus*. In the Dublin mountains, as well as in West Cork and West Kerry and locally on the Forth Mountain of Co. Wexford the heathers may have *Ulex gallii* as a co-dominant. *Erica cinerea*, but also locally*, Empetrum nigrum, Arctostaphylos uva-ursi* and *Vaccinium vitis-idaea* also form part of the dwarf shrub element. The dwarf shrub *Daboecia cantabrica* occurs only in the Connemara region and south-west Mayo (Nelson, 1989), and is not listed in the Annex I habitat definition. Other rare heathers (*Erica vagans* and *E. ciliaris*) occur only at one or two sites (Curtis, 2000).

Typical dry heathland grasses and sedges include *Agrostis* spp., *Deschampsia flexuosa, Nardus stricta, Festuca* spp. and *Carex binervis* (Fossitt, 2000). Common broadleaved plants include *Galium saxatile, Potentilla erecta* and *Rumex acetosella*, with additional species such as *Scilla verna*, *Jasione montana, Armeria maritima* and *Plantago maritima* in coastal areas (Fossitt, 2000).

Fossitt (2000) states that *Ulex* spp. form elements of heathland only where they are low-growing. Similarly, other authorities (JNCC, 2004, 2005) include *Ulex minor* and *U. gallii*, but not *U. europaeus* in the lists of qualifying dwarf shrub species. *Ulex* spp. are particularly conspicuous in the heaths of the east. Heather-dominated dry heath is most abundant in Kerry and Cork.

Calcareous heath (HH2) habitats do fall within the Annex 1 habitat (Fossitt, 2000). Calcareous heaths may be distinguished by the presence of calcicole species such *Helianthemum* spp., *Thymus* spp., *Galium verum*, *Anthyllis vulneraria, Antennaria dioica, Sanguisorba minor* and *Carlina vulgaris*.

The red data book for Ireland (Curtis & McGough, 1988) lists a total of 13 rare plant species which occur in heathland habitats. These are plants which are found in fewer than ten 10km grid squares, or which declined more than 66% since 1970 on the basis of their 10km square distribution. Of these, five are species of established, closed heath, the remainder being species of open, establishing heathland. They are *Erica vagans, Filago minima, Lotus subbiflorus, Gnaphalium sylvaticum, Ornithopus perpusilla, Orobanche rapum-genistae, Pyrola media, Simethis planifolia, Trifolium glomeratum, Trifolium subterraneum, Tuberaria guttata, Vicia lathyroides* and *Viola lactea.*

6.2.1 Conservation Status of Habitat Typical Species

An accurate assessment of the condition of typical habitat species can not be carried out in the absence of a specific monitoring programme, aside from the contribution they make the assessment of overall habitat condition (section 6.1.1). The conservation status for typical species is therefore Unknown (XX).

7 Impacts and Threats

Regional NPWS staff are responsible for patrolling designated sites and enforcing relevant legislation (e.g. Habitats Directive 92/43 EEC or the Wildlife Act 2000). NPWS Conservation Rangers are required to summarise information collected on the integrity of sites within their areas during the course of their duties. They are given the responsibility for reporting the information required under the Site Inspection Reporting (SIR) programme. Reporting is carried out on a three-year cycle that began in 1998.

The Research Branch Monitoring Section of NPWS developed the SIR programme to be used as a monitoring tool. Local NPWS staff log the following information: activities occurring on the site and their effects on the site's integrity, follow-up actions including all outcomes such as prosecutions, notifiable actions and positive management undertaken and site patrolling frequency and purpose. The available data is summarised for cSAC sites designated in Table 2 below. Note that this shows that agriculture is the most common influence on the dry heaths in the sample, with burning the most frequent agricultural activity. Other commonly occurring activities include sand and gravel extraction, and urbanisation and industrialisation. Unfortunately, SIR gives no indication of the severity of the influence.

Other non-listed possible impacts include acidification, tropospheric ozone and nitrogen enrichment caused by atmospheric deposition. This can lead to vegetation changes including a reduction in the lichen and bryophyte interest. Nitrogen deposition can increase the likelihood of insect defoliation of upland heathland (UK BAP, 1999). Furthermore, climate change could potentially lead to changes in vegetation composition and structure, although any increase in temperature may also be accompanied by possible increases in rainfall and wind speeds. The future position is still unclear but *Calluna vulgaris* does have a relatively wide tolerance of temperature and rainfall, providing the overall climate remains oceanic. It is likely that within the time span of this plan, other factors, notably high stocking levels, will have by far the greatest impact on upland heathland vegetation and species (UK BAP, 1999).

It is considered that the biggest impacting influences on large areas of dry heath are burning, overgrazing, bracken invasion and sand and gravel extraction.

Table 2: Site Inspection Reporting (SIR) data for cSACs designated for Dry Heath (showing the Habitats Directive 92/43/EEC activity code).

Activity		**Causal agent (number of cases)**					**Total Area affected (ha)**
		Other	**Owner or Occupier**	**Statutory body**	**Third party**	**Unknown**	
Agriculture and Forestry	Agricultural improvement (103)	0	1	0	0	0	25.0
	General Forestry management (160)	0	0	0	0	1	0.0
	Grazing (140)	0	0	1	0	0	0.0
	Irrigation (130)	0	0	0	0	1	0.1
	Overgrazing by deer (144)	1	0	0	0	0	5.0
	Removal of scrub (152)	0	1	0	0	0	20.0
	Stock feeding (171)	0	1	0	0	0	0.0
	Animal breeding (170)	0	2	0	0	0	0.2
	Cultivation (100)	0	1	0	1	0	13.0
	Fertilisation (120)	0	2	0	0	0	10.0
	forestry planting (161)	0	1	0	1	0	0.0
	Agriculture and forestry activities not referred to above (190)	0	2	0	0	1	0.5
	Overgrazing by sheep (142)	0	2	0	2	0	30.0
	Burning (180)	1	3	3	1	28	2,206.8
	ALL	**2**	**17**	**4**	**5**	**31**	**2,310.6**
Human induced changes in hydraulic conditions	Drainage 810)	0	0	1	1	0	0.0
	Landfill, land reclamation and drying out, general (800)	0	0	1	0	0	1.0
	All	**0**	**0**	**2**	**1**	**0**	**3**
Leisure and Tourism	Motorised vehicles (623)	0	0	0	1	0	0.0
	Other outdoor sports and leisure activities (690)	0	0	0	0	1	1.0
	Walking, horseriding and non-motorised vehicles (622)	0	0	0	0	1	0.0
	All	**0**	**0**	**0**	**1**	**2**	**1.0**
Mining and Extraction of Minerals	Sand and gravel extraction (300)	0	2	1	4	5	5.3
	All	**0**	**2**	**1**	**4**	**5**	**18.5**
Natural processes (biotic and abiotic)	Erosion (900)	1	0	0	0	1	0
	Invasion by a species (954)	0	1	0	0	1	32.0
	Other forms or mixed forms of inter-specific floral competition (979)	1	0	0	0	0	0
	All	**2**	**1**	**0**	**0**	**2**	32.0
Pollution and other human impacts/activities	Trampling, overuse (720)	0	0	0	1	0	0.0

Activity		Causal agent (number of cases)					Total Area affected (ha)
		Other	Owner or Occupier	Statutory body	Third party	Unknown	
	Vandalism (740)	0	0	0	1	0	13.0
	All	**0**	**0**	**0**	**2**	**0**	**13.0**
Transportation and communication	Paths, tracks, cycling tracks (501)	0	0	1	1	2	1.9
	Electricity lines (511)	0	0	2	0	0	0.1
	Routes, autoroutes (502)	0	2	0	0	0	1.5
	Communication networks (500)	0	0	0	0	1	0
	All	**0**	**2**	**3**	**1**	**3**	**3.5**
Urbanisation, industrialisation and similar activities	Urbanised areas, human habitation (400)	0	4	0	0	1	3.5
	Disposal of household waste (421)	0	0	0	0	3	0.2
	Disposal of inert materials (423)	0	0	1	0	1	1.5
	Dispersed habitation (403)	0	0	0	1	0	1.0
	All	**0**	**4**	**1**	**1**	**5**	**6.2**
	TOTAL	**4**	**27**	**12**	**15**	**49**	**2,385.9**

8 Future Prospects

8.1 Negative Future Prospects

Dry heaths are still at risk from many of the impacts identified, though the following positive measures may assist in their conservation.

8.2 Positive Future Prospects

8.2.1 The Rural Environment Protection Scheme (REPS)

REPS is an EU-funded Department of Agriculture, Food and Forestry scheme for environmentally sensitive farming, introduced in 1995, which includes incentives to reduce stocking densities within proposed NHAs, cSACs and on land designated as degraded (over-grazed). The positive impact of this scheme for Dry Heathland conservation is dependent on various factors such as the uptake of REPS and the suitability of prescriptions.

8.2.2 National Farm Plan Scheme (NFPS)

The NFPS launched in February 2006 operates on designated areas (cSACs, SPAs) and commonage land. It follows on from the requirements of the EU Natural Regulations and the Wildlife (Amendment) Act 2000. The scheme allows the Department to pay farmers and landowners for losses incurred through restrictions caused by the designation of lands, and to pay for certain actions which are beneficial to wildlife, as agreed in a Farm Plan (such as reduced stocking density, sensitive positioning of feeding points and regulation of the use of fertilisers and herbicides). These farm plans should reduce damage to Dry Heathlands, though its success is obviously dependant on the uptake by farmers.

8.2.3 International projects

International work on heathland, provide case studies, examples of best-practice, and networking opportunities. For example the European Heathlands Network has been established to enable all persons involved or interested in ecological research, conservation of wildlife, and in policy formulation and implementation in relation to European heathlands to meet, stimulate discussion, promote communication, further the understanding of heathland ecosystems and disseminate information as widely as possible (http://www.english-nature.org.uk/heathlands/).

8.2.4 Notifiable actions

Dry heath within cSACs is protected in part through a list of Notifiable Actions. This lists activities which should not be carried out without consent and includes such land management activities as application of fertilisers, pesticides or herbicide, intensive burning regimes, grazing at intensities above those agreed in farm plans, re-seeding, dumping, ploughing or rock extraction. It also lists activities such as afforestation, and various forms of development.

8.2.5 Forestry Policy

It is government policy that forestry planting will not take place with open heathland areas within designated sites.

8.2.6 Protection of individual species

Many of the rarest plants within heathlands are projected under the 1976 Wildlife Act, which makes it illegal to alter, damage or interfere with, in any way, their habitats.

8.2.7 Overall Habitat Future Prospects

The NFPS scheme and notifiable actions processes are benefiting dry heath habitat, though act only on land within designated sites. An estimated 330,870 ha (69%) of the mapped current resource (using the first method used to estimate total area, i.e. polygons with a score >9) falls within designated (NHA and cSAC) sites. However, such sites were particularly susceptible to over-estimation due to parent polygons passing on attribute data to all offspring polygon.

The REPS scheme operates within the wider landscape, though is limited only to areas where landowners choose to enter the scheme. Furthermore, targeting of both of these schemes is limited by the lack of any type of habitat inventory and scarcity of survey data.

Therefore it is deemed that the prospects for the future of the habitat should be assessed as unfavourable inadequate.

9 Overall Assessment of the Habitat Conservation Status

An accurate assessment of the conservation status of habitat area was not possible due to lack of data, though expert NPWS opinion suggested that the conservation status should be Favourable (FV. The conservation status of the habitat range was also believed to be Favourable (FV), again based on NPWS judgement. However, since limited evidence for the increase in impacting activities, and the high incidence of damage caused by these activities, the trend is expected to be negative (magnitude unknown). The conservation status for habitat structure and function is Inadequate (U1); for typical species Unknown (XX), and that for future prospects also Inadequate (U1). This leads to an overall assessment of Inadequate (U1).

The reliability of this conservation assessment has been limited by lack of high coverage and high quality datasets. In particular the comparison between current range and extent and the favourable reference values is particularly difficult, and acquisition of better data should be a primary aim, before this is attempted. It is hoped that more appropriate data will become available during the next reporting cycle.

10 References

Browne, A. (2005). *National inventory of sea cliffs and coastal heaths*. A report to the National Parks and Wildlife Service.

Conaghan, J. (2000). *The distribution, ecology and conservation of blanket bog in Ireland*. Commissioned by National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government 196

Corbet, S. A., Walters, S. M., West, R., Streeter, D., Ratcliffe, D. A. (1999). *Ireland: A Natural History*. The New Naturalist Library.

Cross, J. (2006). The potential natural vegetation of Ireland. Biology and Environment: Proceedings *of the Royal Irish Academ*y, Vol 106B, No 2, 65-116.

Curtis, T. G. F. (2000). *The change in the legal status of* Erica ciliaris *L. Dorset heath in Ireland. Yb. Heather Society, 89-92.*

Curtis, T. G. F, & McGough, H.N. (1988). *The Irish Red Data Book 1: Vascular Plants*. Wildlife Service, Ireland, Dublin.

Derwin, J. (2003/04). *Survey and evaluation of blanket bogs for proposal as Natural Heritage Areas*. Commissioned by National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government.

Derwin, J. & MacGowan, F. (2000). *Raised Bog Restoration Project: A Continuation of the Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland*. Unpublished report, Dúchas the Heritage Service, Dublin.

Fealy, R., Loftus, M, Meehan, R. (2006). *EPA Soil and Subsoil Mapping Project: Summar methodology desription for subsoils, land cover, habitat and soils mapping/modelling. Version 1.2.* Environmental Protection Agency Teagasc.

Fernandez, F., Fanning, M., Mccorry, M. & Crowley, W. (2005). *Raised Bog Monitoring Project 2004-05*. Unpublished report. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Fernandez, F., MacGowan F., Crowley, W., Farrell, M., Croal, Y., Fanning, M. & McKee, A. (2006). *Assessment of impacts of turf cutting on designated Raised Bogs 2003-06*. Unpublished report. National Parks & Wildlife Service, Department of Environment, Heritage Local Government, Dublin.

Fossitt, J. A. (2000). *A guide to habitats in Ireland*. The Heritage Council.

Hewins, E. & Lush, M. (2007). *Desk survey of the extent and conservation status of Irish Dry Heath and Juniperus communis formations.* Supporting report prepared for: National Parks and Wildlife Service, Department of Environment, Heritage and Local Government

.JNCC (2004) *Common Standards Monitoring Guidance for Lowland heathland.*

JNCC (2005) *Common Standards Monitoring Guidance for Upland Habitats*.

Kelly, L., Doak, M. & Dromey, M. (1995). *Raised Bog Restoration Project: An Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland*. Unpublished report, National Parks & Wildlife, Department of Arts, Heritage, Gaeltacht and the Islands, Dublin.

Nelson, E., C. (1989). Heathers in Ireland. Botanical *Journal of the Linnean Society*. 101: 269-277.

NGOs (2002). An investigation into the possibility of selecting further European Dry Heath (4030 cSACs). Evaluation of sites transitted by DÚCHAS compared with NGO proposals. (Habitats 4030 and 5130)

O'Connor, M. (2000). *Action plan for blanket bog and wet heath habitats: Technical aspects.* Edited by Caitriona Douglas.

Osterman, O. P. (1998). The need for management of nature conservation sites designated under Natura 2000. *Journal of Applied Ecology*, 35: 968-973.

Preston, C. D., Pearman, D. A & Dines, T. D. (2002). *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford.

Webb, N. R., (1998). The traditional management of European Heathlands. *Journal of Applied Ecology*, 35: 987-990.

Appendix 1: Dataset review

CORINE Land Cover Map (2000)

The CORINE Land Cover (CLC) map is a pan-European habitat map produced jointly from the European Commission and member states. It uses 44 land cover and land use classes, identified from satellite imagery and using other ancillary data sources, with a minimum mappable unit of 25ha. Its intended use is mainly for policy makers. It is coordinated by the European Environmental Agency throughout Europe and by the Environmental Protection Agency within Ireland.

CLC 2000 was developed out of the original CLC 1990 dataset, firstly correcting the 1990 data and then mapping land cover changes using 2000 satellite imagery and ancillary data. A dataset of the changes was also available. It is based upon a three-tier hierarchy classification system, using 44 land cover classes. It was conducted at 1:100,000 scale and with a minimum mappable unit of 25ha.

The main limitation of CLC 2000 is that ground truthing of the satellite imagery was limited. The scale at which it was conducted was also very coarse. For these reasons O'Connor (2000) determined that these maps cannot be regarded as accurately representing land cover classes in Ireland.

For the purposes of this work the obvious limitation is that the moors and heathlands CLC category does not necessarily equate to the 4030: European Dry Heaths Annex 1 habitat.

Despite these caveats, this was potentially a useful dataset for indicating areas of possible Dry Heath in the Moors and heathlands category and for indicating areas where no heath is present in the other categories.

PEENHAB

The PEENHAB project from the Pan-European Ecological Network (PEEN) aims to develop a methodology to identify spatially all major habitats in Europe. The habitat classes are the Natura 2000 habitats. The map is based on a combination of existing spatial databases (such as land cover, soil data, topographic data and species distribution maps). At the same time a bottom-up approach is used in collaboration with the SynBioSys project.

Management Planning Support Unit (MPSU)

This dataset, produced by the NPWS, comprises mapped habitats within each designated site and is used for the purposes of management planning. Each habitat is coded, with BH1 being heath, BH1d being Dry Heath and SC6 being *Juniperus communis* scrub; though mosaics are allowed. However, the data is known to be of limited quality, often produced without any field survey, and individual polygons are not dated, so it is impossible to determine the age of the data. MPSU data is considered unreliable by NPWS staff, but it may support other datasets.

National Soils and Parent Material Map (Teagasc, 2006)

The soils and subsoils dataset was created by Teagasc using Geological Survey of Ireland (GSI) data under the EPA soils and subsoils mapping project. This was completed in May 2006. The research utilised satellite imagery, aerial photogrammetry and ground truthing to produce a map of soil cover in Ireland. This was intended to be used to target areas suitable for forestry. The soil types covered included those soil types most likely to support heathland communities were 21: shallow well-drained mineral soils derived mainly from acidic parent material, and 43: mineral podsolised soils and peaty topsoil with occasional iron pan layers.

As the data is in vector format it could be used to determine where heathland was likely to occur, though it should be noted that heath is not restricted to this types, and the presence of these types of soils does not mean heathland will definitely exist.

Sites based habitat information

The NPWS operates a site system where sites are given unique codes. Polygons representing designated sites were available, along with a wealth of information in both paper and spreadsheet format which related to these sites. Other sites were located only by site name, or point location, and some additional non-NPWS sites were added in from additional surveys. It was also possible to check for heathland in paper data in site files. The key site datasets were:

- Habitat Assignment Project database;
- Habitat Assignment Project updates December 2006;
- Browne (2005) - survey covering coastal heath sites, both designated sites and others;
- Old CORINE database (no new sites added);
- CORINE implementation document (no new sites added);
- NGO suggestions for extra heath designated sites (NGOs, 2002);

- Additional sites from Derwin, (2003/04) (paper list supplied);
- Conaghan (2000);
- Designated sites where habitat is mentioned in site synopsis.

Commonage Framework Plans (CFP) (Department of Agriculture and Food and the National Parks and Wildlife Service)

Commonage Framework Plans have been jointly produced by the Department of Agriculture and Food and the NPWS. Within these plans, habitats are crudely described and coded, along with vegetation condition categories, land use and plant species in each agricultural sub-unit. Also included are some areas of private land.

Each agricultural sub-unit contains a list of habitats present within it, rather than being split into the separate habitats. This means that individual habitats are not individually mapped, and so the precise extent or area of heathland within these areas cannot be determined. Another limitation on the geographical data is that individual digital polygons are not dated.

Aside from being useful for identifying areas containing heath it is also a key data source for indicating the condition of heath. The condition of heath in general is likely to be similar to that of dry heaths specifically.

Water features

Water features form separate layers within the Ordnance Survey for Ireland Discovery dataset, and the boundaries of these areas should therefore be highly accurate. Obviously any areas that are open water are not Dry Heath, so the layers containing polygons can be said not to contain heathlands. These areas were excluded.

Raised bog data collated for the Raised Bog Conservation Status Assessment

Raised bog data was collated consisting of digitised survey data from the following sources:

- Raised Bog Restoration Project - Kelly *et al.* (1995);
- Raised Bog Restoration Project - A Continuation of the Investigation into the conservation and restoration of selected raised bog sites in Ireland (Derwin & MacGowan; 2000);
- Raised Bog Monitoring Project - Fernandez *et al*. (2005);
- Assessment of Impacts of Turf Cutting on Designated Raised Bogs 2003-06 Project - Fernandez *et al*. (2006)

Further details of these data sources can be found in the Raised Bog Conservation Status Assessment Report. Since these data represented only raised bogs and were accurately mapped it was possible to use these to identify areas that were not dry heath.

Digitised Peatland Map of Ireland (Hammond, 1979)

Hammond's Peatland Map of Ireland was created in 1979 and is the most comprehensive over-view of the distribution of peatlands in 1970's Ireland. The map is based on a number of sources, as follows:

- Detailed soil maps from the National Soil Survey, carried out by An Foras Talúntais since 1968, and covering 10 counties fully and 2 counties partially;
- Aerial photographs from 1973/4 where National Soil Survey maps were unavailable;
- Site visits.

The digital version used was created by the soil division of Teagasc from the original Peatland Map of Ireland.

There are known inaccuracies within the map. Evidence of inaccuracies is provided by O'Connor (2000), and areas of dry heath have been found mapped as blanket bog (see 2007 Active Blanket Bog Conservation Status Assessment Report).

A visual assessment of the data using aerial photographs and other data sources indicated that this map was roughly drawn and not reliable enough to exclude areas from being dry heath, as it appeared to include non-peat habitats and miss areas of obvious bog. For this reason it was only possible to indicate a lower likelihood of the presence of dry heath.

FIPS 1998

The Forest Inventory Planning System (FIPS) was developed by the Forest Service in 1998 and contains areas highlighted as being forestry. When checked with aerial photographs, some of these areas are more likely to be forestry than others. In particular, those areas where the CLASS_CATE field are blank or contain 'Cleared' or 'Planting Grant App' may not be woodland.

Preliminary investigations indicated that FIPS was identifying woodland where CORINE 2000 and commonage data suggested that there was moor and heath (though note some of these differences may have been caused by the 2 year gap between the datasets). Therefore a random selection of these polygons were checked to determine the accuracy of FIPS, and the inaccuracy was confirmed. Also, during the test it was apparent that the FIPS data is positionally inaccurate in relation to the other datasets used. In some cases, especially with small woodlands, the polygon occurred in the adjacent field according to the aerial photographs and other data sources. This inaccuracy varied from area to area, so it is not possible to adjust the data to compensate.

2000 Aerial Photographs

Aerial imagery was available from the Ordnance Survey of Ireland. These date from 2000 and are fully orthorectified, but are low quality compared with other aerial imagery available elsewhere, the resolution appearing to be about 4m. They were used to check for areas of heathland visually when testing the quality of the other datasets.

Contour data

Contour data were also available from the Ordnance Survey of Ireland. This was a very important dataset for determining the location of Dry Heaths, as the slope is a very useful indication of the habitat type. Dry heathland will tend to occur on slopes greater than 5°; shallower slopes are more likely to be wet heath or mire habitats. There is also an upper altitude (approximately 600m), above which alpine habitats, including alpine heath, are more likely.

This data was in vector format, but unfortunately as polylines. Many of the individual contours were also split between multiple polylines, rather than being contiguous, and had some gaps that prevented or made difficult the conversion to longer polygons. Though it was theoretically possible to determine areas of slope greater than 5°, it was extremely difficult due to technological limitations. For these reasons it was only be manually assessed.

Appendix 2: Dataset scoring system

Scores used for using in likelihood setting: Definite positive = +100, High positive = +10, medium positive = +3, low positive = +1, Definite negative = -100, high negative = -10, medium negative = -3, low negative = 10

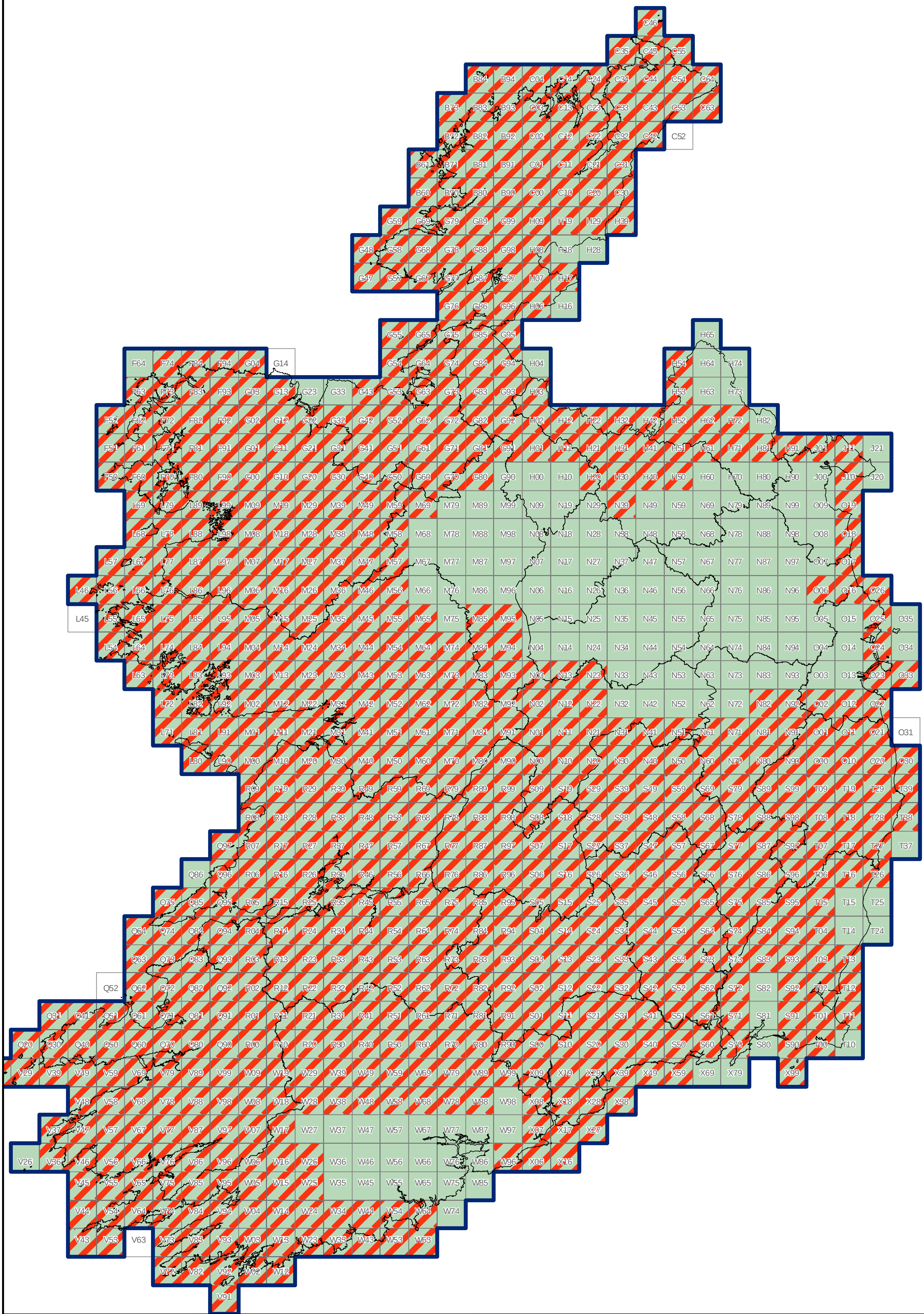
Dataset	Selection	Score
Countrywide datasets		
Commonage Framework Plans (CFP)	Dry heath	+ve high
	Not dry heath	-ve low
CORINE Land Cover Map (2000)	Moors and heaths	+ve low
FIPS 1998	Forestry	-ve low
Management Planning Support Unit (MPSU)	Dry calcareous heath (including *Juniperus communis* scrub)	+ve high
	NOT(Dry calcareous heath (including *Juniperus communis* scrub)	-ve low
	All HH1 Dry siliceous heath or HH2: Calcareous heaths	+ve high
	Part HH1 Dry siliceous heath or HH2: Calcareous heaths	+ve medium
	Not HH1 Dry siliceous heath or HH2: Calcareous heaths	-ve low
	All BH1d (dry heath)	+ve high
	Heath (but dry heath not specified)	+ve medium
	Heath (but sub-set of dry heath not specified)	+ve medium
	BH1 AND NOT(*BH1d*)	+ve low
	Not heath	-ve low
	Habitat 4130	-ve low
	Habitat 4095	-ve low
Digitised Peatland Map of Ireland (Hammond, 1979)	Blanket Bog OR Fen OR Raised Bog	-ve low
	Non-Peat OR null	0
Raised bog	true	-ve high
Raised bog 2005 survey	true	-ve high
National Soils and Parent Material Map (Teagasc, 2006) IfsSoilCat21	43: mineral podsolised soils and peaty topsoil with occasional iron pan layers	+ve low
	21: shallow well-drained mineral soils derived mainly from acidic parent material, and	+ve low
Site datasets		
Site files	Contains evidence of dry heath	+ve high
	No evidence of dry heath	-ve low
Site Synopsis	Contains evidence of dry heath	+ve high
cSAC qualifying feature	Dry heath	+ve high
	Not dry heath	-ve low
Habitat Assignment Project	Heath present HH1-4 (Fossitt, 2000)	+ve high
Habitat Assignment Project	Habitat 4030 present	+ve high
Derwin (2003/4) and pers. comms.	says all raised bog	-ve medium
NGOs (2002)	Y	+ve high
Blanket bog database	contains heath	+ve medium
Browne (2005)	Heath site	+ve medium
Aerial photograph checking of a sub-sample of polygons	Definitely is	+ve Definite
	Definitely not	-ve Definite

4030 **European dry heath**

1. National level	
Habitat Code	4030
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Maps	Map 1: Favourable reference range, current range and maximum favourable reference area (see backing document)

2. Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ PUBLISHED REPORTS: ▪ Browne, A. (2005). *National inventory of sea cliffs and coastal heaths*. A report to the National Parks and Wildlife Service. ▪ Derwin, J. (2003/04). *Survey and evaluation of blanket bogs for proposal as Natural Heritage Areas*. Commissioned by National Parks and Wildlife Service, Department of Environment, Heritage and Local Government. ▪ Conaghan, J. (2000). *The distribution, ecology and conservation of blanket bog in Ireland*. Commissioned by National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government 196 ▪ Fossitt, J. A. (2000). *A guide to habitats in Ireland*. The Heritage Council. ▪ Additional 2007 Conservation Assessment reports: Blanket Bog; Raised Bog.
Range	Map 1: Favourable reference range and current range.
Surface area	86,500 km² (865 grid cells x 100km^2).
Date	1990 - 2006
Quality of data	1 = poor
Trend	Stable
Trend-Period	N/A
Reasons for reported trend	
Area covered by habitat	
Distribution map	Map 1: Favourable reference range, current range and maximum favourable reference extent (see backing document Section 5)
Surface area	Estimated 1,950 to 11,663 km^2 (i.e. **6,807** ± 4,857 km^2),
Date	1990 - 2006
Method used	2 = based on remote sensing data (supplemented by field data and expert judgement)
Quality of data	1 = poor
Trend	Negative, magnitude unknown
Trend-Period	Unknown, but anecdotal evidence from recent decades
Reasons for reported trend	3 = direct human influence (overgrazing 148, forestry 160, abandonment 141, bracken invasion 954)
Justification of % thresholds for trends	Trend based on anecdotally reported increases in the intensity of impacting activities and on consequential loss of habitat. CORINE Land Cover Dataset shows decline in moors and heaths between 1990 and 2000 of –1.13%
Main pressures	148 Overgrazing 141 Abandonment of pastoral systems 160 General Forestry management 161 Forestry planting 180 Burning 120 Fertilisation 103 Agricultural improvement 300 Sand and gravel extraction

Threats	148 Overgrazing 141 Abandonment of pastoral systems 160 General Forestry management 161 Forestry planting 180 Burning 120 Fertilisation 103 Agricultural improvement 300 Sand and gravel extraction
2.5 Complementary information	
Favourable reference range	86,500 km²
Favourable reference area	1,950 to 11,663 km^2 (i.e. **6,807** ± 4,857 km^2)
Typical species	Dwarf shrubs species: *Calluna vulgaris, Vaccinium myrtillus, Ulex gallii, Erica cinerea, Empetrum nigrum, Arctostaphylos uva-ursi, Vaccinium vitis-idaea,* and *Daboecia cantabrica.* Grasses and sedges: *Agrostis spp., Deschampsia flexuosa, Nardus stricta, Festuca* spp. and *Carex binervis* Broad-leaved plants: *Galium saxatile, Potentilla erecta* and *Rumex acetosella*, with additional species *Scilla verna, Jasione montana, Armeria maritima* and *Plantago maritima* in coastal areas and *Helianthemum* spp., *Thymus* spp., *Galium verum, Anthyllis vulneraria, Antennaria dioica, Sanguisorba minor*, and *Carlina vulgaris* in limestone heaths. Method: All the species above are characteristic of Dry Heath in Ireland (Fossitt, 2000). Data not available to assess the conservation status of these species.
Other relevant information	The habitat distribution is based upon polygon 'likelihood' scores; these scores being based upon the available datasets, with a threshold applied. Checking against aerial photographs has found the maps produced to be very approximate only. This is discussed in detail in Sections 3 and 5. The knowledge of the current range and extent of the habitat should be significantly improved before any further attempt to compare against favourable reference values.
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (Fav), though note much uncertainty in data
Area	Favourable (Fav), though note much uncertainty in data
Specific structures and functions (incl. typical species)	Inadequate (U1)
Future prospects	Inadequate (U1)
Overall assessment of CS	Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

European dry heaths

4030

Current Distribution (709 cells)
Current Range (865 cells)
Favourable Reference Range (865 cells)
W48 10km grid cells

Date: August 2007

4060 ALPINE AND BOREAL HEATH
CONSERVATION STATUS ASSESSMENT REPORT

Table of Contents

1 HABITAT CHARACTERISTICS IN IRELAND 2

1.1 DEFINITION OF ALPINE AND BOREAL HEATH 2
1.2 LIST OF ALPINE PLANT SPECIES IN IRELAND 4

2 HABITAT MAPPING 7

2.1 HABITAT RANGE 8
2.2 CONSERVATION STATUS OF HABITAT RANGE 9
2.3 HABITAT EXTENT 12
2.4 CONSERVATION STATUS OF HABITAT EXTENT 17
3.1 STRUCTURES AND FUNCTIONS OF THE HABITAT 18
3.1.1 Conservation Status of Structures and Functions of the Habitat 18
3.2 TYPICAL SPECIES 18
3.2.1 Conservation Status of Habitat Typical Species 19

4 IMPACTS AND THREATS 19

4.1 OVERGRAZING 20
4.2 BURNING 21
BURNING TREND 21
4.3 OUTDOOR RECREATION 22
4.4 QUARRIES 22
4.5 COMMUNICATIONS NETWORKS 22
COMMUNICATIONS NETWORKS TREND 22
4.6 WIND FARM DEVELOPMENTS 22
WIND FARM DEVELOPMENTS TREND 23
4.7 SITE INSPECTION FORM RESULTS 23

5. FUTURE PROSPECTS 23

5.1 NEGATIVE FUTURE PROSPECTS 23
5.2 POSITIVE FUTURE PROSPECTS 23
5.3 OVERALL HABITAT FUTURE PROSPECTS 24

6 OVERALL ASSESSMENT OF HABITAT CONSERVATION STATUS 25

7 APPENDICES 26

8 APPENDIX 1. PUBLISHED SOURCES OF DATA ON ALPINE HEATH HABITAT (THIS INFORMATION IS NOW CONTAINED IN THE FORM AT THE FRONT OF THIS DOCUMENT). **........ 27**

9 APPENDIX 2. UNPUBLISHED SOURCES OF DATA ON ALPINE HEATH HABITAT. 28

10 APPENDIX 3. ALPINE HEATH HABITAT DISTRIBUTION MAPPING 37

11 APPENDIX 4. OTHER SOURCES OF DATA 43

12 APPENDIX 5. COMMONAGE FRAMEWORK PLANS DATA 44

1) APPENDIX 6. DISTRIBUTION OF WIND FARMS IN RELATION TO ALPINE HEATH 45

13 APPENDIX 7. GLOSSARY 48

4060 Alpine and Boreal Heath Conservation Status Assessment Report

1 HABITAT CHARACTERISTICS IN IRELAND

1.1 Definition of Alpine and Boreal Heath

In the historical literature, the convention in Ireland has been to apply the term 'alpine' to those areas of habitat above 350-450 metres (1,200 – 1,500 ft) in altitude. However, the easy application of this label is very difficult as areas of 'alpine' vegetation may occur much lower than this, and the occurrence of this habitat is ultimately dependent on a number of factors principally geographical location, aspect, levels of exposure and not least, biogeographical history. In general, an alpine zone on Irish mountains occurs within the altitudinal range above but, moving northwards and westwards, it is met with at increasingly lower levels. This report also takes into account the alpine heath of the relatively low-lying Burren in the west.

From a vegetation point of view, alpine and boreal heath (hereafter referred to as alpine heath) is confined to the summits and slopes of the mountains whilst, what may be termed as assemblages of alpine plants, are confined to the more or less vertical, bare, north-east facing cliffs, which had their origins during the last glacial periods. It is widely considered that the alpine species occupying these areas are relictual in nature and represent the last vestiges of the arctic/tundra floristic component that was widespread in Ireland during the Pleistocene period.

Alpine heath is relatively widespread and is more derivative in nature; its character being the result of historical factors and especially the changing pattern of land use, principally through grazing and especially through the introduction of sheep to the mountains in the 1860s. Altitude and exposure are the chief factors determining its occurrence as well as the availability of relatively shallow peat. These soil conditions are found chiefly on plateaux and shallow slopes but on very exposed ridges and summits, peat is often absent and then the alpine heath takes on a more grassland-like character. However, in certain places, (such as Muckish Mountain, Co. Donegal (Site Code: 001179)), vegetation ascribable to alpine heath occurs on scree slopes.

There has been little published on the vegetation of Irish mountains, even though some systematic work was carried out on them during the 1970s. However, White and Doyle (1982) recognized 12 associations within 6 Classes, which probably encompass the range of variation found within the alpine cliff and alpine heath communities. Curtis (1993) presented some further details on the affinities of the alpine vegetation of Mount Brandon (000375) and Slieve League (000189). Ivimey-Cook and Proctor (1966) were the first to classify Burren habitats as a whole.

Table 1 presents a list of Associations, indicative of alpine heath, which are specifically alpine in nature but it should be stressed that these often occur as part of a larger mosaic of vegetation, which can include blanket bog, wet heath and dry heath and in the Burren, limestone pavement. Consequently, it is considered that the term 'alpine' only be applied to those categories listed below in which the diagnostic species, appropriate to each is present. It should be noted that there is some doubt as to the exact nature of some of the categories as a systematic phytosociological survey of Irish alpine vegetation has not yet been carried out.

Table 1. Table of plant associations found on alpine heaths in Ireland based on White & Doyle (1982) and Curtis (1993).

Class	Association	Diagnostic species
Acid grass - heathlands	*Achilleo-Festucetum tenuifoliae*	*Agrostis capillaris, Festuca ovina, F .vivipara, Achillea millefolium, Veronica officinalis, Viola riviniana, Trifolium repens, Holcus lanatus.*
	Nardo-Caricetum binervis	*Nardus stricta, Carex binervis, Luzula multiflora, Succisa pratensis.*
Bog and wet heath	*Lycopodio-alpini-Rhacomitrietum lanuginosi*	*Lycopodium alpinum, Racomitrium lanuginosum, Salix herbacea, Carex bigelowii, Juniperus communis* ssp *nana, Arctostaphylos uva-ursi, Vaccinium vitis-idaea.*
	Herberteto-Polytrichetum alpini	Bryophytes principally *Herberta adunca, Pleurozia purpurea, Plagiochila spinulosa, Anastrepta orcadensis, Bazzania tricrenata.*
	*Arctostaphylo-Dryadetum**1	*Dryas octopetala, Calluna vulgaris, Juniperus communis* ssp. *nana, Arctostaphylos uva-ursi, Pyrola minor,**2 *Empetrum nigrum, Listera cordata.*

Notes:

1. The *Arctostaphylo-Dryadetum* is an association found on the higher parts of the Burren and is properly montane in nature
2. This species is unlikely to occur in this community as *Pyrola media* is the characteristic species found within this Association in Ireland.

For most habitats listed in the Interpretation Manual of the Habitats Directive, there is a direct correspondence between its name and an Association of vegetation, which has been formally recognized by phytosociologists. However, for the Habitat Directive categories of alpine habitats there is no direct equivalence between the habitat title and a specific Association of vegetation. Instead, there has been a broad, generic approach to the classification of alpine categories within the Interpretation Manual and consequently the formal assignation of areas of alpine habitat to these is not easily accomplished. As has already been pointed out in **Table 1**, there are probably 5 Associations of vegetation, which can be formally recognized in Ireland for the vegetation found on the more level areas of uplands at altitude where alpine heath would be expected.

The alpine heath Association of the *Lycopodio-alpini-Rhacomitrietum lanunginosi* apparently occurs within 3 Interpretation Manual alpine habitats as follows:

- Alpine and boreal heaths (4060),
- *Juniperus communis* formations on calcareous heaths or grasslands (5130),
- Siliceous scree of the montane to snow levels (8110).

The consequences of this are that the accommodation of Irish alpine habitats, species and vegetation within the categories of the Interpretation Manual is not easily accomplished and it must be recognized, that on the ground, there is a great deal of overlap between Habitats Directive categories.

However, for the purposes of the Habitats Directive Alpine heaths in Ireland are considered to belong to two categories:

- Alpine and boreal heaths (4060)
- *Juniperus communis* formations on calcareous heaths or grasslands (5130)

The five Associations included within the alpine heath and grassland in **Table 1** are the main vegetation categories of these two habitats. It should be noted that there can be a significant grassland component to these two habitats, which has not been highlighted in their descriptions in the Habitats Directive manual. The Acid grass-heathlands listed in **Table 1** and especially the *Achilleo-Festucetum tenuifoliae*, is an Association of very shallow soils at exposed locations at altitude, which overlaps in content with the adjoining alpine heath proper and from which it may in fact be derived from severe erosion.

Though the two categories used to accommodate alpine heath vegetation in Ireland, for the purposes of the Habitats Directive, are appropriate for the designation of Special Areas for Conservation, they cannot be considered comprehensive for the purposes of defining alpine heath and its associated vegetation. For the purposes of confirming the occurrence of and identifying montane areas where alpine heath is found the conspectus of Associations given in **Table 1** should be used. However, a preliminary assignation of the associations of alpine vegetation to the appropriate Habitats Directive categories of alpine heath or *Juniperus communis* formations on calcareous heaths or grasslands is presented in **Table 2**. It is stressed that this is approximate and the production of a definitive account must await a thorough field investigation of the nature of Irish alpine vegetation.

Table 2. NATURA 2000 alpine heath habitat categories and the likely plant associations based on White and Doyle (1982), which they contain.

NATURA 2000 Habitat title	Probable identity of plant association (White and Doyle (1982))
Alpine and boreal heaths 4060	*Lycopodio-alpini-Rhacomitrietum lanuginosi ;* *Achilleo-Festucetum tenuifoliae;* *Nardo-Caricetum binervis*
Juniperus communis formations on calcareous heaths or grasslands 5130	*Arctostaphylo-Dryadetum;* *Lycopodio-alpini-Rhacomitrietum lanuginosi;* *Achilleo-Festucetum tenuifoliaei*

1.2 List of alpine plant species in Ireland

The listing of plant species occurring in alpine areas in Ireland is made possible for the vascular plants by the availability of lists from papers prepared by 19th century botanists, principally H.C. Hart who was the first to systematically examine the major mountain ranges in Ireland and who provided altitudinal data along with species occurrences. This has been added to over the 20th century by the discovery of further sites for alpine plants and it can be concluded that the species complements of Irish mountains is reasonably well known for the ferns and flowering plants. However, for the cryptogams, this is not the case and only certain well-botanised sites such as Ben Bulben (Site Code: 000623) and the Macgillicuddy's Reeks (Site Code: 000365) are well documented. However, the systematic survey of many Irish counties for bryophytes is ongoing and will eventually result in a comprehensive overview of the alpine mosses and liverworts.

Defining an alpine plant in Ireland is often made difficult as what may be alpine here may not be elsewhere in Europe and this is confounded by the behaviour of some lowland species, which occur on mountain tops and cliffs and act as alpine elements. For example, sea pink, *Armeria maritima* is found on the summit of Carrauntoohill at 1,034 m whilst on alpine cliffs a form of the common scurvy grass, *Cochlearia officinalis* a common coastal species, is sometimes found. A further illustration of the ecologically fickle nature of many Irish plants is crowberry, *Empetrum nigrum*, usually a species of high mountains but in County Mayo, it occurs at sea level.

The list of true alpines in Ireland is small, that is species, which never descend lower than 350m or away from cliff habitats and these are the true post-Pleistocene relicts, which can be considered as **Obligate Alpines** due to their virtual confinement to vertical, north-east facing cliffs or on exposed mountain ridges and summits. There conditions are severe enough to inhibit competition from coarser species and inaccessible enough to prevent grazing by animals. These may be joined here by what may be termed **Facultative Alpines**, which are species found in other habitats, not necessarily montane, but, which are also commonly associated with alpine locations. For those species of alpine heath/grassland, few are confined to those habitats and most also occur in the lowlands the Burren in Co. Clare, being the area where the most significant montane assemblages of plants occur outside their usual habitat.

Table 3 lists the alpine and boreal species, which are found at high altitude in Ireland. It excludes species, which are very widespread and found across a range of habitats from sea level to mountain tops.

Table 3: List of species found in alpine heath in Ireland.

Scientific Name	**Obligate or Facultative Alpine Species**
Carex bigelowii	Obligate
Diphasiastrum alpinum	Obligate
Festuca vivipara	Obligate
Poa alpina	Obligate
Salix herbacea	Obligate
Vaccinium vitis-idaea	Obligate
Agrostis canina	Facultative
Agrostis capillaris	Facultative
Antennaria dioica	Facultative
Arctostaphylos uva-ursi	Facultative
Armeria maritima	Facultative
Calluna vulgaris	Facultative
Carex binervis	Facultative
Carex pilulifera	Facultative
Daboecia cantabrica	Facultative
Deschampsia flexuosa	Facultative
Dryas octopetala	Facultative
Empetrum nigrum	Facultative
Erica cinerea	Facultative
Festuca ovina	Facultative
Huperzia selago	Facultative
Hymenophyllum tunbrigense	Facultative
Hymenophyllum wilsonii	Facultative
Jasione montana	Facultative
Juncus squarrosus	Facultative
Juniperus communis	Facultative
Listera cordata	Facultative
Lycopodium clavatum	Facultative
Nardus stricta	Facultative
Pedicularis sylvatica	Facultative
Plantago maritima	Facultative
Pyrola media	Facultative
Silene uniflora	Facultative
Vaccinium myrtillus	Facultative
Marsupella adusta	
Marsupella sprucei	
Racomitrium lanuginosum	
Adelanthus lindenbergianus	Hepatic Mat Community
Anastrepta orcadensis	Hepatic Mat Community
Dicranodontium uncinatum	Hepatic Mat Community
Herbertus aduncus subsp. hutchinsiae	Hepatic Mat Community
Hylocomium umbratum	Hepatic Mat Community
Pleurozia purpurea	Hepatic Mat Community
Scapania nimbosa	Hepatic Mat Community
Scapania ornithopodioides	Hepatic Mat Community

2 HABITAT MAPPING

There has been no recent inventory or mapping of the national alpine and boreal heath resource in Ireland. For the purposes of this survey, an extensive literature review of both published and unpublished material was undertaken (**Appendices 1** and **2**). Records documenting the occurrence of the species recorded of alpine heath (as listed in **Table 3**) were collated in an *MS Access* **Uplands Habitats Database**. This database contains records of the obligate and facultative species of the five Annex I upland habitats (4060, 8110, 8120, 8210, 8220) in Ireland and was designed specifically for the purposes of this report.

The **Upland Habitats Database** of this project, currently holds c.4,500 records of indicator species of all Annex I upland habitats (i.e. 4060, 8110, 8120, 8210 and 8220) which have been gleaned from a variety of sources (both published and unpublished as documented in **Appendices 1** and **2** respectively). Given the antiquity of the bulk of the data (c.1700 of the records date from the 1800s to the 1950s) and the lack of accurate geographical references (only c.1500 records have grid references of varying accuracy (see below and **Appendix 3** for further information) the GIS application of much of the collated data is limited. The bulk of records will not be illustrated in **Figures 1 to 3** due to their lack of grid references.

The database contains information on the following:

- Species Name
- Designated Site Code (NATURA 2000 sites (SACs) or Natural Heritage Areas (NHAs))
- Description of the location of the species
- Altitudinal information (either in feet (‘) or metres (m) depending on the antiquity of the record)
- Grid Reference (if provided) – these were assigned an accuracy rating
- Source of data (published or unpublished reference)
- Date of record
- List of associated species (if present)
- Indication of whether the description indicated a single species record, an assemblage of species or a description of habitat cover*
- Any information on substrate or underlying geology

*Given the variability of data sources, records of indicator species have been described either as an assemblage of species, a single species location or as an indication of habitat cover, depending on the quality and source of the data. For example a historical record by Corry (1884), which only contained details of a particular species at a certain altitude on Ben Whisken (Site Code: 000623) was entered as a single plant species location, whereas a description of several arctic-alpine species on a cliff above a corrie lake on Mount Brandon (Site Code: 000375) by Stelfox (1951) was entered as a species assemblage. Where there was a good description of an area of alpine heath (such as that given by Conaghan et. al. (1994) in the NHA Site Card for the Twelve Bens (Site Code: 002031)) this was entered as habitat cover.

Data for all of the above fields in the database was not necessarily contained in the original publication/source for each record. Based on the description of the locations given, an appropriate SAC Site Code was assigned to each record using the Discovery and 6” Mapping on Arc View 3.2.

GIS

GIS data sources, which are related to ecological factors that determine the occurrence of alpine heath, were used to produce the indicative natural range and potential distribution maps shown on **Figures 1** and **2**. These include:

- Contour lines >350m elevation. Ordnance Survey (1995) – 1:50,000 Discovery Series, 10m contour interval,

- A Digital Terrain Modelling package (2007) generated polygons, which were used to identify areas of potential alpine heath in areas outside the Burren based on the following criteria:
  - elevation above 350m,
  - upland areas above 350m with a slope > 40º,
  - areas of ridges and summits which were identified using a curvature index of 65º.

Investigation of the polygons created by the DTM indicated that not all slopes, which potentially contain alpine heath, had been accurately identified (e.g. the north prison of Lugnaquilla within Wicklow Mountains SAC (Site Code: 002122) was not shown) and this was thought to be due to the use of the slope criteria. The use of this data thus has some limitations.

AERIAL PHOTOGRAPHY

Although the use of recent (2000) digital aerial photographs of Ireland, which were ortho-rectified, was investigated, it became apparent that it was not possible to use these remotely to identify areas of alpine heath. This is because it is not possible to distinguish it accurately from rocky habitats in mosaics of vegetation of wet heath, dry heath, scree habitats and upland grassland.

BURREN HABITAT MAPPING

The following GIS data sources have been used to compile maps for the occurrence of limestone pavement, *Juniperus communis* formations on calcareous substrates and arctic-alpine heath on calcareous substrates;

- Corine 2000 land cover
- Irish Forest Soils (IFS)
- Geological Survey of Ireland solid geology
- Geological Survey of Ireland Karst Heritage sites
- SAC records and digital boundaries
- Landsat Thematic mapper satellite imagery
- Ordnance Survey of Ireland 1995 and 2000 orthophotography (aerial)
- Burren scrub mapping data (Heritage council)
- Burren habitat mapping (Department of Agriculture)

The evidence of limestone pavements, *Juniperus communis* formations on calcareous substrates and arctic-alpine heath on calcareous substrates was recorded in the GIS for each data set and summary distribution and range prepared for 10km squares.

2.1 Habitat Range

Alpine heath is largely restricted to those areas of habitat above 350-450 metres (c.1,200 – 1,500ft) in height. The occurrence of this habitat is ultimately dependent on a number of factors, principally geographical location, aspect, levels of exposure, nature of the solid geology, local erosional features and fluvio-glacial history. The actual range of alpine heath as defined in the Habitats Directive Interpretation Manual is unknown in Ireland.

In general an alpine zone on Irish mountains occurs within the altitudinal range above but as you move northwards and westwards, it occurs at increasingly lower levels. From an alpine vegetation point of view, alpine heath is usually confined to the summits, ridges and upper slopes of the mountains. Alpine heath is relatively widespread in upland areas in selected parts of Ireland.

Figure 1 shows that alpine heath potentially occurs mainly in the north-west in Counties Donegal, Sligo and Leitrim, in the west (Counties Mayo, Galway and Clare) and south-west (Counties Kerry, Cork and Limerick). Apart from these areas, there is a more localised distribution in uplands in the south (Co. Waterford and Tipperary), the north-east (Co. Louth), east (Co.

Wicklow) and south-eastern part (Co. Kilkenny, Co. Carlow/Co. Wexford border) of the country. There is an absence of alpine heath in the midlands of Ireland due to the lowland character of the landscape with the exception of the Slieve Bloom Mountains (Site Code: 000412) on the Co. Laois/Co. Offaly border.

The range in the Burren is within SACs. Any areas outside of SACs are not determinable without field survey. Limestone pavements have been located outside of SACs and there may be Arctic-alpine heaths associated with these but are not easy to spot using remote sensing such as aerial photos or satellite imagery. If discovered however, it may extend the range further south slightly.

Figure 1 shows an indicative map of the natural range of alpine heath in Ireland at a scale of 1 : 2,000,000. This is based on

- the locations of mountain ranges with upland areas >350m in elevation and
- the locations of SAC sites below 350m for which alpine heath is a qualifying interest.
- Burren sites – selected as per Section 2 above

As can be seen this habitat has a naturally discontinuous range in Ireland as it is restricted by altitude.

It must be stated, however, that although areas of alpine heath may occur in these mountain ranges it may not conform to the Habitats Directive definition, as this will depend on the species complement present. In the absence of a dedicated field survey, which will confirm the occurrence of those indicator species this map should be very much viewed as an over-estimation.

NOTE: It is the opinion of the authors of this report that the habitat, which was defined as alpine heath at elevations below 350m in NATURA 2000 forms (e.g. coastal sites) would not correlate to the definition of alpine heath as described in section 1.0 as *Carex bigelowii* is unlikely to be present. However, these sites have been included in the range of the habitat until a field survey confirms the species complement present.

2.2 Conservation Status of Habitat Range

According to the General Evaluation Matrix (Annex E - Explanatory notes Article 17 Habitat Directive) the assessment of the conservation status of the habitat range can be carried out in two different ways. The first method consists of assessing the annual variation in the habitat range extent in the reporting period (a decrease in habitat range greater than 1% per year is deemed Unfavourable Bad). The second is based on the relation between current habitat range extent and the Favourable Reference Range (FRR) (if current habitat range is 10% below FRR the habitat range is considered Unfavourable Bad).

An assessment based on the historical range of the alpine heath habitat indicates that the natural range polygon of the habitat in Ireland as defined (see **Figure 1**), potentially covers **29,300** km² (**293** grid cells selected x 100 km²). No specific studies have been undertaken on the conservation status of the habitat range in Ireland during the reporting period making any assessment of the extent or annual decline or otherwise in the habitat range problematic.

In general, the conservation status of the habitat range is deemed **Favourable** as the physical conditions for the presence of alpine heath are still present and the natural range of the habitat is thus likely to remain unchanged.

The Favourable Reference Range (FRR) is considered the same as the current range.

Habitat Range Area: Can be considered as the area of the polygon, which contains all of the grid cells, which potentially contain the habitat. This covers **29,500** km^2 (**295** grid cells selected x 100 km^2).

Favourable Reference Range: This is considered the same as the Habitat Range Area described above.

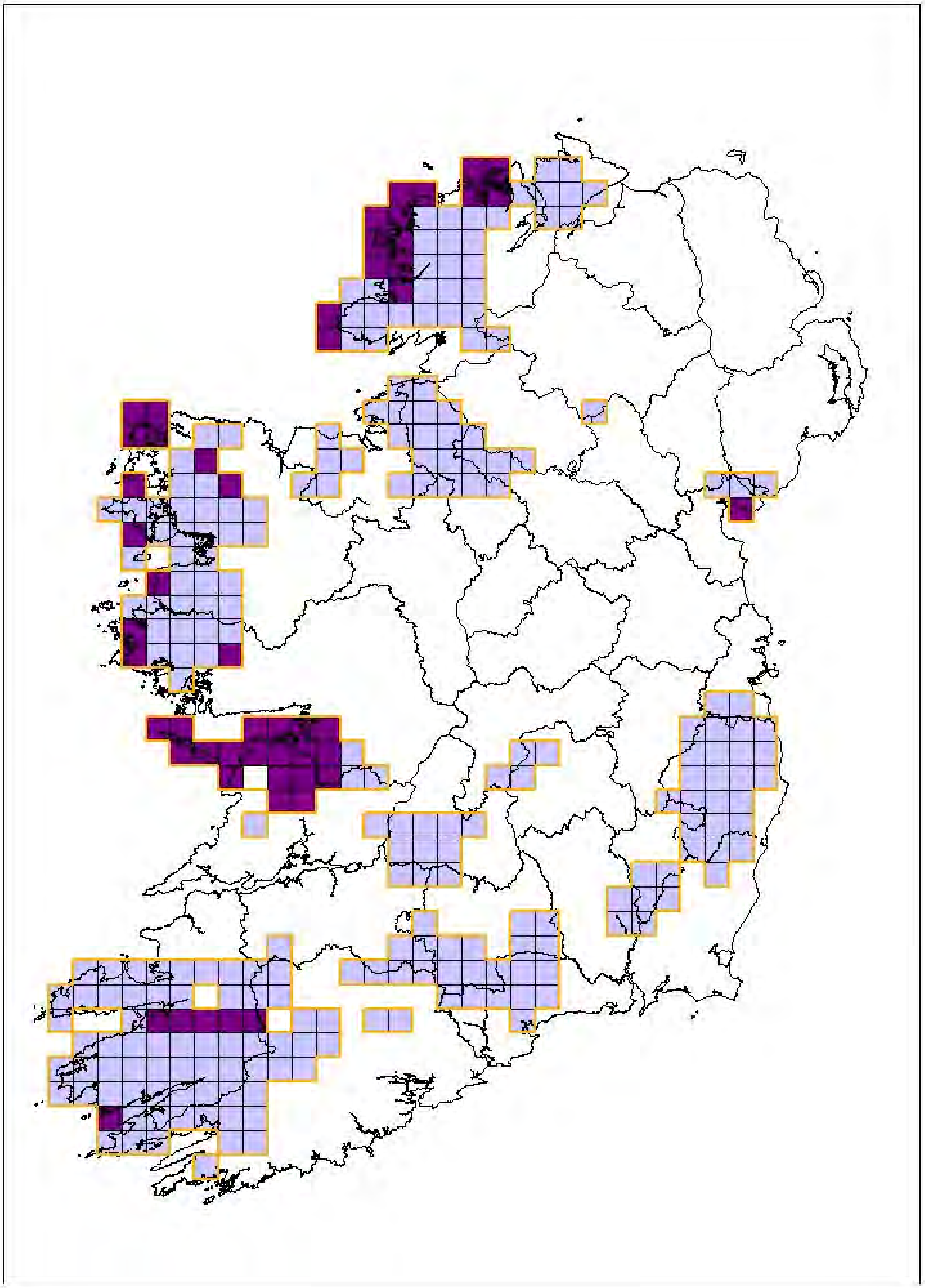


Figure 1. BURREN SQUARES – HEIGHT COLOUR ALSO Map showing the indicative natural Range and Favourable Reference Range of alpine and boreal heath in Ireland based on a 10km² grid, which shows squares (shown in pale blue), which contain upland areas >350m in elevation, which are likely to contain the habitat, and squares, which contain sites for, which alpine heath is a qualifying interest, which are below 350m in elevation including the Burren (purple squares). This map is shown at a scale of 1: 2,000,000.

2.3 Habitat Extent

It is not possible to quantify the extent of alpine heath habitat in Ireland, as there has been no systematic mapping of this habitat.

Habitat/Slopes

The distribution of the habitat as shown on **Figure 2** is based on the locations of ridges and summits at elevations > 350 m within the known range of the habitat. By using the DTM generated polygons for ridges and summits (**Figure 2**) with a curvature of 65º it is possible to produce a very generic estimate of the potential area of alpine heath in Ireland. This method was used on areas outside the Burren.

This figure has inherent inaccuracies in it due to the nature of the Digital Terrain Modelling Criteria. By using a curvature of 65º above elevations of 350m, polygons are created which are unlikely to contain alpine heath. These polygons occur, where for example there is a change in curvature (such as an outcropping area on a mountain slope or where the curvature of the land changes such as around the margins of an upland lake such as Lough Ouler in Wicklow Mountains (Site Code: 002122)). Similarly, although the larger polygons indicating the ridges and summits of the mountain tops are relatively accurate these areas are likely to contain other habitats such as exposed rock or dry and wet heath. The area of ridges and summits as defined using the DTM outside the Burren, is approximately 9,897 Ha or **98.97 km².**

Alpine heath may also occur on general slopes above 350m but these areas are likely to contain a variety of other habitats including rocky habitats, dry heath, wet heath and blanket bog. The area of slopes above 350m in elevation with a slope > 40º in areas within Ireland but outside the Burren is approximately 2,599 Ha or **25.99 km².**

Burren Alpine Heath

The area in the Burren was calculated by adding the N2000 figures for the habitat on the seven sites selected for the habitat. This amounts to **2.83 km²**

Table 4 Sites containing Alpine and Boreal Heath in the Burren

Site code	Site name	Total Area (ha)	Area of alpine and boreal heath (ha)
1926	East Burren	18672.93	1500.00
20	Black Head - Poulsallagh	7807.97	613.00
54	Moneen Mountain	6094.80	552.00
213	Inishmore Island	15767.70	71.00
2244	Ardrahan	201.55	45.00
606	Lough Fingall	579.53	28.00
242	Castletaylor	104.30	16.00
	alpine & juniper heath considered jointly		
	Total		2938.12

Therefore the maximum potential area of alpine heath in Ireland as calculated in this way using height and slope is approximately 12,496 Ha or **124.96 km²** and the N2000 areas from the Burren **2.83 km² (127.8 km²),** but is actually more likely to be less than 9897 Ha or **98.97 km².**

Note that this figure does not include potential alpine habitat in areas below 350m outside of the Burren – many of which are SACs selected with the habitat as a Qualifying Interest.

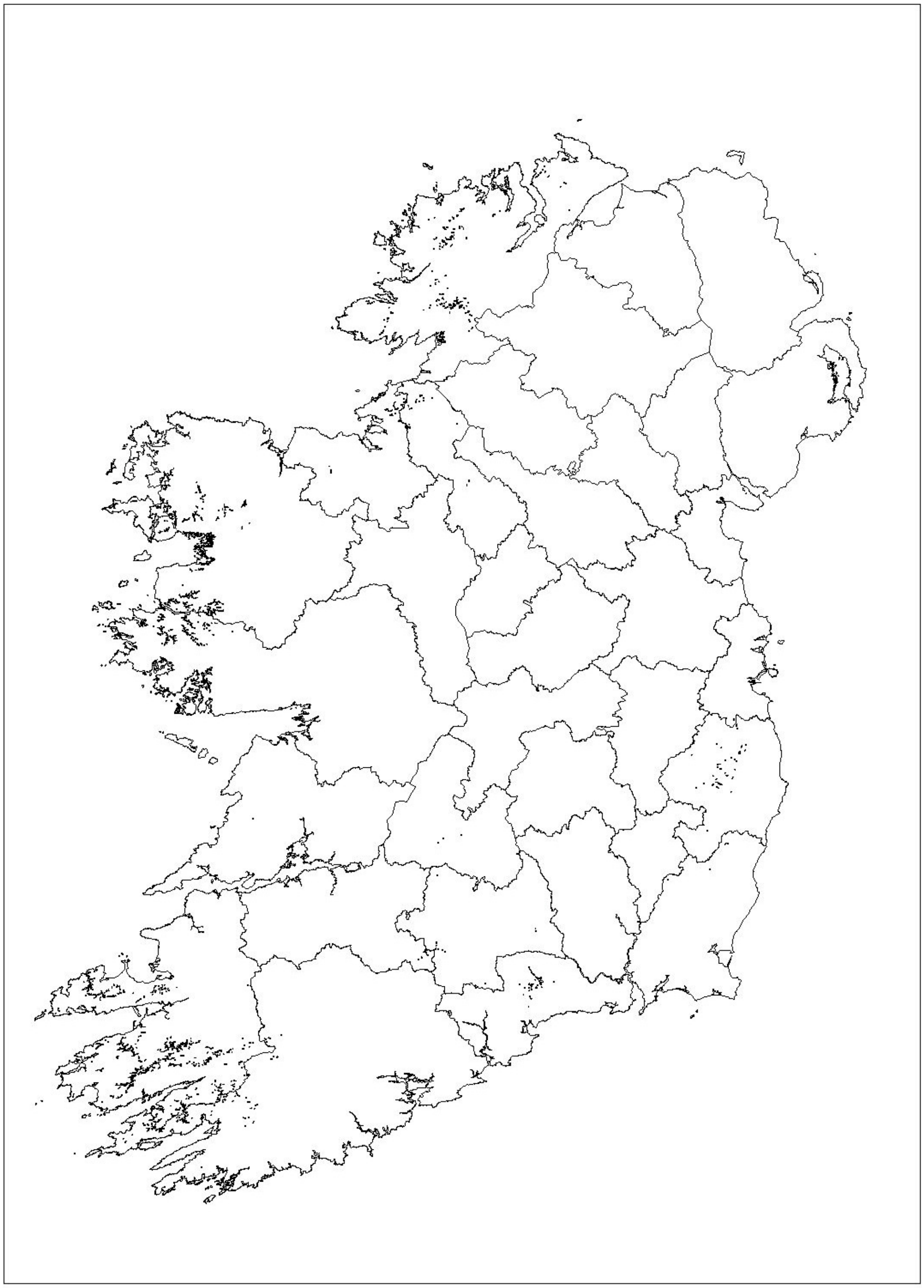


Figure 2. Map showing the likely distribution of alpine and boreal heath in Ireland based on the locations of ridges and summits at elevations >350m within the known range of the habitat. Note that many areas of ridges and summits are not visible at this scale of 1: 2,000,000.

Species

The literature review and consultations with experts on alpine heath has indicated that whilst the presence of indicative obligate arctic-alpine species within known sites is reasonably well documented for certain documented mountain ranges, this information cannot be used to better map the location of the habitat either within a site or on a previously undesignated mountain range. In the absence of a national survey, the best attempt that could be made was to utilise the rare, threatened and scarce plant data, which gives accurate point locations of obligate arctic-alpine species (**Table 3**) coupled with altitudinal information to indicate likely areas of the habitat. This exercise was carried out on areas outside the Burren.

The principal sources of recent information pertaining to the location and distribution of alpine heath habitat species, which included grid references* include:

- National Parks & Wildlife Rare, Threatened and Scarce Plant Databases,
- Rare, Threatened and Scarce Plant County Survey Reports,
- County Floras – many of the locations of indicator species were manually assigned to either a 10km² or 1km² grid based on the descriptions of locations detailed in these publications,
- National Rare and Threatened Bryophyte Surveys,
- Published papers with records of indicator species, which were assigned to either a 10km² or 1km² grid square,
- Unpublished field records of one of the principal authors of this report (Dr. Curtis) and other NPWS staff,

The data collated by the Botanical Society of the British Isles was not used for the following reasons:

- typically the mountain summits were not surveyed during the Atlas 2000,
- the data, which are presented, is available only on a 10km basis and at that scale does not indicate ‘effort ‘i.e. whether a plant was no longer recorded from a location, or that the location was not surveyed,
- the Atlas data are not fully accurate for the Irish context (many of the records were incorrectly gridded, while others were assigned to the wrong year classes. This was despite detailed corrections from NPWS, which were not corrected).

*These data sources listed provided data in a wide variety of levels of mapped accuracy, which ranged from an accuracy of:

- 1m or 10m (recent county rare or threatened plant/bryophyte surveys),
- 100m (unpublished field records),
- 1km² square grids (County flora records),
- 10km² square grids (older publications or historical records of rare or threatened plant species).

These records were thus assigned an accuracy rating (relative to the nearest metre) in the database and were then plotted in Arc View 3.2 using an appropriate visual scale. This data was used coupled with other criteria listed below to indicate the likely extent of the habitat.

The key species used to try to determine an indicative extent of alpine heath in Ireland are the ‘true alpine’ or obligate species species for the habitat listed in **Table 3.**

A map of the indicative extent/locations of alpine habitat, based on species, is presented in **Figure 3**. Note that there is overlap between these species and the true alpines of other upland habitats such as 8120, 8210, 8110 and 8220. There were 79 species records available at this accuracy level, 40 of which were single species records (shown as orange points) and 39 of which are species assemblage records (shown as green points).

To produce a map showing anything other than an indicative extent/location is rendered difficult because the available information relating to the occurrence of this habitat is based on plant species location rather than habitat extent. The areas of alpine heath habitat are often located within a mosaic of other habitats including bogs, wet heath, grassland and scree, and so it is difficult to assume a minimum area where the alpine plant species occur. In addition large areas of upland habitats in Ireland remain unsurveyed.

The accurate mapping of the extent of alpine habitat as defined in the Habitats Directive Interpretation Manual has not been possible, though an estimate using height, slope and N2000 areas has been calculated. On the one hand this is a maximum figure as not all areas > 350 m support the habitat. This may be balanced as figure does not take account of areas of the habitat below 350m outside the Burren. Further field survey work is required to ascertain the extent of the habitat.

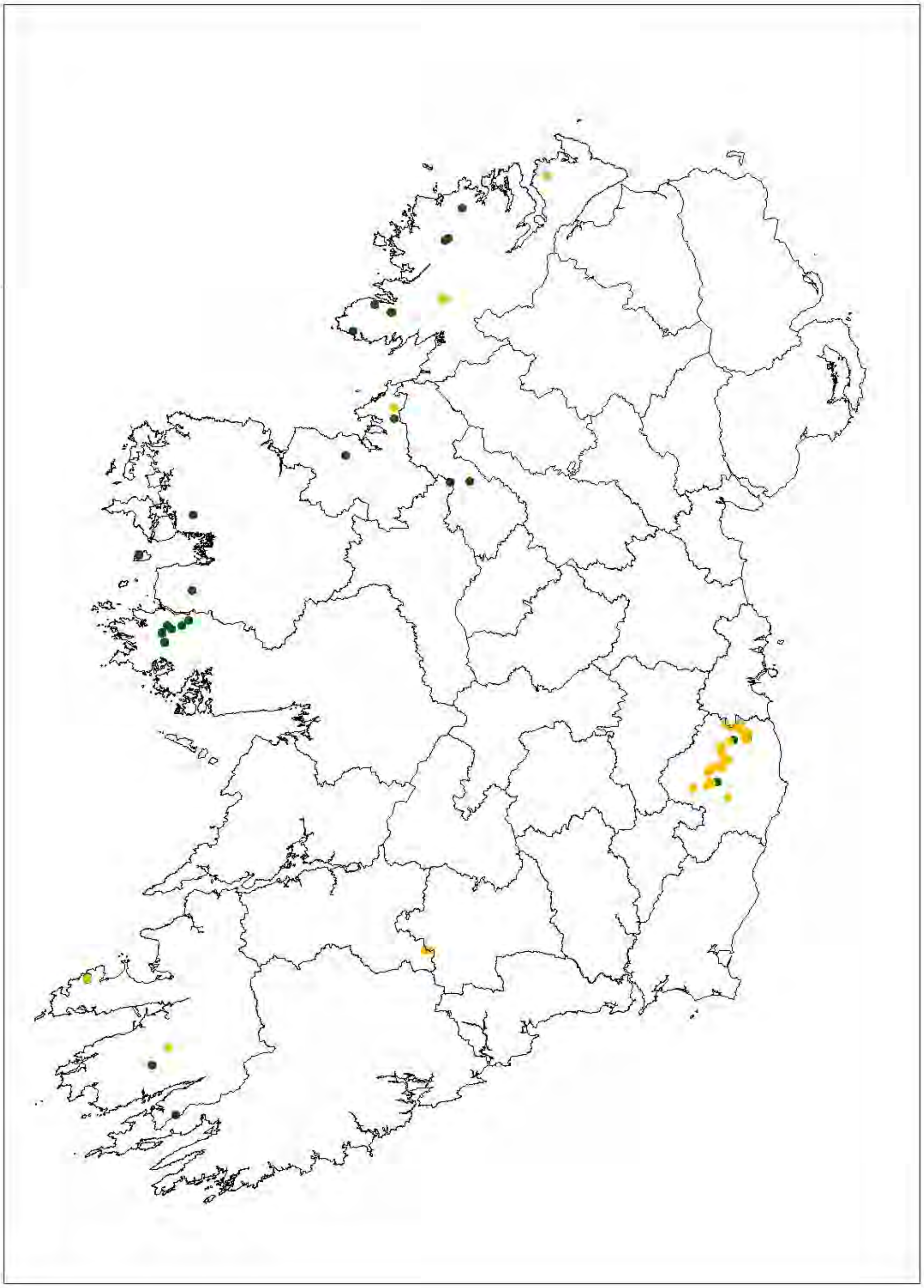


Figure 3. Map showing the indicative extent/location of alpine heath in Ireland outside the Burren based on the distribution of the six obligate alpine indicator species for the habitat (79 records). These have an accuracy of 100m and are colour coded to indicate whether they are either single obligate alpine species records (shown as orange points (40 records)), or either habitat cover or species assemblage records (shown as green points (39 records)). This map is shown at a scale of 1 : 2,000,000.

2.4 Conservation Status of Habitat Extent

According to the General Evaluation Matrix (Annex E - Explanatory notes Article 17 Habitat Directive) the assessment of the conservation status of the extent of a habitat can be carried out in two different ways. The first method consists of assessing the annual variation in the habitat extent in the reporting period (a decrease in habitat extent greater than 1% per year is deemed Unfavourable Bad). The second is based on the relation between current habitat extent and the Favourable Reference Area (FRA) (if current habitat extent is 10% below FRA the habitat extent is considered Unfavourable Bad).

As mentioned previously the current extent of the habitat is **Unknown though a best expert judgement is provided**. The significance of the land use and activities on the extent of this habitat are not clearly understood due to lack of survey data. Any over-grazing impacting activities in so remote a habitat are deemed to be less significant than similar impacts on the wet heath and blanket bogs of the uplands. However, overgrazing by sheep is known to have damaged extensive areas of upland habitats.

The Commonage Framework Plan did not isolate alpine heath, upland exposed rocky slopes or screes as a habitat type within the survey and it is therefore not possible to use any of the data from this survey in accurately identifying the level of grazing damage to alpine heath habitats. A gross measure of the levels of grazing damage to those sites, which contain alpine heath habitats that are located within areas of commonage indicates that approximately 70% of the land has some levels of damage. Given the high levels of damage to other habitats in these commonage areas the impact of grazing is likely to have negatively impacted on the heath. Overgrazing is known to have had a deleterious effect on this habitat in certain sites such as Owenduff/Nephin Complex (534), in Connemara, Co. Galway (Site Code: 002031), Mount Brandon in Co. Kerry (Site Code: 000375) and parts of the Macgillicuddy's Reeks in Kerry (Site Code: 000365) (Dr Curtis pers. obs.).

The loss of the intrinsic suite of species may have led to a reduction in the area of the habitat. Tourism related activities are also deemed to be threats to the alpine habitats. It is recognised that all of these impacting activities may play a role in damaging the habitat. As it is not known whether there has been a loss in habitat area or not, but it is known that there are damaging impacts which may have impacted on the area, a ranking

Area covered by the habitat: The accurate extent of alpine heath habitat in Ireland is **Unknown. However an estimate of 128 km²** has been calculated.
Favourable Reference Area: Though the area is calculated using best expert judgement, it is nonetheless felt that, in this instance, there has been a decline in area within the reporting period (1950s to 2006) due to impacting activities. Loss of habitat equates with loss of specific species. The extent of the loss is unknown but is not considered to be > 10%. Favourable Reference Area is considered to be **Unfavourable Inadequate** as it is perceived to be > the current estimated area.

of **Unfavourable-Inadequate** scoring is given.

The conservation status of the habitat extent is deemed **UnFavourable-Inadequate** and the trend is negative due to impacting activities. Favourable Reference Area is considered to be **Unfavourable Inadequate** as it is perceived to be > the current estimated area. The period for this trend is 1950s to the present. Further survey with more accurate information before the next reporting cycle may indicate a more Favourable Assessment.

3 STRUCTURES AND FUNCTIONS

3.1 Structures and Functions of the Habitat

Satisfactory data on habitat quality and habitat change trends are lacking for this habitat in Ireland.

An increase in the intensity of impacting activities on the habitat has occurred since the 1950's in Ireland. This increase has been due mainly to the overstocking of sheep in the uplands, which resulted in slippage, erosion, loss of species and loss of habitat. Burning in the uplands was often associated with grazing. It is known that a site for alpine heath in Ireland (the Nephin Beg Mountains, which are located within Owenduff/Nephin Complex SAC (Site Code: 000534) are so damaged by overgrazing that the areas of alpine heath on the mountain summits have been lost (Dr Curtis, pers. comm.).

Other land use practices are known to have impacted on this habitat. These include trampling/erosion (such as on Lugnaquilla Mountain (within Wicklow Mountains SAC (Site Code: 002122) (pers. obs.) and the erection of developments such as wind farms (proposed for Corraun Plateau (Site Code: 000485)) or communication masts in the uplands (such as radio communication masts on Kippure Mountain (within Wicklow Mountains SAC (Site Code: 002122) and Keeper Hill (Site Code: 001197) (NHA Site Files)). These activities will have resulted in some decline in the habitat but it is not possible to quantify this. Thus, although the actual trend cannot be quantified it is considered to be negative based on expert opinion. This increase in impacting activities indicates that the decrease in the extent of alpine heath has been coupled by a decline in the structures and functions of the habitat.

Where this habitat occurs in the Burren, it may well form climax vegetation where it is highly exposed, e.g. the upper altitudinal levels of Black Head (Parr pers. comm.). These areas are less vulnerable to change and will retain their structure and function longer due to inaccessibility. However, in other areas where it occurs at lower altitudes, there are threats from scrub encroachment, particularly by *Corylus avellana* and possibly also by *Pteridium aquilinum* where grazing pressure has been relaxed in recent decades. Fertilisation and land reclamation are also threats as in Lough Fingall (000606).

3.1.1 Conservation Status of Structures and Functions of the Habitat

The variation in the conservation status of the structure and functions of alpine heath habitat cannot be quantified though the trend is negative due to the pressures described above. Overgrazing has altered the quality of the habitat in many sites but particularly in those just mentioned. The leisure activities detailed above may have altered the quality of the habitat in localised areas (notably on sites, which are popular hill walking and mountaineering areas such as The Twelve Bens (002031) and Macgillicuddy's Reeks in Co. Kerry (000365) and that of the Wicklow Mountains (002122) very close to a large urban centre.

However according to NPWS, given that the habitat structure is intact in some of the more remote areas and given that damage by grazing is not deemed to be as severe on alpine habitats as it is on blanket bog and wet heath, an assessment **of Unfavourable Inadequate** is appropriate.

3.2 Typical Species

Alpine heath is characterised by some species, which are truly alpine in nature and occur in this habitat due to their altitudinal requirements (Obligate alpine species). It also contains a number of other species, which may also be found in other associated habitats (these are termed Facultative species) and at lower elevations. An important element of this habitat particular to the western counties is the Atlantic Hepatic Mat Community which consists of a rich flora of mosses, liverworts, hornworts and lichens. These have already been listed in **Table 3**.

3.2.1 Conservation Status of Habitat Typical Species

An accurate assessment of the conditions of typical habitat species cannot be carried out in the absence of a specific field monitoring program. However, the assessment of the condition of the structures and functions of the habitat based on impacting activities and the influence of these activities on the typical species of the habitats will let us ascertain the conservation status of the latter. Furthermore, a decline in the habitat's structure and functions as mentioned previously, already indicates a decline in the species typical of the habitat. The conservation status of habitat structures and functions is regarded as **Unfavourable Inadequate** for this habitat. As habitat quality and typical species are so interdependent, it can be suggested that an **Unknown** status would be appropriate but an **Unfavourable Inadequate** conservation status can also be inferred for Typical Species.

4 IMPACTS AND THREATS

The main damages influencing the alpine heath habitat in Ireland based on best expert opinion are as follows:

- 141 abandonment of pastoral systems – in the Burren
- 142 Overgrazing by sheep
- 180 Burning
- 500 Communications networks
- 501 Paths, tracks or cycling paths
- 510 Energy transport
- 513 Other forms – wind generated energy
- 530 Improved access to the site
- 610 Outdoor sports and leisure activities
- 622 Walking, horse riding and non-motorised vehicles
- 623 Motorised vehicles
- 624 Mountaineering, rock climbing, speleology
- 700 Pollution
- 702 Air pollution – acidification – from acid rain
- 720 Trampling, overuse

Table 4. Damaging activities affecting alpine heath, main ecological effects and future trends.

Damage type (EU Code)	Main ecological effects	Likely future trends of damage
Abandonment of pastoral systems (mainly applies to the Burren) (141)	Scrub encroachment Bracken encroachment Competitive grasses out-competing *Dryas octopetala*	The Burren LIFE project currently running will help educate landowners about the needs of conservation worthy habitats under their care.
Overgrazing (142)	Where very severe, complete erosion of alpine heath and underlying peat occurs with very poor prospects for recovery.	Intensity set to decline when destocking recommendations are implemented.
Burning (180)	Repeated burning leads to increase in bare ground and possibly replacement by graminoids and reduction/loss of hepatic mat community species.	Future incidence uncertain. Risk greatest in areas close to urban areas, e.g. Wicklow Mountains.
Quarries (301)		
Communications Networks (500, 501, 530)	Erosion of habitat. Increased access to site.	Future incidence uncertain. Continued trampling.
Wind farm development (501, 510, 513, 530)	Although much intact surface can remain, roadway and turbine base construction leads to severe hydrological damage of peatland and can also lead to increased erosion.	Intensity of development set to increase very rapidly.
Outdoor recreation (610, 622, 623, 624, 720)	Erosion of habitat and loss of species.	Future incidence uncertain. Risk greatest in popular walking areas or close to urban areas, e.g. Ben Bulben, Twelve Bens, Wicklow Mountains.
Air Pollution	Acidification.	Potential loss of ion exchange and subsequent loss of species. At a pH lower than 3 club mosses and other species are unlikely to survive.

4.1 Abandonment of Pastoral Systems

In parts of the Burren, scrub encroachment may be a problem where arctic-alpine heath occurs at lower altitudes (Parr et al. in prep.). It is difficult to separate out the specific threats on Arctic-alpine heaths as these threats are reported for the total areas of the SACs whereas Arctic-alpine heaths are usually only a small proportion of the whole area. Bracken encroachment is also a factor which is becoming apparent almost everywhere and has no particular habitat requirements apart from needing reasonable soil depth (Parr et al. in prep.). This effect is due to lack of overall grazing pressure and while it is not a pressing problem at the moment, if it not addressed with increased grazing pressure, then it may well become dominant in some places and is therefore a threat.

Abandonment of Pastoral Systems Trend

The Burren LIFE project currently running will help educate landowners about the needs of conservation worthy habitats under their care.

4.2 Overgrazing

Overgrazing by sheep is one of the damaging activities affecting this habitat and this has been observed in several locations such as The Nephin Beg Mountain Range (000534), in Co. Mayo but no quantitative data is available on this impact.

A revised and subsequently amended Rural Environment Protection Scheme (REPS) was introduced in May 1999. As a result, degraded commonage areas were assessed and managed according to a specific management tool – "The Commonage Framework Plan (CFP)" surveyed and assessed the condition of most commonage areas in the Republic of Ireland. In order to facilitate the restoration of these areas the Plan recommends a destocking level for each commonage or site surveyed. Within the scheme, damage is assessed according to a 6 point scale ranging from U (undamaged) to S* (very severely damaged) and each point on this scale has an associated destocking level. In addition to mapping the extent and severity of grazing damage within commonages, the habitats occurring within these areas was also indicated but unfortunately upland alpine habitats were not specifically identified. However, approximately 70% of the lands, which contain alpine heath which are located within commonage areas have some levels of damage.

Overgrazing Trend

Stocking rates of livestock in Ireland in general are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (FAPRI-Ireland Partnership 2003). However, this could potentially result in sites being abandoned, which may, in the case of some areas of alpine heath, lead to habitat loss through vegetation encroachment or it may have positive impacts. The Rural Environment Protection Scheme (REPS) and National Farm Plan Scheme also aim to address a reduction in over-grazing levels. The implementation of these three schemes should reduce damage on alpine heath habitat caused by farming activities. To date the results of the implementation of measures recommended by these schemes is unknown, though monitoring as part of the commonage framework planning is on-going.

4.3 Burning

According to O'Connor (2000), periodic controlled burning is a traditional management system of upland areas in Britain and Ireland but the altitudes at which this may occur are not detailed. This burning is carried out to promote new plant growth for grazing animals. This is carried out in the summer months and is associated with areas of high sheep stock densities. In Ireland the grazing animals are principally sheep and to a lesser extent cattle.

Controlled burning of mountain areas for the management of grouse is very limited in the Republic of Ireland in comparison to Britain and Scotland and is only conducted extensively in eastern counties particularly in Co. Wicklow and to some extent in Co. Waterford and Co. Tipperary.

The data relating to Commonage Framework Plans also indicates damage from burning.

Burning Trend

O'Connor (2000) deemed burning as a stable - increasing threat to blanket bog and associated habitats and this may possibly be true for alpine heath also.

4.4 Outdoor Recreation

Trackway erosion of upland habitats such as alpine heath, wet heath, dry heath, screes and rocky slopes, caused by tourist use of popular walking routes has been highlighted as a problem in Ireland since the beginning of the 1990s. Problems with erosion of upland habitats are for example associated with The Wicklow Way (002122) walking route and along popular routes in the Connemara National Park but the impact of these routes on areas of alpine heath specifically is unknown. Tracks are clearly visible in some areas where alpine heath occurs such as on The Twelve Bens (002031). The increase in popularity of hill walking in Ireland in recent years is likely to result in more pressure on sensitive upland habitats. The ease and speed of access to the most remote areas of our mountain ranges has increased with the arrival of ATVs and scrambler bikes.

Outdoor Recreation Trend

Trackway erosion is considered an increasing threat to alpine habitats. There is a similar increase in the threat as a result of increased ownership of ATV's and Four Wheel Drive vehicles and accessibility to upland areas. Hill walking continues to increase as a popular recreation in Ireland and our mountains are actively promoted to visiting walkers.

4.5 Quarries

Quarries are a known historical threat to upland slopes as documented by the location of the quarry on the lower slopes of Muckish Mountain (001179), Co. Donegal and Wicklow Mountains (002122). Removal of limestone pavement for horticultural purposes, also poses a threat as alpine heath typical of the Burren may be present.

Quarrying Trend

The future trends for quarrying are unknown but if the current economic growth continues in Ireland, there may be increasing pressures on siliceous rocky habitat sites for material for the cement and building industries. However, planning control of quarrying has improved greatly with regard to opening of new quarries and re-opening of old works since the introduction of regulations under Section 261 of the Planning and Development Act 2000.

4.6 Communications Networks

The presence of radio communications masts was noted within several of the sites, which are designated for alpine heath.

Communications Networks Trend

The majority of the radio communication masts were erected in these sites prior to the designation process but additional sites may be proposed in the future given the increased development of mobile phone networks, wireless broadband communications and other technologies. The future trends for these developments are unknown, but the presence of existing tracks to masts for maintenance purposes allows for increased access to previously challenging summits and trampling pressures remain for alpine heaths.

4.7 Wind Farm developments

Upland areas of the western counties are deemed as some of the greatest wind energy resource in the country. There is an overlap between sensitive upland areas (i.e. areas of alpine heath, wet heath, dry heath and blanket bog) and the areas of highest average annual wind speeds, which therefore have a high potential to produce wind energy. The sensitive alpine heath habitats are associated with high mountains especially in the west of the country. Therefore, these sensitive areas are the most likely to be targeted by wind farm developers based on economics factors (O'Connor, 2000).

There is an imminent threat to the Irish Government of penalty in the form of an Energy Tax because of failure to comply with the Kyoto Protocol (1997). An increase in funding of alternative energy projects, particularly wind energy, is considered one of the main alternatives to reduce green house effects. However, only those sites with high wind speeds (ƒ 8.5m/s) were deemed viable. As O'Connor (2000) recognised, these areas correspond with areas of uplands and mountains, mostly dominated by blanket bog and, which are likely to contain alpine heath towards the summits.

The main damage to alpine heath from the construction of wind energy farms is caused by the construction of access roads, service roads, service structures and the erection of support pylons for the power cable connection to the national grid. This damage can spread over a large area of an upland site and can cause hydrological disruption to peatlands and to alpine heath by causing the commencement of erosional processes. Other associated impacts are caused by the actual erection of the wind generators and visual impact (O'Connor, 2000).

Wind Farm developments Trend

O'Connor reported a total of 14 large scale wind farms developed in the Republic of Ireland in 2000. According to data provided by EirGrid (see **Appendix 6**) a total of 62 wind farms were connected to the national grid in September 2006. None of these are currently impacting on areas of alpine heath within designated areas but additional projects are under active consideration by planning authorities throughout the country (e.g. an EIS for a proposed wind farm on Corraun Plateau (Site Code: 000485) was reviewed during the data collation phase of this project). There has been a steady increase in the numbers of wind farms built and connected in the last five years, for instance 10 wind farms were connected to the grid within the first 9 months of 2006.

4.8 Site Inspection Form results

Regional NPWS Management is responsible for patrolling designated sites and enforcing relevant legislation (e.g. Habitats Directive 92/43 EEC or the Wildlife Act). NPWS Conservation Rangers are required to summarise information collected on the integrity of sites within their areas during the course of their duties. They are given the responsibility for reporting the information required under the Site Inspection Reporting (SIR) programme. Reporting is carried out on a three yearly cycle that began in 1998.

A single record for the period 2001 – 2003 indicated that burning (180) had impacted on c. 10,000 Ha of upland areas in the Caha Mountains (Site Code: 0000093).

5. *FUTURE PROSPECTS*

5.1 Negative Future Prospects

Alpine heath has undergone a negative impact in the last fifty years principally as a result of overgrazing and leisure activities. Whilst over-grazing is an impact which can be resolved through management agreements with landowners (see Positive Future Prospects below) other damaging activities such as abandonment, acidification, erection of masts or turbines and damage from increased recreational access to the mountains pose threats which are less easily managed.

5.2 Positive Future Prospects

Single Farm Payment (SFP)

As already noted, stocking rates of livestock in Ireland in general are predicted to decrease in the future due to the decoupling of livestock stocking rates from EU subsidies and the introduction of a Single Farm Payment (SFP) (FAPRI-Ireland Partnership 2003). As long as the market value of hill sheep remains low, there is little incentive for farmers to maintain large flocks in the uplands.

Payment under the SFP requires the farmer to keep lands in "Good Agricultural and Environmental Condition"

The Rural Environment Protection Scheme (REPS)

REPS is an EU funded scheme for environmentally sensitive farming, introduced in 1994, which includes incentives to reduce stocking densities within proposed NHAs, SACs and on those land designated as degraded (overgrazed) by the Department of Agriculture, Food and Forestry.

The positive impact of this scheme for siliceous rocky habitat conservation is dependent on several factors such as the uptake of REPS by farmers with large flock numbers in overgrazed areas. A reduction on the stocking density as a result of the implementation of the Commonage Framework Plan recommendations should reduce the impact associated with sheep grazing on areas of rocky habitat.

National Farm Plan Scheme (NFPS)

The NPWS launched a new 5 year National Farm Plan Scheme (NFPS) in February 2006 for landowners who are not in REPS but with designated areas (SACs, SPAs) and commonage. This follows on from the requirements of the EU Natural Regulations and the Wildlife (Amendment) Act, 2000. The scheme allows the Department to pay farmers and landowners for losses incurred through restrictions caused by the designation of lands as a SAC or a SPA or to pay for certain actions, which are of benefit to nature and are agreed in a Farm Plan.

In the particular case of upland habitats, the NFPS provides the following recommendations:

- Stocking density rates must be set down by a planner.
- The location of feeding points to reduce heavy grazing, trampling, poaching and erosion problems should be regulated.
- The use of fertilisers and herbicides and water pollution should be also regulated.

The NFPS prohibits the following practises including: in-filling or rock removal; creation of new tracks or paths. The implementation of the Plan should reduce damage to alpine heath caused by farming activities, particularly overgrazing. Its success obviously depends on the farmers' participation.

Burren LIFE Project

The Burren LIFE project currently running, will help to educate landowners about the needs of conservation-worthy habitats under their care. Careful scrub removal and long-term monitoring on farms within the SACs will help establish where these rare communities are and encourage appropriate management methods.

5.3 Overall Habitat Future Prospects

Several schemes (e.g. SFP, REPS, NFPS) address the recovery of large areas of degraded habitat. A national survey of upland habitats to accurately survey and classify upland habitats such as alpine heath is required. This will provide information to determine the requirements for the conservation of the habitat.

However, a series of impacting activities (i.e. overgrazing, trampling, mountaineering and recreational activities) continue to threaten the habitat both in designated and undesignated sites. In the absence of a field survey, the threats to the habitat are not accurately quantified but it is deemed that the habitat is still moderately threatened and slowly declining. While future prospects are encouraging, the long-term viability is not assured, and thus it is assessed as likely to be **Unfavourable Inadequate.**

6 OVERALL ASSESSMENT OF HABITAT CONSERVATION STATUS

The habitat conservation status of the four main attributes has been assessed as follows:

- The **Favourable Reference Range** (FRR) is estimated to be 100% of the historical habitat range and is thus **Favourable**. The Natural Range for this habitat potentially covers **29,500** km^2 (**295** grid cells selected x 100 km^2), (see **Figure 1**).
- The **Extent** of alpine heath habitat has decreased, though exact figures for the decline are not available. The extent of the habitat is deemed Unknown though NPWS have estimated an area of **128** km^2. The trend is negative due to overgrazing and increasing leisure activities in the uplands. Therefore the current area is considered to be less than the Favourable Reference Area. **This results in Unfavourable – Inadequate.**
- An Unknown - but likely to be **Unfavourable Inadequate (U1)** assessment is given to the habitat **Structures and Functions** based on the increase in impacting activities and expert opinion.
- The habitat's **Future Prospects** are overall deemed to be Unknown - but likely to be **Unfavourable Inadequate (U1)** - due to pressure from impacting activities (e.g. trampling, leisure activities and overgrazing).

Thus, considering the assessment for the four main attributes for this habitat the overall **Conservation Status** for alpine heath is Unknown - but likely to be **Unfavourable Inadequate (U1).**

7 Appendices

8 APPENDIX 1. PUBLISHED SOURCES OF DATA ON ALPINE HEATH HABITAT (this information is now contained in the form at the front of this document).

9 APPENDIX 2. UNPUBLISHED SOURCES OF DATA ON ALPINE HEATH HABITAT

Unpublished sources of data on alpine heath habitat in Ireland.

Name of Author	Information Source	Report
Bleasdale, A., Conaghan, J., Ni Ghrainne, E. and L. Van Doorslaer. (1994).	002008 NHA Site Card (site visit 06/04/94 - 19/04/94).	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. (1998).	A survey of rare plant species in Co. Donegal. Volume A. Protected and threatened species.	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. (1998).	A survey of rare plant species in Co. Donegal. Volume B. Scarce and locally rare species.	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. and A. Bleasdale. (1994).	002031 NHA Site Card (site visit 13/01/94 - 18/02/94)	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. and J. Fuller. (2005).	A survey of rare and threatened vascular plants in County Leitrim.	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. and J. Fuller. (2005).	A survey of rare and threatened vascular plants in County Longford.	Unpublished report, National Parks and Wildlif Service.
Conaghan, J. and J. Fuller. (2005).	A survey of rare and threatened vascular plants in County Sligo.	Unpublished report, National Parks and Wildlif Service.
Curtis T. G. F. and A. Bleasdale. (1994).	Field visit to Maumtrasna (Site Code: 000735).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Carrauntoohill Mountain (Site Code: 000365).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Cloghoge (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Djouce Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Maulin Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Moanbane (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Tonduff Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from site visit to Knockpasheenmore, Twelve Bens (Site Code: 002031).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Tonelegee Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Gravale Mountain (Site Code: 002122).	Unpublished field records.

Name of Author	Information Source	Report
Curtis, T. G. F. (1973).	Field notes from visit to Carrigvore Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1973).	Field notes from visit to Mullaghcleevaun Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1974).	Field notes from visit to Arts Lough (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1974).	Field notes from visit to Baravore Glen (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1974).	Field notes from visit to Mullacor (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1974).	Field notes from visit to Muckanaght, Twelve Bens (Site Code: 002031).	Unpublished field records.
Curtis, T. G. F. (1974).	Field notes from visit to Doughruagh (Site Code: 002031).	Unpublished field records.
Curtis, T. G. F. (1975).	Field notes from visit to Slieve Anierin (Site Code: 000584).	Unpublished field records.
Curtis, T. G. F. (1975).	Field notes from visit to Staghall Mountain & Lough Naweeloge (Site Code: 002047).	Unpublished field records.
Curtis, T. G. F. (1975).	Field notes from visit to Djouce Mountain (Site Code: 002122).	Unpublished field records.
Curtis, T. G. F. (1976).	Field notes from visit to Ox Mountains (Site Code: 001669).	Unpublished field records.
Curtis, T. G. F. (1979).	Field notes from visit to Aranmore Island (Site Code: 000111).	Unpublished field records.
Curtis, T. G. F. (1979).	Field notes from visit to cliffs west of Ballaghbeama Gap (Site Code: 000365).	Unpublished field records.
Curtis, T. G. F. (1979).	Field notes from visit to Erris Head (Site Code: 001501).	Unpublished field records.
Curtis, T. G. F. (1980).	Field notes from visit to Achill Island (Site Code: 001513).	Unpublished field records.
Curtis, T. G. F. (1987).	Field notes from site visit to Connemara/Twelve Bens (Site Code: 002031) on 23/06/87.	Unpublished field records.
Curtis, T. G. F. (1989).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. (1990).	Field notes from site visit to Maumturks (Site Code: 002008).	Unpublished field records.
Curtis, T. G. F. (1990).	Field notes from site visit to Connemara/Twelve Bens (Site Code: 002031) on 23/05/90.	Unpublished field records.
Curtis, T. G. F. (1998).	Field notes from visit to Maum Mountain, Slieve-a-Tooey (Site Code: 000190).	Unpublished field records.
Curtis, T. G. F. and A. O' Sullivan. (1998).	Field notes from visit to Binmore (Undesignated site).	Unpublished field records.
Curtis, T. G. F. and BSBI. (1990).	Field notes from BSBI outing to Brandon Mountain (Site Code: 000375).	Unpublished field records.

Name of Author	Information Source	Report
Curtis, T. G. F. and C. O'Criodain. (1991).	Field notes from site visit to Slieve League (Site Code: 000189) (11/08/91).	Unpublished field records.
Curtis, T. G. F. and H. N. McGough. (1984).	NPWS Rare Plant Survey Database.	NPWS records.
Curtis, T. G. F. and T. Harrington. (1989).	Field notes from visit to Galtee Mountains (Site Code: 000646).	Unpublished field records.
Curtis, T. G. F. et. al. (1988).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1989).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1990).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1991).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1992).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1993).	Field notes from visit to Brandon Mountain (Site Code: 000375).	Unpublished field records.
Curtis, T. G. F. et. al. (1998).	Field notes from visit to Maghera dunes (Site Code: 000190).	Unpublished field records.
Curtis, T. G. F. et. al. (1998).	Field notes from visit to Lough Duff (Site Code: 000375).	Unpublished field records.
Douglas, C., Dunnells, D., Scally, L. and M. B. Wyse Jackson. (1990).	A survey to locate lowland-highland blanket bogs of scientific interest in counties Donegal, Cavan, Leitrim and Roscommon.	Unpublished report, National Parks and Wildlif Service.
Dromey, M. and M. Hackett. (1995).	000584 NHA Site Card (site visit throughout October 1995).	Unpublished report, National Parks and Wildlif Service.
Duff, K., Fox, H. and S. Mullinger. (1993).	000728 NHA Site Card (site visit August 1993, March, April, May 1994).	Unpublished report, National Parks and Wildlif Service.
Duff, N. and J. Wann. (1999).	002243 NHA Site Card (site visit 07 and 08/10/99).	Unpublished report, National Parks and Wildlif Service.
Dunnells, D., Leach, H., Heardman, C., Rule, M., Gilbert, R. and M. Loftus. (1993).	000190 NHA Site Card (site visits 22 - 23/06/94, 13/10/93, 07/02/94 - 09/02/94, 11/02/94, 14/02/94).	Unpublished report, National Parks and Wildlif Service.
Eakin, M., Duggan, D. and R. Millar. (1995).	002047 NHA Site Card (site visit 07/11/95 - 14/12/95).	Unpublished report, National Parks and Wildlif Service.
Fitzgerald, R. (1991).	Slieve League (Site Code: 000189) Rare Plant Survey Site Card (Site Visit 11/08/91).	Unpublished field records.

Name of Author	Information Source	Report
Goodwillie, R., Fossitt, J., Ryan, T., Breen, S., Saich, C. and C. Nolan. (1994).	000646 NHA Site Card (site visit 20/09/95 - 02/11/95)	Unpublished report, National Parks and Wildlif Service.
Hackett, M. (1993).	000002 NHA Site Card (site visit 08 - 09/06/93).	Unpublished report, National Parks and Wildlif Service.
Hakelier, N. (1972).	Rare and Threatened Bryophyte Survey.	Unpublished report, National Parks and Wildlif Service.
Heardman, C., Leach, H. and M. Rule. (1994).	000111 NHA Site Card (Site Visit 22/04/94).	Unpublished report, National Parks and Wildlif Service.
Hodd, T. (1994).	Site Code: 002185 BSBI Atlas field card (site visit June 1994).	Unpublished field records.
Hodd, T. (1997).	BSBI Atlas field card (visit August 1997).	Unpublished field records.
Hodgetts, N. (2001).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Hodgetts, N. (2003).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Hodgetts, N. (2005).	Rare and threatened bryophyte survey in Counties Limerick & Tipperary.	Unpublished report, National Parks and Wildlif Service.
Holyoak, D. (2000).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Holyoak, D. (2001).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Holyoak, D. (2002).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Holyoak, D. (2003).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Holyoak, D. (2004).	Rare and threatened bryophyte survey.	Unpublished report, National Parks and Wildlif Service.
Hunt, C. and E. Lawrie. (1994).	000453 NHA Site Card (site visit 21, 22/03/94, 29, and 30/03/94).	Unpublished report, National Parks and Wildlif Service.
Hunt, J. and S. Hassett. (1995).	000330 NHA Site Card (site visit 25 and 26/09/95).	Unpublished report, National Parks and Wildlif Service.
Lawrie, E. and H. Fox. (1993).	000732 NHA Site Card (site visit 14/10/93 - 25/10/93).	Unpublished report, National Parks and Wildlif Service.

Name of Author	Information Source	Report
Leach H. and C. Heardman. (1994).	001179 NHA Site Card (site visits 29/03/94, 29/03/94, 06/04/94).	Unpublished report, National Parks and Wildlif Service.
Leach, H. (1993).	000189 NHA Site Card (site visit 16/12/93, 20/12/93, 06/01/94).	Unpublished report, National Parks and Wildlif Service.
Leach, H. and C. Heardman. (1994).	000194 NHA Site Card (visit 03/03/94 - 07/03/94).	Unpublished report, National Parks and Wildlif Service.
Leach, H., Heardman, C., Gilbert, R. and M. Rule. (1994).	001141 NHA Site Card (site visits 14/03/94 - 18/03/94, 21/03/04 - 24/03/94).	Unpublished report, National Parks and Wildlif Service.
McKee, A-M. (1999).	A survey of the rare and protected flora of County Mayo.	Unpublished report, National Parks and Wildlif Service.
Mooney, E. (1991).	Mountain blanket bog survey.	Unpublished report, National Parks and Wildlif Service.
Mooney, E., Goodwillie, R. and C. Douglas. (1991).	Survey of mountain blanket bogs of scientific interest.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	002122 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	002185 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	002047 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	002031 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	002008 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	001955 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	001932 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	001501 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	001179 explanatory notes.	Unpublished report, National Parks and Wildlif Service.

Name of Author	Information Source	Report
NATURA 2000. (1999).	000732 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000728 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000646 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000534 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000500 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000485 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000375 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000330 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000194 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000190 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000189 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000111 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (1999).	000093 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (2000).	001513 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (2001).	001197 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
NATURA 2000. (2003).	000365 explanatory notes.	Unpublished report, National Parks and Wildlif Service.

Name of Author	Information Source	Report
Nolan, C. and T. Ryan. (1995).	001952 NHA Site Card (site visits 26/09/95, 28/09/95, 29/0/05, 02/10/95, 04 - 06/10/95).	Unpublished report, National Parks and Wildlif Service.
Nolan, C., O'Donnell, D., Brennan, S. and L. Kelly. (1995).	000093 NHA Site Card (site visit 11/10/95, 13/10/95, 18 - 19/10/95, 25 - 26/10/95, 31/10/95, 01/11/95, 15 - 16/12/97, 18 - 22/12/97, 31/12/97, 10/01/98, 12/01/98).	Unpublished report, National Parks and Wildlif Service.
O' Sullivan, A. (1993).	001278 NHA Site Card (site visit 07/10/93).	Unpublished report, National Parks and Wildlif Service.
O' Sullivan, A., Lowrie, E., Van Doorslaer, L. and S. Mullinger. (1993).	001513 NHA Site Card (site visits 07/05/93, 27/05/93, 25/10/93).	Unpublished report, National Parks and Wildlif Service.
O'Sullivan, A., Strong, D., Lowrie, E., Keane, S. and M. Loftus. (1993).	000485 NHA Site Card (site visits 28 - 30/04/93, 25 - 27/08/93, 19/05/93, 06/10/93, 26 and 27/10/95).	Unpublished report, National Parks and Wildlif Service.
O'Sullivan, A., Van Doorslaer, L., Lowrie, E. and D. Strong. (1993).	000534 NHA Site Card (visits 09 - 11/08/93).	Unpublished report, National Parks and Wildlif Service.
Rare and threatened plant database. (2007).	National Parks and Wildlife Service.	Unpublished report, National Parks and Wildlif Service.
Roden, C., Fuller, J. and J. Conaghan. (2006).	A survey of rare and threatened vascular plants in Counties Clare, Galway and Limerick.	Unpublished report, National Parks and Wildlif Service.
Ryan, C., Flexen, M., Foley, P., O'Sullivan, M., Loftus, M., Heardman, C., Keane, S., O'Connell, P. and D. Scannell. (1995).	000365 NHA Site Card (site visits 13/11/95 - 15/12/95 and 21/02/96 - 15/03/96.	Unpublished report, National Parks and Wildlif Service.
Ryan, C., Foley, P., Flexen, M. and T. O'Donoghue. (1995).	000375 NHA Site Card (site visits 16 - 19/10/5, 25 and 27/10/95, 02/11/95).	Unpublished report, National Parks and Wildlif Service.
Stewart, N. (1993).	Bryophyte Report.	Unpublished report to NPWS.
Stewart, N. F. and C. Roden. (1991).	Slieve League (Site Code: 000189) BSBI Atlas field card (Site Visit 11/08/91).	Unpublished field records.
Van Doorslaer, L. and S. Mullinger. (1993).	001955 explanatory notes.	Unpublished report, National Parks and Wildlif Service.
Van Doorslaer, L. and S. Mullinger. (1993).	001932 NHA Site Card (site visit 19 - 21/05/93 and 25/05/93).	Unpublished report, National Parks and Wildlif Service.
Van Doorslaer, L. and S. Mullinger. (1993).	000477 NHA Site Card (site visit 11/11/93).	Unpublished report, National Parks and Wildlif Service.
Van Doorslaer, L., Mullinger, S., O'Sullivan, A. and E. Lawrie. (1993).	000500 NHA Site Card (visits 22/06/93, 17 - 20/08/93, 30 and 31/08/93, 20 and 21/09/93).	Unpublished report, National Parks and Wildlif Service.

Name of Author	Information Source	Report
Winder, F. G. A. (1997).	Personal communication to Dr. Tom Curtis	Unpublished field records.
Wyse Jackson, M. (1980).	BSBI Atlas field card (visit 01/09/80), (Site Code: 002185).	Unpublished field records.
Wyse Jackson, M. (1984).	BSBI Atlas field card (visit September 1984), (Site Code: 002185).	Unpublished field records.
Wyse Jackson, M. (1993).	BSBI Atlas field card (site visit 12/07/93), (Site Code: 002185).	Unpublished field records.
Wyse Jackson, M., Foley, P., Lockhart, N., Heardman, C., O'Connor, M. and T. O'Donoghue. (1997).	002185 NHA Site Card (visits 08/07/97, 20/03/98 - 16/06/98, 02/12/98 - 05/03/99).	Unpublished report, National Parks and Wildlif Service.

10 APPENDIX 3. ALPINE HEATH HABITAT DISTRIBUTION MAPPING

There has been no recent inventory or mapping of the national alpine heath habitat resource in Ireland. For the purposes of this survey an extensive literature review of both published and unpublished material was undertaken and records documenting the occurrence of the indicator species of the habitat as listed in **Table 3** in the main body of the report were collated in a *MS Access* **Upland Habitats Database**. This database contains records of the obligate and facultative alpine species of the five Annex I upland habitats (4060, 8110, 8120, 8210, 8220) in Ireland and was designed specifically for the purposes of this report.

The database contains information on the following:

- Species Name
- Designated Site Code (NATURA 2000 sites or Natural Heritage Areas)
- Description of the location of the species
- Altitudinal information (either in feet (') or metres (m) depending on the antiquity of the record)
- Grid Reference (if provided) – these were assigned an accuracy rating
- Source of data (published or unpublished reference)
- Date of record
- List of associated species (if present)
- Indication of whether the description indicated a single species record, an assemblage of species or a description of habitat cover*
- Any information on substrate or underlying geology

* Given the variability of data sources, records of indicator species have been described as either an assemblage of species, a single species location or as an indication of habitat cover, depending on the quality and source of the data. For example a historical record by Corry (1884), which only contained details of a particular species at a certain altitude on Ben Whisken (Site Code: 000623) was entered as a single plant species location, whereas a description of several arctic-alpine species on a cliff above a corrie lake on Mount Brandon (Site Code: 000375) by Stelfox (1951) was entered as a species assemblage. Where there was a good description of an area of alpine heath (such as that given by Conaghan *et. al.* (1994) in the NHA Site Card for the Twelve Bens (Site Code: 002031)) this was entered as habitat cover.

Data for all of the above fields in the database was not necessarily contained in the original publication/source for each record and based on the description of the locations given an appropriate Site Code was assigned to each record using the Discovery and 62" Mapping on Arc View 3.2.

The **Upland Habitats Database** currently holds c.4,500 records of obligate and facultative alpine species of all Annex I upland habitats (i.e. 4060, 8110, 8120, 8210 and 8220) which have been gleaned from a variety of sources (both published and unpublished as documented in **Appendices 1** and **2** respectively). Given the antiquity of the bulk of the data (c.1700 of the records date from the 1800s to the 1950s) and the lack of accurate geographical references (only c.1500 records have grid references of varying accuracy (see below for further information) the GIS application of much of the collated data is limited. Full reference should be made to the **Upland Habitats Database** for lists of records for sites and locations/descriptions of indicative alpine species for habitats as the bulk of records will not be illustrated in **Figures 1 to 3** due to their lack of grid references. When reviewing these records of species one needs to be cognisant of the fact that very few of them are uniquely indicative to a particular habitat (e.g. *Polygonum viviparum* (a true alpine species) is found in four of the Annex I upland habitats (8110, 8120, 8210 and 8220)) so records of this species cannot be used to indicate the presence of any single habitat. These species have been identified as being characteristic in the absence of a dedicated field survey of these habitats. On completion of such a survey phytosociological classification and analysis may provide clearer definitions for these habitats in an Irish context.

Several new potential locations for siliceous rocky habitat in addition to those known designated sites for, which siliceous rocky habitat is a qualifying interest (see **below**) were identified in this manner following the literature review. Some of these sites were already designated as SACs but siliceous rocky habitat was not listed as a qualifying interest, others were existing NHAs and others were undesignated sites.

Table. Designated sites for, which alpine heath is a qualifying interest.

Site Code:	Site Name:	Designation:
000020	BLACK HEAD- POULSALLAGH	SAC/NHA
000054	MONEEN MOUNTAIN	SAC/NHA
000093	CAHA MOUNTAINS	SAC/NHA
000111	ARAN ISLAND (DONEGAL) CLIFFS	SAC/NHA
000189	SLIEVE LEAGUE	SAC/NHA
000190	SLIEVE TOOEY/TORMORE ISLAND/LOUGHROS BEG BAY	SAC/NHA
000194	TRANAROSSAN AND MELMORE LOUGH	SAC/NHA
000197	WEST OF ARDARA/MAAS ROAD	SAC/NHA
000213	INISHMORE ISLAND	SAC/NHA
000242	CASTLETAYLOR	SAC/NHA
000330	TULLY MOUNTAIN	SAC/NHA
000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT	SAC/NHA
000375	MOUNT BRANDON	SAC/NHA
000453	CARLINGFORD MOUNTAIN	SAC/NHA
000485	CORRAUN PLATEAU	SAC/NHA
000534	OWENDUFF/NEPHIN COMPLEX	SAC/NHA
000606	LOUGH FINGALL	SAC/NHA
000623	BEN BULBEN, GLENIFF AND GLENADE COMPLEX	SAC/NHA
000646	GALTEE MOUNTAINS	SAC/NHA
001141	GWEEDORE BAY AND ISLANDS	SAC/NHA
001179	MUCKISH MOUNTAIN	SAC/NHA
001501	ERRIS HEAD	SAC/NHA
001513	KEEL MACHAIR/MENAUN CLIFFS	SAC/NHA
001926	EAST BURREN COMPLEX	SAC/NHA
001932	MWEELREA/SHEEFFRY/ERRIFF COMPLEX	SAC/NHA
001952	COMERAGH MOUNTAINS	SAC/NHA
001955	CROAGHAUN/SLIEVEMORE	SAC/NHA
002008	MAUMTURK MOUNTAINS	SAC/NHA
002031	THE TWELVE BENS/GARRAUN COMPLEX	SAC/NHA
002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK	SAC/NHA
002122	WICKLOW MOUNTAINS	SAC/NHA
002185	SLIEVE MISH MOUNTAINS	SAC/NHA
002244	ARDRAHAN GRASSLAND	SAC/NHA

Table. Additional sites identified during the literature review, which are likely to contain alpine heath based on the presence of indicator species and elevation. (Previously undesignated sites were assigned a site code with a leading number of 6 for the purposes of data management and entry).

Site Code:	Site Name:	Designation:
000412	Slieve Bloom Mountains	SAC/NHA
000483	Croaghpatrick	NHA
000633	Lough Hoe Bog	NHA
000770	Mt Leinster/Blackstairs	SAC/NHA
000934	Kilduff, Devils Bit Mountain	SAC/NHA
001873	Derryclogher (Knockboy) Bog	SAC/NHA
001880	Meenaguse Scragh	SAC/NHA
001886	Ballagh Bog	NHA
001890	Mullaghanish Bog	SAC/NHA
002032	Boleybrack Mountain	SAC/NHA
002036	Ballyhoura Mountains	SAC/NHA
002312	Slieve Bernagh Bog	SAC
002386	Conigar Bog NHA	NHA
002388	Slievenamon Bog NHA	NHA
002435	Crockauns/Keelogyboy Bogs NHA	NHA
006001	Curlew Mountains	Undesignated
006002	Raghtin More Mountain	Undesignated
006003	Knockmealdown Mountains	Undesignated
006004	Nephin Mountain	Undesignated
006005	Birreenacorragh Mountain, Nephin range	Undesignated
006006	Buckoogh Mountain, Nephin Range	Undesignated
006008	Brandon Hill, Co. Kilkenny	Undesignated
006009	Common Mountain, Ardara, Co. Donegal	Undesignated
006010	Foilclogh, SE Cahersiveen, Co. Kerry	Undesignated
006011	Pass of Keimaneigh, Sheehy Mountains	Undesignated
006012	Aghla Mountain, south of Lough Finn, Co. Donegal	Undesignated
006013	Banagher Mountain, west of Lough Esk	Undesignated
006015	Bluestack Mountains (Lavagh More)	Undesignated

GIS data sources, which are related to ecological factors that determine the occurrence of alpine heath, were used to produce the indicative range and distribution maps shown on **Figures 1** and **2**. These include:

- Contour lines >350m elevation. Ordnance Survey (1995) – 1:50,000 Discovery Series, 10m contour interval,
- A Digital Terrain Modelling package (2007) generated polygons, which were used to identify areas of potential alpine heath based on the following criteria:
    - elevation above 350m,
    - upland areas above 350m with a slope > 40^{o}
    - areas of ridges and summits using a curvature index of 65^{o}.

Many of these areas have already been designated as SACs/NHAs or are listed as potential NHAs – see following Table. Although the use of recent (2000) digital aerial photographs of Ireland, which were ortho - rectified, was investigated it became apparent that it was not possible to use these remotely to identify areas of alpine heath. This is because it is not possible to distinguish it accurately from wet heath, dry heath, upland grassland and blanket bog.

Table. SACs (designated) and NHAs*, which contain areas of upland habitat at elevations > 350m and potentially contain alpine heath as derived from the digital terrain model.

Site Code:	Site Name:	Designation:
000009	SLIEVE RUSHEN BOG NHA*	NHA
000093	CAHA MOUNTAINS	SAC/NHA
000120	BULBIN MOUNTAIN	NHA
000165	LOUGH NILLAN BOG (CARRICKATLIEVE)	SAC/NHA
000189	SLIEVE LEAGUE	SAC/NHA
000190	SLIEVE TOOEY/TORMORE ISLAND/LOUGHROS BEG BAY	SAC/NHA
000308	LOUGHATORICK SOUTH BOG	SAC/NHA
000330	TULLY MOUNTAIN	SAC/NHA
000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT	SAC/NHA
000375	MOUNT BRANDON	SAC/NHA
000412	SLIEVE BLOOM MOUNTAINS	SAC/NHA
000453	CARLINGFORD MOUNTAIN	SAC/NHA
000483	CROAGH PATRICK	SAC/NHA
000485	CORRAUN PLATEAU	NHA
000500	GLENAMOY BOG COMPLEX	SAC/NHA
000534	OWENDUFF/NEPHIN COMPLEX	SAC/NHA
000584	CUILCAGH - ANIERIN UPLANDS	SAC/NHA
000623	BEN BULBEN, GLENIFF AND GLENADE COMPLEX	SAC/NHA
000633	LOUGH HOE BOG	SAC/NHA
000646	GALTEE MOUNTAINS	SAC/NHA
000735	MAUMTRASNA MOUNTAIN COMPLEX	NHA
000770	BLACKSTAIRS MOUNTAINS	SAC/NHA
000934	KILDUFF, DEVILSBIT MOUNTAIN	SAC/NHA
000939	SILVERMINE MOUNTAINS	SAC/NHA
001057	GOUGANEBARRA LAKE	NHA
001059	HUNGRY HILL BOG NHA*	NHA
001069	LOUGH NAMADDRA AND LOUGH WEST	NHA
001108	CORVEEN BOG NHA*	NHA
001163	LOUGH FINN	NHA
001179	MUCKISH MOUNTAIN	SAC/NHA
001197	KEEPER HILL	SAC/NHA
001342	CLOONEE AND INCHIQUIN LOUGHS, URAGH WOOD	SAC/NHA
001369	LOUGH NAGARRIVA	NHA
001403	ARROO MOUNTAIN	SAC/NHA
001513	KEEL MACHAIR/MENAUN CLIFFS	SAC/NHA
001603	ESHBRACK BOG NHA*	NHA
001656	BRICKLIEVE MOUNTAINS & KEISHCORRAN	SAC/NHA
001669	KNOCKALONGY AND KNOCKACHREE CLIFFS	SAC/NHA
001749	BALLINACOR WOOD	NHA
001767	POWERSCOURT WATERFALL	NHA
001873	DERRYCLOGHER (KNOCKBOY) BOG	SAC/NHA
001879	GLANMORE BOG	SAC/NHA
001880	MEENAGUSE SCRAGH	SAC/NHA
001881	MAULAGOWNA BOG	SAC/NHA
001882	SILLAHERTANE BOG NHA*	NHA
001886	BALLAGH BOG	NHA
001890	MULLAGHANISH BOG	SAC/NHA
001932	MWEELREA/SHEEFFRY/ERRIFF COMPLEX	SAC/NHA
001948	DOUGHILL BOG NHA*	NHA

Site Code:	Site Name:	Designation:
001952	COMERAGH MOUNTAINS	SAC/NHA
001955	CROAGHAUN/SLIEVEMORE	SAC/NHA
002006	OX MOUNTAINS BOGS	SAC/NHA
002008	MAUMTURK MOUNTAINS	SAC/NHA
002012	NORTH INISHOWEN COAST	SAC/NHA
002031	THE TWELVE BENS/GARRAUN COMPLEX	SAC/NHA
002032	BOLEYBRACK MOUNTAIN	SAC/NHA
002034	CONNEMARA BOG COMPLEX	SAC/NHA
002036	BALLYHOURA MOUNTAINS	SAC/NHA
002037	CARRIGEENAMRONETY HILL	SAC/NHA
002046	OWENDOO AND CLOGHERVADDY BOGS	NHA
002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK	SAC/NHA
002122	WICKLOW MOUNTAINS	SAC/NHA
002124	BOLINGBROOK HILL	SAC/NHA
002173	BLACKWATER RIVER (KERRY)	SAC
002185	SLIEVE MISH MOUNTAINS	SAC
002186	GRAGEEN FEN AND BOG NHA*	NHA
002258	SILVERMINES MOUNTAINS WEST	SAC/NHA
002268	ACHILL HEAD	SAC/NHA
002301	RIVER FINN	SAC/NHA
002312	SLIEVE BERNAGH BOG	SAC/NHA
002321	CORRY MOUNTAIN BOG NHA*	NHA
002375	BARNESMORE BOG NHA*	NHA
002383	CROAGHMOYLE MOUNTAIN NHA*	NHA
002384	DOUGH/THUR MOUNTAINS NHA*	NHA
002385	MAUHERSLIEVE BOG NHA*	NHA
002386	CONIGAR BOG NHA*	NHA
002388	SLIEVENAMON BOG NHA*	NHA
002390	NEPHIN MOUNTAIN BOG	NHA
002391	INAGH BOG NHA*	NHA
002393	NEPHIN BEG BOGS	NHA
002397	SLIEVECALLAN MOUNTAIN BOG NHA*	NHA
002415	CARRANE HILL BOG NHA*	NHA
002430	AGHAVOGHIL BOG NHA*	NHA
002434	CROLLY BOG	NHA
002435	CROCKAUNS/KEELOGYBOY BOGS NHA*	NHA
002442	MAGHERA MOUNTAIN BOGS NHA*	NHA
002447	BOGGERAGH MOUNTAINS NHA*	NHA
002449	MOUNT EAGLE BOGS NHA*	NHA
002450	BLEANBEG BOG NHA*	NHA
002453	MEENMORE WEST BOG NHA*	NHA
002454	LOUGH GAY BOG NHA*	NHA

* Only those NHAs, which have NHA in the Site Name, are currently designated.

There are extensive areas of potential locations for this habitat type, which have been identified using this process for, which no field data exists. Many of these areas require urgent site survey and could form the basis of potential NHAs for the habitat. These include the upper elevations of existing designated Blanket Bog NHA sites as due to time constraints during the Blanket Bog NHA survey the mountain summits/upper elevations of these sites were typically not visited. Similarly many of the upper elevations of designated bog sites, which were surveyed during the Mountain Blanket Bog Survey, may also support alpine heath.

11 APPENDIX 4. OTHER SOURCES OF DATA

A. Commonage Framework Plans – Department of Agriculture & Food and the National Parks and Wildlife Service (NPWS).

The Department of Agriculture & Food and the NPWS have produced the Commonage Framework Plans (CFPs) and NHA/SAC/SPA stocking and damage assessments. These plans crudely describe the habitats, condition of the land use and plant species found in each sub-unit of each agricultural unit. Depending on the condition of the land, a % de-stocking is recommended and a time-frame suggested for recovery of the land.

Common ownership of large areas of unfenced heath and bog land is the principal type of land ownership in the western peatland and upland areas of Ireland. Thus, up to 80% of all land in Connemara and west Mayo is commonage (O'Connor, 2000). According to the maps produced by the CFP the overall extent of commonage land in Ireland is approximately 438,000ha. Unfortunately, it is not possible to use this dataset to determine the extent or area of siliceous rocky slopes in Ireland as this habitat was not identified in the report. In addition, the mapping of habitats was done at a crude level and the main mapping criterion was damage level and not habitat type.

The CFPs thus can only be used to provide an indication of the damage status of habitats (including siliceous rocky habitat) on commonage land, and this was crudely used to ascertain the conservation status of structure and functions of this habitat.

B. NPWS Enquiries Database

This is a comprehensive NPWS internal database, which includes data on designated sites and habitats contained within them. This database was used to confirm the sites for, which siliceous scree slope was a qualifying interest.

C. Habitat Assignment Project (NPWS, 2006)

This desktop project was undertaken by NPWS and the main aim was to identify and list the habitats listed in the Annex I of the Habitats Directive (92/43/EEC) which were reported within a series of sources. These sources included NHA site files, MPSU Plans, Natura 2000 Forms, NPWS surveys, Aerial photographs, NGO proposals, etc.

12 APPENDIX 5. COMMONAGE FRAMEWORK PLANS DATA

The CFPs mapped the extent and severity of grazing damage within agricultural sub-units. The criteria use to assess the level of damage and the resultant destocking levels is given below. In addition, the habitats occurring within these areas were also mapped. The following habitats were recognised during the Commonage Framework Plan surveys and their symbols are indicated within brackets:

(I)	Blanket bog	(II)	Wet Heath
(III)	Dry Heath (includes maritime)	(IV)	Upland grassland
(V)	Other habitats	(VI)	Improved grassland
(VII)	Dune		
(VIII)	Unimproved wet grassland		
(IX)	Unimproved dry grassland		
(X)	Fen/Marsh/Swamp		
(XI)	Saltmarsh	(XII)	Beach/Shingle/Reef/Shore
(XIII)	Limestone Pavement / Grassland	(XIV)	Limestone Pavement (>75%)
(XV)	Scrub		
(XVI)	Permanent open water (turlough)		

As can be seen there is no specific category given for alpine heath.

Criteria for the assessment of damage and the resultant destocking levels (Conaghan, 2001).

Damage category	Condition of vegetation/amount of bare soil	Suggested destocking level
Undamaged (U)	Vegetation not grazed or only very lightly grazed. No bare ground present.	0%
Moderate to undamaged (MU)	<5% bare ground. Grazing usually evident, but damage only just detectable.	30%
Moderately damaged (MM)	<5% bare ground. Signs of damage intermediate in intensity between MU and MS.	50%
Moderate to severely damaged (MS)	<5% bare ground. Damage widespread and obvious.	65%
Severely Damaged (S)	>5% bare ground. Damage due to grazing obvious and widespread.	85%
Very Severely Damaged (S*)	>10% bare ground with abundant evidence of high grazing levels.	100%

Commonage lands, which are likely to contain siliceous rocky habitat either on its own or as a mosaic with other habitats, were mapped during the CFP. A broad-brush review of this data indicates that 74% of the lands in commonage within sites, which contain siliceous rocky habitat, show some degree of damage.

1) *APPENDIX 6. DISTRIBUTION OF WIND FARMS IN RELATION TO ALPINE HEATH*

A distribution map (see **Figure 5 to follow**) of the current wind farms connected to the National Grid in the Republic of Ireland has been produced by NPWS based on the list of wind energy suppliers provided by EirGrid (http://www.eirgrid.ie). EirGrid plc is the independent electricity Transmission System Operator (TSO) in Ireland and the market operator in the wholesale electricity trading system. The list includes a total of 62 connected wind farms to September 2006 (see Table below). The table includes the name of the wind farm that mostly corresponds with the townland where the wind farm was erected.

For those projects connected before 2000, the exact location of the wind farm was confirmed on the year 2000 aerial photographs. However those projects connected after 2000 were mapped based on townland. A more accurate location of the project was not available. Although the mapping of the location of some of the wind farms is rather coarse, the townland identification and following location on the map let us ascertain the location of these projects in relation to the distribution of alpine heath. Only 56 of the 62 wind farms were mapped. Five of the un-mapped wind farms are actual extensions of those ones mapped (e.g. Meenanilta (1) was mapped but not Meenamilta (2)). Arklow Banks wind farm, which was connected after 2000, is offshore and it was not possible to gauge the location, as it does not appear on the 2000 aerial photographs.

- The mapping of the wind farms and comparison against the distribution of alpine heath and particularly alpine heath designated sites (i.e. NHAs or SACs) and 2000 aerial photographs indicated that areas of alpine heath are currently unaffected by constructed wind farms however it is known that there are proposals for wind farms in sites, which contain alpine heath such as Corraun Plateau, Co. Mayo.
- As the table below illustrates there has been a steady increase in the number of wind farms built in the last 4 years. Thus, whereas 6 were connected in 2003, there were 12 in 2004, 10 in 2005 and 10 to September 2006.

Transmission System Operator (TSO) and Distribution System Operator (DSO) connected Wind Farms in September 2006 (source EirGrid).

110kV Node	Wind Farm Name	MEC (MW)	Year of Connection
TSO Connected:			
Agannygal	Derrybrien (1)	60.0	2005
Booltiagh	Booltiagh (1)	19.5	2005
Coomagearlaghy	Coomagearlahy (1)	42.5	2006
Crane	Ballywater (1)	31.5	2005
Cunghill	Kingsmountain (1)	23.8	2003
Drumkeen	Meentycat (1)	71.0	2004
Golagh	Golagh (1)	15.0	1997
Total Installed TSO		**263.2**	
DSO Connected:			
Ardnacrusha	Curraghgraigue	2.6	2004
Ardnacrusha	Mienvee	0.7	2004
Arigna	Corrie Mountain	4.8	1997
Arigna	Kilronan (1)	5.0	1997

110kV Node	Wind Farm Name	MEC (MW)	Year of Connection
Arigna	Spion Kop (1)	1.2	1997
Arklow	Arklow Banks (1)	5.2	2003
Ballylickey	Kealkil (Curraglass)	8.5	2006
Bandon	Kilvinane (1)	4.5	2006
Bellacorick	Bellacorick (1)	6.5	1992
Binbane	Burtonport Harbour (1)	0.7	2003
Carlow	Cronelea Upper (1)	2.6	2005
Castlebar	Burren [Mayo] - Lenanevea	2.1	
Castlebar	Cuillalea West (1)	3.4	2004
Castlebar	Raheen Barr (1)	8.7	2003
Cath_Fall	Anarget (1)	2.0	2001
Cath_Fall	Anarget (2)	1.1	2004
Cath_Fall	Meenadreen (1)	3.4	2003
Corderry	Altagowlan (1)	7.6	2005
Corderry	Black Banks (1)	3.4	2001
Corderry	Black Banks (2)	6.8	2005
Corderry	Geevagh (1)	5.0	2006
Corderry	Moneenatieve (1)	4.0	2005
Crane	Kilbranish (Greenoge) (1)	5.0	2005
Dallow	Carrig (1)	2.6	2006
Dallow	Skehanagh (1)	4.3	2006
Drybridge	Dunmore (1)	1.7	
Dunmanway	Coomatallin (1)	6.0	2005
Dunmanway	Curabwee (1)	4.6	1999
Dunmanway	Lahanaght Hill (1)	4.3	2006
Dunmanway	Milane Hill (1)	5.9	2000
Galway	Inis Mean (1)	0.7	2002
Galway	Inverin (Knock South) (1)	3.3	1999
Glenlara	Taurbeg (1)	5.3	2006
Ikerrin	Ballinlough (1)	2.6	2006
Ikerrin	Ballinveny (1)	2.6	2006
Knockeragh	Gneeves (1)	9.4	2005
Letterkenny	Cark (1)	5.0	1997
Letterkenny	Cronalaght (1)	5.0	1997
Letterkenny	Culliagh (1)	1.9	2000
Letterkenny	Meenanilta (1)	2.6	2004
Letterkenny	Meenanilta (2)	2.5	2004
Meath Hill	Gartnaneane I & II	5.0	2004
Shankill	Corneen (1)	3.0	2001
Somerset	Sonnagh Old (1)	7.7	2004
Tonroe	Largan Hill (1)	5.9	2000
Tralee	Beenageeha (1)	4.0	2000
Tralee	Mount Eagle (1)	5.1	2004
Tralee	Tursillagh (1)	15.2	
Tralee	Tursillagh (2)	6.8	2004
Trien	Beale (1)	1.7	2000
Trien	Beale (2)	2.6	2003
Trillick	Crockahenny (1)	5.0	1998
Trillick	Drumlough Hill (1)	4.8	1997
Tullabrack	Moanmore (1)	2.6	2004
Wexford	Carnsore (1)	1.9	2002
Total Installed DSO		**335.4**	

TSO (Transmission System Operator); DSO (Distribution System Operator)

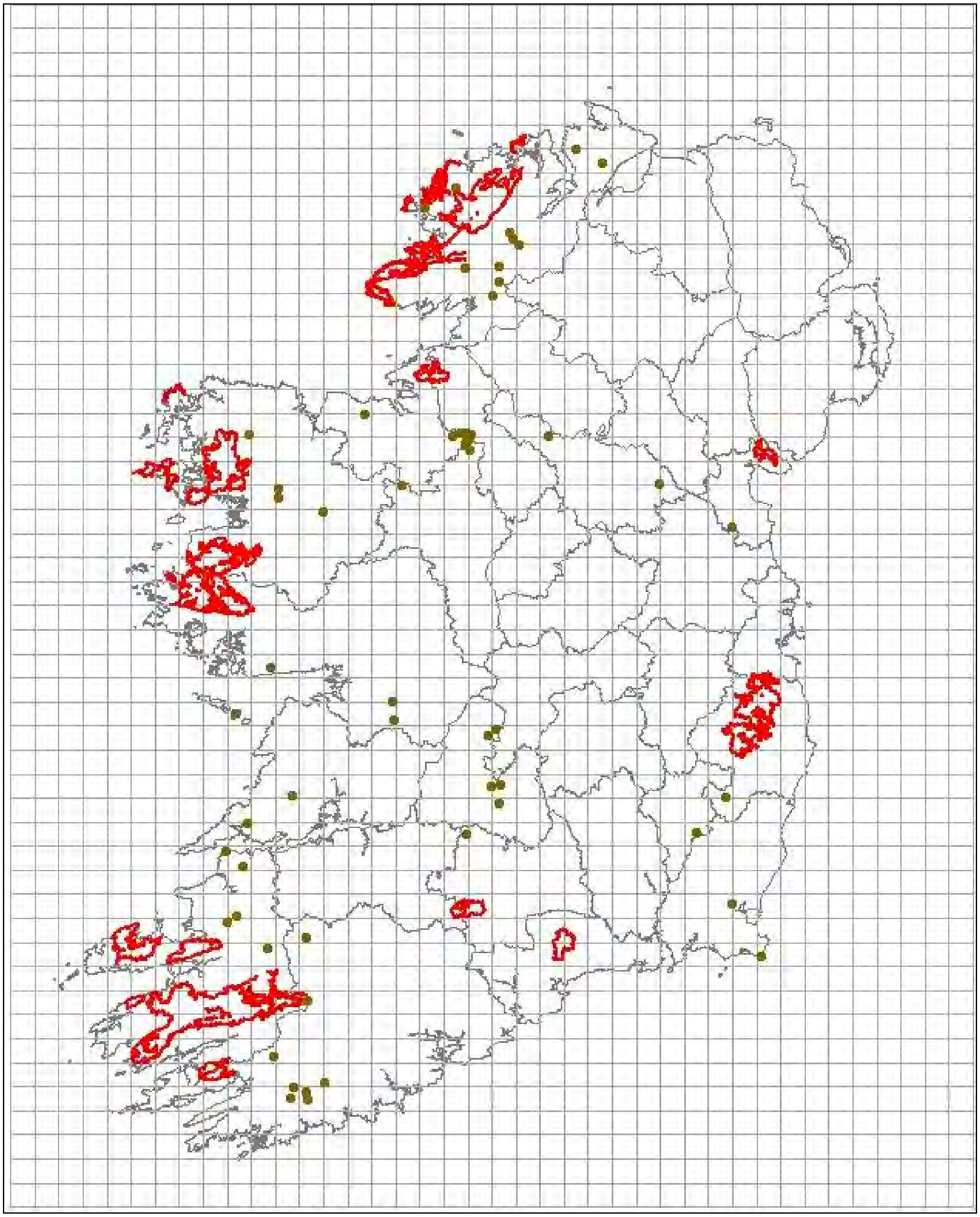


Figure 5. Locations of connected wind farms in 2006 shown as brown dots and designated sites for which alpine heath is a qualifying interest.

13 APPENDIX 7. GLOSSARY

ALPINE HEATH – areas of heath containing the following six alpine indicator species (*Carex bigelowii*, *Diphasiastrum alpinum*, *Festuca vivipara*, *Poa alpina*, *Salix herbacea*, *and Vaccinium vitis-idaea*) found at elevations greater than 350m in Ireland.

ALTITUDE - Vertical height above sea level.

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for, which SACs have to be designated.

BLANKET BOG – Bogs, which carpet the landscape, following the underlying topography. They can cover extensive areas along the west coast and on uplands throughout the country.

CALCAREOUS –Rich in calcium, Lime loving.

CALCAREOUS ROCKY SLOPES – these are areas of exposed rock, which are typically found on the north and north-east facing slopes of mountains of calcareous origin, i.e. limestone mountains. These slopes are typically >40^{o}, and are found at elevations above 350m. Calcareous rocky slope vegetation is also found in mountain ranges, which are siliceous in origin. These are typically areas of cliff, which have been metamorphosed in the past and, which are slightly more mineral rich than the adjoining areas. The true alpine species for this habitat includes – *Alchemilla alpina, Alchemilla glaucescens, Arenaria ciliata, Asplenium viride, Cardaminopsis petraea, Deschampsia caespitosa ssp. alpina, Epilobium alsinifolium, Euphrasia frigida, Oxyria digyna, Phegopteris connectilis, Poa alpina, Polygonum viviparum, Polystichum lonchitis, Salix phylicifolia, Saussurea alpina, Saxifraga hartii, Saxifraga nivalis, Saxifraga oppositifolia, Saxifraga rosacea, Silene acaulis, Thalictrum alpinum.*

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

CORINE - Information and mapping system, developed within the context of the Commission of the European Communities biotope project, which is used as a tool for the description of sites of importance for nature conservation in Europe. It catalogues recognisable communities of flora and fauna. The primary objective of this catalogue is to identify all major communities whose presence contributes to the conservation significance of a site. Included in this list of communities are interesting but rare natural or near-natural communities as well as the more widespread semi-natural ones.

DEHLG - Department of Environment, Heritage and Local Government

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

ENCROACHMENT - The invasion of a species (usually plants) into areas previously uncolonised. This term is often used when an undesirable species advances at the expense of a desirable species or habitat.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions, which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FAVOURABLE REFERENCE AREA - Total surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for, which the present coverage is not sufficient to ensure long-term viability. Favourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FAVOURABLE REFERENCE RANGE - Range within, which all significant ecological variations of the habitat/species are included for a given biogeographical region and which is sufficiently large to allow the long term survival of the habitat/species. Favourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in, which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive, this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

HYDROLOGY - The movement of water through a catchment area including freshwater and seawater inputs, water level changes and drainage mechanisms, which are all influenced by the underlying geology.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the “health” quantity or quality of a habitat or species.

MOSAIC - Used to describe habitats that occur together and cannot easily be mapped separately.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURAL RANGE – The spatial limits within which, the habitat or species occurs.

NHAs - Proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NPWS - National Parks and Wildlife Service

ORTHO-RECTIFIED IMAGE – The 2000 Ordnance Survey flight colour images were used as part of this project. These images were used in TIF format and were ortho-rectified.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats, which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

QUALIFYING INTERESTS – The habitat(s) and/or species for, which an SAC or SPA is designated.

REPS - Rural Environment Protection Scheme. This is an Agri-Environmental programme, which seeks to draw up agreements with farmers, according to the type of farming, landscape and features on the land. The overall objectives of REPS are to achieve: the use of farming practices, which reduce the polluting effects of agriculture by minimising nutrient loss- an environmentally favourable extensification of crop farming, and sheep farming and cattle farming; - ways of using agricultural land, which are compatible with protection and improvement of the environment, the countryside, the landscape, natural resources the soil and genetic diversity; - long-term set-aside of agricultural land for reasons connected with the environment; - land management for public access;- education and training for farmers in types of farming compatible with the requirements of environmental protection and upkeep of the countryside.

SACs - Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from, which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SACs have also been known as cSACs, which stands for "candidate Special Areas of Conservation", and pcSACs, which stands for "proposed candidate Special Areas of Conservation."

SILICEOUS SCREE – these are areas of scree which are typically found on the north and north-east facing slopes of mountains of siliceous origin, but they may occur on other aspects also, particularly in the northern counties of Ireland. These slopes are typically >40º, and are found at elevations above 350m. The true alpine species for this habitat includes – *Cryptogramma crispa*, *Oxyria digyna*, *Polygonum viviparum*, *Salix herbacea* and *Vaccinium vitis-idaea*.

SILICEOUS ROCKY HABITAT – these are areas of rocky slope, which are found on north and north-east facing siliceous slopes with a slope >40º, at elevations above 350m. The true alpine species for this habitat includes – *Cardaminopsis petraea, Deschampsia caespitosa* ssp. *alpina, Euphrasia frigida, Festuca vivipara, Minuartia recurva, Oxyria digyna, Phegopteris connectilis, Poa alpina, Polygonum viviparum, Salix herbacea, Saussurea alpina, Saxifraga hartii, Saxifraga rosacea, Saxifraga stellaris, Thalictrum alpinum, Vaccinium vitis-idaea.*

SPAs - Special Protection Areas for Birds are areas, which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas are protected from significant damage.

SPECIES - The lowest unit of classification normally used for plants and animals.

National Level	
Habitat Code	4060
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)
Biogeographic level	
Biogeographic region	Atlantic (ATL)

Published sources	Anonymous. (1979). Areas of scientific interest in Co. Mayo. *An Foras Forbartha, Dublin.* Barrington, M. A. and R. P. Vowell. (1885). XXV - Report on the flora of Ben Bulben and the adjoining mountain range in Sligo and Leitrim. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. IV - Science. P. 493 - 517. Birks, H. J. B., Birks, H. H. and D. A. Ratcliffe. (1969). Mountain plants on Slieve League, Co. Donegal. *Irish Naturalists' Journal.* Vol. 16. P. 203. Brodie, J. (1991). Some observations on the flora of Clare Island, Western Ireland. *Irish Naturalists' Journal.* Vol. 23. No. 9. P. 376 - 377. Brunker, J. P. (1950). Flora of the County Wicklow. *Dundalgan Press, Dundalk.* Carrothers, E.N. and J.Mc K Moon (1946). *Arabis petraea* Lam. In Co. Leitrim. *Irish Naturalists' Journal.* Vol. VIII (2) pg. 397 Colgan, N (1904). Flora of County Dublin: flowering plants, higher cryptograms and *characeae.* Hodges Figgis, Dublin. Corry, T. H. (1884). On the heights attained by plants on Ben Bulben. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. IV - Science. P. 73 - 77. Cotton, D. F. C. and M. Cawley. (1991). New records of vascular plants from Cos. Sligo (H28) and Leitrim (H29). *Irish Naturalists' Journal.* Vol. 24. No. 7. P. 288 - 295. Curtis, T. (1976). A preliminary report on areas of scientific interest in Co. Wicklow. *An Foras Forbartha, Dublin.* Curtis, T. G. F. (1981). Report on field outing to Kincaslough, Co. Donegal, 16th - 17th June. *Watsonia.* Vol. 13. No. 3. P. 261. Curtis, T.G.F. (1983). Proposed Nature Reserve at Lough Fingall, Co. Galway. Nature Reserve Schedule, Wildlife Service, Dublin. Unpublished. Curtis, T.G.F., Bassett, J.A. & McGough, H.N. (1985). The present status and ecology of *Helianthemum nummularium* in Ireland. *Irish Naturalists' Journal,* Vol 21., No. 12, pp 515-519.. Curtis, T. G. F. and Madden, B (2005). Site report for proposed wind farm at Slieve Corraun. Published EIS. Curtis, T. G. F. and C. Mhic Daeid. (1981). Report on field outing to Mullaghanattin, Glencar, Co. Kerry, 21st - 23rd July. *Watsonia.* Vol. 13. No. 3. P. 261 - 262. Curtis, T. G. F. and C. Mothershill. (1977). New additions to the flora of County Leitrim (H29). *Bulletin of The Irish Biogeographical Society.* No. 2. P. 42 - 44. Curtis, T. G. F., Goodwillie, R. and R. Young. (1978). Areas of scientific interest in Co. Sligo. *Revised and expanded report. An Foras Forbartha, Dublin.* Curtis, T. G. F. and McGough, H.N., and Akeroyd, J.R. (1981). The flora of the Mullet Peninsula. West Mayo (H27). Bulletin of the Irish Biogerographical Society. No 5. Pgs. 38-46.

Curtis, T.G.F. and R. Young. (1977). Areas of scientific interest in Co. Wicklow. *An Foras Forbartha, Dublin.*

Curtis, T. G. F. (1993). *Polygonum viviparum* in Ireland with particular reference to the flora and vegetation of the Mount Brandon range, Co. Kerry. *Irish Naturalists' Journal.* Vol. 24. No. 7. P. 274 – 280

Day, G. V. (2002). BSBI field meetings in Ireland 2002. *Irish Botanical News.* P. 39 - 42.

Doyle, G.J and Kirby, E. N. (1987). *Listera cordata* (Lesser Twayblade) growing in the Twelve Bens range, Connemara. *Irish Naturalists' Journal.* Vol. 22, No. 6 pgs. 246-248.

Doyle, G. J. and P. J. Foss. (1986). A resurvey of Clare Island Flora. *Irish Naturalists' Journal.* Vol. 22. No. 3. P. 85 - 89.

Dublin Naturalists Field Club. (1998). Flora of County Dublin. *Dublin Naturalists Field Club, Dublin.*

Fahy, E. (1974). A preliminary report on areas of scientific interest in County Tipperary. *An Foras Forbartha, Dublin.*

Fitzgerald, R. D. (1955). Report of the autumn meeting in Ireland. *Transactions of the British Bryological Society.* Vol. II. 1952 - 1955. P. 125 - 128.

Galweggy, S. and F. Winder. (1998). Distribution of flowering plants on the cliffs of Coumshingaun, Co. Waterford (H6). *Irish Naturalists' Journal.* Vol. 26. No. 3/4. P. 132 – 135.

Gilbert, O. L. and A. M. Fryday. (1996). Observations on the lichen flora of high grounds in the west of Ireland. *Lichenologist.* Vol. 28. No. 2. P. 113 - 127.

Goodwillie, R. (1972). A preliminary report on areas of scientific interest in Co. Sligo. *An Foras Forbartha, Dublin.*

Goodwillie, R. (1978). Areas of scientific interest in Co. Leitrim. *An Foras Forbartha, Dublin.*

Goodwillie, R. (1979). Field survey of Clare Island cliffs. *An Foras Forbartha, Dublin.*

Green, P. R. (2005). The highest plant species in Co. Waterford (V.C. H6). *Irish Botanical News.* No. 15.

Green, P. R. (2007). *Minuarta recurva* found in Co. Waterford (V.C. H6). *BSBI News.* No. 104

Hart, H. C. (1881). IXI - On the Botany of the Galtee Mountains, Co. Tipperary. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. III. - Science. P. 392 - 402.

Hart, H. C. (1882). Notes on mountain plants in Kerry. *Journal of Botany.* 20. P. 174 - 176.

Hart, H. C. (1883). XCI – Report on the flora of the mountains of Mayo and Galway. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. III - Science. P. 694 - 768.

Hart, H. C. (1884). IXXIX – Report upon the botany of the Macgillicuddy's Reeks, Co. Kerry. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. II – Science. P. 573 – 593.

Hart, H. C. (1884). XV – Notes on the plants of some of the mountain ranges of Ireland. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. IV - Science. P. 211 - 251.

Hart, H. C. (1885). XXXVI - On the botany of the River Suir. *Scientific Proceedings of the Royal Dublin Society.*

Hart, H. C. (1885). XXI – Report on the flora of south-west Donegal. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. IV - Science. P. 443 – 469.

Hart, H. C. (1886). Further report on the flora of southern Donegal. *Scientific Proceedings of the Royal Irish Academy.* Ser. II Vol. IV – Science. P. 568 – 569.

Hart, H. C. (1891). On the range of flowering plants and ferns of the mountains of Ireland. *Scientific Proceedings of the Royal Irish Academy.* Ser. III. Vol. I. P. 512 – 570.

Hodd, T. (1997). In search of alpine plants on the northern slopes of Mangerton Mountain, South Kerry (v. c. 1). *Irish Botanical News.* No. 7: 23-27.

Ivimey-Cook, R.B. & Proctor, M.C.F. 1966. *The Plant Communities of the Burren, Co. Clare*. Proceedings of the Royal Irish Academy 64B: 211-301.

Keane, S. & Walsh, T. 1995. NHA Internal Report to National Parks & Wildlife Service, Dublin.

Kertland, M. P. H. (1955). The Botanical Society of the British Isles - Field Meeting at Dunfanaghy, Co. Donegal, June 1955. *Irish Naturalists' Journal.* Vol. XI. P. 349 - 350.

Kirby, N., Lockhart, N. and D. Synnott. (1980). Bryological observations at Gleniff, Co. Sligo (H28). *Bulletin of The Irish Biogeographical Society.* No. 4. P. 30 - 32.

Kirby, E.N. & MacGowran, B.A. 1979. *A vegetation survey of the proposed National Park in the Burren, Co. Clare.* Unpublished report to the National Parks and Monuments Branch of the OPW, Dublin.

McGough, H.N. 1984. *A Report on the Grasslands and Closely Related Vegetation Types of the Burren Region of Western Ireland: a preliminary report*. National Parks & Wildlife Service, Dublin.

Moore, J. J. (1996). *Minuartia recurva* (All.) Schinz. & Thell. New tot eh British Isles. *Irish Naturalists' Journal.* Vol. 15, No. 5 pgs. 130-132

Moran, B. (1992). Report on DNFC field trip to Co. Sligo. *The Dublin Naturalist's Field Club Newsletter.*

Nash, D. (1993). Plant records from North Tipperary (H10). *Irish Naturalists' Journal.* Vol. 24. No. 7. P. 295 - 296.

O'Criodain, C. (1992). *Conservation of Grassland Sites of Scientific Interest in Ireland*. Internal Report to National Parks & Wildlife Service, Dublin.

O'Donovan G. (1987). Ecosystem dynamics of limestone grassland in the Burren National Park Co. Clare. Ph.D. Trinity College Dublin.

Parnell, J. (1982). Abnormal plants of *Jasione montana. Irish Naturalist's Journal*. Vol. 20. No. 11. Pg 507.

Perring, F. H. and S. M. Walters. (1990). Atlas of the British Flora. *BSBI, Wiltshire.*

Porley, R. and N. Hodgetts. (2005). Mosses and liverworts. *The New Naturalist Library, HarperCollins.* . XIII. Pgs 265-289.

Praeger, R. L. I. (1905). Plants of the Ben Bulben District. *Irish Naturalist.* Vol. XIV. Pg 221.

Praeger, R. L. I. (1905). *Dryas octopetala* on Muckish. Irish Naturalist. Vol. XIV. Pg 224.

Praeger, R. L. I. (1905). The flora of the Mullet and Iniskea. Irish Naturalist. Vol. XIV. Pgs 229-244.

Praeger, R. L. I. (1905). Achill Island Plants. Irish Naturalist. Vol. XIV. Pgs 220-221.

Praeger, R. L. I. (1909). A tourist's flora of the west of Ireland. *Hodges Figgis, Dublin.*

Praeger, R. L. I. (1911). Clare Island Survey 10. *Phanerogamia* and *Pteridophyta*. *Scientific Proceedings of the Royal Irish Academy.* 31: pgs. 1 – 47

Praeger, R. L. I. (1903). The flora of Clare island. *Irish Naturalists' Journal.* Vol. 12. P. 277 - 294.

Praeger, R. L. I. (1905). The flora of Achill Island. *Irish Naturalist.* VolPraeger, R. L. I. (1932). On the flora of Aranmore, Co. Donegal. *Irish Naturalists' Journal.* Vol. IV. P. 50 - 54.

Praeger, R. L. I. (1934). *The botanist in Ireland*. Hodges Figgis, Dublin.

Roden, C. (1978). Plant records from the mountains around Lough Nafooey (H16). *Irish Naturalists' Journal.* Vol. 19. No. 6. P. 208.

Roden, C. (1984). New stations for *Pinguicula grandiflora* and *Saxifraga x polita* in the west of Ireland. *Irish Naturalists' Journal.* Vol. 21. No. 8. Pg 369.

Roden, C. M. (1986). A survey of the flora of some mountain ranges in the west of Ireland. *Irish Naturalists' Journal.* Vol. 22. No. 2. P. 52 - 59.

Rodwell, J. S. (1998). British Plant Communities. Volume 3 – Grasslands and Montane Communities. *Cambridge University Press, Cambridge.*

Scannell, M. J. P. (1975). *Cryptogramma . crispa* in west Galway. Irish Naturalist's Journal. Vol. 18. Pg 336.

Scannell, M. J. P. (1985). Caha Mountains, Co. Cork - a report of a BSBI field trip 10th – 11th September 1985. *BSBI News.* No. 44. P. 29..

Scully, R. W. (1889). Further notes on the Kerry Flora. *Journal of Botany* 27. pgs. 85 - 92.

Scully, R. W. (1916). Flora of County Kerry including the plants, ferns, *charaeae*, etc. *Hodges Figgis, Dublin.*

Sheehy Skeffington, M. and M. O'Connell. (1985). Botanical notes from three sites in east Mayo and Sligo. *Irish Naturalists' Journal.* Vol. 21, P. 419-420.

Stelfox, A. W. (1944). Comments on H. C. Hart's 'Botany of the Galtee Mountains, Co. Tipperary' Proc. R. I. Acad. 3, (2), No. 6 April 1981. *Irish Naturalists' Journal.* Vol. VIII P. 138 - 142.

Stelfox, A. W. (1946). Further notes on the flora of the Galtee Mountains and the Glen of Aherlow. *Irish Naturalists' Journal.* Vol. VIII. P. 327 – 331.

Stelfox, A. W. (1947). The willow herb *Epilobium nummulariaefolium* on Brandon Mountain in south Kerry. *Irish Naturalists' Journal.* Vol. ? P. 101.

Stelfox, A. W. (1948). Hart's station for *Polygonum viviparum* in Kerry and its flora. *Irish Naturalists' Journal.* Vol. IX. P. 121 - 123.

Stelfox, A. W. (1950). Goldilocks (*Ranunculus auricomus*) in Co. Kerry. *Irish Naturalists' Journal.* Vol. X. P. 80 - 81.

Stelfox, A. W. (1951). The beech fern and the wall rue at about 2,000 feet on Brandon Mountain, in South Kerry: and the old record for *Thalictrum alpinum*. *Irish Naturalists' Journal.* Vol. X. No. 5.

Stelfox, A. W. (1954). The 'Scottish' element in the flora of Co. Donegal. *Irish Naturalists' Journal.* Vol. XI. P. 220 - 224.

Stelfox, A. W. (1955). *Salix hibernica*. *Irish Naturalists' Journal.* Vol. 15. pgs.. 25 - 29.

Stewart, S. A. (1882). IXXIV - Report on the botany of the mountainous portion of Co. Fermanagh to the west of Lough Erne and the adjoining district of County Cavan. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. II - Science. P. 531 - 544.

Stewart, S. A. (1885). XX - Report on the botany of Lough Allen and the Slieveanierin Mountains. *Scientific Proceedings of the Royal Irish Academy.* Ser. II. Vol. IV - Science. P. 426 - 442.

Synnott, D. M. (1986). An outline of the flora of Co. Mayo. *Glasra.* 9: 13 - 117.

Vanden Berghen, C. (1972). La flore de l'Irlande. Le vegetation de I'ile Achill et de la presqu'ile de Corraun (comte de Mayo, Ilrande). *Les Naturalistes Belges.* 53. No. 4.

Waldren, S. and L. Scally (1993). Ecological factors determining the distribution of *Saxifraga spathularis* and *Saxifraga hirsuta*. *Biogeography of Ireland; Past, Present and Future. M. J. Costelloe and K. S. Kelly (eds).* Occ. Publ. Irish Biogeographic Society No. 2.

Webb, D. A. (1943). Some new county records. *Irish Naturalists' Journal.* Vol. VIII. pgs. 114 - 115.

Webb, D. A. and M. J. P. Scannell. (1983). Flora of Connemara and the Burren. *Royal Dublin Society and Cambridge University Press, Cambridge.*

White, J. and G. Doyle. (1982). The vegetation of Ireland: a catalogue raisonné. *Journal of Life Sciences. Royal Dublin Society.* 3. pgs. 289 - 368.

Willmot, A. (1979). An ecological survey of the ferns of the Burren, Co. Clare, Ireland. *The Fern Gazette.* Vol. 15. No. 5. P. 249 - 265.

Willmot, A. (1983). An ecological survey of the ferns of the Killarney district, Co. Kerry, Ireland. *The Fern Gazette.* Vol. 15. No. 5. P. 249 - 265.

Wilson, P. (1988). Recent sand shadow development on Muckish Mountain, Co. Donegal. *Irish Naturalists' Journal.* Vol. 22. No. 12. P. 529 - 531.

Winder, F. G. A. (1995). Has Wicklow lost two of its few alpine plants? *Irish Naturalists' Journal.* Vol. 25. No. 1. P. 35 - 36.

Winder, F. G. A. (1997). Communication to the climbing community. *Mountain Log.*

Winder, F. G. A. (2001). Viewing points for alpine plants in Wicklow. *Irish Naturalists' Journal.* Vol. 26. No. 12. P. 478 - 479.

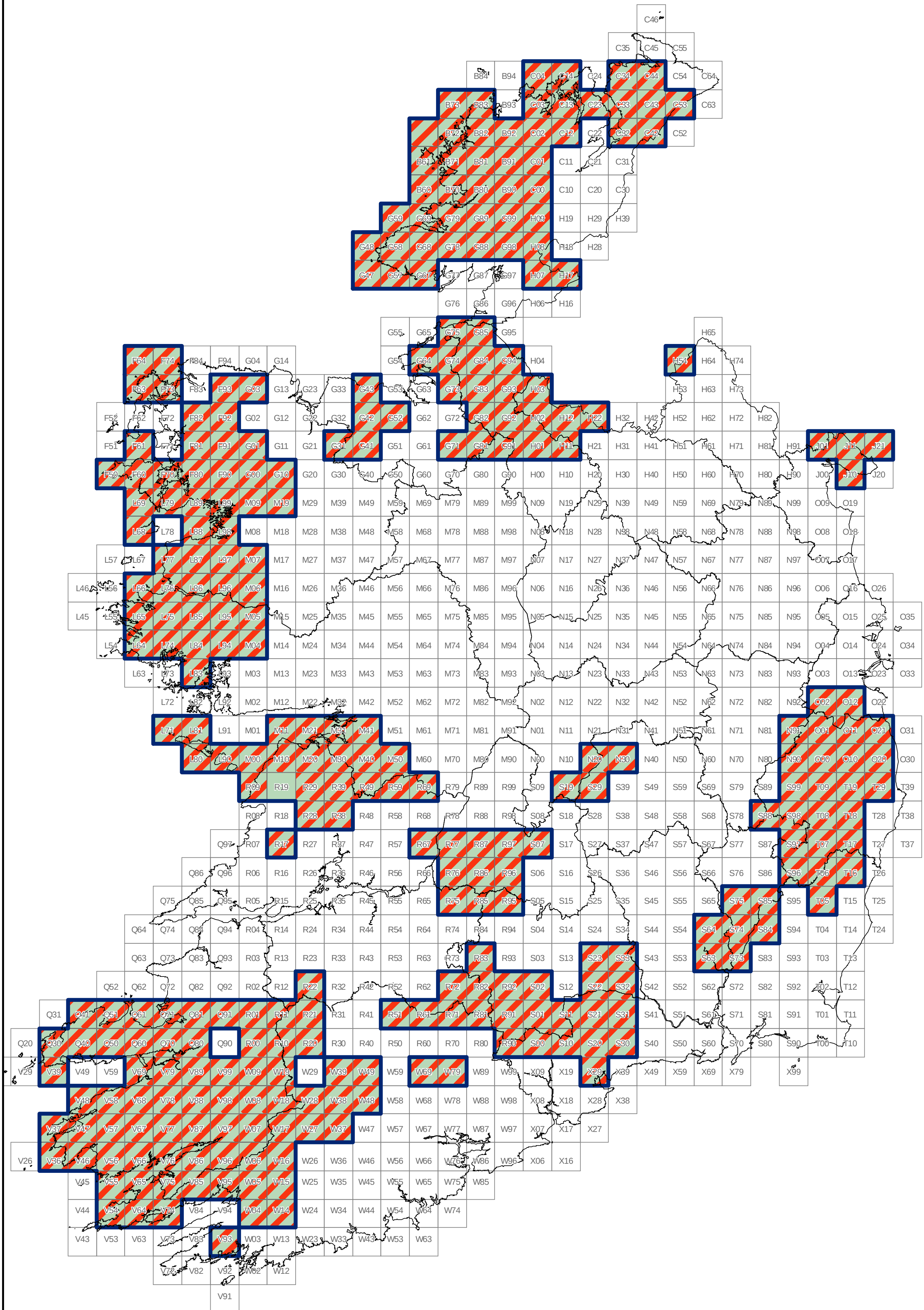
Young, R. (1972). Areas of Scientific Interest in Co. Waterford. *An Foras Forbartha, Dublin.*

Young, R. (1973). A report on areas of biological and geological interest in County Donegal. *An Foras Forbartha, Dublin.*

Range	
Surface area	The Natural Range for this habitat potentially covers 29,500 km² (295 grid cells selected x 100 km²).
Date	1800s to 2006.
Quality of data	1 = poor (based on very incomplete data with expert opinion).
Trend	Likely to be stable.
Trend-Period	1950 - 2006
Reasons for reported trend	
Area covered by habitat	
Surface area	Estimated to be 128 km²
Date	1800 - 2006.
Method used	1 =Mostly based on expert opinion
Quality of data	1 = poor (based on very incomplete data with expert opinion)
Trend	Negative.
Trend-Period	1950 – 2006
Reasons for reported trend	3 = direct human influence (overgrazing and trampling)
Justification of % thresholds for trends	Increase in the intensity of impacting activities are likelt to result in habitat loss, however the magnitude is unknown.
Main pressures	141 Abandonment of Pastoral Systems – in the Burren 142 Overgrazing by sheep 180 Burning 301 Quarries 500 Communications networks 501 Paths, tracks or cycling paths 510 Energy transport 513 Other forms – wind generated energy 530 Improved access to the site 610 Outdoor sports and leisure activities 622 Walking, horse riding and non-motorised vehicles 623 Motorised vehicles 624 Mountaineering, rock climbing, speleology 700 Pollution 702 Air pollution – acidification –from acid rain 720 Trampling, overuse

Threats	141 Abandonment of Pastoral Systems – in the Burren 142 Overgrazing by sheep 180 Burning 301 Quarries 500 Communications networks 501 Paths, tracks or cycling paths 510 Energy transport 513 Other forms – wind generated energy 530 Improved access to the site 610 Outdoor sports and leisure activities 622 Walking, horse riding and non-motorised vehicles 623 Motorised vehicles 624 Mountaineering, rock climbing, speleology 700 Pollution 702 Air pollution – acidification –from acid rain 720 Trampling, overuse
Complementary information	
Favourable reference range	Favourable, as the Favourable Reference Range is similar to Range for this habitat, potentially covering 295 km² (295 grid cells selected x 100 km²), (see **Figure 1**).
Favourable reference area	
Typical species	Vascular plants within alpine heath are described as either obligate (true) alpine species or facultative species (which are those that are also found at lower elevations and in other habitats). The mosses, liverworts and lichens, which form the Atlantic Hepatic Mat Community, also form an important element of this habitat. **Obligate alpine species:** *Carex bigelowii, Diphasiastrum alpinum, Festuca vivipara, Poa alpina, Salix herbacea, Vaccinium vitis-idaea*. **Facultative species:** *Agrostis canina, Agrostis capillaris, Antennaria dioica, Arctostaphylos uva-ursi, Armeria maritima, Calluna vulgaris, Carex binervis, Carex pilulifera, Daboecia cantabrica, Deschampsia flexuosa, Dryas octopetala, Empetrum nigrum, Erica cinerea, Festuca ovina, Huperzia selago, Hymenophyllum tunbrigense, Hymenophyllum wilsonii, Jasione montana, Juncus squarrosus, Juniperus communis, Listera cordata, Lycopodium clavatum, Nardus stricta, Pedicularis sylvatica, Plantago maritima, Pyrola media, Silene uniflora, Vaccinium myrtillus*. **Bryophytes (Atlantic Hepatic Mat Community):** *Marsupella adusta, Marsupella sprucei, Racomitrium lanuginosum, Adelanthus lindenbergianus, Anastrepta orcadensis, Dicranodontium uncinatum, Herbertus aduncus* subsp. *hutchinsiae, Hylocomnium umbratum, Pleurozia purpurea, Scapania nimbosa, Scapania ornithopodiodes.*

Typical species assessment	The list of typical species submitted was derived using best expert judgement. Species lists may be compiled during field-based surveys, however all surveys that assess habitat condition focus on changes in or presence/absence of indicator species. Therefore the conservation status of all typical species is rarely assessed apart from assessments derived from best expert judgement.
Other relevant information	1. As this habitat is restricted by altitude, the range does not extend beyond the current known distribution except in the Burren where the habitat occurs to sea level. 2. By using the Digital Terrain Model generated polygons for the locations of mountain ranges with upland areas >350m in elevation and the locations of SAC sites below 350m for which alpine heath is a qualifying interest it is possible to produce a very rough estimate of the potential range of this habitat in Ireland. This figure has inherent inaccuracies in it due to the nature of the Digital Terrain Modelling. These areas are also likely to contain other habitats such as calcareous and siliceous rocky slopes, blanket bog or dry and wet heath. 3. The area is estimated based on the DTM for both ridges and summits and for slopes > 40^0 above 350 m in height. It is not possible to accurately determine what percentage of this area corresponds to alpine heath as opposed to the other habitats listed above. In addition areas of alpine heath below 350 m have not been included. Such areas exist where exposure is high. The area of alpine heath estimated to occur in The Burren region is based on that supplied on N2000 forms. The overall national area cannot be more accurately determined in the absence of a dedicated field survey to confirm the complement of species present. However, a figure has been estimated**.** 2.5.2 Favourable reference area: The precise surface area of alpine heath in Ireland is unknown and cannot be accurately determined in the absence of a dedicated field survey to confirm the complement of species present. Nonetheless, a rough estimate of current area has been given as 128 km2. It is felt that Favourable Reference Area is > current area leading to an assessment of Unfavourable Inadequate.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	**Favourable**
Area	**Unfavourable Inadequate**
Specific structures and functions (incl. typical species)	**Unfavourable Inadequate (U1)** – based on the increase in impacting activities and expert opinion.
Future prospects	**Unfavourable Inadequate (U1)** – due to pressure from impacting activities (e.g. overgrazing, trampling).
Overall assessment of CS	**Unfavourable Inadequate (U1).**



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Alpine Heath

4060

Current Distribution (294 cells)
Current Range (295 cells)
Favourable Reference Range (295 cells)
W48 10km grid cells

Date: October 2007

Background to the conservation assessments for Killarney Shad *Alosa fallax killarnensis* in the Republic of Ireland

1. Introduction

Three taxa of shad are recognised in Ireland – the Allis shad (*Alosa alsoa* L.), the Twaite shad (*Alosa fallax* Lacepede) and the landlocked Killarney shad (*Alosa fallax killarnensis* Regan).

The Twaite and Allis shad show many similarities in their life cycles, spending their adult life at sea or in the lower reaches of estuaries and ascending to fresh water to spawn in early summer. Spawning takes place after dark and, where many fish are congregated, is evidenced by frenzied activity and turbulence in the water in the immediate area. The spawning females shed their eggs into the water where they are fertilised by the males and the eggs either drop into the gravelled bed or begin to drift downstream. Those eggs that fall into gravels hatch after several days and then drift downstream. The larval stages develop rapidly and young fish may be 8-9cm in length in the autumn of the first season (Bracken and Kennedy 1967, King and Green unpublished data). The fish may remain in estuarine waters during their second year before finally going to sea where they mature. Adult Twaite shad may return to spawn in successive years (iteroparous) whereas Allis shad are considered to spawn once in their life (semelparous).

The Killarney shad is a landlocked form of Twaite shad, found in the lakes of Killarney (Regan 1912, Trewavas 1938, O' Maoleidigh 1990). This form feeds almost exclusively on zooplankton (Trewavas 1938, O' Maoleidigh 1990, King and Roche 2000) and has a gill raker count of 43-53 (Trewavas 1938). The Killarney shad does not grow to the same size as the anadromous Twaite shad. Adult fish captured in Killarney ranged in size from 17-22 cm (O' Maoleidigh 1990) and the largest fish taken in recent surveys was 21 cm in length (Roche and Rosell 2003). Spawning is reported to take place in summer during the June-July period. This is considerably later than the May spawning time of the anadromous Twaite shad on the R. Barrow at St. Mullins.

Detailed studies on comparative meristic and morphometric features of the anadromous Twaite and the Killarney shad (O'Maoleidigh *et al.* 1988, O'Maoleidigh 1990) indicated no genetic differences between the two forms.

2. Range

Killarney shad was first reported as a subspecies of Twaite shad by Trewavas (1938). This species was further studied during the 1980's (O'Maoleidigh *et al*. 1988, O'Maoleidigh 1990). Subsequently, fish communities on L. Leane were sampled during two surveys, carried out in 1991 (O'Grady 1993, unpublished report to National Parks & Wildlife Service) and 1999 (King and Roche 2000, unpublished report to Kerry Co. Council) by the Central Fisheries Board [CFB]. The surveys involved the use of selective gill netting and the nets used sampled only the larger and older portion of the population. The technique did not facilitate sampling of juvenile shad.

Both surveys indicated the presence of substantial populations of adult Killarney shad in L. Leane with the shad being widely distributed in the lake. A more recent study (Roche and Rosell 2003 unpublished report to National Parks and Wildlife Service) focussed on shad only and involved use of hydroacoustic techniques linked with ground-truthing via multi-mesh gill nets. This study collected samples from younger age groups than the earlier studies. Surveys of the Muckross Lake and Upper Lake in Killarney in 2002 and 2003 did not yield Killarney shad (F. Igoe, personal communication). Lough Leane intersects with 38 1km squares – 38km^2 is taken as the range for the species.

2.1 Trends

The Killarney shad has never been recorded in any lake except Lough Leane. Its range therefore has remained stable.

3. Population

Killarney shad were the most abundant species of fish caught in the 2003 fish survey of Lough Leane (Roche and Rosell, 2003), with a total of 166 specimens caught at 8 different locations. Both length-frequency and age-frequency investigations of these 166 fish suggested that the population showed good levels of recruitment and survival and normal growth patterns. Scale analysis revealed animals from 1+ to 8+ years, that first spawning normally occurs at age 3 in both males and females, and that multiple spawning did occur. The precise timing of and locations for spawning have yet to be determined. In the 2003 survey, 52% of females and 88% of males captured were spent fish (Roche and Rosell 2003). This would suggest a normal degree of spawning success. From their hydroacoustic data, the authors estimated that the shad population in L. Leane probably exceeds 20,000 individuals of 1+ years or older. This appears to be a healthy figure, but previous reports on Killarney shad have produced no equivalent population estimate with which to compare this figure.

3.1 Pressures and threats

In respect of the Killarney shad, it is not considered that leisure angling or commercial fishing pressures arise. The taxon is present in L. Leane only and this lake has been subject to nutrient enrichment and eutrophication arising in considerable measure from tourism pressure and extensive infrastructural development in the town of Killarney. King and Roche (2000) reported substantial differences in CPUE for Killarney shad between the 1991 and 1999 fish surveys and identified a possible linkage between lake water level and status of the dominant age group of shad in each of the surveys. A difference of 0.8 m in surface water level in L. Leane was identified between the spawning periods that generated the dominant age class in each of the two surveys. Such a difference would lead to loss of extensive areas of shallow littoral in the bays and island areas where the Killarney shad are considered to spawn. Thus, some control on water levels, in order to maintain an elevated level in June-July and counter a natural pattern of falling levels, would be of benefit to Killarney shad spawning effort.

There is also some recent concern at the arrival of two alien fish species in the Leane catchment – with rudd now known from Lough Leane itself and dace recently identified from the Flesk river (Peter O'Toole, pers comm). The exact impact these species will have on the shad is as yet unknown, but some form of resource competition is possible.

4. Habitat

Killarney shad have been recorded from locations throughout Lough Leane (King and Roche, 1999; Roche and Rosell, 2003). Their distribution within the lake varies diurnally in response to prey migration, but also seasonally, as they move to shallower waters to spawn. Spawning of Killarney shad takes place in shallow bays and on selected gravelled shallows that adjoin the lakeshore and several of the larger islands.

4.1 Trend

There is no evidence that the other lakes in Killarney ever supported shad. The absence of shad from Muckross Lake can largely be explained by habitat availability. Despite their proximity, the underlying geology and the nature of river inputs to Muckross and Leane are substantially different. While Lough Leane is mesotrophic, t Muckross lake is in effect oligotrophic and does not appear to support the plankton densities necessary to support a shad population. There are no known suitable spawning areas within Muckross lake either (P. O'Toole & W. Roche pers comm.). The same applies to the Upper Lake. There is some concern that man induced water level fluctuations and excessive nutrient inputs could reduce the availability and quality of the existing habitat for shad, but to date the extent of suitable habitat has been stable. The extent of habitat is taken as the entire lake – 19.52 km^2.

5. Future prospects

Lough Leane is designated SAC, in part because of its important for the endemic race of shad, it is also part of Killarney National Park. Implementation of the EU Water Framework Directive, the Nitrates Directive and the Urban Wastewater Directives should be conducive to improvement in water quality in this lake.

There has been considerable concern in the past about nutrient levels in Lough Leane. Eutrophication has led to serious algal blooms with a hypertrophic chlorophyll concentration of 71mg/m^3 recorded in 1997. Given the lakes proximity to the tourist centre of Killarney and the potential nutrient inputs from the River Flesk, future eutrophication episodes and algal blooms cannot be ruled out.

While considerable fluctuations in the total phosphorus and maximum chlorophyll concentrations have been measured, Lough Leane is in fact showing signs of recovery; the abundance of phytoplankton in the lake has returned to the levels of 15 years ago. The implementation of nutrient management plans appears to have resulted in a significant overall improvement in water quality (Toner *et al.* 2005).

Overall, and notwithstanding the fact that any species limited to a single site is at a heightened risk of extinction (all your eggs in one basket scenario), the future prospects for the Killarney Shad appear to be good. This species has been subject to severe pollution incidents in the past and a healthy population persists in Lough Leane. Further work is required, nonetheless, to better understand the breeding ecology and biology of the species.

6. Complementary information

6.1 Favourable reference range

There has been no change in the range of this species and there are no suitable adjacent areas where the species could expand. The present range ($38km^2$) is taken as the favourable reference range.

6.2 Favourable reference population

There are no data on the potential carrying capacity of Lough Leane and only one population estimate for the Killarney shad so that we have no basis for assessing trends. However, that estimate by Roche and Rosell (2003) was of more than 20,000 individuals of 1+ years or older. This appears to be a very healthy figure and until more data becomes available 20,000 individuals of 1+ years or older will be taken as the favourable reference value.

6.3 Suitable habitat for the species

Killarney shad have been recorded from locations throughout Lough Leane, but have not been recorded anywhere else. There is some concern that man induced water level fluctuations and excessive nutrient inputs could reduce the availability and quality of the existing habitat for shad, but to date the extent of suitable habitat has been stable. The extent of existing habitat – $19.52km^2$ - is therefore taken as the area of suitable habitat.

7. Conclusions

Range:	Favourable
Population:	Favourable
Habitat:	Favourable
Overall:	Favourable

REFERENCES

King, J.J. & Roche, W.K. (2000) Fish Populations in L. Leane, Killarney: Report of a fish stock survey carried out in June 1999. A report commissioned by the Lough Leane Catchment Monitoring and Management group and prepared by the Central Fisheries Board. Central Fisheries Board. Dublin.

O' Grady, M. F. (1993) A fish stock survey of L. Leane, Co. Kerry and management recommendations for this resource. Report commissioned by Office of Public Works (Parks and Monuments Section), Central Fisheries Board.

O' Maoleidigh, N. (1990) *A study of fish populations in the Killarney Lakes*. Unpublished Ph.D. Thesis, National University of Ireland.

O'Maoleidigh, N., Cawdrey, S., Bracken, J. J. and Ferguson, A. (1988) Morphometric, meristic character and electrophoretic analyses of two Irish populations of Twaite shad, *Alosa fallax* (Lacepede). *Journal of Fish Biology*, **32**, 355-366.

Regan, C. T. (1912) The twaite shad in Killarney lakes. *The Irish Naturalist*, 21, 63.

Roche, W.K. and Rosell, R.S. (2003) Killarney shad (*Alosa fallax killarnensis*) investigations, 2003. Unpublished report to National Parks and Wildlife Service. Central fisheries Board. Dublin.

Trewavas, E. (1938) The Killarney Shad or Goureen (*Alosa fallax Killarnensis* Regan 1916). *Proceedings of the Linnaean Society, London*, 150, 110-112.

P. Toner, J. Bowman, K. Clabby, J. Lucey, M. McGarrigle, C. Concannon, C. Clenaghan, P. Cunningham, J. Delaney, S. O'Boyle, M. MacCárthaigh, M. Craig and R. Quinn (2005) Water Quality in Ireland 2001-2003. EPA, Ireland

5046 Killarney shad (Alosa fallax killarnensis)

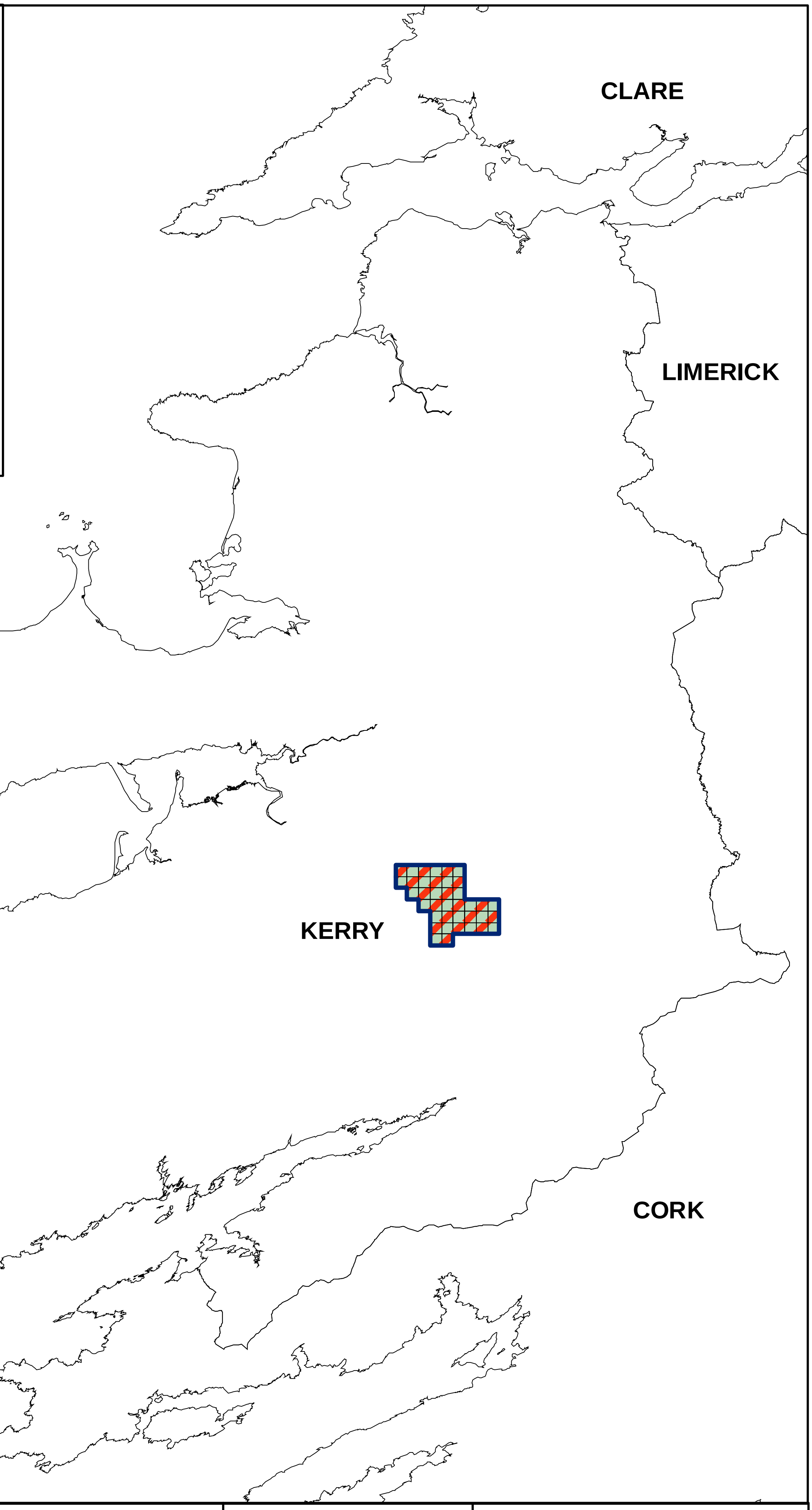
1. National Level	
Species code	5046
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)

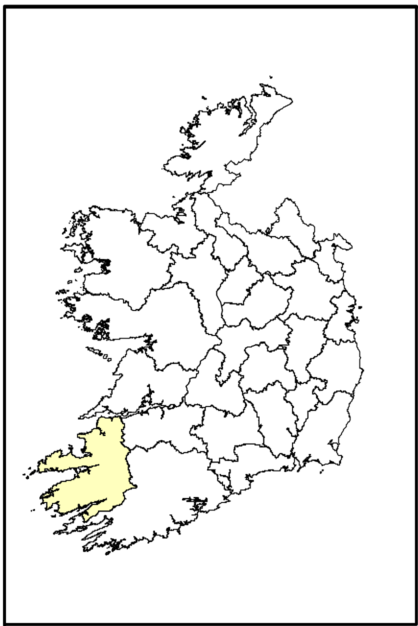
2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	**King, J.J. & Roche, W.K. (2000**) Fish Populations in L. Leane, Killarney: Report of a fish stock survey carried out in June 1999. A report commissioned by the Lough Leane Catchment Monitoring and Management group and prepared by the Central Fisheries Board. Central Fisheries Board. Dublin. **O' Grady, M. F. (1993)** A fish stock survey of L. Leane, Co. Kerry and management recommendations for this resource. Report commissioned by Office of Public Works (Parks and Monuments Section), Central Fisheries Board. **O' Maoleidigh, N. (1990)** *A study of fish populations in the Killarney Lakes*. Unpublished Ph.D. Thesis, National University of Ireland. **O'Maoleidigh, N., Cawdrey, S., Bracken, J. J. and Ferguson, A. (1988)** Morphometric, meristic characterand electrophoretic analyses of two Irish populations of Twaite shad, Alosa fallax (Lacepede). *Journal of Fish Biology*, **32**, 355-366. **Regan, C. T. (1912)** The twaite shad in Killarney lakes. *The Irish Naturalist*, 21, 63. **Roche, W.K. and Rosell, R.S. (2003)** Killarney shad (*Alosa fallax killarnensis*) investigations, 2003. Unpublished report to National Parks and Wildlife Service. Central fisheries Board. Dublin. **Trewavas, E. (1938)** The Killarney Shad or Goureen (*Alosa fallax Killarnensis* Regan 1916). *Proceedings of the Linnaean Society, London*, 150, 110-112.
2.3 Range	
2.3.1 Surface area	38km^2
2.3.2 Date	June 2007
2.3.3 Quality of data	3 = good
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	1994 - 2007
2.3.7 Reasons for reported trend	N/a
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	>20,000 1+ fish
2.4.2 Date of estimation	2003
2.4.3 Method used	1 = based on expert opinion
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	Unknown, but assumed to be stable
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	N/a
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	701 – Water pollution (eutrophication) 853 – management of water levels
2.4.11 Threats	701 – Water pollution (eutrophication) 853 – management of water levels 954 – invasion by a species
2.5 Habitat for the species	
2.5.2 Area estimation	19.52km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	0 = stable

2.5.6 Trend-Period	1994 - 2007
2.5.7 Reasons for reported trend	N/a
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	38km^2
2.7.2 Favourable reference population	20,000 1+ fish
2.7.3 Suitable Habitat for the species	19.52km^2
2.7.4 Other relevant information	- The population trend is unknown but likely to be stable. - The population estimate is based on fish older than one year.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Favourable (FV)
Habitat for the species	Favourable (FV)
Future prospects	Favourable (FV)
Overall assessment of CS[1]	Favourable (FV)

[1] A specific symbol (e.g. arrow) can be used in the unfavourable categories to indicate recovering populations





1:500,000

0 2.5 5 10 Kilometers

Killarney Shad

5046

Current Distribution (38 grid squares)
Current Range (38 grid squares)
Favourable Reference Range (38 grid squares)
1km grid squares

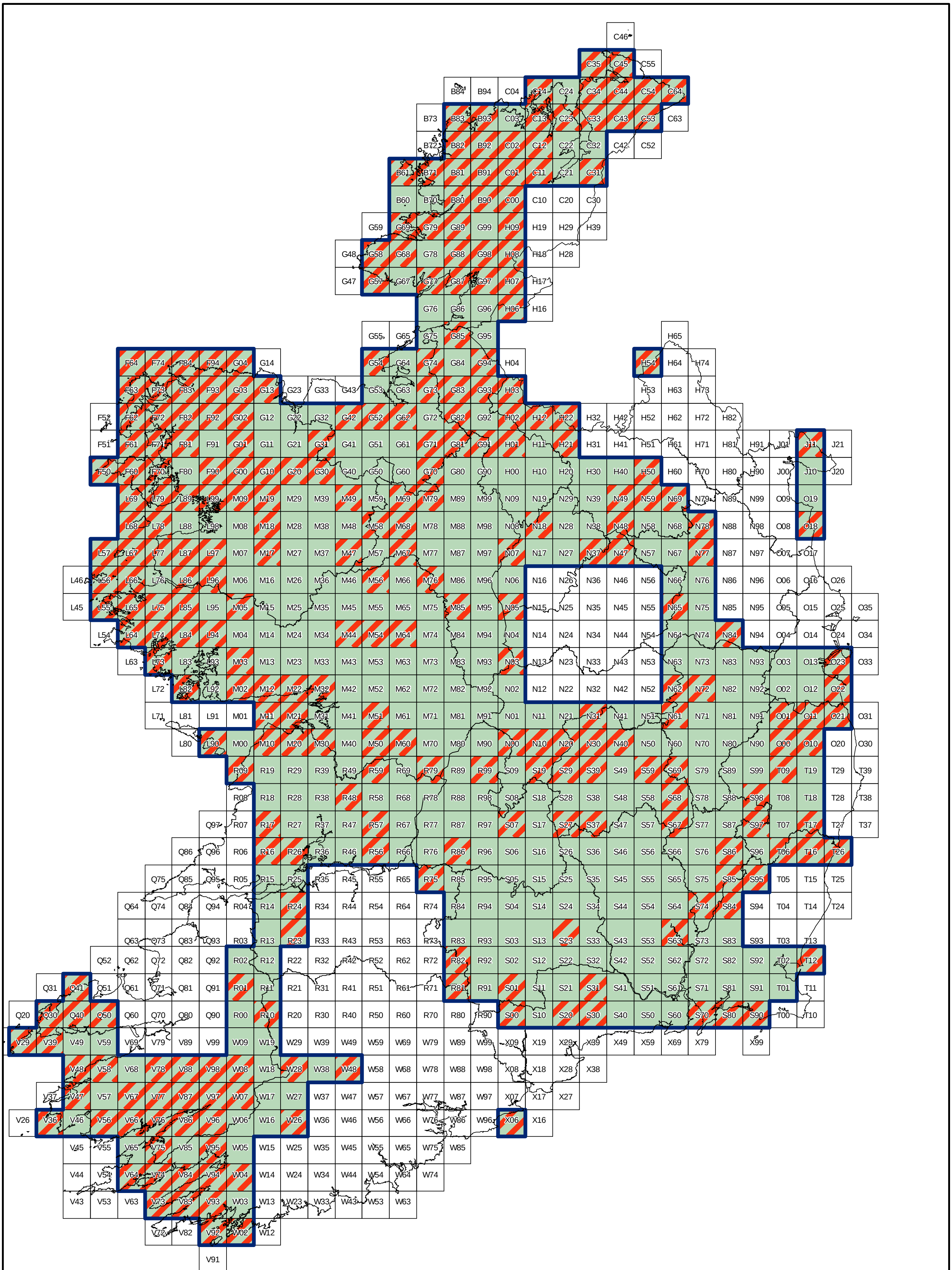
Date: August 2007

1. National Level	
Species code	5113 Cladonia subgenus Cladina
Member State	IE
Biogeographic regions concerned within the MS	ATL

2. Biogeographic level	
2.1 Biogeographic region	ATL
2.2 Published sources	None
2.3 Range	
2.3.1 Surface area	57400
2.3.2 Date	1967-2006
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Stable
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	NA
2.4 Population	
2.4.1 Population size estimation	275 grid squares occupied
2.4.2 Date of estimation	1967-2006
2.4.3 Method used	2 = extrapolation from surveys
2.4.4 Quality of data	1 = poor
2.4.5 Trend	Stable
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	NA
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	NA for genus
2.4.11 Threats	NA for genus
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	2006
2.5.4 Quality of data	1 = poor
2.5.5 Trend	Declining
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	3 = direct human influence (restoration, deterioration, destruction)
2.6 Future prospects	poor

2.7 Complementary information	
2.7.1 Favourable reference range	57400
2.7.2 Favourable reference population	27500
2.7.3 Suitable Habitat for the species	Unknown

2.7.4 Other relevant information	Distribution records collated for this genus were, in many cases, incidental to habitat surveys. Pressures & threats were not listed as they would not have the same impact on all of the species in the genus. A study was commissioned in 2006 by the National Parks & Wildlife Service, Department of Environment, Heritage & Local Government, Ireland to investigate Wildlife trade in Ireland. There was no evidence of collection of any species from this grouping for trade in Ireland. Of the 17 garden centres visited one stocked *Cladonia rangiferina*, was sourced in the UK. They all noted that demand was generally very low, and that synthetic products were usually used instead. None of the eleven additional garden centres contacted by phone stocked Cladonia species. Cladonia is also used in modelling by architects and hobbyists to create miniature model trees and hedges. However, the material is bought packaged and spray-painted from suppliers in the UK and Europe. There is no indication of any Irish enterprise supplying this trade. Although this genus occurs in many widespread habitats, the condition of these habitats is considered to be inadequate. The conservation assessments for Fixed dunes, Blanket bog and Raised bog habitats should be taken into consideration for this assessment. The area of suitable habitat is very difficult to determine for a genus.
2.8 Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Population	Favourable (FV)
Habitat for the species	Inadequate (U1)
Future prospects	Inadequate (U1)
Overall assessment of CS[1]	Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Cladonia spp.
subgenus _cladina_

5113

Current Distribution (275 cells)

Current Range (574 cells)

Favourable Reference Range (574 cells)

W48 10km grid cells

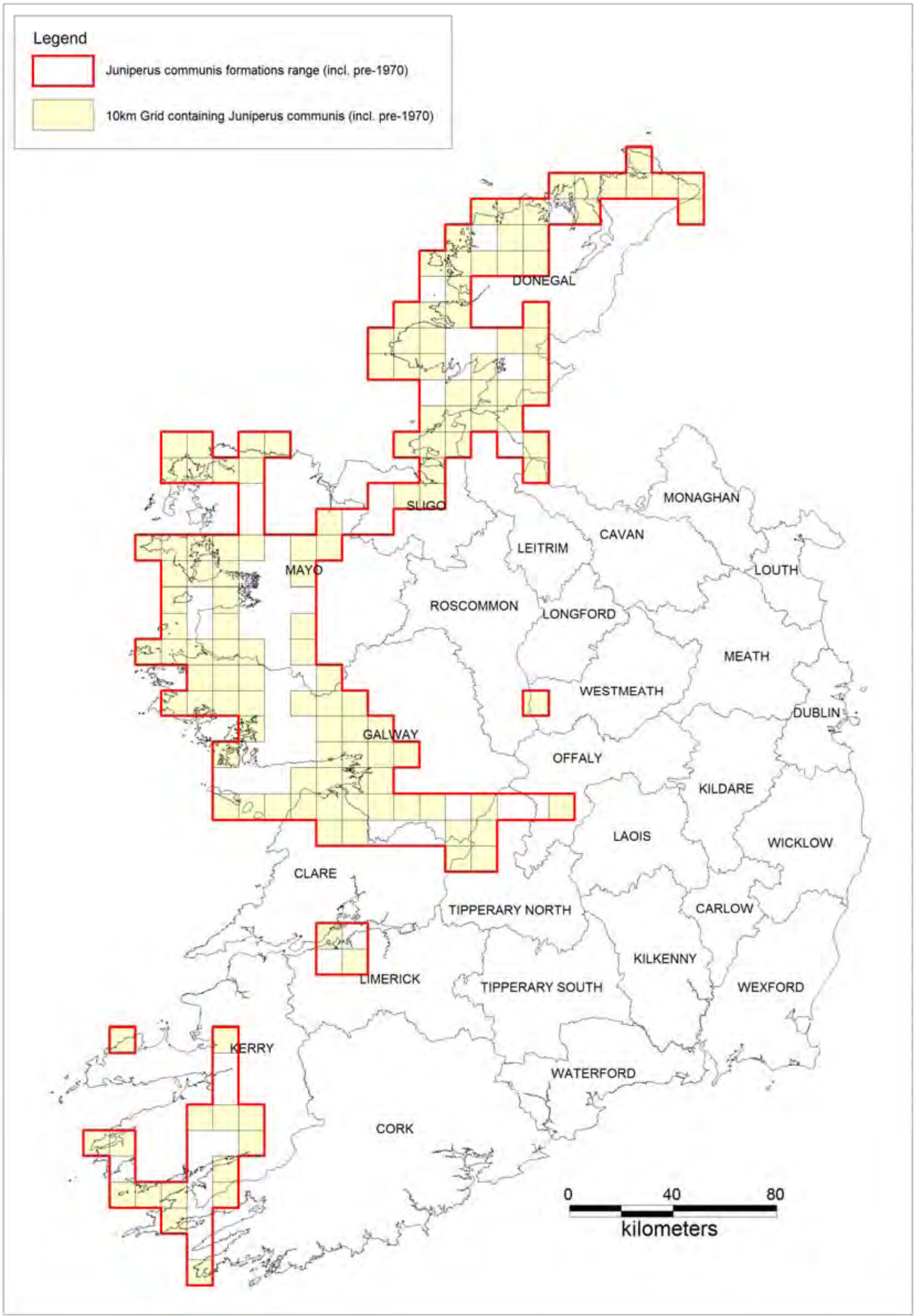
Date: January 2008

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

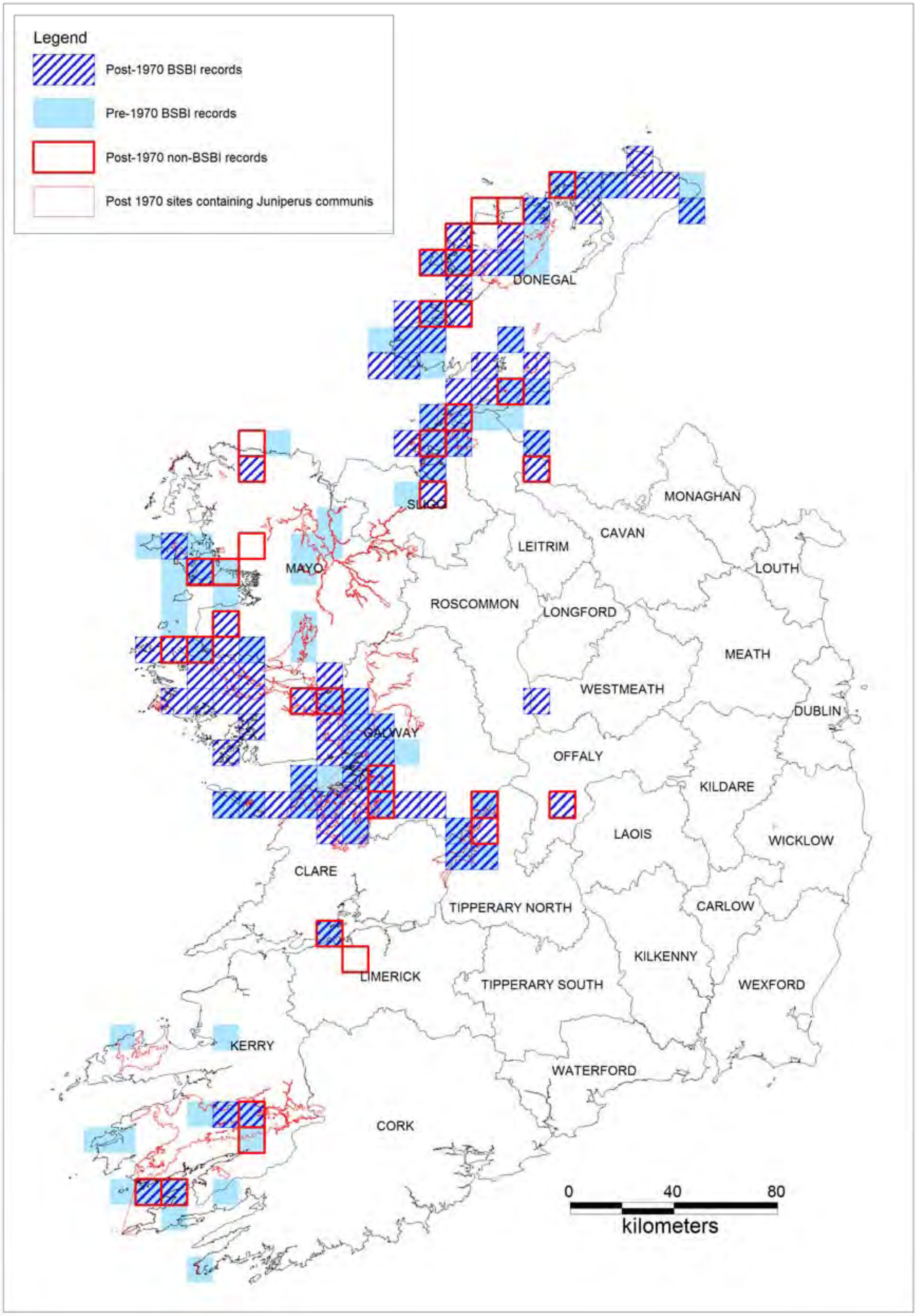
1 Maps....2
2 Habitat characteristics in Ireland....6
3 Habitat mapping....6
4 Habitat Range....9
4.1 Conservation Status of Habitat Range....9
4.2 Habitat Extent....10
4.2.1 Data set comprehensiveness....10
4.2.2 Area based on estimate of habitat stands....11
4.3 Conservation Status of Habitat Extent....12
5 Structures and Functions....12
5.1 Habitat Structures and Functions....12
5.2 Conservation Status of Habitat Structures and Functions....13
5.3 Typical Species....13
5.3.1 Conservation Status of Habitat Typical Species....13
6 Impacts and Threats....14
7 Future Prospects....15
7.1 Negative Future Prospects....15
7.2 Positive Future Prospects....15
7.2.1 The Rural Environment Protection Scheme (REPS)....15
7.2.2 National Farm Plan Scheme (NFPS)....16
7.2.3 Notifiable actions....16
7.2.4 Site-specific management....16
7.2.5 Monitoring....18
7.2.6 Overall Habitat Future Prospects....18
8 Overall Assessment of the Habitat Conservation Status....18
9 References....19
Appendix 1: Dataset review....20

1 Maps



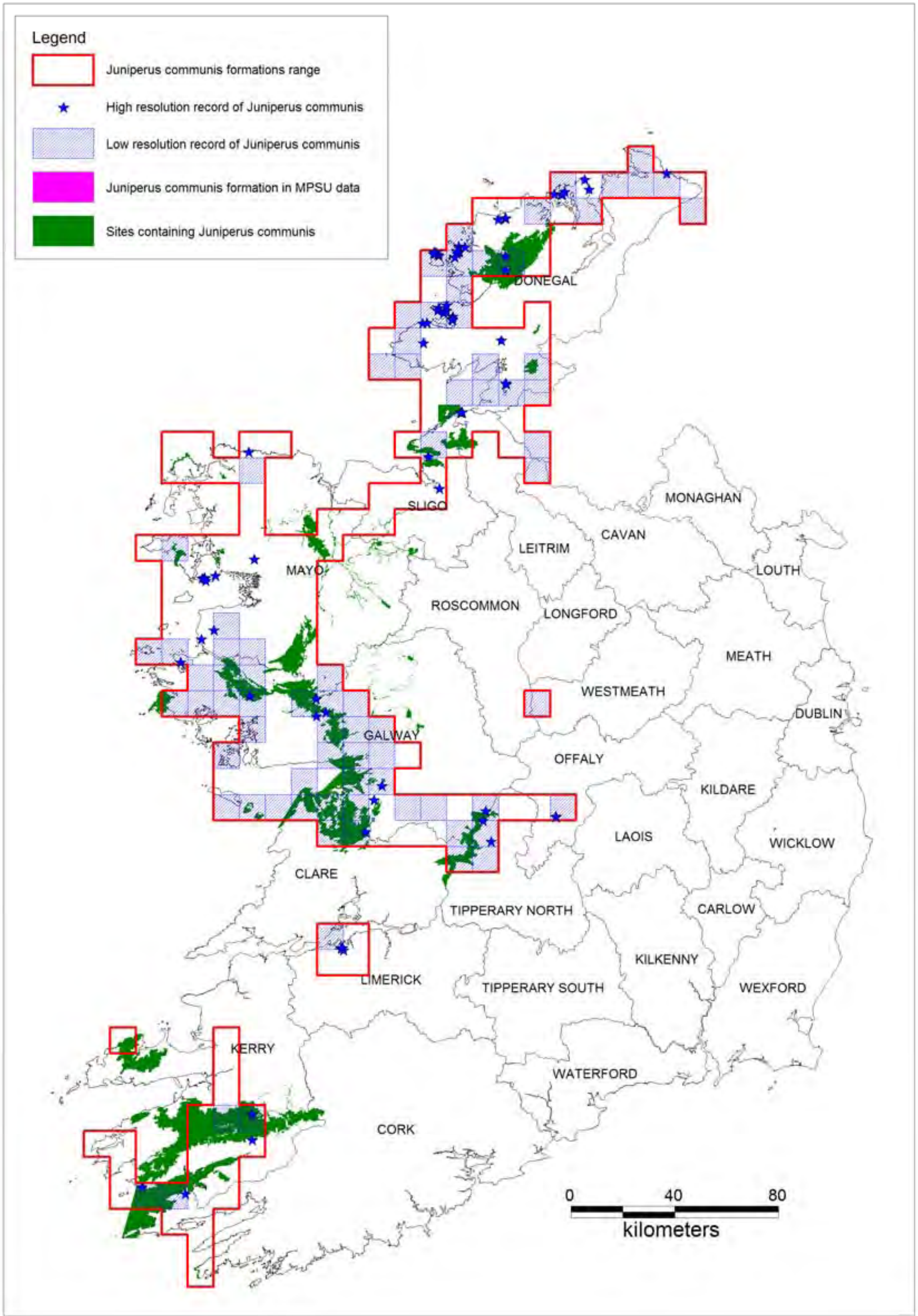
Reproduced from Ordnance Survey material by permission of the Government (Permit No 5953).

Map 1. Range of all pre and post 1970 species and habitat records of *Juniperus communis,* equivalent to estimate of favourable reference range and current range of *Juniperus communis* formations on heathland or calcareous grasslands (5130).



Reproduced from Ordnance Survey material by permission of the Government (Permit No 5953).

Map 2. The distribution and source of all records at the 10km grid square scale for *Juniperus communis* formations on heathland or calcareous grasslands (5130), equivalent to current extent at 10km grid scale.



Reproduced from Ordnance Survey material by permission of the Government (Permit No 5953).

Map 3. All post 1970 species and habitat records of *Juniperus communis* formations *(variable resolution),* on heathland or calcareous grasslands (5130).

2 Habitat characteristics in Ireland

Juniperus communis formations on heathland or calcareous grasslands (5130) includes formations with *Juniperus communis* of plain to montane levels. They mainly correspond to phytodynamic succession of mesophilous or xerophilous calcareous and nutrient poor grassland, and heathlands. These habitats include stands of Festuca-Brometea and Elyno-Sesleretea grasslands, and Calluno-Ulicetea minoris heathland which contain *Juniperus communis*. A ‘formation’ is taken to vary from single or widely scattered plants to dense stands of *Juniperus communis*.

3 Habitat mapping

Figure 1 is a schematic representation of the approach taken for mapping the habitat. The mapping of the habitat used the following species records, referenced to the Irish National Grid:

- Wyse-Jackson of NPWS (2005-06) – various records;
- Locations (target notes) for *Juniperus communis* from NHA files;
- Botanical Society of the British Isles (BSBI) records, available on the National Biodiversity Network (NBN) gateway (these records are those which were used in the New Atlas of the British and Irish Flora (Preston *et al*. 2002).
- Other miscellaneous *Juniperus communis* records available from the NBN gateway, including those from Environment and Heritage Service species datasets.

It also used the boundaries of any designated sites which were reported as containing the habitat, according to NPWS databases and site files. Most sites overlapped with smaller grid-referenced records and/or target notes, so it was assumed in these cases that the location of *Juniperus communis* was restricted to these higher resolution locations. In some cases, there was no other record overlapping with a site. In these cases the sites contributed to the estimate of number of *Juniperus* communis formation stands (assumed 1 per site - see section 4.2), but did not contribute to the estimate of habitat range.

The draft conservation report for *Juniperus communis* formations on calcareous substrates (O’Donavan, 2007), was similarly based upon site file information and BSBI records. Comparison with locations on calcareous substrates documented and key information and text from that report have been incorporated here.

Dataset summaries are provided in Appendix 1.

Note that it has not been possible to separate *Juniperus communis* records within 5030, from occurrences within other habitats including 4060: Alpine and sub-alpine heath, *Juniperus communis* on alpine rocky slopes and screes (covered by 8220, 8210, 8110 and 8120) and *Juniperus communis* within limestone pavement (covered by 8240: limestone pavement). Also, *Juniperus communis* within dune systems and other habitats have not been separated. The range and extent of the habitat has been assumed to be the same as that for the species.

The range was defined as the smallest polygon containing all grid squares where the habitat was recorded, drawn using a minimum of 90 degree angles. Gaps in the habitat distribution of greater than 2 grid squares or as a result of unsuitable ecological conditions for the development of the habitat, were deemed enough to justify a break in the range.

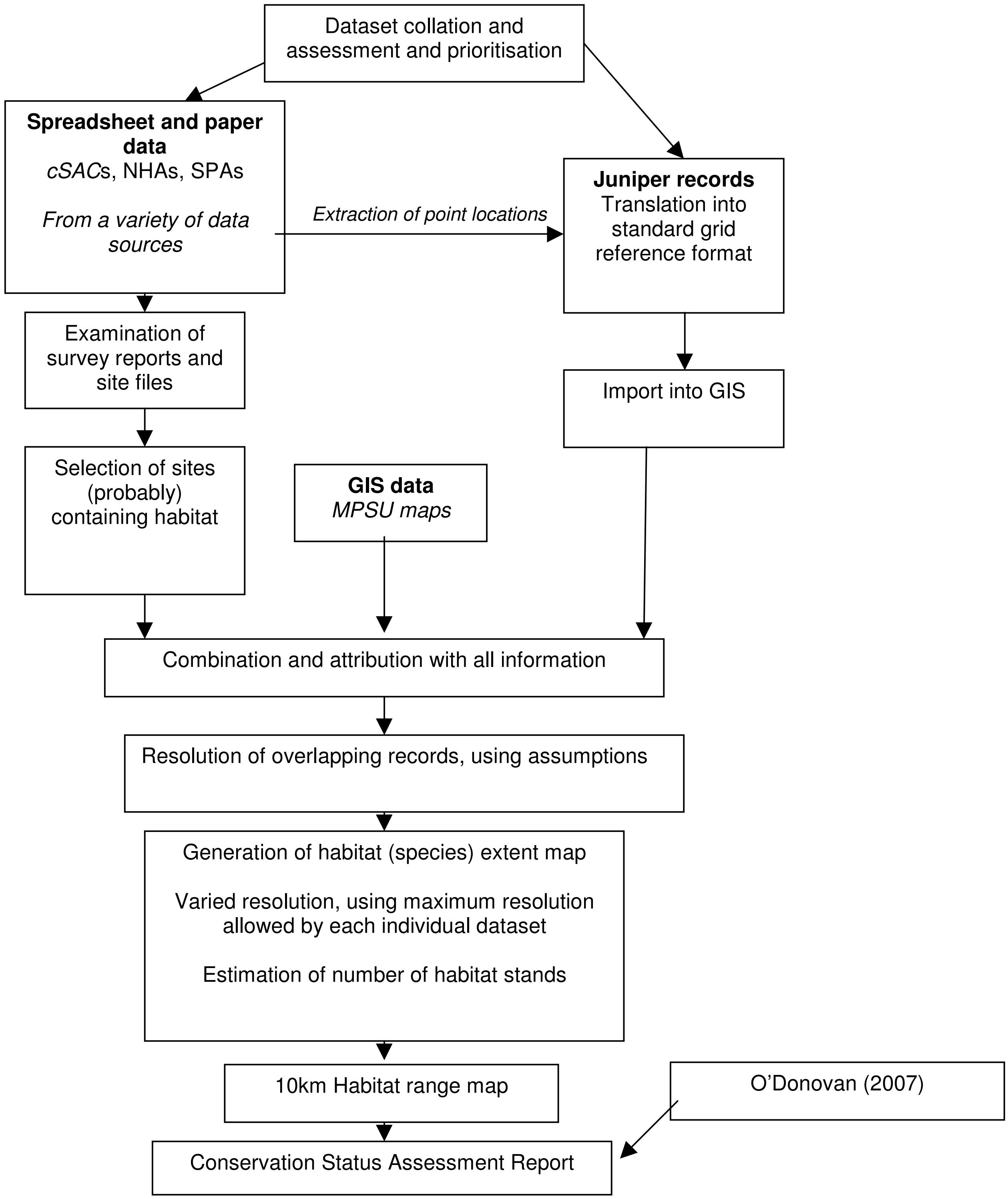


Figure 1: Flow of work for *Juniperus communis* formations on heathland or calcareous grasslands (5130)

4 Habitat Range

Juniperus communis occurs in a wide variety of plant communities as it can grow on both acid and alkaline soils throughout the British Isles from sea level to the highest montane areas. *Juniperus communis* can be a pioneer element of all types of open ground communities except for those in wet areas, and is especially characteristic of free-draining soils. It is limited by shading, and cannot persist in dense woodland.

Map 1 shows the range for the habitat in Ireland. This is simply based upon all records (site, and both pre- and post-1970 species records), though excluding parts of large SAC sites which do not intersect with other records and where the *Juniperus communis* distribution was probably very restricted within the SAC site. More detail on the justification for including individual records can be found in section 4.2 below.

Juniperus communis formations are concentrated towards the north and west of the country, as shown in the habitat range Map 1. This gives a current range of the habitat of 18,500 km^2. (If all of the area within large SAC sites containing *Juniperus communis* were included, an additional 6,400km^2 would be covered. However it was decided not to include these squares in the range as lack of target notes for the species or records suggest that the *Juniperus communis* distribution was probably very restricted within these (mainly large) sites - see section 4.2 for more details. If only post-1970 records are included in the range, the range was reduced to 13,100 km^2.

Of the current estimated range of 18,500 km^2, an estimated 3,800km^2 is from sites and records on calcareous substrates (O'Donovan, 2007).

4.1 Conservation Status of Habitat Range

If the favourable reference range is also considered to be that of all (pre and post 1970) records (similarly excluding parts of SAC sites which did not intersect with other records and appropriately linked), the area covered by the FRR is also 18,500 km^2. This is equivalent to the determined current range (Map 1). Hence, since current range equates to the favourable reference range, a Favourable (FV) conservation status can be allocated. However, because of questions concerning the comprehensiveness of recording, and reliance on single species records, there is some uncertainty over the accuracy of this estimate of current range. Furthermore, evidence suggests that within this range, the area of the habitat may be descreasing (see section 4.2.1 below).

4.2 Habitat Extent

4.2.1 Data set comprehensiveness

Map 3 shows the available post 1970 *Juniperus communis* records, which are at variable resolution, overlaid with the estimate of current range (which includes pre-1970 records). It also shows the parts of SAC sites which fell outside of the range (either because there were no other records associated with them, or where these existed, they only covered part of the SAC site).

Map 2 shows the distribution and source of all records at the 10km grid square scale. This shows that in some cases, pre-1970 BSBI *Juniperus communis* species records have not been re-recorded in later years, except via overlapping whole SAC site records. Conversely, many post-1970 records did not have an underlying older record. As a result, the range of available post-1970 records; (13,100km^2 containing 100 grid squares) was 10% greater than that for pre-1970 records (11,900 km^2 containing 83 grid squares). The post 1970 records included BSBI records supplemented by other NBN data sources, Wyse-Jackson (2005-06) and SAC site target notes; pre-1970 records were all from the BSBI. This suggests either an expansion of the species (and the conservation status would be favourable), or historical poor coverage by the BSBI dataset; though the latter is more likely.

If it is assumed (based on the acknowledged historical under-recording within Ireland), that all post-1970 records were also present pre-1970, but that post-1970 recording was more comprehensive, this equates to a decline of 29.2% in range for a period spanning 30 years or more. If a second assumption is made that all species losses occurred in the 36 year period 1970-2006, this equates to an Irish loss of 0.81% per year, which means that the conservation status of the habitat range could be considered to be Unfavourable Inadequate (U1).

However, if the post-1970 dataset is also considered not to be comprehensive, and it is assumed that *Juniper communis* still exists, at least in some of the areas where recorded pre-1970, the decline in the species is not so clear. This assumption is based upon expert judgement of NPWS staff, is supported in part by the existence of recent non-BSBI records (mainly Wyse-Jackson (2005-2006), outside of any areas recorded as containing the species by recent BSBI. In reality, the species probably has not declined so significantly in Ireland as it has in the UK, as many of its sites are now protected and/or are very remote (O'Donovan, 2007). However, the risk to the species from aging, non regenerating populations, remains.

The decline of *Juniperus communis* has been more strongly, demonstrated in the UK by repeat surveys at specific sites (Clifton *et al*., 1997; Plantlife, 2004). In Northern Ireland a recent survey found that the species was found at only 65% of previously recorded sites (Preston *et al*., 2006). These latter surveys all provide supporting evidence to the decline of the species across the British Isles.

4.2.2 Area based on estimate of habitat stands

The estimated extent of the habitat was based on the estimated number of (pre and post 1970) habitat stands. In order to estimate the number of stands of the habitat, the number of *Juniperus communis* records were counted, making the following assumptions:

1. Where no target note information was available for SAC sites, only one stand of *Juniperus communis* was present within the SAC site;
2. Duplicate records of *Juniperus communis* for individual 10km by 10km grid squares did not relate to the same stand;
3. Every record related to a stand/formation of *Juniperus communis* habitat;
4. Where coarse resolution records of *Juniperus communis* contained finer resolution records it was assumed that the coarser resolution records were a duplicate of the finer resolution ones. In instances where a coarse resolution record was duplicated by a finer resolution record, one of the duplicate records was removed for every fine scale record they contained – for example: if a grid square had three records at a grid square resolution and two records at 6-figure resolution, the two 6-figure records were both counted but only one of the grid squares were. Where site-based records were concerned it was dependant upon the size of the site and the resolution of the record(s) it contained or containing it.

Under-estimation of the number of *Juniperus communis* stands may have arisen due to assumptions 1 and 4. Over-estimation of the number of *Juniperus communis* stands may have arisen due to assumptions 2, 3 and 4.

This resulted in the identification of 281 *Juniperus communis* records (i.e. assumed stands), plus one 8.8ha polygon identified by MPSU. (When pre-1970 records were excluded, there were an estimated 206 stands included).

If the average stand size for *Juniperus communis* was 10m by 30m (0.3 ha), then this will result in an estimated total area of 93.1 ha of habitat . If the average stand size is 100m by

100m (i.e. 1 ha) than the estimated total area is 289.9 ha. The total area of *Juniperus communis* formation may well lie somewhere between the highest and lowest estimate two values*, i.e*. 153±136 ha.

The estimated stand size of 0.3 ha or 1 ha used, and the inclusion of pre-1970 records is based upon the expert judgement of NPWS staff.

4.3 Conservation Status of Habitat Extent

Given the uncertainty of the comprehensiveness of the various Irish datasets, but based on accepted increasing occurrence of moribund populations with no regeneration, together with evidence from abroad, the habitat favourable reference area was thought to be higher than current area, with an overall negative trend in habitat area. Hence it was allocated an Unfavourable Inadequate (U1). status overall, though more survey data is needed to fully understand the scale of the decline.

5 Structures and Functions

5.1 Habitat Structures and Functions

An important issue within many *Juniperus communis* populations is the occurrence of even-aged stands, and lack of new recruitment from seeds into the population (Plantlife, 2004, Preston *et al*., 2006). Vegetative regeneration in *Juniperus communis* is usually unsuccessful. Populations of the species in Northern Ireland are largely senescent with little evidence of recruitment (Preston *et al*. 2006). Grazing may severely impact seed regeneration, though other requirements for seed regeneration (presence of bare ground, lack of shade) are also important, and complete removal of grazing may not in itself enable regeneration (UK BAP, 1999). Intermittent grazing may be ideal (removal periods of 10 years are suggested), with seedlings appearing during and just after severe grazing once herbivores are removed (Plantlife, 2004). In lowland England, many younger *Juniperus communis* populations date back to the loss of rabbit grazing from mxyomatosis in 1954-55 following years of heavy grazing, which created ideal open ground conditions for young seedlings. The average life span for *Juniperus communis* in the warm climate of southern England is 100-130 years and seed viability reduces with age, so regeneration should be promoted after about 50 years if it is not occurring naturally (Plantlife, 2004). Regenerating already aging populations of the species may be difficult.

As the seeds of *Juniperus communis* are transient (meaning that they persist in the soil for less than one year), successful regeneration probably requires a parent or nearby population of healthy, fruiting *Juniperus communis* (Plantlife, 2004). Other records of *Juniperus communis* appearing spontaneously are apparently from bird dispersal (Plantlife, 2004).

Though it is not a very palatable plant, sufficiently abundant herbivores may strongly affect the physiognomy of the bushes, and in some cases, eliminate the species altogether (Rodwell, 1991). Excessive burning may also destroy both young regeneration and adult bushes (UK BAP).

There have been no similar studies carried out in Ireland as yet. In Ireland, there appears to be a great deal of variation in the condition of the habitat. In one cSAC (Lough Derg, Site Code 11) it is abundant, growing to full height across the site. In other sites growth is inhibited, and it is largely low growing.

5.2 Conservation Status of Habitat Structures and Functions

Based on the evidence outlined above the conservation status of the habitat structure and functions in Ireland is unknown. However, taking the UK information into account and using best expert judgement, the conservation status of the habitat structure is Inadequate (U1). More survey information is required to fully understand the condition of the habitat within Ireland.

5.3 Typical Species

The habitat is defined by *Juniperus communis*. When this occurs in heathlands, the typical species are *Calluna vulgaris, Vaccinium myrtillus, Empetrum nigrum, Erica tetralix, Deschampsia flexuosa* and *Nardus strict*a. In calcareous grasslands, it grows along with species typical of Festuco-Brometea/ Elyno-Seslerietea communities such as *Calluna vulgaris, Empetrum nigrum, Erica cinerea, Carex flacca, C binervis, C panicea, Festuca rubra, Antennaria dioica, Pilosella officinarum, Rosa pimpinellifolia Arctostaphylos uva-ursi, Empetrum nigrum, Dryas octopetala, Sesleria albicans, Crataegus monogyna, Rhamnus catharticus, Taxus baccata, Arbutus unedo, Fraxinus excelsior, Crataegus monogyna, Ulex europaeus, Corylus avellana, Anacamptis pyramidalis, Gymnadenia conopsea, Listera ovata, Dactylorhiza spp., Ophrys insectifera, Orchis morio, Spiranthes spiralis*, and the lower plants *Hypnum cupressiforme* and *Pseudoscleropodium purum.*

5.3.1 Conservation Status of Habitat Typical Species

An accurate assessment of the condition of typical habitat species can not be carried out in the absence of a specific monitoring programme. Furthermore, the conservation of these species is secondary to that of *Juniperus communis*, which asserts the more exacting set of requirements for its own survival. The conservation status for typical species is therefore, Unknown.

6 Impacts and Threats

Grazing and browsing (by deer, rabbits and livestock) is an important factor for *Juniperus communis* populations. Grazers may, in some cases, eliminate the species altogether (Rodwell, 1991). Protection from grazing may be realised when the plants are located on inaccessible rock exposures or in bogs. In Northern Island the species occurs mainly on high, steep slopes or inaccessible coastal cliffs (Preston *et al*. 2006). Excessive burning may also destroy both young regeneration and adult bushes (UK BAP).

The UK's Modelling Natural Resource Responses to Climate Change (MONARCH) project predicts that raised temperature, more winter rainfall, high rates of evaporation, raised sea levels and increased storminess will adversely affect *Juniperus communis*, particularly where it grows in dry conditions (as the seedlings are not drought tolerant), or in coastal areas which will be subject to increased storminess (Plantlife, 2004).

Finally *Juniperus communis* formations are subject to the negative influences impacting on the semi-natural communities in which they occur, particularly change of land use to intensive agriculture, and afforestation (Plantlife, 2004).
There is very limited actual data available by which the impacts and threats to Irish *Juniperus communis* habitat can be objectively assessed. Specific actions include 148 Overgrazing, 141 Abandonment of pastoral systems, 180 Burning, and 990Other natural processes (lack of opportunity for regeneration).

A brief review of data held within a sub-sample of cSAC Natura 2000 paper files for designated *Juniperus communis* formations was collated. This shows sites designated for *Juniperus communis* may be threatened by over-grazing, agricultural improvement, pavement removal, burning and scrub encroachment, succession to woodland and invasion by *Rhododendron* spp. Also there have been four directly recorded incidences of damage due to developments and nearly all by the owner/occupier. Flooding has been seen as a threat at Coole-Garryland but otherwise the main recognised threats are fertilisation, overgrazing, and land reclamation. Outside of protected areas, Juniper removal has been noted on a cursory visit to some limestone pavements at Cappaghmore (Figure 1) where Juniper and limestone pavement was being removed as part of agricultural improvements (S. Ward pers. comm.).

Figure 1: *Juniperus communis* clearance for agricultural purposes at Cappaghmore (Photo Stephen Ward-April 2007)

7 Future Prospects

7.1 Negative Future Prospects

Juniperus communis formations on heathland or calcareous grasslands are still at risk from many of the impacts identified above, though the following positive measures may assist in their conservation.

7.2 Positive Future Prospects

7.2.1 The Rural Environment Protection Scheme (REPS)

REPS is an EU-funded Department of Agriculture, Food and Forestry scheme for environmentally sensitive farming, introduced in 1995, which includes incentives to reduce stocking densities within proposed NHAs, cSACs and on land designated as degraded (over-grazed).

The positive impact of this scheme for conservation of *Juniperus communis* formations is dependent on various factors such as the uptake of REPS and the suitability of prescriptions.

7.2.2 National Farm Plan Scheme (NFPS)

The NFPS launched in February 2006 operates on designated areas (cSACs, SPAs) and commonage land. It follows on from the requirements of the EU Natural Regulations and the Wildlife (Amendment) Act 2000. The scheme allows the Department to pay farmers and landowners for losses incurred through restrictions caused by the designation of lands, and to pay for certain actions which are beneficial to wildlife, as agreed in a Farm Plan (such as reduced stocking density, sensitive positioning of feeding points and regulation of the use of fertilisers and herbicides).

These farm plans should reduce damage to *Juniperus communis* formations, though its success is obviously dependant on the uptake by farmers.

7.2.3 Notifiable actions

Juniperus communis formations within SACs are protected in part through a list of Notifiable Actions. This lists activities which should not be carried out without consent and includes such land management activities as application of fertilisers, pesticides or herbicide, intensive burning regimes, grazing at intensities above those agreed in farm plans, re-seeding, dumping, ploughing or rock extraction. It also lists activities such as afforestation, and various forms of development.

7.2.4 Site-specific management

Considering the life span of *Juniperus communis* is somewhere between 100-130 years, and knowing that the majority of current *Juniperus communis* stands may be approaching 50 years in age with declining seed production, it is obvious that regeneration should be promoted vigorously now. A detailed and tested prescription for management of natural regeneration is not yet available. However, suggested management recommendations to enhance recruitment and regeneration (from O'Donovan, 2007) follow.

The requirements for successful *Juniperus communis* recruitment are as follows:

- A nearby population of healthy, fruiting *Juniperus communis*.
- Open bare ground or short slow-growing vegetation and nutrient poor soils
- Removal of nutrient rich top-soils and competing vegetation
- Continuous heavy grazing followed by no grazing
- Cutting and/or burning to remove vegetation and reduce nutrients
- Disturbance of soils to create open patches

After seedlings appear, grazing by rabbits or domestic stock should be reduced for about 10 years after. Light grazing is possible, but not fully recommended - summer grazing is thought to be better than winter grazing. Where *Juniperus communis* is growing in good quality calcareous grassland, the requirement to reduce grazing and disturb the ground may conflict with best practice for the grassland management and control of other scrub species. In such cases it is therefore suggested that a nearby area, which might currently be arable, can be managed for Juniper regeneration. In northern England and Scotland, increasing levels of natural regeneration seem to rely on ground disturbance followed by initial protection from grazing where grazing levels, by sheep, deer or rabbits, are high. Fences, where used, need to be marked to avoid bird collisions and sited below the skyline, but the situation also needs to be monitored as the growth of rank vegetation will eventually create conditions that are unsuitable for *Juniperus communis*. Otherwise, emerging seedlings may have to be guarded against herbivores.

In cases where *Juniperus communis* has small or unhealthy populations with no regeneration, then cuttings need to be taken from the extant *Juniperus communis* on the site or new plants reared from their available seed. Ideally seedlings are preferred as they retain genetic diversity and techniques have improved recently to increase germination and survival rates. Deer or goats may suppress the growth of young bushes. Conversely, if grazing is intensive and continuous over many years, then damage to *Juniperus communis* can be serious as its loss is progressive and stands are fragmented into communities of scattered individuals.

In lowland Britain, *Juniperus communis* is likely to be part of a successional community leading to woodland, and although this natural process should be included as part of *Juniperus communis* ecology on large scale nature reserves, it might be necessary on small sites, to prolong the reproductive life of existing *Juniperus communis* bushes present. One aspect of this is to prevent the initial invasion of other woody plants by the removal of their seed parents in the local vicinity. This has historically happened on very open chalk downlands where monocultures of *Juniperus communis* resulted from the absence of other seed-parents in hedges and other scrub.

The specific associated flora and fauna of *Juniperus communis* should be taken into account in conservation management.

7.2.5 Monitoring

There are known gaps in the current knowledge of *Juniperus communis* distribution. Greater efforts need to be made to grid populations and spend more time assessing and mapping the populations. In Ireland, the habitat also requires improved mapping within designated sites. Attempts should also be made to re-find all pre-1970 records.

7.2.6 Overall Habitat Future Prospects

The NFPS scheme and notifiable actions processes may be benefiting the habitat, though act only on land within designated sites. The REPS scheme operates also within the wider landscape, though is limited only to areas where landowners choose to enter the scheme. There is a lack of detailed information on the precise extent and condition of the habitat within the country, making it difficult to target future work. Furthermore, the threats to habitat 5130 are bound up with the threats to other Annex I habitats such as Limestone pavements and arctic alpine heaths. Therefore it is deemed that the prospects for the future of the habitat should be assessed as Unfavourable Inadequate (U1).

8 Overall Assessment of the Habitat Conservation Status

The conservation status of both habitat range and area was considered to be Favourable (FV). The conservation status of the habitat extent is Inadequate (U1). . The conservation status for structures and function is unknown (XX), but is expected to be unfavourable, due to the continuation of impacting activities, and anecdotal evidence for poor seedling recruitment. The conservation status for future prospects was deemed Inadequate (U1). This leads to an overall assessment of Inadequate (U1).

References

Clifton, S. J, Ward, L.K. & Ranner, D., S. (1997). The status of Juniper *Juniperus communis* L. in north-east England. *Biological Conservation* 79 67-77.

O'Donovan, G. (2007). Juniperus communis *formations on calcareous substrates (5130) Conservation Status Assessment Report.*Report to National Parks and Wildlife Service, Dublin.

Plantlife (2004). Juniperus communis *L. Species dossier* (Part 1 and Part 2). http://www.plantlife.org.uk/

Preston J, Provan J, McDonald R (2006) *Distribution and genetic variation of juniper* Juniperus communis *in Northern Ireland*. Report to Environment & Heritage Service.

Preston, C. D., Pearman, D. A & Dines, T. D. (2002). *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford.

Rodwell, J.S. (1991). *British Plant Communities: Volume 1. Woodlands and Scrub.* University Press, Cambridge.

UK BAP (1999). UK Biodiversity Group Tranche 2 Action Plans – Volume III: Plants and fungi.

Appendix 1: Dataset review

Botanical Society of the British Isles (BSBI) data

Full resolution access was arranged for the BSBI New Atlas data from the NBN Gateway. The BSBI data on the NBN Gateway is that held electronically by the BSBI, and used in the creation of the New Atlas Flora of the British Isles (Preston *et al*., 2002).

One limitation of this data was that it only contains records up to the end of 1999. However it still contained 8.9 million verified plant records for Britain and Ireland. More up to date data was not available, as it had yet to be processed by the BSBI.

These point records were translated into polygons covering the area for which each record relates. For example, if a record is at 5-figure resolution a square for it that covers the area to which the record was created (100m x 100m). This allowed these data to be accurately used to indicate the presence of *Juniperus communis* formations.

Management Planning Support Unit (MPSU) data

This dataset, produced by the NPWS, comprises mapped habitats within each designated site and is used for the purposes of management planning. Each habitat is coded, with BH1 being heath, BH1d being Dry Heath and SC6 being *Juniperus communis* scrub; though mosaics are allowed. However, the data is known to be of limited quality, often produced without any field survey, and individual polygons are not dated, so it is impossible to determine the age of the data. MPSU data is considered unreliable by NPWS staff, but it may support other datasets.

Sites based habitat information

The NPSW operates a site system where sites are given unique codes. Polygons representing designated sites were available, along with a wealth of information in both paper and spreadsheet format which related to these sites. Other sites were located only by site name, or point location. It was also possible to check for *Juniperus communis* formations in paper data in site files. The key site datasets were:

- Habitat Assignment Project database;
- Habitat Assignment Project updates December 2006;
- Old Corine database (no new sites added);
- Designated sites where habitat mentioned in site synopsis;

- Locations (target notes) for *Juniperus communis* from NHA files;

Wyse-Jackson (2005-06)

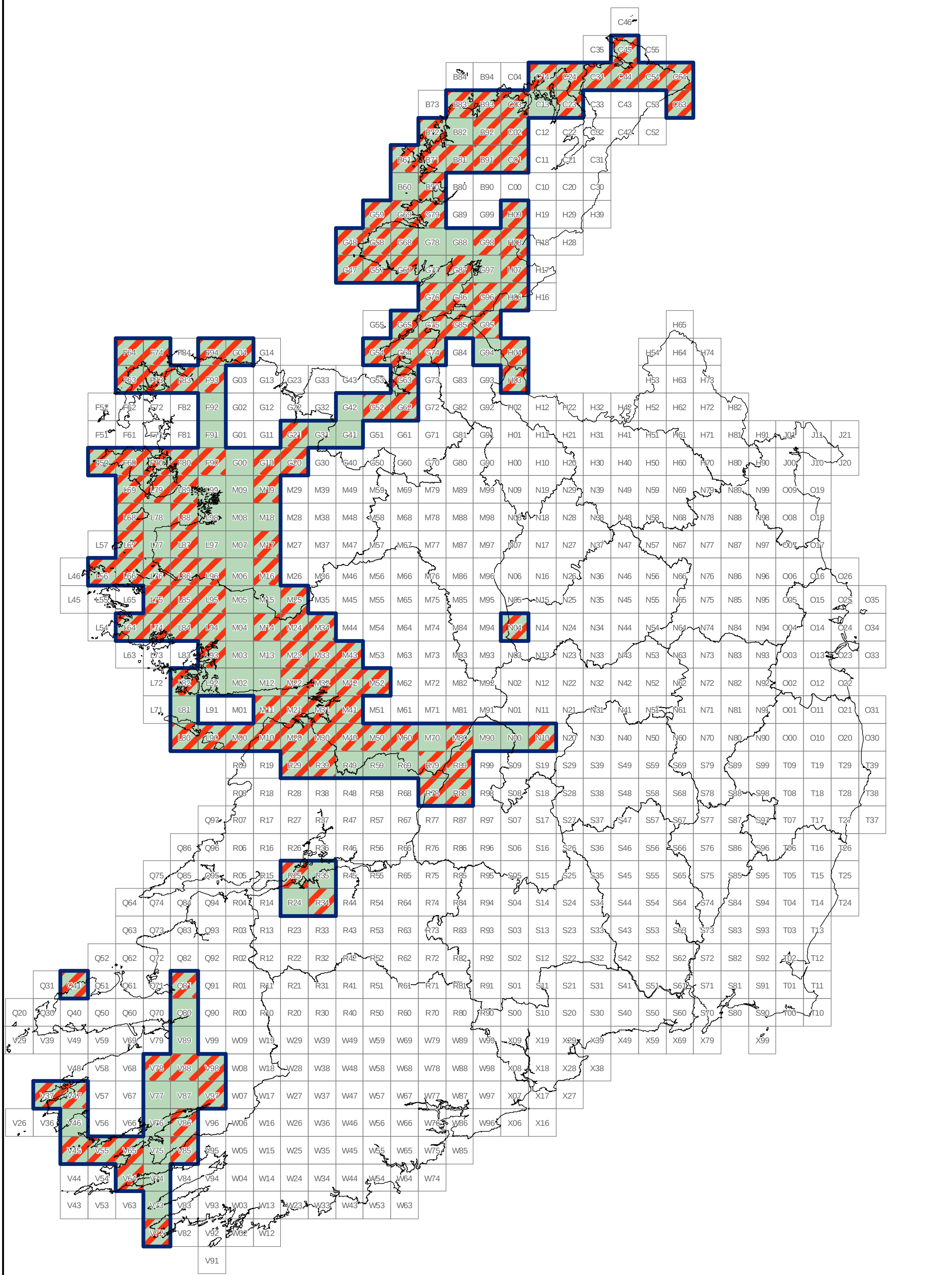
A paper file containing ad hoc paper records made by various NPSW staff and others.

5130 *Juniperus communis* formations on heaths or calcareous grasslands

1. National level	
Habitat Code	5130
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Atlantic (ATL)

2. Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	PUBLISHED REPORTS: ▪ Clifton, S. J, Ward, L.K. & Ranner, D., S. (1997). The status of Juniper *Juniperus communis* L. in north-east England. *Biological Conservation* 79 67-77. ▪ Plantlife (2004). Juniperus communis *L. Species dossier* (Part 1 and Part 2). http://www.plantlife.org.uk/ ▪ Preston, C. D., Pearman, D. A & Dines, T. D. (2002*). New Atlas of the British and Irish Flora.* Oxford University Press, Oxford. ▪ Preston J, Provan J, McDonald R (2006) *Distribution and genetic variation of juniper* Juniperus communis *in Northern Ireland*. Report to Environment & Heritage Service. ▪
Range	
Surface area	18,500km² (see Map 1). Pre and post 1970 range of *Juniperus communis* (excluding parts of large SAC sites which do not coincide with any other record).
Date	1800 - 2005
Quality of data	2 = moderate (Unclear due to uncertainty over comprehensiveness of recording over time, and reliance on single species records)
Trend	Unknown
Trend-Period	n/a
Reasons for reported trend	n/a
Area covered by habitat	
Surface area	Estimated 0.093 to 0.290 km^2 - based on estimated number of individual habitat stands, of 10m x 30km or 100m x 100m size (pre-and post 1970 records).
Date	1800 - 2005
Method used	Based on expert opinion
Quality of data	2 = moderate (expert opinion used to extrapolate from single species records to habitat area. Also unclear due to uncertainty over comprehensiveness of recording over time).
Trend	Unknown, though perhaps negative
Trend-Period	n/a
Reasons for reported trend	3 = direct human influence (particularly overgrazing 148) 5 = indirect anthropogenic influence (most notably lack of opportunity for regeneration)
Justification of % thresholds for trends	There may be a decline in Ireland similar to that documented for UK and NI (Clifton *et al.* (1997); Plantlife (2004) and Preston *et al.* (2006)).
Main pressures	148 Overgrazing 141 Abandonment of pastoral systems 180 Burning 990 Other natural processes (lack of opportunity for regeneration) 120 Fertilisation 800 Land reclamation 600 Holiday home development

Threats	148 Overgrazing 141 Abandonment of pastoral systems 180 Burning 990 Other natural processes (lack of opportunity for regeneration) 930 Flooding 151 Scrub removal 954 Invasion by Rhododendron ponticum
2.5 Complementary information	
Favourable reference range	18,500km² (see Map 1). Pre and post 1970 range of *Juniperus communis (*excluding parts of SAC sites which do not coincide with any other record).
Favourable reference area	Unknown, but probably greater than present area
Typical species	The habitat is defined by the presence of *Juniperus communis*. In heaths: *Calluna vulgaris, Vaccinium myrtillus, Empetrum nigrum, Erica tetralix, Deschampsia flexuosa, Nardus stricta.* In grasslands species typical of Festuco-Brometea/ Elyno-Seslerietea communities: *Calluna vulgaris, Empetrum nigrum, Erica cinerea, Carex flacca, C binervis, C panicea, Festuca rubra, Antennaria dioica, Pilosella officinarum, Rosa pimpinellifolia, Arctostaphylos uva-ursi, Empetrum nigrum, Dryas octopetala, Sesleria albicans, Crataegus monogyna, Rhamnus catharticus, Taxus baccata, Arbutus unedo, Fraxinus excelsior, Crataegus monogyna, Ulex europaeus, Corylus avellana, Anacamptis pyramidalis, Gymnadenia conopsea, Listera ovata, Dactylorhiza spp., Ophrys insectifera, Orchis morio, Spiranthes spiralis*, and the lower plants *Hypnum cupressiforme* and *Pseudoscleropodium purum*
Typical species assessment	The list of typical species submitted was derived using best expert judgement. Species lists may be compiled during field-based surveys, however all surveys that assess habitat condition focus on changes in or presence/absence of indicator species. Therefore the conservation status of all typical species is rarely assessed apart from assessments derived from best expert judgement.
Other relevant information	• Pre 1970 BSBI records which were not re-recorded post 1970 have been included within the range. Absence, post 1970, is not necessarily indicative of habitat/species loss. The area may not have been re-recorded comprehensively. • It has not been possible to entirely separate *Juniperus communis* records within 5030 from occurrences within other habitats including 4060: Alpine and sub-alpine heath, *Juniperus communis* on alpine rocky slopes and screes (covered by 8220, 8210, 8110 and 8120) and *Juniperus communis* within limestone pavement (covered by 8240: limestone pavement). All records are included. A "formation" is taken to vary from single or widely scattered plants to dense stands of *Juniperus communis.*
2.6 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV) (though there is some uncertainty due to uncertainty over comprehensiveness of recording over time, and reliance on single species records)
Area	Unfavourable Inadequate (U1)
Specific structures and functions (incl. typical species)	Unfavourable Inadequate (U1)
Future prospects	Unfavourable Inadequate (U1)
Overall assessment of CS	Unfavourable Inadequate (U1)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Juniperus communis
formations on heaths
or calcareous grasslands

5130

Current/Favourable Distribution (141 cells)
Current Range (191 grid cells)
Favourable Reference Range (191 cells)
W48 10km grid cells

Date: August 2007