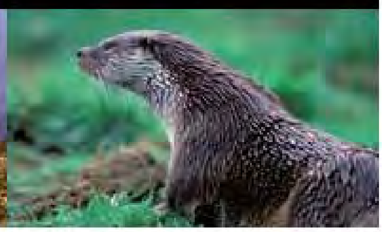
The Status of EU Protected Habitats and Species in Ireland

Backing Documents, Article 17 forms, Maps
Volume 1



Contents - Conservation Status Assesment Backing Documents

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**
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

Conservation Assessment of Geyer's whorl snail *Vertigo geyeri* in Ireland

July 2007

Contents

1.0 Ecology of Geyer's whorl snail *Vertigo geyeri* in Ireland

Vertigo geyeri is one of 8 species of whorl snail (genus *Vertigo*) living in Ireland. The whorl snails are amongst the smallest of the country's land molluscs with a size ranging from 1.7 to 2.2mm in height and 1 to 1.5mm in width. All whorl snails favour damp or wet habitats, especially marshes where they live mostly in moss, leaves and decaying vegetation. Some of the species of whorl snails (especially *Vertigo geyeri*) are particularly sensitive to changes in hydrology. Such changes have become more evident in recent times, with the result that 4 of the 8 species are now listed on Annex II of the European Habitats & Species Directive.

Vertigo geyeri is considered to be under threat in Ireland (Moorkens, 2006a, b). It is stringent in its requirement of saturated water conditions in calcareous, ground water fed flushes that are often limited in size to a few metres square. These habitats are generally found in mosaics of suitable patches within wider fen macro-habitats, which in Ireland can themselves fall within wider site habitats that be as diverse as raised bog laggs, transition mires, lake shores, hill or mountain slopes, and wetlands associated with coastal dunes and machair (Moorkens, 2003). Within these macrohabitats, however, the snail is consistent in where it lives, within the saturated and decaying roots of small sedges (particularly *Carex viridula* ssp. *brachyrrhyncha*), associated fen mosses (particularly *Drepanocladus revolvens* and *Campyllium stellatum*).

Within its macro-habitat, the snail needs constancy of hydrological conditions, but with enough variation to provide refugia for the meteorological extremes that the habitat must endure. It requires an openness of habitat that prevents succession by shade loving plants and more competitive shade loving snails.

This species is hermaphrodite but may often be self-fertilising with some cross fertilisation (Pokryszko, 1987). One to ten uncalcified, separated eggs are produced which have a 2 week development period (Falkner *et al*. 2001). The main reproductive period may vary considerably from site to site and depending upon meteorological conditions. At some sites the main period appears to be March/April and the species reaches sexual maturity in less than a year, with maximum numbers of adults observed in the autumn (September/October) (Cameron *et al*. 2003). However, at a site in Anglesey (Sharland 2000) found that there was an extended and variable breeding season with no clear annual cycle. Individuals may live for somewhat more than a year, but less than two years. Population densities seem frequently to be low, but up to 200 individuals/m² have been recorded (Killeen 2003).

Dispersal mechanisms are uncertain, but hypotheses include transport by charadriiform birds and/or grazing animals (including wild ungulates), dependent upon circumstance (Cameron *et al*. 2003). The ability of the species to self-fertilise makes it possible for a single coloniser to establish a new population.

2.0 Data sources

Recording in Ireland of non-marine molluscs including *Vertigo geyeri* falls into three main phases: The first half of the 20th century when the fauna was studied by R.A. Phillips, R.J. Welch and A.W. Stelfox; the early 1970s when recording was carried out by members of the Conchological Society of Great Britain & Ireland as part of a general molluscan 10km mapping project (Kerney 1976, 1999); and then from the mid 1990s by E.A. Moorkens working under contract to National Parks and Wildlife to identify potential SACs for the species (Moorkens

1995, 1997, 1998, 1999a, b, 2000). Part of Moorkens work included revisiting sites where *Vertigo geyeri* had previously been recorded, and which resulted in the addition of several new sites. Since 2000, further sites have been discovered following general surveys and EIAs (Moorkens 2004, 2006b; unpublished reports) and surveys by Holyoak (2005).

None of the early work included a quantitative element, and only in some of the latter studies was there any detailed mapping of the species within sites. However, in 2005 and 2006 work was carried out to survey, compile management prescriptions, and set up baseline monitoring survey stations for those parts of the 14 SACs known to support *Vertigo geyeri* (Moorkens 2006b, 2007a). One site (at Pollardstown Fen in Co. Kildare) has been the subject of detailed annual monitoring since 1998 (including quantitative sampling and population estimates) (Moorkens 2003, 2006c).

The range of the *V. geyeri* population is therefore based upon good quality and up-to-date data.

3.0 Range

3.1 Current Range

Range was assessed using the IUCN criteria for extent of occurrence (IUCN, 2001), and its interpretation as discussed by the European Commission (2006), and 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 Range of *Vertigo geyeri* for Ireland was considered to be the range of 10km square records from 1994 onwards (see also section 2.3 below). The cut off date of 1994 was chosen as this was the time when the Habitats Directive became effective and also the time in Ireland when a more detailed phase of mollusc recording commenced. The range outline was drawn following IUCN guidelines, but taking into consideration that populations are restricted by geology and hydrology. There is no vagrancy issue with *Vertigo geyeri*, but outliers cannot be joined with larger blocks where there is no possible habitat in between, so 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"* (European Commission, 2006) was only utilised in situations where habitat was deemed to be possible within a region, and outliers were left standing alone.

Appendix 1, Figure 1 shows all pre- and post-1994 records by 10km square. Figure 2 shows post-1994 records only by 10km square, and the estimated current range and favourable reference range. It has been recorded from a total of 29 ten kilometre squares, but it has only been recorded in 22 ten kilometre squares since 1994. However, given the small areas of micro-habitat that occur for the species within a much wider gross habitat area, the range of the animal in Ireland should include those 10km squares where potential habitat exists and thus where the snail may occur but is not known to do so to date. Thus the 10km squares that are not known to support *V. geyeri*, but are known to support Annex I 7220 habitat of petrifying springs with tufa formation and / or alkaline fen (Annex I 7230) and are directly adjacent to 10km squares known to support *V. geyeri* have also been added to the known range of the species. Apart from using the distribution of the species as basis for the range determination, tufa spring as potentially suitable habitats in proximity to existing populations have been added. The mapping of the species current range was therefore defined by the smallest polygon size containing all 10 km grid squares where the species was recorded, drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species 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. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps also occur. The current range has thus been estimated as 4300 km^2.

3.2 Favourable reference range

The Favourable Reference Range (FRR) for *Vertigo geyeri* in Ireland is taken to be its present (post 1994) known range (2200 km^2) and adjacent 10km squares that have potential to support the species (2300 km^2), giving a total of 4300 km^2. Many of the sites that were lost prior to 1994 were from bogs and fens in the Midlands which were extensively drained in the early 1970's. Norris & Pickrell (1972) resurveyed records mentioned in R.A. Phillips diaries from the first half of the 20th century, and found most of the sites were either drained, or were being drained at the time of their surveys in 1970 and 1971. Such sites have long since been lost. However, the presence of active petrifying springs with tufa formation is encouraging and such sites should be surveyed for molluscs, as it is likely that unlike the severely drained areas, these are sites where the water table would be at the surface and would provide the saturated habitat that *V. geyeri* requires.

3.3 Conservation assessment of the range

The number of square kilometres is a range estimate only, and should not be taken as an estimate of area of actual habitat or potential habitat of the species. The sites for this species range in their area of macro-habitat, from less than 1ha to over 100ha (such as Ben Bulben springs) in size. *Vertigo geyeri* is specific in its macro- and micro-habitat requirements, particularly with respect to ground water levels and vegetation composition. Therefore, suitable habitat within any site may be very restricted, but also immediately recognisable. In large sites such as Ben Bulben, *Vertigo geyeri* is widespread over a large area but suitable flush habitat maybe as little as a few hundred square metres. In smaller sites, there may only be tens of square metres. There is unlikely to be more than 5 hectares of Ireland occupied by *Vertigo geyeri* at any one time, but the exact area of occupancy varies from year to year depending on local hydrogeological conditions.

Vertigo geyeri is considered to be a relict species, and unlikely to naturally colonise new sites with ease. It is therefore conservation dependent in terms of species spread (translocation is likely to be necessary if new sites are to be colonised) and protection of current sites. It is currently considered to be threatened in the Republic of Ireland with a local IUCN status of Vulnerable (Moorkens, 2006a). As the Range of the species is based on recent range, and covers the current known populations, and it is considered that this range can be sustainable for the species in Ireland if all sites are conserved, it is allocated a Favourable conservation status.

- **Species Range Area:** Can be considered as the area of the grid cells occupied by suitable habitat within 1 10km square of known occupied areas, which is 4300 km^2 (43 grid cells x 100 km^2)
- **Favourable Reference Range:** 4300 km^2 (43 grid cells x 100 km^2)

4.0 Population

4.1 Population estimation

The estimation of population in terms of numbers of individuals for a tiny, annual invertebrate species is not feasible or practicable.

Vertigo geyeri populations fluctuate naturally over time, and short term changes in environmental conditions can rapidly influence population size, especially if meteorological conditions have been extreme for the area in the months preceding the survey. Population size may be higher during wet, humid summers, whilst periods of drought or changes to site management such as increased grazing or mowing result in lower population levels. Population numbers for *V. geyeri* also vary considerably with season.

At an SAC in Scotland, densities ranging from 80-200 individuals/ m^2 were recorded, and 200/ m^2 at a site in north-west England (Killeen 2003). However, both of these sites cover a large area and suitable *V. geyeri* habitat covers only a fraction of the site. At a site on Anglesey, Sharland (2000) recorded densities of 50-150 individuals/ m^2. She estimated that there was a maximum of 0.5ha of suitable habitat and that the population at the site was between 100,000 and 500,000 individuals. Similar densities of individuals/ m^2 have been recorded on occasions in the best habitat at Pollarstown Fen in Ireland (Moorkens, 2003). In general, if the habitat is in favourable condition, and there is successful reproduction, all suitable habitat in a site should support at least 50 individuals per m^2 in early autumn (best expert opinion). Thus at sites such as Pollardstown Fen (area 200ha), it is estimated (Moorkens, 2006c) that there is a maximum of 1880m^2 of 'prime' habitat within an area of c.50ha of 'macro-habitat'. Therefore in favourable years the *V. geyeri* population could exceed 100,000 individuals.

Vertigo geyeri has been recorded from 36 separate sites. A site may be termed as having a defined habitat boundary such as a fen or lake shore. For large sites such as Ben Bulben where a network of flushes occurs over a wide area, a separate site is delineated on a 1km square basis. Where large sites straddle two 10km squares, this is taken as 2 sites (for range estimation purposes). Appendix 2 shows all records of *Vertigo geyeri*, and Appendix 3 shows the records in chronological order of when they were last recorded at each site. The snail has not been recorded at 8 of these sites since 1994.

Vertigo geyeri has been recorded from sites in the Midlands and in the North-west. To date, *V. geyeri* has been found in 10 Irish counties: Donegal, Galway, Kildare, Laois, Leitrim, Mayo, Offaly, Roscommon, Sligo and Tipperary. A significant portion of the sites have been discovered since 1995, with the most recent addition from Drimmon Lough in Roscommon in 2006.

4.2 Current population

Given this variation of individuals from year to year, the number of viable populations surveyed from 1994 to 2006 has been chosen as the best proxy in order to estimate population status. Thus there are 28 viable populations for this species. There is baseline data for 20 of the 28 sites, which is the number of sites that was surveyed in 2005 and 2006.

4.3 Favourable reference population

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*' (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of *Vertigo geyeri* in the Republic of Ireland, the population Conservation Status should be based upon maintaining the current number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). On this basis the FRP would be 28 sites in favourable condition, based on the condition assessment categories.

A year with very low recorded numbers should not necessarily be interpreted as a long-term population decline, especially if meteorological conditions have been extreme for the area in the months preceding the survey. However, the snail may also persist for a while in less than ideal conditions and changes in vegetation and moisture conditions that are heading in one direction in spite of meteorological fluctuations should be cause for concern. Thus the assessment of condition and conservation status must take into consideration this variation. It is important to be careful not to make a false negative condition assessment where the fluctuations are only temporary and equally important not to make a false positive condition assessment where the snail is persisting but facing continuous decline. This is the reason why monitoring of populations by initially repeating transect counts two or three times in rapid succession, followed by frequent spot check surveillance is better than by infrequent intensive studies. This would provide an accurate baseline and would lead to accurate trend assessment. Frequent short surveys are also important given the fact that individuals only live for a year, and population declines need to be highlighted quickly, so that remedial action can take place before a population is lost.

From past studies, it can be seen that trends in population are only apparent through good quality data from baseline surveys which are followed by regular monitoring. There are very few examples of long-term studies but Moorkens (2006c) has demonstrated that trend only become detectable when there is regular monitoring over time.

Sharland 2000 recorded both seasonal and annual variation in a *V. geyeri* population at a site in Anglesey. However, as this study only covered a 2 year period there is insufficient longevity to determine any trends. Subsequent monitoring at the site (Killeen & Moorkens 2004) showed no significant change in abundance or extent and the population was regarded as being stable. The study of the *Vertigo geyeri* population at Pollardstown Fen has shown that a contraction of suitable habitat and abundance of the snail takes place when the micro-hydrogeological conditions change from the habitable parameters that have been established for the species (Kuczynska & Moorkens, in prep.).

Baseline surveys of the *Vertigo geyeri* populations in the 14 Irish SACs (Appendix 4) were carried out in 2005 and 2006 (Moorkens 2006b, 2007a), and, therefore reliable information on populations trends will not be available until future rounds of monitoring have been completed. However, the following comments may be made for the 14 SACs based upon Condition Assessment criteria given in Appendix 5 using 2005/2006 field data and previous observations:

SAC Site	County	Population Status
Polaguil Bay, Horn Head,	Donegal	Favourable
Sheskinmore	Donegal	Favourable
Pollardstown Fen	Kildare	Unfavourable
Fin Lough	Offaly	Favourable
Tievebaun & Meenaphuill	Leitrim	Favourable
Lough Talt	Sligo	Favourable
Clonaslee Esker	Laois	Unfavourable
Ballyness Bay	Donegal	Favourable
Rosmoney	Mayo	Unfavourable
Annaghmore Lough	Roscommon	Favourable
Bellacorick Bog	Mayo	Unfavourable
Dooaghtry	Mayo	Unfavourable
Ox Mountains	Sligo	Favourable
Lisduff Fen	Offaly	Favourable

While some SACs have been allocated an unfavourable status, there is no trend data for these sites, except for Pollardstown Fen, which has been allocated an Unfavourable status. It is possible that some habitat is extremely limited at these locations and the low amplitude of penetration into alternative micro-habitat areas places the population under stress. Repeat surveys are important in distinguishing the natural situation of a specific population from an adverse trend.

4.4 Conservation assessment of the population

Conservation assessments from 2006 were based on a single survey, and thus trend data is not available, except for Pollardstown Fen, which is currently in unfavourable status for the snail. Trend data is considered to be important in establishing whether populations are sustainable. Further trend data is required from Pollardstown Fen in order to establish whether the population can recover, be sustainable with its depleted population, or decline further.

Expert opinion considers that in order to conserve the long term viability of the species in the Republic of Ireland, the population Conservation Status should be based upon number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). On this basis the FRP would be 28 actively reproducing sites with no negative trends in population (i.e. all sites where the species has been found since 1994). Given the lack of trend data in most of the sites and the negative reporting on the one site with trend data, the population conservation status for *V. geyeri* in 2007 is therefore **unfavourable - inadequate**.

5.0 Habitat

Macrohabitats associated with this species are listed in Cameron *et al*., 2003 as follows:

- Annex I habitat 7140, transition mires (but not quaking bogs): (Corine 54.5)
- Annex I habitat 7210 (calcareous fens with *Cladium mariscus* and species of the Caricion davallianae): fen-sedge beds (Corine 53.3)

- Annex I habitat 7220 petrifying springs with tufa formation (Cratoneurion; Palustriella) (Corine 54.12)
- Annex I habitat 7230 (alkaline fens – low sedge-rich communities): rich fens (Corine 54.2)

These are generally scarce and fragmented habitats in Ireland, and suitable *Vertigo geyeri* habitat within sites is often very small in area and localized (see Section 3.1 below). On this basis it was considered that the joining of 10km squares to form polygons would give an over-estimate of the species’ range in Ireland (see Section 2.1 above).

5.1 Current condition of *Vertigo geyeri* Habitat

Given the snail’s population fluctuations, seasonally, annually, resulting from changes in meteorological conditions or changes to site management such as increased grazing or mowing which result in lower population levels, the snail’s area of occupancy, relative abundance, vegetative habitat and hydrological conditions must be used in combination to assess its condition (see Appendix 5 for assessment criteria).

Some general favourable habitat indicators are:

- Average height of vegetation: *Schoenus* tussocks not more than 75cm, sedge/moss lawns 5-15cm
- Plant species composition: Very favourable condition: Yellow sedge lawn, in particular with *Carex viridula* subsp. *brachyrrhyncha,* mosses *Drepanocladus revolvens, Campylium stellatum*, tussocks of *Schoenus nigricans*
- Other favourable plant species indicators: *Pinguicula vulgaris, Briza media, Equisetum palustre, Juncus articulatus*
- Ground saturated
- Spring flow with network of dendritic trickles
- Site management: appropriate light grazing

A decline in favourable condition of the habitat is implicated by the following conditions:

- A reduction in ground moisture levels
- An increase in ground moisture levels
- Spring flow channeled
- An increase of *Filipendula ulmaria* or *Molinia caerulea*
- An increase in *Menyanthes trifoliata* or *Juncus subnodulosus* monoculture
- An increase in scrub cover compared to the baseline
- A change in management regime to under- or over-grazing

A baseline survey has been undertaken in 20 sites for this species, where transects have been mapped by category from assessment of the above characteristics. Repeat survey is needed in order to establish the normal fluctuations that are characteristic of each site before assessment of real change can be made. This has been done already in Pollardstown Fen, where some negative trends have been observed.

Of the 28 current known populations of *V. geyeri*, the maps of the 20 that have been assessed for habitat quality for the snail have been digitised, and areas of habitat estimated. Within the 20 sites, 1.16 Hectares of optimal habitat for the snail was found, 5.18 Hectares of optimal / sub-optimal mosaic, 22 Hectares of sub-optimal habitat, and 2.38 Hectares of habitat with some potential for sub-optimal habitat and snail occurrence.

The habitat definitions are as follows:

Optimal habitat is where *V. geyeri* could survive in the majority (>50%) of the habitat. This allows for areas that have, for example, *Schoenus nigricans* tussocks. The snail cannot be found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5 to 6 centimetres of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is cropped open sedge swards and moss carpets within undulating terrain. The topographical changes provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. geyeri*, but the majority of the habitat cannot. This can be due to terrain being generally too high, but with small suitably wet runnel flushes occurring within, or where habitat is on the margin of base tolerance for the species, where acid influence promotes mainly calcifuge species, but where occasional groundwater seepage influence provides a suitable patch that the snail can occupy. Alternatively the snail may be restricted by succession due to lack of grazing, where the snail is shaded out of most of the area, except for patches prevented from growth by being wetter than their surroundings.

From the area estimations and the quality of habitat, and extrapolating for all 28 populations, there is likely to be a total of 1.6 Hectares of optimal habitat. In addition, there may be another 42.6 Hectares of lower quality habitat, where the average area of occupancy would be closer to 10%, and therefore approximately 4 Hectares would additionally be occupied, giving a total of about **5 Hectares** in total. As trend data is not yet available, it will be important to re-evaluate this data following future survey, as it is currently not established if sub-optimal habitat at any site is natural and sustainable, or whether it was once optimal habitat that has deteriorated and may not be sustainable.

5.2 Conservation assessment of *Vertigo geyeri* habitat

As only one round of baseline survey has been carried out to date at the majority of sites, and baseline transects were chosen with suitable habitat where *V. geyeri* was present, trends in the majority of the habitats cannot be determined. However, the condition of the habitats at some of the cSACs were considered to be poor, mainly due to either under- (parts of Fin Lough, Pollardstown Fen) or over-grazing (Dooaghtry, parts of Ballyness Bay), and at others the reason is not as obvious (Bellacorrick, Rosmoney, Clonaslee) and repeated survey is needed. Although the **habitat conservation status** is unfavourable for at least parts of 7 of the 14 cSACs, the lack of information on the recoverability of these sites i.e. trend data means it is classified as **Unfavourable – inadequate** (see also Appendix 6).

SAC Site Code	SAC Name	Extent of optimal habitat within the site
000147	Horn Head and Ringclevan	Favourable
000197	West Of Ardara/Maas Road	Favourable
000396	Pollardstown Fen	Unfavourable
000576	Fin Lough (Offaly)	Unfavourable (some components)
000623	Ben Bulben, Gleniff and Glenade Complex	Favourable
000633	Lough Hoe Bog	Favourable
000859	Clonaslee Eskers & Derry Bog	Unfavourable
001090	Ballyness Bay	Unfavourable (some components)
001482	Clew Bay Complex	Unfavourable
001626	Annaghmore Lough	Favourable
001922	Bellacorick Bog Complex	Unfavourable
001932	Mweelrea/Sheefry/Erriff Complex	Unfavourable
002006	Ox Mountains Bogs	Favourable
002147	Lisduff Fen	Favourable

6.0 Future Prospects

6.1 Current pressures

Sites which support *Vertigo geyeri* are naturally occurring ecosystems which have survived in areas that have not suffered from intensive agriculture, drainage or other severe human influences. The most serious threats to any *Vertigo geyeri* sites are:

100 Cultivation: change in agricultural practice e.g. from low intensity grazing to arable/hay/silage

110 Use of pesticides: *Vertigo geyeri* is susceptible to agricultural and other pesticides

120 Fertilisation: *Vertigo geyeri* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat

140 Grazing: changes in grazing animal, particularly from sheep to cattle grazing, increases in grazing levels and changes to current grazing practice (lengths of grazing periods)

141 Abandonment of pastoral systems

149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment

161 Forestry planting: afforestation of *V. geyeri* habitat results in its total destruction

171 Stock feeding: supplementary feeding of stock in snail habitat

310 Peat extraction: whether hand or machine cut, cutting of *V. geyeri* habitat or nearby habitat resulting in hydrological or other knock-on changes can result in its total destruction

500 Communications networks: where encroachment into *V. geyeri* habitat has been allowed, or interferes with the hydrogeology of the habitat for the species.

501 Paths, tracks: trampling erosion and fragmentation of habitat

622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion and fragmentation

623 Motorised vehicles: habitat is lost through erosion and fragmentation, particularly where cars are driven on to sensitive fen habitats

800 Landfill, land reclamation and drying out

810 Drainage: changes in hydrology particularly from ditch deepening or abstraction and digging out of springs

850 Modification of hydrographic functioning: *V. geyeri* is sensitive to changes that affect as little as 10mm differences to the water table at its habitat.

A basic requirement for this species is maintenance of the existing hydrological regime, so management practices that alter site hydrology or hydrogeology (whether ground water or surface water are affected) can be very damaging to it. Such management practices could be damaging whether carried out on-site or elsewhere in the catchment supporting the hydrology of the site. Nutrient enrichment, whether from agricultural run-off, use of fertilisers (including organic manures) or slurry spreading, can also be damaging, as would be pesticide use (including herbicides). Sheep-dip run-off would be especially damaging. Any form of soil cultivation (including ploughing) is inimical to the survival of this snail. Heavy grazing (particularly by large, heavy breeds of beef cattle), or use of supplementary stock-feeding facilities on-site, is damaging to this species. Changing of grazing species from sheep to cattle leads to a decline in habitat quality. Scrub encroachment, whether by native species or exotic conifers seeding themselves into the site from neighbouring conifer plantations, can cause habitat alteration leading to loss of this species. Burning of vegetation is similarly harmful.

In Ireland, the complete loss of *Vertigo geyeri* sites has been a direct result of drainage of wetlands in the Midlands. At sites where the species is in low numbers, particular attention needs to be paid to whether hydrological or management changes have taken place, and to pressure on the wider off-site areas that have the potential to affect the smaller sites, particularly from urban spread. Climate change may lead to longer and more frequent periods of drought, and therefore it is particularly important to protect a wide enough area to secure the future of this species. Areas close to current habitat that are currently too wet for the snail may become suitable in the future if conditions become drier, and thus must also be protected.

Given its known former range (2900km^2), the small size and vulnerability of some existing sites, strict conservation policies for protected sites and their regular monitoring is important. In order to establish the relative stability of different sites, it is particularly important to have two or three rounds of transect surveillance in quick succession to assess the normal fluctuations for a site, followed by less regular survey to establish if there is a trend in one direction. As the species is short-lived (essentially an annual species), frequent rapid surveys to confirm status are essential if any negative changes are to be reversed before the population is lost.

6.2 Threats

The most serious threats to *Vertigo geyeri* include all of the above pressures, which are likely to remain and/or intensify in the future, and also:

400 Urbanised areas, human habitation: if encroachment into *V. geyeri* habitat is allowed

840 Flooding: from hydrogeological changes resulting in higher than acceptable water levels in the snail habitat

990 Other processes: climate change, in particular leading to changes of weather pattern causing more extensive flooding and/or drought periods

6.3 Positive impacts

Vertigo geyeri is not protected under Irish law, but has protection in its SACs under the Habitat's Directive, and the Republic of Ireland Habitat's Regulations (Statutory Instrument 94 of 1997).

Vertigo geyeri is protected in SACs that contain a number of Annex I habitats, including Alkaline Fens, Calcareous fens with *Cladium mariscus,* and petrifying springs with tufa formation. If the full communities of these habitats are protected, and in particular the management of hydrogeology, leaf litter and grazing levels are suitable, this should favourably protect the invertebrate community within these habitats, including *V. geyeri.*

6.4 Future Prospects Conservation Status

While there is a considerable lack of quantitative data, *Vertigo geyeri* appears to be in good condition in 7 of the 14 SACs designated for its protection, and it enjoys the benefit of protection within some reasonably large SAC complexes. Its prospects in the other 7 SACs are less favourable and, with the lack of any protection mechanism in place, sites outside protected areas are likely to be less secure.

The range of *Vertigo geyeri* has decreased considerably from its historical range, but has good protection in some of its SACs, and has reasonably wide distribution still, particularly in more remote areas of Ireland. The range conservation status is considered to be **favourable**.

The extent of suitable habitat in good condition in 7 of its SACs is considerable, and the extent of unsuitability of the others is currently unknown. Information is deficient outside protected areas, and within 7 SAC's, habitat has Favourable Conservation Status. Due to the lack of trend data habitat conservation status is classified as **unfavourable - inadequate**.

The populations appear to be in good condition in 9 of its SACs. Information is deficient outside protected areas. The lack of trend data contributes to the population conservation status classification of **unfavourable - inadequate**.

Considering the impacts, pressures and threats to *Vertigo geyeri* in the Republic of Ireland today, the overall Conservation Status for Future Prospects is **unfavourable - inadequate**. More information is desirable in order to make a more confident and informed assessment in the future. In order to address this, a Species Monitoring Plan will be written, which will specify monitoring work that needs to be carried out in order to fully assess the condition of the populations of this species. This monitoring will be designed to identify any negative effects and initiate an investigation into the causes of any negative trends, and initiate measures that can be taken to mitigate against negative affects before it is too late. It is expected that the implementation of this monitoring plan will lead to improved data to assist reporting in 2013, as well as to improved protection of the populations.

Range	**Favourable**
Population	**Unfavourable - inadequate**
Range of appropriate habitat	**Unfavourable - inadequate**
Future prospects	**Unfavourable - inadequate**
Overall Assessment	**Unfavourable - inadequate**

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Appendix 1: Range of *Vertigo geyeri* in Ireland

Figure 1: 10km squares with records of *Vertigo geyeri* in the Republic of Ireland

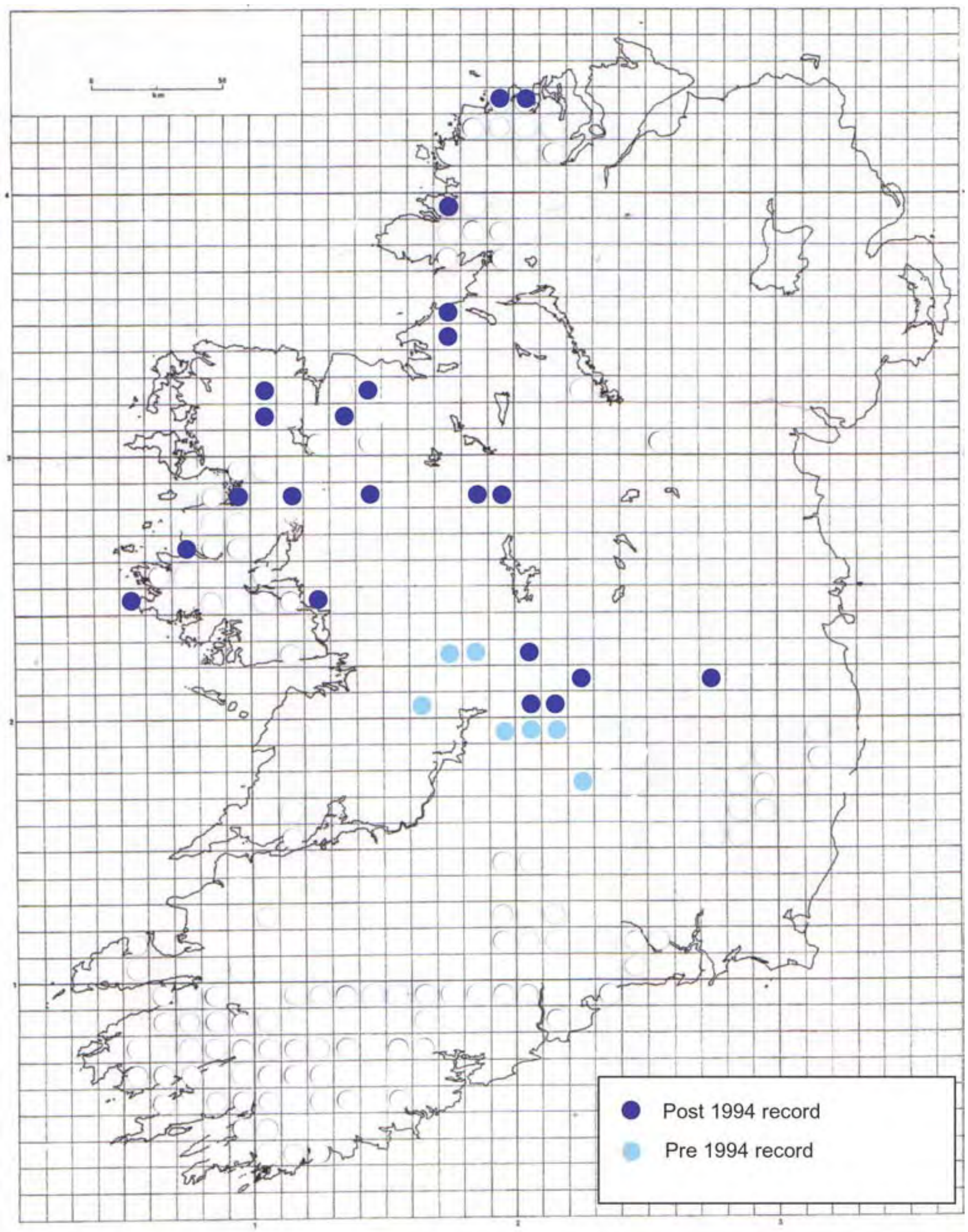
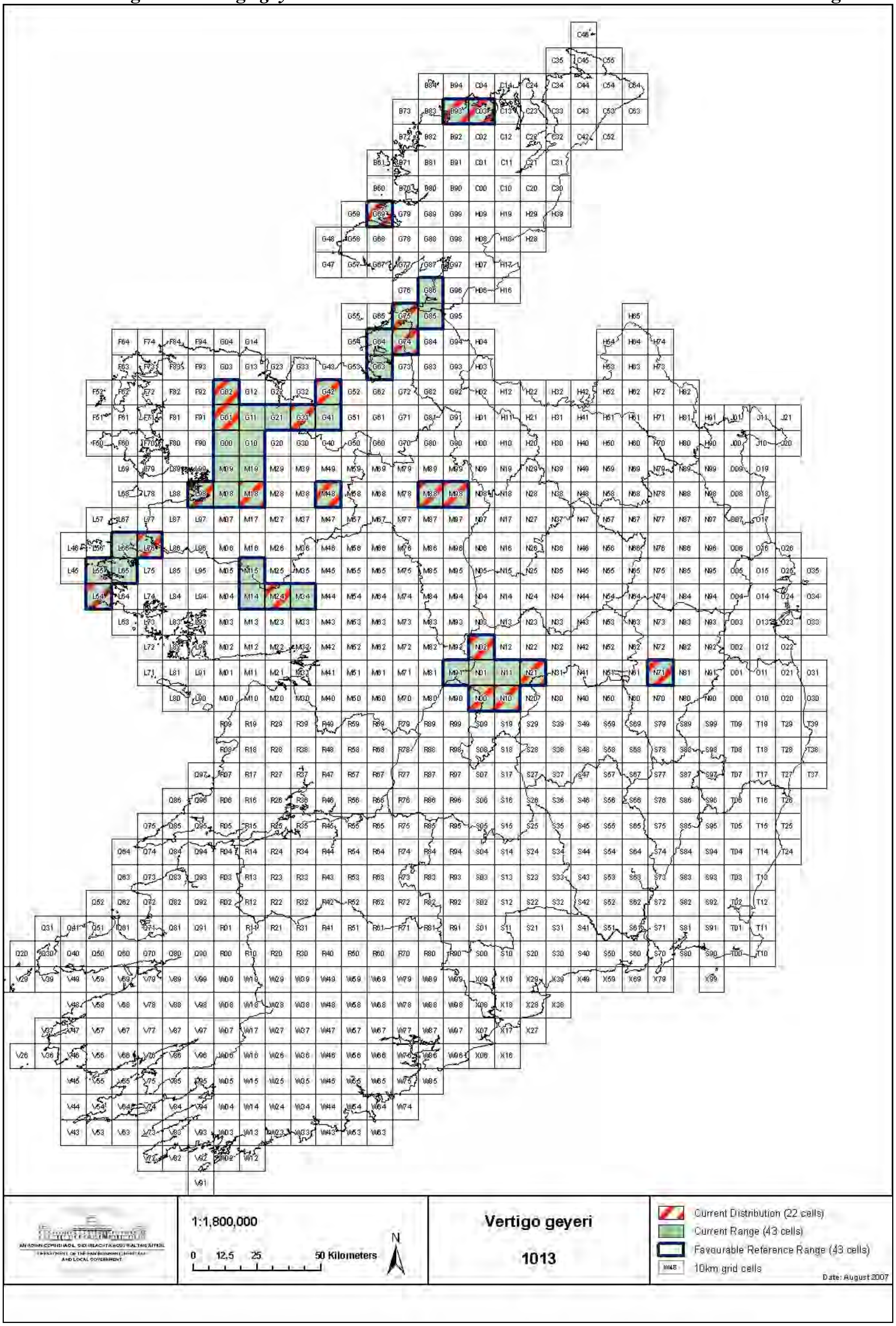


Figure 2 Vertigo *geyeri* current distribution and current / favourable reference range



Appendix 2: Vertigo *geyeri* records from Ireland

County	Site	Grid Ref	Date	Recorder	Reference
Donegal	Sheskinmore	G7095	06.viii.1998	E.A.Moorkens	Moorkens 1998
Donegal	Polaguil Bay	B9938	29.vi.2002	G.Holyoak	Holyoak 2005
Donegal	Polaguil Bay	C0039	vii.2006	E.A.Moorkens & I.J.Killeen	Moorkens 2007
Donegal	Ballyness Bay	B9233	21.viii.2002	G.Holyoak	Holyoak 2005
Galway	Cloonascragh Bog (Tuam)	M4650	30.viii.1936	R.A.Phillips	A.Norris & D.G.Pickrell 1972
Galway	Cloonscragh Fen	M8726	1970	A.Norris & D.G.Pickrell	A.Norris & D.G.Pickrell 1972
Galway	South of Knock	L5846	20.vi.2004	G.Holyoak	Holyoak 2005
Galway	Carrowmoreknock	M2140	29.vi.2004	G.Holyoak	Holyoak 2005
Galway	Cloonkeely	M2045	07.vii.2004	G.Holyoak	Holyoak 2005
Kildare	Pollardstown Fen	N7715	1969	G.Visser	A.Norris & D.G.Pickrell 1972
Laois	Rathdowney	S2979	?1935	R.A.Phillips	A.Norris & D.G.Pickrell 1972
Laois	Clonaslee Esker	N2712	26.vii.1998	E.A.Moorkens	Moorkens 1998
Leitrim	Glencar	G7542	1999	D. Cotton	Holyoak 2005
Leitrim	Glenade	G7548	1999	D. Cotton	Holyoak 2005
Leitrim	Glencar	G7644	1999	D. Cotton	Holyoak 2005
Leitrim	Glenade	G7850	1999	D. Cotton	Holyoak 2005
Mayo	Bellacorrick	G0522	21.vii.1998	E.A.Moorkens	Moorkens 1998
Mayo	Cooley Lough	M1382	27.v.2003	G.Holyoak	Holyoak 2005
Mayo	Island Lake	M4882	21.vii.2003	G.Holyoak	Holyoak 2005
Mayo	Dooaghtry	L7369	x.2003	G.Holyoak	Holyoak 2005
Mayo	Rosmoney	L9486	23.ix.2003	G.Holyoak	Holyoak 2005
Mayo	Brackloon	G0718	15.iv.1999	G.Holyoak	Holyoak 2005
Offaly	Roscrea Bog	S1695	ii.1935	R.A.Phillips	Phillips 1935
Offaly	Lisduff Fen	N0800	1978	R.C.Preece & B.Coles	Conch Soc, Moorkens 1997
Offaly	SE of Birr	S1098	1984	B. Colville & B. Coles	Colville & Coles 1984
Offaly	Fin Lough	N0329	03.x.1998	E.A.Moorkens	Moorkens 1998
Offaly	Killaun Bog	N1105	05.x.1998	E.A.Moorkens	Moorkens 1998
Roscommon	Annaghmore Lough	M9084	23.viii.2001	G.Holyoak	Holyoak 2005
Roscommon	Annaghmore Lough	M8983	23.viii.2001	G.Hol	lyoak 2005
Roscommon	Lough Nablasbarnagh	M9082	13.vii.2006	E.A.M I.J.Killeen	Moorkens 2007
Roscommon	Drimmon Lough	M9387	30.x.2006	E.A.Moorkens & I.J.Killeen	Moorkens 2007
Sligo	Lough Talt	G3915	10.viii.1992	M.Cawley	Cawley 1996, Moorkens 1997
Sligo	Dromore West	G4429	07.vi.2002	G.Holyoak	Holyoak 2005
Tipperary	Roscrea Summerhill	S1090	ii.1935	R.A.Phillips	A.Norris & D.G.Pickrell 1972
Tipperary	Fiagh Bog	R9598	1970	A.Norris & D.G.Pickrell	A.Norris & D.G.Pickrell 1972

Appendix 3: *Vertigo geyeri* records from Ireland – last recorded dates in chronological order

County	Site	Grid Ref	First record	Last seen	Reference
Laois	Rathdowney	S2979	1935	1935	Moorkens 1998
Tipperary	Roscrea Bog	S1695	1935	1935	Moorkens 1998
Galway	Cloonascragh Bog (Tuam)	M4650	1936	1936	Moorkens 1998
Galway	Cloonscragh Bog	M8726	1970	1970	Moorkens 1995, 1997
Offaly	Roscrea Bog	S1695	1935	1970	Moorkens 1995, 1997
Tipperary	Fiagh Bog	R9598	1970	1970	Moorkens 1995
Offaly	SE of Birr	S1098	1984	1984	Moorkens 1998
Offaly	Killaun Bog	N1105	1998	2001	
Mayo	Cooley Lough	M1382	2003	2003	
Mayo	Island Lake	M4882	2003	2003	
Galway	South of Knock	L5846	2004	2004	
Galway	Carrowmoreknock	M2140	2004	2004	
Galway	Cloonkeely	M2045	2004	2004	
Donegal	Sheskinmore	G7095	1998	2005	Moorkens 2006
Laois	Clonaslee Esker	N2712	1998	2005	Moorkens 2006
Leitrim	Glencar	G7548	1999	2005	Moorkens 2006
Leitrim	Glencar	G7644	1999	2005	Moorkens 2006
Leitrim	Glenade	G7850	1999	2005	Moorkens 2006
Leitrim	Glenade	G7748	1999	2005	Moorkens 2006
Mayo	Bellacorrick	G0522	1998	2005	Moorkens 2006
Mayo	Dooaghtry	L7369	2003	2005	Moorkens 2006
Mayo	Brackloon	G0718	1999	2005	Moorkens 2006
Offaly	Lisduff Fen	N0800	1995	2005	Moorkens 2006
Offaly	Fin Lough	N0329	1998	2005	Moorkens 2006
Sligo	Lough Talt	G3915	1992	2005	Moorkens 2006
Donegal	Polaguil Bay	B9938	2002	2006	Moorkens 2007a
Donegal	Polaguil Bay	C0039	2006	2006	Moorkens 2007a
Donegal	Ballyness Bay	B9233	2002	2006	Moorkens 2007a
Mayo	Rosmoney	L9486	2003	2006	Moorkens 2007a
Roscommon	Annaghmore Lough	M9084	2001	2006	Moorkens 2007a
Roscommon	Annaghmore Lough	M8983	2001	2006	Moorkens 2007a
Roscommon	Drimmon Lough, Cordrummon	M9387	2006	2006	Moorkens 2007b
Roscommon	Lough Nablasbarnagh	M9082	2006	2006	Moorkens 2007a
Sligo	Dromore West	G4429	2002	2006	Moorkens 2007a
Kildare	Pollardstown Fen	N7715	1969	2007	

Appendix 4: Special Areas of Conservation (SAC) in Ireland designated for *Vertigo geyeri*

SAC Site Code	SAC Name	County	Site
000147	Horn Head and Ringclevan	Donegal	Polaguil Bay, Horn Head,
000197	West Of Ardara/Maas Road	Donegal	Sheskinmore
000396	Pollardstown Fen	Kildare	Pollardstown Fen
000576	Fin Lough (Offaly)	Offaly	Fin Lough
000623	Ben Bulben, Gleniff and Glenade Complex	Leitrim	Tievebaun & Meenaphuill
000633	Lough Hoe Bog	Sligo	Lough Talt
000859	Clonaslee Eskers & Derry Bog	Laois	Clonaslee Esker
001090	Ballyness Bay	Donegal	Ballyness Bay
001482	Clew Bay Complex	Mayo	Rosmoney
001626	Annaghmore Lough	Roscommon	Annaghmore Lough
001922	Bellacorick Bog Complex	Mayo	Bellacorick Bog
001932	Mweelrea/Sheefry/Erriff Complex	Mayo	Dooaghtry
002006	Ox Mountains Bogs	Sligo	Ox Mountains
002147	Lisduff Fen	Offaly	Lisduff Fen

Appendix 5: Condition Assessment Criteria

A protocol was devised for monitoring *Vertigo geyeri* at a site in north-west England (Killeen 2001) and which was subsequently adapted for monitoring sites on Anglesey (Killeen & Moorkens 2004). A similar approach to that at Anglesey was taken when devising the methodology for the baseline surveys of the *V. geyeri* SACs in Ireland (Moorkens 2006b, 2007a). Condition of the snail population and its habitat was carried out by measuring environmental variables and snail abundance at intervals along linear transects (or in the case of very small sites – the whole site).

The attributes measured in the baseline surveys were:

Type of micro-habitat (species composition and sward height) along a linear transect
Hydrological field assessment - Wetness within each micro-habitat zone
Presence and abundance of *Vertigo geyeri*

Habitat and wetness were classified into Optimal, Sub-Optimal and Unsuitable. In broad terms, these are as follows:

- Optimal - Flushed fen grassland with sedge/moss lawns 5-20cm tall, containing species such as *Carex viridula* subsp. *brachyrrhyncha, Pinguicula vulgaris, Briza media, Equisetum palustre, Juncus articulatus* and the mosses *Drepanocladus revolvens, Campylium stellatum*, with scattered tussocks of *Schoenus nigricans* no greater than 80cm tall. Water table between 0- 5cm of the soil surface, but not above ground level.
- Sub-optimal - Vegetation composition as above but either vegetation height is less than 5cm or greater than 15cm, or the water table is below 5cm or ground is flooded at the time of sampling.
- Unsuitable - Any other habitat

To assess the Condition/Favourable Conservation Status of each site/SAC, additional attributes such as management and other negative impacts need to be taken into account. Therefore, the following simple matrix has been devised:

Attribute	**Pass - Favourable**	**Pass/Fail***	**Fail - Unfavourable**
Overall condition of site	Good	Moderate	Poor
Extent of optimal habitat within the site	Extensive	Resticted	Sparse
Vertigo geyeri abundance	Present common	Present scarce	Absent
Management regime	Appropriate – no change needed	Appropriate – some changes needed	Damaging
Other negative impacts	None	Some but recoverable	Damaging – not recoverable

Pass/Fail* - Pass if there are other favourable attributes, fail if there are other unfavourable attributes

Appendix 6: Condition Assessment after first round baseline monitoring

SAC Site Code	SAC Name	Overall condition of site	Extent of optimal habitat within the site	*Vertigo geyeri* abundance (population)	Management regime	Other negative impacts
000147	Horn Head and Ringclevan	Favourable	Favourable	Favourable	Favourable	
000197	West Of Ardara/Maas Road	Favourable	Favourable	Favourable	Favourable	
000396	Pollardstown Fen	Unfavourable	Unfavourable	Unfavourable	Unfavourable	May be affects of wider scale drainage
000576	Fin Lough (Offaly)	Unknown	Unfavourable (some components)	Favourable	Unfavourable (some components)	May be affects of wider scale drainage
000623	Ben Bulben, Gleniff and Glenade Complex	Favourable	Favourable	Favourable	Favourable	
000633	Lough Hoe Bog	Favourable	Favourable	Favourable	Favourable	
000859	Clonaslee Eskers & Derry Bog	Unfavourable	Unfavourable	Unfavourable	Unfavourable	
001090	Ballyness Bay	Unknown	Unfavourable (some components)	Favourable	Unfavourable (some components)	
001482	Clew Bay Complex	Unfavourable	Unfavourable	Unfavourable	Unfavourable	
001626	Annaghmore Lough	Favourable	Favourable	Favourable	Favourable	
001922	Bellacorick Bog Complex	Unfavourable	Unfavourable	Unfavourable	Unfavourable	May be affects of wider scale drainage
001932	Mweelrea/Sheefry/Erriff Complex	Unfavourable	Unfavourable	Unfavourable	Unfavourable	
002006	Ox Mountains Bogs	Favourable	Favourable	Favourable	Favourable	
002147	Lisduff Fen	Favourable	Favourable	Favourable	Favourable	May be affects of wider scale drainage

1013 Geyer's whorl snail (*Vertigo geyeri*)

1. National Level	
Species code	1013
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	43 10km squares

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	Cawley, M., 1996. Notes on some non-marine Mollusca from Co. Sligo and Co. Leitrim including a new site for *Vertigo geyeri* Lindholm. *Irish Naturalists' Journal* 25: 183-185. Colville, B. & Coles, B., 1984. A week's snail collecting in Ireland. *Conchologists' Newsletter* 89: 192-196. Grierson, P.H. (1902). Some land and freshwater snails from Co. Clare. *Ir. Nat.* **11**, 139-140. Holyoak, G.A., 2005. Widespread occurrence of *Vertigo geyeri* (Gastropoda: Vertiginidae) in north and west Ireland. *Irish Naturalists' Journal* **28**: 141-150. Kerney, M. (1976) *Atlas of the land and freshwater molluscs of the British Isles.* ITE, Conchological Society, London. P92. Kerney, M.P., 1999. *An atlas of the land and freshwater molluscs of Britain and Ireland.* Harley Books, Colchester. Kevan, D.K., 1933. *Vertigo angustior* Jeffreys and *Acicula lineata* (Drap.) in Co. Kildare. *Irish Naturalist* **4**: 178. Moorkens, E.A., 1995. Mapping of proposed SAC sites for *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1997. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1997 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1998. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1998 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999a. Molluscan Survey 1999 Volume I: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999b. Molluscan Survey 1999 Volume II: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2000. An inventory of Mollusca in potential SAC

	sites with special reference to *Vertigo* species: 2000 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2003a. The *Vertigo* workshop field excursion to Pollardstown Fen (Co. Kildare) with a provisional list of the Mollusca known from the site. *Heldia* **5** (7): 179-180. Moorkens, E.A., 2003b. Final Baseline Report on Molluscan Surveys of Pollardstown Fen 1998-2003. Report to Kildare County Council. Moorkens, E.A., 2004a. Non-marine Mollusca: New and notable records for Ireland. *Bull. Ir. Biogeog. Soc.* **28**: 189-198. 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. Management prescriptions for *Vertigo geyeri* at cSAC sites for the species in the Republic of Ireland. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2006c. Report on Molluscan Surveys of Pollardstown Fen 2006. Unpublished report to Kildare County Council. Moorkens, E.A., 2007a. Management prescriptions for *Vertigo geyeri* at cSAC sites for the species in the Republic of Ireland. Unpublished report to National Parks and Wildlife. Norris, A., & Pickrell, D. G., 1972. Notes on the occurrence of *Vertigo geyeri* Lindholm in Ireland. *Journal of Conchology* **27**: 411-417. Phillips, R.A., 1935. *Vertigo genesii* in central Ireland. *Journal of Conchology* **20**: 142-145.
2.3 Range	
2.3.1 Surface area	4300km²
2.3.2 Date	2007
2.3.3 Quality of data	Good
2.3.4 Trend	0
2.3.6 Trend-Period	1994 – 2007
2.3.7 Reasons for reported trend	NA
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	28 populations, not all long term viable
2.4.2 Date of estimation	2007
2.4.3 Method used	2
2.4.4 Quality of data	1 poor (not all sites were assessed, 20 have baseline data, 1 with trend data)
2.4.5 Trend	Stable
2.4.7 Trend-Period	1994 - 2006

2.4.8 Reasons for reported trend	3
2.4.9 Justification of % thresholds for trends	The number of populations has remained stable, however there has been deterioration within 25% of the populations
2.4.10 Main pressures	100 Cultivation: change in agricultural practice e.g. from low intensity grazing to arable/hay/silage 110 Use of pesticides: *Vertigo geyeri* is susceptible to agricultural and other pesticides 120 Fertilisation: *Vertigo geyeri* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat 140 Grazing: changes in grazing animal, particularly from sheep to cattle grazing, increases in grazing levels and changes to current grazing practice (lengths of grazing periods) 141 Abandonment of pastoral systems 149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment 161 Forestry planting: afforestation of *V. geyeri* habitat results in its total destruction 171 Stock feeding: supplementary feeding of stock in snail habitat 310 Peat extraction: whether hand or machine cut, cutting of *V. geyeri* habitat or nearby habitat resulting in hydrological or other knock-on changes can result in its total destruction 501 Paths, tracks: trampling erosion and fragmentation of habitat 622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion and fragmentation 623 Motorised vehicles: habitat is lost through erosion and fragmentation, particularly where cars are driven on to sensitive fen habitats 800 Landfill, land reclamation and drying out 810 Drainage: changes in hydrology particularly from ditch deepening or abstraction and digging out of springs 850 Modification of hydrographic functioning: *V. geyeri* is sensitive to changes that affect as little as 10mm differences to the water table at its habitat.
2.4.11 Threats	All of the above, plus 400 Urbanised areas, human habitation: if encroachment into *V. geyeri* habitat is allowed 500 Communications networks: if encroachment into *V. geyeri* habitat is allowed, or interferes with the hydrogeology of the habitat for the species. 840 Flooding: from hydrogeological changes resulting in higher than acceptable water levels in the snail habitat 990 Other processes: climate change, in particular leading to changes of weather pattern causing more extensive flooding and/or drought periods
2.5 Habitat for the species	
2.5.2 Area estimation	44 Hectares habitat, approximately 5 Hectares occupied at any one time
2.5.3 Date of estimation	2006
2.5.4 Quality of data	2=moderate

2.5.5 Trend	- = net loss
2.5.6 Trend-Period	1994 - 2007
2.5.7 Reasons for reported trend	3
2.6 Future prospects	2

2.7 Complementary information	
2.7.1 Favourable reference range	4300 km²
2.7.2 Favourable reference population	28 viable populations
2.7.3 Suitable Habitat for the species	44 Hectares habitat, approximately 10 Hectares occupied at any one time

2.7.4 Other relevant information

Vertigo geyeri is not protected under Irish law (Wildlife Act), and is considered to remain under threat and is listed as Vulnerable in Ireland (Moorkens, 2006a).

Vertigo geyeri is protected in SACs that contain a number of Annex I habitats, including Alkaline Fens, Calcareous fens with *Cladium mariscus,* and petrifying springs with tufa formation. If the full communities of these habitats are protected, and in particular the management of hydrogeology, leaf litter and grazing levels are suitable, this should favourably protect the invertebrate community within these habitats, including *V. geyeri.*

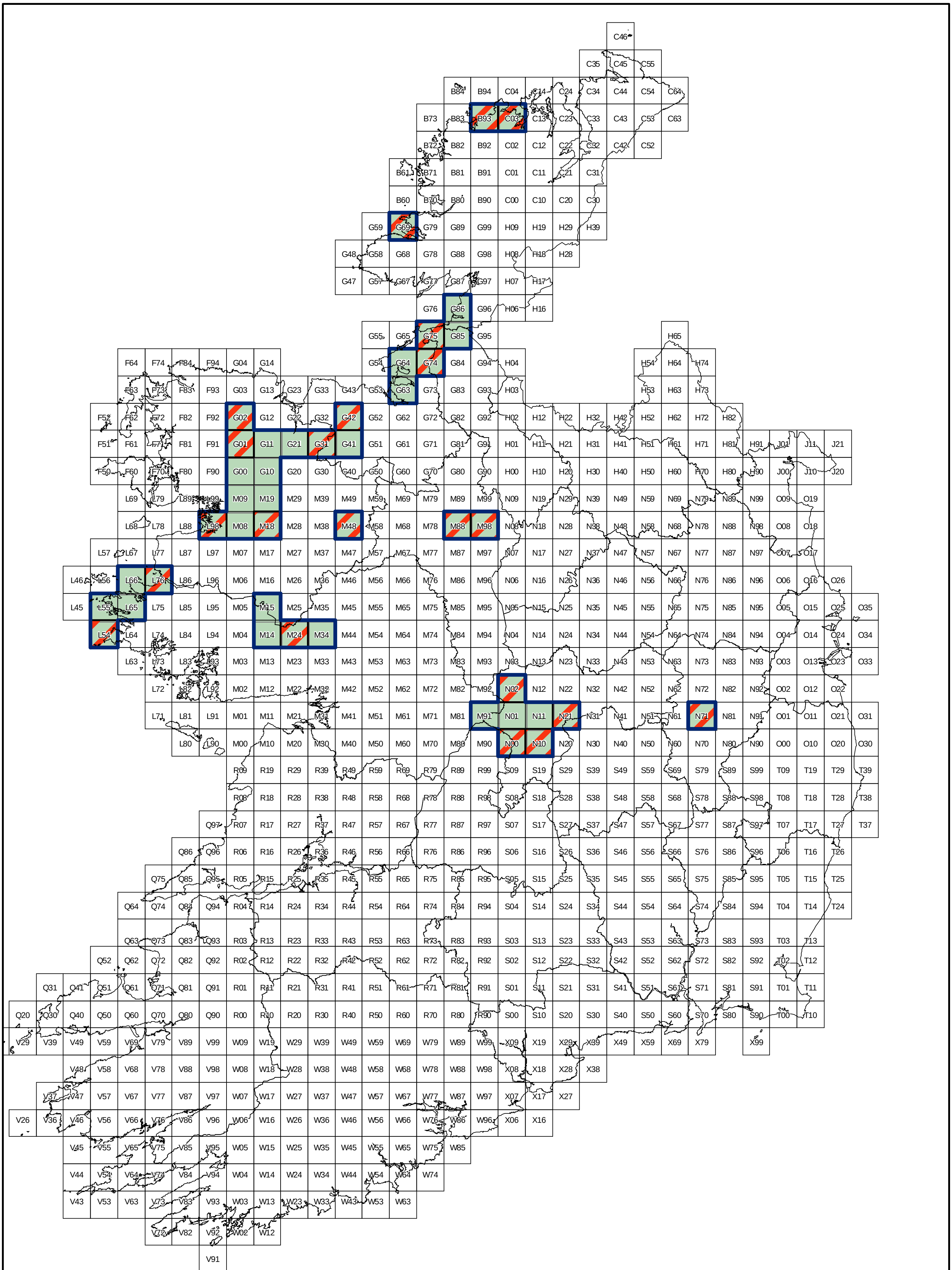
Conclusions are based on best expert judgement as trend data is not yet available.

Serious losses occurred through bog drainage in midlands from 1970-1994, thus populations are more separated than in the earlier half of the 20th Century.

New survey effort found many new populations and sites, and there may be more yet to find, but this is very unlikely to be an expansion, but rather an artefact of greater effort.

While population and habitat appear more stable in recent years, some habitat is in poor condition, and the only site where trend data is available (Pollardstown Fen) shows considerable decline. The set Favourable Reference Ranges should be enough, if conserved adequately, to be sustainable in the long term. Neither population nor habitat could be confidently said to be favourable, and future prospects will only be secured with the strong site conservation policies needed in a country still undergoing widespread development.

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

Vertigo geyeri

1013

Current Distribution (22 cells)
Current Range (43 cells)
Favourable Reference Range (43 cells)
W48 10km grid cells

Date: August 2007

Conservation Assessment of the narrow-mouthed whorl snail *Vertigo angustior* in Ireland

July 2007

Contents

1.0 Ecology of the narrow mouthed whorl snail *Vertigo angustior* in Ireland

Vertigo angustior is one of 8 species of whorl snail (genus *Vertigo*) living in Ireland. The whorl snails are amongst the smallest of the country's land molluscs with a size ranging from 1.7 to 2.2mm in height and 1 to 1.5mm in width. In two of the species, *Vertigo angustior* and *V. pusilla*, the shell is sinistrally coiled i.e. the mouth is on the left when viewed from the front, whereas all other whorl snails (and most other Irish molluscs) have the mouth on the right side. These 2 sinistral whorl snails are sometimes found living together, particularly in maritime habitats. *Vertigo angustior* is the smaller of the two, with a reddish-coloured shell covered with fine vertical raised lines (striations), whereas *V. pusilla* is larger with a light horn-coloured, and almost smooth shell. All whorl snails favour damp or wet habitats, especially marshes where they live mostly in moss, leaves and decaying vegetation. Some of the species of whorl snails (including *Vertigo angustior*) are particularly sensitive to changes in hydrology. Such changes have become more evident in recent times, with the result that 4 of the 8 species are now listed on Annex II of the European Habitats & Species Directive.

Vertigo angustior is mainly a European species but extends through Turkey and into Iran. It ranges from southern Scandinavia to the Mediterranean and from Ireland to the Caspian Sea (Cameron *et al*. 2003). It has a threat status of Vulnerable in Ireland (Moorkens, 2006a).

At a broad level, *Vertigo angustior* appears to be present in a very wide range of habitat categories of grassland, fen, marsh, salt marsh and flood plain, but the ecotone within which it is restricted means that the exact conditions which its presence demands are rare, and a lot of habitat that is "almost correct" is devoid of the snail, and other sites have an appropriate ecotone restricted to a narrow band only a few metres wide (but of variable length). Sites where the species is widespread, especially those where a variety of suitable habitats and wetness conditions occur within the one general site are of high importance.

This species is hermaphrodite and often self-fertilising (Pokryszko, 1987). The main reproductive period may vary considerably from site to site and depending upon meteorological conditions. At some sites the main period appears to be March/April and the species reaches sexual maturity in less than a year, with maximal numbers of adults observed in the autumn (September/October) (Cameron *et al*. 2003, Sharland 2000, Killeen 2003, Moorkens & Gaynor 2003). Individuals may live for somewhat more than a year, but less than two years. Population densities are often very high in some maritime situations with densities in excess of 1000 individuals/m² have been recorded (Killeen 2003).

Available information suggests that this species can be dispersed by various mechanisms over distances of up to 100m within a twelve month period. It has been recorded as transported by slugs and small mammals, and wind-blown litter is also likely to play a significant role (Cameron *et al*. 2003; Falkner et al., 2001).

2.0 Data sources

Recording in Ireland of non-marine molluscs including *Vertigo angustior* falls into three main phases: The first half of the 20th century when the fauna was studied by R.A. Phillips, R.J. Welch and A.W. Stelfox; the early 1970s when recording was carried out by members (mainly A. Norris and M.P. Kerney) of the Conchological Society of Great Britain & Ireland as part of a general molluscan 10km mapping project (Kerney 1976); and then from the mid 1990s by E.A. Moorkens working under contract to National Parks and Wildlife to identify potential SACs for the species (Moorkens 1995, 1997, 1998, 1999a, b, 2000; Kerney, 1999). Part of Moorkens work included revisiting most of the sites where *Vertigo angustior* had previously been recorded, but the extensive surveys of potential *V. angustior* habitats along the western seaboard also resulted in the addition of several new sites. Since 2000, further sites have been discovered following general surveys and EIAs (Moorkens 2004a, 2006b; unpublished reports). In 2006 all of the SAC dune systems on the eastern seaboard (Co. Dublin through to Co. Waterford) with potentially suitable habitat for *V. angustior* were surveyed but failed to yield any un-recorded populations (Moorkens 2007b).

None of the above work included a quantitative element, and only in some of the latter studies was there any detailed mapping of the species within sites. However, in 2006 work was carried out to survey, compile management prescriptions, and set up baseline monitoring survey stations for those parts of the 12 SACs known to support *Vertigo angustior* (Moorkens 2007a). One site (at Doonbeg in Co. Clare) has been the subject of detailed annual monitoring (including quantitative sampling and population estimates) since 1998 (Moorkens & Gaynor 2003).

The range of the *V. angustior* population is therefore based upon good quality and up-to-date data.

3.0 Range

3.1 Current range

Range was assessed using the IUCN criteria for extent of occurrence (IUCN, 2001), and its interpretation as discussed by the European Commission (2006), and 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 Range of *Vertigo angustior* for Ireland was considered to be the range of 10km square records from 1994 onwards (see also section 2.3 below). The cut off date of 1994 was chosen as this was the time when the Habitats Directive became effective and also the time in Ireland when a more detailed phase of mollusc recording commenced. The range outline was drawn following IUCN guidelines, but taking into consideration that there is no vagrancy issue with *Vertigo angustior*, and outliers cannot be joined with larger blocks where there is no possible habitat in between, so 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"* (European Commission, 2006) was only utilised in situations where habitat was deemed to be possible within a region, and outliers were left standing alone.

The range was larger in the pre-1994 period, but extensive drainage has occurred and is considered to have destroyed the inland wetland sites, and river management changes have severely altered the south eastern sites. The old record for the west (Dog's Bay) and for the south west (Goleen) are from 1984 and 1939 respectively. These sites were surveyed and the species was not refound, but they should be checked at least one more time, as the transition zone where these animals live could be very restricted, particularly in dry years. Until these sites are formally considered extinct they should be included part of the current range.

Appendix 1, Figure 1 shows all pre- and post-1994 records by 10km square. Figure 2 shows post-1994 records only by 10km squares, and Figure 3 shows the estimated range in polygons. It has been recorded from a total of 32 10km squares, but it has only been recorded in 27 10km squares since 1994. The current range encompassing the current distribution in 32 10km squares.

Vertigo angustior has been recorded from 36 separate sites. A site may be termed as having a defined habitat boundary such as a fen, lake or dune system. For dune situations if there is more or less continuous habitat over 2 to 3 kilometres, it is taken to be one site. Where large sites straddle 2 two 10km squares, this is taken as 2 sites (for range estimation purposes). Appendix 2 shows all records of *Vertigo angustior*, and Appendix 3 shows the records in chronological order of when they were last recorded at each site. The snail has not been recorded at 7 of these sites since 1994.

Vertigo angustior has been recorded principally from sites along the western seaboard of Ireland from west Cork to North Donegal. Additional sites are known inland in the south east. To date, *Vertigo angustior* has been found in 11 Irish counties: Carlow, Clare, Cork, Donegal, Galway, Kerry, Kildare, Kilkenny, Limerick, Mayo and Sligo. The most recent new county record has been from Limerick in 2005.

There are several records from the early 20th century particularly from Donegal which pertain to dead shells collected from shell pockets in dunes (Stelfox 1906, Welch 1906, 1909). The age of these shells is uncertain – they could be anything between a few years old and a few thousand years old (Postglacial sub-fossils). Similarly, there are records of old shells or fossils from other inland sites in Mayo, Dublin, Kildare, Offaly and Waterford (Kerney 1999). As there is such doubt over the age of sites that have only dead shells recorded, all such records are treated as fossil and excluded from the Conservation Assessment.

3.2 Favourable reference range

The area of *Vertigo angustior* Range in Ireland was calculated as 3200 km^2. This equates to the number of 10km squares with records since 1994, with the addition of Goleen and Dog's Bay, which need further investigation, and with 3 additional 10km squares which comprised squares between two squares with known records and also having potential habitat for the species. It is best expert judgement that this range is sustainable if all current sites are maintained in favourable condition.

The present range of *Vertigo angustior* is the western seaboard of Ireland from west Cork to North Donegal with additional inland sites in the south east.

3.3 Conservation assessment of the range

The Favourable Reference Range (FRR) for *Vertigo angustior* in Ireland is taken to be its present (post 1994) range which is 3200 km^2. In Ireland, the main decline of *Vertigo angustior* sites appears to be a result of loss of riverside and canal-side habitat, particularly from drainage of marshy areas in the midlands and south east. Older losses from coastal sites possibly date back to the time period around the Irish famine, where heavy grazing of coastal grassland by traditional grazers and rabbits was more intense, and some tillage was practiced in places.

The number of kilometres square is a range estimate only, and should not be taken as an estimate of area of actual habitat or potential habitat of the species. The sites range from a few tens of square metres (e.g. Louisa Bridge), to over 100ha (e.g. Strandhill, Ballysadare Bay) in area. *Vertigo angustior* is specific in its habitat requirements, particularly with respect to ground water levels and vegetation composition. Therefore, suitable habitat within a larger site such as Pollardstown Fen may be very restricted (e.g. transitional marsh) but also immediately recognisable. In large dune sites such as Streedagh or Doonbeg, *Vertigo angustior* is widespread across the sites but suitable/optimum habitat maybe as little as a few hectares. Area of occupancy also varies considerably from year to year depending on meteorological conditions.

As the Range of the species is based on recent range, and covers the current known populations, it is allocated a Favourable conservation status. It is unlikely that sites that have lost this species many years ago could be restored.

- **Species Range Area:** Can be considered as the area of the grid cells occupied by the habitat which is 3200 km^2 (32 grid cells x 100 km^2)
- **Favourable Reference Range:** 3200 km^2 (32 grid cells x 100 km^2)

4.0 Population

4.1 Population estimation

The estimation of population in terms of numbers of individuals for a tiny, annual invertebrate species is not feasible or practicable.

Vertigo angustior populations fluctuate naturally over time, and short-term changes in environmental conditions can rapidly influence population size and structure, especially if meteorological conditions have been extreme for the area in the months preceding the survey. Population size may be higher during wet, humid summers, whilst periods of drought or changes to site management such as increased grazing or mowing result in lower population levels. Population numbers for *V. angustior* also vary considerably with season.

Sharland (2000) found that field sampling of a *Vertigo angustior* population at Whiteford Burrows, south Wales, gave highest densities of individuals in October and November. At many of the sites in England and Wales, densities in excess of 1000 individuals/m^2 have been recorded (Killeen 2003). Similar densities of individuals/m^2 have been recorded on occasions in the best habitat at Doonbeg, Co. Clare, Ireland. Moorkens & Gaynor (2003) estimated that there was a maximum of 15ha of 'prime' habitat within an area of c.49ha of 'macro-habitat'. Population estimates for the site have ranged between 10 and 20 million individuals. However, at Pollardstown Fen (area 200ha), the maximum area of potential occupancy was 3200m^2 and the actual suitable habitat considerably less (Moorkens 2003b). Given the low density of snails at the site, the actual population is unlikely to exceed 25, 000 individuals.

A year with very low recorded numbers should not necessarily be interpreted as a long-term population decline, especially if meteorological conditions have been extreme for the area in the months preceding the survey. However, the snail may also persist for a while in less than ideal conditions and changes in vegetation and moisture conditions that are heading in one direction in spite of meteorological fluctuations should be cause for concern. Thus the assessment of condition and conservation status must take into consideration this variation. It is important to be careful not to make a false negative condition assessment where the fluctuations are only temporary and equally important not to make a false positive condition assessment where the snail is persisting but facing continuous decline. This is the reason why monitoring of populations by frequent spot check surveillance is better than by infrequent intensive studies.

Trends in population can only be achieved by having good quality data from baseline surveys which are followed by regular monitoring. There are very few examples of long-term studies but Moorkens & Gaynor (2003) and Moorkens (2004b) from two sites in Clare and Moorkens (2006c) from Pollardstown Fen, Co. Kildare provide some population information and demonstrate that trends only become detectable when there is regular monitoring over time.

Sharland (2000) found that field sampling of a *Vertigo angustior* population at Whiteford Burrows, south Wales, gave highest densities of individuals in October and November. Adults dominated in the population in June and July (c. 80% of all individuals), whereas in November 60-70% of individuals were juveniles. Another study on *V. angustior* at Gait Barrows in northwest England (Killeen 1998) showed large differences in the juvenile component between years. In October 1996 the population was dominated by adults (82.4%) whereas in October 1998 adults comprised only 42.4%. At many of the sites in England and Wales, densities in excess of 1000 individuals/m^2 have been recorded (Killeen 2003).

Baseline surveys of the *Vertigo angustior* populations in the 12 Irish SACs were not carried until 2006 (Moorkens 2007a), and, therefore reliable information on populations trends will not be available until future rounds of monitoring have been completed.

The cSAC populations for *V. angustior* divide into two categories. There are sites with widespread habitat for the species, where the snail is present in high numbers throughout the extent of the available habitat. Of particular importance are sites with both dune grassland and wetland elements, allowing a large population to reproduce each year in the best area for conditions during that particular season. Coastal sites at Dooonbeg, Strandhill and Streedagh provide outstanding examples. In contrast, some sites are likely to have had much more widespread available habitat in the past, such as at Dooaghtry and Kinlackagh Bay (dune habitat not suitable due to grazing levels, snail restricted to stream edge) and Pollardstown Fen and Louisa Bridge (snail in very restricted ecotone, probably nearby grassland habitat has altered). While the latter site populations are classified as unfavourable, it is possible that the snail has existed continuously for a long time within this restricted ecotone, although these sites are likely to be more vulnerable to change and to losses during exceptional years than sites with greater amplitude of habitat. Further work is needed.

4.2 Current population

Given this variation of individuals from year to year, the number of viable populations surveyed from 1994 to 2006 has been chosen as the best proxy in order to estimate population status. The two populations at Dog's Bay (Co. Galway) and Goleen (Co. Cork) are also included for the reasons described above. Thus there are 31 viable populations for this species. There is baseline data for 13 of the 31 sites, which is the number of sites that was surveyed in 2006.

4.3 Favourable reference population

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'* (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of *Vertigo angustior* in the Republic of Ireland, the population Conservation Status should be based upon number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). On this basis the FRP would be 31 sites **in favourable condition**, based on the condition assessment categories, shown in Appendix 6.

4.4 Conservation assessment of the population

Conservation assessments from 2006 were based on a single survey, and thus trend data is not available. This trend data is considered to be important in establishing whether populations are sustainable. The overall assessment for population is therefore inadequate.

5.0 Habitat

Macro-habitats associated with this species are listed in Cameron *et al*., 2003 as follows:

- Fixed dunes: fixed coastal dunes with herbaceous vegetation (HDAnnex I habitat category 2130), grey dunes (Corine 16.22)
- Dune Slacks: humid dune slacks (HD Annex I habitat 2190, Corine 16.3)
- Unimproved, climax maritime grassland (where it occurs close to, but not in, seasonally-flooded dune slacks): ecotone between grey dunes (Corine 16.22) and humid dune slacks (Corine 16.3)
- Machair (HD Annex I habitat 21A0)
- Humid tall herb communities: meadowsweet (*Filipendula*) stands and related communities (Corine 37.1)
- Limestone pavement Natura 2000 Code 8240 Corine 62.3
- Talus slopes (of usually calcareous boulders) with some deciduous trees Corine 62.1 (*Fraxinus, Tilia, Ulmus*)
- Alder (A*lnus*) swamp forest (central Europe) Corine 44.91
- Well-drained (almost always on slopes), open, deciduous forest (frequently dominated by *Fraxinus*) on the coast of southern Scandinavia Corine 41.34
- Saltmarsh/grey dune transition (ecotone between grey dunes (Corine 16.22) and saltmarsh couch beds (Corine 15.35))

- Saltmarsh/dune heath/lowland heath transition (ecotone between saltmarsh (Corine 15.3), heather brown dunes (Corine 16.24) and Atlantic *Erica-Ulex* heaths (Corine 31.23)
- Calcareous fen/unimproved humid grassland transition (ecotone between fen-sedge beds (Corine 53.3) or rich fens (Corine 54.2) and eutrophic humid grasslands (Corine 37.2))
- Marsh/unimproved grassland transition (ecotone between marsh and Atlantic and sub-Atlantic humid meadows (Corine 37.21).
- Lake margins/well-drained unimproved neutral to calcareous grassland transition (no applicable Corine code)
- Unimproved, lightly grazed/mown, humid grassland: Atlantic region - Atlantic and sub-Atlantic humid meadows (Corine 37.21), and Continental region – subcontinental *Cnidium* meadows (Corine 37.23)
- Unimproved lightly grazed (by rabbits) maritime grassland: semi-natural maritime grassland
- Unimproved, lightly-grazed grassland at the margins of alluvial floodplain systems: ecotone of Atlantic and sub-Atlantic humid meadows (Corine 37.21) with alluvial-flooded, eutrophic, humid grasslands (Corine 37.2)

Although the macro-habitat of *V. angustior* is wide ranging, micro-habitat, which determines the snail's area of occupancy, is much more restricted.

In Ireland *Vertigo angustior* is found associated with decaying vegetation in the litter layer, or in damp moss, in open unshaded habitats. Generally it occurs in open-structured, humid litter, but in very wet conditions can climb 10-15cm up the stems of plants or onto damp decaying timber. In dry conditions it may be found in the soil, just below the litter layer. In grassland situations it occurs at the base of tussocks and in fixed dune grassland among moss patches at the edge of dune slacks. It may also be found in and under flood debris. This species requires friable and permanently moist litter, shaded by moderately tall herbaceous or grassy vegetation. It normally occurs in association with permanently moist but free-draining (permeable) soil, not subject to inundation. It is the latter requirement that makes seemingly suitable and widespread habitat unable to sustain a population of *V. angustior*. It can tolerate salt spray and brief submersion by high water spring tides.

The micro-habitat occupied by populations of *V. angustior* living in dune grassland habitat are by far the most important in terms of population numbers and area of occupancy. They provide the most sustainable habitats for the species into the future. In older literature (e.g. Kerney and Cameron, 1979), the "dune phase" of *V. angustior* was described as "among moss in wet hollows in sand dunes". In fact, the dune habitat is in humid fixed grassland, and the species rarely moves to dune hollows or slacks, except during very dry periods. The "marsh phase" of the snail is described as very wet permanently marshy grassland. Again, the exact ecotone is at the edge of an environment that is permanently very wet, within grassland (often dominated by *Potentilla anserina*) that has excellent drainage. The juxtaposition of permanently wet marsh and well drained grassland makes the marsh phase rare, often associated with eskers immediately adjacent to very wet marsh. Without good knowledge of local soils and geology, the chances of finding marsh habitat sites are low. These are the sites that are found mainly inland and in the east of the country, such as esker-associated Pollardstown Fen population. Pressure on the wider habitats near eskers makes these sites particularly vulnerable. An exception to the marsh sites is the very wet Killanley Glebe, the oldest Irish record (Warren, 1879). This site has widespread undulating marsh, stream and grassland habitat and is of exceptional quality and importance.

Habitat quality and structure plays an important role in assessment of condition at *V. angustior* sites. The assessment criteria are shown in Appendix 6, the targets for Favourable Condition would require that all optimum habitat is retained at each site.

5.1 Current condition of *Vertigo angustior* Habitat

As only one round of baseline survey has been carried out to date, and baseline transects were chosen with suitable habitat where *V. angustior* was present, trends in the majority of the habitats cannot be determined. However, the condition of the habitats based on expert opinion of suitability for this species was assessed for the baseline.

The majority of the larger sites were in favourable habitat condition. At the smaller sites where the area of occupancy was restricted, alternative potential habitats were not occupied, mainly due to unsuitable management for the species (mostly sheep grazing, which results in the loss of *V. angustior*). The habitats of these sites have been given an initial assessment of unsuitable, but this may be upgraded in future if sustainability at the restricted site becomes apparent, therefore their **habitat conservation status** is listed as unknown. In advance of further trend data, the overall classification for the country is **Unknown**.

SAC Name	Management regime	Extent of optimal habitat	Habitat Status	Comment
Slieve Tooey/Tormore Island/Loughros (Glencolmcille)	Favourable	Favourable	Favourable	
Inishmore Island (Cill Mhuirbhigh & airport)	Favourable	Favourable	Favourable	
Pollardstown Fen	Unknown	Unfavourable	Unknown	Needs repeat surveys to assess sustainability of habitat
Killala Bay / Moy Estuary (Killanley Glebe)	Favourable	Favourable	Favourable	
Ballysadare Bay (Strandhill peninsula)	Favourable	Favourable	Favourable	
Cummeen Strand / Drumcliff Bay (Strandhill Airport)	Favourable	Favourable	Favourable	
White Strand / Carrowmore Marsh	Favourable	Favourable	Favourable	
Rye Water Valley / Carton (Louisa Bridge)	Unknown	Unfavourable	Unknown	Dry, limited habitat in 2006
Streedagh Point Dunes	Favourable	Favourable	Favourable	
Mweelrea/Sheefry/Erriff Complex (Dooaghtry)	Unfavourable in wider site	Unfavourable	Unknown	Habitat good where snail found to be present in 2006
Ballyhoorisky Point to Fanad Head (Kinlackagh)	Unfavourable in wider site	Unfavourable	Unknown	Dry, limited habitat in 2006
Kenmare River (Derrynane)	Unfavourable in wider site	Unfavourable	Unknown	Needs repeat surveys to assess sustainability of habitat

Of the 29 current known populations of *V. angustior*, 13 have been assessed for habitat quality for the snail, and habitats have been mapped, digitised, and areas of habitat estimated. Within the 13 sites, 52Hectares of optimal habitat for the snail was found, 53 Hectares of optimal / sub-optimal mosaic, 64 Hectares of sub-optimal habitat, and 12 Hectares of habitat with some potential for sub-optimal habitat and snail occurrence.

The habitat definitions are as follows:

Optimal habitat is where *V. angustior* could survive in the majority (>50%) of the habitat. This allows for areas that have, for example, *Iris pseudacorus* tussocks within cropped wet grassland. The snail cannot be found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5 to 6 centimetres of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is fixed narrow grass grey dune habitat within dune peaks of unfixed marram grass. The topographical changes also provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. angustior*, but the majority of the habitat cannot. An example would be in terrain that is generally too wet, but with small areas of sloping transition edges.

From the area estimations and the quality of habitat, and extrapolating for all 29 populations, there is likely to be a total of 116 Hectares of optimal habitat, and thus 58 Hectares at any one time would be occupied by the snail within this habitat. In addition, there would be another 288 of lower quality habitat, where the average area of occupancy would be closer to 10%, and therefore approximately 29 Hectares would additionally be occupied, giving a total of **87 Hectares in total**. As trend data is not yet available, it will be important to re-evaluate this data following future survey, as it is currently not established if sub-optimal habitat at any site is natural and sustainable, or whether it was once optimal habitat that has deteriorated and may not be sustainable.

5.2 Conservation assessment of *Vertigo angustior* habitat

The sustainability of the habitat must be assessed on a site by site basis following repeated survey. Therefore habitat status must be reported as inadequate.

6.0 Future Prospects

6.1 Current pressures

The most serious pressures in *Vertigo angustior* sites are:

100 Cultivation: change in agricultural practice e.g. dunes or wetlands from grazing to

arable/hay/silage

110 Use of pesticides: *Vertigo angustior* is susceptible to agricultural and other pesticides

120 Fertilisation: *Vertigo angustior* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat

140 Grazing: changes in grazing animal in dune sites to sheep grazing, increases in grazing levels and changes to current grazing practice in marsh sites

141 Abandonment of pastoral systems

149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment

300 Sand and gravel extraction: loss of habitat in esker / wetland interface habitats

171 Stock feeding: supplementary feeding of stock in snail habitat

190 Agriculture and forestry activities not referred to: introduction of exotic sea buckthorn and other species for the purposes of protection from wind and for other purposes

501 Paths, tracks: trampling erosion and fragmentation of habitat

601 Golf courses: Loss of habitat from golf courses without very extensive areas of rough

608 Camping and caravans: continuing expansions of Caravan Parks or other intensification

622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion and fragmentation

623 Motorised vehicles: habitat is lost through erosion and fragmentation, particularly where cars are driven on to sensitive dune habitats

810 Drainage: changes in hydrology particularly from ditch deepening or abstraction

900 Erosion: coastal erosion both natural and through trampling damage

Vertigo angustior is sensitive to modification of site hydrology which affects ground-water or surface water; heavy-grazing by livestock such as cattle leading to poaching; any grazing by sheep; supplementary feeding of livestock; lack of grazing or other laissez faire management leading to scrub encroachment; vegetation burning; all forms of soil cultivation; silage production; use of fertilisers (including organic manures) and slurry spreading (including creamery waste etc.); eutrophication, including exposure to agricultural run-off giving rise to changes in plant community structure; application of pesticides (including herbicides). Exposure to leisure activities, especially on coastal sites, can have serious negative impact on *V. angustior* populations e.g. installation of caravan parks, marina development (on estuaries), motor vehicles/sports. Introduction of shrubs, e.g. *Hippophae rhamnoides*, can also be a problem on coastal sites.

In Ireland, the main loss of *Vertigo angustior* sites appears to be a result of loss of riverside and canal-side habitat, exploitation of esker sites and drainage of local wetlands or more extensive areas, and sheep grazing and over exploitation of dune sites.

6.2 Threats

The most serious threats to *Vertigo angustior* include all of the above pressures, which are likely to remain and/or intensify in the future, and also:

400 Urbanised areas, human habitation: if encroachment into *V. angustior* habitat is allowed

500 Communications networks: if encroachment into *V. angustior* habitat is allowed, or interferes with the hydrogeology of the marsh habitat for the species.

871 Sea defence or coastal protection works: through modification of natural and dynamic coastal habitats

990 Other processes: climate change, in particular leading to higher sea levels and subsequent erosion of habitat, and leading to changes of weather pattern causing more extensive flooding and/or drought periods

6.3 Positive impacts

Vertigo angustior is not protected under Irish law, but has protection in its SACs under the Habitat's Directive, and the Republic of Ireland Habitat's Regulations (Statutory Instrument 94 of 1997) (Appendix 4).

Vertigo angustior is protected in cSACs that contain a number of Annex I habitats, including Fixed coastal dunes with herbaceous vegetation (grey dunes) (HD Annex I habitat category 2130), Dune Slacks (HD Annex I habitat 2190) and Machair (HD Annex I habitat 21A0). The snail is likely to continue to flourish in a number of coastal cSACs for which it is not a designated feature (Appendix 5).

6.4 Future Prospects Conservation Status

While there is a considerable lack of quantitative data, *Vertigo angustior* appears to be in very good condition in its coastal sites, within its own cSACs and most likely also within other cSACs not designated for the snail. There is a lack of trend data from the inland marsh sites, and these sites are also more difficult to protect as the hydrogeological influences on these sites may be complex and are as yet unknown.

The range of *V. angustior* was researched through widespread dune survey from 1997 to 2006. Dominant communities at both eastern and western dune systems were grassland and open communities. The molluscan species that were most common in the western *V. angustior* sites are species of calcareous damp habitats, with high incidences of *Carychium tridentatum, Cochlicopa lubrica,* and *Vallonia costata,* all of which are excellent *V. angustior* indicators and live in a calcareous damp but not saturated environment. The eastern sites had more *Columella aspera, Arion intermedius, Oxychilus alliarius* and *Trochulus striolatus*. All of these are acid tolerant damp species that have some tolerance of drying. This is essentially the difference between the western and eastern habitats, the western sites have a damp maritime Atlantic influence and have built up good levels of calcium in the fixed dune soil, whereas the eastern dune sites are less fixed, have built up less calcium, are on more acid geology, and are subjected to less annual rainfall than their westerly equivalents. This result agrees with the hypothesis by Moorkens & Gaynor (2003) that the western dune *V. angustior* habitats are being maintained by rainfall as well as by a high groundwater table. It is unlikely that a significant easterly maritime population for this species has been missed and therefore the inland *V. angustior* marsh populations should be considered to have a high conservation importance.

At inland sites where the *V. angustior* habitat is in the wettest margin of an otherwise large area of agricultural land with a high carrying capacity for livestock, conservation management is needed, such as to fence off the snail habitat for some of each year, as it will be vulnerable to serious trampling damage otherwise.

Of particular importance is the absence of sheep grazing from all sites supporting *V. angustior*. As sheep grazing is such a common element of Irish agriculture, including coastal sites, it is essential that it never forms part of management practices in sites that are to conserve *V. angustior*.

Of help into the future will be the acquisition of multiple data sets of repeated transects, which will help to build up a picture of the natural variation of *V. angustior* location and numbers from year to year. For this reason a repeat survey is recommended for these sites within a short period of time. Without this information, levels of acceptable change will not easily be estimated and it will be more difficult to assess change as a consequence of habitat interference, especially where that interference may be remote from the ecotone in which its affects are manifest.

The range of *Vertigo angustior* has decreased from its historical range, but has good protection in some of its SACs, and has reasonably wide distribution still, particularly in more remote areas of Ireland. The range conservation status is considered to be **favourable**.

The extent of population numbers and areas of occupancy in coastal SACs is good, but population is clearly restricted in inland sites, but the extent of their vulnerability is currently unknown. Information is also deficient outside most protected areas. Due to the lack of trend data population conservation status is classified as **inadequate**.

The extent of suitable habitat in good condition in coastal SACs is considerable, and the extent of vulnerability of the inland sites is currently unknown. Information is also deficient outside most protected areas. Due to the lack of trend data habitat conservation status is classified as **inadequate**.

Considering the impacts, pressures and threats to *Vertigo angustior* in the Republic of Ireland today, the overall Conservation Status for Future Prospects is **inadequate**. More information is desirable in order to make a more confident and informed assessment in the future. In order to address this, a Species Monitoring Plan will be written, which will specify monitoring work that needs to be carried out in order to fully assess the condition of the populations of this species. This monitoring will be designed to identify any negative effects and initiate an investigation into the causes of any negative trends, and initiate measures that can be taken to mitigate against negative affects before it is too late. It is expected that the implementation of this monitoring plan will lead to improved data to assist reporting in 2013, as well as to improved protection of the populations. Although the overall assessment is unknown, the likely true status of the species in the Republic of Ireland is favourable, but more data would be needed to confirm this.

Range	**Favourable**
Population	**Inadequate**
Range of appropriate habitat	**Inadequate**
Future prospects	**Inadequate**
Overall Assessment	**Inadequate**

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Appendix 1: Records of *Vertigo angustior* in Ireland

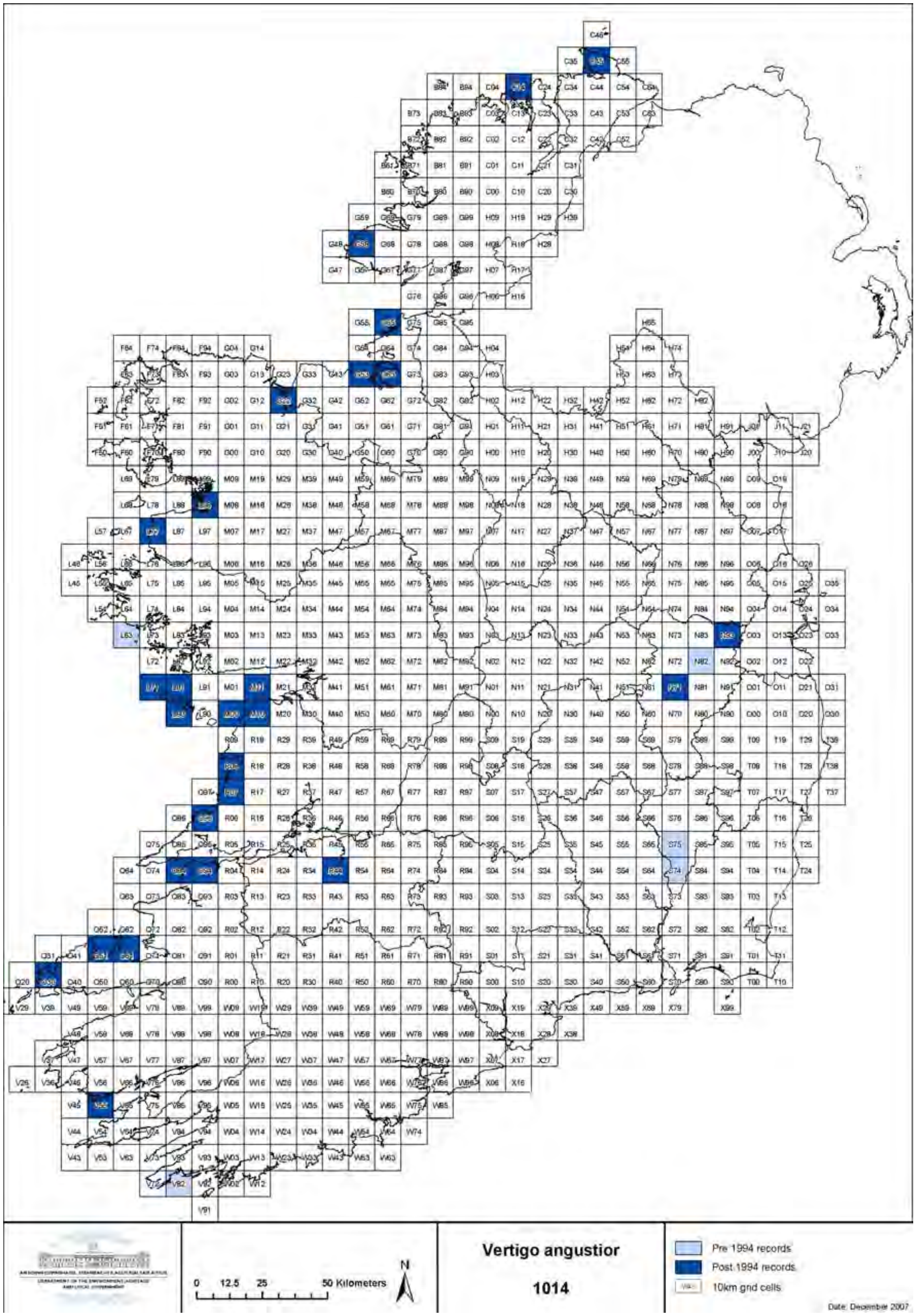


Figure 1: 10km squares with records of *Vertigo angustior* in the Republic of Ireland

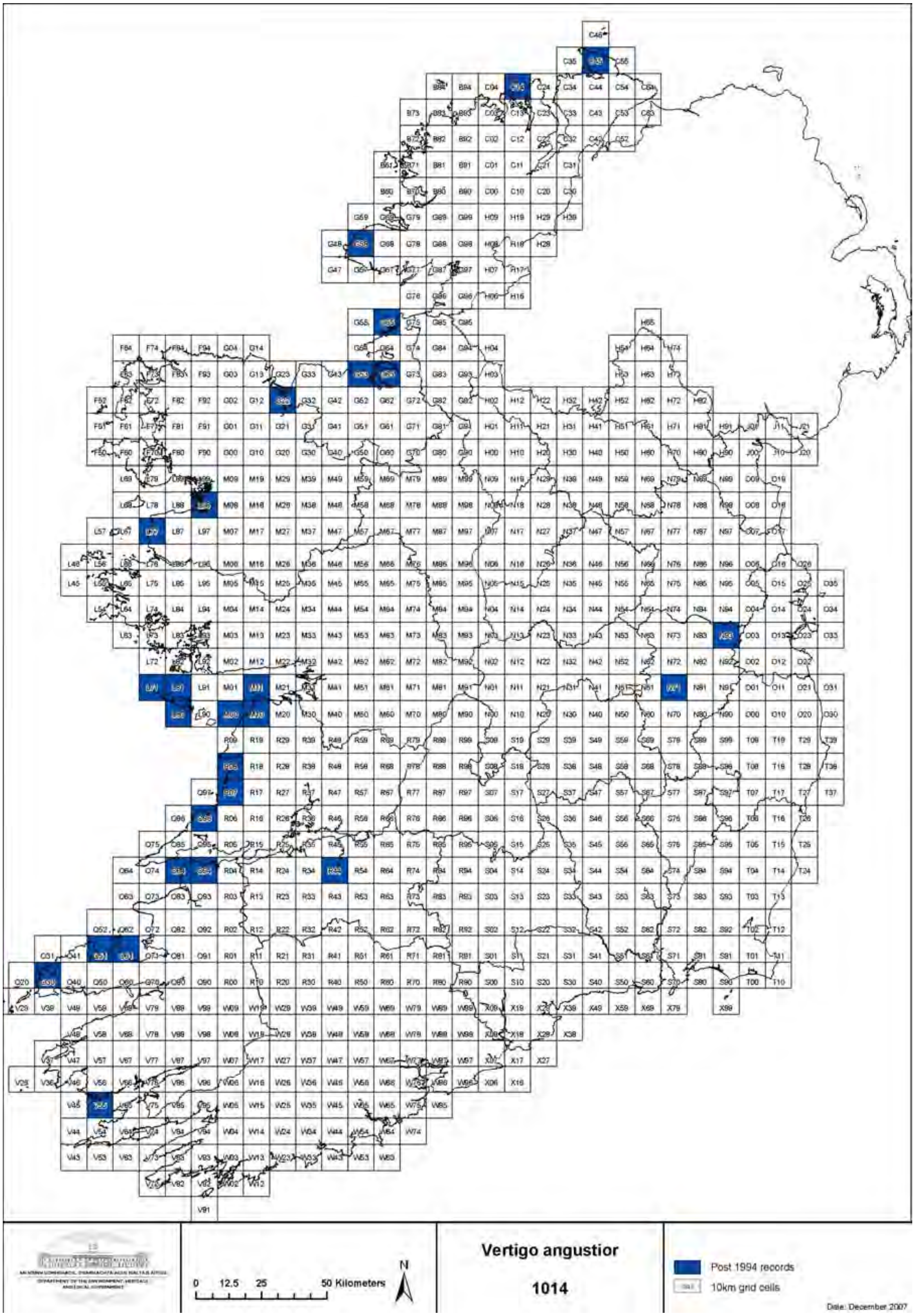


Figure 2: 10km squares with records of *Vertigo angustior* in the Republic of Ireland since 1994

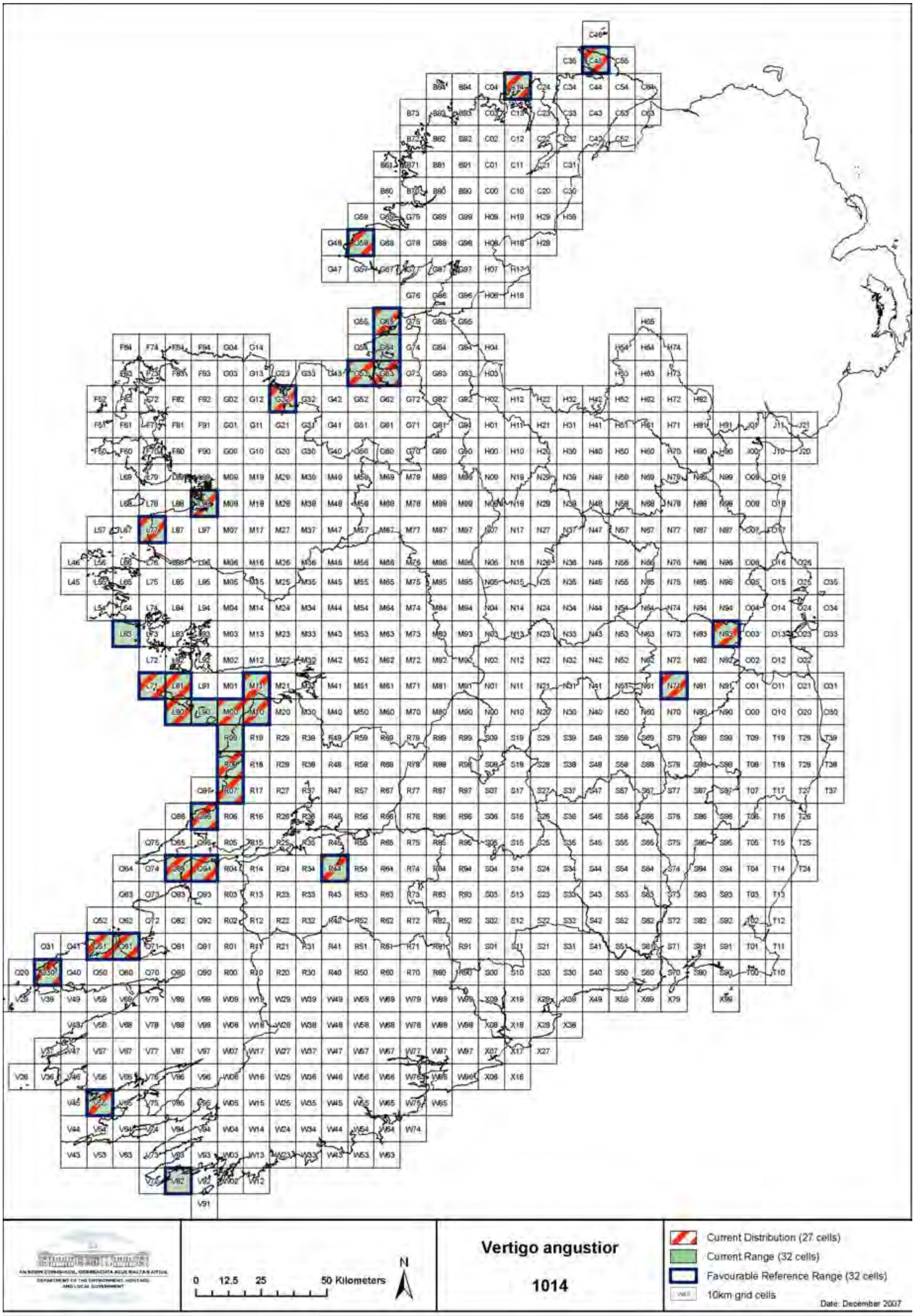


Figure 3: Range of *Vertigo angustior* in the Republic of Ireland

Appendix 2: *Vertigo angustior* records from Ireland

County	Site	Grid Ref	Date	Recorder	Reference
Carlow	Borris Bridge	S75	c. 1900	P.H.Grierson	Grierson 1904
Clare	Milltown Malbay	Q07	Pre- 1845	W.H.Harvey	Brown 1845
Clare	Lehinch	Q0988	1900	P.H.Grierson	Grierson 1902
Clare	Poulsallagh	M0801	1993	P. Tattersfield	Unpublished
Clare	Black Head	M1411	1993	P. Tattersfield	Unpublished
Clare	Doonbeg	Q9968	1998	E.A.Moorkens	
Clare	Fanore	M1308	19.iii.1999	E.A.Moorkens	Moorkens 1999a
Clare	Spanish Point	R0378	21.iii.1999	E.A.Moorkens	Moorkens 1999a
Cork	Goleen	V82	iv.1939	W.E.R.Hackett	Ellis 1951
Donegal	Ballycramsy	C4351	1981	R. Anderson	Anderson 1981
Donegal	Glencolmcille	G5285	09.x.2000	E.A.Moorkens	Moorkens 2000
Donegal	Kinlackagh Bay	C1844	2002	G. Holyoak	Conch Soc
Donegal	Malin Dunes	C4152	31.vii.1998	E.A.Moorkens	Moorkens 1998
Galway	Dog's Bay	L63	1906	A.W. Stelfox	Stelfox 1911
Galway	Inishmore (W end)	L7711	1990	P. Tattersfield	Tattersfield 1999
Galway	Cill Mhuirbhigh Inishmore	L8310	vii.1999	E.A.Moorkens	Moorkens 1999b
Galway	Inishmore airport,	L8907	vii.1999	E.A.Moorkens	Moorkens 1999b
Kerry	Cloghane, Dingle	Q51	v. 1909	J.R. le B. Tomlin	Stelfox 1915
Kerry	Ferriter's Cove, Dingle	Q3205	17.ix.1914	A.W. Stelfox	Stelfox 1915
Kerry	Derrynane	Q5358	1949	H.E.Quick	Specimens in BMNH
Kerry	Beal Point	Q9048	02.iv.1999	E.A.Moorkens	Moorkens 1999a
Kerry	Ballybunnion	Q8640	03.iv.1999	E.A.Moorkens	Moorkens 1999a
Kerry	Fermoyle	Q5413	03.iv.1999	E.A.Moorkens	Moorkens 1999a
Kerry	Stradbally, Dingle	Q5914		E.A.Moorkens	Moorkens Rep
Kerry	Kilshannig/Maharees	Q6115	iv.2003	E.A.Moorkens	Moorkens Rep
Kildare	Leixlip	N9936	16.iv.1933	D.K.Kevan	Kevan 1933
Kildare	Digby Bridge, Sallins	N8624	01.iv.1971	C.R.C. Paul & A.Norris	Norris & Colville 1974
Kildare	Pollardstown Fen	N7715	iv.2002	I.J.Killeen	Moorkens 2003a
Kilkenny	Graiguenamanagh	S74	09.iv.1933	R.A.Phillips	Conch Soc
Limerick	Curragh Chase	R4148	29.v.2005	E.A.Moorkens & I.J.Killeen	Moorkens 2006
Mayo	Killanley Glebe	G2624	1879	A. Warren	Warren 1879
Mayo	Dooaghtry	L7469	15.ix.1909	A.W. Stelfox	Stelfox 1912
Mayo	Bartraw, Clew Bay	L9184	18.viii.2005	E.A.Moorkens & I.J.Killeen	Unpublished
Sligo	Strandhill Ballysadare Bay	G5934	vii.1983	M. Cawley	Cawley 1996
Sligo	Strandhill Airport	G6036	07.xii.1992	M. Cawley	Cawley 1996
Sligo	Streedagh	G6450	15.vii.1992	M. Cawley	Cawley 1996

Appendix 3: *Vertigo angustior* records from Ireland – last recorded dates in chronological order

County	Site	Grid Ref	First record	Last seen	
Clare	Milltown Malbay	Q07	1845	1845	
Carlow	Borris Bridge	S75	1900	1900	
Kilkenny	Graiguenamanagh	S74	1933	1933	Moorkens 1997
Cork	Goleen	V82	1939	1939	
Kerry	Cloghane, Dingle	Q51	1909	1971	Moorkens 1995
Kildare	Digby Bridge, Sallins	N8624	1971	1971	Moorkens 1995
Galway	Dog’s Bay	L6838	1906	1984	Colville & Coles 1984
Clare	Poulsallagh	M0801	1993	1994	
Clare	Black Head	M1411	1993	1994	
Kerry	Ferriter’s Cove, Dingle	Q3205	1914	1997	Moorkens 1997
Kildare	Leixlip	N9936	1933	1997	Moorkens 1997
Donegal	Ballycramsy	C4351	1981	1998	Moorkens 1998
Donegal	Malin Dunes	C4152	1998	1998	Moorkens 1998
Clare	Spanish Point	R0378	1999	1999	Moorkens 1999a
Kerry	Ballybunnion	Q8640	1999	1999	Moorkens 1999a
Kerry	Fermoyle	Q5413	1999	1999	Moorkens 1999a
Kerry	Stradbally, Dingle	Q5914	1999	2003	Moorkens Rep
Clare	Lehinch	Q0988	1900	2004	Moorkens Rep
Kerry	Beal Point	Q9048	1999	2004	Moorkens Rep
Kerry	Kilshannig, Maharees	Q6115	2003	2004	Moorkens Rep
Galway	Inishmore (W end)	L7711	1990	2005	Moorkens Rep
Limerick	Curragh Chase	R410485	2005	2005	Moorkens 2006
Mayo	Bartraw, Clew Bay	L914843	2005	2005	Unpublished
Clare	Fanore	M1308	1999	2006	Moorkens 2007a
Clare	Doonbeg	Q9968	1998	2006	Moorkens 2007a
Donegal	Glencolmcille	G5285	2000	2006	Moorkens 2007a
Donegal	Kinlackagh Bay	C1844	2002	2006	Moorkens 2007a
Galway	Cill Mhuirbhigh Inishmore	L8310	1999	2006	Moorkens 2007a
Galway	Inishmore airport,	L8907	1999	2006	Moorkens 2007a
Kerry	Derrynane	Q5358	1949	2006	Moorkens 2007a
Kildare	Pollardstown Fen	N7715	2002	2006	Moorkens 2007a
Sligo	Killanley Glebe	G264248	1879	2006	Moorkens 2007a
Mayo	Dooaghtry	L7469	1909	2006	Moorkens 2007a
Sligo	Strandhill Ballysadare Bay	G5934	1983	2006	Moorkens 2007a
Sligo	Strandhill Airport	G6036	1992	2006	Moorkens 2007a
Sligo	Streedagh	G6450	1992	2006	Moorkens 2007a

Appendix 4: Special Areas of Conservation (SAC) in Ireland designated for *Vertigo angustior*

SAC Site Code	SAC Name	County	Site
000190	Slieve Tooey/Tormore Island/Loughros	Donegal	Glencolmcille
000213	Inishmore Island	Galway	Cill Mhuirbhigh & airport
000396	Pollardstown Fen	Kildare	Pollardstown Fen
000458	Killala Bay / Moy Estuary	Mayo	Killanley Glebe
000622	Ballysadare Bay	Sligo	Strandhill Ballysadare Bay
000627	Cummeen Strand / Drumcliff Bay	Sligo	Strandhill Airport
001007	White Strand / Carrowmore Marsh	Clare	Doonbeg
001398	Rye Water Valley / Carton	Kildare	Louisa Bridge
001680	Streedagh Point Dunes	Sligo	Streedagh
001932	Mweelrea/Sheefry/Erriff Complex	Mayo	Dooaghtry
001975	Ballyhoorisky Point to Fanad Head	Donegal	Kinlackagh Bay
002158	Kenmare River	Kerry	Derrynane

Appendix 5: Special Areas of Conservation (SAC) in Ireland where *Vertigo angustior* is present but is not a named feature

Site	SAC Site Code	SAC Name	County
Poulsallagh	00020	Black Head-Poulsalach complex	Clare
Black Head	00020	Black Head-Poulsalach complex	Clare
Ballycramsy	02012	North Inishowen Coast	Donegal
Malin Dunes	02012	North Inishowen Coast	Donegal
Spanish Point	01021	Carrowmore Point to Spanish Point	Clare
Fermoyle	02070	Tralee Bay and Magharees Peninsula, west to Cloghane	Kerry
Stradbally, Dingle	02070	Tralee Bay and Magharees Peninsula, west to Cloghane	Kerry
Lehinch	00036	Inagh River Estuary	Clare
Kilshannig, Maharees	02070	Tralee Bay and Magharees Peninsula, west to Cloghane	Kerry
Inishmore (W end)	000213	Inishmore Island	Galway
Curragh Chase	00174	Curraghchase woods	Limerick
Bartraw, Clew Bay	01482	Clew Bay Complex	Mayo
Fanore	00020	Black Head-Poulsalach complex	Clare

Appendix 6: Condition Assessment Criteria

Condition of the *Vertigo angustior* snail population and its habitat was carried out by measuring environmental variables and snail abundance at intervals along linear transects (or in the case of very small sites – the whole site) (Moorkens 2006b, 2007a).

The attributes measured in the baseline surveys were:

Type of micro-habitat (species composition and sward height) along a linear transect
Hydrological field assessment - Wetness within each micro-habitat zone
Presence and abundance of *Vertigo angustior*

Habitat and wetness were classified into Optimal, Sub-Optimal and Unsuitable. In broad terms, these are as follows:

- **Optimal** habitat is where *V. angustior* could survive in the majority (>50%) of the habitat. This allows for areas that have, for example, *Iris pseudacorus* tussocks within cropped wet grassland. The snail cannot be found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5 to 6 centimetres of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is fixed narrow grass (principally *Festuca rubra*) grey dune habitat within dune peaks of unfixed marram grass. The topographical changes also provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

- **Sub-optimal** habitat is where there are patches of vegetation and conditions that support *V. angustior*, but the majority of the habitat cannot. An example would be in terrain that is generally too wet, but with small areas of sloping transition edges.

- **Unsuitable** habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance. This may be natural unsuitability, or alternatively the snail may be restricted by excessive grazing or fertilisation of flat areas of dune grassland, or by patches of weeds arising due to enrichment in the past.

To assess the Condition/Favourable Conservation Status of each site/SAC, additional attributes such as management and other negative impacts need to be taken into account. Therefore, the following simple matrix has been devised:

Attribute	**Pass - Favourable**	**Pass/Fail***	**Fail - Unfavourable**
Overall condition of site	Good	Moderate	Poor
Extent of optimal habitat within the site	Extensive	Resticted	Sparse
Vertigo angustior abundance	Present common	Present scarce	Absent
Management regime	Appropriate – no change needed	Mostly appropriate – some changes needed	Damaging
Other negative impacts	None	Some but recoverable	Damaging – not recoverable

Pass/Fail* - Pass if there are other favourable attributes, fail if there are other unfavourable atrributes

1014 The narrow-mouthed whorl snail (*Vertigo angustior*)

1. National Level	
Species code	1014
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	32 10k squares

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	Cawley, M., 1996. Notes on some non-marine Mollusca from Co. Sligo and Co. Leitrim including a new site for *Vertigo geyeri* Lindholm. *Irish Naturalists' Journal* 25: 183-185. Colville, B. & Coles, B., 1984. A week's snail collecting in Ireland. *Conchologists' Newsletter* 89: 192-196. Grierson, P.H. (1902). Some land and freshwater snails from Co. Clare. *Ir. Nat.* **11**, 139-140. Grierson, P.H., 1904. *Vertigo angustior* in County Carlow. *Irish Naturalist* **13**: 294. Kerney, M. (1976) *Atlas of the land and freshwater molluscs of the British Isles.* ITE, Conchological Society, London. P92. Kerney, M.P., 1999. *An atlas of the land and freshwater molluscs of Britain and Ireland.* Harley Books, Colchester. Kevan, D.K., 1933. *Vertigo angustior* Jeffreys and *Acicula lineata* (Drap.) in Co. Kildare. *Irish Naturalist* **4**: 178. Moorkens, E.A., 1995. Mapping of proposed SAC sites for *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1997. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1997 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1998. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1998 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999a. Molluscan Survey 1999 Volume I: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999b. Molluscan Survey 1999 Volume II: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report

	to National Parks and Wildlife. Moorkens, E.A., 2000. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo* species: 2000 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2003a. The *Vertigo* workshop field excursion to Pollardstown Fen (Co. Kildare) with a provisional list of the Mollusca known from the site. *Heldia* **5** (7): 179-180. Moorkens, E.A., 2003b. Final Baseline Report on Molluscan Surveys of Pollardstown Fen 1998-2003. Report to Kildare County Council. Moorkens, E.A., 2004a. Non-marine Mollusca: New and notable records for Ireland. *Bull. Ir. Biogeog. Soc.* **28**: 189-198. Moorkens, E.A. 2004b. Annual Conservation Repart and 5 year summary report for the development and maintenance of the golf links at Doonbeg, Co. Clare. Unpubklished report for Doonbeg Golf Club Limited. Moorkens, E. A., 2006a. Irish non-marine molluscs - an evaluation of species threat status. *Bull. Ir. biogeog. Soc.* **30**: 348-371. Moorkens, E.A., 2007a. Management prescriptions for *Vertigo angustior* at cSAC sites for the species in the Republic of Ireland. Unpublished report to National Parks and Wildlife.
2.3 Range	
2.3.1 Surface area	3200km²
2.3.2 Date	2007
2.3.3 Quality of data	Good
2.3.4 Trend	-10%
2.3.6 Trend-Period	1970 to 2006
2.3.7 Reasons for reported trend	3
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	31 viable populations (if include Goleen & Dog's Bay)
2.4.2 Date of estimation	2007
2.4.3 Method used	2 Baseline survey only from 13 sites
2.4.4 Quality of data	1 poor (not all sites were assessed, 13 have baseline data, no trend data)
2.4.5 Trend	Decreasing
2.4.7 Trend-Period	1970 - 2006
2.4.8 Reasons for reported trend	3 (mostly drainage, habitat destruction)

2.4.9 Justification of % thresholds for trends	Based on best expert judgement. There is no trend data available, based on likely losses at inland sites.
2.4.10 Main pressures	100 Cultivation: change in agricultural practice e.g. dunes or wetlands from grazing to arable/hay/silage 110 Use of pesticides: *Vertigo angustior* is susceptible to agricultural and other pesticides 120 Fertilisation: *Vertigo angustior* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat 140 Grazing: changes in grazing animal in dune sites to sheep grazing, increases in grazing levels and changes to current grazing practice in marsh sites 141 Abandonment of pastoral systems 149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment 171 Stock feeding: supplementary feeding of stock in snail habitat 190 Agriculture and forestry activities not referred to: introduction of exotic sea buckthorn and other species for the purposes of protection from wind and for other purposes 300 Sand and gravel extraction: loss of habitat in esker / wetland interface habitats 501 Paths, tracks: trampling erosion and fragmentation of habitat 601 Golf courses: Loss of habitat from golf courses without very extensive areas of rough 608 Camping and caravans: continuing expansions of Caravan Parks or other intensification 622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion and fragmentation 623 Motorised vehicles: habitat is lost through erosion and fragmentation, particularly where cars are driven on to sensitive dune habitats 810 Drainage: changes in hydrology particularly from ditch deepening or abstraction 900 Erosion: coastal erosion both natural and through trampling damage
2.4.11 Threats	All of the above, plus 400 Urbanised areas, human habitation: if encroachment into *V. angustior* habitat is allowed 500 Communications networks: if encroachment into *V. angustior* habitat is allowed, or interferes with the hydrogeology of the marsh habitat for the species. 871 Sea defence or coastal protection works: through modification of natural and dynamic coastal habitats 990 Other processes: climate change, in particular leading to higher sea levels and subsequent erosion of habitat
2.5 Habitat for the species	

2.5.2 Area estimation	87 Hectares (summation of measured habitats)
2.5.3 Date of estimation	2007
2.5.4 Quality of data	2=moderate
2.5.5 Trend	-5% (based on loss of inland habitats, see comp info)
2.5.6 Trend-Period	1970-2006
2.5.7 Reasons for reported trend	3
2.6 Future prospects	2 (poor prospects without strong conservation, very poor prospects of inland habitat type)

2.7 Complementary information	
2.7.1 Favourable reference range	32 10k squares
2.7.2 Favourable reference population	31 viable populations
2.7.3 Suitable Habitat for the species	87 Hectares

2.7.4 Other relevant information

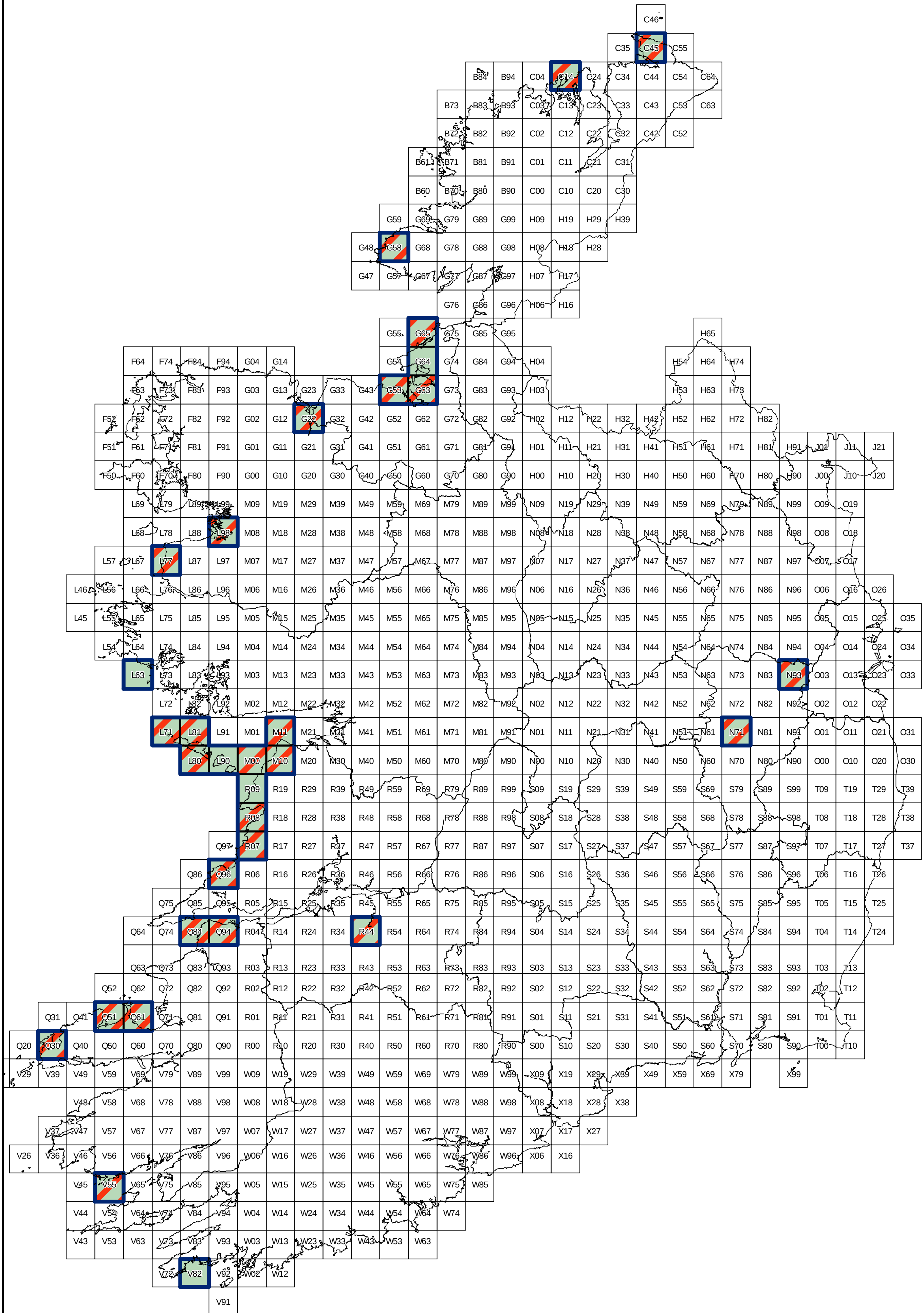
Habitat is classified as optimal and sub-optimal, but while best sites have large areas of optimal habitat, other sites may only have the capacity for sub-optimal habitat (in snail terms), which may be extremely stable and thus support a continuous population. Only repeated survey will provide sufficient evidence of the stability of the habitat, to determine if habitat suitability is stable or declining over time. The classifications are based on best expert judgement in the absence of trend data.

Vertigo angustior is not protected under Irish law (Wildlife Act), and is considered to remain under threat and is listed as Vulnerable in Ireland (Moorkens, 2006).

Vertigo angustior is protected in cSACs that contain a number of Annex I habitats, including Fixed coastal dunes with herbaceous vegetation (grey dunes) (HD Annex I habitat category 2130), Dune Slacks (HD Annex I habitat 2190) and Machair (HD Annex I habitat 21A0), and protection of these habitats will also help the snail. The snail is also likely to continue to flourish in a number of coastal cSACs for which it is not a designated feature, but where these habitats are protected.

Population, habitat and future prospects are classified as inadequate due to the expert judgement that the poor habitat and populations in some inland sites are due to genuine declines rather than long term stable but sub-optimal habitat, but this will be reviewed following the collection of trend data.

2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	FV Favourable
Population	U1 Inadequate
Habitat for the species	U1 Inadequate
Future prospects	U1 Inadequate
Overall assessment of CS1	U1 Inadequate



1:1,800,000

0 12.5 25 50 Kilometers

Vertigo angustior

1014

- Current Distribution (27 cells)
- Current Range (32 cells)
- Favourable Reference Range (32 cells)
- W48 10km grid cells

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

Date: January 2008

Conservation Assessment of Desmoulin's whorl snail *Vertigo moulinsiana* in Ireland

July 2007

Contents

1.0 Ecology of Desmoulin's whorl snail *Vertigo moulinsiana* in Ireland

Vertigo moulinsiana is one of 8 species of whorl snail (genus *Vertigo*) living in Ireland. The whorl snails are amongst the smallest of the country's land molluscs with a size ranging from 1.7 to 2.7mm in height and 1 to 1.5mm in width. *Vertigo moulinsiana* is the largest, with a height of 2.2 – 2.7mm. All whorl snails favour damp or wet habitats, especially marshes where they live mostly in moss, leaves and decaying vegetation. Some of the species of whorl snails (including *V. moulinsiana*) are particularly sensitive to changes in hydrology. Such changes have become more evident in recent times, with the result that 4 of the 8 species are now listed on Annex II of the European Habitats & Species Directive.

Vertigo moulinsiana is considered to be an Atlantic-Mediterranean species with a range extending from Ireland to Russia and south to North Africa, but the main populations are in western and Central Europe.

The species mainly inhabits calcareous, lowland wetlands. It occurs in swamps, fens and marshes usually bordering rivers, canals, lakes and ponds (Cameron *et al*. 2003) where very humid conditions prevail, often enhanced by open water evaporation during the spring to autumn (Moorkens 2006a).

Vertigo moulinsiana lives on both living and dead stems and leaves of tall plants: grasses (eg *Glyceria maxima),* sedges (e.g. *Carex riparia* and *Cladium mariscus,* and reeds (e.g. *Phragmites australis)* (Killeen 2003a, b; Cameron *et al*. 2003). As well as the tall vegetation structure of the habitats above, *V. moulinsiana* requires a stable hydrology, where the water-table is at, or slightly above, the ground surface for much of the year and any seasonal flooding is of very low amplitude (Tattersfield & McInnes 2003). It climbs tall vegetation in the summer and autumn, and in winter it descends to litter level, and in severe conditions aestivates on the lower leaves of plants.

Water-borne transportation is believed to be the principal dispersal mechanism Desmoulin's whorl snail (Killeen 2003a, Cameron *et al*. 2003). By the nature of its wetland habitat, the snails are likely to be able to float on the water surface or attached to floating vegetation, and can therefore disperse during periods of flooding. Dispersal is also believed to be mediated by mammals, the snail being brushed from vegetation as the animals pass, and then adhering to their body hair. A similar dispersal is inferred by attachment to the feet and feathers of birds. The ability of the species to self-fertilise makes it possible for a single coloniser to establish a new population.

Vertigo moulinsiana is hermaphrodite, but may often self-fertilise (Pokryszko, 1987). The eggs develop in less than two weeks, and the main reproductive period is in the summer, peak numbers of adults being recorded then, with large numbers of juveniles being recorded in the autumn. Population densities of more than 1000 individuals/m² have been recorded for this species at sites in England, but are subject to considerable annual fluctuation, the same sampling stations recording densities varying from 200 - 600 individuals/m² in successive years (Killeen 2003a, b).

2.0 Data sources

Recording in Ireland of non-marine molluscs including *Vertigo moulinsiana* falls into three main phases: The first half of the 20th century when the fauna was studied by R.A. Phillips and A.W. Stelfox; the early 1970s when recording was carried out by members (mainly A. Norris and M.P. Kerney) of the Conchological Society of Great Britain & Ireland as part of a general molluscan 10km mapping project (Atlas published, Kerney 1976); and then from the mid 1990s by E.A. Moorkens working under contract to National Parks and Wildlife to identify potential SACs for the species (Moorkens 1995, 1997, 1998, 1999a, b, 2000). Part of Moorkens work included revisiting most of the sites where *Vertigo moulinsiana* had previously been recorded, but the work also resulted in the addition of several new sites. Since 2000, further sites have been discovered following surveys of the Grand and Royal Canals (Moorkens & Killeen 2005), general surveys and EIAs (Moorkens 2004, 2006b, unpublished reports). Further sites were found in 2006 as part of a wide-ranging survey for the species in the Shannon Basin (Moorkens 2007b).

None of the above work included a quantitative element, and only in some of the latter studies was there any detailed mapping of the species within sites. However, in 2006 work was carried out to survey, compile management prescriptions, and set up baseline monitoring survey stations for those parts of the 7 SACs known to support *Vertigo moulinsiana* (Moorkens 2007a).

The range of the *V. moulinsiana* population is therefore based upon good quality and up-to-date data.

3.0 Range

3.1 Current range

Range was assessed using the IUCN criteria for extent of occurrence (IUCN, 2001), and its interpretation as discussed by the European Commission (2006), and 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 distribution of the species is illustrated on a 10km Irish National Grid. Intersecting the location of species' records between 1994 and 2006 with the 10km grid has generated this map. The current range was defined by the smallest polygon size containing all 10 km grid squares where the species was recorded, drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species 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. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps may also occur. The current range spans 41 10 km squares.

The cut off date of 1994 was chosen as this was the time when the Habitats Directive became effective and also the time in Ireland when a more detailed phase of mollusc recording commenced.

Appendix 1, Figure 1 shows all pre- and post-1994 records by 10km square. Figure 2 shows post-1994 records only by 10km square, with the species current range and favourable reference range shown. It has been recorded from a total of 39 ten kilometre squares, but it has only been recorded in 22 ten kilometre squares since 1994. *V. moulinsiana* has possibly been lost from a further 3 ten km squares in the last 5 years, where the habitat of the known population has been severely altered or destroyed.

Vertigo moulinsiana has been recorded from 52 separate sites. A site may be termed as having a defined habitat boundary such as a fen or lakeshore. For riparian situations such as along canals and rivers a separate site is delineated on a 1km square basis. Where large sites straddle two 10km squares, this is taken as 2 sites (for range estimation purposes). Appendix 2 shows all records of *Vertigo moulinsiana*, and Appendix 3 shows the records in chronological order of when they were last recorded at each site. The snail has not been recorded at 26 of these sites since 1994.

Vertigo moulinsiana has been recorded mostly from sites in the Midlands and the Shannon Basin from Lough Derg to Longford, with outlying sites from Kerry in the west to Wicklow in the east. To date, *Vertigo moulinsiana* has been found in 17 Irish counties: Carlow, Clare, Dublin, Galway, Kerry, Kildare, Kilkenny, Laois, Limerick, Longford, Meath, Offaly, Roscommon, Tipperary, Westmeath, Wexford and Wicklow. There are also Postglacial fossil records from Counties Mayo, Dublin and Tipperary. The most recent new county record additions have been Galway (1998), Westmeath (2003), Limerick (2005) and Roscommon (2006).

3.2 Favourable reference range

The range of *Vertigo moulinsiana* has become smaller in recent years than it was in former times, when habitat for the species was widespread along the major river basin flood plains. It is likely that this habitat began to experience losses when large-scale modification became widespread. With the building of the canals towards the end of the 18th Century, a new set of habitat corridors became available to the species, and most of the modern populations for the snail are within sites that are likely to have been colonised from the canal corridors. Therefore, the canals have acted as sources and the fens, ditches and lake margins that currently host the snail have acted as sinks. It is unlikely that new and natural connection and recolonisation could occur between these isolated sites, should they come under pressure or for whatever reason lose a living population.

Favourable reference range in Ireland is difficult to estimate with certainty. If all current populations of the snail are protected and maintained in favourable condition, this may be sustainable in the long term. However, it may be that this species is more dynamic than is currently scientifically understood, and may require large-scale functioning corridors in order to sustain a sufficient number of sites on a long-term basis. A large number of former sites have been lost relatively recently, and thus long term studies on sustainability of individual populations are not yet known.

The mapping of the species favourable range was defined by the smallest polygon size containing all 10 km grid squares where the species was recorded, drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species 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. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps may also occur.

The favourable reference range is therefore the current range of 41 10km squares plus 11 additional 10km squares, giving a total of 52 10 km squares.

3.3 Conservation assessment of the range

The current range in Ireland was calculated as 4100 km^2. This equates to the number of 10km squares with records since 1994.

The present range of *Vertigo moulinsiana* is the Midlands, and the Shannon Basin from Lough Derg to Longford, with some outlying squares in areas of old calcareous wetland.

The Favourable Reference Range (FRR) for *Vertigo moulinsiana* in Ireland is taken to be 5200 km^2 (see above). Many of the sites lost are from riparian margins of the Grand and Royal Canals which have been cleaned and marginal vegetation has been lost. Other sites have been lost through large-scale drainage. The current range is therefore 79% of its favourable range.

The Range of the species is based on recent surveys, and covers the current known populations, and it is allocated an Unfavourable conservation status. Designation status of *Vertigo moulinsiana* populations are shown in Appendix 4 to 5.

- **Species Range Area:** Can be considered as the area of the grid cells occupied by the habitat which is 4100 km^2 (41 grid cells x 100 km^2)
- **Favourable Reference Range:** 5200 km^2 (52 grid cells x 100 km^2)

4.0 Population

4.1 Population estimation

The estimation of population in terms of numbers of individuals for a tiny, annual invertebrate species is not feasible or practicable. Attempts have been made to determine population size of another *Vertigo* species in Ireland (*V. angustior*) (Moorkens & Gaynor 2003) but this was in a dune grassland environment where it was possible to achieve greater accuracy with snail sampling and estimation of area of suitable habitat.

Vertigo moulinsiana populations fluctuate naturally over time, and short term changes in environmental conditions can rapidly influence population size, especially if meteorological conditions have been extreme for the area in the months preceding the survey. Population size may be higher during wet, humid summers, whilst periods of drought or changes to site management such as increased grazing or mowing result in lower population levels. Population numbers for *V. moulinsiana* also vary considerably with season with low numbers in late winter and early spring to very high numbers in late summer and autumn when the snail's have reproduced (Killeen 2003b). In general, if the habitat is in favourable condition, and there is successful reproduction, all suitable habitats in a site should support at least 100 individuals per m^2 in early autumn (best expert opinion). Thus at sites such as Pollardstown Fen, it is estimated (Terrascope, 2003) that there is 835m^2 of 'prime' habitat and nearly 10ha of habitat which supports sparse *V. moulinsiana* habitat, and therefore in favourable years the *V. moulinsiana* population could exceed 1 million individuals.

The population size estimates for this species cannot be set at lowest or poor year values as an acceptable minimum, as the dynamics of the snail (and possibly the genetic integrity) within a meta-population are likely to be controlled by the penetrability of the habitat in favourable years (Moorkens, 2006a). Populations that normally reside in short sections of ditch can spread throughout large areas of fen in wet conditions, allowing sub-populations to interbreed and spread.

4.2 Current population

A year with very low recorded numbers should not necessarily be interpreted as a long-term population decline, especially if meteorological conditions have been extreme for the area in the months preceding the survey. However, the snail may also persist for a while in less than ideal conditions and changes in vegetation and moisture conditions that are heading in one direction in spite of meteorological fluctuations should be cause for concern. Thus the assessment of condition and conservation status must take into consideration this variation. It is important to be careful not to make a false negative condition assessment where the fluctuations are only temporary and equally important not to make a false positive condition assessment where the snail is persisting but facing continuous decline. This is the reason why monitoring of populations by frequent spot check surveillance is better than by infrequent intensive studies.

Trends in population can only be achieved by having good quality data from baseline surveys which are followed by regular monitoring. There are very few examples of long-term studies on any of the *Vertigo* species, but Tattersfield & Killeen (2006) at a *Vertigo moulinsiana* site in southern England, Moorkens & Gaynor (2003) at a *V. angustior* site in Clare, and Moorkens (2006c) at Pollardstown Fen with *V. geyeri,* have all clearly demonstrated that trend only becomes detectable when there is regular monitoring over an approximately 10 year period.

Killeen (2003b) recorded both seasonal and annual trends in a *V. moulinsiana* population at a site in southern England. In early June the population density was relatively low, mostly less than 50 individuals/m^2. This increased gradually into mid July and then rapidly through September to peak in October at densities as high as c. 600/m^2. The same general trends were shown over a 5 year period, but there were considerable fluctuations from year to year. The populations appeared to have good and bad years; for example in 1997 and 2000, the population densities peaked at c. 500 and c. 600 individuals/ m^2 respectively, whereas in 1998 the population peaked at c.260/ m^2 and in 2001 at c. 200/m^2. Evidence from another UK SAC which had been monitored over a 10 year period showed the snail had declined (in both numbers and extent) in 4 of the 8 component sites within the larger SAC, and appears to have been lost from two more (Tattersfield & Killeen, 2006).

Baseline surveys of the *Vertigo moulinsiana* populations in the 7 Irish SACs were carried out in 2006 (Moorkens 2007a), and, therefore reliable information on populations trends will not be available until future rounds of monitoring have been completed. However, the following comments may be made for the 7 SACs based upon Condition Assessment criteria given in Appendix 6 using 2006 field data and previous observations:

SAC Name	County	Status	Comments
River Barrow & River Nore	Carlow	Unfavourable	Needs further work to establish if sustainable
Ballynafagh Bog	Kildare	Favourable	
Pollardstown Fen	Kildare	Favourable	
Rye Water Valley / Carton	Kildare	Favourable	
Lisbigney Bog	Laois	Unfavourable	*V. moulinsiana* not found in 2006
Mountmellick	Laois	Favourable	
Charleville Wood	Offaly	Favourable	

Given the ongoing loss of sites (50% in the last 100 years), the overall trend of the *Vertigo moulinsiana* population in Ireland is likely to be continued decline, unless the underlying causes of population loss are successfully addressed.

4.3 Favourable reference Population

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'* (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of the species in the Republic of Ireland, the population Conservation Status should be based upon number of populations in favourable condition and not on number of individuals which is an unreliable measure (see above). On this basis the FRP is considered to be 30 sustainable sites (i.e. all sites where the species has been found since 1994, plus at least one population for each of the 4 canal squares which held former populations), including all seven sites designated as SAC for the species.

Favourable Reference Population: 30 sustainable sites, including all seven sites designated as SAC for the species, where population data is considered to be favourable.

Favourable population data criteria:

Conservation objective (population data)	*Vertigo moulinsiana* is in favourable condition where:
Area of occupancy Lower limit	*V. moulinsiana* is present in 50% of samples
Population Lower limit	and where: 40% of samples contain at least 10 adult snails
Trend data	and where: long term data show at least some years with 30% of samples having over 50 individuals, and long term trend data not showing continuous decline

4.4 Conservation assessment of Population

The full list of condition assessment categories are shown in Appendix 7, and are based on a long term survey strategy for monitoring this species (Killeen & Moorkens, 2003). As one of the seven SACs was found to be in unfavourable condition, with *V. moulinsiana* not found in 2006 (the only population known from this 10km square), the **Population Status** is considered to be **Unfavourable - bad**.

5.0 Habitat

Macrohabitats associated with this species are listed in Cameron *et al*., 2003 as follows:

- Annex I Habitat 7230 Calcareous Fens: Rich Fens (Corine 54.2)
- Annex I habitat 7210 (Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*): Fen-sedge beds (Corine 53.3)
- Annex I habitat 7220: petrifying springs with tufa formation (*Cratoneurion*) (Corine 54.12)
- Water fringe vegetation: reedbeds and large sedge communities e.g. *Glyceria maxima* swamp, *Carex elata* swamp, *Typha/Phragmites* beds, most communities of Corine 53 (water-fringe vegetation), especially: common reed beds, dry *Phragmites* beds (53.112), reedmace beds (53.13), medium-tall waterside communities (53.14), reed sweetgrass beds (53.16), and large *Carex* beds (53.21)
- *Alnus* swamp woodland (Corine 44.91)

As well as the tall vegetation structure of the habitats above, *V. moulinsiana* requires a stable hydrogeology, where the water-table is at, or slightly above, the ground surface for much of the year and any seasonal flooding is of very low amplitude (Tattersfield & McInnes 2003).

Moorkens (2005) carried out a review to document the sites in the Republic of Ireland that have been designated or have been proposed for designation for conservation purposes by NPWS and include the habitats listed above that are known to support *Vertigo moulinsiana*. The designations, or proposed designations, are as SACs, NHAs and SPAs. From this list, and based on the known Irish distribution of the species, a recommended set of sites was proposed for survey for this species. All information was retrieved from the NPWS internal Database of designated sites.

This search for potential sites for *Vertigo moulinsiana* via the NPWS database did not prove very useful. The problem appeared to be that the specific invertebrate habitat that this species requires is not categorised effectively by any Annex I habitat, CORINE habitat, or NPWS habitat, which are all based on gross habitat types, or habitats as exemplified by vegetation species or structure. The combination of required macro-habitat and micro-habitat, or supporting features that this invertebrate requires cannot be found via the NPWS database alone. This underlines the importance of database design to suit invertebrate features, such as has been done within the Molluscan database of Falkner *et al*. (2001). It was concluded that in the absence of more useful site information, the best approach was to take a subset of these sites for survey. The desktop study highlighted the Shannon Basin has having the greatest potential for locating new populations but the subsequent survey of 39 sites only yielded 4 new records. On this basis it was considered that the joining of 10km squares to form polygons would give an over-estimate of the species' range in Ireland (see Section 2.1 above).

5.1 Current condition of *Vertigo moulinsiana* Habitat

As only one round of baseline survey has been carried out to date, and baseline transects were chosen with suitable habitat where *V. moulinsiana* was present, trends cannot be determined. However, the condition of the habitats based on expert opinion of suitability for this species was assessed for the baseline.

Given the snail's population fluctuations, seasonally, annually, resulting from changes in meteorological conditions or changes to site management such as increased grazing or mowing which result in lower population levels, the snail's area of occupancy, relative abundance, vegetative habitat and hydrological conditions must be used in combination to assess its condition (see Appendix 6 for assessment criteria).

Ground water levels are one of the most important factors influencing the distribution of *V. moulinsiana*. Apparently suitable sedge-dominated habitats occur in many of the sites supporting the species, but the snail is absent. This absence is considered to be correlated directly with ground water levels, with the species requiring water levels to be at, or slightly above the local ground surface for at least part of the year (Tattersfield & McInnes, 2003). In ditch or lakeside conditions, such as at Mountmellick, Charleville and parts of Pollardstown, tall vegetation and deep layers of basal litter allow the snail to live in high water levels all year round. Thus at these places, the moisture levels are mainly 4, whereas at other, more extensive fen sites (e.g. Ballynafagh) they vary between 3 and 4.

Some general favourable habitat indicators are:

- Average height of vegetation not less than 70cm when measured in September
- Plant species composition and cover: Reed sweet grass, greater and lesser pond sedges, tussock sedge and saw sedge, branched burr-reed and yellow flag indicate favourable conditions, as can sparse *Phragmites* and *Phalaris*.
- Ground moisture levels at between 2 and 4
- Site management: no grazing or very light or rotational grazing within an extensive area

A decline in quality of the habitat is implicated by the following conditions:

- A reduction in ground moisture levels
- A significant rise in water levels such that aquatic plants (e.g. watercress *Rorippa nasturtium-aquaticum,* and fool's water cress *Apium nodiflorum*) become dominant
- An increase in rank herbs (particularly nettle *Urtica dioica*, thistle *Cirsium* spp., meadowsweet *Filipendula ulmaria*, great willow-herb *Epilobium hirsutum* and butterbur *Petasites* spp.) with vegetation height increasing or decreasing beyond parameters
- An increase in scrub cover compared to the baseline
- A change in management regime or intensity: heavy grazing and poaching of banks indicate unfavourable management
- A decrease in water quality leading to eutrophication and changes in nutrient status of marginal vegetation

Using the assessment criteria shown in Appendix 6, the targets for Favourable Habitat Condition (based upon best expert opinion) are:

Conservation objective	*Vertigo moulinsiana* is in favourable condition where:

Habitat extent Lower limit	75% of samples are dominated by suitable vegetation (Classes I & II) (Baseline chosen from suitable habitat)
Soil moisture Lower limit	75% of samples fall within soil moisture classes 3-4 (Baseline chosen from suitable habitat)

Sites for this species range in area from a few tens of square metres (some riparian margins) to over 200ha, such as at Pollardstown Fen. *Vertigo moulinsiana* is very specific in its habitat requirements, particularly with respect to ground water levels and vegetation composition. Therefore, suitable habitat within a larger site may be very restricted (e.g. ditches or wet depressions). In large sites such as Ballynafagh Bog and Pollardstown Fen, *Vertigo moulinsiana* is widespread across the sites but suitable habitat maybe as little as a few hundred square metres.

Of the 26 current known populations of *V. moulinsiana*, 7 have been assessed for habitat quality for the snail, and habitats have been mapped, digitised, and areas of habitat estimated. Within the 7 sites, 0.38 Hectares of optimal habitat for the snail was found, 5.23 Hectares of optimal / sub-optimal mosaic, 0.68 Hectares of sub-optimal habitat, and 45 Hectares of habitat with some potential for sub-optimal habitat and snail occurrence.

The habitat definitions are as follows:

Optimal habitat is where *V. moulinsiana* could survive in the majority (>50%) of the habitat. This allows for areas that have, for example, sloping lake edges where *Phragmites* may be inundated in the downslope area for part of the year. The snail cannot overwinter in inundated vegetation, but in dry summers would descend to this humid zone until lower temperatures resumed. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of temporally unsuitable microhabitat is necessary.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. moulinsiana*, but the majority of the habitat cannot. An example would be in terrain that is generally too dry, but with small areas of wet depressions.

From the area estimations and the quality of habitat, and extrapolating for all 26 populations, there is likely to be a total of 1.41 Hectares of optimal habitat. In addition, there would be another 145.5 Hectares of lower quality habitat, where the average area of occupancy would be closer to 10%, and therefore approximately 15 Hectares would additionally be occupied, giving a total of 16.5 Hectares in total. As trend data is not yet available, it will be important to re-evaluate this data following future survey, as it is currently not established if sub-optimal habitat at any site is natural and sustainable, or whether it was once optimal habitat that has deteriorated and may not be sustainable.

5.2 Conservation assessment of *Vertigo moulinsiana* habitat

The sustainability of the habitat must be assessed on a site by site basis following repeated survey.

As only one round of baseline survey has been carried out to date, and baseline transects were chosen with suitable habitat where *V. moulinsiana* was present, trends in the majority of the habitats cannot be determined. However, one of the cSACs at Lisbigney Bog has failed as suitable habitat was not found during the baseline survey. It is considered that 25 Hectares occupied with the snail within 155 Ha of general V. moulinsiana habitat is needed for favourable status, if Lisbigney Fen is to be restored and some canal sites need to be established. The **habitat conservation status** is likely to be good for the majority of SACs but unfavourable at Lisbigney. Due to the lack of trend data it is classified as **Inadaquate**.

6.0 Future Prospects

6.1 Current pressures

Desmoulin's whorl snail is considered to be a species that is dependent upon the conservation of habitat and preservation of high water levels and is therefore vulnerable (Seddon 1997). Its IUCN Irish local threat status in Moorkens (2006a) is also "Vulnerable". Drainage of wetlands has been the principal cause of the species' decline throughout its European range. Killeen (2003a) lists the factors, applicable at any site, which could adversely affect the Desmoulin's whorl snail populations – these are summarized below:

100 Cultivation: change in agricultural practice e.g. from low intensity grazing to arable/hay/silage

110 Use of pesticides: *Vertigo moulinsiana* is susceptible to agricultural and other pesticides

120 Fertilisation: *Vertigo moulinsiana* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat

140 Grazing: increases in grazing levels and changes to current grazing practice (lengths of grazing periods)

149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment

161 Forestry planting: afforestation of *V. moulinsiana* habitat results in its total destruction

171 Stock feeding: supplementary feeding of stock in snail habitat

180 Burning: Burning in large fen habitats results in loss of available habitat

310 Peat extraction: whether hand or machine cut, cutting of *V. moulinsiana* habitat or nearby habitat resulting in hydrological or other knock-on changes can result in its total destruction

500 Communications networks: where encroachment into *V. moulinsiana* habitat is allowed, or interferes with the hydrogeology of the habitat for the species.

501 Paths, tracks: trampling erosion and fragmentation of habitat, replacing bankside habitat with hard tracks

622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion

701 Water pollution: *Vertigo moulinsiana* is sensitive to eutrophication and consequent vegetation changes to its riparian and fen habitats

800 Landfill, land reclamation and drying out

810 Drainage: changes in hydrology particularly from ditch deepening or abstraction and

digging out of springs

852 Modifying structures of inland water course: many sites have been lost through increasingly intensive management of canal and river systems

In Ireland, the greatest loss of *Vertigo moulinsiana* sites has been through drainage of wetlands, and riparian management of the Grand and Royal Canals. Further pressure on habitats through spread of urban development is likely.

Given its former known range (3900km^2), the small size and vulnerability of some existing sites, and the poor future prospects of some populations, strict conservation policies for protected sites and their regular monitoring is important. In order to establish the relative stability of different sites, it is particularly important to have two or three rounds of transect surveillance in quick succession to assess the normal fluctuations for a site, followed by less regular survey to establish if there is a trend in one direction. As the species is short-lived (essentially an annual species), frequent rapid surveys to confirm status are essential if any negative changes are to be reversed before the population is lost.

6.2 Threats

The most serious threats to *Vertigo moulinsiana* include all of the above pressures, which are likely to remain and/or intensify in the future, and also:

400 Urbanised areas, human habitation: if encroachment into *V. moulinsiana* habitat is allowed

840 Flooding: from hydrogeological changes resulting in higher than acceptable water levels in the snail habitat

990 Other processes: climate change, in particular leading to changes of weather pattern causing more extensive flooding and/or drought periods

6.3 Positive impacts

Vertigo moulinsiana is not protected under Irish law, but has protection in its SACs under the Habitat's Directive, and the Republic of Ireland Habitat's Regulations (Statutory Instrument 94 of 1997).

Vertigo moulinsiana is protected in SACs that contain a number of Annex I habitats, including Alkaline Fens, Calcareous fens with *Cladium mariscus,* and petrifying springs with tufa formation. If the full communities of these habitats are protected, and in particular the management of hydrogeology, leaf litter and grazing levels are suitable, this should favourably protect the invertebrate community within these habitats, including *V. moulinsiana.*

6.4 Future Prospects Conservation Status

Vertigo moulinsiana is considered to remain under threat and is listed as Vulnerable in Ireland (Moorkens, 2006a). While there is a considerable lack of quantitative data, *Vertigo moulinsiana* appears to be in good condition in 5 of the 7 SACs designated for its protection, and it enjoys the benefit of protection within some reasonably large SAC complexes. Its prospects outside protected areas appear to be less secure, and one SAC (Lisbigney) has suffered from drainage that appears to have led to the loss of the snail, and the site was the only known one for this 10 km square.

The range of *Vertigo moulinsiana* has decreased considerably from its historical range, but has good protection in some of its SAC. It falls short of the likely favourable reference range for Ireland, and thus it has an **unfavourable - bad** range conservation status.

The extent of suitable habitat in good condition in 5 of its SACs is considerable, although one is very unsuitable. Information is deficient outside protected areas, and within 5 SAC's, habitat has Favourable Conservation Status. Due to the lack of trend data habitat conservation status is classified as **inadequate**.

The populations appear to be in good condition in 5 of its SACs. Information is deficient outside protected areas. The absence of any individuals in one of the SACs suggests this population has been lost. The population conservation status is therefore classified as **unfavourable - bad**.

Considering the impacts, pressures and threats to *Vertigo moulinsiana* in the Republic of Ireland today, the overall Conservation Status for Future Prospects is **unfavourable - bad**. More information is desirable in order to make a more confident and informed assessment in the future. In order to address this, a Species Monitoring Plan will be written, which will specify monitoring work that needs to be carried out in order to fully assess the condition of the populations of this species. This monitoring will be designed to identify any negative effects and initiate an investigation into the causes of any negative trends, and initiate measures that can be taken to mitigate against negative affects before it is too late. It is expected that the implementation of this monitoring plan will lead to improved data to assist reporting in 2013, as well as to improved protection of the populations.

Range	**Unfavourable - bad**
Population	**Unfavourable - bad**
Range of appropriate habitat	**Inadequate**
Future prospects	**Unfavourable - bad**
Overall Assessment	**Unfavourable - bad**

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Appendix 1: Range of *Vertigo moulinsiana* in Ireland

Figure 1: 10km squares with records of *Vertigo moulinsiana* in the Republic of Ireland

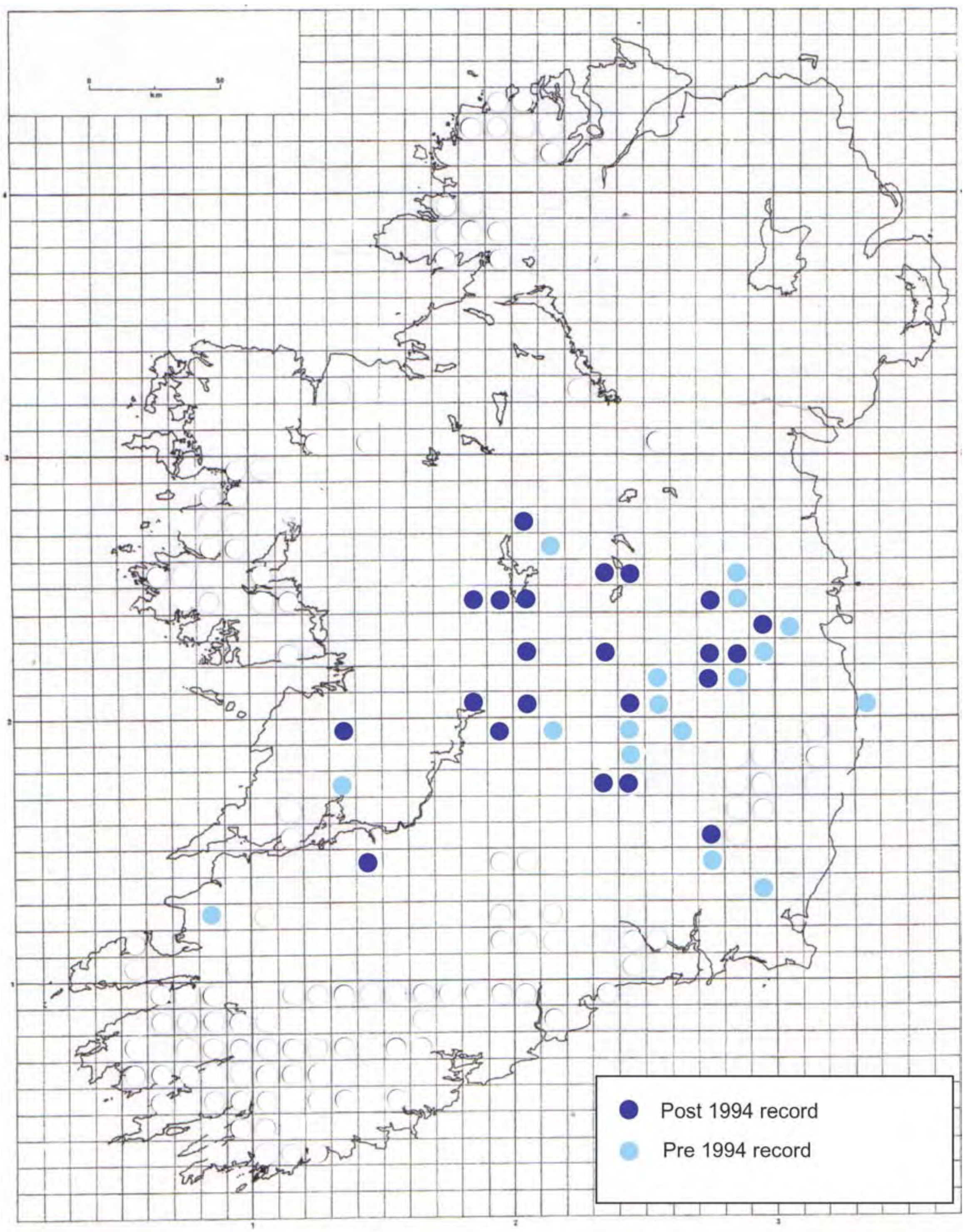
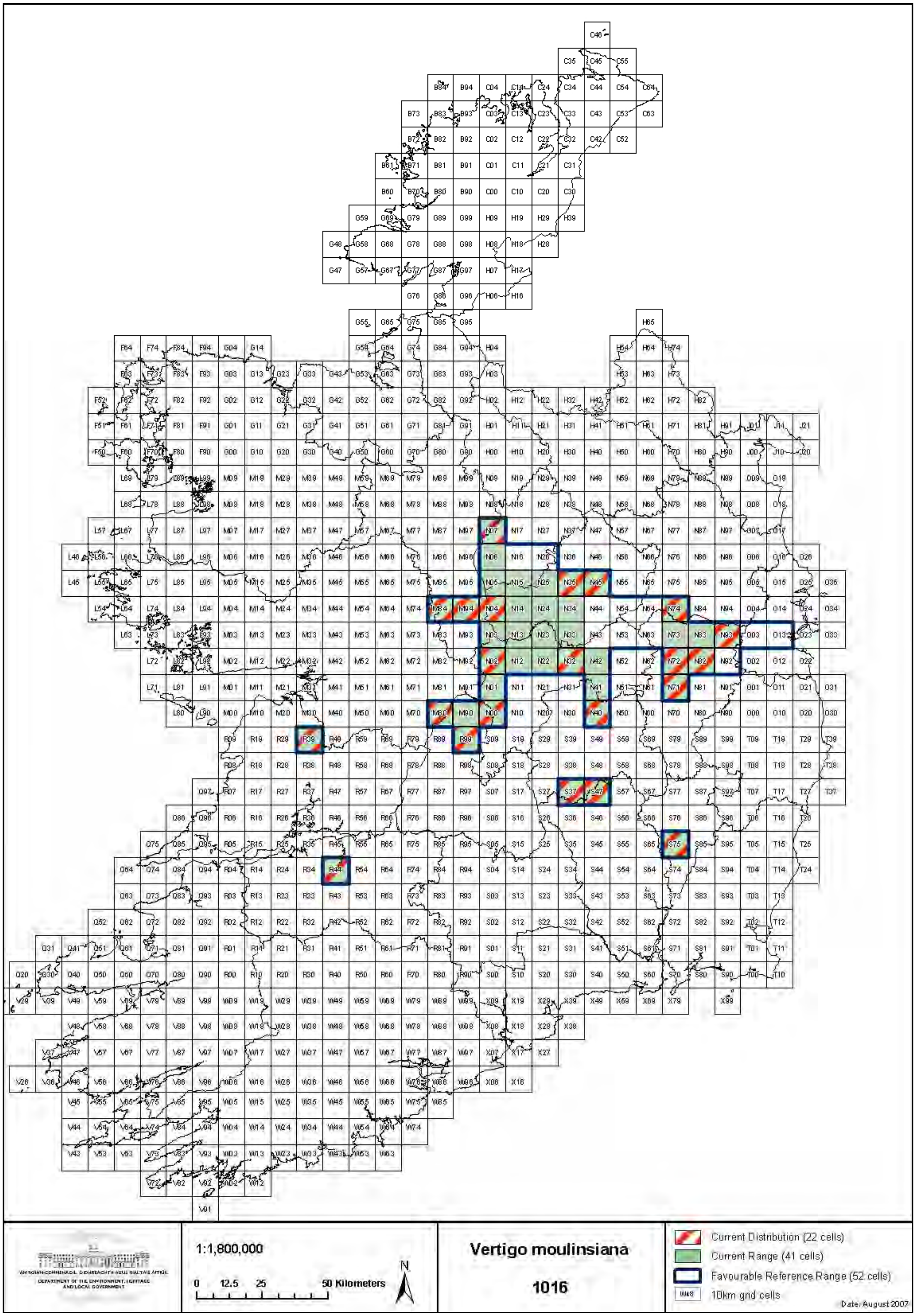


Figure 2: Current distribution, current range and favourable range of *Vertigo moulinsiana* in the Republic of Ireland



Appendix 2: Vertigo *moulinsiana* records from Ireland

County	Site	Grid Ref	Date	Recorder	Reference
Carlow	Borris	S7150	20.ix.1997	E.A.Moorkens	Moorkens 1997
Carlow	Tinnahinch	S74	ix.1907	R.A.Phillips	Phillips ms
Clare	Ballybeg Lake, near Ennis	S37	15.ix.1929	R.A.Phillips	Phillips ms
Clare	Mullaghmore	R3094	14.vii.2006	RA Cameron	Pers. comm..
Dublin	1/4m NW of Ballymakaily Br. Gollierstown	O03	25.vii.1945	A.E.Stelfox	Conch Soc
Dublin	¼ mile W of Clondalkin	O03	1945	A.E.Stelfox	Conch Soc
Dublin	By Royal Canal Clondalkin	O0675	03.viii.1972	A.Norris & M.P.Kerney	Conch Soc
Galway	Portumna	M8503	25.ix.1998	E.A.Moorkens	Irish database
Kerry	Dromkeen Bridge	Q8229	02.viii.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	S of Ardrigh Hill, near Athy	S69	24.ix.1933	A.E.Stelfox	Conch Soc
Kildare	Landenstown	N82	27.ix.1939	A.E.Stelfox	Stelfox Colln
Kildare	Pluckerstown Bridge	N7521	04.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	Pollardstown Fen	N7715	04.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	N of Monasterevin	N7211	02.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	By Grand Canal, Cloncurry	N7021	02.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	Devonshire Br, NW of Kill	N9223	02.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	Limerick Bridge, Naas	N8718	01.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	Digby Bridge, Sallins	N8624	01.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Kildare	By Rye Water, Leixlip	N9936	12.x.1995	E.A.Moorkens & A. Norris	Moorkens 1995
Kildare	Ballynafagh Lake	N8129	9. ix. 1997	E.A.Moorkens	Moorkens 1998
Kildare	Blackwood Feeder	N8025	12. ix. 1997	E.A.Moorkens	Moorkens 1998
Kildare	Moyvally	N7342	13.x.1998	E.A.Moorkens	Irish database
Kilkenny	Graiguenamanagh	S74	ix.1931	R.A.Phillips	Phillips ms
Laois	Durrow	S47	1909	R.A.Phillips	Phillips ms
Laois	Abbeyleix	S48	17.v.1926	R.A.Phillips	Phillips ms
Laois	Maryborough	S49	16.iii.1930	R.A.Phillips	Phillips ms
Laois	S of Portarlington	N50	15.v.1949	A.E.Stelfox	Stelfox Colln
Laois	Bergin's Br, E of Portarlington	N5813	02.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Laois	Mountmellick, Dangan's Br	N4908	03.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Laois	Lisbigney Bog	S4679	12.viii.1998	E.A.Moorkens	Moorkens 1998
Laois	SW of Boston Br	S3377	14. vii.2002	E.A.Moorkens	Irish database
Limerick	Curragh Chase	R4148	29.v.2005	E.A.Moorkens & IJ.Killeen	Moorkens 2006b
Longford	Savage Br, Kilashee	N0870	v.2003	E.A.Moorkens & IJ.Killeen	Moorkens 2004
Longford	Island Bridge, Keenagh	N1163	13.iv.1968	J.Chatfield & A.Norris	Conch Soc
Meath	Summerhill	N84	xi.1905	P.H. Grierson	Conch Soc
Meath	By R. Boyne below Trim	N85	03.vii.1938	A.E.Stelfox	Stelfox Colln
Offaly	Charleville Lake	N3123	6. x. 1998	E.A.Moorkens	Moorkens 1998
Offaly	Tullamore	N3525	xi.2002	E.A.Moorkens & IJ.Killeen	Moorkens 2004
Offaly	Lisduff fen	N0800	2005	E.A.Moorkens & IJ.Killeen	Moorkens 2006c
Offaly	Fin Lough	N0329	2005	E.A.Moorkens & IJ.Killeen	Moorkens 2006c
Roscommon	Royal Canal, Cloondara	N06274	04.v.2006	E.A.Moorkens & IJ.Killeen	Moorkens 2007
Roscommon	North of Eskerbeg	M9440	25.ix.2006	E.A.Moorkens & IJ.Killeen	Moorkens 2007
Roscommon	Cuileenirwan Lough	M8846	25.ix.2006	E.A.Moorkens & IJ.Killeen	Moorkens 2007
Tipperary	Aglish Fen	S9497	04.iv.1971	A.Norris & M.P.Kerney	Conch Soc
Tipperary	2 miles E of Roscrea	S1690	03.iv.1971	C.Paul & M.P.Kerney	Conch Soc
Tipperary	Fiagh Bog	R9598	1970	A. Norris & D. Pickrell	Norris & Pickrell 1972
Westmeath	Kildallan Br	N3456	v.2003	E.A.Moorkens & IJ.Killeen	Moorkens 2004
Westmeath	Lough Owel	N4256	iv.2004	E.A.Moorkens & IJ.Killeen	Moorkens 2004
Westmeath	Waterstown Lough	N0945	22.ix.2006	E.A.Moorkens & IJ.Killeen	Moorkens 2007
Westmeath	North of Athlone	N0644	22.ix.2006	E.A.Moorkens & IJ.Killeen	Moorkens 2007
Wexford	Mackmine	S93	iv.1933	R.A.Phillips	Conch Soc
Wicklow	The Murrough	O30	25.viii.1954	A.E.Stelfox	Conch Soc

Appendix 3: *Vertigo moulinsiana* records from Ireland – last recorded dates in chronological order

County	Site	Grid Ref	First record	Last seen	Reference
Meath	Summerhill	N84	1905	1905	
Carlow	Tinnahinch	S74	1907	1907	
Laois	Durrow	S47	1909	1909	
Laois	Abbeyleix	S48	1926	1926	
Clare	Ballybeg Lake, near Ennis	S37	1929	1929	
Laois	Maryborough	S49	1930	1930	
Kilkenny	Graiguenamanagh	S74	1931	1931	
Kildare	S of Ardrigh Hill, near Athy	S69	1933	1933	
Wexford	Mackmine	S93	1933	1933	
Meath	By R. Boyne below Trim	N85	1938	1938	
Kildare	Landenstown	N82	1939	1939	
Dublin	¼ m NW of Ballymakaily Br. Gollierstown	O03	1945	1945	
Dublin	¼ mile W of Clondalkin	O03	1945	1945	
Laois	S of Portarlington	N50	1949	1949	
Wicklow	The Murrough	O30	1954	1954	
Longford	Island Bridge, Keenagh	N1163	1968	1968	
Kerry	Dromkeen Bridge	Q8229	1971	1971	
Kildare	Pluckerstown Bridge	N7521	1971	1971	Moorkens 1995
Kildare	Devonshire Br, NW of Kill	N9223	1971	1971	
Kildare	Digby Bridge, Sallins	N8624	1971	1971	Moorkens 1995
Kildare	Limerick Bridge, Naas	N8718	1971	1971	
Kildare	N of Monasterevin	N7211	1971	1971	
Laois	Bergin's Br, E of Portarlington	N5813	1971	1971	Moorkens 1995
Tipperary	2 miles E of Roscrea	S1690	1971	1971	
Tipperary	Aglish Fen	S9497	1971	1971	
Dublin	By Royal Canal Clondalkin	O0675	1972	1972	
Kildare	By Grand Canal, Cloncurry	N7021	1971	1995	Moorkens 1995
Tipperary	Fiagh Bog	R9598	1970	1995	Moorkens 1995
Laois	Lisbigney Bog	S4679	1998	1998	Moorkens 2007a
Kildare	Moyvally	N7342	1998	1999	Moorkens 1999b
Laois	SW of Boston Br	S3377	2002	2002	
Offaly	Tullamore	N3525	2002	2002	Moorkens 2004
Longford	Savage Br, Kilashee	N0870	2003	2004	Moorkens 2004
Westmeath	Kildallan Br	N3456	2003	2004	Moorkens 2004
Westmeath	Lough Owel	N4256	2004	2004	Moorkens 2004
Galway	Portumna	M8503	1998	2005	Anderson pers comm
Limerick	Curragh Chase	R4148	2005	2005	
Offaly	Fin Lough	N0329	2005	2005	Moorkens 2006
Offaly	Lisduff fen	N0800	2005	2005	Moorkens 2006
Carlow	Borris	S7150	1997	2006	Moorkens 2007a
Clare	Mullaghmore	R3094	2006	2006	Cameron pers comm
Kildare	By Rye Water, Leixlip	N9936	1995	2006	Moorkens 2007a
Kildare	Ballynafagh Lake	N8129	1997	2006	Moorkens 2007a
Kildare	Blackwood Feeder	N8025	1997	2006	Moorkens 2007a
Laois	Mountmellick, Dangan's Br	N4908	1971	2006	Moorkens 2007a
Offaly	Charleville Lake	N3123	1998	2006	Moorkens 2007a
Roscommon	Cuileenirwan Lough	M8846	2006	2006	Moorkens 2007b
Roscommon	North of Eskerbeg	M9440	2006	2006	Moorkens 2007b
Roscommon	Royal Canal, Cloondara	N0674	2006	2006	Moorkens 2007b
Westmeath	North of Athlone	N0644	2006	2006	Moorkens 2007b
Westmeath	Waterstown Lough	N0945	2006	2006	Moorkens 2007b
Kildare	Pollardstown Fen	N7715	1971	2007	Moorkens 2007a

Appendix 4: Special Areas of Conservation (SAC) in Ireland designated for *Vertigo moulinsiana*

SAC Site Code	SAC Name	County	Site
000396	Pollardstown Fen	Kildare	Pollardstown Fen
000571	Charleville Wood	Offaly	Charleville Wood
000869	Lisbigney Bog	Laois	Lisbigney Bog
001387	Ballynafagh Bog	Kildare	Ballynafagh Bog
001398	Rye Water Valley / Carton	Kildare	Louisa Bridge
002141	Mountmellick	Laois	Disused Canal
002162	River Barrow & River Nore	Carlow	Borris

Appendix 5: Special Areas of Conservation (SAC) in Ireland where *Vertigo moulinsiana* is present but is not a named feature

SAC Site Code	SAC Name	County	Site
000576	Fin Lough (Offaly)	Offaly	Fin Lough
002147	Lisduff Fen	Offaly	Lisduff Fen

Appendix 6: Condition Assessment Criteria

The protocol devised for monitoring *Vertigo moulinsiana* in the UK (Killeen & Moorkens 2003) has been adapted for assessing the Condition of populations in Ireland. The attributes used to assess Condition are:

Area of occupancy of *Vertigo moulinsiana* in transects or plot areas
Population density of *Vertigo moulinsiana* in transects or plot areas
Vegetation species class
Ground moisture levels

These 4 are considered to be the most meaningful and easily measurable attributes for condition assessment as they are the ones that show the fastest response to condition change.

Vegetation

For condition assessment, the plant species were classified into 4 groups. Class I contains the plant species upon which *Vertigo moulinsiana* is found most often in the active season, Class II is less favoured and Class III is rarely utilised. Thus Class I has the plant species which have the highest value as indicators of favourable habitat.

Class I	**Class II**	**Class III**	**Class IV**
Glyceria maxima	*Phalaris arundinacea*	*Petasites fragrans*	All other species
Carex acutiformis	*Phragmites australis*	*Mentha aquatica*	
Carex elata	*Sparganium erectum*	*Polygonum amphibium*	
Carex paniculata	*Filipendula ulmaria*	*Epilobium* spp.	
Carex riparia		*Urtica dioica*	
Cladium mariscus			
Schoenus nigricans			

Ground moisture level

Ground moisture levels recorded on a scale of 1-5 at each replicate sampling point:

1 Dry. No visible moisture on ground surface.
2 Damp. Ground visibly damp, but water does not rise under pressure
3 Wet. Water rises under light pressure
4 Very wet. Pools of standing water, generally less than 5cm deep.
5 Site under water. Entire sampling site in standing or flowing water over 5cm deep.

Appendix 7: Criteria Targets

Conservation objective (for favourable condition)	To maintain *Vertigo moulinsiana* in favourable condition where
Area of occupancy Lower limit	*V. moulinsiana* is present in 50% of samples
Population Lower limit	and where: 40% of samples contain at least 10 adult snails
Trend data	and where: long term data show at least some years with 30% of samples having over 50 individuals, and long term trend data not showing continuous decline
Habitat extent Lower limit	75% of samples are dominated by suitable vegetation (Classes I & II) (Baseline chosen from suitable habitat)
Soil moisture Lower limit	75% of samples fall within soil moisture classes 3-4 (Baseline chosen from suitable habitat)

1016 Desmoulin's whorl snail (*Vertigo moulinsiana*)

1. National Level	
Species code	1016
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	41 10km squares

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	Colville, B. & Coles, B., 1984. A week's snail collecting in Ireland. *Conchologists' Newsletter* 89: 192-196. Kerney, M. (1976) *Atlas of the land and freshwater molluscs of the British Isles.* ITE, Conchological Society, London. P92. Kerney, M.P., 1999. *An atlas of the land and freshwater molluscs of Britain and Ireland.* Harley Books, Colchester. Moorkens, E.A., 1995. Mapping of proposed SAC sites for *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1997. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1997 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1998. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri:* 1998 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999a. Molluscan Survey 1999 Volume I: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 1999b. Molluscan Survey 1999 Volume II: An inventory of Mollusca in potential SAC sites with special reference to *Vertigo angustior, V moulinsiana* and *V geyeri.* Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2000. An inventory of Mollusca in potential SAC sites with special reference to *Vertigo* species: 2000 survey. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2003a. The *Vertigo* workshop field excursion to Pollardstown Fen (Co. Kildare) with a provisional list of the Mollusca known from the site. *Heldia* **5** (7): 179-180. Moorkens, E.A., 2003b. Final Baseline Report on Molluscan Surveys of Pollardstown Fen 1998-2003. Report to Kildare County Council.

	Moorkens, E.A., 2004a. Non-marine Mollusca: New and notable records for Ireland. *Bull. Ir. Biogeog. Soc.* **28**: 189-198. Moorkens, E. A., 2006a. Irish non-marine molluscs - an evaluation of species threat status. *Bull. Ir. biogeog. Soc.* **30**: 348-371. Moorkens, E.A., 2006c. Report on Molluscan Surveys of Pollardstown Fen 2006. Unpublished report to Kildare County Council. Moorkens, E.A., 2007a. Management prescriptions for *Vertigo moulinsiana* at cSAC sites for the species in the Republic of Ireland. Unpublished report to National Parks and Wildlife. Moorkens, E.A., 2007b. Survey for *Vertigo moulinsiana* in the Shannon Basin. Unpublished report to National Parks and Wildlife.
2.3 Range	
2.3.1 Surface area	4100km²
2.3.2 Date	2007
2.3.3 Quality of data	2 Moderate
2.3.4 Trend	- 43%
2.3.6 Trend-Period	1905-2006
2.3.7 Reasons for reported trend	3
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	25 viable populations
2.4.2 Date of estimation	2007
2.4.3 Method used	Baseline survey only from 13 of 26 sites
2.4.4 Quality of data	1 poor
2.4.5 Trend	-8% (1 population lost out of 13 surveyed in 2006)
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	3
2.4.9 Justification of % thresholds for trends	N/A

2.4.10 Main pressures	100 Cultivation: change in agricultural practice e.g. from low intensity grazing to arable/hay/silage 110 Use of pesticides: *Vertigo moulinsiana* is susceptible to agricultural and other pesticides 120 Fertilisation: *Vertigo moulinsiana* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat 140 Grazing: increases in grazing levels and changes to current grazing practice (lengths of grazing periods) 149 Undergrazing: from loss of habitat due to excessive shade and scrub encroachment 161 Forestry planting: afforestation of *V. moulinsiana* habitat results in its total destruction 171 Stock feeding: supplementary feeding of stock in snail habitat 180 Burning: Burning in large fen habitats results in loss of available habitat 310 Peat extraction: whether hand or machine cut, cutting of *V. moulinsiana* habitat or nearby habitat resulting in hydrological or other knock-on changes can result in its total destruction 500 Communications networks: where encroachment into *V. moulinsiana* habitat is allowed, or interferes with the hydrogeology of the habitat for the species. 501 Paths, tracks: trampling erosion and fragmentation of habitat, replacing bankside habitat with hard tracks 622 Walking, horseriding and non-motorised vehicles: habitat is lost through erosion 701 Water pollution: *Vertigo moulinsiana* is sensitive to eutrophication and consequent vegetation changes to its riparian and fen habitats 800 Landfill, land reclamation and drying out 810 Drainage: changes in hydrology particularly from ditch deepening or abstraction and digging out of springs 852 Modifying structures of inland water course: many sites have been lost through increasingly intensive management of canal and river systems
2.4.11 Threats	The most serious threats to *Vertigo moulinsiana* include all of the above pressures, which are likely to remain and/or intensify in the future, and also: 400 Urbanised areas, human habitation: if encroachment into *V. moulinsiana* habitat is allowed 840 Flooding: from hydrogeological changes resulting in higher than acceptable water levels in the snail habitat 990 Other processes: climate change, in particular leading to changes of weather pattern causing more extensive flooding and/or drought periods

2.5 Habitat for the species	
2.5.2 Area estimation	16.5 Hectares occupied within 147 Ha habitat
2.5.3 Date of estimation	2007
2.5.4 Quality of data	2=moderate
2.5.5 Trend	- net loss (loss of all habitat at Lisbigney)
2.5.6 Trend-Period	1994 - 2006
2.5.7 Reasons for reported trend	3
2.6 Future prospects	Bad

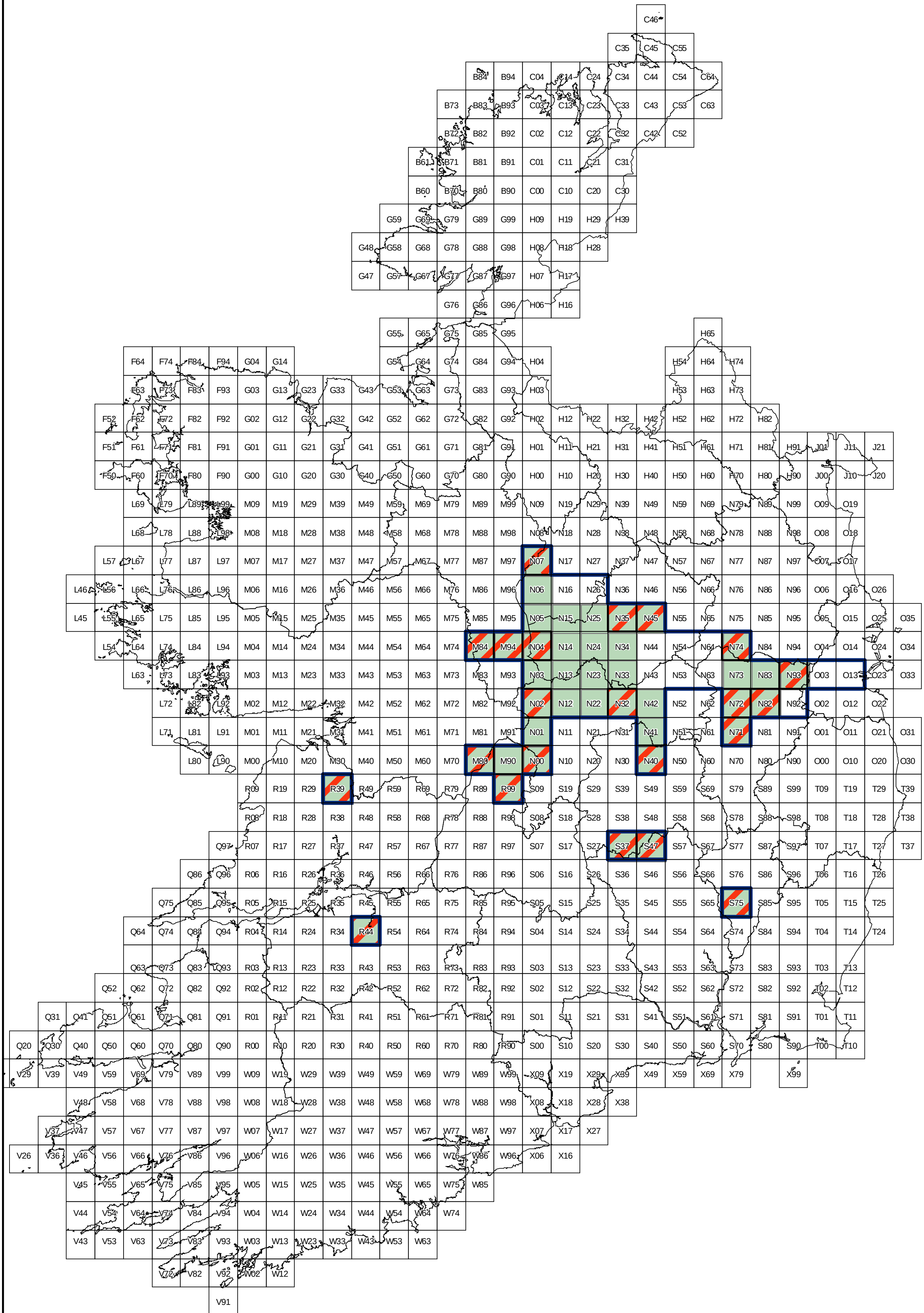
2.7 Complementary information	
2.7.1 Favourable reference range	5200km^2
2.7.2 Favourable reference population	30 viable populations (as judged that some canal sites needed)
2.7.3 Suitable Habitat for the species	25 Hectares occupied within 155 Ha habitat (must need to be increased if Lisbigney is to return to habitat, and some canal sites need to be restored)

2.7.4 Other relevant information

Vertigo moulinsiana is not protected under Irish law (Wildlife Act), and is considered to remain under threat and is listed as Vulnerable in Ireland (Moorkens, 2006a).

Vertigo moulinsiana is protected in SACs that contain a number of Annex I habitats, including Alkaline Fens, Calcareous fens with *Cladium mariscus,* and petrifying springs with tufa formation. If the full communities of these habitats are protected, and in particular the management of hydrogeology, leaf litter and grazing levels are suitable, this should favourably protect the invertebrate community within these habitats, including *V. moulinsiana.*

2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unfavourable Bad (U2)
Population	Unfavourable Bad (U2)
Habitat for the species	Inadequate (U1)
Future prospects	Unfavourable Bad (U2)
Overall assessment of CS1	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

Vertigo moulinsiana

1016

Current Distribution (22 cells)
Current Range (41 cells)
Favourable Reference Range (52 cells)
W48 10km grid cells

Date: August 2007

Background to the conservation assessment of the Kerry Slug (*Geomalacus maculosus*)

1. Introduction

The Kerry slug *Geomalacus maculosus* is an attractive spotted slug in the family Arionidae. It was first discovered by Caragh Lake in 1842 and described as a species new to science in 1843 (Allman, 1843, 1844, 1846). The same species was then found in Northern Spain in 1868 and in Northern Portugal in 1873, and a record for the species from Brittany, France has been referred to but never been confirmed (Simroth, 1891, Platts & Speight, 1988; Falkner *et al.,* 2002).

As well as *Geomalacus maculosus*, *G. anguiformis* (Morelet, 1891), and *G. oliveirae* Simroth, 1891 are very similar species endemic to Iberia (Rodriguez *et al*., 1993; Castillejo & Rodriguez, 1991; Castillejo *et al*., 1994). A further new species, *Geomalacus malagensis* Wiktor & Norris, 1991 was described as from southern Spain (Wiktor & Norris, 1991; Castillejo *et al*., 1994), which completes the species of this genus mentioned in the current Fauna Europea list (www.faunaeur.org). One further species is listed as *Geomalacus moreleti* (Hesse, 1884) in Castillejo (1998), but this is listed in a separate genus as *Letourneuxia moreleti* (Hesse, 1884) in Fauna Europea. This species is also endemic to Iberia. There is no evidence that any of these other *Geomalacus* species occur or have occurred in Ireland.

Geomalacus maculosus is therefore a geographically very restricted species (Iberia and Ireland) from a Genus that is also very restricted in world terms (Iberia only for members other than *G. maculosus*). The distribution of *G. maculosus* has been described as "Lusitanian", as it inhabits the Atlantic region of Iberia and Ireland (Scharff, 1893, 1899).

While the Kerry slug can be fed in captivity on porridge, carrots and other vegetables, in the wild it has only been observed feeding on lichens, liverworts and mosses growing on these rock outcrops in both habitat types, but also on similar species growing on mature trees and timber in its woodland context (Boycott & Oldham, 1930; Platts & Speight, 1988; Rosas et al., 1992; Rodriguez *et al.,* 1993; Speight, 1996). This restricted diet appears to have prevented its expansion into wider habitats, thus unlike species from other genera of this family, *Geomalacus* is not a pest species, and remains associated with wild habitats away from the influence of man.

Geomalacus emerges to feed in very damp and humid conditions, on very cloudy warm damp days either during or after rain, or at dawn, dusk and during the night if it is not too cold or dry. In Iberia it is considered to be nocturnal in habits, and during sunny periods in Ireland it also rests in refugia during daylight hours (Platts & Speight, 1988).

The external features and anatomy of *G. maculosus* is well described (Platts & Speight, 1988; Rodriguez *et al*., 1993; Castillejo *et al*., 1994; Castillejo, 1998). The size of the slug is difficult to measure while alive, adult live animals can appear to be up to 70 - 80mm long, but often contract when disturbed, into a ball shape, unlike any other Irish slug. They can also elongate and flatten themselves to take refuge in crevices, animals of 40 – 50mm at rest can reach 120mm when elongated (Platts & Speight, 1988). This changeable length has led to a preference for measurements being given for relaxed preserved specimens, a maximum of 70mm for adults with a mantle length of 30mm (Castillejo *et al*., 1994). Juveniles are up to

30mm long for relaxed preserved specimens, with a mantle length of 10mm (Castillejo *et al*., 1994).

Copulation and reproduction details are given by Platts & Speight (1988), with eggs deposited in batches of 18 – 30, between July and October. The slug is capable of self-fertilisation also. Eggs are large, approximately 6 - 8.5mm by 3 - 4.25mm, and take 6 – 8 weeks to hatch. Juveniles take two years to mature, and in total can live for up to seven years.

2. Range

Range was assessed using the IUCN criteria for extent of occurrence (IUCN, 2001), and its interpretation as discussed by the European Commission (2006), and 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 Range of *Geomalacus maculosus* for Ireland was considered to be the range of 10km square records from 1965 onwards. The cut off date of 1965 was chosen because before this recording for *Geomalacus* was very casual, and recording effort was made prior to the publication of the first molluscan atlas for the area (Kerney, 1976), and 1965 remained the cut off date for old records in the updated atlas (Kerney, 1999). The range outline was drawn following IUCN guidelines, but taking into consideration that populations must be within sandstone geology, and following guidelines of 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"* (European Commission, 2006).

In Ireland, the Kerry slug is restricted to the sandstone geology of west Cork and Kerry. In this region the Kerry Slug has been recorded from 50 10km squares since 1965. The date of 1965 was chosen as this distribution was described in the most recent molluscan atlas (Kerney, 1999) and has been updated to include records from the Irish molluscan database and NPWS records.

Most of the information prior to 2004 is limited to presence/absence data of the slug. Although specific information on population sizes and demographics is lacking, the information on the range itself is considered to be good.

The area of *Geomalacus maculosus* Range in Ireland was calculated as 5,800 km^2.

2.1 Range Trend

Based on recent survey work at some of the sites originally surveyed by Speight & Platts (1988), there is no evidence for any decline in the range of the slug in south-west Ireland (E. Moorken pers comm.). The range of *G. maculosus* in both Iberia and Ireland appears to be restricted by habitat and has not demonstrated any recent expansion or contraction at the 10km level, although local extinctions may have occurred. Extensive afforestation leading to population isolation and extirpation is the most likely cause of such local events.

2.2 Favourable reference range

As there is no evidence of any recent reduction in range, the Favourable Reference Range (FRR) for *Geomalacus maculosus* in Ireland is taken to be its present range which is 5,800 km^2.

3. Population

The estimation of any invertebrate species is difficult to undertake for a number of reasons. Firstly, survey for *Geomalacus* individuals when the slugs are not active can itself have a negative impact on the species micro-habitat. Secondly, numbers of active slugs may vary considerably with weather conditions. Thirdly, invertebrate numbers can fluctuate with climatic conditions in an episodic or cyclical manner, and thus the combination of confounding factors contributing to an overall Irish population estimation make the number somewhat meaningless, as the maximum and minimum estimates are likely to be very different. No comprehensive population estimate exists for this species. In the absence of such information, the number of 10km squares occupied by the species (50) is taken as a proxy for population.

To try to improve this data in the future, some quantitative work will need to be undertaken as a means of estimating adult numbers, as well as reproductive success and expected densities per extent of micro-habitat, thus potentially leading to suitable proxy survey, for example of lichen-covered rocks, within wider areas of habitat. Improved data is expected in the next reporting period. This will also be useful in comparing the importance of woodland versus open habitat as potential sources and sinks for wider metapopulations.

3.1 Population trends

Formal baseline monitoring for Republic of Ireland *Geomalacus* SACs began in 2004 and to date 13 sampling stations of 100m x 100m have been established (NPWS, unpublished data). The emphasis for the work from 2004-2007 has been to establish populations that have adults and juveniles, and thus the knowledge that successful reproduction has occurred within two years of the survey. It is intended that these stations will be expanded in number to cover the wider range of the species, and that more information can be gathered on population size during the next survey round.

The population trend and population trend magnitude cannot be ascertained, but evidence that *Geomalacus* is still present and has successfully bred within two years of each of the 13 monitoring station surveys during the period 2004-2007 indicates that conditions for the slug are appropriate there. At the 10km level there has been no change in population since 1988.

3.2 Pressures / Threats

The Kerry slug is particularly prone to changes to its habitat. The main pressures and threats are the same and come from forestry, agricultural improvement (such as reclamation, stock intensification and burning) and one off housing. The spread of *Rhododendron ponticum* poses a specific problem where it occurs as it changes the humidity regime of the woodland and open habitats it invades, making them unsuitable for *Geomalacus*. These are the specific pressures / threats identified:

103 – Agricultural improvement (reclamation)
110 – Use of pesticides
142 – Overgrazing by sheep

153 – removal of scrub
160 - General Forestry management
162 – artificial planting (gardens)
180 – Burning
403 – Dispersed habitation
502 – Routes / autoroutes
702 – Air pollution
954 – Invasion by a species (*Rhododendron ponticum*)

3.3. Favourable reference population

There has been no detailed work done on kerry slug population densities. It is likely that conditions in protected areas, such as Killarney National Park, have not changed dramatically in recent years and therefore continue to effectively support sustainable slug populations. It is not possible to make such assumptions for areas that do not have habitat conservation status, and there are gaps in scientific knowledge on micro- and macro-habitat size needed to support a sustainable population.

Further research and monitoring is required to address these issues and to allow meaningful population estimates in the future. In the interim 10km squares can be taken as a proxy for population. As there has been no decline in range since 1988, the number of 10km squares known to be occupied at present (50) will be taken as favourable reference population

4.0 Habitat

Within its range in west Cork and Kerry, the Kerry slug lives in two broad habitat types. The first type is oak dominated woodland, or mixed deciduous woodland with a mixture of oak and birch. The habitat is often sloping, with outcropping of rock or with boulders scattered amongst the trees. Both trees and rock are in undisturbed, humid conditions and clean air, with a good lichen, or mixture of lichen, liverwort and moss flora. In this habitat, slugs can graze the organic film of the lichen and associated flora of both trees and rocks.

The second broad habitat is open situations of unimproved oligotrophic open moor or blanket bog. Within the open ground habitat sandstone outcrops and boulders, largely bare of vegetation except for lichens and mosses, must be present in sufficient quantity to provide the same food to graze as in the woodland habitat.

The habitat of *Geomalacus maculosus* in Ireland fits well with a number of Habitats Directive Annex I and CORINE habitats. It is restricted to areas of sandstone geology in the Cork and Kerry region featuring the following Annex I habitats:

91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*
8220 Siliceous rocky slopes with chasmophytic vegetation
7130 Blanket bog
4030 European dry heaths
4010 Northern Atlantic wet heaths with *Erica tetralix*
4060 Alpine and Boreal heaths
3110 Oligotrophic waters (shores of acid oligotrophic lakes)

The following CORINE 2000 habitats are suitable for *Geomalacus*:

2.3.1.2 Unimproved grassland
3.1.1 Broad-leaved forests
3.2.1 Natural grassland
3.2.2 Moors and heathlands
3.3.2 Bare rocks
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

All of the above are macro-habitats, and the presence of the Kerry Slug is only possible if its micro-habitat requirements are met. Of particular importance is sandstone boulder or rock outcropping, in conditions of high humidity, with sufficient lichen and moss flora to support the food requirements of the slug population.

As stated above, conservation of habitat for *Geomalacus* depends on maintaining sufficient micro-habitat within the larger macro-habitat area. The source of information on suitable macro-habitat is from the Geological Survey of Ireland bedrock geology map series (No 20, 21 and 24). The location of the sandstone bedrock provides a useful demarcation of potential habitat within the 10km range shown above. Although the sandstone geology continues as far north as Fermoy and as far east as Youghal, no records for the species have come from this part of the sandstone area. The decrease in humid Atlantic influence is likely to reduce the opportunity for survival of both the slug and its associated food species.

Until more detailed information becomes available on micro-habitat availability and usage, the extent of Old Red Sandstone within the slug's range – 3,529km2 – can be used to indicate the maximum extent of available habitat.

4.1 Habitat trends

Any decline in *Geomalacus* would be associated with either *Rhododendron* spread within conservation areas, or changes in habitat use (e.g. afforestation) leading to negative macro- or micro-habitat changes outside conservation areas. Assessment of habitat quality will form part of ongoing monitoring work.

4.2 Suitable habitat for the species

Until more detailed information becomes available on micro-habitat availability and usage, the extent of macro-habitat present for *G. maculosus* can be estimated from the extent of Old Red Sandstone within the slug's range – 3,529km2. The true extent of suitable micro-habitat, when it is established, is likely to be significantly smaller than this area.

Geomalacus is protected within some of the biggest SACs in the country, together comprising a combined area of almost 90,000 hectares. Within these protected locations, it is likely that the area of suitable habitat is sufficiently large and stable for the long term survival of the species. Data for areas outside of protected areas is less complete. In the absence of comprehensive information on wider habitat trends, the existing area of suitable macro-habitat, (3,529km2) is assessed, based on best expert judgement, as sufficient for the long term viability of the species.

5 Future Prospects

5.1 Negative impacts and threats

As the Kerry slug is a species associated with semi-natural and unimproved habitats, and requires a lichen or moss-rich diet, the biggest threat to this species is change and disturbance to this habitat requirement. In Spain, it has been noted that any transformation of the natural environment causes the species to disappear (Ramos, 1998).

Moorkens (2006) describes the threats to this species, and these include intensification of land use, tourism and general development pressure, expansion of coniferous plantation forestry, and spread of exotic species such as *Rhododendron* into its semi-natural woodland habitat.

As lichens are particularly sensitive to atmospheric pollution (Hawkesworth & Rose, 1976), any factors leading to a reduction in lichen abundance is likely to similarly affect *Geomalacus*.

There is no evidence of threat from climate change to date, but if in future areas of sufficient humid conditions are reduced, this may affect *Geomalacus* distribution. If so, the Irish population may be less affected than the Iberian population and become of even greater significance.

The level of separation of individual populations, the potential permeability through corridors and potential factors that may lead to isolation and fragmentation, the population size variability, ease of dispersal, requirements of refugia micro-habitat, and consequent requirements for land management require further investigation. These need to be clarified in order to make informed management decisions into the future.

5.2 Positive Impacts

Geomalacus is protected under Irish law from deliberate destruction under the Wildlife Act (Statutory Instrument 112 of 1990). This demands that all deliberate damage to the slug and its habitat is prohibited. However, the law does not cover activities that are licensed by other authorities.

Geomalacus is protected in SACs that contain a number of Annex I habitats, including the priority habitats of Active Blanket Bog and Alluvial forests. If the full communities of these habitats are protected, including the mature woodland structure and lower flora, this should favourably protect the invertebrate community within these habitats, including the Kerry slug.

6 Conclusion

In spite of the lack of quantitative data, *Geomalacus* appears to be widespread within its range, and enjoys the benefit of protection within large SAC complexes. The future prospects for the species appear to be favourable.

The range of *Geomalacus* can be considered to be stable based on the most recent presence / absence information. It has a Favourable Conservation Status.

Current population and favourable reference population can only be estimated as a number of 10km squares. There has been no change in population at this level. This parameter is taken as favourable.

The extent of suitable habitat in good condition remains large, and SACs designated for this species are extensive. Although information is deficient outside protected areas, within SACs, the habitat has Favourable Conservation Status.

Considering the impacts, pressures and threats to *Geomalacus* in the Republic of Ireland today, the overall Conservation Status for Future Prospects is Favourable. But more information is desirable in order to make a more confident and informed assessment in the future. In order to address this, a Species Action Plan has been written, which specifies measures that can be taken to assess the prospects for the species. It is expected that the implementation of this Species Action Plan will lead to improved data to assist reporting in 2013.

Range	Favourable
Population	Favourable
Range of appropriate habitat	Favourable
Future prospects	Favourable
Overall Assessment	Favourable

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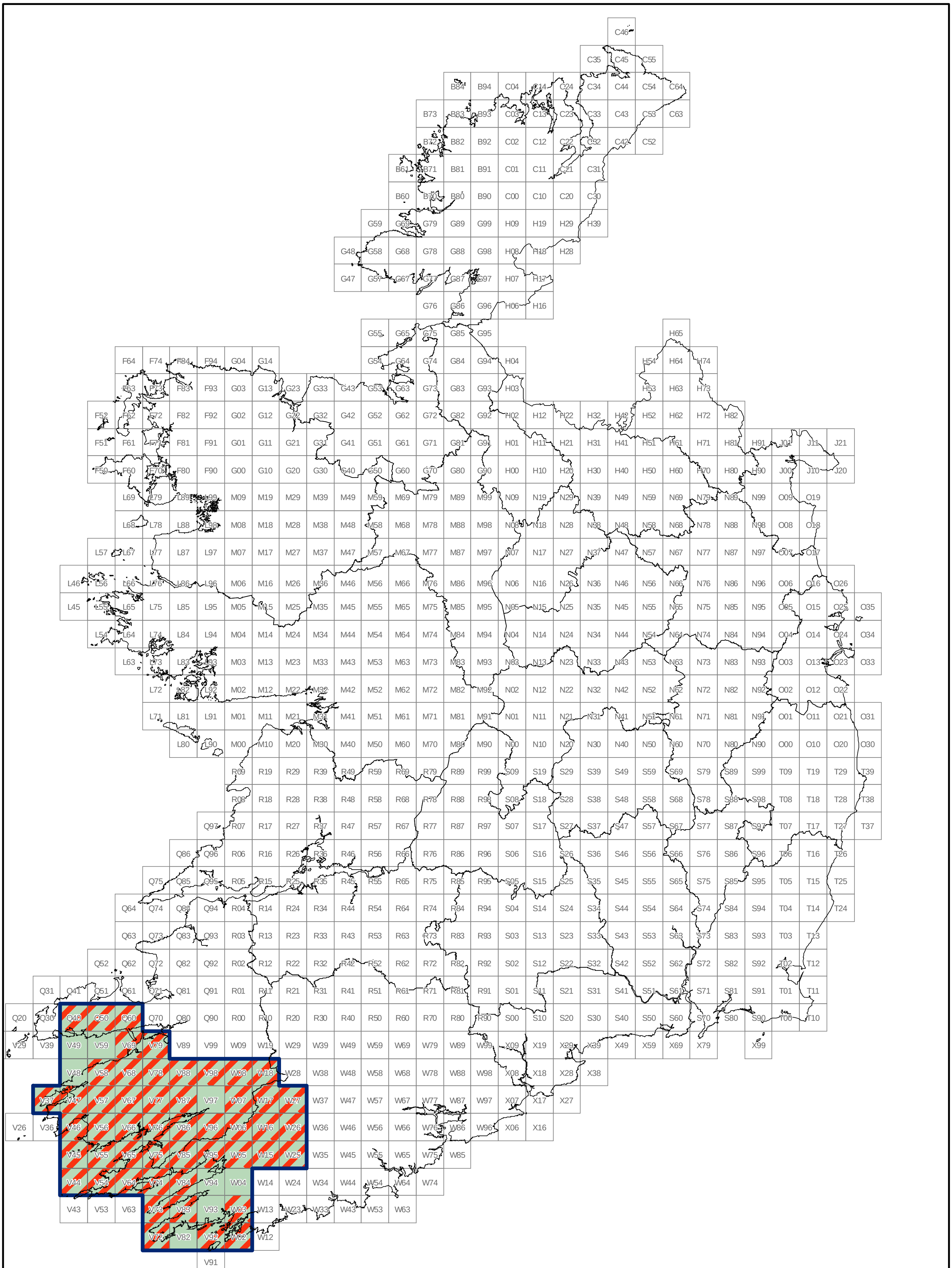
1024 Kerry slug (*Geomalacus maculosus*)

1. National Level	
Species code	1024
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	**Boycott, A. E. & Oldham, C. (1930)** The food of *Geomalacus maculosus*. *Journal of Conchology* 19: 36. **Kerney, M. (1976)** *Atlas of the land and freshwater molluscs of the British Isles.* ITE, Conchological Society, London. P92. **Kerney, M. (1999)** *Atlas of the land and freshwater molluscs of Britain and Ireland*. Harley, Essex. P119. **Moorkens, E. A. (2006)** Irish non-marine molluscs – an evaluation of species threat status. *Bull. Ir. biogeog. Soc*. **30**, 348-371. **Platts, E.A. & Speight, M.C.D. (1988)** The taxonomy and distribution of the Kerry slug, *Geomalacus maculosus* Allman, 1843 (Mollusca: Arionidae) with a discussion of its status as a threatened species. *Ir.Nat.J*., **22**: 417-430. **Scharff, R.F. (1893)** Note on the geographical distribution of *Geomalacus maculosus* Allman, in Ireland. *J. Mollus. Stud*. **1893,** 17-18. **Speight, M.C.D. (1996)** *Geomalacus maculosus* Allman, 1843. In: Van Helsdingen, P.J., Willemse, L. & Speight, M.C.D. (eds.) Background information on invertebrates of the Habitats Directive and the Bern Convention. Pt.III: Mollusca and Echinodermata. *Nature and Environment*, No.81: 433-437. Council of Europe, Strasbourg.
2.3 Range	
2.3.1 Surface area	5,800 km²
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	1988 - 2007
2.3.7 Reasons for reported trend	N/a
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	In the absence of more detailed data, 10 km squares are taken as a proxy of population. The species is known to be present in 50 10km grid cells.
2.4.2 Date of estimation	May 2007
2.4.3 Method used	1 = based on expert opinion
2.4.4 Quality of data	1 = poor
2.4.5 Trend	0 = stable
2.4.7 Trend-Period	1988-2007
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	103 – Agricultural improvement (reclamation) 110 – Use of pesticides 142 – Overgrazing by sheep 153 – removal of scrub 160 - General Forestry management 162 – artificial planting (gardens) 180 – Burning 403 – Dispersed habitation 502 – Routes / autoroutes 702 – Air pollution 954 – Invasion by a species (*Rhododendron ponticum*)

2.4.11 Threats	103 – Agricultural improvement (reclamation) 110 – Use of pesticides 142 – Overgrazing by sheep 153 – removal of scrub 160 - General Forestry management 162 – artificial planting (gardens) 180 – Burning 403 – Dispersed habitation 502 – Routes / autoroutes 702 – Air pollution 954 – Invasion by a species (*Rhododendron ponticum*)
2.5 Habitat for the species	
2.5.2 Area estimation	3,529km2
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	1988 - 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	5,800 km²
2.7.2 Favourable reference population	50 10km grid cells
2.7.3 Suitable Habitat for the species	3,529 km²
2.7.4 Other relevant information	
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	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

Kerry Slug
Geomalacus maculosus

1024

Current Distribution (50 cells)
Current Range (58 cells)
Favourable Reference Range (58 cells)
W48 10km grid cells

Date: October 2007

Margaritifera margaritifera (the 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

The freshwater pearl mussel lives in oligotrophic, acid to neutral waters of rivers flowing over granite or sandstone rock, mainly in the western part of Ireland, but also in areas of the south and south east where geological conditions allow. The ecology of the species is particularly notable in that individuals can grow to very large sizes relative to other freshwater molluscs, building up thick calcareous valves, in rivers which have soft water with low levels of calcium. Their shell building is consequently very slow, and individuals in natural conditions live to over a hundred years of age (Comfort 1957).

As their name suggests, *Margaritifera* has the ability to occasionally produce pearls. When adult numbers were very high in certain rivers, pearls were an important cultural aspect of the river (Lucey 2005). However, there is currently no sustainable way to extract pearls (Moorkens & Costello 2004), and thus pearl fishing is illegal in Ireland.

Populations of *Margaritifera margaritifera* are known from North America, northern and central Europe and Russia. The species is declining throughout its range and is listed in the IUCN red data book as endangered worldwide (Baillie & Groombridge 1996).

Members of the pearl mussel family, Margaritiferidae, have a complex life cycle. They live to over 100 years of age (Comfort 1957), maturing between seven and 15 years of age (Meyers & Milleman 1977, Smith 1978, Young & Williams 1983a), and can have a prolonged fertile period lasting into old age (Bauer 1987).

Sexes are normally separate, sperm is released into the open water via the male's exhalent siphon, is carried to the eggs via the female inhalant siphon, and fertilisation occurs in the brood chambers (Smith 1979, E. Ross 1988). These develop into the larval stage, called glochidia, which are temporarily brooded in the female gills from June each year, and are then released into the open water in high numbers in an event lasting one to two days between July and September, probably dictated by temperature in the river during development (Young & Williams 1983a, Bauer 1987, Ziuganov *et al*. 1994, Moorkens 1996, Hastie & Young 2003). Bauer (1987) looked at 200 gravid *M. margaritifera* from seven populations and found a range from less than 1 million to over 9 million (average of 4 million) glochidia per gravid female. In Scotland, Young & Williams (1983a) found a maximum of 16.85 million glochidia per female, and in Ireland, E. Ross (1988) found between 0.2 and 28.4 million, with an average of 9.8 million glochidia being produced per female in a sample of 104.

A small percentage of glochidia will be inhaled by passing salmonid fish (Bauer & Vogel 1987), which act as the pearl mussels' temporary hosts. In a laboratory study, Young & Williams (1983b) found glochidia to be no longer viable after 24 hours. The same authors calculated in field studies that failure to find a host within 24 hours occurred 99.9996% of the time (Young & Williams 1983a).

Glochidia are 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). The valves close on a filament of the salmonid gills, and nourishment is 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 this time they increase to about six times their original length. In a field study, Young & Williams (1983a) found a 95% loss of glochidia while attached to fish. A laboratory study showed losses of 88 to 95% (Young & Williams 1983b).

Those that survive on the fish develop into young mussels. They fall off in early summer (normally June) and bury into gravel, remaining buried for about five years, until large enough to withstand the flow of open water, moving stones, and perhaps trout predation (Cranbrook 1976, Wells *et al.* 1983, Moorkens 1996). Young & Williams (1983a) estimated from field studies that only about 5% of young mussels falling off fish survive to reach three to six years of age in rivers capable of supporting recruitment.

The retention of a glochidial stage is unusual for a creature living in fast flowing water. Most freshwater molluscs have developed means of depositing eggs safely in gelatinous masses or attached to aquatic vegetation, but pearl mussels release glochidia into the current, and rely on the salmonid host to keep the glochidia from flowing to the sea. In addition, the host attachment stage may act as a mechanism for dispersal of populations to new rivers, or upstream within a river (Purser 1988, Oliver *et al*. 1993).

Fish hosts vary throughout the range of pearl mussels. In Europe, *M. margaritifera* has been shown to use brown trout *S. trutta* L. more in Scotland (Young & Williams 1983a) and Atlantic salmon *Salmo salar* more in Russia (Cunjak 1991). In north-eastern North America, the brook trout *Salvelinus fontinalis* was also used by *M. margaritifera* (Smith 1976). In Ireland, pearl mussel rivers are either currently or historically important rivers for migratory salmonids (salmon and/or sea trout), but Irish pearl mussels also encyst on resident brown trout (Moorkens 1999). Fish do not normally suffer any disability from having glochidia attached, but there have been records of death in salmon where abnormally large quantities of glochidia were attached under experimental conditions (Karna & Millemann 1978). Indeed Ziuganov & Nezlin (1988) have proposed that the relationship of pearl mussels and salmon is symbiotic. The fish provides the essential step in the mussel's life cycle, and mussels improve water quality by filtering water. Each mussel can filter up to 50 litres of water per day (Ziuganov & Nezlin 1988). In the Varzuga River in Russia, Ziuganov & Nezlin (1988) estimated that mussels filter 90% volume of the river during low water years.

2. Data sources

Recording of non-marine molluscs in Ireland, including *Margaritifera margaritifera* falls into three main phases. From the 19th Century to the early 1970s there were few natural historians in the country. In the first half of the 20th century, irregular records were published from trips made by Phillips, Stelfox, and Welch (Stelfox 1911, 1929). In the early 1970s some intensive general molluscan presence/absence recording was carried out by members (mainly A. Norris and M.P. Kerney) of the Conchological Society of Great Britain & Ireland as part of a general molluscan 10 km mapping project (Kerney 1976). The second phase of recording came from a series of research studies by E. Ross (1984, 1988), H. Ross (1988), E. Moorkens (1991, 1996) and C. Beasley (1996) and from J. Lucey (1993) at the EPA. The third phase of recording was to enable strategic conservation work to be carried out. From the mid 1990s onwards work was carried out by NPWS to identify suitable SAC rivers (Moorkens 1995, Ross 1999) under contract and, following training, by NPWS regional staff (records in national database). Baseline monitoring for condition assessment commenced in 2004 and is continuing (Moorkens 2004, 2005 a, b and c, 2006 a, b and c; Ross 2004 a and b, 2005 a and b, 2006 a, b, c, d and e). Of the approximately 142 rivers and lakes with known records, 52 have had some survey information and the remaining 87 are merely records of presence. The designation status of *Margaritifera* rivers and lakes are shown in Appendix II to IV.

3. Range

3.1. Current Range

The current range of *Margaritifera margaritifera* in Ireland includes the western sea board from Donegal to Cork and parts of the south east, with some outlying populations in the counties bordering the Republic and Northern Ireland.

The current range is considered to include all rivers and lakes in which the species has been recorded since 1970, as well as those waterbodies known to contain mussels prior to 1970 but not surveyed since that date. Only those rivers in which *Margaritifera margaritifera* has been confirmed as extinct have been omitted from this current range. The loss of these populations is long established (19^{th} to early 20^{th} Century) and the causes known (e.g. mining, reservoir building).

Further survey work is necessary to confirm the continued presence of mussels in rivers and lakes not surveyed in recent years.

Appendix I shows the current and historical range of *Margaritifera margaritifera* in Ireland. In mapping the range, only those 10 km squares containing positive records for the species were included.

The area of the current *Margaritifera margaritifera* range is 14,200 km^2.

3.2. Favourable Reference Range

The Favourable Reference Range (FRR) for *Margaritifera margaritifera* in Ireland is taken to be its present range which is 14,200 km^2.

It is recognised, however, that further survey work is required to check to confirm the current range. This work is ongoing as part of a rapid assessment survey for the species.

3.3. Conservation assessment of the range

As the current range is equivalent to the FRR, the conservation status of the range is considered Favourable (Table 1).

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

Range Parameter	Value
Current Range	**14,200 km^2**
Favourable Reference Range	**14,200 km^2**
Range Conservation Assessment	**Favourable**

4. Population

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

A *Margaritifera margaritifera* **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. A population, therefore, could occupy a river and its tributaries and associated lakes. Fragmented groups of mussels within a catchment that were separated by significant distances or barriers, e.g. a large lake or a main river channel, have been considered as separate populations.

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. margaritifera* condition assessment (See Table 2).

Table 2 The *Margaritifera margaritifera* 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

Attribute	Target to pass	Notes
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

4.1. Current Population

The total historical number of *Margaritifera margaritifera* populations documented for the Republic of Ireland was 99. Of these, six are considered to be extinct. All six are thought to have become extinct before 1970. A number of the remaining 93 populations need to be verified or re-surveyed to confirm the presence/ continued presence of *M. margaritifera*.

An attempt was made to assess the viability of the 93 extant populations. NPWS *Margaritifera margaritifera* monitoring was designed to yield the population structure parameters necessary to allow full condition assessment.

Full population structure condition assessments were completed for a total of 23 populations, which included 34 rivers and lakes (See Appendix VI). These 23 populations included all of the largest *Margaritifera margaritifera* populations and all of those known to have reproduced successfully since the 1970s. All 23 populations failed the condition assessment.

Partial condition assessments were also completed for other rivers, e.g. where there was recent evidence of an unnatural kills or declines in the numbers of adult mussels, which pointed to failures.

The conclusion, therefore, was that no extant *Margaritifera margaritifera* populations in the Republic of Ireland can be considered viable.

4.2. Favourable Reference Population

As the six populations that are considered to be extinct have been extinct since 1970, the favourable reference population if the 1970 populations were considered to be the appropriate target to restore would be 93 viable populations. However, the level of development, drainage, and intensive usage of many of these catchments make them impossible to restore without removal of usages that have been enjoyed for half a century or more. It is considered better to take the number of viable populations that should have a reasonable chance of restoration, namely, those that were viable at the time of implementation of the Habitat's Directive in 1994.

There are eleven populations that were considered, by expert judgement, to be viable in 1994 (Bandon, Barrow-Mountain, Bundorragha, Caragh, Corrib - Owenriff, Eske, Kerry

Blackwater, Leannan, Newport, Owenagappul, and Slaney - Dereen). These 11 populations cover the main parts of the species' range. There are other rivers that have not yet been surveyed, but whose age profile could indicate that they were also viable in 1994. Priority will be given to establishing the status of all populations with prior records, and whose status is currently unknown. The discovery of populations with an age class of thirteen years or less would indicate viability in 1994, and these will be added to the list of restorable populations and, hence, the favourable reference population. Although it is considered that these catchments will have the best chance of being restored (as their damage has been the most recent and therefore potentially the most recoverable), some large scale damage such as from widespread coniferous forestry may be difficult to reverse.

4.3. Conservation assessment of the population

As the current number of viable *Margaritifera margaritifera* populations is zero and the Favourable Reference population is 11 viable populations, the conservation status of the population in **unfavourable – bad** (See Table 3)**.**

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

Population Parameter	Value
Current Population	**93 un-viable populations**
Favourable Reference Population	**11 viable populations**
Population Conservation Assessment	**Un-favourable - Bad**

5. Habitat

The habitat of *Margaritifera margaritifera* in Ireland does not fit well with any particular Habitat's Directive Annex I or CORINE habitat. It is restricted to near natural, clean flowing waters, often downstream of ultra-oligotrophic lakes. A small number of records are from the lakes themselves. The essential conditions for *Margaritifera* habitat are described in Table 4.

Margaritifera requires stable cobble and gravel substrate with very little fine material below pea-sized gravel. Adult mussels are two-thirds buried and juveniles up to 5-10 years old are totally buried within the substrate. 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 ultra-oligotrophic rivers. Phosphorus must never reach values that could allow for sustained, excessive filamentous algal growth.

The presence of sufficient salmonid fish to carry the larval glochidial stage of the pearl mussel life cycle is essential.

Intact natural catchments prevent fine sediment and nutrient losses to the river (see Section 9.2, Catchment habitat for *Margaritifera*, 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.

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

Attribute	Target to pass	Notes
Water Quality		
Orthophosphate	0.005mg/l median value unless evidence of higher historical data from times of recruitment	The target level given in the UK FCT based upon Bauer (1988) is <0.03mg/l, but recent evidence from Ireland (Moorkens 2006) found that the highest median levels associated with effectively recruiting populations are 0.005mg/l.
Nitrate	0.125mg/l median value	No target given in UK FCT but Bauer (1988) gives <0.5mg/l, but Moorkens (2006) found that the highest median levels associated with effectively recruiting populations are 0.125mg/l.
Suspended Solids	<10mg/l maximum value associated with natural events	Suspended solids should be rare rather than chronic and attributable to natural conditions.
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

Attribute	Target to pass	Notes
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

5.1. Current condition of *Margaritifera* habitat

The above habitat criteria were used to assess *M. margaritifera* SACs using mussel monitoring data and EPA water quality data, where available. Although a few rivers were data deficient in some or all of these categories, those rivers for which data were available all failed (Appendix VI). Water quality data and siltation, algal and macrophyte observations show that current populations are failing as a result of poor substrate quality. In some cases this poor substrate quality is because of severe enrichment as well as physical siltation.

5.2. Conservation assessment of *Margaritifera* habitat

From the above assessment it is clear that pearl mussel habitat is poor throughout the range of the species in Ireland. *Margaritifera* cannot recruit the next generation until its habitat is clean enough to allow juvenile survival. Consequently the conservation assessment of *M. margaritifera* habitat is unfavourable - bad.

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

Habitat Parameter	Value
Current Habitat	**Habitat quality fails mussel requirements the areas occupied by all 91 populations**
Favourable Reference Habitat	**High quality juvenile and adult mussel habitat available within the area occupied by the ? 91 populations**
Habitat Conservation Assessment	**Un-favourable - Bad**

6. Pressures

There are a number of factors leading to the decline and loss of pearl mussel populations internationally and most of those are evident in Ireland (Araujo & Ramos 2001, Moorkens 1999).

The loss of pearl mussel populations mostly occurs from continuous failure to produce new generations of mussels because of the loss of clean gravel beds, which have become infiltrated by fine sediment and/or over-grown 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 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, they 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 to 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 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 a similar effect on the mussel substrate as dying/decomposing algae and macrophytes.

Table 6 **The *Margaritifera margaritifera* 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.

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 are pressures that are present in many Irish *Margaritifera* catchments and their cumulative effects have had very severe impacts on 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 increae the fine sediment and nutrient load to the river. The cumulative effects of such practices can have very severe impacts on mussels.

Liming of land has a negative effect on *Margaritifera* populations, through direct toxic effects, and through increased growth rates leading to shortened life expectancy and, thus, loss of reproductive years (Bauer *et al*. 1991, Skinner *et al*. 2003). In some countries, acidification problems are so severe that liming is considered to have a more positive than negative effect (Henrikson *et al*. 1995). However, water chemistry data from declining Irish pearl mussel rivers indicate high peaks of calcium and conductivity levels that are likely to have been caused by liming.

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 vast majority of Irish pearl mussel populations now exceed the recommended range of nutrient levels for this species. The most seriously damaging nutrient is most probably phosphorus, as it is the limiting nutrient in most Irish pearl mussel rivers. Phosphorus promotes algal growth.

142 Overgrazing by sheep

143 Overgrazing by cattle

148 Overgrazing, general

Explanation: Overgrazing by sheep in mountainous moor and blanket bog habitats in the upper reaches of pearl mussel catchments has led to loss of vegetation and exposure of peaty soils. This problem has been very serious in some catchments, particularly in parts of the west of Ireland. The bare peaty soil erodes easily and releases fine sediment into the river. Similarly, overgrazing by cattle and other animals along the banks of pearl mussel rivers has lead to, and continues to cause, bank erosion. Furthermore, drinking access for cattle causes direct damage and death to mussels, as well as encouraging further bank erosion and sediment mobilisation.

150 Restructuring agricultural land holding

Explanation: Removal of hedges, copses and scrub from lands surrounding pearl mussel rivers is linked with possible kills of adult mussels and declines n the quality of juvenile habitat. These land changes lead to exposure of bare ground that causes 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. These newly drained areas are more conducive to agricultural practices of greater intensity than before, thus the problem is exacerbated and ongoing.

160 General forestry management

Explanation: Forestry planting, drainage, ground preparation, clear-fell, replanting, thinning and all management practices associated with clear fell plantation have been a major source of both silt and nutrients in pearl mussel catchments. The drainage and other preparations of land for planting and the practice of clear felling leads to exposure of bare ground that can erode and release silt into the river. 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 mussel rivers 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.

Acidification has been well documented as a threat to salmonid populations both internationally (e.g. Maitland *et al*. 1987, Henrikson *et al*. 1995, Lacroix, 1989) and in Ireland (Bowman & Bracken 1993, Allott *et al*. 1990, Kelly Quinn *et al*. 1997). In Ireland, acidification is linked with coniferous plantations in acid-sensitive areas rather than industrial pollution. As salmonid hosts can come from anywhere within the pearl mussel catchment, protection of the entire catchment from acidification is essential.

Acidification has also been noted as a direct threat to *Margaritifera* from the first first international IUCN red data book for invertebrates (Wells *et al*. 1983). Work carried out in Scandinavia has provided evidence for pearl mussel decline from acidification (Okland & Okland 1986, Eriksson *et al*. 1981, 1982, 1983; Henriksen *et al*. 1995, Raddum & Fjellheim 2004). A lowering of pH directly influences pearl mussels through a gradual destruction of their calcareous shell, and also their genital organs (causing infertility), and through problems with regulation of acid-base mantle fluid homeostasis (Vinogradov *et al*. 1987).

171 Stock feeding

Explanation: The introduction of nutrients to *Margaritifera* catchments 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 rivers for the purposes of enhancing fish numbers for angling can also be very damaging to pearl mussel habitat, including 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 loss of mussels and their habitat in some parts of the river. In other areas ponds are created where silt accumulates with further loss of juvenile and adult habitat.

240 Taking / removal of fauna

Explanation: Pearl fishing has been a major problem in the past, and kills from pearl fishing have been observed in recent years in spite of the practice being illegal under Irish law.

Margaritifera margaritifera has been exploited for its pearls since Roman times, for leisure and commercial gain, and Ireland's mussels were well known sources of pearls for many years (Lucey 2005, Cranbrook 1976). Pearl fishing has been cited as a threat to pearl mussels across most of its range, and in countries with very low numbers of individuals such as Germany, there are historical records of pearl fishing causing population decline. Recent records of pearl fishing in Ireland are anecdotal, and generally involve Scottish visitors, some of whom come from families that traditionally made a visit to known haunts at periodic intervals. The decline in pearl mussels and the lack of sufficient recruitment has made any pearl fishing unsustainable and the use of tongs to open mussels for pearls has been shown to be damaging (Moorkens & Costello 2004). Thus pearl fishing is outlawed in Ireland and any illegal fishing is considered to pose a threat to that population.

300 Sand and gravel extraction

301 Quarries

Explanation: Pearl mussel populations have been damaged in the past and continue to be damaged both directly through removal of gravel from pearl mussel river beds, and indirectly through silt and other pollution from quarrying activities. Severe episodes of silt lead to adult mussel kills, large and small releases of silt destroy juvenile habitat. Another common problem is the release of calcium from limestone quarries, which increases growth rate in adult mussels, thus shortening mussel lives and reducing the long fertile period required for pearl mussel life history strategy.

310 Peat extraction

Explanation: Hand and machine cutting of peat, including the drainage channels used in the process, leads to losses of pearl mussel juvenile habitat from infiltration of river bed substrate by fine peat particles released from bare soil.

330 Mines

Explanation: Pollution of water courses from open cast and underground mining by mined heavy metals, and chemicals used in the process of extraction of mined products has led to the loss of pearl mussel populations.

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 elevation 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.

410 Industrial and commercial areas

Explanation: Pearl mussels have already been lost from intensively industrialised areas of Ireland, but local and more rural industries such as meat processors and creameries operate adjacent some extant pearl mussel rivers. High BOD levels and other pollutants 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 marerials

Explanation: There is evidence of reduced habitat quality for Pearl mussels in rivers where land fill sites are present in the catchment. Decreased habitat quality is also found in rivers where household and other waste is dumped into or adjacent the river instead of being properly disposed of, and in rivers where inert materials such as builder's rubble have been used as infill within the flood plain area to raise and level the ground for more intensive usage.

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 a direct connection between the groundwater contributing to the interstitial gravels and the unimproved low nutrient vegetation in the flood plain (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 Ireland, 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 most negative effects have occurred where structures were not spaced wide enough and, thus, not enough flood plain habitat has been left on either side of the river (see above). The damage is exacerbated where flow changes have occurred, and consequent 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 permanent effects, i.e. both from construction and operation. Other permanent effects include excessive shading under the bridge, and disturbance to adult mussels and reproduction 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 then cause knock-on long term damage to beds of mussels upstream and downstream of the structure.

510 Energy transport

Explanation: There is evidence of mussel kills where pipe lines have been routed across river beds, from instream works in the river causing silt episodes, and also from exposure of bare ground where the pipe has been dug in on either side of its entry into the river causing soil erosion. Electricity lines have been successfully taken across pearl mussel rivers by helicopter, thus avoiding the need to interfere with the river or the flood plain. There would be damage if existing crossing points at pearl mussel rivers were used at the early design stage of any routing.

530 Improved access to site

Explanation: There is evidence of increased dumping and pearl fishing at pearl mussel beds that are in close proximity to sites with easy access.

600 Sport and leisure structures

Explanation: There is evidence of increased silt and nutrient releases and depressed pearl mussel habitat where golf courses, sports pitches and camp sites have been developed nearby.

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 0.005mg/l P is considered to be essential to the maintenance of oligotrophic waters for reproducing pearl mussel rivers (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, causing adult and juvenile deaths and increases 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 causes 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 of flow, sediment and nutrient dynamics (Clarke 2002, Wood 1997, Madsen *et al*. 2001, Barko *et al*. 1991). Phosphorus that resulted in macrophyte growth continues to be released and mobilised as the macrophytes decompose (Barko & Smart 1980, Rooney *et al*. 2003).

800 Landfill, land reclamation and drying out, general

Explanation: See 420-423 above.

810 Drainage

830 Canalisation

Explanation: Both arterial drainage of the river and catchment and field drainage associated with agriculture and forestry impact on pearl mussels. Arterial drainage, canalisation, boulder removal, etc. has 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 river channels hosting pearl mussels, 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: Destruction and damage to habitats in the catchments of pearl mussels, such as through bog drainage and in-filling of floodplains has changed the hydrology of some rivers. A small number of pearl mussel rivers are also regulated above the populations. Flow regulation can have serious negative effects on pearl mussel populations (Mc Allister *et al*. 1999, Araujo & Ramos 2001). These manifest mainly in two ways. Firstly, consistent but unnatural flows, particularly more prolonged low flows can cause stress to adult and juvenile mussels by raising temperature, reducing oxygen, concentrating pollutants and providing conditions for silt deposition and algal growth. Secondly, rapid changes in flow regime such as where sluices or dams are opened and closed regularly, is damaging to pearl mussel populations. This may be due to the energy effort of individuals, concentrated on digging into substrate or moving around leading to a state of continuous stress. Where rapid changes are occurring at very sensitive times of the year, loss of annual glochidial production or newly dropped juvenile mussels can occur. These phases of the life cycle normally occur at periods of low flow, and losses in a natural system through flooding are rare events.

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.

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.

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*. It is unlikely (in the foreseeable future) that Irish habitats 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 sea level may increase the salinity of a higher percentage of the lower reaches of some mussel rivers, which would have particularly serious ramifications for populations that have now become restricted to the bottom end of rivers. Hastie et al.

(2003) predict that a number of Scottish populations may be lost as a result of climate change.

966 Antagonism arising from introduction of species

Explanation: The introduction of the zebra mussel (*Dreissena polymorpha*) or other exotic species into pearl mussel rivers could result in major declines to 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 of *Margaritifera* in most rivers, there could be concern for the rivers of the Barrow and Suir catchments in places where calcium levels are more elevated than in other catchments.

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 19 Special Areas of Conservation have been designated for *Margaritifera margaritifera*, much work is required, throughout its catchment, in order to restore and sustain mussel populations for the future. The success of the SAC designations 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 recently intensified in parts of pearl mussel catchments, and 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 catchment management plans. The mechanism for compensation needs to be put in place before demands can be made on the landowners.

Water quality in Ireland is monitored by the Environmental Protection Agency. While there has been a decrease in the number of seriously polluted rivers, of particular concern for

Margaritifera is the loss of high quality rivers. Q 5 and Q 4-5 river sites, which are of the highest quality under the EPA Q value system, have continuously been lost since reporting was established in the 1970s. The EPA have noted with particular concern the reduction in the highest quality Q5 stations, the number of which has almost halved between the reporting periods 1995-1997 and 2001-2003, decreasing from 4.6 per cent to 2.7 per cent of all river stations (EPA 2006). The majority of the recorded instances of slight and moderate pollution can be attributed to the impact of nutrients inputs from agriculture and municipal sources (EPA 2006). The loss of Q 5 and Q 4-5 sites demonstrates the national trend of deterioration in the water and habitat quality of the near-natural rivers required by *margaritifera*,

Developments that include potentially damaging activities have recently been granted planning approvals in pearl mussel catchments. To allow these approvals in advance of a management plan to restore favourable conservation status to these catchments will make recovery more difficult and, in some cases, perhaps impossible. Use of Part 8 of the Irish Planning Act by county councils for developments on pearl mussel rivers without appropriate assessment under the Habitats Directive has also been a problem.

It should be noted that some of the outlying areas of the species' range include populations with low numbers of individuals. The future prospects for these small populations is likely to be poor and conservation of genetics through captive breeding may be a more pragmatic short to medium term objective for conservation in rivers with severely depleted numbers.

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 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 pearl mussel from extinction must become evident in order for positive actions to make a real difference. Time is also limited as the further populations decline, the harder they will be to save in the future.

8.3. Conservation assessment of future prospects

As the negative indicators outweigh the positive ones in both number and magnitude, there is no doubt that the assessment of future prospects is Unfavourable – bad (Table 7).

Table 7 The conservation assessment for the future prospects of *Margaritifera margaritifera* 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**
Positive Indicators	• **Future policy, legislation and management under the WFD** • **Drat *Margaritifera* SAP** • **Improved *Margaritifera* monitoring**
Future Prospects Conservation Assessment	**Un-favourable - Bad**

9. Complementary Information

9.1. Population estimate

The estimation of pearl mussel numbers is difficult to undertake, as survey for individuals can itself have a negative impact on pearl mussel conservation. Population estimates are based on numbers of individuals visible at the surface, which are adults. Younger mussels remain within the river bed substratum until mature enough to withstand the flowing water conditions. The main threat to *Margaritifera* is the deterioration of this juvenile habitat, so a large adult population cannot be considered in itself to constitute a favourable situation.

Population estimates have been made for rivers that have undergone full monitoring surveys. For some other rivers, population estimates have been made for sections of river.

Population estimation for *Margaritifera* in the Republic of Ireland is by standard methods, which have been published (Anon. 2004).

The most recent population estimate of *Margaritifera margaritifera* adult individuals in Ireland (2006) is 12,000,000, based on a total of 8,151,690 from 20 rivers that have had full surveys and an estimated average of 33,000 individuals per river for the remaining 119 unsurveyed rivers (including 15 SACs not yet counted).

The *Margaritifera* rivers in Ireland essentially divide between those with small populations that have not reproduced effectively for many years (known as reproductively unviable populations), and those with large adult numbers and some recent recruitment. The former set of rivers have generally reached habitat conditions whereby recovery of the river is likely to take longer than the lifetime of the mussel population living there and, thus, recovery is very unlikely. The latter set of rivers will become unrecoverable over time, and need urgent action to be undertaken to improve their reproductive viability. The following 13 rivers were known to be reproducing in 1994 or later, from the presence of both juveniles and younger age classes, but are currently not reproducing enough young to ensure their future favourable conservation status:

Table 8 ***Margaritifera* rivers known to be reproducing in or after 1994**. Rivers were judeged to be reproducing on the basis of the presence of juveniles and sub-adult age classes.

River	Status	Comment	Source
Ownagappul	Suitable recruitment in some places	Recent decline (since 1999)	Ross expert opinion; Ross 1999, 2005b
Owenriff	Good recruitment up to 2001, currently no recruitment	Recent decline (since 2004)	Moorkens expert opinion; Moorkens 2004, 2006c
Kerry Blackwater	Good recruitment in 1999	Recent decline, unfavourable recruitment 2004	Ross expert opinion; Ross 1999, 2004a
Kealduff	Good recruitment in 1999	Recent decline, unfavourable recruitment 2004	Ross expert opinion; Ross 1999, 2004a
Caragh	Good recruitment in 1999	Recent decline, unfavourable recruitment 2004	Ross expert opinion; Ross 1999, 2004b
Owenroe	Good recruitment in 1999	Recent decline, unfavourable recruitment 2004	Ross expert opinion; Ross 1999, 2004b
Caraghbeg	Good recruitment in 1999	Recent decline, unfavourable recruitment 2004	Ross expert opinion; Ross 1999, 2004b
Mountain	Juvenile recruitment in 1995	Steep decline in 2006	Moorkens and Ross expert opinion; Moorkens 1995; Ross 2006b
Dereen	Juvenile recruitment in 1995	Steep decline in 2006	Moorkens and Ross expert opinion; Moorkens 1995, Ross 2006e
Newport	Juvenile recruitment in 1995	Steep decline in 2005	Moorkens expert opinion; Moorkens 1996, 2005a
Bundorragha	Juvenile recruitment in 1995	Recent decline, unfavourable recruitment 2005	Moorkens expert opinion; Moorkens 1995, 2005b
Owenea	Juvenile recruitment in 1992	Steep decline in 2005	Moorkens expert opinion; Beasley & Roberts 1996; Moorkens 2005d
Eske	Juvenile recruitment in 1995	Steep decline in 2006	Moorkens expert opinion; Moorkens 1995, 2006a

The SAC condition assessments (Appendix VI) and the comparison of abundance categories at sites surveyed in 1988 (Appendix VII) show that, in spite of having a large minority (up to 46%) of the EU's adult pearl mussels, and thus holding international populations of the utmost importance, recent habitat declines in Ireland have led to an almost total collapse in pearl mussel reproduction.

9.2. Catchment habitat for *Margaritifera*

The conservation of habitat for *Margaritifera* depends on maintaining the river habitat, and the surrounding bank side habitat. The terrestrial habitat surrounding both banks of *Margaritifera* rivers is very important. Sustainable populations of pearl mussels require unimproved catchments that export only natural background levels of silt and nutrients. Thus 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:

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)

Intact natural catchments protect the river from fine sediment and nutrient damage. Restoration of natural catchment levels of nutrient and sediment export are considered to be essential to the future viability of *Margaritifera* populations.

9.3. Threat status of *Margaritifera*

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

10. Overall conservation assessment

Table 9 Overall Conservation Assessment for *Margaritifera margaritifera*.

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

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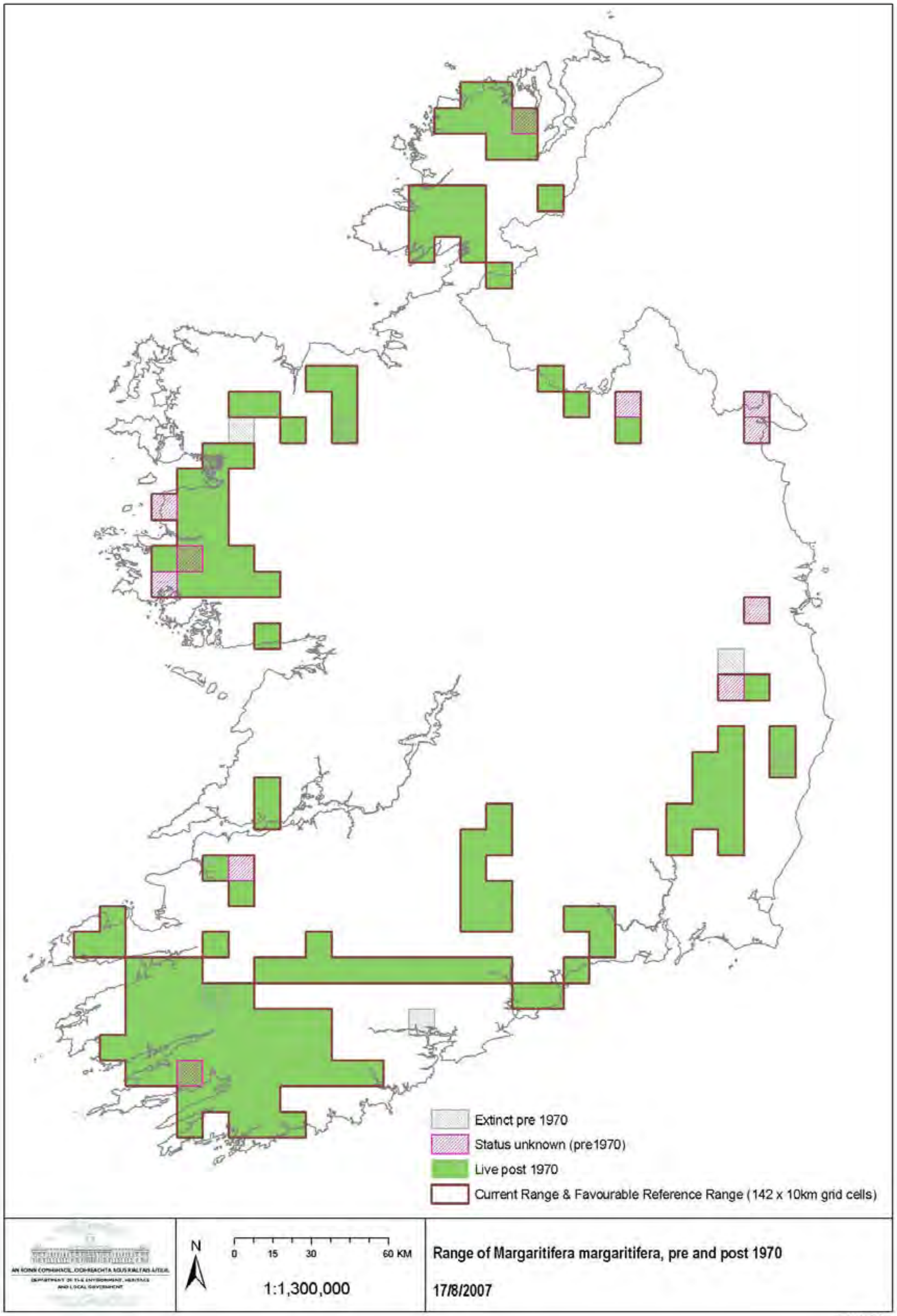
Appendix I

Map of the Range and Distribution of *Margaritifera margaritifera* in Ireland



Appendix II

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

SAC Site Code	Name of SAC	County	Rivers / Lakes
000163	LOUGH ESKE AND ARDNAMONA WOOD SAC	Donegal	Eske
000197	WEST OF ARDARA/MAAS ROAD SAC	Donegal	Owenea
000297	LOUGH CORRIB SAC	Galway	Owenriff
000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT SAC	Kerry	Caragh, Caragh Lake, Caraghbeg, Lough Acoose, Meelagh, Owenroe
001932	MWEELREA/ SHEEFFRY/ ERRIFF COMPLEX SAC	Mayo	Bundorracha
000140	FAWNBOY BOG/ LOUGH NACUNG SAC	Donegal	Clady
002047	CLOGHERNAGORE BOG AND GLENVEAGH NATIONAL PARK SAC	Donegal	Owencarrow, Glaskeelan
002171	BANDON RIVER SAC	Cork	Bandon, Caha
002170	BLACKWATER RIVER (CORK/ WATERFORD) SAC	Cork / Waterford	Blackwater, Allow, Licky
002173	BLACKWATER RIVER (KERRY) SAC	Kerry	Blackwater, Dereendaragh, Kealduff
002176	LEANNAN RIVER SAC	Donegal	Leannan
002165	LOWER RIVER SHANNON SAC	Clare	Cloon
002137	LOWER RIVER SUIR SAC	Waterford	Clodiagh
002144	NEWPORT RIVER SAC	Mayo	Newport
002162	RIVER BARROW AND RIVER NORE SAC	Carlow	Augnabrisky, Ballymurphy, Mountain
000375	MOUNT BRANDON SAC	Kerry	Owenmore
002031	THE TWELVE BENS/GARRAUN COMPLEX SAC	Galway	Dawros
001879	GLANMORE BOG SAC	Cork	Owenagappul, Barrees
000781	SLANEY RIVER VALLEY SAC	Wicklow, Carlow	Dereen

Appendix III

Special Areas of Conservation (SACs) including but not designated for *Margaritifera margaritifera* in Ireland

SAC Site Code	Name of SAC	County	Rivers / Lakes
000365	KILLARNEY NATIONAL PARK, MACGILLYCUDDY'S REEKS AND CARAGH RIVER CATCHMENT	Kerry	Cappal, Finnihy, Cottoners, Flesk, Lough Leane, Finnow, Owneykeagh, Owenreagh
001932	MWEELREA/SHEEFFRY/ERRIFF COMPLEX	Mayo	Erriff
002165	LOWER RIVER SHANNON	Kerry	Feale
00090	GLENGARRIFF HARBOUR AND WODDLAND SAC	Cork	Glengarriff
0002298	RIVER MOY	Mayo	Deel
002170	BLACKWATER RIVER (CORK/WATERFORD)	Cork/ Waterford	Owentaraglin
000375	MOUNT BRANDON	Kerry	Owenascaul
000781	SLANEY RIVER VALLEY	Wicklow/ Carlow	Slaney, Derry, Bann
002137	LOWER RIVER SUIR	Tipperary/ Waterford	Clodiagh (Tipp), Aherlow, Multeen
000163	LOUGH ESKE AND ARDNAMONA WOOD	Donegal	Lough Eske

Appendix IV

Rivers with Margaritifera populations with no Site designation

River	Catchment	County	River	Catchment	County
Tar	Suir	Waterford	Laune	Laune	Kerry
Tay	Tay	Waterford	Lough Currane	Currane	Kerry
Mahon	Mahon	Waterford	Cummeragh	Currane	Kerry
Owneykeagh	Flesk	Kerry	Owreagh	Owreagh	Kerry
Lee	Lee	Cork	Brown Flesk	Maine	Kerry
Sullane	Lee	Cork	Kilcurry	Castletown	Louth
Foherish	Sullane Lee	Cork	Galey	Feale	Kerry
Laney	Sullane Lee	Cork	Sheen	Sheen	Kerry
Toon	Lee	Cork	Baurearagh	Sheen	Kerry
Mealagh	Mealagh	Cork	Roughty	Roughty	Kerry
Owenaher	Moy	Sligo	Owenshagh	Owenshagh	Kerry
Easky	Easky	Sligo	Glanrastel	Owenshagh	Kerry
Owenacahina	Glengarriff	Cork	Glantrasna	Owenshagh	Kerry
Coomerkane	Glengarriff	Cork	Dromoghty	Dromoghty	Kerry
Ilen	Ilen	Cork	Bunnow	Bunnow	Kerry
Saivnose	Ilen	Cork	King's	Liffey	Wicklow
Owennashingaun	Ilen	Cork	Avoca	Avoca	Wicklow
Glan (Dunmanus)	Glan	Cork	Aughrim	Avoca	Wicklow
Roury	Roury	Cork	Derry Water	Aughrim Avoca	Wicklow
Barrow	Barrow	Carlow	Ow	Aughrim Avoca	Wicklow
Augavaud	Barrow	Carlow	Avonmore	Avoca	Wicklow
Blackwater	Bandon	Cork	Vartry	Vartry	Wicklow
Coomhola	Coomhola	Cork	Tobergal	L. Cullin	Mayo
Owvane	Owvane	Cork	Crumpaun	Newport	Mayo
Leamawaddra	Leamawaddra	Cork	Owenwee	Owenwee	Mayo
Four mile water	Four mile water	Cork	Bunowen	Bunowen	Mayo
Trafrask	Trafrask	Cork	Finny	Lough Mask	Mayo
Adrigole	Adrigole	Cork	Feenone	Roonah Lough	Mayo
Clashduff	Adrigole	Cork	Graney	Scarriff, L Derg	Clare
Glashaboy	Glashaboy	Cork	Erne	Erne	Cavan
Derryneen	Recess	Galway	Annalee	Erne	Cavan
Owentooey	Recess	Galway	Swanlinbar	Erne	Cavan
Ballynahinch Lake	Recess	Galway	Larah	Erne	Cavan
Recess	Recess	Galway	Liffey	Liffey	Dublin
Lough Inagh	Recess	Galway	Lough Fern	Leannan	Donegal
Furbo (Knock)	Lough Inch system	Galway	Glaskeelan	Leannan	Donegal
Glengawbeg	Owenriff Corrib	Galway	Finn	Foyle	Donegal
Woodford	Woodford L. Derg	Galway	Derg	Lougn Derg	Donegal
Tullaghobegly	Tullaghobegly	Donegal	Carrownamaddy	Carrownamaddy	Donegal
Waterfoot	Erne	Donegal	Eany	Eany water	Donegal
Stragar	Stragar	Donegal	Oily	Oily	Donegal
Loughaderry	Stragar	Donegal			

139 total, 33 designated SAC, 21 non-designated SAC, 84 non-designated non-SAC

Appendix V

Condition assessment categories for *Margaritifera margaritifera*

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	0.005mg/l median value unless evidence of higher historical data from times of recruitment	The target level given in the UK FCT based upon Bauer (1988) is <0.03mg/l, but recent evidence from Ireland (Moorkens 2006) found that the highest median levels associated with effectively recruiting populations are 0.005mg/l.
Nitrate	0.125mg/l median value	No target given in UK FCT but Bauer (1988) gives <0.5mg/l, but Moorkens (2006) found that the highest median levels associated with effectively recruiting populations are 0.125mg/l.

Attribute	Target to pass	Notes
Suspended Solids	<10mg/l maximum value associated with natural events	Suspended solids should be rare rather than chronic and attributable to natural conditions.
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 VI

Condition assessment of SAC rivers designated for *Margaritifera margaritifera*

Catchment	Eske	Owenea	Owenriff	Caragh	Caragh	Caragh	Caragh	Caragh
Attribute	**Eske**	**Owenea**	**Owen-riff**	**Caragh**	**Caragh Lake**	**Caragh-beg**	**Lough Acoose**	**Meelagh**
Mussels								
Density 1	F	F	F	F	D	F	D	F
Density 2	F	F	P	P	D	P	D	F
Numbers of live individuals	F	F	F	F	D	F	D	F
Numbers of dead shells	F	F	F	P	D	P	D	P
Age structure 1	F	F	F	F	D	F	D	F
Age structure 2	F	F	F	F	D	F	D	F
Age structure 3	F	F	F	F	D	F	D	F
Age structure 4	F	F	F	F	D	F	D	F
Water Quality								
Orthophosphate	F	F	F	F	D	D	D	F
Nitrate	F	D	F	F	D	D	D	P
Suspended Solids	D	D	D	D	D	D	D	D
BOD	F	P	P	F	D	D	D	F
Substrate Condition								
Siltation	F	F	F	F	D	F	D	P
Redox measurements	F	D	F	D	D	D	D	D
Plant Growth								
Filamentous algae	F	F	F	F	D	F	D	P
Macrophytes	F	F	F	F	D	F	D	P
Adjacent Land Use Issues	F	F	F	F	D	F	D	D
Evidence of pearl fishing within reporting period	P	D	P	P	D	P	D	P
Total # fails	16F	13F	14F	13F	0F	10F	0F	9F
Total # data deficients	1D	4 D	1D	2D	18D	5D	18D	3D
Total # passes	1P	1P	3P	3P	0P	3P	0P	6P
Population	**F**	**F**	**F**	**F**	**D**	**F**	**D**	**F**
Water quality	**F**	**F**	**F**	**F**	**D**	**F**	**D**	**F**

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

……..cont.

Appendix VI cont.

Catchment	Caragh	Laune – Gearhameen	Bundo-rragha	Clady	Owencarrow	Leannan	Leannan	Bandon	Bandon
Attribute	**Owen-roe**	**Owen-reagh**	**Bundo-rragha**	**Clady**	**Owen-carrow**	**Glask-eelan**	**Leanna n**	**Bandon**	**Caha**
Mussels									
Density 1	F	F	F	F	F	F	D	F	F
Density 2	P	D	P	P	F	F	D	P	F
Numbers of live individuals	D	D	F	F	D	D	D	D	F
Numbers of dead shells	P	D	P	P	D	D	D	D	F
Age structure 1	F	D	F	F	D	D	D	D	F
Age structure 2	F	D	F	F	F	F	D	F	F
Age structure 3	F	D	F	F	D	D	D	D	F
Age structure 4	F	D	F	F	F	F	D	F	F
Water Quality									
Orthophosphate	F	P	F	P	D	D	F	F	F
Nitrate	P	P	F	P	D	D	P	F	F
Suspended Solids	D	D	D	D	D	D	D	D	D
BOD	F	P	P	P	D	D	P	F	D
Substrate Condition									
Siltation	F	D	F	P	D	D	D	D	F
Redox measurements	D	D	F	F	D	D	D	D	D
Plant Growth									
Filamentous algae	F	D	F	P	D	D	D	D	D
Macrophytes	F	D	F	P	D	D	D	D	F
Adjacent Land Use Issues	D	D	F	F	D	D	D	D	F
Evidence of pearl fishing within reporting period	P	D	P	P	D	D	D	D	D
Total # fails	10F	1F	13F	8F	4F	4F	1F	6F	13F
Total # data deficients	4D	14D	1 D	1 D	14 D	14 D	15D	11 D	5 D
Total # passes	4P	3P	4P	9P	0P	0P	2P	1P	0P
Population	**F**	**D**	**F**	**F**	**F**	**F**	**D**	**F**	**F**
Water quality	**F**	**P**	**F**	**F**	**D**	**D**	**F**	**F**	**F**

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

……..cont.

Appendix VI cont.

Catchment	Black-water Munster	Black-water Munster	Licky	Black-water Kerry	Black-water Kerry	Black-water Kerry	Cloon	Slaney - Derreen
Attribute	**Black-water Munster**	**Allow**	**Licky**	**Black-water Kerry**	**Dereen-daragh**	**Kealduff**	**Cloon**	**Derreen**
Mussels								
Density 1	F	D	F	F	D	F	F	F
Density 2	F	D	F	P	D	P	D	P
Numbers of live individuals	F	D	F	F	D	D	D	F
Numbers of dead shells	F	D	F	P	P	P	D	F
Age structure 1	F	D	F	F	D	P	D	F
Age structure 2	F	D	F	F	D	F	F	F
Age structure 3	F	D	F	F	D	P	D	F
Age structure 4	F	D	F	F	D	F	F	F
Water Quality								
Orthophosphate	F	F	F	P	F	F	F	F
Nitrate	F	F	F	P	P	P	F	F
Suspended Solids	D	D	D	D	D	D	D	D
BOD	F	F	F	P	F	F	F	F
Substrate Condition								
Siltation	F	D	F	F	D	P	D	F
Redox measurements	D	D	D	D	D	D	D	D
Plant Growth								
Filamentous algae	F	D	F	F	D	F	D	P
Macrophytes	F	D	F	P	D	P	D	F
Adjacent Land Use Issues	F	D	F	F	F	F	F	F
Evidence of pearl fishing within reporting period	D	D	P	F	P	P	D	P
Total # fails	15F	3F	15F	10F	5F	7F	7F	14F
Total # data deficients	3 D	15D	2D	2 D	9D	3D	11 D	2D
Total # passes	0P	0P	1P	6P	4P	8P	0P	2P
Population	**F**	**D**	**F**	**F**	**D**	**F**	**F**	**F**
Water quality	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**

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

……..cont.

Appendix VI cont.

Catchment	Suir - Clodiagh	Newport	Barrow - Mountain	Barrow - Mountain	Barrow - Ballymurphy	Owenmore	Dawros	Ownagappul	Ownagappul
Attribute	Clod-iagh	New-port	Augh-nabrisk y	Moun-tain	Bally-murphy	Owen-more	Dawros	Barrees	Owna-gappul
Mussels									
Density 1	F	F	D	F	F	F	F	F	F
Density 2	F	P	D	F	F	F	P	P	P
Numbers of live individuals	F	F	D	F	F	D	D	D	F
Numbers of dead shells	F	F	D	F	F	D	D	P	F
Age structure 1	F	F	D	F	F	D	D	P	P
Age structure 2	F	F	D	F	F	D	D	F	F
Age structure 3	F	F	D	F	F	D	D	P	P
Age structure 4	F	F	D	F	F	D	D	F	F
Water Quality									
Orthophosphate	F	F	D	F	D	F	F	D	D
Nitrate	F	F	D	F	D	P	P	D	D
Suspended Solids	D	D	D	D	D	D	D	D	D
BOD	F	F	D	P	D	F	P	D	D
Substrate Condition									
Siltation	F	F	F	F	F	D	D	F	P
Redox measurements	D	F	D	D	D	D	D	D	D
Plant Growth									
Filamentous algae	P	F	D	F	F	D	D	F	F
Macrophytes	P	F	D	F	F	D	D	P	P
Adjacent Land Use Issues	F	F	D	F	F	D	D	P	F
Evidence of pearl fishing within reporting period	P	P	D	P	P	D	D	P	P
Total # fails	13F	15F	1F	14F	13F	4F	2F	5F	7F
Total # data deficients	2 D	1 D	17D	2 D	5 D	13D	14D	6D	5D
Total # passes	3P	2P	0P	2P	1P	1P	2P	7P	6P
Population	**F**	**F**	**D**	**F**	**F**	**F**	**F**	**F**	**F**
Water quality	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**

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

Appendix VII

Comparison of abundance categories assessed in Ross (1988) with more recent surveys.

River	Grid Reference	Abundance Category 1988	More recent Abundance Category
Leannan	C1319	C	D
Leannan	C1622	R	D
Clady	B8323	A	C 2006
Owenea	G7893	A	R 2005
Newport	L9994	A	C 2005
Bunowen	L8181	C	D
Bundorragha	L8464	A	A 2005
Finny	M0159	R	D
Erriff	L9365	O	D
Dawros	L6959	A	D
Recess	L9040	C	D
Derryneen	L8947	A	D
Furbo	M1824	O	D
Cloon	R1761	A	D
Cloon	R1758	O	D
Owenmore	Q5111	A	C 1999
Owenascaul	Q5903	O	D
Cottoners	V7994	O	D
L. Acoose	V7685	R	D
Caragh Lake	V7188	C	D
Owenagappul	V6955	A	O 2005
Glengarriff	V9257	C	D
Lee	W3067	R	D
Lee	W2366	O	D
Blackwater	W4099	O	D
Blackwater	W3698	A	D
Clodiagh W	S4216	O	Ab 2006
Slaney	S8772	C	D
Erne	H5209	O	D

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

Summary Table

Number improved	0
Number unchanged	1
Number declined	7
Data Deficient	22

1029 Freshwater pearl mussel (*Margaritifera margaritifera*)

Data Comments/Guidelines for reporting data	
1. National Level	
Species code	1029
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole territory, but particularly the western third, south and south east.

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	Beasley, C.R. (1996) The distribution and ecology of the freshwater pearl mussel *Margaritifera margaritifera* L. 1758, in County Donegal, Ireland and its implications for its conservation. PhD Thesis, Queens University, Belfast. 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. (1995). *Mapping of proposed SAC rivers for* Margaritifera margaritifera. Volumes 1 & 2. Unpublished report for National Parks and Wildlife Service. 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.* 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 Owenriff River SAC, County Galway*. Unpublished report for National Parks and Wildlife Service. Moorkens, E. A. (2005a). *Monitoring Populations of the Freshwater Pearl Mussel. Baseline survey of the Newport River cSAC, County Mayo*. Unpublished report for National Parks and Wildlife Service. Moorkens, E. A. (2005b). *Monitoring Populations of the Freshwater Pearl Mussel. Baseline survey of the Bundorragha River cSAC, County Mayo*. Unpublished report for National Parks and Wildlife Service. Moorkens, E. A. (2005c). *Monitoring Populations of the Freshwater Pearl Mussel. Repeat survey of the Owenriff River SAC, County Galway*. Unpublished report for National Parks and Wildlife Service.

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Ross, E.D. (2004b) *A Pilot Project to Develop a Monitoring Protocol for the Freshwater Pearl Mussel* Margaritifera margaritifera *(L.) in the Caragh River, County Kerry, Ireland*. Internal National Parks and Wildlife Service Report.

Ross, E.D. (2005a) *Initiation of a monitoring program for the freshwater pearl mussel,* Margaritifera margaritifera *(L.) in the Licky River.* Internal National Parks and Wildlife Service Report.

Ross, E.D. (2005b) *Initiation of a monitoring program for the freshwater pearl mussel,* Margaritifera margaritifera *(L.) in the Ownagappul River.* Internal National Parks and Wildlife Service Report.

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	Ross, E.D. (2006d) *Report on searches for juvenile* Margaritifera margaritifera *(L.) in the Caragh River, Co. Kerry.* Internal National Parks and Wildlife Service Report. Ross, E.D. (2006e) *Report on searches for juvenile* Margaritifera margaritifera *(L.) in the Dereen River (Co. Carlow).* Internal National Parks and Wildlife Service Report. Ross, H.C. G. (1988) Aspects of the ecology of the freshwater pearl mussel Margaritifera margaritifera (L.) in NW Ireland, with special reference to life history strategy. M.Sc. Thesis, Queen's University, Belfast.
2.3 Range	
2.3.1 Surface area	14,200 km^2
2.3.2 Date	2006
2.3.3 Quality of data	2 (moderate)
2.3.4 Trend	0 (stable)
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	
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	2 (moderate)
2.4.5 Trend	-100%
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	3 (direct human influence)
2.4.9 Justification of % thresholds for trends	In 1994 there were 11 viable populations. By 2006 all 11 were considered un-viable.
2.4.10 Main pressures	101 Modification of cultivation practices 103 Agricultural improvement (for the same reasons) 110 Use of pesticides 120 Fertilisation 142 Overgrazing by sheep 143 Overgrazing by cattle 148 Overgrazing, general 150 Restructuring agricultural land holding 160 General forestry management (all aspects of forestry management) 171 Stock feeding 220 Leisure fishing

	240	Taking / removal of fauna
	300	Sand and gravel extraction
	301	Quarries
	310	Peat extraction
	330	Mines
	400	Urbanised areas, human habitation
	410	Industrial and commercial areas
	420	Discharges
	421	Disposal of household waste
	422	Disposal of industrial waste
	423	Disposal of inert materials
	500	Communications networks
	501	Paths, track, cycling tracks
	502	Routes, autoroutes
	507	Bridge, viaduct
	510	Energy transport
	530	Improved access to site
	600	Sport and leisure structures
	700	Pollution
	800	Landfill, land reclamation and drying out, general
	810	Drainage
	830	Canalisation
	840	Flooding
	850	Modification of hydrographic functioning
	853	Management of water levels
	860	Dumping, depositing of dredged deposits
	900	Erosion
	960	Interspecific faunal relations
	964	Genetic pollution
2.4.11 Threats	101	Modification of cultivation practices
	103	Agricultural improvement (for the same reasons)
	110	Use of pesticides
	120	Fertilisation
	142	Overgrazing by sheep
	143	Overgrazing by cattle
	148	Overgrazing, general
	150	Restructuring agricultural land holding
	160	General forestry management (all aspects of forestry management)
	171	Stock feeding
	220	Leisure fishing
	240	Taking / removal of fauna
	300	Sand and gravel extraction
	301	Quarries
	310	Peat extraction
	330	Mines
	400	Urbanised areas, human habitation
	410	Industrial and commercial areas
	420	Discharges
	421	Disposal of household waste

	422 Disposal of industrial waste 423 Disposal of inert materials 500 Communications networks 501 Paths, track, cycling tracks 502 Routes, autoroutes 507 Bridge, viaduct 510 Energy transport 530 Improved access to site 600 Sport and leisure structures 700 Pollution 800 Landfill, land reclamation and drying out, general 810 Drainage 830 Canalisation 840 Flooding 850 Modification of hydrographic functioning 853 Management of water levels 860 Dumping, depositing of dredged deposits 900 Erosion 960 Interspecific faunal relations 964 Genetic pollution 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	- (net loss)
2.5.6 Trend-Period	1994-2006
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	14,200 km^2
2.7.2 Favourable reference population	11 Viable Populations
2.7.3 Suitable Habitat for the species	Unknown

2.7.4 Other relevant information

The units of population used in this assessment were the number of viable populations.

A *Margaritifera margaritifera* **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. A population, therefore, could occupy a river and its tributaries and associated lakes. Fragmented groups of mussels within a catchment that were separated by significant distances or barriers, e.g. a large lake or a main river channel, have been considered as separate populations.

Whether or not a *Margaritifera margaritifera* population was **viable** was determined by a series of population structure parameters which formed the basis of the *M. margaritifera* 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.

A *Margaritifera* population will be considered to be in decline where the range/ area of occupancy of that population is constricting, i.e. all stretches of rivers, tributaries and lakes that contain mussels must continue to maintain themselves on a long-term basis.

The total number of extant populations is 93, but all 93 are considered to be un-viable.

Six populations have been documented as becoming extinct pre-1970

The most recent population estimate of *Margaritifera margaritifera* adult individuals in Ireland (2006) is 12,000,000, based on a total of 8,151,690 from 20 rivers that have had full surveys and an estimated average of 33,000 individuals per river for the remaining 119 unsurveyed rivers (including 15 SACs not yet counted). In spite of having a large minority (up to 46%) of the EU's adult pearl mussels, and thus holding international populations of the utmost importance, recent habitat declines have led to an almost total collapse in pearl mussel reproduction.

The habitat for the species is currently unsuitable for the survival of adult mussels and/or the recruitment of juveniles owing to siltation of the substratum and poor water quality. 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.

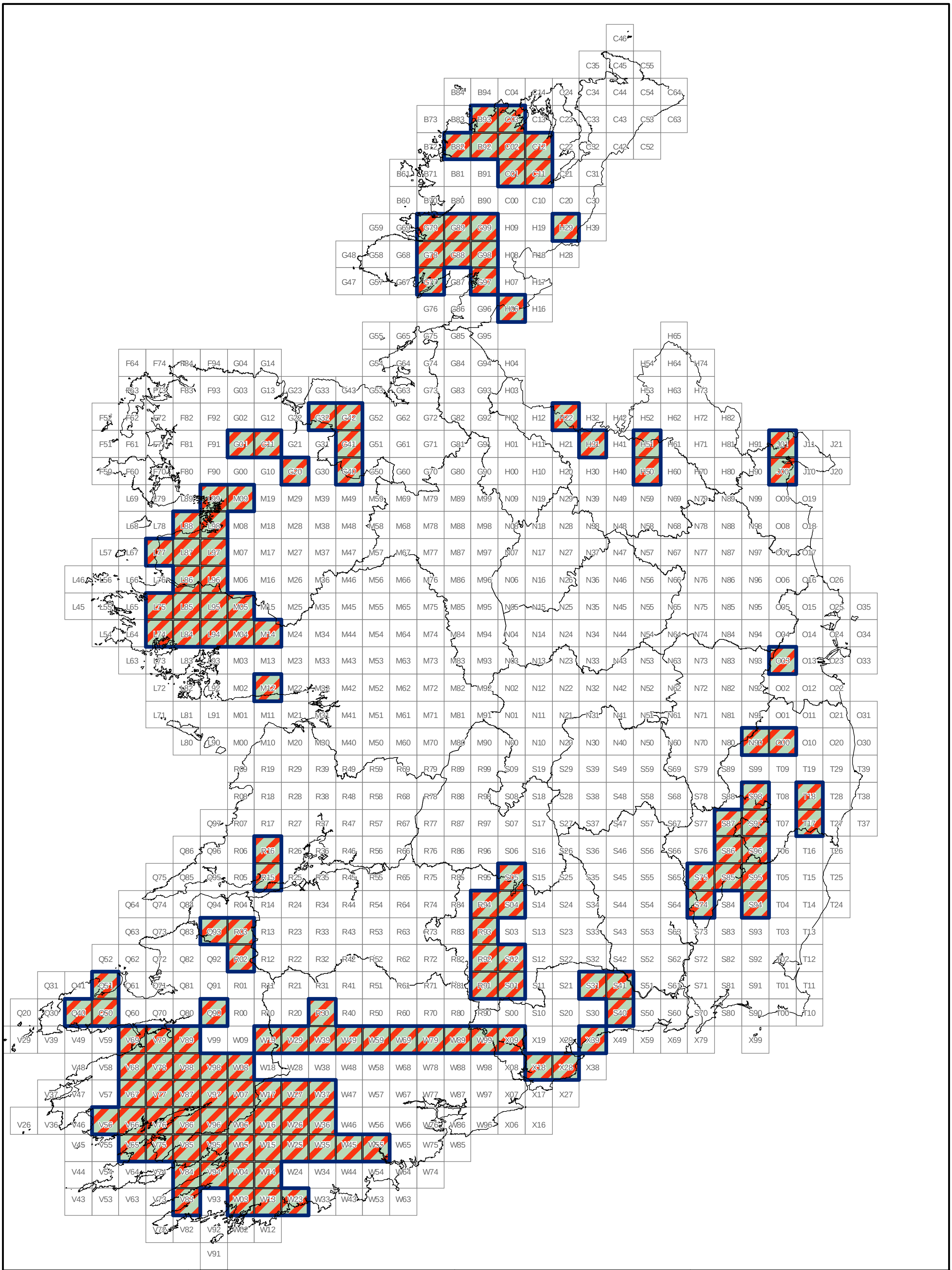
These three are determined by flow and substratum conditions and cannot readily be estimated. As a result, the area of "Suitable Habitat for the Species" is currently unknown.

The conservation of habitat for *Margaritifera* depends on maintaining the river habitat, and the surrounding bank side habitat. The terrestrial habitat surrounding both banks of *Margaritifera* rivers is very important. Sustainable populations of pearl mussels require unimproved catchments that export only natural background levels of silt and nutrients. Thus, 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:

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 margaritifera* is listed as **critically endangered** in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs (Moorkens, 2006d).

2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable
Population	Unfavourable – Bad
Habitat for the species	Unfavourable – Bad
Future prospects	Unfavourable – Bad
Overall assessment of CS[1]	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 margaritifera

1029

Current Distribution (142 cells)
Current Range (142 cells)
Favourable Reference Range (142 cells)
W48 10km grid cells

Date: August 2007

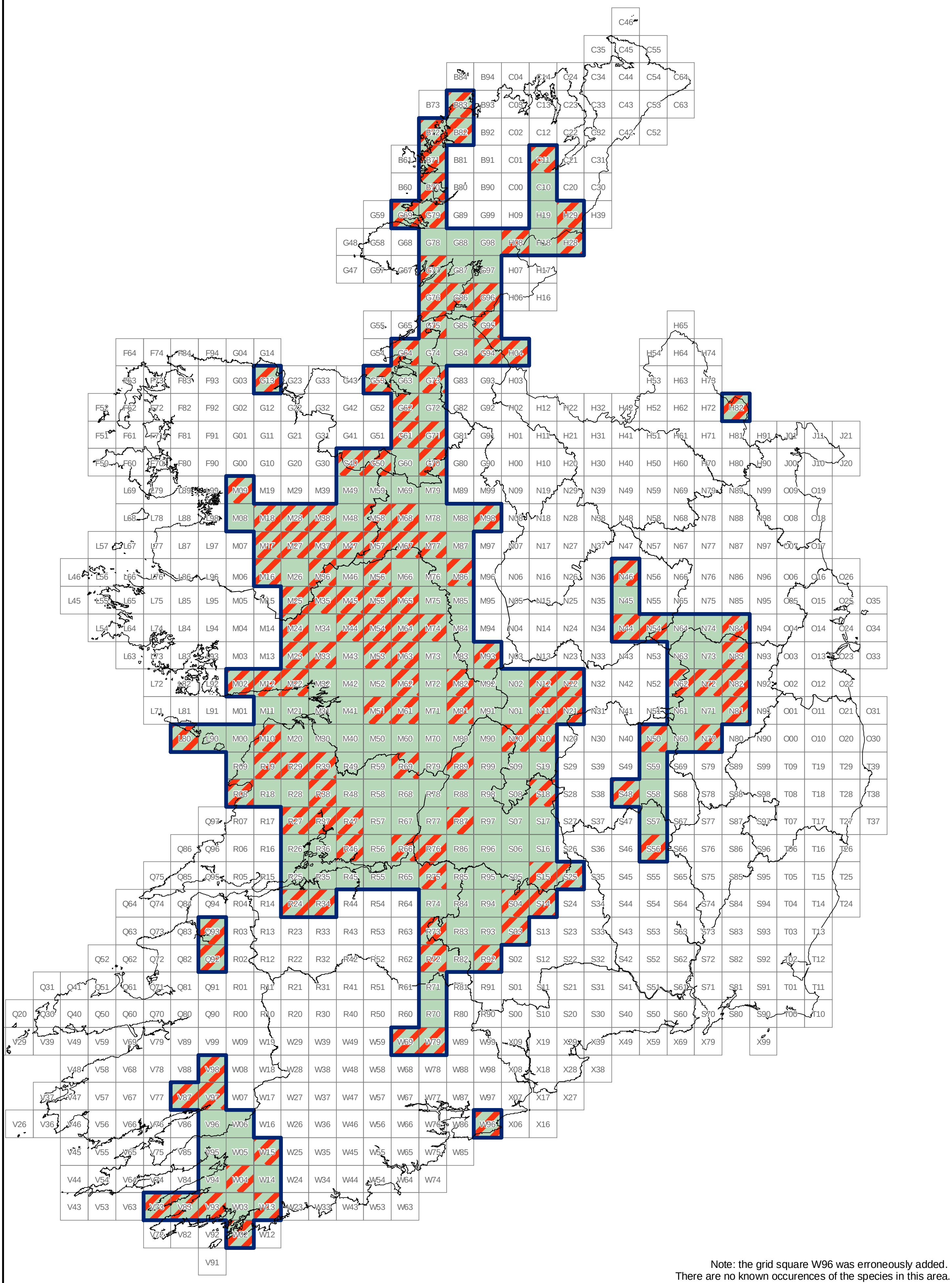
1065 Marsh Fritillary (*Euphydryas aurinia*)

1. National Level	
Species code	1065
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.nbn.org.uk/
2.3 Range	
2.3.1 Surface area	25,300 km²
2.3.2 Date	1997-2007
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	1995-2007
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	48 core 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	2 = moderate
2.4.5 Trend	– = net loss by 0.04% (2.4.6) loss of 2 core populations
2.4.7 Trend-Period	1995-2006
2.4.8 Reasons for reported trend	Assumed main reasons for change of populations where known 3 = direct human influence (restoration, deterioration, destruction)
2.4.9 Justification of % thresholds for trends	Using 1% per year when assessing trends
2.4.10 Main pressures	141 abandonment of pastoral systems 502 roads, motorways 400 Urbanised areas
2.4.11 Threats	141 abandonment of pastoral systems 400 502 roads, motorways Urbanised areas
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	NA
2.5.4 Quality of data	NA
2.5.5 Trend	Stable (losses & gains likely)
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? 2 = poor prospects

2.7 Complementary information	
2.7.1 Favourable reference range	25,300 km²
2.7.2 Favourable reference population	50 core populations
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	The food source for the larvae, *Succisa pratensis*, is widespread in Ireland. This species occurs in a variety of habitats, including areas dominated by bare peat. There is evidence that ground disturbance through burning or other activities is beneficial for this species. Although there is likely to be enough habitat for the species to occupy, the quality of the habitat is declining due to inappropriate management.
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)



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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Euphydryas aurinia

1065

- Current Distribution (133 squares)
- Current Range (253 squares)
- Favourable Reference Range (253 squares)
- W48 10km grid squares

Date: October 2007

CONSERVATION ASSESSMENT OF THE WHITE-CLAWED CRAYFISH Austropotamobius pallipes (Lereboullet, 1858) IN IRELAND.

Report to NPWS by Julian D. Reynolds, May 2007

OUTLINE:

1.0 Ecology of the White-clawed Crayfish in Ireland

The White-clawed Crayfish, *Austropotamobius pallipes* (Lereboullet), is a species complex extending from Spain to Italy and Croatia, north to Switzerland, Austria, western Germany, France, the U.K. and Ireland (Souty-Grosset *et al.* 2006). *A. pallipes pallipes* is a relatively uniform northern taxon of France, the U.K. and Ireland, where it was first reported in 1680 (Lucey 1999). It is most commonly found in first-order streams, but it finds its greatest ecological expression in Ireland, where it occurs in small and medium-sized lakes, large rivers, streams and drains wherever there is sufficient lime (Lucey and McGarrigle 1987, Reynolds 1978, 1982, 1997, 1998, Reynolds and Demers 2006, Gallagher *et al.* 2006). Elsewhere in its range, it may be restricted to upper courses by interactions with other indigenous decapods (e.g. *Astacus astacus* in France). However, for the past century it is becoming restricted to headwaters through disease transmitted by introduced American crayfish which are now spreading across Europe, chiefly *Pacifastacus leniusculus* – the Signal or Californian Crayfish; *Orconectes limosus* – the American or Spiny-cheeked Crayfish, and *Procambarus clarkii* – the Louisiana or Red Swamp Crayfish (Souty-Grosset et al. 2006). The impact on *A. pallipes* is well documented for the U.K. and France (e.g. Holdich *et al.* 1999).

Often considered as a biological indicator species of good quality waters (e.g. Grandjean et al. 2003), there is growing recognition that *A. pallipes* can occur in water of lower quality, down to a Q value of around 3 or an ASPT of 4 (Demers and Reynolds 2002, 2003, Gallagher et al. 2006). It is now generally considered as a keystone or heritage species rather than as a bioindicator (Reynolds and Souty-Grosset 2003, Füreder and Reynolds 2003, Howells and Slater 2004), because of its traditional importance and its large size (to around 11 cm total body length), longevity (at least 10 years) and dominant position in the ecosystem (Matthews and Reynolds 1992). The species is omnivorous, with juveniles more reliant than adults on animal foods (Reynolds and O'Keeffe 2005). Indicating its keystone status, *A. pallipes* had a marked impact on stands of charophytes and on most macroinvertebrates in caged experiments in an Irish lake (Matthews, Reynolds and Keatinge 1993).

The species prefers relatively cool temperatures and adequate dissolved oxygen and lime, although tolerating significant fluctuations in these parameters (Lyons and Kelly-Quinn 2003, Demers *et al.* 2006, Reynolds *et al.* 2002, Trouilhé *et al.* 2006, Souty-Grosset *et al.* 2006 Chapter 2). However, crayfish are susceptible to some pesticides and to certain organic compounds in water (Trouilhé *et al.* 2006) and periodic discharges from sewage treatment plants have been suggested as leading to its elimination from much of the lower Liffey (Demers and Reynolds 2002).

Habitat heterogeneity is important (Smith *et al.* 1996); juveniles live among submerged tree roots, gravel or macrophytes, while larger crayfish must have stones to hide under, or an earthen bank in which to burrow (Holdich and Rogers 2000, Demers *et al.* 2003, Gallagher et al. 2006). Brooding females in particular require undisturbed shelter over a prolonged winter-spring period.

2.0 Methodology: Mapping Assessment Data

2.1 Distribution

There have been many surveys reporting crayfish in Ireland (Appendix 6). The Irish distribution of *A. pallipes* was first summarized by Thompson (1843) and, more recently, described by Reynolds (1978, 1982). It was first mapped in detail by Lucey and McGarrigle (1987) using records chiefly from 1976 on, and later by Holdich *et al.* (1999), building on and updating the former. Both drew heavily on the river water quality monitoring surveys, carried out over a three year cycle, of the Environmental Protection Agency (EPA) and its antecedents the Environmental Research Unit and An Foras Forbartha. EPA monitoring results from 1990 on provided most of the data for the last published Irish database and map (Demers *et al*. 2005), which was also used in the *Atlas of Crayfish in Europe* (Souty-Grosset *et al*. 2006). These data and others were compiled in a NPWS database containing some 983 records mostly from 1991-2003, but some stretching back to 1984.

For the current data set, Drs Kevin Clabbey, John Lucey and Martin McGarrigle kindly provided 6-figure coordinates for some 344 positive records from the EPA's current round of monitoring (2004-2006). These, together with 103 positive recent records (2005-2006) out of 277 data records from Central Fisheries Board surveys provided by Dr Jimmy King and a smaller number of river and lake records from Julian Reynolds and other sources, were compiled to make up an overall current database of about 496 recent records of crayfish for the period 2004-2006, which was used to describe the current distribution of White-clawed Crayfish in Ireland. The results of different sampling campaigns generally concurred; although the EPA found crayfish in stretches where they were considered to be absent by Demers and Reynolds (2003), while the CFB turned up crayfish in some stretches considered devoid of crayfish by EPA sampling. Note that the sampling methodology used was generally not crayfish-specific; not all surveys at some sites were positive and repeatable; thus sites where crayfish were not recorded may represent sampling error rather than population loss.

This current crayfish distribution data was mapped using ArcView GIS 3.2, and compared with all records on the NPWS (National Parks and Wildlife Service) database of earlier crayfish records. In each case where older records did not match current records, all mis-matched records were evaluated by date and river system. Where there were only older records, at least 5 km distant from current records, these were deleted from the current distribution. Preliminary maps were created and circulated to field staff for comment, and updates incorporated in the final data set.

2.2 Range

In Ireland, White-clawed Crayfish may occur both in large rivers and small headwater tributaries, as well as in lakes. The EPA records are for sites several kilometres apart, leaving intervening stretches uninvestigated, but the CFB records for selected river systems are often grouped within 100-500 m of each other, and serve to demonstrate good crayfish populations throughout a stretch between EPA sites. Stretches of watercourse with contiguous positive records were selected and highlighted. The combined data allowed rivers where crayfish are known or reliably considered to occur to be mapped and their lengths measured. However, the data does not provide enough information particularly about the smaller water-courses. To allow for their probable presence in tributary streams, all 10 x 10 km grid squares which included a recent positive sighting or presumed presence were selected. The Irish 10 km^2 grid and Ordnance Survey watercourse distribution was overlaid with these crayfish records to show the overall envelope within which areas actually occupied occur (EC 2006). The range outline was then drawn following IUCN Guidelines. The resulting polygon was the smallest polygon achievable using a minimum of 90^o angles, that contained all known crayfish sites. Areas of unsuitable habitat within the envelope were left uncoloured. A maximum of three adjacent non-occupied grid squares was allowed to be included within the polygon.

To create the favourable reference range, all areas noted as occupied by crayfish in the NPWS database (chiefly since the early 1990s) were included in the envelope, and a polygon again drawn following the same rules.

2.3 Habitat

Crayfish require moderate to good water quality (less than 10% of records were from moderately polluted stretches, Q3 or lower), slow to moderate current and a heterogeneous habitat with different types of shelter (Foster 1993, Naura and Robinson 1998, Smith et al. 1996, Demers *et al*. 2003, Gallagher *et al*. 2006, Souty-Grosset *et al*. Chapter 2; see also Appendix 8). As crayfish do not migrate to breed, the habitat used by adult and juvenile crayfish for foraging, shelter and breeding is considered to be identical with the range demonstrated by sampling.

As fewer than 1% of sites positive for crayfish were assessed as having water quality Q values less than 3, streams with Q<3 were deemed unsuitable habitat for crayfish. However, only short stretches of most Irish rivers are in this category in EPA datasheets and compilations (e.g. Toner *et al.* 2005); e.g. in the Maigue system only one of 8 negative sites was below Q3 (Appendix 8.1).

3.0 Results

3.1 Current Range

The envelope containing all grid cells with positive current records for White-clawed Crayfish in Ireland is shown in Appendix 1. The current polygon was calculated as 291 10 km grid squares, including small areas unsuitable or formerly present, and involving an estimated 2,650 km of water-courses, excluding smaller tributaries (Appendix 2).

The current range of White-clawed Crayfish in Ireland spans most of the Irish lowlands overlying either Palaeozoic limestone rock or lime-rich glacial deposits, and includes 17 of the 36 Hydrometric Areas in the country (Appendix 3). It extends from South Donegal and the north midlands (Erne system) to Limerick, Cork and Waterford (Maigue, Awbeg and Suir systems), and from the Corrib in the west to the Boyne and Liffey systems in the east. However, crayfish are absent from acid Palaeozoic rocks, as in Wicklow, Kerry, Connemara and west Donegal, as well as from most of Northern Ireland. There are a few disjunct squares. Most of County Clare, while suitable for crayfish, lacks populations, and the outlier in the Castlelodge River in mid-Clare may be an introduction. There are two squares in north-western Mayo which have always been disjunct (Demers *et al.*, 2006) and one in south Donegal which abuts onto suitable habitat in Northern Ireland.

3.2 Range Conservation Status

The Favourable Reference Range (FRR) for the White-clawed Crayfish in Ireland takes in areas considered to be suitable for the species, and includes all 10 km squares where the species has been recorded in the recent past (some records from 1984; most since 1991) (Appendix 3). It is calculated at 334 10 km squares. The current distribution represents a 13% decrease on this figure. However, as the field survey methodology used was generally not crayfish-specific, sites where crayfish were not recorded may represent sampling error rather than population loss. There has been some diminution in the range of this species in the last 50 years, believed owing to one or more outbreaks of Aphanomycosis (crayfish plague) in the 1970s (Reynolds 1988, Matthews and Reynolds 1992, Demers and Reynolds 2002), to decreasing water quality (Demers and Reynolds 2003, Lyons and Kelly-Quinn 2003) and to habitat loss through arterial drainage (McCarthy 1977, Lucey and McGarrigle 1987). There is also evidence that crayfish populations are not static, but are currently returning to some decimated areas (e.g the Boyne catchment, Appendix 8.3) while being lost from others (e.g. the Nore catchment, Sweeney 2006).

Because the current range represents a decrease on the favourable reference range, the assessment is **Unfavourable Inadequate.**

4.0 Population

4.1 Population Estimates

Most information on crayfish occurrence is derived from a single site visit, using one or more of a variety of sampling methods. The EPA sampling protocol involves a site visit every three years and includes 2 minutes pond net sweeping over a variable extent of substrate. CFB sampling protocols varied depending on the monitored species and desired outcomes, and included trapping, fyke-netting, electro-fishing and sweep-netting, all of which would yield crayfish as by-catch but with different levels of catch per unit of effort (CPUE). Demers and Reynolds (2002, 2003) used a 15 minute netting and crayfish-specific hand-search at each site, while in other surveys (e.g. Byrne et al. 1999, Cullen et al. 2003), a fleet of traps was set, stones were turned or hand nets used. Crayfish taken by sweep-nets and stone turning often include juveniles and sometimes berried females, while trapping yields only adults. The EPA database recorded crayfish abundance or class size and life stage for some sites, e.g. juveniles were recorded for streams in the Awbeg, Barrow, Boyne, Deel, Maigue, Nore, Shannon and Suir catchments.

Numbers and sizes of crayfish encountered varied from one or two up to more than forty, chiefly juveniles. From literature, it is likely that favourable habitat patches shelter some 10 – 20 crayfish per square metre. With current information, no reliable estimates can be made of the size of crayfish populations in Ireland. Population estimates, based on Category D (number of localities) indicate that crayfish populations currently occur in some 23 localities (catchments or sub-catchments separated by physical barriers).

No ongoing surveillance of breeding crayfish has been made in the wild in Ireland. In most surveys, breeding crayfish and early juveniles are found more by accident than intention. As adults and juveniles prefer somewhat different habitat types, both may not be found together in a sample (Demers *et al.* 2003). In most samples sex ratios were close to parity, although in populations studied by trapping, proportions of males exceeded females (see also Gallagher *et al.* 2006). In a studied lake, all mature females were mated and spawned, but not all males participated (Woodlock and Reynolds 1988a, 1988b), suggesting dominance hierarchies operating (Reynolds *et al.* 1992). It is therefore assumed that most or all mature females breed every year in Irish White-clawed Crayfish populations, and that sex ratios are appropriate. There is no evidence to support the idea that a population may be present, but not breeding successfully.

4.2 Population Trends

There is insufficient detailed information to indicate overall population trends at present. Using locality as an indicator of population, crayfish were known from some 24 sub-catchments in the recent past (since 1990). While routine sampling will not always reveal known populations, there is some evidence that not all White-clawed Crayfish populations may be stable (see, e.g., Demers *et al.* 2005). Crayfish were noted to have disappeared from upper reaches of the Erne, to reappear some years later (Faris 1936). In the Boyne, stocks now appear to be slowly recovering following catastrophic loss some

20 year earlier (Demers and Reynolds 2003). There has been some demonstrable diminution in the range of this species in the last 50 years. Crayfish disappeared from certain lakes in the 1980s, notably White Lake (1985), Lough Bane (1986), Lough Owel (1986) and Lough Lene (1987) in the headwaters of the Deel (Boyne) and Inny (Shannon) catchments (Reynolds 1988, Matthews and Reynolds 1992). This is believed to be as a result of an outbreak of crayfish fungal plague (Aphanomycosis) in the 1980s, the spores introduced perhaps by visiting anglers. The disease spread through the Inny and Boyne systems, eradicating known populations. Other population losses have been attributed to local pollution or to deteriorating water quality conditions, e.g. in Pallas Lake, last seen in 1967 (Lucey and McGarrigle 1987); the Lower Liffey and Eastern Multeen (Demers and Reynolds 2002, 2003), and some Nore tributaries (Lyons and Kelly-Quinn 2003). There have been periodic unexplained crayfish mortalities in Lough Owel, most recently in about 2003, but crayfish are still present there (T. Finnen, pers. comm). There are no current crayfish records from the Nenagh, Eslin and Rinn Rivers and fewer than formerly in the Little Brosna and Clare Rivers and in tributaries of the Moy and Nore catchments (Sweeney 2006). While losses may occur rapidly, recovery is much slower for this long-lived, late-breeding species than for most macroinvertebrates which have seasonal or circum-annual life cycles. However, since crayfish-specific methods have not so far been widely used in Ireland; current knowledge may reflect to some extent both patchiness of populations and the sampling methods and conditions when a site is surveyed.

4.3 Population Conservation Status

White-clawed crayfish are widespread across much of Ireland, and over time and given suitable conditions, the populations are envisaged to spread and recolonise areas from which they appear to have been lost. Therefore, it may appear that the population status is favourable. However, the "Explanatory Notes and Guidelines" for Article 17 reporting state that "*favourable reference value must be at least the size of the population when the Directive came into force*". Since there were 24 localities positive for crayfish when the

Directive came into force, and as the current population estimate is 23, the population attribute must be assessed as **Unfavourable inadequate.**

5.0 Habitat

While the White-clawed Crayfish is relatively tolerant of less than pristine water quality, population disappearances have been documented in systems where quality has deteriorated from Q3-4 to Q3 (Lyons and Kelly-Quinn 2003) or an ASPT below 4. The habitats and conditions used by the White-clawed Crayfish, present to some degree in most lowlands Irish water-courses, are:

- Stream bank, suitable for burrowing
- Tree-roots
- Cobble and stones
- Aquatic vegetation, particularly *Fontinalis antipyretica*, *Rorippa nasturtium-aquaticum* and *Apium nodiflorum* in streams, and charophytes in lakes.
- Water quality of Q3 and above, pH generally 7.0 and above, adequate lime, and cool temperature (below 20^{o}C).

Evidence for the correlation between presence of White-clawed Crayfish in a water body and availability of suitable habitat is, however, not absolute – while crayfish are most abundant in a heterogeneous habitat with some cobble, stretches of water that appear deficient in suitable shelter may still hold good stocks as long as water quality is reasonably good (Appendix 8.2). Crayfish may therefore occur in a wider range of habitats than those listed here, or may move between most favourable habitat patches, so a definition of stretches with most suitable habitats is not relevant or possible here. However, many streams with apparently suitable habitat do not contain crayfish – e.g. much of County Clare. Streams with pH <6.5 and insufficient lime lie mostly outside the favourable distribution envelope, e.g. in County Cork.

5.1 Habitat Conservation Status

White-clawed Crayfish can occur in Ireland in suitable large rivers (e.g. Suir, Barrow) and moderate sized lakes (e.g. Lough Owel, 9500 ha, Lough Lene, 400 ha) as well as small streams. This is unlike the situation elsewhere in its European range, where the species is largely restricted to headwater first-order streams. Even where shelter and substrate appears unsuitable, crayfish may be concentrated in suitable habitat pockets, moving out after dark to forage more widely. Water temperature is generally favourable (below 20^{o}C) in Ireland, but should be monitored in the current scenario of climate change. Organic compounds in effluents also need monitoring (Trouilhé et al. 2006).

While habitats needed by the White-clawed Crayfish are taken as being present across its total range, there is opportunity for improvement, e.g. in materials and methodology used in construction of retaining banks, river crossings and other works (e.g. Peay 2003). In addition, the maintenance of long-term water quality is important. Macroinvertebrate water quality may not continue to show signs of adverse impacts more than a season later, but as crayfish are long-lived and slow to breed, they are better monitors of long-term status than are other determinants.

Because suitable habitat occurs throughout the favourable reference range of the crayfish, the assessment of the area of suitable habitat is **Favourable.**

6.0 Future prospects

Current negative impacts and pressures are relatively minor, but not entirely understood. The future of the White-clawed Crayfish in Ireland is most likely to be stable under current and future environmental controls, provided that no alien crayfish species are introduced.

6.1 Negative Impacts / Pressures and Threats

Negative impacts and threats are discussed below under three main headings, with Natura codes where applicable:

I. Loss of water quality. Occasional discharges from industry or waste treatment plants may eradicate the crayfish from stretches of river which appear suitable, and natural repopulation this long-lived, slow-growing species will be very slow. Main impacts are:

- 420: Discharges: e.g. 421 sewage effluent, 422 Industrial discharges, also 701 organic compounds in water, now believed to be a significant negative factor influencing crayfish distribution (Trouilhé et al. 2006)

- 310, 330: mining may release heavy metals, while peat extraction leads to silt sedimentation and degrades stream bed habitat

II. Loss of habitat quality. Any disturbance of the substrate will dislodge large numbers of crayfish, for example:

- 140 cattle watering, trampling (Williams 2006 reports mortality consequent on cattle trampling).

- 502 infrastructural development, notably road building and weir construction, releasing silt and reconstructing streambed and bank habitats.

- 810, 820, 830 alteration of stream morphology by canalisation and dredging

- 952 eutrophication of lakes and rivers

III. Angling, leisure and introductions.

- 220, 690 increased recreational fishing

- 954 introduced species:

    - invasive pondweeds, fish species, changing interspecific relationships

- invasive Ponto-Caspian invertebrates e.g. *Dreissena* (zebra mussel), *Corophium* etc.
- 963 disease from introduced North American crayfish.

The last is the most serious single threat facing the White-clawed Crayfish. Ireland is now the only European country without non-indigenous crayfish species, all of American origin carrying crayfish plague lethal to the White-clawed Crayfish (see Matthews and Reynolds 1990, Souty-Grosset et al. 2006). There is a long history of crayfish transfer by humans (e.g. Henttonen and Huner 1999, Souty-Grosset *et al.* 2006 Chapter 4). The U.K. currently has six alien crayfish species, and their White-clawed Crayfish stocks are in strong decline. It is important to advise the public about the dangers of releasing non-indigenous crayfish species into the freshwater environment anywhere on the island of Ireland, as many water-courses interconnect and alien, plague-carrying crayfish could spread rapidly and eradicate the White-clawed Crayfish from most of its Irish range.

6.2 Positive Impacts

In addition to direct measures, a number of programmes and initiatives are now operational or in development in Ireland, that should in theory have a positive impact on available habitat for crayfish.

I. Legislation: The White-clawed Crayfish is protected under national and international legislation; the Wildlife Acts (1976, 2000) and Habitats Directive. The latter, which specifically protects the White-clawed Crayfish in Annex II, is transposed into Irish Law in the European Communities (Natural Habitats) Regulations (S.I. 94 of 1997). The Habitats Directive requires protection for the habitats of crayfish as well as the crayfish themselves.

II. Reserves: Under Annex II, each member state must designate Special Areas of Conservation for the White-clawed Crayfish. Ireland to date has 13 SACs designated for this crayfish, assigned population code C in each case (Appendix 5). These cover some

850 km of river and lakeshore, i.e. around 30% of river length containing crayfish, and an unknown but perhaps equivalent proportion of the lakes. These estimates suggest that perhaps one quarter to one third of the national stock of White-clawed Crayfish is protected within these Special Areas of Conservation in Ireland.

III. Management and Reintroduction: The White-clawed Crayfish has been successfully reintroduced to White Lake (Reynolds et al. 2000), and re-introductions are planned for other SACs. Re-introduced stocks flourished in L. Lene for a decade (Reynolds and Matthews, 1997) before their abrupt disappearance.

IV. Other measures:

- Water Framework Directive, requiring monitoring and improvement of water quality on a catchment by catchment basis.
- The ongoing Water Services Investment Programme is providing waster water collection and treatment infrastructure to secure compliance with the Urban Waste Water Treatment Directive and other Directives
- Agricultural measures: The EC Single Farm Payment and enlargement of the national Rural Environmental Protection Scheme (REPS 4) are both likely to lead to some improvements in water-course quality.
- Forestry management measures: Coillte has established Biodiversity areas - Forestry Management units (FMUs) to be managed with nature as a primary objective – which may have a positive impact on crayfish populations in certain catchments.

6.3 Future Prospects Conservation Status

Despite some declines in range over the past decade, resulting in an unfavourable Conservation Status (current range 87% of favourable range), and an array of pressures and threats, the current range and population structure is not in strong decline and may be quasi-stable .

Sampling methodology and conditions do not always reveal crayfish presence, but the increasing use of crayfish-specific sampling methodology has revealed more populations and will improve our detailed knowledge. Habitat quality may be improved, allowing stronger populations.

From the analysis in Table 1, the overall Conservation Status for future prospects of the White-clawed Crayfish in **Unfavourable – Inadequate**, due to the reduction of range and locality number and the continuing pressures.

ATTRIBUTE	OVERALL ASSESSMENT
Range	**Inadequate (U1)**
Population	**Inadequate (U1)**
Habitat for the species	**Inadequate (U1)**
Future prospects	**Inadequate (U1)**
Overall assessment of CS[1]	**Inadequate (U1)**

[1] A specific symbol (e.g. arrow) can be used in the unfavourable categories to indicate recovering populations

Appendix 1 Current distribution and range of White-clawed Crayfish in Ireland (2006) [map, see above]

Appendix 2 Current distribution and range of White-clawed Crayfish in Ireland – Rivers where species is currently present (2006) [map, see above]

Appendix 3 Current distribution and range versus favourable range of White-clawed Crayfish in Ireland [map, see above]

Appendix 4 Status of crayfish stocks in catchments (Hydrometric Areas) and localities (sub-catchments) in the Republic of Ireland containing Crayfish

Appendix 5 Special Areas of Conservation (SACs) designated for White-clawed Crayfish in Ireland, with current status of crayfish stocks

Appendix 6 Surveys of White-clawed Crayfish in Ireland

Appendix 7 References

Appendix 8 Analysis of some current crayfish records mentioned in text.

1. A typical catchment with good crayfish distribution – the Maigue
2. Correlates of crayfish presence and water quality and speed – Erne catchment
3. Recovery of decimated crayfish stocks – Boyne catchment
4. Reassessment of eight previously studied catchments
5. Patchy distribution of crayfish – the Shannon system

Appendix 4
Status of crayfish stocks in catchments (Hydrometric Areas) and number of localities (sub-catchments) in the Republic of Ireland containing crayfish

[1 - 2. Derry, Tyrone]
3. Bann – Monaghan Blackwater (1 locality; no current records)
[4 - 5. Antrim, Down]
6. Dee (two current records) (1 locality)
7. Boyne and tributaries (sporadic), including Kells Blackwater and Moynalty (patchy) (1 locality)
[8. N Dublin]
9. Liffey, including Rye Water, Morell; Camac (widespread in upper courses over limestone) (2 localities)
[10 - 11. E Wicklow, Wexford]
12. (Slaney - older records)
[13. S Wexford]
14. Barrow (widespread) (1 locality)
15. Nore (stocks apparently diminishing in upper mainstem and Goul, Gully and Erkina tributaries) (1 locality)
16. Suir (widespread), Clodiagh, Pollanassa (3 localities)
[17. Coastal Waterford]
18. Awbeg tributary of Munster Blackwater (widespread) (1 locality)
[19. Lee]
[20. Bandon]
[21– 23. W. Cork, Kerry]
24. Maigue (widespread); Deel (two current records) (2 localities)
25. Lower Shannon (patchy in Mulkear, Little Brosna and Brosna tributaries) (1 locality)
26. Upper Shannon (patchy in Suck, Inny, Camlin and smaller tributaries) (same 1 locality)
27. Castlelodge (one current record) (1 locality)
[28. West Clare]
29. Kilcolgan. Boleyneendorrish. Clarinbridge (3 localities)
30. Corrib – Mask: Robe and Sinking Rivers (sporadic in Clare R.) (1 locality)
[31. Connemara]
32. Carrowbeg (Westport) (1 locality)
[33. NW Mayo]
34. Moy (patchy stocks related to geology, in Deel, Glore, Pollagh. Good stocks in L. Talt) (1 locality)
35. Sligo – Owenmore, Bonet (patchy stocks) (2 localities)
36. Erne – headwaters and some tributaries, including Termon (L. Nageage, Veenagrene) (1 locality)

Appendix 5
Special Areas of Conservation (SACs) designated for White-clawed Crayfish (Natura Code 1092) in Ireland, with current status of crayfish stocks

Site Code	Name of SAC	Hydrometric Area	Crayfish Status	Salmonid water
297	L. Corrib	30	Present 2005	Y
633	L. Hoe Bog (L. Talt)	34	Good stocks 2006	
1404	Upper Bonet R	35	Present 2006	
1786	Kilrooskey Lough Cluster	36	Good stocks 2006	
1810	White L., Ben Loughs, L. Doo	07/25-26	Reintroduced	
1919	Glenade Lough	35	Present Bonet R 1997	
1976	L. Gill	35	Present Bonet R 1997	
2120	L. Bane, L. Glass	07/25-26	Extinct 1987	
2121	L. Lene	07/25	Reintroduced; Extinct ca. 2005	
2135	L. Nageage	36	Present ca 2000	
2137	Lower R Suir	16	Present 2006	
2162	R. Barrow, R. Nore	14, 15	Present 2006	Y
2170	R. Blackwater (Awbeg R)	18	Present 2006	Y
2298	R. Moy	34	Present 2006	Y

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Appendix 8
Analysis of current crayfish records

8.1. A typical catchment with good crayfish distribution – the Maigue

The Maigue system (1100 sq. km) drains into the Shannon estuary and is relatively isolated by geography from other river systems. It is tidal to Adare.

All tributaries had positive sites if Mahore and Camoge are considered a single tributary system, for a total of 19/27 sites (70%).

Tributary; No. positive/total sites:
Camoge 4/4
Charleville 1/3
Flemingstown 1/1
Loobagh 4/5
Mahore (upper Camoge) 0/2
Maigue 5/6
Morningstar 4/6

Q characteristics: All but one negative sites had a Q value of 3 or above. The Maigue is chiefly lowland-draining, but through arterial drainage, is moderately fast-flowing at many sites. It drains agricultural areas and a number of towns (Bruff, Charleville, Croom, Kilmallock) but crayfish populations appear good.

8.2. Correlates of crayfish presence and water quality and speed – Erne catchment

Erne Catchment: 14 tributary streams, with a total of 34 positive sites out of 77 (48%).

Tributary; positive/total sites:
Annalee 2/12 sites
Araghan 1/2 sites
Bunnoe 3/4 sites
Cavan 1/4 sites
Cullies 4/6 sites
Dromore 2/10 sites
Erne 8/10 sites
Finn 6/6 sites
Knappagh 1/3 sites
Lahan Stream 1/2 sites
Laragh 2/5 sites
Madabawn Stream 1/3 sites
Magherainey 1/2 sites
Stradone 1/2 sites

Water Quality x	Pos. sites =	SCORE	Neg. sites	SCORE
4-5 :	3	13.5	1	4.5
4 :	17	68	11	44
3-4 :	10	35	16	56
3 :	3	9	6	18
2-3 :	0	0	5	5
Sum, mean score	33	3.8	36	3.5

Water quality is slightly higher for crayfish sites than for negative sites. Crayfish not found at Q<3.

Water speed x	Pos. sites =	SCORE.	Neg. sites	SCORE
Fast:5	0	0	4	20
Mod F: 4	2	8	4	16
Mod: 3	15	45	17	51
Mod S: 2	7	14	7	14
Slow: 1	9	9	4	4
Sum, mean score	33	2.3	36	3

Water speed is slower for crayfish sites than for negative ones. Crayfish not found at Fast sites.The interaction of speed and quality seems strongest at slow speeds and low quality.

8.3. Recovery of decimated crayfish stocks – Boyne catchment

The Boyne once held good stocks of crayfish (Lucey and McGarrigle 1985), but they were impacted in 1987 by an episode of crayfish plague originating in Lough Lene (Deel tributary). Few or no crayfish were found in subsequent surveys except in the Kells Blackwater. Crayfish were successfully reintroduced to Lough Lene and stocks built up rapidly, but this population crashed again around 2004 and none were found in 2006.

Demers & Reynolds (2002) trapped and hand-netted 19 sites but found crayfish only in Kells Blackwater and Moynalty. They assumed that the plague outbreak which originated in Lough Lene (Deel tributary) had wiped out all crayfish in the mainstem Boyne and its tributaries, but that pollution levels above the confluence with the Kells Blackwater, at Navan, had isolated the Kells Blackwater populations. However, EPA data in the last 10 years found crayfish at one site each in the Athboy (1997, 2000) and Longwood Blackwater (1997). This and the current information suggest that the extinction was not complete, and that the river's crayfish stocks may be slowly recovering. However, the impact of the recent population crash in Lough Lene has yet to be assessed.

21 tributary streams in Boyne mainstem and Kells Blackwater subcatchment;
Number of positive sites / total number of sites:

Mainstem:		Kells Blackwater:	
Athboy (Tremblestown)	0/7*	Kells B'water	5/14
B'water Longwood	0/4*	Chapel Lake str.	1/1
Boycetown	0/2	Lislea	0/1
Boyne	3/15*	Moynalty	3/7
Castlejordan	1/3*	Nadreegeel L st	2/3
Deel	2/8 [2 L.Lene]*	Yellow (Kells BW)	0/1
Glash	0/2		
Kinnegad	0/3		
Knightsbrook	0/3*		
Mattock	0/4 [d/s]		
Riverstown	0/2		
Rochfortbridge	0/1		
Skane	0/4		
Stonyford	2/3 [CFB]*		
Yellow (Castlejn)	0/3*		
TOTAL	8/ 64 sites		11/ 27 sites

*Sites positive in 1985 (Lucey & McGarrigle 1985).

8.4. Reassessment of eight catchments

Demers & Reynolds (2002) assessed crayfish stocks of eight Irish catchments including the Boyne. Findings are assessed in relation to the current dataset, as follows:

Awbeg (Munster Blackwater):
    D&R 2002: 4/4 positive sites. CPUE 0.8 (1.4-1.3)
    Current Data 6/11 positive sites, all sites currently Q 3 to 4.
Barrow (Mainstem and Slate):
    D&R 2002: 8/9 positive sites. CPUE 2.8 (0.4-6.6)
    Current Data 21/29 positive sites, all sites currently Q 3-4 except one pos. site Q2.
Boyne: D&R 2002: 5/19 positive sites. CPUE 0.3 (0-0.8)
    Current Data 19/91 (see Appendix 8.3)
Brosna (Shannon):
    D&R 2002: 6/8 positive sites. CPUE 1.8 (0.1-5.4)
    Current Data 17/52 (see Appendix 8.5)
Inny (Shannon):
    D&R 2002: 0/5 positive sites.
    Current Data 8/21 (see Appendix 8.5)
Liffey: D&R 2002: 7/14 positive sites. CPUE 1.8 (0.1-4.0)
    Current Data 10/35
Little Brosna (Shannon):
    D&R 2002: 0/7 positive sites.
    Current Data 3/26 (see Appendix 8.5)
Multeen (Suir):
    D&R 2002: 3/6 positive sites. CPUE 1.0 (0.1-2.2)
    Current Data 3/11 positive sites, all sites currently Q 4 or 4.5.

Water quality at almost all sites examined is average to good, and suitable for crayfish. Demers & Reynolds (2002) noted that the range and numbers of crayfish found were reduced in all catchments from previous records, being not found in the eastern Multeen, Inny, Little Brosna or mainstream Boyne. They suggested that crayfish plague emanating from the midlands to directly affect the Inny and Boyne systems may have resulted in a loss of crayfish stocks in some of these rivers. Intermittent pollution is adduced as a reason for the Multeen situation, and low water quality in the middle Liffey. The more detailed sampling by EPA corroborates this in part, but shows that extinction of stocks is not complete in Inny or Little Brosna, nor in the Boyne mainstem.

8.5. Patchy distribution of crayfish – the Shannon system

An examination of the eastern Shannon tributaries shows sporadic and patchy presence of crayfish, but reasons are not clearcut. (Data: number of positive/total sites)

Nenagh River:	**Little Brosna:**	**Brosna:**	**Inny:**	**Camlin:**	**Rinn:**
0/15 sites:	3/26 sites :	17/52 sites :	7/21 sites + :	8/17 sites :	0/18 sites :
0/3 tributaries	2/8 tribs	8/15 tribs	4/8 tribs	3/5 tribs	0/7 tribs
Dolla 0/1	Breagmore 0/4	Brosna 6/14	Dungolman 0/3	Aghnashannagh0/1	Arderry 0/1
Nenagh 0/8	Bunow 2/3	Borra 0/2	Gaine 0/3	Camlin 6/9	Black 0/4
Ollatrim 0/6	Camcor 0/5	Clodiagh 3/8	Glore 1/2	Clooncoose 1/ 2	Cloone 0/3
	Clareen 0/2	County 0/1	Inny ??	Fallan 0/3	Creelaghta 0/1
	Golden Gro. 0/2	Dysart 0/2	Lenamore 2/2	Rhine 1/2	Fardrumman 0/1
	Little Brosna 0/6	Durrow 0/1	Mountnugent 1/4		Rinn 0/5
	Pallas 0/2	Gageborough 2/4	Rath 3/3		Relagh 0/3
	Rock (Birr) 1/2	Gorragh 1/1	Tang 0/1		
		Little 0/2	Yellow 0/3		
		Pollagh 0/1			Eslin: 0/4
		Silver Kilcormac1/6			
		Silver Tullamore 1/3			
		Syanon Castle 2/2			
		Tullamore 1/3			

Crayfish were not found in the downstream (Nenagh) or upstream (Rinn and Eslin) tributaries examined. In between, they occurred in some of the tributaries (underlined above), but were not recorded in others. As with the Maigue catchment (see above), there is no obvious correlation with human settlement; in the Brosna catchment are Clara, Kilbeggan, Moate, Mullingar and Tullamore while the Rinn lacks major towns. Assuming that crayfish were originally present throughout, agricultural land use, arterial drainage, or habitat suitability (mud banks, sluggish flow) may all be negative factors.

For all positive sites in the Brosna (n=18), Q values average 3.8 (range 3 – 4.5), but none lie below 3. Negative sites (n=24) averaged 3.5 (range 1 – 4.5).

For the Camlin and Inny, positive sites (n=8 in both cases) averaged 3.8 and 4 respectively, again none below 3, while negative sites averaged 3.6 (range 2.5 – 4, n=6 for the Camlin, 3.5-4, n=7 for the Inny).

There was no obvious correlation with water speed in either system, as seen in the Erne (see above, Appendix 8.2).

1092 White-clawed Crayfish (*Austropotamobius pallipes)*

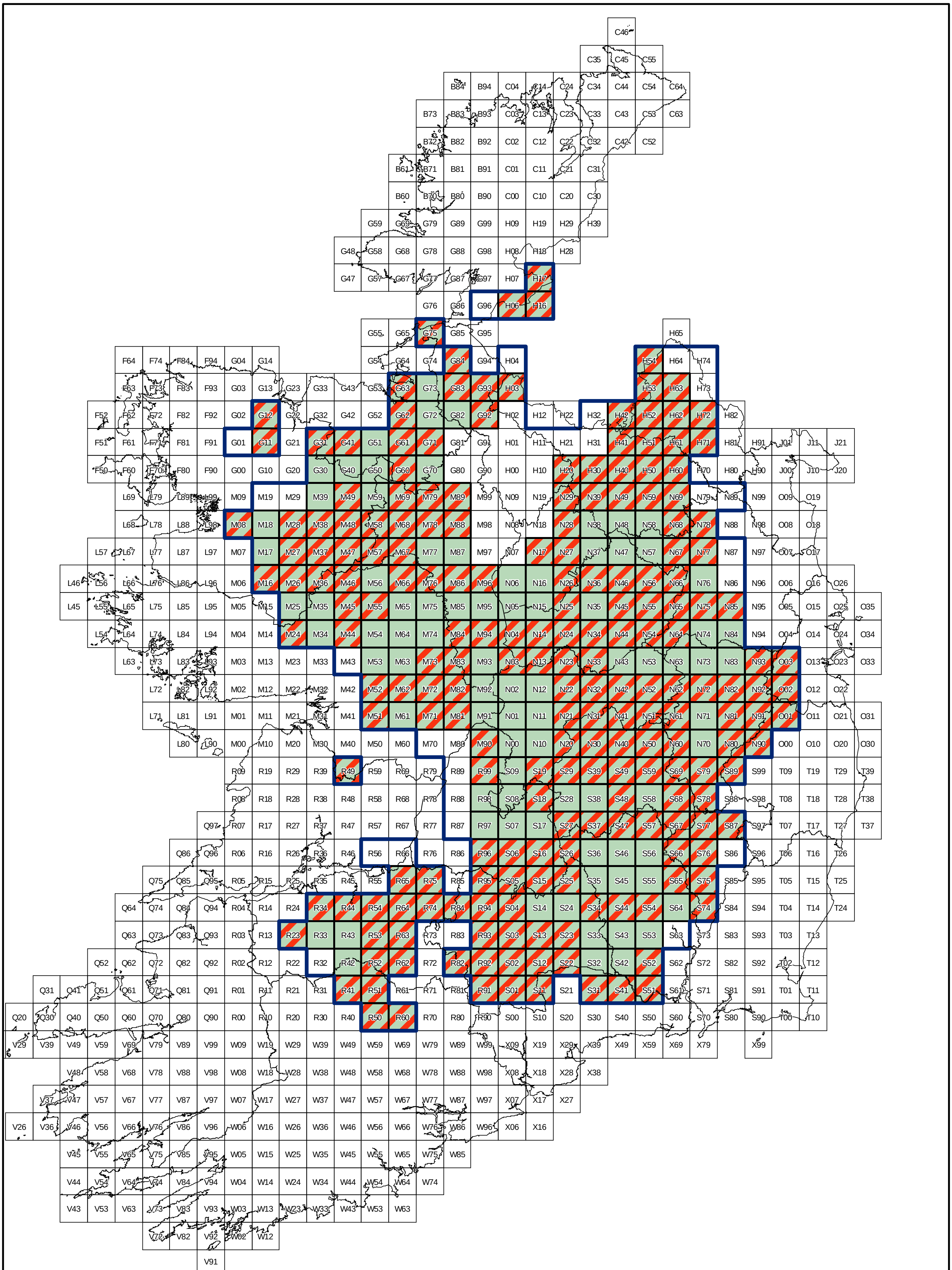
National Level	
Species code	1092
Member State	Ireland IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	29,100 km^2 (291 grid cells x 100 km)

Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	CULLEN, P., CAVALLEY L., McCARTHY T.K. 2003. Observations on experimental trapping of *Austropotamobius pallipes* (Lereboullet) in a western Irish stream. In: Holdich, D.M. and Sibley, P.J. (Eds), Management and conservation of crayfish, 152-158. Environment Agency Bristol 247 pp. DEMERS A., LUCEY, J., McGARRIGLE, M.L., REYNOLDS, J.D. 2005. The distribution of the white-clawed crayfish *Austropotamobius pallipes* in Ireland. Biology & Environment, Proc. Roy Ir. Acad. 105B: 65-69. DEMERS A., REYNOLDS J. D., 2002. A survey of the white-clawed crayfish, *Austropotamobius pallipes* (Lereboullet) and of water quality in two catchments of Eastern Ireland. Bulletin Français de la Pêche et de la Pisciculture, 367: 729-740. DEMERS A., REYNOLDS J. D., 2003. The distribution of the white-clawed crayfish, *Austropotamobius pallipes*, in eight catchments in Ireland in relation to water quality, in HOLDICH D. M. & SIBLEY P. J. (eds), Management & Conservation of Crayfish. Environment Agency, Bristol : 94-103. GOUIN N., GRANDJEAN F., PAIN S., SOUTY-GROSSET C., REYNOLDS J., 2003 Origin and colonization history of the white-clawed crayfish, *Austropotamobius pallipes*, in Ireland. Heredity, 9: 70-77. LUCEY, J., McGARRIGLE, M. 1987. The distribution of the freshwater crayfish in Ireland. Irish Fisheries Investigations A29, 1-13. 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. O'CONNOR, W. 2007. A survey of juvenile lamprey populations in the Corrib and Suir Catchments. Irish Wildlife Manuals No. 26. NPWS, Dublin. REYNOLDS, J.D. 1982. Notes on the Irish distribution of the freshwater crayfish. Bull. Ir. Biogeog. Soc. 6: 18-24. REYNOLDS J. D., 1997. The present status of freshwater crayfish in Ireland. Bulletin Français de la Pêche et de la Pisciculture, 347: 693-700. REYNOLDS J. D., DEMERS A., 2006. Comparison of white-clawed crayfish populations in Irish and French streams, with comments on its future survival in Europe. Bulletin Français de la Pêche et de la Pisciculture, 380-581: 11115-1120. REYNOLDS J., GOUIN N., PAIN S., GRANDJEAN F., DEMERS A., SOUTY-GROSSET C. 2002. Irish crayfish populations, ecological survey and preliminary genetic findings. Freshwater Crayfish 13: 584-594. SOUTY-GROSSET C., HOLDICH D., NOEL P., REYNOLDS J., HAFFNER P. 2006. Atlas of crayfish in Europe. Muséum national d'Histoire naturelle, Paris. 187 pp. (Patrimoines naturels, 64).
Range	
Surface area	29,100 km^2 (291 grid cells x 100 km)
Date	2007

Quality of data	2 = moderate
Trend	-12.87% = net loss by 12.87% (decrease from 334 to 291 10-km squares)
Trend-Period	c.1991-2003 vs 2004-2006
Reasons for reported trend	4 = indirect anthropogenic influence 6 = disease
Population	
Distribution map	[insert]
Population size estimation	23 current localities (sub-catchments)
Date of estimation	2007
Method used	2 = extrapolation from surveys of part of the population, sampling
Quality of data	2 = moderate
Trend	-4%
Trend-Period	c.1991-2003 vs 2004-2006
Reasons for reported trend	1 = improved knowledge/more accurate data??? 4 = indirect anthropogenic influence
Justification of % thresholds for trends	
Main pressures	140 Grazing – cattle trampling 220 Leisure fishing 310 Peat extraction 330 Mines 420 Discharges 500 Communication networks 701 Water pollution 810 Drainage 820 Removal of sediments (mud) 830 Canalisation 952 Eutrophication 963 Introduction of disease
Threats	140 Grazing 220 Leisure fishing 310 Peat extraction 420 Discharges 502 Routes, autoroutes 701Water pollution 952 Eutrophication 954 Invasion by a species 963 Introduction of disease
Habitat for the species	
Area estimation	33,400 km^2 (334 grid cells x 100 km)
Date of estimation	2007
Quality of data	1=poor
Trend	0 = Stable
Trend-Period	c.1991-2003 vs 2004-2006
Reasons for reported trend	
Future prospects	moderate

Complementary information	
Favourable reference range	33,400 km^2 (334 grid cells x 100 km)
Favourable reference population	24 localities [23 current localities and the Monaghan Blackwater]
Suitable Habitat for the species	Unknown – precise area of river and lake margin habitat suitable for crayfish is not currently known. The area is believed adequate for the species; however it is unclear whether the decrease in range in the north midlands is due to a decline in habitat quality. The conclusion therefore is “inadequate”.

Other relevant information	Positive Impacts: Significant conservation measures in place in the country presently e.g. up to 33% of watercourses inhabited are within SACs. Implementation of the water framework directive which will require monitoring and improvement of watercourses, pressure for clean water brought by Anglers' associations. Negative Impacts: Pressure on rivers from new housing. Problem of eutrophication due to agricultural use of fertilisers and manure spreading. Trampling by watering cattle. Possible spread of introduced species which may compete with or oust *A. pallipes*. The current crayfish range is 13% below the favourable reference range. However, as the field survey methodology used was generally not crayfish-specific, sites where crayfish were not recorded may represent sampling error rather than population loss. There is also evidence that crayfish populations are not static, but are currently returning to some decimated areas while being lost from others. Range is therefore assessed as Unfavourable Inadequate rather than Unfavourable Bad. As the species is currently lost from part of the range but the habitat is still there, the area given for the species' habitat exceeds the value for the species' range.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	**Inadequate (U1)** current range represents a decrease on the favourable reference range
Population	**Inadequate (U1)** decrease in number of localities from 24 to 23
Habitat for the species	**Inadequate (U1)** suitable habitat occurs throughout the current range but possibly not the favourable reference range
Future prospects	**Inadequate (U1)** reduction of range and number of localities and continuing pressures
Overall assessment of CS[1]	**Inadequate (U1)**



1:1,800,000

0 12.5 25 50 Kilometers

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

Crayfish
Austropotamobius pallipes

1092

Current Distribution (207 cells)
Current Range (291 cells)
Favourable Reference Range (334 cells)
W48 10km grid cells

Date: September 2007

Background to the conservation assessments for the sea lamprey *Petromyzon marinus*, the river lamprey *Lampetra fluviatilis* and the brook lamprey *Lampetra planeri* in Ireland

1. Introduction

Three taxa of lamprey are recognised in Ireland – the Sea lamprey (*Petromyzon marinus* L.), the River lamprey (*Lampetra fluviatilis* L.) and the Brook lamprey (*Lampetra planeri* Bloch).

There is uncertainty about the relationship between the brook and river lamprey which has led to the term "paired" or "satellite" species (Johns and Gibson 1998; Potter 1980a; Zanandrea 1959). It is generally assumed that *L. planeri* evolved from an ancestral parasitic form (*L. fluviatilis*) and became non-parasitic (Hubbs and Potter 1971; Malmqvist 1978). Glaciation may have promoted evolution of non-parasitic species by blocking migratory routes and preventing anadromy (Bell and Andrews 1997). Therefore, migration of *L. fluviatilis* in Ireland and other countries may have been terminated during the last Ice Age giving rise to the resident non-parasitic *L. planeri*. While the two forms have been seen at the same spawning sites they have not been observed breeding together in such situations (Potter 1980a). This may be due to the rapid post-metamorphic growth as parasites of the river lamprey leading to a large difference in size between the adults of the two forms (Bell and Andrews 1997). The brook and river lamprey do not differ notably in chromosome number or in nuclear DNA contents (Schreiber and Engelhorn 1998). Of particular relevance is the fact that the ammocoetes of river and brook lamprey cannot be distinguished by visual means and consequently many of the lamprey records we have simply state "*Lampetra* sp." . As a result, for the purposes of this assessment, the brook lamprey and river lamprey are treated together, despite the fact that their management requirements differ.

The sea and river lampreys show many similarities in their life cycles, spending their adult life at sea or in the lower reaches of estuaries, living as external parasites on other fish species, and ascending to fresh water to spawn. The sea lamprey spawning migration commences in early summer and spawning can occur from May to early August. The river lamprey, on the other hand, has an autumn spawning migration, primarily, although a smaller spring run can also occur. Spawning takes place in April. Adults of both taxa excavate nests or redds in gravel material of suitable size. The spawning females shed their eggs into the water where they are fertilised by the males and the eggs are washed into the gravel interstices at the downstream end of the redd. After hatching, the young larvae, commonly referred to as ammocoetes, swim or are washed downstream by the current to areas of fine sediment in still water, where they burrow. They live as filter feeders and may remain in fine sediment habitat for several years before transforming into young adult fish.

The brook lamprey (*L. planeri*) is the smallest of the three lampreys native to Ireland, the adults ranging in size from 15 to 20cm. It is the only one of the three which is non-parasitic and spends all its life in freshwater. Adults of the three taxa are easily distinguished but this is not the case with the ammocoete or juvenile stages. The ammocoetes of river and brook lamprey cannot be distinguished by visual means whereas the juvenile sea lamprey can be distinguished from the river/brook juveniles

(Gardiner 2003). This inability to distinguish ammocoetes of all three taxa does create problems in assessing status and distribution of river and brook lamprey.

Reviews have recently been published by Kelly and King (2001) and by Igoe *et al*. (2004).

2. Range

2.1 Sea lamprey

Kurz and Costello (1999) compiled the first review of available information on records of all three taxa in Ireland. Between this baseline and subsequent survey work, much of it funded by the National Parks and Wildlife Service (NPWS), observational responses to pages in the Central Fisheries Board (CFB) website and an information leaflet campaign by NPWS, considerable awareness has been created and many additional records added. Sea lamprey become evident at spawning time when the large redds are clearly visible in channels. Spawning has been observed in the R. Moy in Ballina, the R. Corrib in Galway city, the Fergus in Ennis, the Shannon at Castleconnell and Plassey, the neighbouring R. Mulkear at Annacotty, at the Cork Waterworks on the R. Lee, the Munster Blackwater in Fermoy and in the R. Suir at Clonmel. Redd count surveys have been undertaken by Central Fisheries Board on the Munster Blackwater and Slaney (King and Linnane 2004) and on the Suir and Nore (CFB unpublished data). These have permitted an appraisal of location and extent of spawning effort.

Staff of Eastern Regional Fisheries Board recorded a sea lamprey on the R. Glyde in May 2007 and on the R. Vartry in June 2007, in what may be the first records for these systems. Evidence of redd construction, but without sightings of adult fish, have come from ERFB staff on the Boyne and Liffey. When an ERFB record from the Avoca catchment is added, this points to a penetration of all the major east-coast catchments by *Petromyzon marinus*.

There is no recorded coverage for sea lamprey from the R. Lee around the west Cork and Kerry coasts to Castlemaine. This may be largely a consequence of their not being observed in many of these remote and thinly-populated areas. Sea lamprey adults are reported from the Killarney National Park (Kurz and Costello 1999) and from the R. Feale (O’Connor 2006 (a); P. Halpin, ShRFB pers. comm.). The species is widely recorded in waters of the Shannon estuary and major tributaries – in the Deel (P. Halpin, ShRFB pers comm.), Fergus, Shannon and Mulkear. There are also some records pointing to the presence of a land-locked population of sea lamprey in L. Derg (O’ Connor pers comm.; ESB 1998; responses to CFB website).

Apart from records in Galway city and occasional records from Oughterard, there are no reports on the Galway and west Mayo coastline or influent channels. Sea lamprey are commonly reported on the Moy and from the Deel, a tributary catchment of L. Conn. In 2007, adult fish were also reported well up the catchment in the Castlebar River and in the R. Eignagh by Fisheries Board staff (P. Traynor, NWRFB pers. comm.; G. Wightman CFB). There are records of sea lamprey from the Garavogue system, with one email report of a sea lamprey in Sligo as early as January (Diarmuid Neilan, pers. comm.).

From the above it may be reasonable to assume that sea lamprey are widely distributed and penetrate rivers right around the coast. The extent of penetration and numbers involved is another issue to be discussed below.

Based on recent distribution records, the range of the sea lamprey has been calculated as 201 10km grid squares (20,100km^2).

2.2 River lamprey

Kurz and Costello (1999) is the initial reference point for records of this taxon, as with sea lamprey. The river lamprey spawns in spring and migrates into freshwater in the year prior to spawning. It has, primarily, an autumn migration but may also display a spring migration (Witkowski and Koszewski 1995). Central Fisheries Board has carried out extensive fyke netting surveys in the autumn period (late August – early November) both in the context of trapping river lamprey and as a standard procedure for estuarine fish surveys. To date, autumn fyke sampling has been carried out by CFB (2002 – 2006) in circa 25 major estuarine waters around the coast of the Republic of Ireland. River lamprey have only been captured in east- and south-east coast waters i.e. from the Boyne to the Suir. Spring sampling for other species has reported river lamprey by-catch, supporting the idea of both an autumn and spring run. The Slaney estuary has continuously produced samples, known locally as ‘sticky eels’ and this is considered to be the single-most important river lamprey channel in the state, based on observations to date. Kurz and Costello (1999) report adult river lamprey from the Munster Blackwater, Killarney National Park, the Lower Shannon and the L. Gill catchment in Sligo.

2.3 Brook lamprey

This is the smallest of the Irish species and is the least-likely to be observed. Kurz and Costello (1999) again provide some specific records including those of Gibson (1953) based on observations in a tributary channel of L. Ennel. Brook lamprey are non-parasitic as adults and do not migrate to sea. They overwinter after transforming from the ammocoaete stage and migrate short distances upstream to spawn in the following spring. The redds constructed are very small and a well-trained eye is required to note the structures. Spawning has been observed in small streams and drains, opportunistically by CFB staff (D. Lyons, B. Lehane, L. Connor pers comm..). Focussed stream walking with identification and enumeration of brook lamprey redds has been undertaken on a small scale in the Slaney catchment (J. Morris, ERFB pers comm.) and on a more extended basis in tributaries of the Erne catchment (F. Green NRFB pers comm.).

Taken together, and including juvenile lamprey data (see below), the current range of *Lampetra* in Ireland is calculated as 462 10km grid cells (46,200km^2).

2.4 Juvenile lamprey

Records of juvenile lamprey were compiled by Kurz and Costello (1999). Juvenile lamprey, because of their sedentary habit, are the most accessible life history stage of these taxa and are the normal target in lamprey surveys. Sampling is generally via electric fishing. There was no systematic or catchment-wide information on lamprey distribution prior to the inception of a series of surveys by NPWS in 2003. This programme quickly identified the juvenile lamprey as the most amenable target for data collection on presence/absence, population structure and size. This, in turn, provided an opportunity to develop an appraisal of status in the catchment. To date a series of catchment-based studies have been completed and published on line by NPWS covering the Slaney and Munster Blackwater (King and Linnane 2004), the Moy (O'Connor 2004), the Boyne (O'Connor 2006 (b)), the Barrow (King 2006), the Feale (O'Connor 2006 (a)), the Suir and the Corrib (O'Connor 2007). Additional distributional data from a range of catchments was compiled by King and Lehane (unpublished report to NPWS). Data sets from the R. Nore, funded by OPW, were collected in the context of the Kilkenny Flood Relief Scheme (Lyons and King unpublished reports to OPW; Connor 2006). CFB has an on-going study with the Northern Regional Fisheries Board on juvenile lamprey in the Erne catchment (King and Green unpublished data). Additional data on distribution comes from on-going studies of CFB, funded by OPW, examining the impacts of channel maintenance on status and distribution of juvenile lamprey (King *et al*. unpublished data).

As mentioned above, the major problem in examining juvenile lamprey is the impossibility of distinguishing juveniles of river and of brook lamprey. Thus field surveys can simply record juveniles as being sea- or river/brook. This has obvious ramifications when trying to assess the degree of anadromy of river lamprey. Field surveys carried out since NPWS's initiative in 2003 point to a widespread distribution of juvenile river/brook lamprey, where suitable habitat is available. Frequently, juvenile lamprey are absent or poorly represented in a channel as a consequence of unsuitable habitat. The sampling programmes conducted to date have focussed on sampling in characteristic types of habitat, as described in Maitland (2003).

Juvenile sea lamprey are much less common and are absent in many surveys to date. They appear to be most widespread in the Munster Blackwater. Their distribution is frequently focussed into the lower reaches of catchments, with upstream penetration impeded by large weirs. They have been recorded in the lower reaches of the Feale and Moy with poor representation in the Slaney. O'Connor (2006 (b)) in his survey of the Boyne identified new problems in distinguishing juvenile sea lamprey from juvenile river/brook lamprey. This work has heightened caution among Irish workers in this area and, while the guide of Gardiner (2003) remains the principal work for discriminating, one is conscious of the observations of O'Connor and possible ramifications for mis-identification.

2.3 Trends

In the absence of historical or recent data sets for comparison it is not possible to make any definitive comment on trends in range. However, it is likely that since the Habitats Directive came into force (1994) the range of these lampreys has not changed. From the available data, it would appear that sea lamprey penetrate rivers to spawn right around the coast. While they may not ascend every river it is clear that they are not confined to specific areas. In contrast, the river lamprey records of CFB, based on survey effort, are confined to the east- and south east. This may be an accident of sampling. However as fyke netting effort has been put in right around the coast, at same time of year, it would appear significant that CFB's river lamprey records appear confined to the east coast. The CFB data set does not concur with records of Kurz and Costello (1999) and it is apparent that additional sampling in season is required in a number of catchments to ascertain the status of adult river lamprey.

Data compiled to date do not indicate any relationship between juvenile lamprey population status and water quality, as recorded in the EPA 'Q' rating system (O'Connor 2007; King and Lehane unpublished data).

3. Population

A substantial body of data has now been compiled providing information on presence/absence, population structure and population size. It is apparent from the Irish studies to date that lamprey juveniles are extremely non-normally distributed within catchments, within individual streams and even within adjacent silt banks. Sampling has been confined to areas that appear visually to be suitable to act as juvenile habitat. Even allowing for this, a large proportion of sites sampled to date have registered as being devoid of ammocoetes. The fundamental problem with population assessment is one of deciding how many samples to take, both within a catchment and within an individual channel, in order to develop a meaningful statistical base line to permit future comparison. In general, the Irish studies have been catchment-based and this is considered a sound basis. Within this approach, individual rivers are surveyed, with the number of sampling sites per river being related to the length of the channel.

The range of density values (number of ammocoetes/m^2) has been shown to vary dramatically along individual channels, often with zero as the lowest value and maxima ranging from as little as five to in excess of 100 individuals. This pattern is common throughout the systems examined to date. Individual channels with data of concern include main stem waters such as the R. Deel in west Limerick, with no juveniles recorded in four sites spaced along the main stem, and the Black River in the Inny catchment, again with no lamprey recorded in four sites spaced along the channel length. Zero density results were recorded in a number of sites on tributaries of the Barrow and this is considered to be due to insufficiency of suitable sediment in otherwise alluvial channels.

In contrast are waters such as the R. Bann, in the Slaney system, with numbers in excess of 60 ammocoetes per unit area over four replicates, and the R. Nore at Ossory Meadow with 13 ammocoetes per unit area over 11 replicates. Harvey and Cowx (2003) propose reference values for population density of juvenile river/brook populations in addition to an appraisal of the number of sampling stations required for a catchment. The sampling station effort for Irish catchments to date has paralleled the recommendations of Harvey and Cowx (2003).

Populations of sea lamprey appear to be substantially smaller than those of river or brook lamprey. This is the case as recorded by enumeration of juveniles and as recorded by redd counting (e.g. on the R. Nore and R. Suir main stems). More importantly, the populations tend to be focussed in the downstream areas of some catchments and it is considered that this is due to inability to penetrate upstream due to obstructions. Harvey and Cowx (2003) make similar observations on UK data sets and recommend a reference density of sea lamprey of 0.1/m^2 on a catchment basis, well below the recommended level of >2/m^2 for river/brook juveniles. The experience to date in Ireland would support the approach of Harvey and Cowx (2003), however further work is required to establish realistic and meaningful density figures that would reflect favourable reference conditions across the range of Irish riverine situations.

In the absence of sufficient detailed population data, the number of 10km squares in the range is taken as a proxy for population: 201 for sea lamprey; 462 for *Lampetra*.

3.1 Pressures and threats

Improvement in fish passage facilities in major Irish channels (Code No. 850 – specifically weirs) could permit a greater spatial dispersal of lamprey adults within a catchment. This, in turn would facilitate a greater dispersal of ammocoetes with enhanced scope for colonisation of available sediments. Such improvement is particularly critical for sea lamprey. This species ascends rivers to spawn at a time of greater likelihood of low water levels and hence, an increased likelihood of being obstructed by barriers such as large weirs. The impact of such obstruction is considered to be manifest in the large aggregations of spawning sites or redds in gravelled areas immediately downstream of such impassable weirs. This is addressed specifically at 6.1 below. Passage obstruction is not considered to be as significant for river lamprey, as these migrate in autumn and can use elevated flows to help ascend weirs. They have been captured upstream of Clohamon Weir on the Slaney, a structure that impedes sea lamprey progress, and upstream of the weir at Islandbridge on the Liffey.

Water quality and eutrophication are not considered to be highly significant in impacting on lamprey status, in general. O'Connor (2007) found lampreys in rivers with Q values as low as 2 and suggested that, if anything, lampreys seem to favour slightly elevated levels of organic material and filamentous algae. King and Lehane (unpublished data) examined lamprey ammocoete density in the context of water quality as recorded in the EPA 'Q' rating system and found no linkage or correlation. Both low and high density values for ammocoetes were found in a wide range of water quality types.

Gross pollution and specific pollutants (Code No. 701) have been shown to lead to lamprey mortality along with other fish species present. Both dead adult river lamprey and lamprey ammocoetes were collected in the Owenavarragh, on the east coast following a major fish kill (Donnacha Byrne, ERFB). Similarly, dead lamprey have been taken in the Avoca river well downstream of the Avoca mining area where metal leachate (Code No. 330) can discharge to the river in certain hydraulic conditions (Donnacha Byrne, ERFB). Such leachate is not a permanent barrier as salmon and sea lamprey (J. O' Brien ERFB) have been recorded considerable distances above the mining area.

There is no known commercial fishery for lamprey in Ireland, but anecdotal reports record individuals catching ripe or spent sea lamprey (Code No. 220) for domestic consumption (M. Lennon, NWRFB, pers comm.). River lamprey are taken in fyke nets as eel by-catch on the Slaney but are returned alive to the water (D. Rossiter, pers. comm.).

It is becoming increasingly common for anglers to use pieces of lamprey (adults and ammocoetes) as bait (Code No. 290). This material is sold in vacuum pack units from fishing tackle freezers. If this material derives from dead spent lamprey, river or sea, then there may be nothing wrong with the practise. However, if this material is obtained through interception of migrating pre-spawning adults then it may be deleterious to spawning stocks. There are reports that some of this frozen material is coming in to Ireland from the UK, however, any uncontrolled removal of adult lamprey is not considered tenable given our current knowledge of Irish stocks.

The 'cleaning' of rivers, or channel maintenance, is seen to have considerable potential to impact adversely on lamprey populations (Code No. 810, 811, 820). Inappropriate timing of channel maintenance could lead to disruption of redd structures in gravelled area with egg washout and dispersal. Removal of silt is a typical procedure in channel cleaning or maintenance, as practised by the Office of Public Works Drainage Division, River Drainage Boards and Local Authorities. Such silt not infrequently contains populations of juvenile lamprey that may find themselves stranded on bank slope or spoil lines where they are predated on or die of desiccation. It is clear that such a process can lead to substantial losses of juveniles. The extent of damage is not known but is the subject of a current study, commissioned by OPW. The study is intended to examine such impacts and identify mitigations. A current mitigation operated by Waterways Ireland on the Barrow SAC involves machine staff examining spoil removed from the channel, picking out juvenile lamprey and placing them into buckets of water for later return to the channel.

It is considered that future threats are generally the same as the present pressures, although awareness of lamprey conservation issues is already reducing the impact of river drainage and channel maintenance works on these species and these activities should be less of a threat in the future. Nonetheless, if lamprey population levels remain at the apparent present low levels then there is even greater likelihood that some populations, most especially of the sea lamprey, may fail to achieve favourable conservation status without extensive intervention management.

4. Habitat

The requirements to facilitate successful spawning of anadromous lamprey include unimpeded access from the sea through the estuarine and tidal areas and up rivers to the spawning grounds, where gravelled areas of suitable particle diameter are available for redd construction. In addition, availability of extensive and widely distributed areas of fine silt material is required to provide habitat for juvenile lamprey or ammocoetes.

Spawning habitat is not considered to be threated in Ireland. However, there are serious problems of penetration in many major river systems. This causes underutilisation of available gravelled areas and an inability of the river and sea lamprey to achieve their optimum dispersal for spawning. This in turn restricts the ability of juveniles to avail of sedimenting habitat.

O'Connor (2004) has identified arterial drainage as a major factor in altering the hydraulic regime in impacted channels and, in turn, eliminating juvenile lamprey habitat. The processes of straightening, of removal of bed high points and subsequent formation of extensive uniform glide areas are considered by him to have reduced the areas available for natural sediment deposition – the natural homes for juvenile lamprey. The 'cleaning' of rivers, or channel maintenance, is also seen to have considerable potential to impact adversely on lamprey habitat through removal of silt deposits and, possibly also, through removal of gravel shoals or their re-distribution within the channel cross-section.

Further work is required to identify the actual extent of suitable lamprey habitat in Ireland. In the absence of this information we can only estimate at the 10km level using distribution data as a guide: 201 10km grid cells (20,100km^2) for sea lamprey; 462 10km grid cells (46,200km^2) for *Lampetra*.

4.1 Trend

No new arterial drainage schemes have been initiated since the early 1990's. Other inchannel engineering works, such as major urban flood relief schemes, have been cognisant of potential impacts on lamprey and some specific studies on lamprey status and on scheme impacts have been undertaken.

Since 2003, OPW has rolled out a new training protocol for its field staff, including excavator drivers. This protocol incorporates a series of strategies designed to incorporate environmentally-sensitive work practises. Of relevance to juvenile lamprey is the procedure whereby maintenance is done from one bank and the non—working bank slope habitat and water's edge area are to be left untouched. This should serve to leave intact areas of sediment, even though areas on the working side may be removed.

Overall, the extent and quality of lamprey habitat can be considered to have remained stable since the Directive came into force.

5. Future prospects

The implementation of the Habitats Directive has helped bring about an awareness of the lamprey and their biology and status among fisheries personnel and others involved in aquatic ecology in Ireland. Furthermore, the initiative of NPWS in commissioning catchment-wide surveys has stimulated a substantial database on distribution and status of juvenile lamprey. This process has also identified areas where further investigations should be focussed.

Improvement in fish passage facilities in major Irish channels is imperative if sea lamprey are to achieve their anadromous capacity and attain maximum dispersal in catchments where they are found.

Going forward, it is imperative that a sampling protocol be developed that will assess presence/absence, population structure and density of lamprey in channels in a manner that will permit comparative assessment in the context of the 6-year rolling reporting cycle of member states to the EU.

More information on the extent of suitable habitat and habitat utilisation is also required. The walkover survey methodology as developed by Scottish Natural Heritage (APEM 2004) is considered very suitable for mapping the extent of spawning area and of juvenile habitat along extended reaches of channel. This 'extensive' approach can be used to complement the 'intensive' electric fishing approach, which is essentially confined to point locations. A combination of both may be useful in providing an appraisal of population size of ammocoetes in any reach of channel.

Implementation of the EU Water Framework Directive (WFD) may be important in strengthening the argument for improved passage through current barriers. This measure is pertinent in WFD under the 'connectivity' area, where hydromorphological continuity and connectivity are required as well as continuity for species over their natural range.

Overall it is considered that the future prospects of the sea lamprey are poor. This is largely a reflection of its restricted range, as described above. It is envisaged that the implementation of the management measures described below (see 6.1) are required to ensure the long term survival of this species in Ireland.

While recognising the difficulties distinguishing the *Lampetra* species in the field, it would appear that the brook lamprey is certainly widespread throughout the country and that the river lamprey is not as restricted by weirs as the sea lamprey. The future prospects of these species appears to be good.

6. Complementary information

6.1 Favourable reference range

Sea lamprey adults appear to be dispersed right around the Irish coast and this marine area should be seen as part of their natural range. Thus, all river systems with suitable ecology, and without natural obstructions to upstream passage, should be seen as constituting the reference freshwater range for this species in Ireland. The catchments of a number of major Irish rivers are considered to be part of the favourable reference range for sea lamprey, although the species is partly or wholly impeded from accessing large areas of these due to instream obstructions.

Studies by CFB (J. King unpublished data) have demonstrated a large degree of redd construction downstream of large weirs on major channels, with very little redd construction above the barriers. What is even more serious is that these obstructions generally occur in the lower reaches on these major rivers. Thus the weirs at Clonmel, on the Suir, and the weir at Thomastown on the Nore and that at Clohamon on the Slaney represent the first obstruction to sea lamprey passage and are in the lower reaches of each system. In each case, redd 'accumulation' has been recorded downstream of the structures. Furthermore, the weir in Galway city is considered to impede access to the entire Corrib lake system with its very large hinterland of tributary channels.

Full access to these important systems is considered critical for the long term viability of the sea lamprey. Following discussions (with J. King & W. O'Connor) an arbitrary figure of 60km of channel upstream of these weirs is added to each catchment to provide the favourable reference range. In the case of the Corrib this was mapped as 30km up the lake to include the Owenriff (where there were historic records of sea lamprey pre-dating the Galway weir) and 30km up the Clare catchment, identified by W. O'Connor as the most obvious suitable channel to include based on his recent survey work in the area (O'Connor, 2007). In each of these four catchments, measures will be required to address lamprey access through a substantial number of barriers, to ensure upstream access to the favourable reference range and help ensure the favourable conservation status of the species.

The FRR of the sea lamprey is thus calculated as the current range (20,100km^2) plus 20 additional 10km grid squares: 22,100km^2 in total. As the CR is 9.9% smaller than the FRR, this parameter is considered to be Unfavourable – Inadequate.

Sea lamprey migration is also restricted by weirs on other smaller catchments e.g. at Annacotty, on the Mulkear, and in Ennis, on the Fergus. However, the inclusion of further upstream areas here is not considered vital to the long term viability of the species at this stage.

The distribution of adult river lamprey appears confined to the east coast and part of the south east, based on CFB records. This must, however, be confirmed by additional and more intensive netting surveys in autumn in estuaries outside this range. If the marine range is confined then the freshwater range should cover all those channels and catchments discharging to the east coast. The natural range in freshwater should extend to headwaters where suitable ecology and flow conditions are available.

River lampreys, because of their primarily autumn-focussed migration, are not impeded by weir and other barriers to the same degree as sea lampreys. Thus river lamprey have been taken on the Slaney upstream of Clohamon Weir in October, although sea lamprey do not pass this structure in May-June. One of the principal factors preventing an accurate assessment of degree of penetration, and hence assessment of natural or favourable range, is the inability to distinguish between juvenile river and brook lamprey. The only way to assess the degree of penetration of river lamprey is to trap adult fish sequentially upstream in their autumn migration or to initiate telemetry studies. What is clear from observations and from limited netting is that river lamprey come in to estuaries from early autumn and rapidly move up though these estuaries and upward into rivers.

Until (and unless) evidence becomes available to show otherwise, the current range of *Lampetra* is taken as the favourable reference range. As the range is stable and not smaller than the favourable reference range, it can be considered to be Favourable.

6.2 Favourable reference population

In addition to problems of access to the favourable reference range experienced by sea lamprey, it is considered that the actual size of the adult population available to occupy the range is, in many cases, quite low. This statement is based on number of redds counted along substantial segments of the Nore and Suir main stems. Suffice it to say that if the salmon redd counts were as low in the comparable sections then the situation would be considered to be very grave.

The only quantitative data on population size relates to redd counts of adult sea lamprey, where enumeration can reasonably be undertaken over long segments of channel. Data from the Slaney, Nore and Suir point to a low level of redd cutting and serious impediments to upstream passage. The Munster Blackwater was shown to have the widest distribution of juvenile sea lamprey, pointing to some degree of upstream escapement to headwaters, at least in some years. However, even here it was clear that sea lamprey juveniles constituted only a small proportion of the overall juvenile population at any site examined.

From observations of netting effort it would appear that the Slaney carries a larger population of river lamprey adults than other channels and these fish can penetrate into major tributaries far up the catchment by early autumn. No estimate of population size is possible – a considerable degree of netting effort over a full season of migration would be required in a series of estuaries in order to develop some form of comparative analysis.

In the absence of detailed population information, the number of 10km grid cells in the FRR is taken as a proxy for favourable reference population. Sea lamprey: 221; *Lampetra* : 462. As the current sea lamprey population is 9.9% smaller than the FRP, this parameter is considered to be Unfavourable – Inadequate. This parameter is considered to be Favourable for *Lampetra*.

6.3 Habitat for the species.

The degree of sediment deposition is a key factor for juvenile lamprey. In some large channels, extensive lateral deposits of silt occur naturally and these may be heavily colonised. Not infrequently, it is not possible to sample these areas by the conventional technique of electric fishing due to excessive depth. Thus, the recording of juvenile lamprey may be more influenced by our ability to sample them rather than by their actual presence or absence.

O'Connor has coined the term 'alcove habitat' to describe the niche areas or slots where sediment can accumulate in flowing channels and in which juvenile lamprey are likely to accumulate. Such niches may be targets for removal in channel maintenance. Straightening of channels and creation of trapezoidal cross-sections may reduce the capacity of channels to trap and retain silt that might otherwise become juvenile lamprey habitat. The installation of low-level structures as channel enhancement devices for salmonid fish can lead to local increases in ammocoete numbers, presumably through the structures permitting sediment focussing and deposition (M. O' Grady and F. Igoe, pers comm.). However, where drained channels have been left undisturbed for a number of years it is clear from surveys that sediment can accumulate to the level where it can support large densities of juvenile lamprey (CFB unpublished data; King and Lehane unpublished data).

It is considered that substantial areas of habitat are available for spawning by brook and by sea lamprey. Direct observations of river lamprey spawning are few in Ireland but it is likely that sufficient habitat is available. As mentioned previously, it is not likely that extent of habitat is limiting but that access to this habitat is a constraining factor.

The number of 10km squares in the FRR is taken as a proxy for habitat for each taxon: Sea lamprey: 221; *Lampetra* : 462. This parameter is taken as Favourable for the *Lampetra* spp., but Unfavourable – Inadequate for sea lamprey.

Summary of Conclusions		
	Sea Lamprey	***Lampetra***
Range	Unfavourable – Inadequate (U1)	Favourable (FV)
Population	Unfavourable – Inadequate (U1)	Favourable (FV)
Habitat for the species	Unfavourable – Inadequate (U1)	Favourable (FV)
Future prospects	Unfavourable – Inadequate (U1)	Favourable (FV)
Overall assessment of status	Unfavourable – Inadequate (U1)	Favourable (FV)

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1095 Sea lamprey (*Petromyzon marinus*)

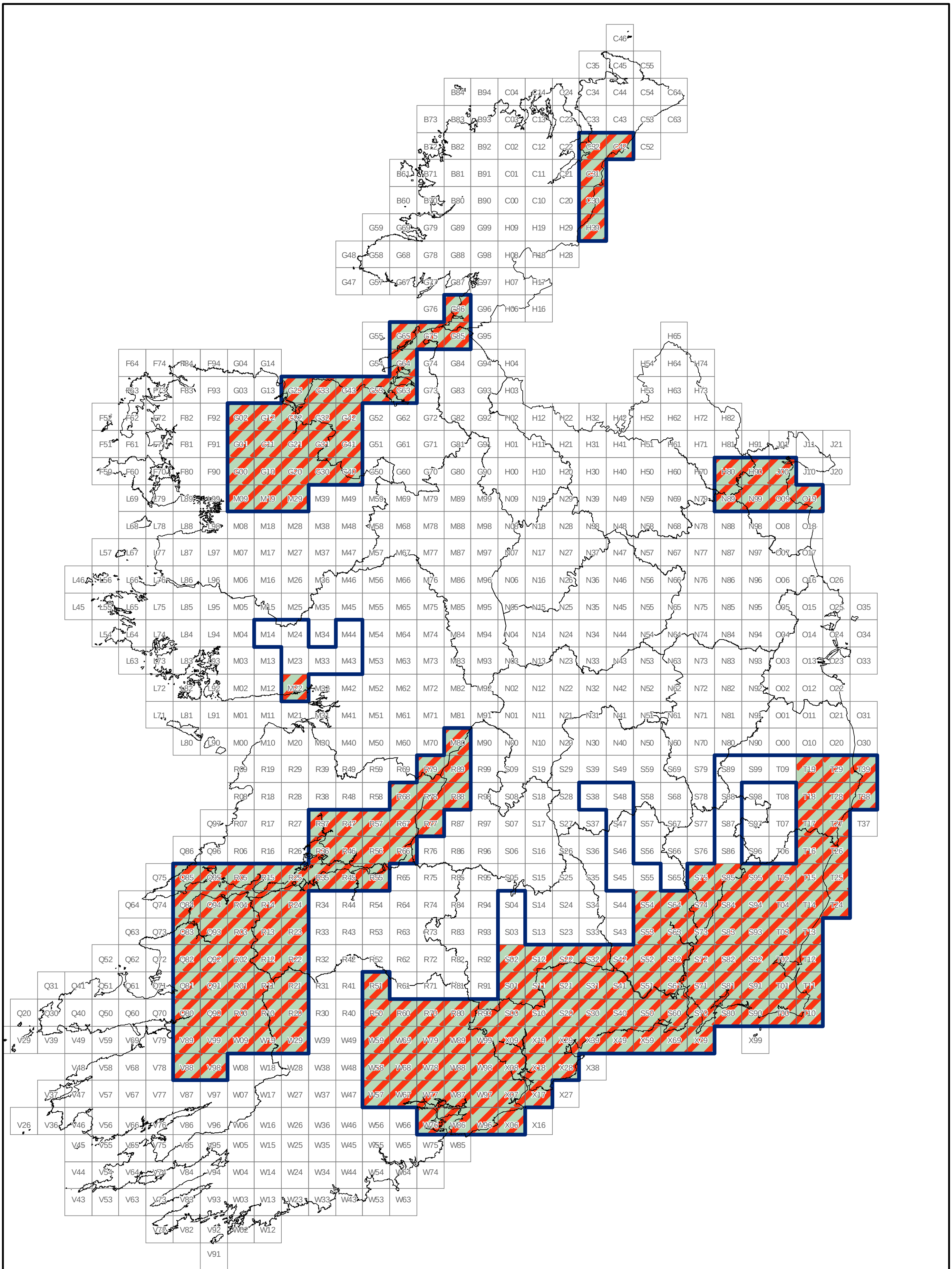
1. National Level	
Species code	1095
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	**Gardiner, R. 2003** *Identifying lamprey: A field key for sea, river and brook lamprey*. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4, English Nature, Peterborough. 27pp. **Harvey, J. & Cowx, I. 2003** *Monitoring the river, sea and brook Lamprey,* Lampetra fluviatilis, L. planeri *and* Petromyzon marinus*.* Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough. **Hubbs, C. L. & Potter, I. C. 1971** Distribution, phylogeny and taxonomy In M. W. Hardisty and I. C. Potter (eds.) *The Biology of Lampreys*, Volume 1, Academic Press, London. **Igoe, F., Quigley, D.T.G., Marnell, F., Meskell, E., O'Connor, W. & Byrne, C. 2004** The sea lamprey *Petromyzon marinus* (L.), river lamprey *Lampetra fluviatilis* (L.) and brook lamprey *Lampetra planeri* (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation. *Biology and Environment: Proceedings of the Royal Irish Academy.* **104 B** (3), 43-56. **Kelly, F. L. & King, J. J. 2001** A review of the ecology and distribution of three lamprey species, *Lampetra fluviatilis* (L.), *Lampetra planeri* (Bloch) and *Petromyzon marinus* (L.): a context for conservation and biodiversity considerations in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* **101B**, 165-185. **King, J.J. 2006** The status and distribution of lamprey in the R. Barrow SAC. *Irish Wildlife Manuals* No. 21. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **King, J.J. & Linnane, S.M. 2004** The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals* No 14. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **Kurz, I. & Costello, M. J. 1999** An outline of the biology, distribution and conservation of lampreys in Ireland. *Irish Wildlife Manuals* No. 5. Dublin, Duchas – the Heritage Service. **Maitland, P. S. 2003** *Ecology of the river, brook and sea lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough. **O'Connor, W. 2004** A survey of juvenile lamprey populations in the Moy catchment. *Irish Wildlife Manuals,* No. 15. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2006 (a)** A baseline survey of juvenile lamprey populations in the River Feale catchment. *Irish Wildlife Manuals* No. 22. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2006 (b)** A baseline survey of juvenile lamprey populations in the River Boyne catchment. *Irish Wildlife Manuals* No. 24. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2007** A baseline survey of juvenile lamprey populations in the Corrib and Suir catchments. *Irish Wildlife Manual* No 26. National Parks and Wildlife Service, Dept. of Environment, Heritage and local Government, Dublin Ireland.
2.3 Range	
2.3.1 Surface area	20,100km^2

2.3.2 Date	June 2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys of part of the country)
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	210 10km grid squares
2.4.2 Date of estimation	2007
2.4.3 Method used	2 = extrapolation from surveys of part of the population
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	0 = stable
2.4.7 Trend-Period	1994 - 2007
2.4.8 Reasons for reported trend	N/a
2.4.9 Justification of % thresholds for trends	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field
2.4.10 Main pressures	220 – Leisure fishing 290 – Use as bait 330 – Mines (leachate) 701 – Water pollution (eutrophication) 810 – Drainage 811 – management of aquatic vegetation 820 – Removal of sediments 850 – specifically weirs 853 – management of water levels
2.4.11 Threats	220 – Leisure fishing 290 – Use as bait 701 – Water pollution (eutrophication) 810 – Drainage 811 – management of aquatic vegetation 820 – Removal of sediments 850 – specifically weirs 853 – management of water levels
2.5 Habitat for the species	
2.5.2 Area estimation	20,100km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	1 = poor
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	2 = poor prospects

2.7 Complementary information	
2.7.1 Favourable reference range	22,100km^2
2.7.2 Favourable reference population	221 10km grid squares
2.7.3 Suitable Habitat for the species	22,100km^2
2.7.4 Other relevant information	
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Unfavourable – Inadequate (U1)
Population	Unfavourable – Inadequate (U1)
Habitat for the species	Unfavourable – Inadequate (U1)
Future prospects	Unfavourable – Inadequate (U1)
Overall assessment of CS[1]	Unfavourable – Inadequate (U1)

[1] A specific symbol (e.g. arrow) can be used in the unfavourable categories to indicate recovering populations



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

Sea Lamprey

1095

- Current Distribution (201 grid cells)
- Current Range (201 grid cells)
- Favourable Reference Range (221 grid cells)
- W48 10km grid cells

Date: July 2007

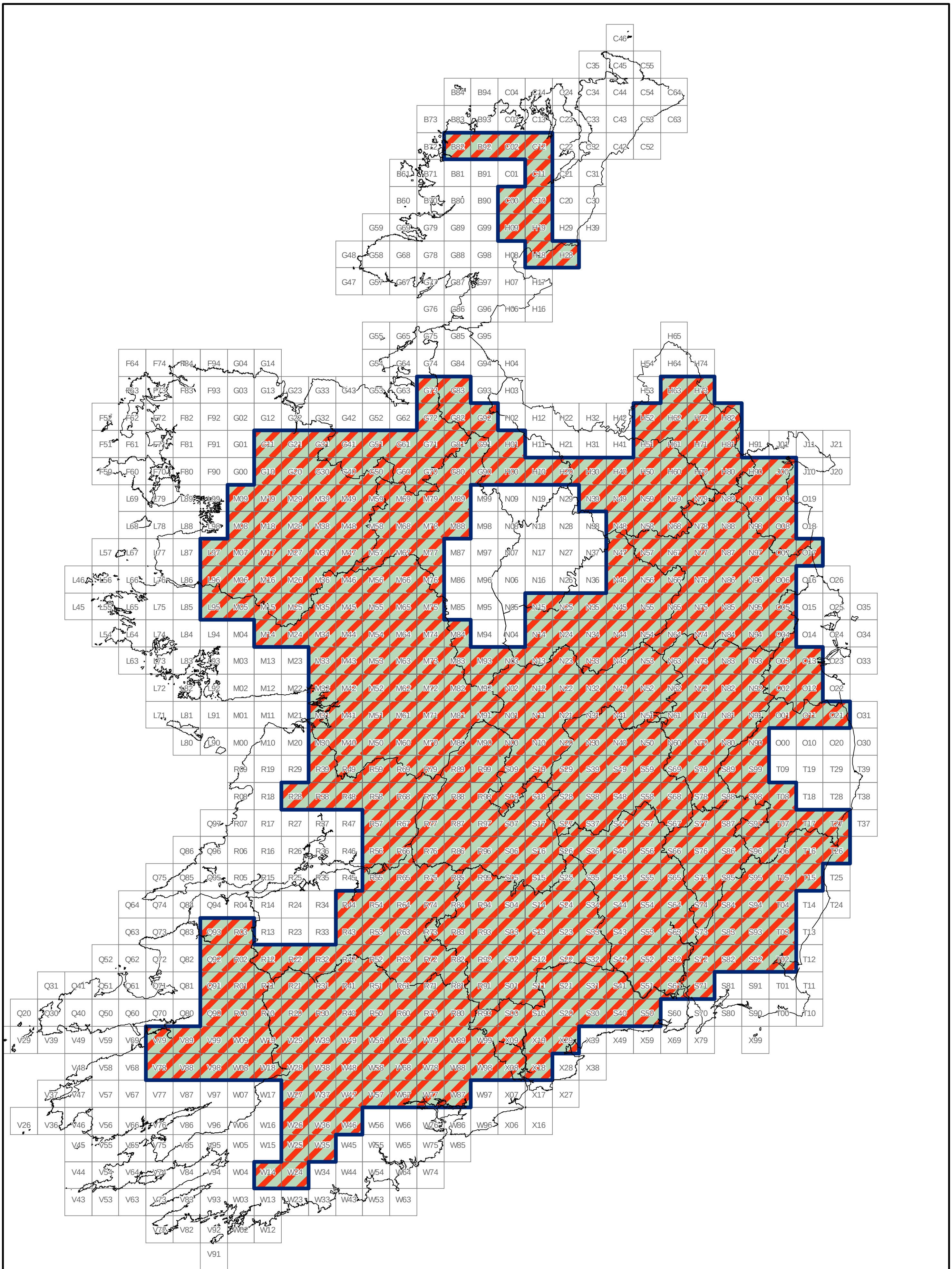
1099 & 1096 River lamprey (*Lampetra fluviatilis*) & Brook lamprey (*L. planeri*)

1. National Level	
Species code	1099 & 1096
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	**Gardiner, R. 2003** *Identifying lamprey: A field key for sea, river and brook lamprey*. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4, English Nature, Peterborough. 27pp. **Harvey, J. & Cowx, I. 2003** *Monitoring the river, sea and brook Lamprey,* Lampetra fluviatilis, L. planeri *and* Petromyzon marinus*.* Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough. **Hubbs, C. L. & Potter, I. C. 1971** Distribution, phylogeny and taxonomy In M. W. Hardisty and I. C. Potter (eds.) *The Biology of Lampreys*, Volume 1, Academic Press, London. **Igoe, F., Quigley, D.T.G., Marnell, F., Meskell, E., O'Connor, W. & Byrne, C. 2004** The sea lamprey *Petromyzon marinus* (L.), river lamprey *Lampetra fluviatilis* (L.) and brook lamprey *Lampetra planeri* (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation. *Biology and Environment: Proceedings of the Royal Irish Academy.* **104 B** (3), 43-56. **Kelly, F. L. & King, J. J. 2001** A review of the ecology and distribution of three lamprey species, *Lampetra fluviatilis* (L.), *Lampetra planeri* (Bloch) and *Petromyzon marinus* (L.): a context for conservation and biodiversity considerations in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* **101B**, 165-185. **King, J.J. 2006** The status and distribution of lamprey in the R. Barrow SAC. *Irish Wildlife Manuals* No. 21. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **King, J.J. & Linnane, S.M. 2004** The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals* No 14. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **Kurz, I. & Costello, M. J. 1999** An outline of the biology, distribution and conservation of lampreys in Ireland. *Irish Wildlife Manuals* No. 5. Dublin, Duchas – the Heritage Service. **Maitland, P. S. 2003** *Ecology of the river, brook and sea lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough. **O'Connor, W. 2004** A survey of juvenile lamprey populations in the Moy catchment. *Irish Wildlife Manuals,* No. 15. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2006 (a)** A baseline survey of juvenile lamprey populations in the River Feale catchment. *Irish Wildlife Manuals* No. 22. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2006 (b)** A baseline survey of juvenile lamprey populations in the River Boyne catchment. *Irish Wildlife Manuals* No. 24. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland. **O'Connor, W. 2007** A baseline survey of juvenile lamprey populations in the Corrib and Suir catchments. *Irish Wildlife Manual* No 26. National Parks and Wildlife Service, Dept. of Environment, Heritage and local Government, Dublin Ireland.

2.3 Range	
2.3.1 Surface area	46,200km^2
2.3.2 Date	June 2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys of part of the country)
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	462 10km grid squares
2.4.2 Date of estimation	2007
2.4.3 Method used	2 = extrapolation from surveys of part of the population
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	0 = stable
2.4.7 Trend-Period	1994 - 2007
2.4.8 Reasons for reported trend	N/a
2.4.9 Justification of % thresholds for trends	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field
2.4.10 Main pressures	220 – Leisure fishing 290 – Use as bait 330 – Mines (leachate) 701 – Water pollution (eutrophication) 810 – Drainage 811 – management of aquatic vegetation 820 – Removal of sediments 850 – specifically weirs 853 – management of water levels
2.4.11 Threats	220 – Leisure fishing 290 – Use as bait 701 – Water pollution (eutrophication) 810 – Drainage 811 – management of aquatic vegetation 820 – Removal of sediments 850 – specifically weirs 853 – management of water levels
2.5 Habitat for the species	
2.5.2 Area estimation	46,200km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	1 = poor
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	good prospects
2.7 Complementary information	
2.7.1 Favourable reference range	46,200km^2
2.7.2 Favourable reference population	462 10km grid squares
2.7.3 Suitable Habitat for the species	46,200km^2
2.7.4 Other relevant information	
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



DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Brook Lamprey

1096

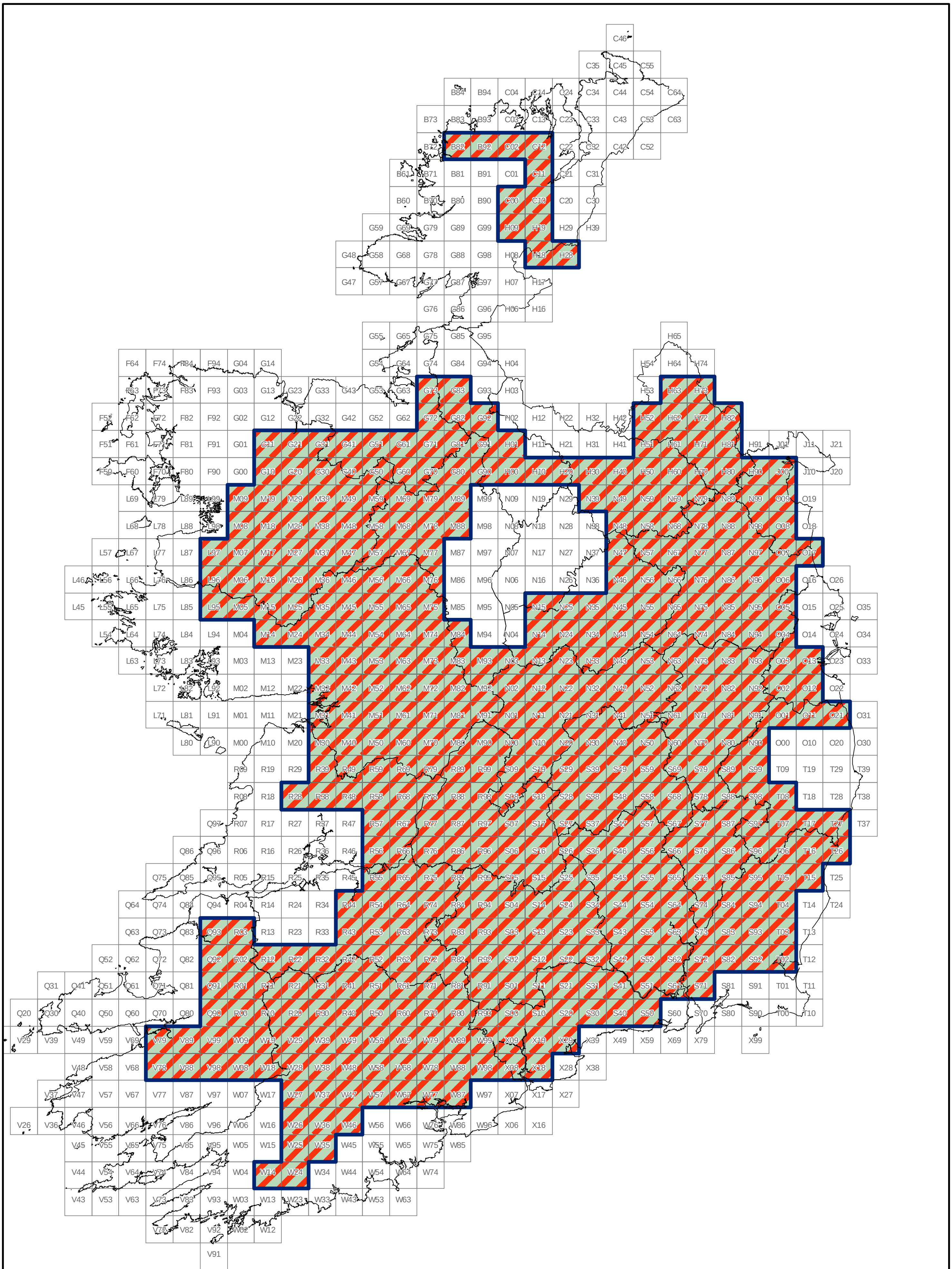
Current Distribution (462 grid cells)

Current Range (462 grid cells)

Favourable Reference Range (462 grid cells)

W48 10km grid cells

Date: July 2007



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

River Lamprey

1099

Current Distribution (462 grid cells)
Current Range (462 grid cells)
Favourable Reference Range (462 grid cells)
W48 10km grid cells

Date: July 2007

Background to the conservation assessments for Allis Shad (*Alosa alosa*) and Twaite Shad (*Alosa fallax fallax*) 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 Lough Leane, Killarney and is covered under a separate background document.

2. Range

2.1 Pre-1994 data

Allis and twaite shad can be found along the coasts of Western Europe from southern Iceland and Norway to Spain (Maitland & Hatton-Ellis, 2003). Early Irish data, compiled by Went (1953), indicated a concentration of reports of twaite shad along the south coast of Ireland with the limited references to allis shad being confined to northern and north-western areas. Subsequent to Went's review a small number of notes and references to shad appeared in the *Irish Naturalists' Journal*. These included reports of allis shad from the R. Ilen, where local information pointed to the species' being common in summer months (Gibson 1956), and from the coast of Northern Ireland (Cummins 1961, Vickers 1961). Reports on twaite shad consisted of one record from Cork Harbour (O'Rourke, 1964). Bracken and Kennedy (1967) provided a substantial update with reference to additional twaite shad records spread from Dundalk Bay in the north-east southward to Dingle Bay in the south-west.

The majority of the allis shad material reported by Bracken and Kennedy (op. cit.) was taken at sea off west Cork and Kerry in the 1951-61 period. A substantial number of fish were taken by trawler in Dingle Bay during 1960 with the data set suggesting the possibility of movement to spawning areas in one or more rivers discharging to Dingle Bay. One specimen was taken in Galway Bay and several were taken in the R. Ilen estuary. The most unusual record was a fish of 44 cm found dead on the shore of the upper lake in Killarney.

Minchin (1977) captured both allis and twaite shad in October 1976 off Wexford on the south-east coast of Ireland. Some of these fish were captured at a depth of 30m. Fahy (1982) identified the presence of a small-scale commercial fishery for shad in the Wexford Harbour area at the mouth of the Slaney.

Quigley and Flannery (unpublished data) kindly made available material compiled by them on twaite and allis shad captures, primarily at sea, over the period 1980-1996. The twaite shad records included fish from Killary Harbour and Killybegs representing a northward extension on previous known distribution data for this species in Ireland. The majority of the allis shad samples were taken off the Kerry coast, but fish also came from Dunmore East (Waterford estuary), Loop Head (mouth of R. Shannon), Achill Island and the Sligo coast.

2.2 Post-1994 data

Kurz and Costello (1996) and Aprahamian & Aprahamian (1990) reported that twaite shad spawned at the head of the tide in the R. Nore, R. Suir and R. Barrow. The review by Kurz and Costello (1996) additionally indicated the Munster Blackwater and R. Slaney as channels where the species might also spawn. These authors reported historical references to a spawning population in the R. Ilen and reported recent sightings of twaite shad in the R. Liffey, R. Erne, R. Laune, R. Boyne, R. Shannon and its tributary the R. Mulkear. The above locations are based on anecdotal comment, in the main, and little by way of scientific reports or data on individual fish is available. The same review found no evidence of allis shad spawning anywhere in Ireland (Kurz & Costello, 1996).

Both allis and twaite shad were found in the Waterford Harbour area in the period 1996-98 by Doherty and McCarthy (2002). Survey work by the Central Fisheries Board (CFB) and staff of the Southern Regional Fisheries Board (SRFB) in the period 1999-2000 confirmed the presence of twaite shad in the R. Barrow, the R. Suir and R. Munster Blackwater.

As far back as 1958 the Irish Specimen Fish Committee (ISFC) listed both allis and twaite shad in its weight categories for 'specimen fish'. Fish above a specified weight, currently set at 1.1 kg for twaite shad, qualify as 'specimens' by the ISFC (ISFC 2004). Bodies must be submitted for ratification and all material submitted to ISFC is available to Central Fisheries Board personnel for scientific study. No specimens of allis shad have been recorded by ISFC but records of twaite shad began to be submitted from 1980 onwards. Apart from a single specimen of twaite shad from Carrick-on-Suir on the R. Suir, all specimen fish were taken at St. Mullins on the R. Barrow. More recently a one-day competition in mid-May has been organised annually by the St. Mullins Angling Club. The specimen weight has been regularly adjusted by the ISFC over the years to ensure a balance between conservation of the species and reward for anglers.

Database material collected by CFB in the period 2000 – 2006 confirmed the presence of twaite and allis shad, as well as fish considered on the basis of gill raker counts to be hybrids, in the SAC waters of the Slaney, Barrow-Nore, Suir and Munster Blackwater (King and Roche In Press). Much of the material was presented by commercial salmon netsmen passing by-catch to officers of the Regional Fisheries Boards. Deep-sea commercial samples came as isolated specimens to various ports, where they were retained by officers of the Department of the Marine, Marine

Institute (MI) or Bord Iascaigh Mhara (BIM). The recent SAC data and marine–caught material repeat the distribution information available from the pre-2000 period.

Doherty *et al*. (2004) considered allis shad to be transitory non-spawning migrants in Irish waters. Since their review there have been additional records of adult allis shad (and hybrids) from the four SAC waters. Two records of allis shad penetration up to 25km into riverine water in the Munster Blackwater (near Fermoy) are considered significant. Fish of 0+ age group were found in both the Suir and Barrow in 2005 (J. King pers. comm.) and fish of 2+ age group in the Munster Blackwater in 2003 (King and Linnane, 2004). These results suggest that in some years successful spawning may occur in some of these SAC waters. Further work is required to confirm this.

A note on hybrids

Hybrids between allis and twaite shad have been reported from several other countries (e.g. R. Loire in France, Solway Firth in the UK, R. Lima in Portugal (Maitland & Hatton-Ellis, 2003)). They may form a significant proportion of the population in some systems and it has been suggested that such extensive hybridisation is a result of man-made obstacles to migration, which force both species to utilise the same spawning grounds (Maitland & Hatton-Ellis, 2003). Data on hybrids is collated by the Central Fisheries Board, but has not been included in the maps and assessments for the allis and twaite shads.

Summary

Allis shad can be found along the coasts of Western Europe from southern Iceland and Norway to Spain (Maitland & Hatton-Ellis, 2003). There are occasional records of allis shad around the Irish coast from Mayo (anti-clockwise) to Wexford. Recent data (post 1994) shows a concentration of sightings in the south-east of the country with some additional records from the south-west and west. Records from the south-east include substantial numbers of marine-caught young south of Waterford Harbour, as well as animals in the Suir, the Munster Blackwater and the Barrow. We have yet to establish that this species is breeding in Ireland, but if it is occuring it seems likely that it is happening within the large river SACs in the south (already designated for the twaite shad). **Since 1994, the allis shad has been recorded from 14 50km grid**

cells around the Irish coast – this area (35,000km^2) is taken as the extent of its current range.

There are sporadic, historical sightings of twaite shad from Donegal (anti-clockwise) to Dublin. However, all recent records for the twaite shad come from the south-east. Since 2003, twaite shad spawning activity has been recorded in three of the four SACs designated for the species; good numbers are known from the Barrow, with a low presence confirmed in spawning areas of the Suir and Blackwater. No spawning has been recorded in recent years in the Nore or Slaney. **Since 1994, there have been records of twaite shad from 4 50km grid cells – this figure (10,000km^2) is taken as the extent of the species current range.**

2.3 Trends

The available distribution data, particularly in the case of the marine records, are opportunistic rather than being the consequence of dedicated scientific survey work. However, to some extent they probably do reflect the sparse, migratory nature of these shad in Irish waters. Parallels with the situation in Britain are interesting: in both Britain and Ireland there are no known spawning sites for allis shad, yet both sub-adults and sexually mature specimens are still regularly found around our coasts. And although they too have declined, twaite shad appear to have been less affected by modifications to estuaries and rivers and continue to spawn in a three or four locations in both countries.

Overall, it would appear that there has been no change in the range of either species since the Directive came into force.

3. Population

The annual angling effort and competition at St. Mullins on the Barrow provides some form of barometer on shad status in this water. It confirms the presence of shad, predominantly twaite shad females in spawning condition, during the month of May annually. What is clear is that the numbers of 'specimen' fish fluctuate annually. However, this variation arises from numerous sources including quality and quantity of angling effort, weather, tide and river flow conditions and consequently these figures are of limited value.

In short, there is no baseline available in terms of population size for allis or twaite shad either at sea or in rivers. Some data has been collated, however, on the demographics of both species. Analysis of twaite shad from the Barrow has shown a size range of 20 - 43cm and an age range of 2-7 years (Doherty *et al.,* 2004). Similarly, specimens caught in the Slaney and Munster Blackwater between 2000 and 2003 varied in size from 20 – 46 cm (King & Linnane, 2004) suggesting that at least 6 age classes were also represented at those sites. Spawning populations are known to occur in the Barrow, Munster Blackwater and the Suir. No spawning has been recorded in recent years in the Nore or Slaney.

In the absence of more detailed population information for the twaite shad the number of recent spawning populations (3) is taken as a proxy for population size.

Allis shad specimens of 5 – 9 years were reported from the Barrow by Doherty *et al.* (2004). More recently, fish of 0+ age group were found in both the Suir and Barrow in 2005 (J. King pers. comm.) and fish of 2+ age group in the Munster Blackwater in 2003 (King and Linnane, 2004). Spawning of this species has yet to be confirmed from any river in Ireland.

In the absence of more detailed population information on the allis shad the number of 10km squares with recent (post 1994) records is taken as a proxy for population size – 25 10km squares.

3.1 Population trends

In the first half of the 20th Century commercial shad catches of greater than 100 metric tonnes were recorded in the North and Baltic seas (Doherty *et al.,* 2004). But, allis and twaite shad populations have declined throughout Europe and most fisheries have collapsed (Maitland & Hatton-Ellis, 2003). Anecdotal reports indicate a decline in shad numbers around Irish coasts: draft nets on the Slaney have caught fewer over the past number of years. Similar reports come from Carrick-on-Suir on the Suir, where shad were once a nuisance to salmon anglers and where spawning activity was observed by local people at night. There is no baseline, however, against which to measure this decline; the number of actual records for these species held by the CFB has increased significantly as a result of greater survey effort (Table 1).

No. of records	Pre 1994	1994-2006
Twaite shad	40	410
Allis shad	16	126

Table 1. No. of records of twaite and allis shad from Irish waters (Source: CFB data).

For the twaite shad, however, a decline can be measured at the most basic level i.e. number of breeding populations. It is clear that twaite shad have been known, as recently as 1990 (Aprahamian & Aprahamian 1990), to breed in at least five Irish rivers. It is possible that the Nore and Slaney populations had been small and precarious for some time before that, nonetheless, regular breeding now only occurs in three rivers.

3.2 Pressures and threats

Restricted access to spawning grounds as a result of man-made barriers to migrations (Code No. 850 – specifically weirs) is known to have impacted on shad populations throughout Europe. In channels where both allis and twaite shad have existed this restriction may force the two species to breed together and lead to genetic loss through hybridisation (Code No. 964). The presence of hybrids may be indicative of this process in Irish rivers. This introgression would ultimately lead to a population resembling most closely the predominant or favoured species. Carstairs (2000) concluded that this process might have led to the decline of, and in some cases demise of, allis shad in some UK channels. Improvement in fish passage facilities in major Irish channels could permit a spatial, and hence genetic, separation of allis and twaite shad in the same catchment.

The EPA (2001) has identified many Irish estuaries as being eutrophic (Code No. 701). This has not prevented passage of anadromous species, such as eel, salmon and shad. However, there may be critical enrichment levels that trigger oxygen or other conditions that impact adversely on adult or juvenile shad activity and survival. Eutrophication of twaite shad spawning areas could have a critical impact on breeding success (Doherty *et al*., 2004); gravelled areas at spawning sites should be clear of algal growths to prevent smothering of the eggs falling onto the river bed.

Leisure fishing (Code No. 220) for shad has been pointed to as a possible pressure, with a requirement to provide bodies of fish to ISFC to claim a specimen (Code No. 240). However, angling occurs only on the R. Barrow at St. Mullins – where the largest population of twaite shad appears to occur. In addition, anglers there are very conservation-minded with a catch-and-release and caution-in-handling approach very evident. Many anglers do not submit fish as specimens, even though the fish would have reached the required weight.

Much of the CFB database comes from commercially-caught shad (Code No. 210). Two types of commercial activity are identified. In one, the commercial fishing is done from trawlers at sea and shad present as a by-catch. Mortalities are inevitable here and the shad are frequently associated with herring or mackerel shoals appearing on the trawler radar.

The second commercial fishing pressure is one for Atlantic salmon taking place in inshore and estuarine waters, again with shad presenting as by-catch. Netsmen indicate that the traditional snap-netting undertaken from small boats on the Suir permits a return alive of shad taken in the bag-type nets, whereas draft netting appears to lead to mortality, as with drift netting. Current legislation and regulations has eliminated the salmon drift net fishery and confined commercial salmon capture to estuarine waters. Within these, quotas and conservation limits determine if commercial salmon fishing will be permitted in any one year. At present, no commercial salmon fishing is permitted in any of the four SAC estuaries designated for twaite shad. This may be a benefit to the species, although the number of specimens taken as by-catch appears to have been small. Shad may still appear as by-catch in netting operations for other estuarine fish species waters.

Besides drift netting, it is considered that future threats are the same as the present pressures. If population levels remain at the apparent present low levels then there is even greater likelihood of hybridisation and introgression. Implementation of Water Framework Directive (WFD) requirements should lead to improvements in water quality attributes in estuaries and rivers. This may, in turn, facilitate habitat use by anadromous shad. In addition, physical barriers to upstream migration, particularly for allis shad, may also come under scrutiny under WFD, which requires that 'connectivity' exist in watercourses. Such geomorphological connectivity would benefit biological connectivity and would benefit all life history stages of all anadromous fish species.

4. Habitat

Shad spend most of their lives at sea, but move into the estuaries of large rivers to breed. In some European rivers, allis shad have been known to ascend upstream for several hundred kilometres (Maitland & Hatton-Ellis 2003); twaite shad normally spawn near the tidal limits. Unimpeded access from the sea through the estuarine and tidal areas to the spawning grounds is essential. Spawning grounds comprise deep pool areas and backwaters for adults to rest and gravelled areas where eggs are laid. The gravels should be clear of algal growths and the interstitial spaces in the gravels free of fine deposits. The most successful rivers have substantial lengths of tidal channel or estuary downstream of the spawning areas to enable development of the juvenile stages prior to going to sea.

Despite recent focussed survey effort we still have very limited information about habitat usage by shads in Irish estuarine waters and rivers; our understanding of their habits in the marine environment is even more patchy. The only known estuarine waters where fish in spawning condition have been recently (post-2000) found are the four waters designated as SACs. The only well known spawning site for the twaite shad is at St. Mullins on the Barrow, but there is good historical records for Carrick-on-Suir being the focus of spawning on the Suir. King's Island, Cappoquin and Inistioge are the probable focus sites for twaite shad spawning on the Slaney, Blackwater and Nore respectively. The waters downstream of each of these sites are considered to constitute good habitat for nursery function for 0+ and 1+ shad (J. King pers. comm.).

Allis shad have been recorded up to 25km upstream of the head of the tide in the Munster Blackwater. High water flows facilitate upstream migration in this species. Although allis shad of various ages and sizes have been found in Irish estuaries, there is no historical or recent data to show that this species breeds in Irish rivers, or even to what extent they rely on Irish coastal waters or estuaries for part of their life cycle.

In the absence of more detailed information on habitat use by the twaite and allis shads, the number of 10km squares with recent (post 1994) records is taken as a proxy for the extent of habitat – 2,500 km^2 for the allis; 1,400 km^2 for the twaite.

4.1 Trend

There has been no apparent change in habitat availability since the Directive came into force (1994).

5. Future prospects

The current status of the twaite shad population in the R. Slaney is considered to be vulnerable, based on recent information from commercial draft-net fishermen who have been netting the estuarine area over many years. The same can be said of the once-common shad populations in the R. Suir at Carrick-on-Suir where the presence of shad, as indicated by angling encounters and observation of spawning, has not been noted by local people, in any quantity, in recent years. Equally, no shad have been recorded from the Nore in recent years. Comparative drift net sampling by CFB in the spring period generated satisfactory numbers of twaite shad on the Barrow, substantially lower numbers on the Suir and M. Blackwater and no fish whatever on the Slaney (J. King pers. comm.).

Improvement in fish passage facilities in major Irish channels could permit a spatial, and hence genetic, separation of allis and twaite shad in the same catchment. It would be imperative that the upstream channel provide suitable spawning habitat including extensive areas of fast-flowing shallows over cobble and gravel as well as pool areas and backwaters (Maitland & Hatton-Ellis, 2003). Such terrain is present in the R. Nore and R. Suir whereas dredging and navigation weirs on the R. Barrow render it less suitable as spawning habitat. Addressing such obstructions may be required under both Water Framework Directive and Habitats Directive. Such measures would provide 'infrastructural support' for the shad species but could only be beneficial to shad conservation if shad were available to penetrate these new areas in sufficient numbers to find mates and engage in successful spawning.

Shoaling species such as shad may be particularly susceptible to marine capture. A marine sample of 55 fish taken by one trawler on one day highlights this problem (King & Linnane, 2004). This sample was taken due south of the entry to the Barrow – Nore and Suir SACs. The sample was dominated by young allis shad, of a size smaller than that encountered in Irish estuarine waters. Major loss of pre-spawning or virgin adult fish would be particularly damaging in the case of allis shad, shown to be predominantly semelparous. Marine interception may have even more widespread implications if mixing of shoals from different geographic areas, such as Ireland and Wales – south-west England, occurs at sea, as might be the case off the Irish south-east coast.

On a positive note, the designation of four waters as SACs for shad has provided a stimulus for investigations on these species. This has already yielded useful information. Going forward, it is imperative that a sampling protocol be developed that will measure shad production, in some manner, to permit a comparison from year to year. Trials to date have indicated a number of strategies that may be adapted to achieve this. These require to be bedded down and used in consecutive years up to the next round of mandatory reporting.

Implementation of the EU Water Framework Directive, the Nitrates Directive and the Urban Wastewater Directives should be conducive to improvement in water quality in Irish rivers and estuaries, which should, in turn, help shad conservation in the four Irish SACs.

Overall, the propects of the twaite shad must be considered Poor. Given the uncertainty about the status of allis shad in Irish water, no definitive statement about the future propsects of this species can be made – it is considered Unknown.

6. Complementary information

6.1 Favourable reference range

Historical records quoted by Went (1953) and Bracken and Kennedy (1967) place shad in Lough Erne (1772), in Lough Corrib (1684), in Killaloe on the Shannon (1860) and in the Upper Lake in Killarney (1953). These are not unlikely, given the recent records of Allis shad penetration into the Munster Blackwater up to 25 km into the riverine zone. These historical records may be examples of extreme vagrancy, or of a once-normal spawning migration. There are no recent records of anadromous shad from the Erne, Corrib, Shannon or Laune.

Range does not appear to be a limiting factor for either the allis shad or twaite shad (J. King pers. comm.) and notwithstanding occasional records of vagrants from around the coast, there is no evidence that range has reduced. It is considered that the current ranges - 35,000km^2 for the allis shad and 10,000km^2 for the twaite shad - are sufficient. This parameter is considered favourable for both species.

6.2 Favourable reference population

Further survey work is required on both allis and twaite shad populations in Ireland to establish whether the present numbers are sufficient to maintain the species in the long-term or whether remedial measures may be required to encourage population increase. **For the allis shad the priority must be to establish whether the species is actually breeding in any Irish river system. Until such work has been completed no Favourable reference population can be estimated for this species and its population status must be considered Unknown.**

For the twaite shad there is good information to show that breeding has occurred in 5 rivers within the past 20 years – R. Barrow, R. Suir, R. Slaney, R. Nore and Munster Blackwater. Spawning has not been confirmed elsewhere. **Until more detailed information becomes available on the actual numbers of twaite shad required to maintain a healthy population in each of these rivers, regular breeding in each of these five systems can be taken as a proxy for favourable reference population. In recent years regular breeding has only been confirmed in three of the five**

populations and consequently this parameter is considered to be Unfavourable – Bad.

6.3 Habitat for the species

Despite recent focussed survey effort we still have very limited information about habitat usage by shads in Irish estuarine waters and rivers; our understanding of their habits in the marine environment is even more patchy. Although, there is no evidence of any decline in the extent of shad habitat and by and large aquatic habitat quality is improving in Ireland, more survey work is required before we can assess whether the current extent and quality of habitat available to the anadromous shads is sufficient to provide for their long term survival in Ireland. **This parameter is considered as Unknown for both species.**

Summary of Conclusions		
	Allis shad	**Twaite shad**
Range	Favourable (FV)	Favourable (FV)
Population	Unknown (XX)	Bad (U2)
Habitat for the species	Unknown (XX)	Unknown (XX)
Future prospects	Unknown (XX)	Inadequate (U1)
Overall assessment of status	Unknown (XX)	Unfavourable - Bad (U2)

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Vickers, K. U. 1959 Unusual fish from north-east Irish coast. *The Irish Naturalists Journal*, **13**, 22.

Went, A. E. J. 1953. The status of the shads, *Alosa finta* and *A. alosa* Cuvier, in Irish waters. *The Irish Naturalists Journal* **11**: 8-11.

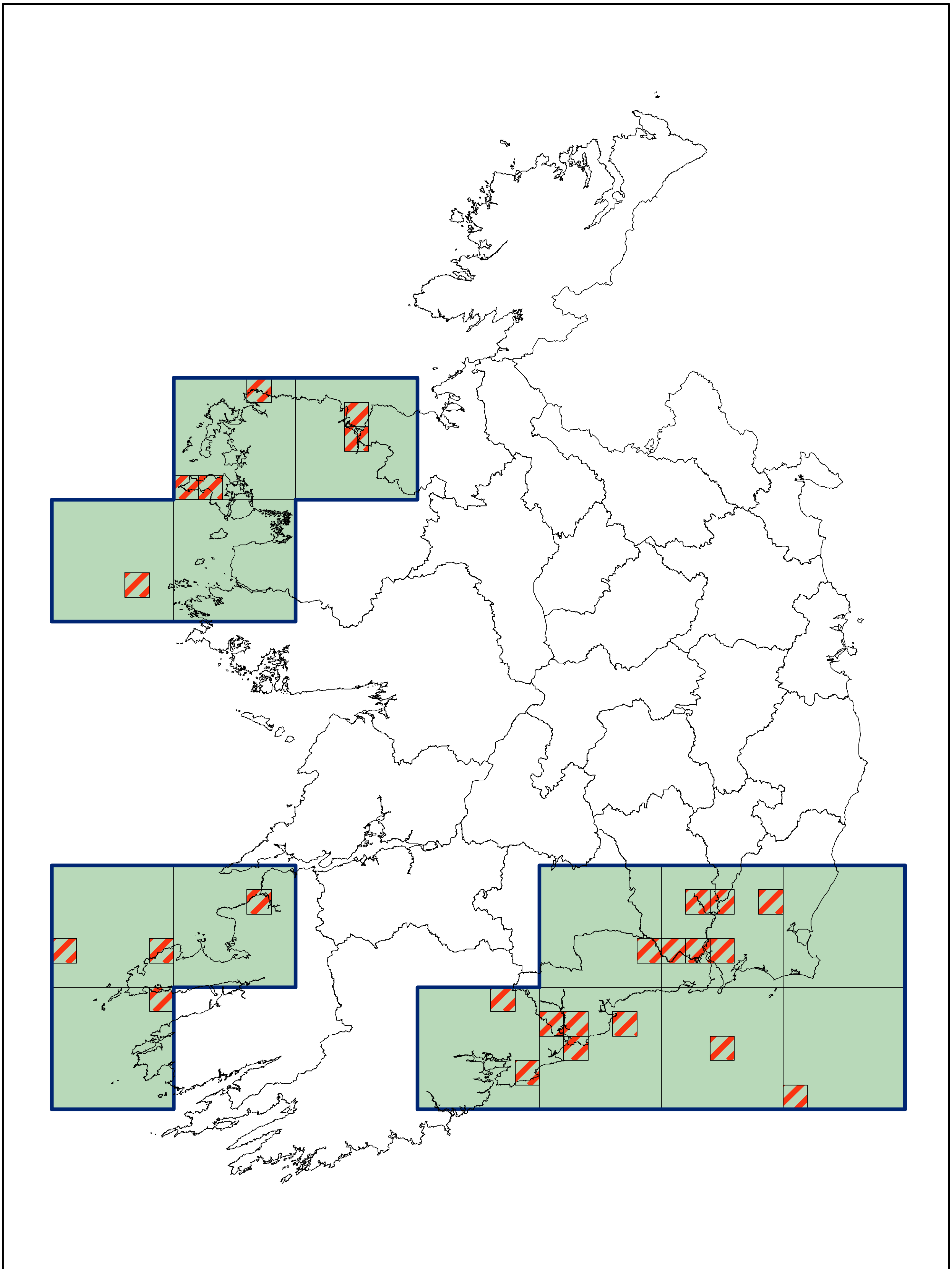
1102 Allis shad (*Alosa alosa)*

1. National Level	
Species code	1102
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	**Doherty, D. & Mc Carthy, T. K. (2002)** Aspects of the ecology, parasites and future conservation of Twaite shad (*Alosa fallax*) and Allis shad (*Alosa alosa*) in south-eastern Ireland. In M.J. Collares-Pereira, I.G. Cowx and M.M. Coelho (eds), *Conservation of Freshwater Fishes: options for the future*. Fishing News Books, Oxford: 98-112. **Doherty, D., O'Maoileidigh, N. & Mc Carthy, T. K. (2004)** The biology, ecology and future conservation of twaite shad (*Alosa fallax*), Allis shad (*Alosa alosa*) and Killarney shad (*Alosa fallax killarnensis*) in Ireland. *Biology & Environment: Proceedings of the Royal Irish Academy* 104: 93-102. **Fahy, E. (1982)** A commercial net fishery taking Twaite shad *Alosa fallax* (Lacepede) in the estuary of the river Slaney. *The Irish Naturalist's Journal* 20: 498-500. **King, J.J. & Linnane, S.M. (2004)** The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals*, No 14. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland.. **King, J. J. & Roche, W. K. (In Press)** Aspects of anadromous Allis shad (*Alosa alosa* Linnaeus) and Twaite shad (*Alosa fallax* Lacepede) biology in four Irish Special Areas of Conservation (SACs): status, spawning indications and implications for conservation designation. *Hydrobiologia.* **Kurz, I. & Costello, M.J. (1996)** Current knowledge on the distribution of lampreys, and some other freshwater fish species listed in the Habitats Direective, in Ireland. Unpublished report to NPWS, Dublin. **Maitland, P.S. & Hatton-Ellis, T.W. (2003)** Ecology of the Allis and Twaite shad. *Conserving Natura 2000 Rivers Ecology Series* No. 3. English Nature, Peterborough. **Went, A. E. J. (1953)** The status of the shads, *Alosa finta* and *A. alosa* Cuvier, in Irish waters. *The Irish Naturalists Journal* 11: 8-11.
2.3 Range	
2.3.1 Surface area	35,000km^2
2.3.2 Date	May 2007
2.3.3 Quality of data	1 = poor
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	Presence/absence, use GIS based map – vector format or grid map
2.4.1 Population size estimation	25 10km squares
2.4.2 Date of estimation	June 2007
2.4.3 Method used	2 = extrapolation from surveys
2.4.4 Quality of data	1 = poor
2.4.5 Trend	unknown
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	N/a
2.4.9 Justification of % thresholds for trends	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field

2.4.10 Main pressures	212 – Professional fishing – trawling (bi-catch) 213 – drift net fishing 220 – Leisure fishing 701 – Water pollution (eutrophication) 850 – Modification of hydrographic functioning (specifically weirs) 964 – genetic pollution
2.4.11 Threats	212 – Professional fishing – trawling (bi-catch) 220 – Leisure fishing 701 – Water pollution (eutrophication) 850 – Modification of hydrographic functioning (specifically weirs) 964 – genetic pollution
2.5 Habitat for the species	
2.5.2 Area estimation	2,500 km^2
2.5.3 Date of estimation	July 2007
2.5.4 Quality of data	1 = poor
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	N/a
2.6 Future prospects	Unknown

2.7 Complementary information	
2.7.1 Favourable reference range	35,000 km^2
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unknown (XX)
Overall assessment of CS	Unknown (XX)



1:2,000,000

0 12.5 25 50 Kilometers

Allis shad
Alosa alosa

1102

Current Distribution (25 10km grid cells)
Current Range (14 50km grid cells)
Favourable Reference Range (14 50km grid cells)

Date: July 2007

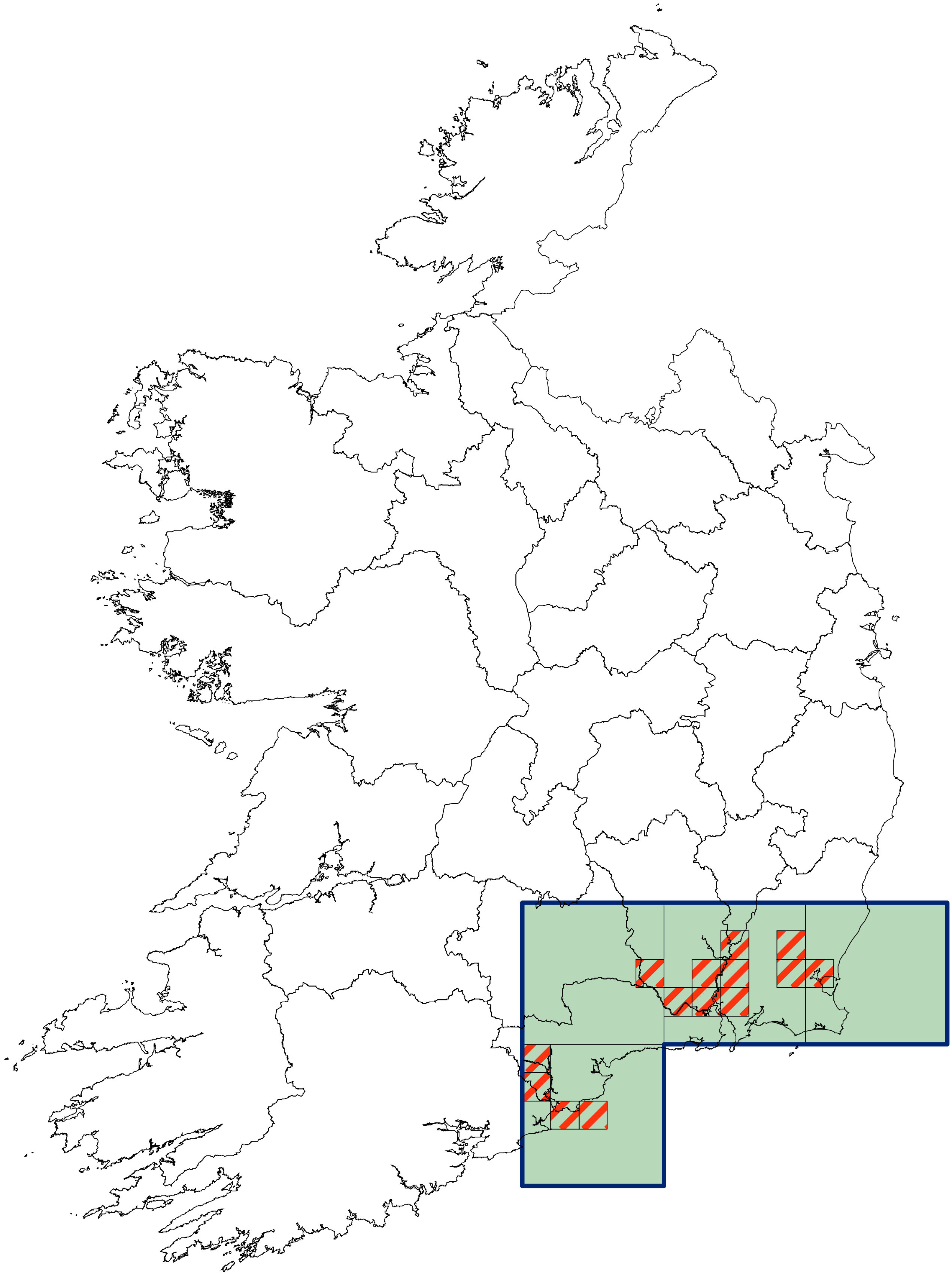
1103 Twaite shad (*Alosa fallax*)

1. National Level	
Species code	1103
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	**Doherty, D. & Mc Carthy, T. K. (2002)** Aspects of the ecology, parasites and future conservation of Twaite shad (*Alosa fallax*) and Allis shad (*Alosa alosa*) in south-eastern Ireland. In M.J. Collares-Pereira, I.G. Cowx and M.M. Coelho (eds), *Conservation of Freshwater Fishes: options for the future*. Fishing News Books, Oxford: 98-112. **Doherty, D., O'Maoileidigh, N. & Mc Carthy, T. K. (2004)** The biology, ecology and future conservation of twaite shad (*Alosa fallax*), Allis shad (*Alosa alosa*) and Killarney shad (*Alosa fallax killarnensis*) in Ireland. *Biology & Environment: Proceedings of the Royal Irish Academy* 104: 93-102. **Fahy, E. (1982)** A commercial net fishery taking Twaite shad *Alosa fallax* (Lacepede) in the estuary of the river Slaney. *The Irish Naturalist's Journal* 20: 498-500. **King, J.J. & Linnane, S.M. (2004)** The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals*, No 14. National Parks and Wildlife Service, Dept. of Environment, Heritage and Local Government, Dublin Ireland.. **King, J. J. & Roche, W. K. (In Press)** Aspects of anadromous Allis shad (*Alosa alosa* Linnaeus) and Twaite shad (*Alosa fallax* Lacepede) biology in four Irish Special Areas of Conservation (SACs): status, spawning indications and implications for conservation designation. *Hydrobiologia.* **Kurz, I. & Costello, M.J. (1996)** Current knowledge on the distribution of lampreys, and some other freshwater fish species listed in the Habitats Direective, in Ireland. Unpublished report to NPWS, Dublin. **Maitland, P.S. & Hatton-Ellis, T.W. (2003)** Ecology of the Allis and Twaite shad. *Conserving Natura 2000 Rivers Ecology Series* No. 3. English Nature, Peterborough. **Went, A. E. J. (1953)** The status of the shads, *Alosa finta* and *A. alosa* Cuvier, in Irish waters. *The Irish Naturalists Journal* 11: 8-11.
2.3 Range	
2.3.1 Surface area	10,000km^2
2.3.2 Date	May 2007
2.3.3 Quality of data	1 = poor
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	Presence/absence, use GIS based map – vector format or grid map
2.4.1 Population size estimation	3 breeding populations
2.4.2 Date of estimation	June 2007
2.4.3 Method used	2 = extrapolation from surveys
2.4.4 Quality of data	2 = moderate
2.4.5 Trend	From 5 regular breeding populations to 3 = - 40%
2.4.7 Trend-Period	c1990 - 2007
2.4.8 Reasons for reported trend	3 = direct human influence 4 = indirect human influence
2.4.9 Justification of % thresholds for trends	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field

2.4.10 Main pressures	212 – Professional fishing – trawling (bi-catch) 213 – drift net fishing 220 – Leisure fishing 701 – Water pollution (eutrophication) 850 – Modification of hydrographic functioning (specifically weirs) 964 – genetic pollution
2.4.11 Threats	212 – Professional fishing – trawling (bi-catch) 220 – Leisure fishing 701 – Water pollution (eutrophication) 850 – Modification of hydrographic functioning (specifically weirs) 964 – genetic pollution
2.5 Habitat for the species	
2.5.2 Area estimation	1,400 km^2
2.5.3 Date of estimation	July 2007
2.5.4 Quality of data	1 = poor
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	Poor

2.7 Complementary information	
2.7.1 Favourable reference range	10,000 km^2
2.7.2 Favourable reference population	5 breeding populations
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Unfavourable – Bad (U2)
Habitat for the species	Unknown (XX)
Future prospects	Unfavourable – Inadequate (U1)
Overall assessment of CS	Unfavourable – Bad (U2)



1:2,000,000

0 12.5 25 50 Kilometers

Twaite shad
Alosa fallax fallax

1103

Current Distribution (14 10km grid cells)
Current Range (4 50km grid cells)
Favourable Reference Range (4 50km grid cells)

Date: July 2007

Supporting material for the 'Main Results of the Surveillance under Article 11' for the Annex II species, (*Salmo salar* L.), Atlantic Salmon, in Ireland

This document contains a summary overview and background information pertaining to Atlantic salmon in Ireland to support the surveillance requirement identified in the EU Habitats Directive (92/43/EEC). It forms part of the first reporting cycle which will be repeated every six years. Apart from the summary overview the report is structured to follow the reporting format of Annex B (the main results of surveillance).

SUMMARY OVERVIEW

The Atlantic salmon (*Salmo salar* L.) is one of the species covered by the Habitats Directive (92/43/EEC). The Directive states that:

"If a species is included under this Directive, it requires measures to be taken by individual member states to maintain or restore them to favourable conservation status in their natural range".

The conservation status of a species refers to the sum of influences acting on the species concerned that may affect the long-term distribution of its populations within its territory. Conservation status is "favourable" when:

> - population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
>
> - the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
>
> - there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis;

The Directive provides for management measures to be taken to maintain or restore, at favorable conservation status, natural habitats and species of wild fauna and flora of Community interest.

Currently 26 Irish salmon rivers are listed by the National Parks and Wildlife Service under the terms of the Directive (Appendix II). However, all salmon populations within its natural range, not only those in the specified 26 rivers, within the jurisdiction of the member state must be reported. A total of 148 rivers have been identified as constituting the natural range of salmon in Ireland.

O'Maoileidigh et al. (2007) report the status of Irish salmon in an international context as follows: "World catches of Atlantic salmon (S*almo salar*) increased dramatically during the 1960's and peaked in 1973.

This increase in the catch was associated with the expansion of marine salmon fisheries and the development of more efficient fishing technology and gears (including mono-filament nets). The catch has significantly declined in recent years from a maximum of over 12,000 tonnes in total in 1973 to only 2,110 tonnes in 2005, 46 t below the confirmed catch for 2004 (2,156 t) and the lowest in the time series. This overall decline is partially due to control measures introduced by many countries to curtail fishing effort and closures of some fisheries. However, a decline in the overall size of salmon populations has also occurred. Despite the very restrictive measures in force in the high seas fisheries of Greenland and Faroes in recent years no significant increase in catches in homewater countries is evident."

Furthermore they state that "Irish homewater commercial catches have also fluctuated widely in this period but appear to reflect the trend in world catches. In the early part of the time series, the greatest proportion of the homewater salmon catch was traditionally caught by the inshore draft nets up to 1968. From 1968 on, the draft net catch decreased, while there was a corresponding increase in the drift net catch to 1976. The sudden decline in the catch of all engines subsequently is attributable to several factors including the salmon disease Ulcerative Dermal Necrosis (UDN), poor marine survival and some overfishing. The drift net catch fluctuated in the 1980s with high catches recorded in a number of years, while the draft net catch remained low but stable. In the mid 80s and early 1990s, the drift net catch decreased considerably. There was a slight recovery in the catch up to 1994 but this was not sustained. The 2001 to 2006 values are derived from the logbooks reports of commercial fishermen and angling logbooks, (Central Fisheries Board, 2006).

A Salmon Management Task Force was established by the Minister for the Marine and Natural Resources in 1996 to review the management of Irish salmon stocks. The task force recommended a new rationale for management of salmon stocks based on achieving spawning escapement targets for each specific stock and maintaining stocks above conservation limits. The proposed new system provides that the number of fish available for capture is the surplus after the spawning requirements are met. This allows a faster response if the stocks are threatened.

In 2001, significant progress was made towards establishing conservation limits for each river in each of the 17 salmon fishing districts and estimating the surplus (if any) after conservation limits have been met. An initial commercial TAC of 219,619 fish was imposed for the 2002 season, followed by reduced TACs of 182,000 fish for 2003 and 162,000 fish in 2004 and 139,900 in 2005. A TAC of 91,000 salmon was recommended for the 2006 fishery based on the recommendations of the National Salmon Commission."

In 2006 a government decision was taken to comply with scientific advice provided by the Commission, through its Standing Scientific Committee. The advice is set out below:

- The overall exploitation in most districts should immediately decrease, so that Conservation Limits can be consistently met.

- Furthermore, due to the different status of individual stocks within the stock complex, mixed stock fisheries present particular threats to the status of individual stocks.
- Thus, the most precautionary way to meet national and international objectives is to operate fisheries on individual river stocks that are shown to be within precautionary limits i.e. those stocks which are exceeding their Conservation Limits.
- Fisheries operated in estuaries and rivers are more likely to fulfil these requirements

There are two main components in the Irish salmon stock - 1 Sea Winter (1SW) salmon, generally referred to as grilse, which return to freshwater primarily during the summer months, and 2 Sea Winter (2SW) salmon or spring salmon, which return primarily during spring. The incidence of older sea age groups (> 2SW) is low.

Up to 2006 a large scale drift net fishery operated in June/July which exploited mainly 1SW fish. New regulations introduced in 2007 have resulted in closure of the drift net fishery and the commercial inshore fishery (mainly draft nets) operates from mid-May to July. Rod fisheries can operate over an extended period between January and October (depending on the fishery), with the main fisheries exploiting grilse in the June to September period.

Supporting material for Annex B

BIOGEOGRAPHIC LEVEL

Range

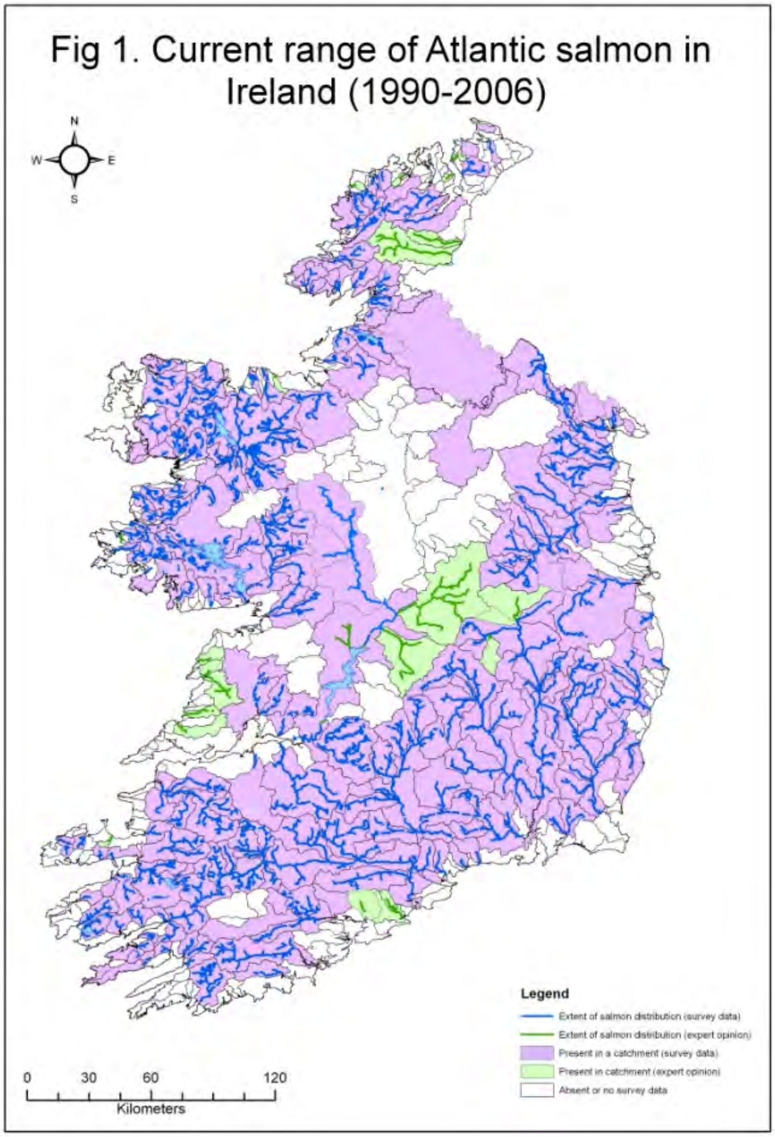


Fig. 1. The range of Atlantic salmon in Ireland based on data from 1990-2005

In Ireland, 148 rivers have been identified as salmon catchments (NASCO 2005, CNL (05) 45). The range of salmon in these catchments (Fig. 1) was established by plotting electro-fishing survey information, known salmon spawning areas or salmon redd count data, and salmon rod catch data.

These data points were generated by staff from the Central and Regional Fisheries Boards and the Marine Institute.

The catchments marked in green lacked any of the aforementioned data sources but salmon presence was established from expert opinion. While salmon have a nominal presence in some other catchments, the 148 designated rivers are regarded as encompassing the natural range of salmon in Ireland. Hydro-electric barriers on the rivers Liffey, Lee, Shannon and Erne restrict the distribution of salmon in these four catchments.

The range of salmon has not changed significantly in the recent decades as no major new barriers have been erected. While the reporting period for the Directive commences in 1994, data are presented from 1990 to provide a more comprehensive range overview.

Reporting of range

For the purposes of Article 17 reporting, the Current Range for Salmon has been plotted on a standardised grid square basis.

Using the Irish National Grid 10km grid cells the spatial data on the distribution of salmon in Ireland (river vectors and lake polygons) was intersected with the 10km grid to generate a grid based map of salmon distribution.

Following the IUCN criteria for extent of occurrence (IUCN, 2001) where the 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'*.

and the EU Guidelines on the derivation of range for the purposes of Article 17 reportin where the range is described 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"* (European Commission, 2006)

the range for salmon was derived as the smallest envelope or polygon, which describes the distribution of the species and where the polygon was drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps (i.e. non-occupied squares) in the distribution of 3 or more grid squares (10-km side) or oblique gaps of 2 or more squares were deemed sufficient to justify a break in the range.

Population

Distribution map – data sources

Salmon spawning areas and redd count data

Between 2004 and 2006 data on the distribution of known salmon spawning areas and individual salmon redd counting locations were compiled by Regional Fisheries Board staff and incorporated into a national database by the Central Fisheries Board (Fig. 2). One of the many functions of the database was to provide a national overview of the distribution of salmon in all catchments based on spawning locations.

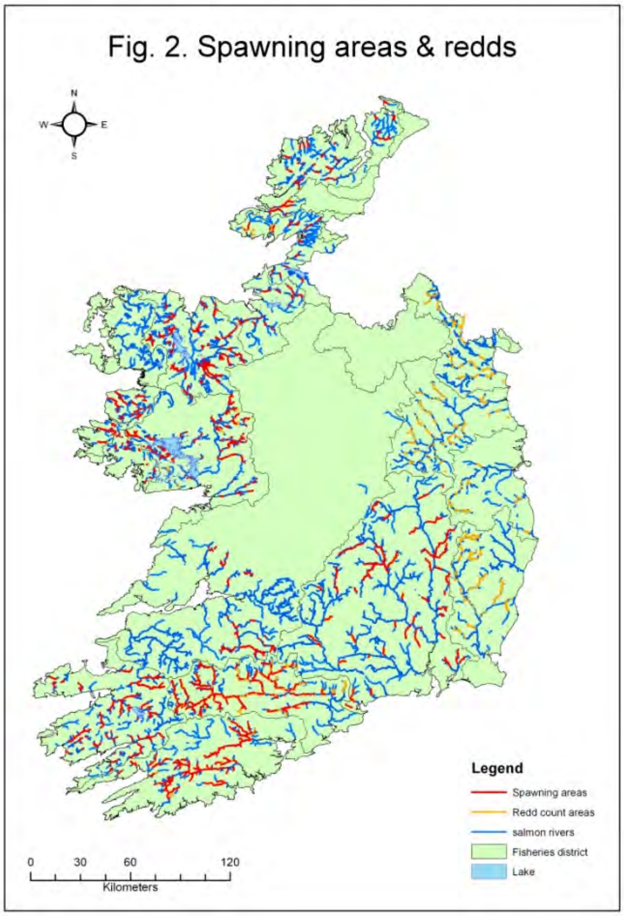


Fig. 2. Atlantic salmon - current spawning and redd count areas.

Population size estimation

Adult Salmon

The Irish salmon stock comprises one sea winter salmon (1-SW) and multi sea winter salmon (MSW). The estimated total population of 1-SW salmon in 2006 was 236,764 of which 126,652 1-SW fish are estimated to spawn (O'Maoiléidigh *pers. comm.*). The total estimated population of multi-sea-winter salmon is 35,763, of which 25,269 are estimated to spawn in 2006 (O'Maoiléidigh *pers. comm.*). Data on population size is derived from catch data, unreported catch and exploitation rate from micro-tagged salmon.

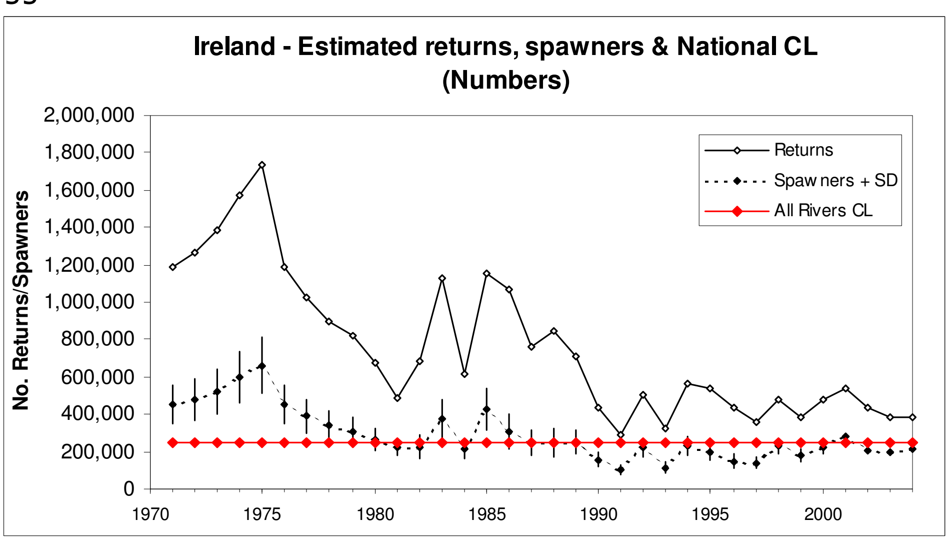


Fig. 3. Estimated returns, spawners & National Conservation Limit for Atlantic salmon in Ireland 2005 (Anon, 2006a)

Salmon Populations in Individual Rivers

Data on rod catch, rod exploitation rate, commercial catch and, where available, counter data, are analysed annually by the Standing Scientific Committee (SSC) of the National Salmon Commission to provide an estimate of the status of salmon stocks in each of the designated 148 Irish salmon rivers. The estimate of spawning salmon is compared to the individual salmon conservation limit (CL) for each river to determine if it is above or below CL. Up to 2006 the scientific process entailed assessment at the Fisheries District level and Fisheries District Conservation Limits (aggregated river specific CLs) were calculated to assess if District returns exceeded CL. Catch advice from 2007 onwards will be based on assessment of spawning stock and attainment of CL on an individual river basis.

A conservation limit is defined by the North Atlantic Salmon Conservation Organisation (NASCO) as "***the spawning stock level that produces long-term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship".*** The EU Commission's DG Environment accept that the Conservation Limit approach used by the Standing Scientific Committee (SSC) is an appropriate conservation reference point for Irish salmon stocks.

For the 2007 season, the SSC advised that:

- 43 rivers are meeting and exceeding their Conservation Limits
- 34 rivers are not meeting their Conservation limits
- 74 small rivers have insufficient data to make an assessment of population status.

The above totals 151 rivers due to some subdividing in the extent of certain angling fisheries in some of the 148 identified salmon rivers.

Rivers above and below CL or unassessed rivers are illustrated in Fig. 4 and listed in Appendix 1, 2 & 3.

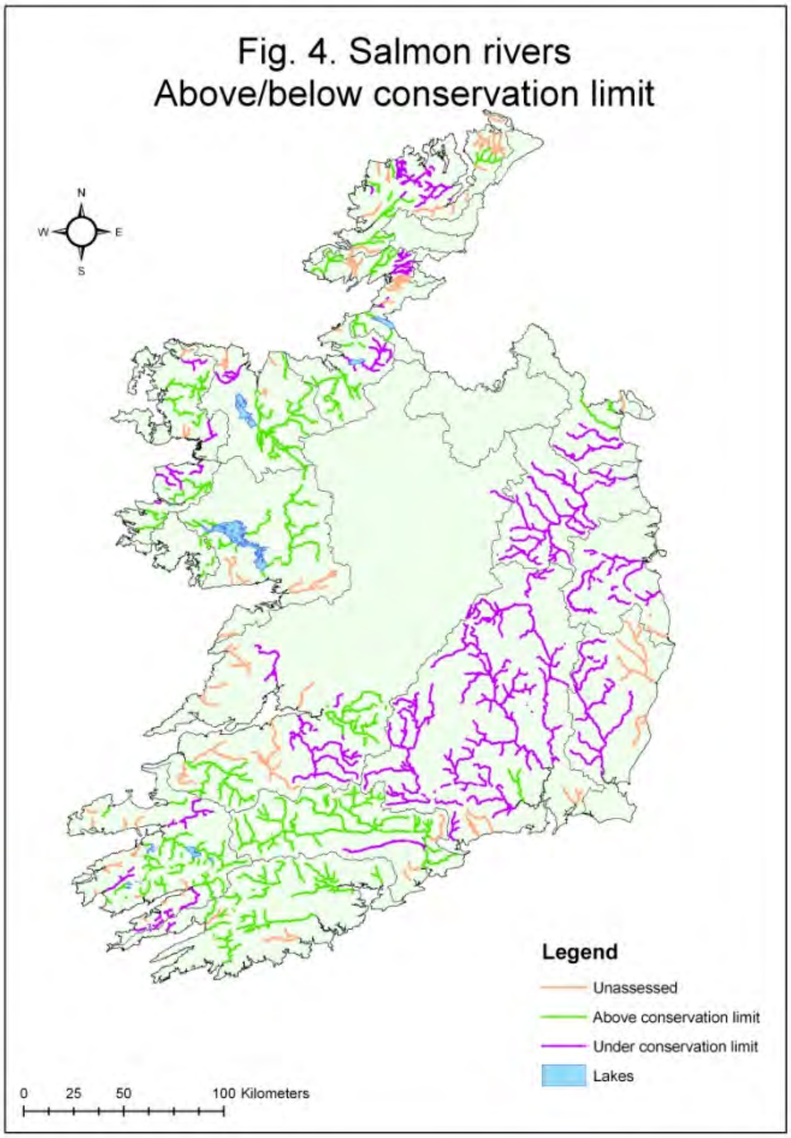
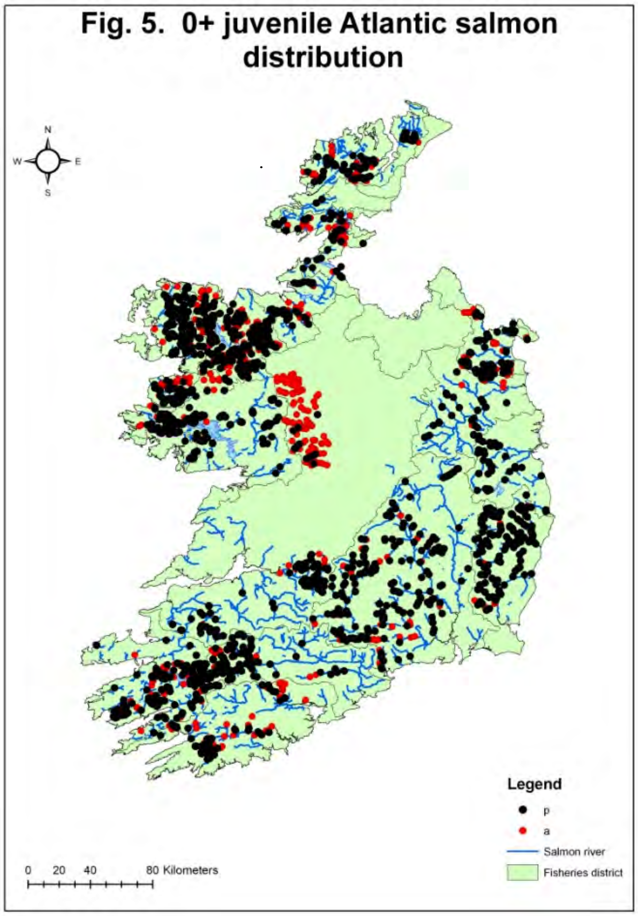
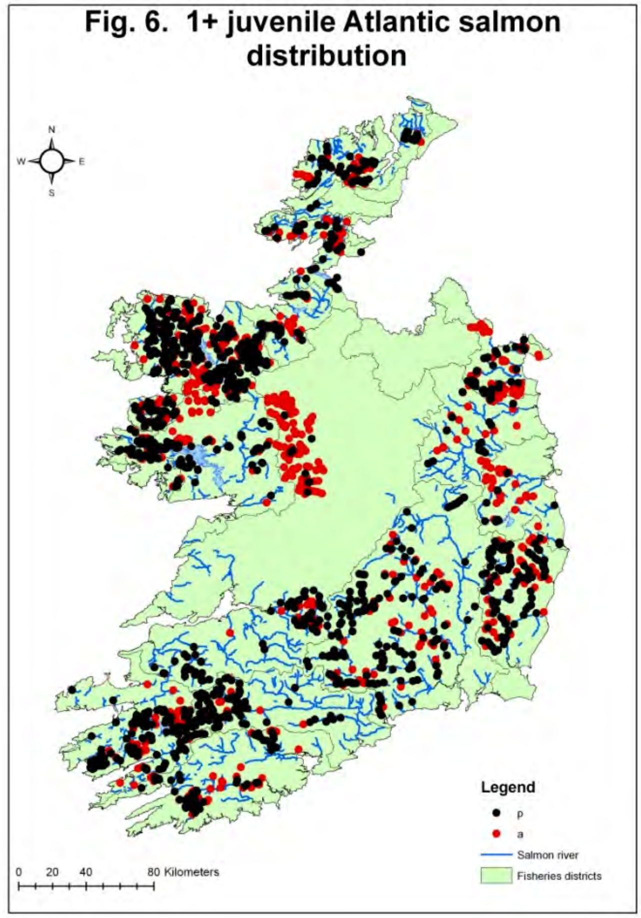


Fig. 4. Salmon rivers - Conservation Limit (CL) status 2006

Juvenile Salmon

The distribution of juvenile salmon (0+ and ≥1+) at 4,126 electro-fishing sites surveyed over the 1990-2006 period nationally are shown, Figs. 5 & 6. These data contribute to the generation of salmon range data (Fig. 1) and the map of salmon distribution in Annex B. Juvenile salmon are widespread throughout the country. Small numbers of juvenile salmon are present in some Lower Shannon tributaries. However, the middle and upper Shannon are largely devoid of juvenile salmon based on electrofishing data. Pre-1990 survey data were not included (Figs. 5 & 6) which accounts for obvious absences in some catchments.





Figs. 5 & 6. The distribution of 0+ (Fig. 5) and ≥1+ (Fig.6) juvenile salmon at 4,126 electrofishing sites surveyed over the period 1990-2006.

Estimation of Juvenile Salmon Abundance

Electro-fishing data has been collated since 1990 to provide an indication of juvenile salmon abundance nationally. Data are presented for 0+ and ≥1+ salmon (Figs. 7 & 8). The juvenile abundance data is presented in three formats depending on data quality:

- Ist fishing minimum density estimates (no./m^2) based on a single pass (one electro-fishing run). Typically this represents up to 50% of fish present per m^2 (0+ and ≥1+) of channel area sampled.
- Multiple fishing minimum density estimates (no./m^2) based on two or three passes summed and divided by the total area fished.
- Estimated densities (no. /m^2) which is a calculated estimate of density based on multiple fishings.

This approach was used to make best use of the available raw data and to allow some degree of standardization and comparability of results.

Densities of juvenile salmon are variable with poorer densities recorded along the eastern seaboard. Higher densities are evident in the south west, west and north-west.

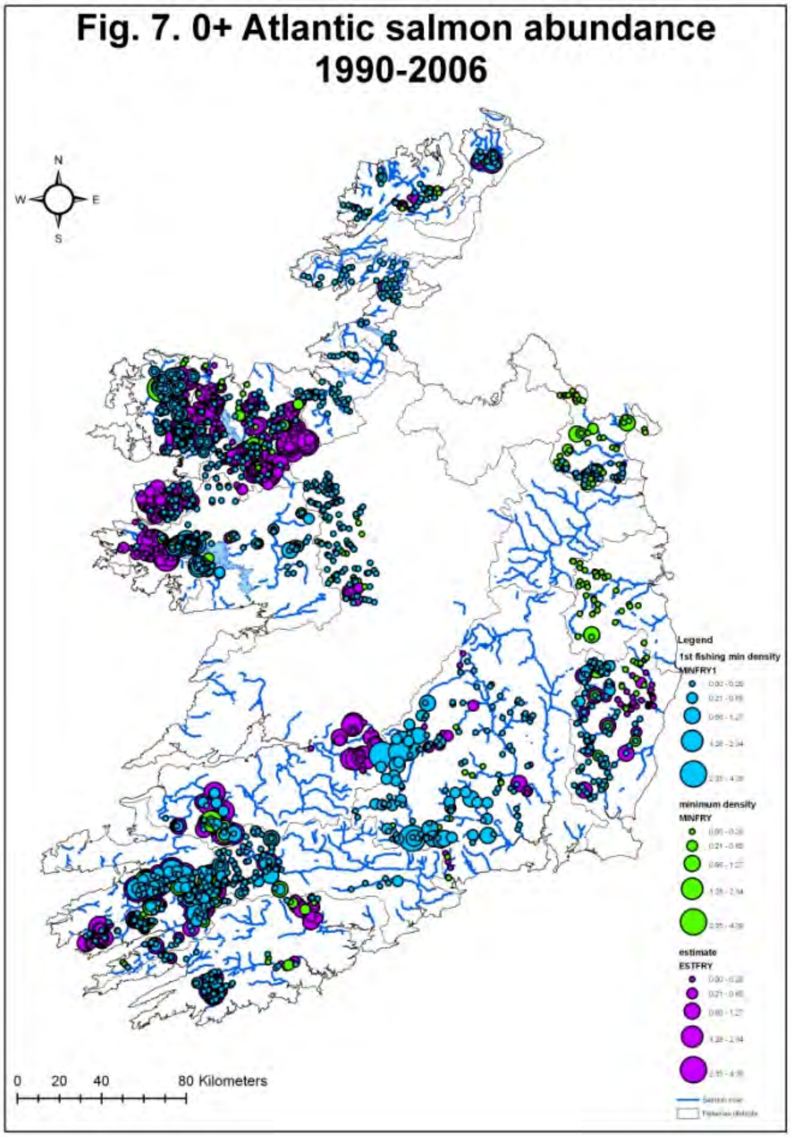
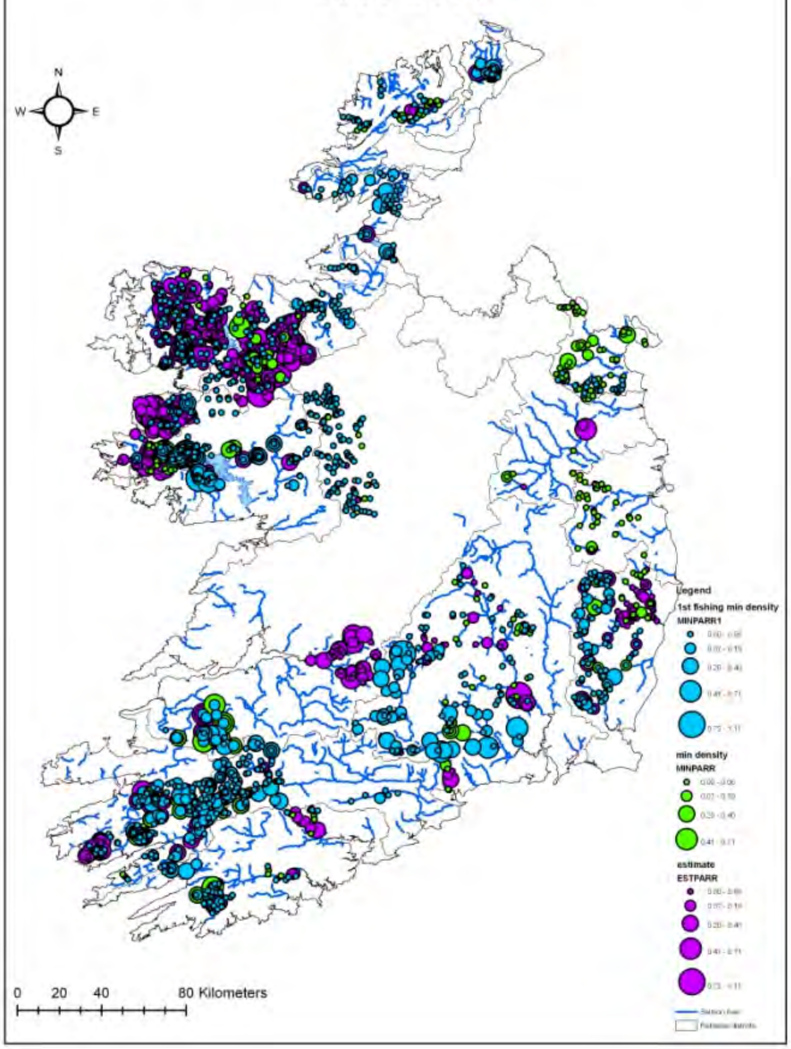


Fig. 7. & 8. Juvenile salmon abundance (0+ in Fig. 7. and ≥ 1+ in Fig. 8.) represented by 1st fishing, multiple fishing minimum densities or estimated densities. All densities presented as no. fish/m^2.

Fig. 8. 1+ Atlantic salmon abundance 1990-2006



Reasons for reported trend

Climate Change

Closure of marine mixed stock fisheries for salmon and even complete closure of some salmon rivers to harvest fisheries may not ensure that all rivers will meet or exceed Conservation Limits in the short term. There are several identifiable problems mitigating against immediate recovery and this must be taken into account for future management over and above management of fisheries. In some instances, such as climate change leading to poorer marine survival of salmon, it may not be possible to tackle the specific problems directly. Some of these specific problems are outlined below.

Marine Survival

Although there has been considerable fluctuation, estimates of marine survival prior to 1996 for wild stocks were generally higher compared to more recent years with survival rates in excess of 20% (i.e. 20 adult returns to the coast for every 100 smolts migrating, Figure 9) (Anon, 2006a).

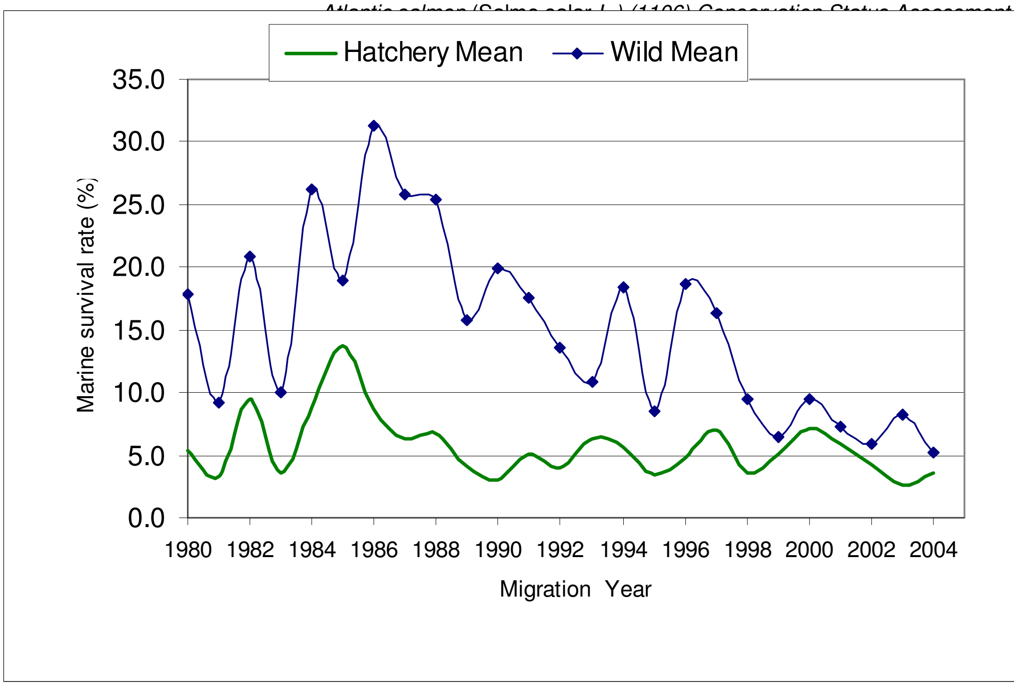


Fig. 9. Marine survival (from smolt release to return to the coast) for wild and hatchery salmon.

The current estimates suggest that less than 10% of the wild smolts that go to sea from Irish rivers are surviving (i.e. less than 10 adults returning for every 100 smolts migrating). Survival rates from hatchery fish are usually lower than for wild fish. The decline is not as apparent for hatchery reared fish, although the highest survival values were also recorded in the 1980s.

Marine survival is influenced by many factors (Fig.10). There are real concerns relating to factors causing mortality at sea such as predation by seals, diseases and parasites, marine pollution etc. However, there is insufficient empirical information to allow anything other than general advice to be given on these factors at this stage i.e. the more the effects each individual factor can be reduced the more salmon will return to our coasts and rivers. Clearly more specific investigations need to be carried out on these other factors.

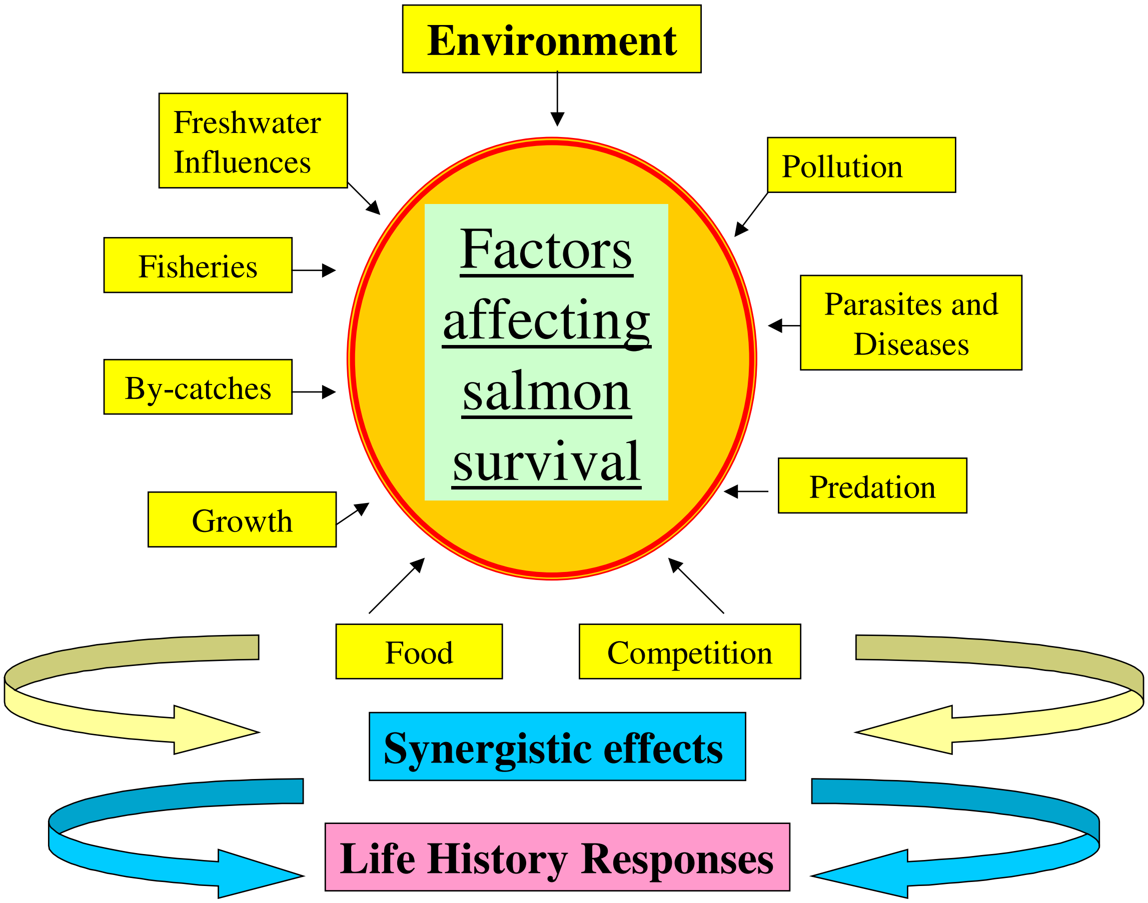


Fig.10. The factors which individually and synergistically affect the marine survival of salmon and which cause significant changes to life history responses such as population structure, fitness and size (Anon 2006a).

Marine survival is currently the lowest it has been since the present assessment programme commenced in 1980 and probably since the 1970s also considering the information available for the Burrishoole index site. There are also indications from data sets going back further than 1970, that the 1970s and 1980s were a period of unusually high abundance with high marine survivals (Boylan & Adams 2006).

Main Pressures

Status of stocks in Ireland

It is evident that current salmon stock abundance in Ireland is lower than previously recorded. This decline has been contributed to by poor marine survival which has become apparent throughout the range of North Atlantic Salmon. The Salmon Management Task Force Report to the Minister (1996) identified up to 40 factors which mitigated against salmon survival in Irish waters, both in the marine and freshwater. O'Grady and Gargan (1993) identified 18 major factors affecting salmon populations in Ireland and provided data on the magnitude of these problems in 27 catchments surveyed by the Central Fisheries Board.

Recent habitat impact information for the 148 Irish salmon rivers was collated for NASCO (CNL (05) 45) and is set out into 18 principal categories in Appendix 4. Several habitat impacts may prevail in any single salmon river. Data are summarised in Fig. 11. The information suggests that agricultural enrichment, forestry related pressures and poor water quality resulting from inadequate sewage treatment are the major pressures affecting Irish salmon rivers.

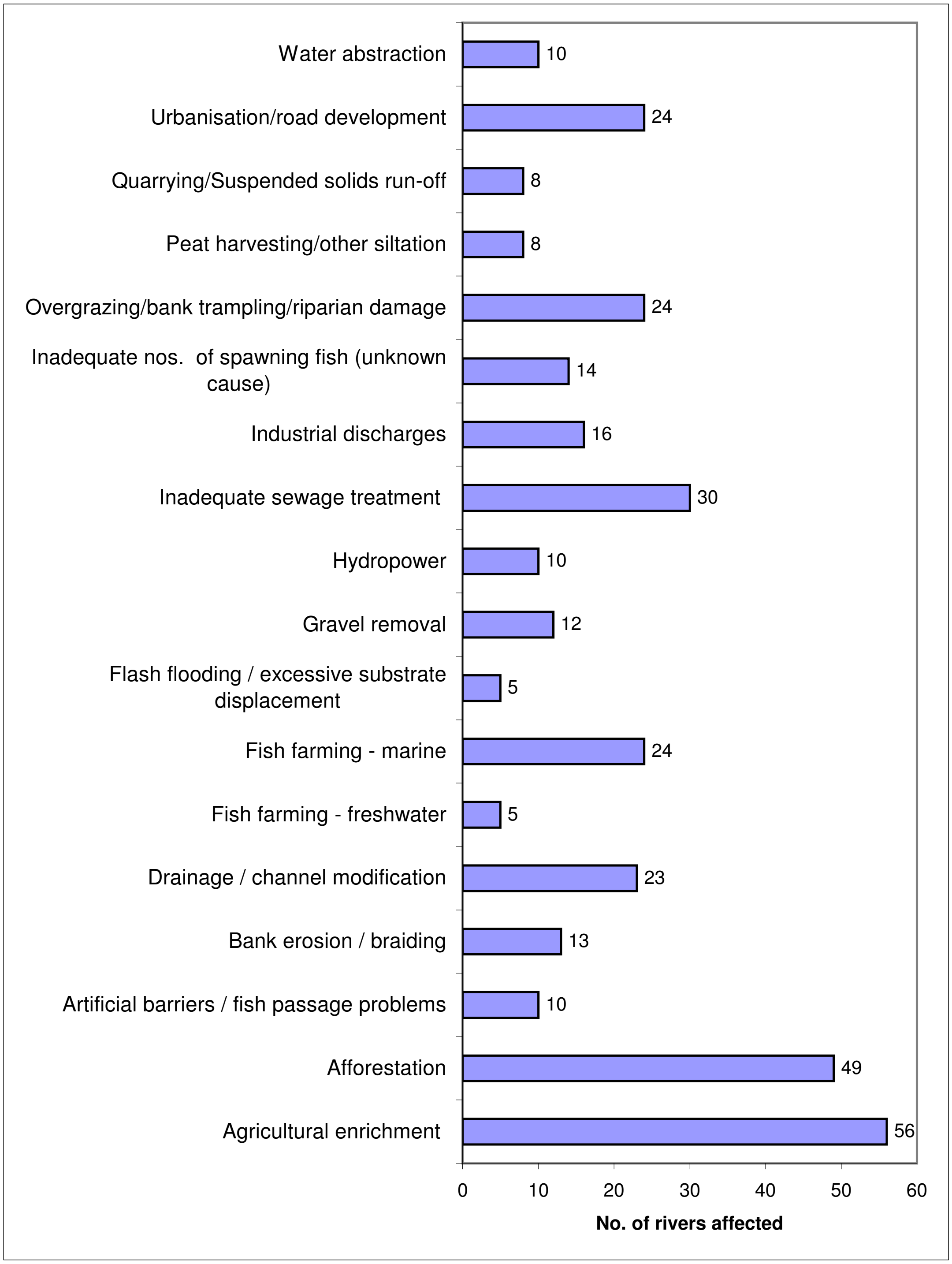


Fig. 11. Habitat Pressures in Irish Salmon Rivers (Anon 2006b)

Main Pressures

Pressures, as listed and coded in Appendix E of the Guidance for Reporting on the Habitats Directive, are grouped where common themes exist.

100 Cultivation

110 Pesticides

120 Fertilisation

140 Grazing

700 Pollution

701 Water pollution

950 Biocenotic evolution

951 Accumulation of organic material

952 Eutrophication

A national review of water quality in Ireland is presented tri-annually by the Environmental Protection Agency (EPA). A review of data arising from surveys carried out over 13,000km of river channel, 120 lakes and 23 estuaries during the period 1995-1997 showed that while the overall condition of waters in Ireland remains satisfactory compared to other European countries, water quality is deteriorating (Lucey *et al.,* 1999).

The long-term trends (since 1971) show pollution continuing to increase from slight to moderate, attributable mainly to eutrophication from organic (animal manure) and artificial fertilisers and to a lesser extent from point sources (domestic sewage) discharges. Some increases in seriously polluted channels are attributed mainly to suspected agricultural activities (Lucey et al., 1999). More recent monitoring by the Environmental Protection Agency (EPA) found that 70% of Ireland's river water is satisfactory, 17% is slightly polluted, 12% is moderately polluted, and less than 1% is seriously polluted in the years 2001 to 2003 The steady decline in water quality evident prior to 1995/97 appears to have been arrested (Fig. 12).

McGinnity et al. (2003) found that 17.3 % of accessible habitat in salmon rivers is at least slightly polluted (Q 3/4) while 4.5% of salmon habitat is at least moderately polluted (Q3).

The extensive use of fertilisers in forestry and agriculture has increased the input of phosphate and nitrate to rivers. This occurs in forestry both directly by initial site fertilization and indirectly during clear-cutting operations when soils are disturbed and as a consequence of over application, leaching and surface run-off from fields and farmyards in agriculture.

The risk is enhanced if operations coincide with heavy precipitation. Drainage of uplands conducted by foresters and farmers can increase soil erosion with consequential impacts on spawning gravels downstream.

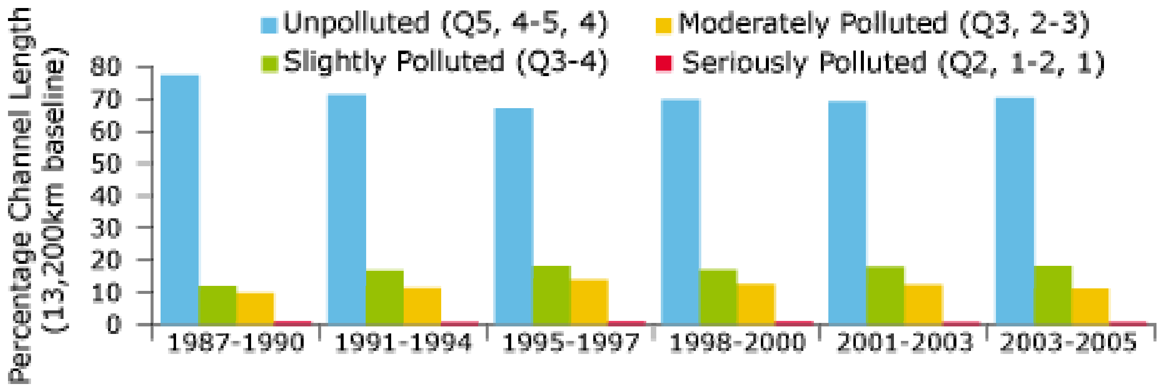


FIG 12: River water quality in Ireland (13,200 km baseline) (EPA 2007)

Organic enrichment of surface water bodies from agricultural sources arises from intensive livestock rearing, run-off from fertiliser application, and farmyard point source enrichment. Agricultural enrichment has been identified as one of the major pressures on Irish salmon stocks. Agricultural impacts include the various adverse effects of overgrazing by unsustainable populations of sheep in the more remote upland areas of the west in particular as well as the more usual organic pollution and eutrophication caused by diffuse and point sources of agricultural wastes. EU subsidies led to a significant increase in the sheep numbers grazing poor mountain heathlands in the west of Ireland. This has resulted in serious overgrazing on both hillside and river valley areas. O' Grady & Gargan (1993) suggested that the destruction of heathland has lead to increased run-off rates in watercourses resulting in higher peak flows during flood periods. Silt run-off has also increased because of the lack of vegetation. These factors, in combination with overgrazing along river banks, have resulted in significant increase in bank destabilsation leading to siltation and channel braiding.

Pesticides – the use of the organo-phosphates and cybermethrin in sheep-dipping operations and subsequent run-off into streams has been identified as a pressure on juvenile salmon stocks through loss of invertebrate populations, particularly in upland spawning and nursery streams.

Agricultural activities regularly feature as the main causative agent contributing to fish kill statistics mostly through deoxygenation. Agriculture is identified as the greatest single cause of the fish kills reported during the period 1995-1997, which showed a substantial increase over the previous period. During that period, it was estimated that agriculture was most likely to have been responsible for 97 fish kills; industry for 37 and sewage for 24 (Lucey *et al.*, 1999).

Agriculture continues to be a major factor in fish kills in recent years although acid mine drainage related kills occurred frequently in the Avoca catchment (in the south east) in several years (Fig.13 & 14).

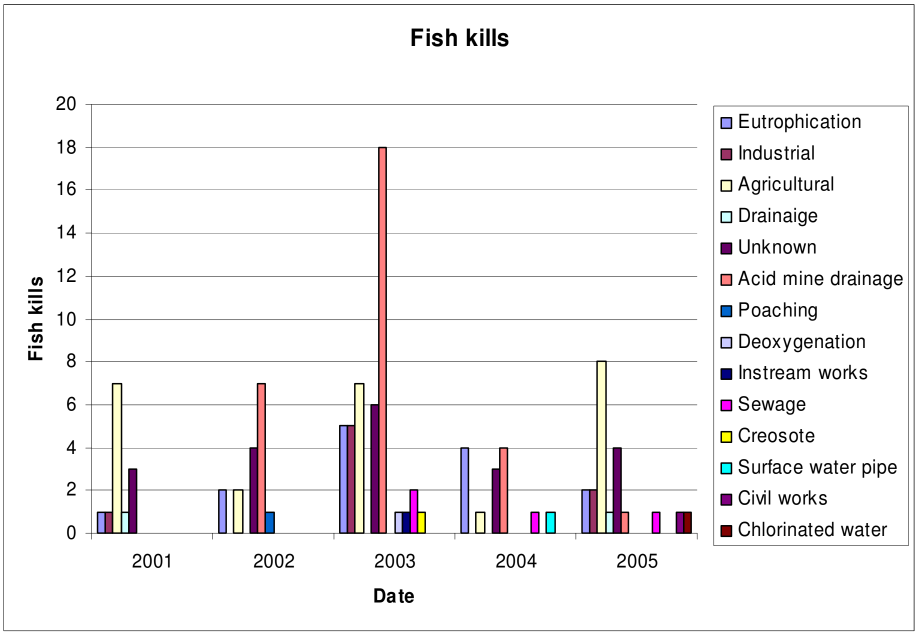


Fig 13. Fish kills according to cause in Ireland 2001-2005 (CFB/ RFB Fish kill database 2007).

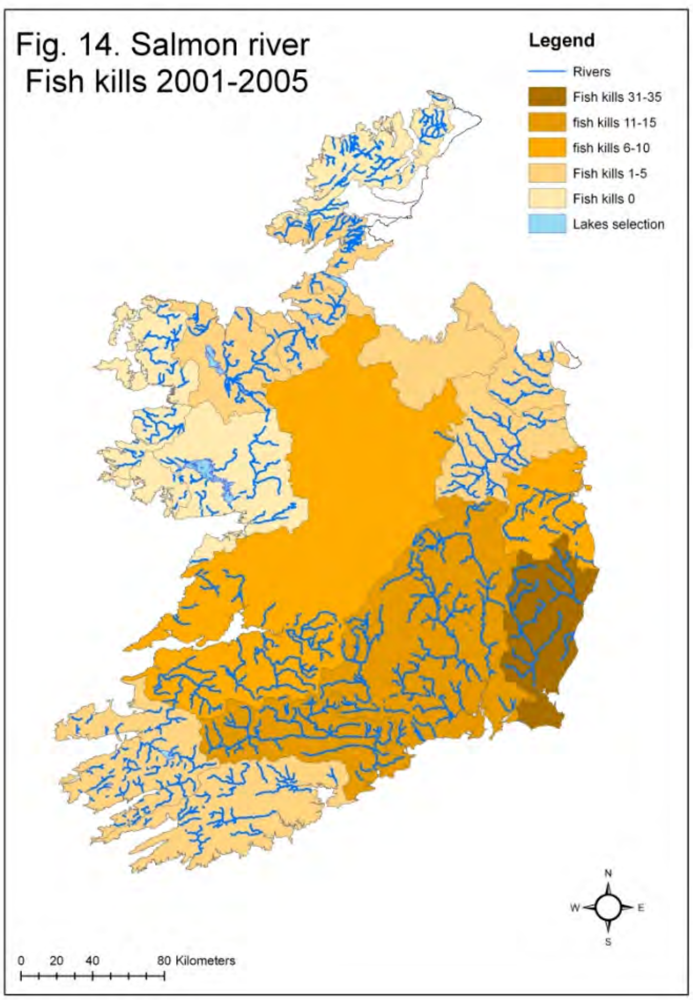


Fig 14. Salmon river fish kills 2001-2005 by Fisheries District.

The EU Water Framework Directive came into effect in December 2000 and was transposed into Irish law in December 2003. The objectives of the WFD are to retain high and good status waterbodies and restore to good status those sites which are currently at a lesser status. Fig.12. illustrates that at present 70.5% of all Irish rivers have a satisfactory water quality status. Good status as defined by the WFD equates approximately to Q4 in the EPA's national scheme of biological classification and is required to be achieved by 2015. Under the Water Framework Directive, risk assessments were conducted on all watercourses to determine the likelihood (risk) of each waterbody not attaining good status by 2015. A risk assessment was carried out on all watercourses to determine the risk category (1a, 1b, 2 a or 2 b) to which any waterbody would be assigned (Figs. 15, 16 &17). The risk assessment procedures (Fig. 15) were based on the most recent local and national data and where appropriate, expert judgement. There are four risk categories, Table 1.

Table 1. EU WFD risk category classification

1a	Waterbody "at risk" and available information is comprehensive and/or conclusive.
1b	Water body "probably at risk" but available information could be improved
2a	Water body "probably not at risk" but available information could be improved.
2b	Water body "not at risk" and available information is comprehensive and/or conclusive.

Table 2. Risk assessment for Irish salmon river waterbodies

1a	At risk	16%
1b	Probably at risk	50%
2a	Probably not at risk	10%
2b	Not at risk	28%

Based on the risk categories above, the majority of available area in Irish salmon rivers is classified as being "probably at risk OR at risk of not attaining good quality status" by 2015, (Table 2, Fig 17). This assessment is based on a set of stringent criteria and the outcome is based on adopting the precautionary approach. The compilation of the characterisation report was established that the river monitoring programme conducted since 1971 only relates to ~ 1/3 of all surface water channels. 1st and 2nd order streams constitute about 77% of the national river network of approximately 74,000km in length (Anon 2007c) and these are not represented in the National Water Quality monitoring programme. This assessment of the risk status of 1st and 2nd order streams was carried out in 2005 & 2006 resulted in the reclassification of many of the water bodies studies into the "at risk" category. The report expressly states that the SSRS does not classify waters according to ecological status however it does signify a high percentage of waters are at risk of not achieving good status by 2015. The evaluation is based on the actual existing macro invertebrate communities of the small streams and this implies that the majority of the waters are adversely impacted currently. In the context of the WFD it is proposed that EPA Q value 5 & 4-5 equate to "High", Q4 signifies "Good" and Q 3-4 "moderate" Poor and Bad status are signified by lower Q values. Significant differences have been demonstrated for fish communities with salmonids dominating at higher Q values, sticklebacks or no fish predominate at Q3 or less. Salmon parr are statistically more abundant at Q4 than at Q3-4 in waters situated downstream of impassable barriers (Kelly *et al* 2007).

Cultivation, Pollution and Eutrophication as future threats

Following the implementation of the Water Framework Directive and the formation of river basin district management structures, a collective approach to reducing all adverse impacts including cultivation, pollution and eutrophication on aquatic resources is now in place. Having characterised the risks posed to water-bodies nationally, Programmes of Measures are being developed to address habitat impacts / land use practices and to restore impaired water bodies to good status.

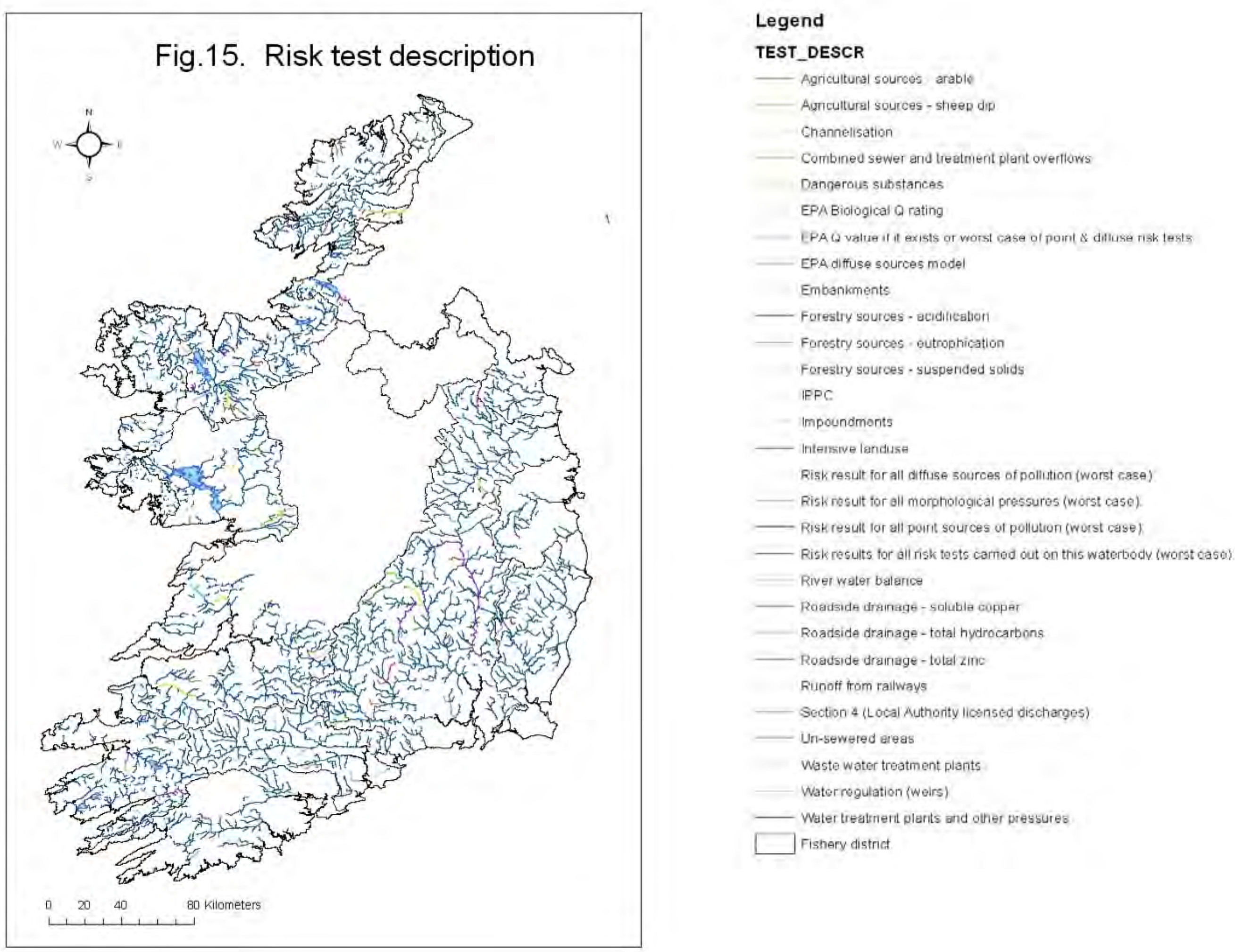


Fig.15. Risk test description for Irish salmon rivers (Information courtesy of EPA).

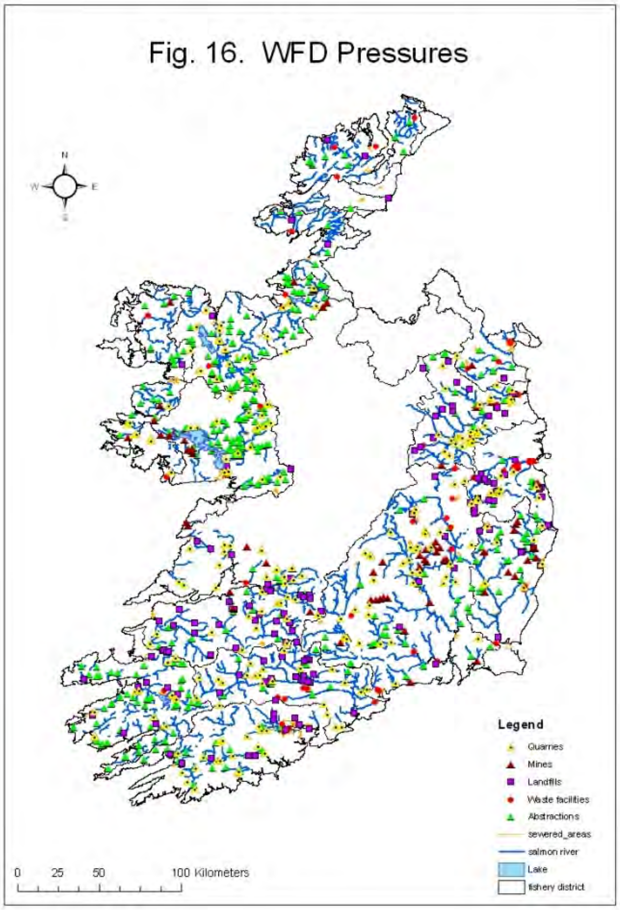


Fig.16. The risk assessments for surface water bodies were undertaken for each of the pressures identified. These include, abstractions, pressures arising from structural changes, point sources pressures and diffuse source pressures (Information courtesy of EPA).

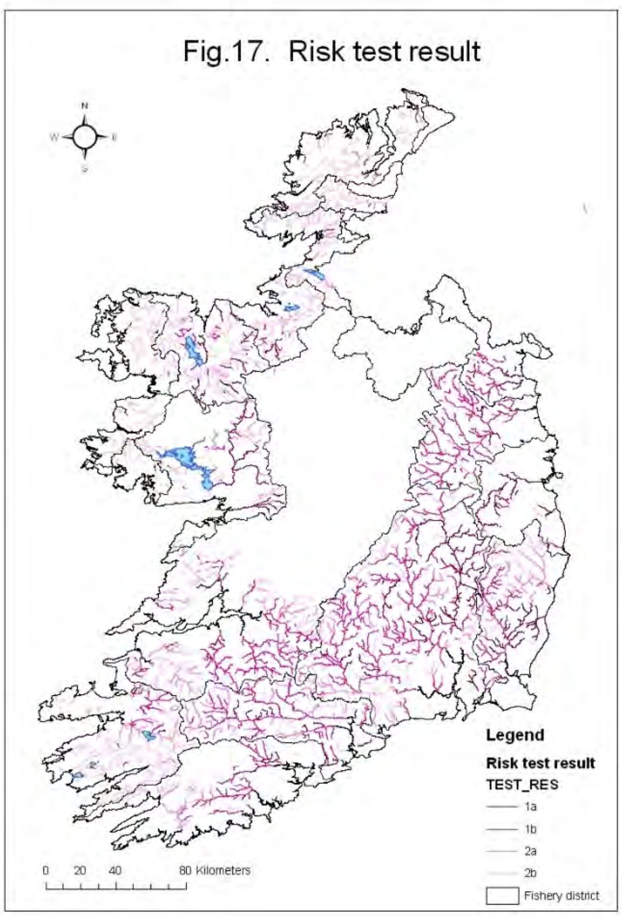


Fig.17. Risk test result for Irish salmon rivers (Information courtesy of EPA).

140 Grazing

720 Trampling/Overuse

900 Erosion

A combination of habitat impacts including land drainage, afforestation /reafforestation, gravel removal, over-grazing and other factors can result in bank erosion and braiding (excessive channel widening and loss of channel depth) resulting in loss of channel form and the natural riffle/glide/pool sequence and introduction of fines into streambed substrates. This reduces the quantity and quality of habitat for juvenile salmon production.

Since the 1970s overgrazing by sheep has become a very serious problem in the west and northwest of Ireland. The impacts of this problem on riverine channels have been documented in O'Grady et al (2002a, b). In summary, overgrazing on both hillsides and the valley floors has lead to increased run off rates causing unnaturally high bank erosion levels and a complete physical destabilisation of some river channels. The problem has had serious negative impacts on all ecological strata of river corridors and the aquatic flora and fauna, fish stocks and bird species associated with river corridors have been affected (O'Grady et al 2002, a & b).

Localised excessive bank erosion, caused by bank trampling by livestock, can also be extensive and destructive even in catchments where the natural hydrology of the watershed has not been altered markedly by land management.

Overgrazing as a future threat

Overgrazing by livestock, particularly sheep, in upland areas in the west of Ireland was a significant pressure on salmon stocks and their habitat in the recent past. A change in EU policy linking subsidies to the area of land farmed rather than the number of livestock held has resulted in a significant reduction in sheep numbers in upland areas and a reduction in overgrazing. Field surveys have indicated a recovery of instream stability, increased macrophyte and invertebrate abundance and improved densities of juvenile salmonids in several areas previously affected by overgrazing.

160 General forestry management

161 Forestry planting

953 Acidification

Although Ireland has the most favourable climate for tree growing in the EU, it has one of the lowest proportions of tree cover. However, coniferous afforestation is a widespread commercial activity in Ireland (Fig. 18) particularly in upland areas and on poor quality low lying agricultural lands (O'Grady, 2002). Shading, tunnelling, acidification in acid sensitive catchments, hydrological regime change, erosion, sedimentation and enrichment are impacts that are often associated with commercial forest programmes. Coniferous plantations in areas of poor base geology which are acid sensitive can sometimes cause acidification problems (Bowman and Bracken, 1993, Allott *et al.*, 1997 and Kelly-Quinn *et al.*., 1997). Many Irish salmon rivers have some coniferous plantation, particularly in their upper reaches.

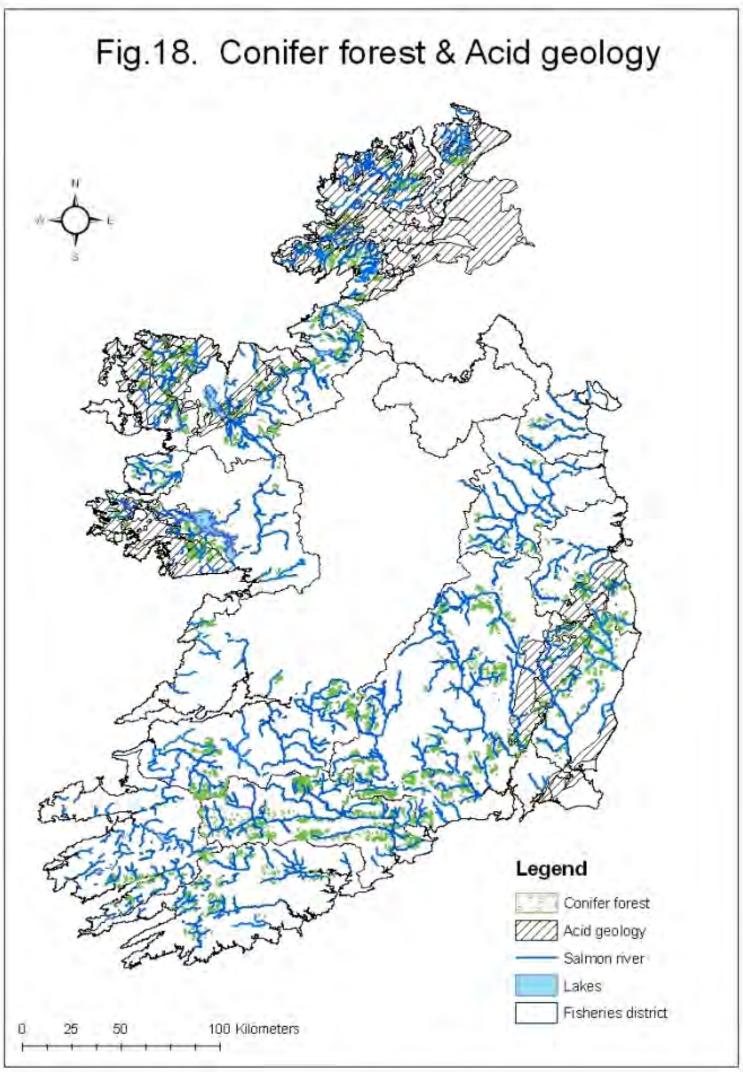


Fig. 21. Potential pressures on Irish salmon rivers including acid geology & conifer forestry cover(Forestry Services, GSI).

There are concerns about the possible negative effects of conifer afforestation to fish stocks particularly where steep upland areas are planted. Potential problems include increased run-off rates through afforested drainage networks and the discharge of increased sediment loads and phosphorous to catchments, (O'Grady 2002). Phosphorous can cause cultural eutrophication problems in watercourses further downstream. Planting of coniferous trees too close to stream banks has resulted in excessive shade (tunnelling) and subsequent bank erosion and siltation, Smith (1980). Tunnelled areas ≥100m in length, rarely support more than 40% of the juvenile salmon numbers observed in adjacent open areas (O'Grady, 2006).

General forestry management as a future threat

New environmental guidelines for forestry management and protection of the fisheries resource have recently been published (REF). Implementation of these guidelines will reduce the impact of potentially adverse forestry practises on watercourses and fish stocks.

Various reasons, including the discontinuance of State afforestation, high land prices, the devaluing effect on land of the irreversible conversion to forestry has meant that the current rate of afforestation is not achieving the Government's target for the industry (EPA, 2006). Clear felling has been shown to result in elevated phosphourous export/loss to waters (Cummins & Farrell 2001). This has resulted in significant eutrophication in upland areas.

200 Fish & Shellfish aquaculture

962 Parasitism

Freshwater Fish Farming

Freshwater fish farming is the production of trout and salmon in freshwater. Rearing fish in freshwater can result in enrichment, siltation and dewatering of surface water channels. Escapes may result in predation on wild juvenile salmonids, genetic introgression and transfer of disease.

Marine Fish Farming

Marine salmon farming can lead to increased marine mortality of migrating salmon smolts if sea lice are not adequately controlled (Skilbrei & Wennevik, 2005). Studies in Ireland (Tully and Whelan, 1993), Scotland (Butler 2002 & Watt, 2002) and Norway (Heuch and Mo, 2001) have indicated that in spring, the majority of sea lice nauplii arise from ovigerous lice infesting farmed salmon.

Tully *et al.* (1999) have demonstrated that the presence of salmon farms significantly increased the level of sea lice infestation on sea trout post smolts. Similar findings have been reported from Norway (Grimnes *et al.*., 2000) and Scotland (Mackenzie *et al.*, 1998, Butler & Watt, 2002). In areas with lice epizootics, lice have been implicated in the mortality of 48-86% of wild salmon smolts in Norway (Holst and Jakobsen, 1998). Recent studies in Ireland undertaken as part of a wider EU funded study (SUMBAWS Q5RS-2002-00730) also demonstrate that salmon smolts entering bays with salmon aquaculture suffer increased marine mortality.

Maintenance of near zero ovigerous sea lice levels on marine salmon farms in spring is critical to ensure that migrating salmon smolts do not suffer increased marine mortality from sea lice infestation.

Marine fish farming / Parasitism as a future threat

Unless sea lice on marine salmon farms are maintained at near zero levels in spring when salmon smolts are migrating to sea, there is continued potential for impact on migrating salmon stocks. The mechanisms for control and regulation of sea lice on marine salmon farms in Ireland are currently being reviewed. Implementation of the requirements of the EU Habitats Directive may have implications for the effective management of sea lice on marine salmon farms.

The introduction of G. salaris to Ireland poses the most significant immediate threat to Irish salmon stocks. The parasite is present in a number of countries in continental Europe including Norway and there is the potential for the introduction of the parasite through importation of live fish for salmon farming purposes from infected areas. Anglers coming from these areas also pose a significant threat of the introduction of the parasite on untreated tackle and equipment. An information brochure has been published to alert anglers of their responsibilities.

210 Professional fishing

In Ireland, while there are some completely private ("several") fisheries where the rights to fish are inherited, all commercial salmon fishermen and anglers must have a state licence (commercial or recreational) to fish. In 1997 the number of public commercial fishing licences issued was capped at the 1995 level i.e. 775 public drift net licences, 464 draft net licences and 132 licences for other commercial fishing methods. This cap on licences did not include private or special local area licences (56 drift net licences, nine draft net licences and four other-method licences). In the case of commercial fishermen the licence entitles them to fish only within the district where the licence is issued and only within the season and with the fishing gear permitted. A public or special area local licence is not an inherited right and must be applied for annually.

The principal fishing methods used to catch salmon in Ireland are drift nets, draft nets, snap nets and rod and line. Only the drift nets are operated outside estuaries and therefore conform to the definition of salmon mixed stock fisheries; these nets accounted for 70.5% of the total national salmon catch in 2005 (Table 3). The number of fishermen (i.e. employed in the fishery) is estimated from the ratios of numbers licensed to numbers employed in Whelan and O'Connor (1974).

From the early 1960s to the mid 1970s, the drift net catch increased rapidly, following the introduction of synthetic, and then monofilament, nets. This was probably responsible for the simultaneous decline in the draft net catch and resulted in the proportion of the catch taken by drift nets increasing from 20% to 70% during this period, while the proportion taken by draft nets declined from 50% to 20%.

Table 3. Summary information on fishing methods employed to catch salmon in Ireland in 2005 (excluding Lough Foyle area half catch) (Anon 2006b)

Fishing method	No. Licences issued	Estimated number of fishermen	% of total catch in 2005
Drift nets	877	2,400	70.5%
Draft nets	518	1,700	11.7%
Snap nets	139	375	2.1%
Traps, bag nets, pole nets, loop nets, head weir	12	32	>1%
Rod	28,738	<28,738	15.6%

Since 1990, reported catches by all methods have remained relatively stable at around 600t, which is about one third of the peak catch (2216t) recorded in 1975. Over this period, the proportion of the total catch taken by drift nets has varied between about 65% and 75%.

211 Fixed location fishing

There are 518 salmon draft net licences available in Ireland. This traditional fishery operates in estuaries and defined river mouths and prior to the advent of drift net fishing the majority of salmon in Ireland were taken by draft nets. In 2005 the inshore fixed location fishery (draft, snap and others) accounted for approximately 15% of the national catch.

213 Drift net fishing

Drift netting for salmon has been operated on a large scale in Ireland since the 1960s. Since the 1980s, drift netting has accounted for approximately 75% of the total catch of Irish salmon.

Additional controls were introduced on commercial fishing in 1997 with the shortening of the drift net season to the months of June and July, a four day fishing week with no night time fishing, a cap on the number of licences and restricting the fishery to within 6 miles of the coast. In 2000, The Irish authorities established the National Salmon Commission to advice on salmon management. The Commissions role was to advise the Minister on the conservation management, protection and development of salmon.

A Standing Scientific Committee, whose role was to advise and assist the Commission on all technical and scientific matters in relation to the performance of the Commissions functions, was also established.

A mandatory salmon carcass tag and log book scheme was introduced in 2001 for all fishing sectors and the sale of rod caught salmon was banned. In 2002 a Total Allowable Catch (TAC) for commercial salmon fishermen was introduced and a bag limit of 20 fish per angler per season. The commercial quota was set at 219,000 salmon. In 2003, the commercial quota was reduced to 182,000 salmon and further reduced to 162,000 salmon in 2005. The Irish Government reaffirmed its commitment to aligning with the scientific advice for the 2007 salmon season and reduced the commercial salmon TAC to 91,000 in 2006.

In 2005 the Irish Government confirmed its commitment to have national and district quotas fully aligned with scientific advice provided by the Standing Scientific Committee by 2007. To fulfil Ireland’s international obligations, the terms of reference for the Standing Scientific Committee were amended in 2005 with the need to consider international obligations, the most relevant being the EU Habitats Directive. This required all salmon stocks across their natural range to be in favourable conservation status. Information from micro-tagging had shown that the offshore Irish drift net fishery exploits salmon from a range of Irish rivers, some below conservation limits.

The fishery also exploits salmon from other European countries. Continuation of the offshore fishery would not allow all salmon stocks to remain within favourable conservation status and was not consistent with the objectives of the Directive. Based on the need to provide scientific advice in line with the Directive, the Standing Scientific Committee provided the following advice to the NSC in 2007 (Anon, 2007a):

- The overall exploitation in most districts should be immediately reduced, so that Conservation Limits can be consistently met.
- Furthermore, due to the different status of individual stocks within the stock complex, mixed stock fisheries present particular threats to the status of individual stocks.
- Thus, the most precautionary way to meet national and international objectives is to operate fisheries on river stocks that are shown to be within precautionary limits i.e. those stocks which are exceeding their Conservation Limits.
- Fisheries operated in estuaries and rivers are more likely to fulfil these requirements.

The Irish Government committed to aligning with scientific advice in 2007 thus implementing NASCO and ICES recommendations and complying with the Habitats Directive. The Government also recognised that compliance with scientific advice from 2007 onwards could mean hardship for commercial fishermen and vulnerable coastal communities.
Accordingly, the Government appointed an Independent Group to examine all the implications of aligning with scientific advice for commercial fishermen salmon fishing. The Independent Group reported to the Minister in October 2007 that a hardship scheme be introduced for the fishermen affected by the Government decision to move towards single stock salmon fishing only.

For the 2007 season, the Standing Scientific Committee advised that there were:

- ❖ 43 rivers meeting and exceeding their Conservation Limits and therefore a harvest fishery could take place on the surplus of salmon over the Conservation Limit.

- ❖ 34 rivers not meeting their Conservation limits and there is no surplus over the Conservation Limit to allow a harvest fishery to take place.

- ❖ 74 small rivers where the average rod catch was less than 10 salmon annually since 2001. The rod catch from these rivers combined is less than 0.5% of the current estimated national rod catch. While these are not significant fisheries they are important in their own right in the context of conserving biodiversity. The Standing Scientific Committee advise that no harvest fisheries should take place in these rivers until such time as additional information becomes available to assess the status of these stocks relative to their Conservation Limit

The Standing Scientific Committee also advised that:

- Harvest of salmon should only be allowed in rivers where there is a surplus above the Conservation Limit identified and that no more than this surplus should be harvested (listed in Appendix 1).
- Where a surplus is available for all rivers in an embayment, an estuarine fishery can proceed but the surplus must be based on the 75% probability that all of the rivers contributing will meet and exceed their Conservation Limit simultaneously i.e. Killary Harbour (Ballinakill), estuary of the Owenmore and the Owenduff rivers (Bangor), Appendix 1.
- Harvest fisheries should not take place in rivers without an identifiable surplus above the Conservation Limit (Appendix 2) and further efforts are made to rebuild these stocks.

- No harvest fisheries should take place in those rivers where the average rod catch has been less than 10 salmon annually until such time as additional information becomes available to assess the status of these stocks relative to their Conservation Limit (Appendix 3).

Professional Fishing / Fixed Location Fishing as a future threat

The overall effect of these regulations means that no drift net fishery will operate in Ireland in 2007 and this pressure will not impact on salmon stocks. Inshore draft net and other forms of inshore fishing will only operate where salmon stocks are above conservation limit. Therefore professional fishing will not constitute a threat to salmon stocks in the future.

220 Leisure fishing

Salmon angling is an important economic activity in Ireland. In 2005 there were 28,738 salmon rod licences issued and the total reported catch was 22361 accounting for 15.6% of the national catch. Following the introduction of new regulations in 2007, a harvest fishery for rod and line can only operate on 43 out of a total of 151 salmon fisheries. Rod and line catches are limited to a proportion of the available surplus on an individual river basis.

Leisure fishing as a future threat

Leisure fishing will only operate on rivers where conservation limits are exceeded. Catch and release angling may be permitted on rivers meeting a high percentage of conservation limit.

243 trapping/poisoning/poaching

Poaching (illegal fishing) of salmon at sea and in rivers is an ongoing problem for Irish salmon stocks. The Scientific Committee of the National Salmon Commission currently applies a figure of 10% to account for unreported catch. This estimate includes illegally captured salmon in the commercial and rod fisheries and also poached salmon in rivers.

The Central and Regional Fisheries Boards protection staff coordinates the national salmon protection and conservation programme. This programme is operated by the Regional Boards with support from the Naval Service, the Gardaí Síochána and the Air Corps.

The Fisheries Boards operate two large fisheries protection vessels and in 2005, in conjunction with the Naval Service, a total of 11,150 yards of illegal net was seized (Table 4).

Table 4. Details of the LPV, Naval and Air Corps Operations during 2005(Anon 2006b)

Sea Patrols

	Days on Patrol	No. of Licence Checks	Length of Net Seized (Yards)	Prosecutions & Warnings
Bradán Beatha	160	455	3550	8
Cosantóir Bradán	156	506	4300	11
Naval Service	64	160	3300	2
Total	380	1121	11150	21

The Regional Fisheries Boards seized 24,000 yds of illegal nets (in coastal and freshwaters) and 59 prosecutions were initiated in 2005.

Poaching as future threat

With the cessation of drift net fishing around the Irish coast from 2007 onwards, increased protection will be required to enforce the new regulations. Additional operational resources, totalling €4 m over three years (2007-2010), have been allocated to the Central and Regional Fisheries Boards for fisheries protection.

300 Sand and gravel extraction

Natural stream bed structure is changed where gravel is removed directly from watercourses. Riffle/glide/pool sequences are often disturbed leading to reduced juvenile production. Substrate mobility in the affected area can be increased leading to erosion and subsequent loss of habitat and invertebrate and fish productivity.

With increased availability of heavy machinery and developments in road building, housing and agriculture, extraction of gravel from rivers was a significant problem in many salmon catchments in the 1980s but is less so in recent years.

Gravel extraction as a future threat

With improved communication between operators and Fisheries Boards staff the incidences of gravel extraction have declined. In recent years, gravel removal is generally carried out without significant impact on the natural channel although isolated incidences of damage to habitat continue to occur. Therefore vigilance is required to ensure that this level of cooperation is continued.

301 Quarries

Quarrying and associated washing of quarried materials is carried in several salmon river systems (Fig. 16) and can lead to the input of fine suspended material to the watercourse. Pollutants including dangerous substances such as metals and fuel, can travel through the ground water into surface waters effecting water quality and damaging the aquatic flora and fauna. This material can have a deleterious effect on the juvenile stages (eggs and fry) and render spawning areas unsuitable. At some quarries the water table is lowered to permit quarrying which can affect nearby wet areas. The transfer of groundwater to surface water can change water quality.

Quarries as a future threat

A range of legislation exists to deal with the establishment and operation of waste management, quarry and mine sites and contaminated lands. The Waste Management Act is the primary control for regulated waste management and the EPA administers the licensing of waste facilities.

Under the Planning and Development Act quarries four years or older must register with local authorities and planning applications over five hectares usually require an EIA. Proposed new mines require 3 types of permits and in general require an EIA.

The EPA, Department of Communications, Marine and Natural resources (DCMR) and Geological Survey of Ireland (GSI) will complete characterising historic mine sites in Ireland by the end of 2007 gaining better information about the sites and their environmental impact.

310 Peat extraction

312 Mechanical removal of peat

910 silting up

Many peat bogs in Ireland are harvested on a large scale to provide fuel for electricity generation, fuel for the domestic market or to produce horticultural products. Problems associated with commercial peat harvesting include drainage of peatland resulting in increased run-off and increased siltation leading to increased sedimentation instream. Gravel compaction will reduce the salmon spawning capacity of the channel and losses in instream floral and faunal production will also impact on the capacity of the channel to produce juvenile salmon.

The most serious problems arising from peat extraction are siltation and subsequent compaction of gravels where large scale peat harvesting has caused the escapement of large quantities of silt into watercourses. Siltation from peat extraction and bank erosion (Code 900) has a number of serious consequences.

Compacted gravels can no longer function as salmonid spawning areas and it has also been shown that eggs laid in clean gravels which have subsequently been silted over by peat have failed to hatch (Crisp 1993). Settlement of peat particles/silt on the river bed can seriously reduce both the diversity and abundance of the aquatic flora and invertebrate fauna. Such discharges can lead to an accelerated rate of secondary bank (or berm) formation thereby creating long uniform glides where previously riffle/glide/pool sequences had predominated. These berms can quickly vegetate, stabilise and change the hydrology of a channel.

In state owned peat harvesting operations, more attention is now been paid to the entrapment of loose peat particles with the provision of an adequate number, and regular maintenance, of effective silt traps. Planting of deciduous hedgerows along bog drains help to minimise this problem.

Another example of silting/compaction of gravels results as an indirect consequence of cultural eutrophication. In a number of zones in Irish rivers (Liffey, Suir and lower Shannon) this phenomenon has lead to the generation of extensive beds of the macrophyte species *Potamogeton pectinatus* (Caffrey, 1990). This plant can grow on loose gravel beds and over a period of years entraps silt to a point where these gravel deposits can no longer function as salmonid spawning areas.

The Environmental Protection Agency's (EPA) national monitoring programme has demonstrated that Irish waters are becoming increasingly eutrophic over time. Catchments dominated by peat soils are viewed as sensitive to eutrophication because the peat has a low capacity to bind or fix phosphorous and because the buffering capacity of the water in the system is poor.

Peat extraction as a future threat

Bord na Mona is the principal commercial peat harvesting body and operates under the IPPC licensing system. Small private operators are not licensed. Surveys of the extent of peat extraction and associated pressures are being conducted by the Shannon River Basin District. Several peat burning electricity generating stations have closed in recent years.

330 Mines

331 Open cast mining

332 Underground mining

Mining activities can lead to serious contamination if leachate containing toxic metals is allowed access to watercourses. Old mining or abandoned mine sites which were not reclaimed after operations have ceased, can present significant threats to the aquatic environment. For example, the ongoing presence of high levels of copper and zinc in the Avoca River which has severely impacted on salmon populations in the river, is a long-standing problem due to the discharges of drainage waters from the defunct copper mines into the main channel. Most mining related fish kills in Ireland in recent years (Fig. 13) were attributable to acid mine drainage in the Avoca which ceased production in 1982. Mining is identified as a significant pressure for WFD risk assessment purposes (Fig. 16) particularly in the south east of the country. The potential risk posed by any contamination is site specific and is determined by connectivity between the sources of contamination and any potential receptor (e.g. the aquatic environment).

Mining as a future threat

Elevated values of different metals may render previously uneconomical ore deposits attractive for mining thus posing a potential threat to adjacent watercourses. Additional safeguards have been put in place and all new mining developments must secure an Integrated Pollution Prevention and Control (IIPC) license from the EPA. This single integrated license covers all aspects of air and water pollution, and noise and waste issues.

The main objective of IPC licensing is to prevent or resolve potential pollution problems rather than transferring them from one part of the environment to another. Risk minimization to the whole environment by preventing the emission of potentially polluting substances is a key aim.

400 Urbanisation areas/human habitation

420 discharges

421 disposal of household waste

422 disposal of industrial waste

In urban areas wastewater from domestic and industrial sources is piped to treatment plants where pollutants are removed. In recent decades urbanisation and associated hard infrastructural development has increased in Ireland due to increased population and economic growth. Increased development has lead to increases in effluent discharges and associated water quality problems. This contributes to eutrophication of rivers and has impacts on juvenile salmon production. Mc Ginnity et al. (2003) identified that rivers in the east, southeast and south are impacted by poor water quality. This is not unexpected given the concentration of urban development on the east coast and that of intensive agricultural activity in the south of the country.

Urbanisation etc as a future threat

Significant upgrading of wastewater treatment plants has occurred in Ireland between 2000 and 2006 to assist local authorities in complying with the Urban Wastewater Treatment Directive. The EPA regulates major industrial activities through the Integrated Pollution Prevention and Control (IIPC) regulations while the local authorities license small-scale industrial discharges to waters under the Water Pollution Acts. The implementation of the EU Water Framework Directive and changes to the EU Common Agriculture Policy provide some likelihood of improving water quality conditions in the future. However, it is likely that demographic trends will continue on their current upward trajectory and thus it will be increasingly difficult to allocate scarce water resources between freshwater fisheries and the utilities required to sustain industrial and population development. However, this should not be a reason to allow any further deterioration in the freshwater fisheries resource and appropriate safeguards must be put in place. NASCO goes further in recommending in its plan of action for the protection of Atlantic salmon habitat that the productive capacity of Atlantic salmon habitat be maintained and where possible, increased (Anon, 2001).

502 routes, autoroutes

Infrastructural development including road construction has increased over the past decade. Channel diversions, culverting of rivers, bridge floor design and operational problems associated with road construction have resulted in habitat impacts. Increased levels of run-off and the requirement for additional assimilative capacity in rivers are problems associated with urbanisation and road building.

Routes, autoroutes as a future threat

Specific codes of practise have been drawn up covering the construction of roadways (NRA, 2004; Murphy et. al, 2005). However, it is likely that the aquatic environment and the biota will be at risk for the foreseeable future with the continuation of major infrastructural road-building projects.

810 – Drainage

811- management of aquatic & bank vegetation for drainage purposes

Land drainage results in a change in the hydraulic characteristics of the surface water drainage network. This leads to increased and rapid run-off of water and thus to shorter, but more intense, flood events. Consequently, bank erosion and substrate loading can increase. The geomorphological response of the river is to widen, become shallower and increase substrate fines resulting in reduced habitat quality.

Arterial drainage is the re-engineering of natural river channels to increase the rate and volume of water transfer from land to sea resulting in loss of natural stream and bankside structure.

Some of Ireland’s major salmonid catchments have been subjected to arterial drainage schemes at some time between 1840 and 1980. The more major mechanised schemes took place from 1950s onwards. While the short-term impact of these schemes was very detrimental to salmon stocks, recent studies have shown that the long term impact has been varied and complex ranging from positive, to neutral, to negative in relation to salmon stocks (O'Grady 1991(a), 1991(b);O'Grady & King 1992 and O'Grady & Curtin 1993).

The long term negative impacts of drainage on the fish carrying capacity of Irish salmonid rivers are, in most cases, very significant. Surveys have shown little physical recovery of the natural form of channels even 60 years after drainage (O'Grady 2006).

Any land management practise or, combination of practises, which lead to a significant alteration in the natural morphology of a channel and/or its riparian zone, will have negative consequences for fish stocks. It is difficult to quantify the negative impact of drainage alone as a factor. In general terms drainage of smaller channels (<6m) will usually result in a significant loss in the standing crop of 1+ year-old salmonids. In larger (>6m) channels there will be a reduction in the number of resting pools for adult salmon (O'Grady 2007 *et al.*). Salmon catchments which have been subjected to arterial drainage are shown in Table 5.

Table 5. List of Irish salmon catchments subjected to arterial drainage

Catchment	***Period of works***	***Catchment area drained (km^2)***	***Rehabilitation work carried out***
Glyde & Dee	1950-1957	106	No
Feale	1951-1959	107	Yes
Corrib-Clare	1954-1964	303	Yes
Maine	1959-1963	47	No
Deel	1962-1968	48	Yes
Moy	1960-1971	247	Yes
Corrib-Headford	1967-1973	79	Yes
Boyne	1969-1986	481	Yes
Maigue	1973-1986	123	Yes

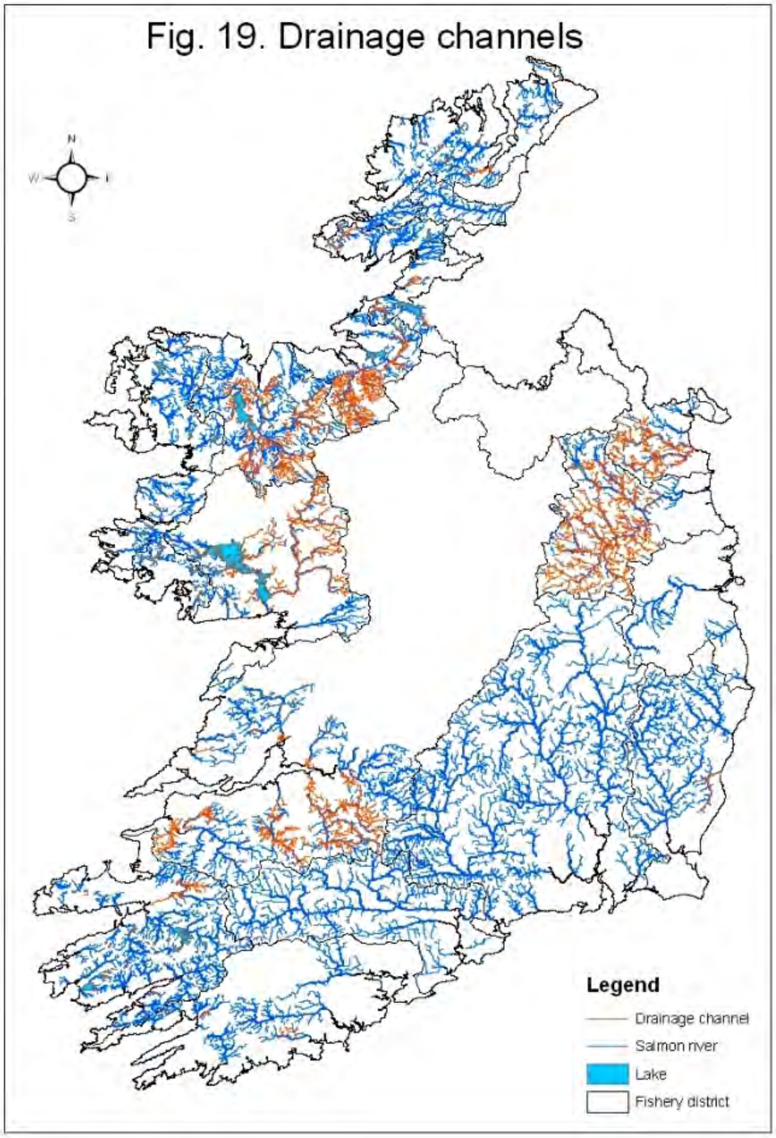


Fig.19. The extent of large scale OPW drainage programmes in Irish salmon catchments.

Drainage as a future threat

Large scale arterial drainage programmes such as those that were carried out in the latter part of the last century are unlikely to be undertaken in the future. Rehabilitation works have been carried out by the Fisheries Boards to restore salmon productive capacity at locations in drained rivers in conjunction with the Office of Public Works, (Table 5). The OPW plans to invest considerable resources in restoring riverine habitat in drained channels over the coming years.

Drained channels are subject to regular maintenance which may have further consequences for salmonid stocks. An experimental drainage maintenance programme has been undertaken in recent years to design a drainage maintenance strategy which will have the greatest benefit to fish production *including salmonids. The programme has clearly identified the feasibility of introducing environmentally sensitive strategies as a 'norm' so that such approaches become 'standard'* (King 1996, King *et al*., 2000, 2002)

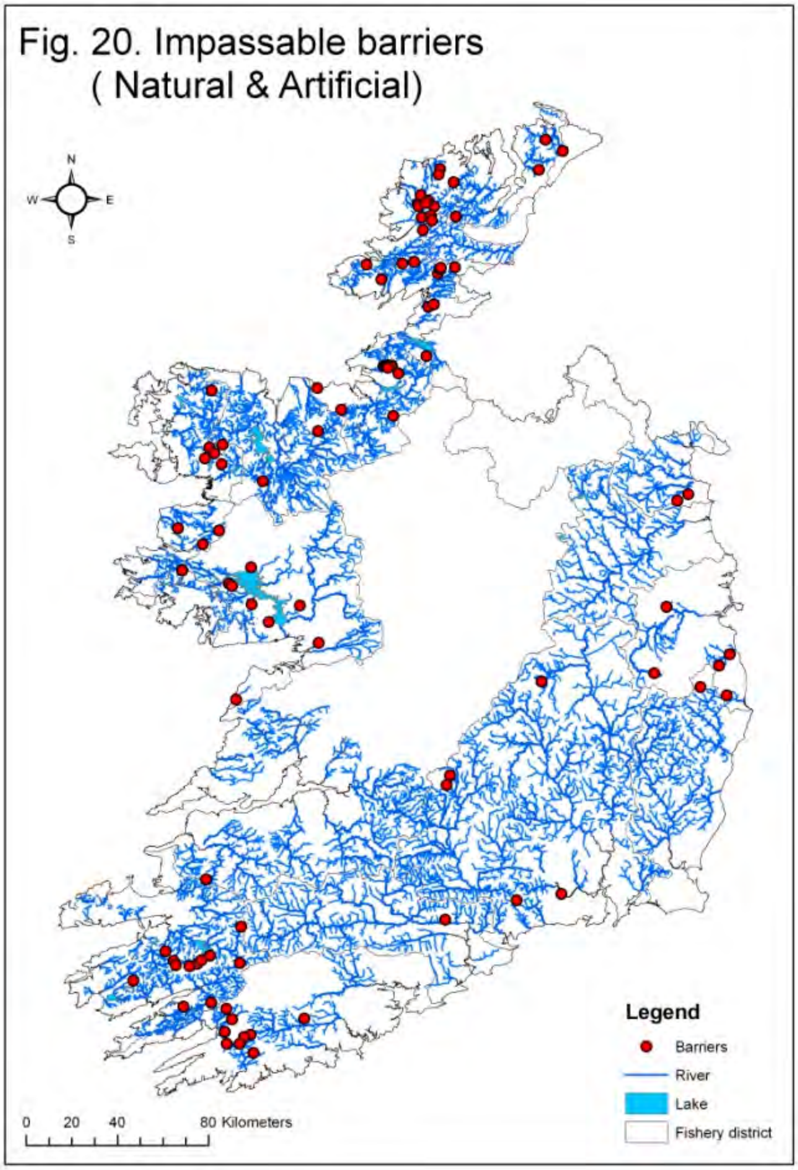


Fig.20 Impassable barriers on Irish salmon rivers

850 Modification of hydrographic functioning

852 Modifying Structures of Inland Water Courses

Artificial Barriers

Large-scale hydro-power schemes, small hydro-schemes, weirs for water abstraction, old mill weirs or other obstacles constitute a potential problem that may prevent or impede upstream passage of adult salmon or downstream passage of smolts, resulting in stress, onset of disease and mortality of these fish. Such artificial barriers also present opportunities for predator aggregations and illegal fishing. In certain instances artificial barriers present an impediment to natural fish migrations and community structure. Where possible or neseccary measures are now required under WFD to reduce these impacts. Current policy with the DCMNR is to remove defunct/derelict weirs where they create unnecessary impediments to fish passage. The location of artificial and natural barriers to salmon migration (Mc Ginnity *et al*., 2003) is shown in Fig. 20

Hydropower

A number of large-scale hydro-power schemes (Shannon, Lee, Erne, Liffey) cause smolt passage problems and impede the upstream passage of adult salmon resulting in reduced salmon production. These rivers have been described as being non-self sustaining as a result (McGinnity *et al*.., 2003). Many smaller hydropower schemes are also operational in Ireland and can impact on salmon populations in different ways including fish passage (upstream and downstream) and impacts on the natural channel (reduced flows).

Weirs

Many large stone weirs were built in Irish rivers in the 18th and 19th centuries principally to power mills. Over time, fish passes have been incorporated into these structures to varying degrees of success and efforts continue to improve fish passage at such weirs.

Irish rivers are relatively low gradient channels and consequently weirs often impound a significant length of channel. Electro-fishing surveys have shown that the capacity of such individual ponded reaches to support both juvenile salmon and trout and adult trout are seriously impacted.

In quantitative terms salmonid numbers in impounded reaches are usually ≤10% of that in adjacent free flowing zones (O'Grady, 2002).

Modification of hydrographic functioning as a future threat

Large-scale, high-head hydropower generating stations are unlikely to be constructed on Irish salmon rivers in the future Guidelines on the planning, design, construction & operation of small-scale hydro-electric schemes and fisheries have been published recently (Anon, 2007b). It is envisaged that these guidelines will be included in the planning regulations governing any future small scales schemes.

The EU WFD requires that waters currently at high ecological status are maintained in that category. River continuity (the ability of sediment and migratory species to pass freely up/down rivers) is an important quality supporting ecological status under the hydromorphological element. In high status waters, "the continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport". If any structure impedes or prevents the passage of fish in waters of high status, to the extent that species composition and abundance are changed even slightly from the type-specific communities, then such a structure *contravenes the terms of the WFD. Likewise, with regard to the biological quality elements of fish, fauna and river continuity, anthropogenic activities must not result in a downgrading of water bodies in any category, for example from good status to moderate status.*

Accordingly, any in-river structure must not downgrade the status of a water body (WFD, 2003) as this will most likely impact on conservation status of salmon. In this regard, a pilot study is in progress to develop a methodology to assess the impact of weirs and other obstructions on fish passage. Improvements are required in initialising the impact of hydro dams on upstream/downstream migration of fish particularly salmon

920 Drying out (Water abstraction)
In Ireland, where the economy has been very strong over the past decade, there is competition for water for utilities, agriculture and industry. Any changes in natural water flow regimes (water quantity) (Fig. 16) will impact on ecological functioning with respect to spawning requirements and availability and quality of nursery habitats particularly during periods of reduced flow.

Drying out (water abstraction) as a future threat

The availability of adequate water of suitable quality is fundamental to salmon ecology. Increased demand from different sectors continues to threaten the species and potential impacts are likely to be magnified as a consequence of climate change and surface water flow predictions (Sweeney 2002) Currently various pieces of legislation (Water Supply Act, Water Pollution Act, Nitrates Directive and the Groundwater Directive) contribute to the control of water abstraction. A unified approach to management of the water resource is required in order to properly control abstractions and safeguard fish, including salmon, in watercourses. Water impoundment is suggested as an ecologically acceptable solution to the ecologically unsustainable practise of withdrawal/abstraction during extended periods of reduced flows.

960 Interspecific faunal relations

961 Competition

954 Invasion by a species

Salmon and trout populations colonised Ireland after the last Ice Age and have been living sympatrically although there is a level of competition between both species for food and space. Coarse fish, notably roach (*Rutilus rutilus*) introduced to Ireland in 1889 have become widespread throughout Ireland since the 1980s and can be present in very large numbers contributing to increased competition for food with juvenile salmon in some catchments including the Corrib, Boyne, Suir and Barrow.

Other coarse fish species, previously confined to a small number of catchments (dace) or recently introduced to Ireland (chub), are likely to be illegally introduced to other catchments thus increasing competition for food and space.

Competition as a future threat

The spread of roach, dace or chub to new salmon catchments would increase competition with native juvenile salmon stocks.

963 Introduction of Disease

Native fish populations, including salmon, harbour naturally occurring diseases which are rarely manifested unless fish are subject to stressful conditions (e.g. drought conditions, high water temperatures etc). Freshwater and marine aquaculture is potential sources of disease introduction to wild fish populations.

Currently, regulatory procedures are in place with the objective of preventing disease transfer.

All steps in the aquaculture production process, from hatchery to processing plant, including transportation of live fish materials, must be conducted in accordance with appropriate fish health protection practices i.e. farms operate to an Approved Fish Health Management Plan. Epidemiological zones (either with or without specific pathogens) have not been specifically established for the following diseases: VHS, IHN, ISA and the parasite *Gyrodactylus salaries* as at the moment, the entire country is a single zone, since Ireland is free of the diseases listed. Should an outbreak /outbreaks occur, appropriate local epidemiological zones would be established. The Fish Health Unit of the Marine Institute carries out an annual monitoring programme for all the diseases listed. A list of prevailing infectious diseases and parasites, including methods used for their control, has been established and maintained by the appropriate authorities and is available from Marine Institute / Dept. Communications, Marine & Natural Resources. Generic Contingency Plans have been established for the early identification and detection of, and rapid response to, an outbreak of any new disease or parasite infection likely to affect Atlantic salmon. To date there have been no known movements of live salmonids and their eggs from hatcheries to areas containing Atlantic salmon stocks, or to facilities where there is a risk of transmission of infection to such areas, other than those from facilities where regular inspections have not detected significant diseases and parasites. Medicines and disinfectants are being used with care and in accordance with manufacturers' instructions and in compliance with regulatory authorities and this is monitored by private veterinarians, Dept of Agriculture and Marine Institute.

Recently, a study commenced on biophysical properties on Pancreas Disease Virus in an effort to control the disease on fish farms. Additional major collaborative studies are planned with Norway and Scotland.

Disease as a future threat

The regulations currently in place, in conjunction with the new EU Fish Health Directive, are aimed at preventing the introduction of disease

However, concern has been expressed about the culture of new fish species and the potential threat of the introduction of new diseases. The threat presented by incidents such as the unauthorised/illegal importation of carp from France in recent years and the interception of live fish by customs officers at Holyhead in 2006 illustrate that this is an ongoing problem.

The introduction of G. salaris to Ireland poses the most significant immediate threat to Irish salmon stocks. The parasite is present in a number of countries in continental Europe including Norway and there is the potential for the introduction of the parasite through importation of live fish for salmon farming purposes from infected areas. Anglers coming from these areas also pose a significant threat of the introduction of the parasite on untreated tackle and equipment.

An information brochure has been published to alert anglers of their responsibilities. A contingency plan to deal with the parasite if recorded to Ireland and prevent its spread is in the latter stages of preparation.

974 Genetic Pollution

Genetic interactions with cultured Atlantic salmon into Irish river systems can occur as a consequence of the deliberate (stocking or ranching) or inadvertent (farm escape) release of hatchery fish into the wild. On average, 3.5million unfed fry are stocked into Irish rivers each year. A further 800,000 are released as smolts (Marine Institute ESOPS Database). There is no systematic demographic or genetic monitoring of fish farm escapees in Irish rivers. However, the average percentage of escapee salmon occurring in coastal commercial fisheries from 1991 to 2004 ranges from less than 0.1% in Donegal to 0.6% in Mayo. However some qualification on the representativeness of these estimates is required in that the commercial fisheries are operated for a short period of eight weeks in the summer whereas most large scale escapes are likely to occur in the winter as a result of storm damage to cages. There were no reports from the industry of large-scale escapes in 2004, 2005 or 2006. Generally, and in agreement with expectations (Hindar *et al.,* 1991), empirical studies on interactions between wild and cultured salmon, i.e. an examination of a long-term dataset for a wild population in Ireland that has been subjected to hatchery introductions (P. McGinnity *pers comm.)* and a number of common garden experiments (McGinnity et al. 1997; McGinnity et al. 2003; Fleming et al., 2000; deEyto et al., 2007), show a change in the genetic make up and a loss in productivity in the recipient wild populations.

Genetic pollution as a future threat

Stringent containment procedures are required on marine salmon farms to avoid compromising wild salmon populations. A major expansion of the existing finfish *cage culture operations in Ireland would constitute a potential threat to Irish salmon populations.*

965 Predation

Pike (*Esox lucius L.*) are known to prey on salmon smolts during the spring period. Salmon smolts passing through large lakes on their downward migration are frequently recorded in pike stomachs in Lough Corrib on the Corrib system and Lough Conn and Cullin on the Moy system. Pike have been recorded accumulating in significant numbers where inflowing streams enter lakes in spring. Predation on salmon smolts also takes place on large rivers like the Boyne and Barrow, where salmon smolts have been recorded in significant numbers in pike stomachs in spring.

Pike population size is low on many large salmon rivers, such as the Nore, Suir, Slaney and Blackwater, most likely due to lack of spawning areas, and thus predation on smolts is low in these systems.

There have been rare incidences of large pike preying on adult salmon in both Lough Corrib and Lough Conn, and two grilse of 4lb and 5lb were recorded in one large pike on one occasion. Little is known of the significance of trout predation on salmon smolts in rivers or lakes but it is believed to be less than that of pike. Salmon smolts have been recorded in the stomachs of ferox trout in Lough Corrib.

Predation by birds (cormorants, mergansers and goosanders) takes place on salmon eggs, fry and parr. Large numbers of cormorants may congregate in the lower sections of rivers and prey heavily on migrating salmon smolts. Kennedy and Greer 1988 estimated that predation by cormorants on the River Bush in Northern Ireland accounted for losses of 51 – 66 % of the migrating salmon smolt run. Large numbers of cormorants are regularly seen on the rivers Slaney, Lackagh, Leannon, Nore and Barrow feeding on juvenile fish including juvenile salmon.

Predation by seals, primarily grey seals, has been significant in recent years. Seals regularly take seals from salmon drift nets and fishermen in some areas report up to 30% of their catch being taken by seals. Predation by seals on salmon in estuaries and rivers also takes place with the Moy estuary a particular problem area.

Predation as a future threat

With the cessation of drift net fishing for salmon, the predation of salmon by seals from nets will not take place. However it is not known what impact the change in the fishery will have on predation by seals on salmon in estuaries and rivers.

The recent illegal stocking/introduction of chubb to the lower river Inny presents a significant threat through expansion and colonisation of traditional salmon spawning & nursery areas. Pressures include displacement, competition for food and predation by chubb on salmon & trout ova & fry.

Habitat for the species

The habitat for salmon (Fig. 21.) is defined as the available riverine habitat for salmon downstream of impassable barriers. The area calculated as the wetted area habitat (km^2) in 148 designated salmon rivers. Lacustrine data is presented separately.

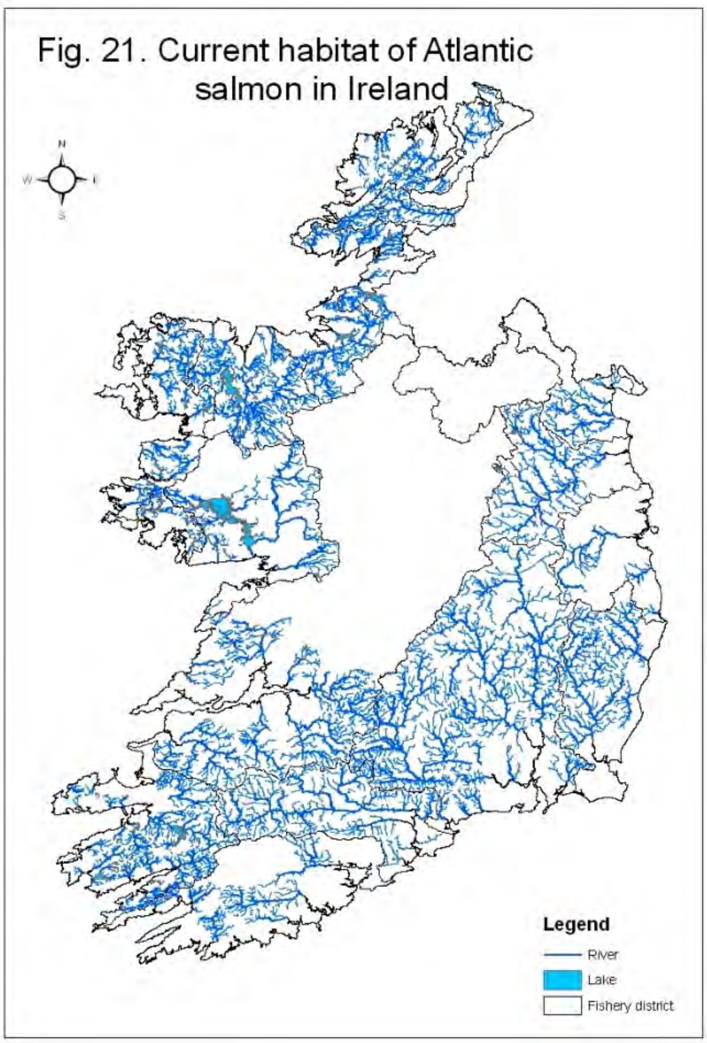


Fig. 21. Current habitat of Atlantic salmon in Ireland

Complementary information

Favourable reference range	**This has been expressed as the current range of Atlantic salmon (2006)**
Favourable reference population	**Expressed as the no. of salmon rivers meeting their conservation limit**
Suitable Habitat for the species	**This is the current available habitat for Atlantic salmon (2006)**

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Database

CFB fish kill database

CFB electrofishing database

Marine Institute ESOPS Database

Appendix 1 (ANON 2007)

Table 1 Potential harvest available for rivers above Conservation Limit

River name	District	Surplus Total	Surplus 1SW	Surplus 2SW	Surplus Common Estuary	Total River CL	1SW CL Component	MSW CL Component
Castletown	Dundalk	42				197		
Fane	Dundalk	223				543		
Black Water	Waterford	265				346		
Blackwater	Lismore		4186	277			11861	893
Owennacurra	Cork	461				179		
Lower Lee (Martin, Shournagh, Brid	Cork	1614				1184		
Bandon	Cork		1331	122			2208	192
Ilen	Cork	502				1014		
Mealagh	Cork	63				88		
Coomhola	Cork	277				306		
Roughty	Kerry	577				1245		
Blackwater (Kerry)	Kerry	236				455		
Sneem	Kerry	84				371		
Cummeragh (Waterville)	Kerry		558	114			279	57
Caragh	Kerry		643	108			698	114
Owenmore R. (Kerry)	Kerry	109				102		
Laune	Kerry		6199	971			2738	446
Feale	Limerick		3282	1406			1641	703
Mulkear	Limerick	1349				6284		
Corrib	Galway		349	26			8575	547
Cashla	Connemara	300				349		
Screebe	Connemara	263				155		
Ballynahinch	Connemara	623				1088		
Erriff	**Ballinakill**	**1621**				**1300**		
Bundorragha	**Ballinakill**		**360**	**78**			**120**	**42**
Common estuary **	**Ballinakill**				**1648**			
Dawros	Ballinakill	271				582		
Owenglin (Clifden)	Ballinakill	257				372		
Srahmore (Burrishoole)	Bangor	494				453		
Owenduff	**Bangor**		**1038**	**213**			**1058**	**232**
Owenmore R. (Mayo)	**Bangor**		**2837**	**276**			**3226**	**281**
Common estuary **	**Bangor**				**3233**			
Moy	Ballina		18626	1641			15309	1331
Easky	Ballina	752				1297		
Ballysadare	Sligo	848				5098		
Drumcliff	Sligo	112				474		
Duff	Ballyshannon	478				1182		
Drowes	Ballyshannon		2422	346			1211	150
Eany	Ballyshannon	950				1740		
Glen	Ballyshannon	336				957		
Owenea	Letterkenny	2105				1713		
Gweebarra	Letterkenny		545	61			631	62
Clady	Letterkenny	58				515		
Tullaghobegly	Letterkenny	147				226		
Crana	Letterkenny	431				1119		

(** In the case of fisheries operating in a common estuary the surplus is for all fisheries including the rod fisheries - in order to maintain a 75% probability of meeting the Conservation Limit in all rivers simultaneously this is less than the combined total of surpluses in each river seperately)

Appendix 2 (ANON 2007)

Rivers below Conservation Limits

River name	District	Deficit Total	Deficit 1SW	Deficit 2SW	Total River CL	1SW CL Component	MSW CL Component
Glyde	Dundalk	-1604			2172		
Dee	Dundalk	-1724			2410		
Boyne	Drogheda	-5009			14274		
Dargle	Dublin	-532			639		
Liffey	Dublin	-2719			4391		
Slaney	Wexford		-1934	-558		5234	1476
Barrow	Waterford	-8859			12026		
Nore	Waterford	-2106			11958		
Suir	Waterford	-4232			14752		
Colligan	Waterford	-136			338		
Bride	Lismore	-991			1379		
Upper Lee **	Cork	Signif. Below CL					
Glengarriff	Cork	-61			229		
Croanshagh (Glanmore R. and L.)	Kerry	-190			301		
Sheen	Kerry	-241			600		
Inney	Kerry	-76			649		
Maine	Kerry	-784			1487		
Maigue	Limerick	-3624			3907		
Shannon River **	Limerick	Signif. Below CL					
Fergus	Limerick	-1714			2391		
Culfin	Ballinakill	-58			144		
Carrownisky	Ballinakill	-259			365		
Bunowen	Ballinakill	-239			619		
Owenwee (Belclare)	Ballinakill	-114			378		
Newport R. (Lough Beltra)	Bangor		-216	-77		619	229
Glenamoy	Bangor	-194			630		
Cloonaghmore (Palmerstown)	Ballina	-752			1261		
Garvogue (Bonnet)	Sligo		-1680	-368		2395	526
Erne **	Ballyshannon	Signif. Below CL					
Eske	Ballyshannon	-785			1135		
Gweedore (Crolly R.)	Letterkenny	-33			325		
Ray	Letterkenny	-65			433		
Lackagh	Letterkenny	-444			1083		
Leannan	Letterkenny	-2820			3619		

(** Major impounded rivers)

Appendix 3 (ANON 2007)

Table 3 Small rivers with less than 10 rod caught salmon (average 2001 to 2005)

River Name	District	Average Harvest Rod Catch	Conservation Limit
Flurry	Dundalk	<1	123
Vartry	Dublin	<1	189
Avoca	Wexford	1	2959
Owenavorragh	Wexford	<1	810
Corock R	Waterford	<1	734
Owenduff	Waterford	2	201
Pollmounty	Waterford	<1	93
Lingaun	Waterford	<1	353
Clodiagh	Waterford	<1	666
Mahon	Waterford	1	442
Tay	Waterford	1	278
Lickey	Lismore	<1	115
Finisk	Lismore	<1	456
Glenshelane	Lismore	<1	145
Tourig	Lismore	<1	90
Womanagh	Lismore	<1	293
Argideen	Cork	6	391
Owvane	Cork	8	401
Adrigole	Cork	<1	169
Kealincha	Kerry	<1	124
Lough Fada	Kerry	<1	91
Owenshagh	Kerry	7	324
Cloonee	Kerry	<1	75
Finnihy	Kerry	<1	141
Owenreagh	Kerry	<1	106
Emlaghmore	Kerry	<1	73
Carhan	Kerry	<1	93
Ferta	Kerry	3	197
Behy	Kerry	1	142
Cottoners	Kerry	<1	166
Emlagh	Kerry	<1	130
Owenascaul	Kerry	3	193
Milltown	Kerry	<1	83
Feohanagh	Kerry	1	157
Lee	Kerry	<1	586
Brick	Limerick	<1	800
Galey	Limerick	<1	1049
Deel	Limerick	<1	2462
Owenagarney	Limerick	<1	814
Doonbeg	Limerick	4	426
Skivaleen	Limerick	<1	372
Annageeragh	Limerick	2	302
Inagh	Limerick	4	1033
Aughyvackeen	Limerick	<1	226

Table 3 Small rivers with less than 10 rod caught salmon (average 2001 to 2005)

River Name	District	Average Harvest Rod Catch	Conservation Limit
Aille (Galway)	Galway	1	76
Kilcolgan	Galway	3	1682
Clarinbridge	Galway	<1	63
Knock	Galway	<1	123
Owenboliska R (Spidda	Galway	1	550
L.Na Furnace	Connemara	<1	66
Owengarve R.	Bangor	<1	194
Muingnabo	Bangor	<1	351
Ballinglen	Ballina	1	396
Brusna	Ballina	<1	1113
Leaffony	Ballina	<1	218
Grange	Sligo	<1	356
Abbey	Ballyshannon	<1	276
Ballintra (Murvagh R).	Ballyshannon	2	407
Laghy	Ballyshannon	<1	479
Oily	Ballyshannon	5	549
Bungosteen	Ballyshannon	3	418
Owenwee (Yellow R)	Ballyshannon	<1	184
Bracky	Letterkenny	<1	305
Owentocker	Letterkenny	1	519
Owenamarve	Letterkenny	6	160
Glenna	Letterkenny	1	207
Swilly	Letterkenny	7	1083
Isle (Burn)	Letterkenny	<1	510
Mill	Letterkenny	<1	272
Clonmany	Letterkenny	<1	465
Straid	Letterkenny	<1	196
Donagh	Letterkenny	<1	418
Glenagannon	Letterkenny	2	355
Culoort	Letterkenny	<1	223
	Approximate total	79 min to 124 max	

Appendix 4 Identified habitat pressures on Irish Rivers – 2005 (NASCO, CNL (05) 4)

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
2	Flurry (River)	Not threatened with loss	*										*							
3	Castletown (River)	Not threatened with loss	*															*	*	
4	Fane (River)	Not threatened with loss	*																	*
5	Glyde (River)	Not threatened with loss	*				*												*	
6	Dee (River)	Not threatened with loss	*				*												*	
8	Boyne (River)	Not threatened with loss	*				*						*	*				*	*	
15	Liffey (River)	# Threatened with loss	*		*							*	*						*	*
18	Dargle (River)	Threatened with loss		*										*					*	
21	Vartry (River)	Threatened with loss			*								*							*
26	Avoca (River)	Threatened with loss						*						*						
28	Owenavorragh (River)	Threatened with loss	*				*						*	*					*	
31	Slaney (River)	# Threatened with loss	*	*				*				*		*	*			*		*
33	Corock (River)	Not threatened with loss	*	*												*			*	
34	Owenduff (River)	Not threatened with loss	*																*	
35	Pollmounty (River)	Not threatened with loss	*		*														*	
37	Barrow (River)	Not threatened with loss	*	*			*			*	*		*	*		*			*	*
38	Nore (River)	Not threatened with loss	*	*			*						*			*				
39	Black Water	Not threatened with loss	*		*								*							
41	Lingaun (River)	Not threatened with loss				*										*				

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
43	Suir (River)	Not threatened with loss	*			*										*				
44	Clodiagh (River)	Not threatened with loss																		
50	Mahon (River)	Not threatened with loss		*																
51	Tay (River)	Not threatened with loss																		
53	Colligan (River)	Not threatened with loss																		
55	Licky (River)	Not threatened with loss		*				*												
57	Finisk (River)	Not threatened with loss	*																	
58	Glenshelane (River)	Not threatened with loss		*									*							
59	Blackwater (River)	Not threatened with loss	*	*	*					*						*		*		
60	Bride (River)	# Threatened with loss	*										*							
61	Tourig (River)	Not threatened with loss	*																	
62	Womanagh (River)	Not threatened with loss	*																	*
64	Owenacurra	Not threatened with loss	*	*	*											*	*			
66	Lee (River)	Not threatened with loss			*							*								*
69	Bandon (River)	Not threatened with loss	*			*	*			*	*		*			*				
70	Ardigeen (River)	Not threatened with loss	*				*													
72	Ilen (River)	# Threatened with loss		*			*				*				*					
77	Mealagh (River)	Not threatened with loss																		
78	Owvane (River)	# Threatened with loss				*	*			*						*				
79	Coomhola (River)	Not threatened with loss						*												
80	Glengarriff (River)	Not threatened with loss		*					*	*										

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
81	Ardrigole (River)	Not threatened with loss					*					*								
82	Kealincha (River)	Not threatened with loss							*											
83	Lough Fadda (Stream)	Not threatened with loss							*											
84	Croanshagh (River)	Not threatened with loss							*											
85	Owenshagh (River)	Not threatened with loss							*											
86	Cloonee (River)	Not threatened with loss					*		*											
87	Sheen (River)	Not threatened with loss				*			*											
88	Roughty (River)	Not threatened with loss	*	*		*														
89	Finnihy (River)	Not threatened with loss																		
90	Blackwater (River)	Not threatened with loss				*														
92	Sneem (River)	Not threatened with loss							*											
93	Owreagh (River)	Not threatened with loss																		
97	Currane (River)	Not threatened with loss														*				
98	Inny (River)	Not threatened with loss		*		*					*									
99	Emlaghmore (River)	Not threatened with loss																		
101	Carhan (River)	Not threatened with loss																		
102	Ferta (River)	Not threatened with loss																		
103	Behy (River)	Not threatened with loss																		
104	Caragh (River)	Not threatened with loss																		
105	Cottoners (River)	Not threatened with loss				*														
106	Laune (River)	Not threatened with loss	*			*							*						*	

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
107	Maine (River)	Not threatened with loss	*			*	*												*	
108	Emlagh (River)	Not threatened with loss																		
109	Owenascaul (River)	Not threatened with loss				*														
111	Milltown (River)	Not threatened with loss																		
112	Feohanagh (River)	Not threatened with loss																		
114	Owenmore (River)	Not threatened with loss																		
117	Lee (River)	Not threatened with loss	*				*												*	
118	Brick (River)	Not Threatened with loss	*																	
119	Feale (River)	Not Threatened with loss	*	*							*		*	*						
120	Galey (River)	Threatened with loss	*	*																
125	Deel (River)	Threatened with loss	*									*								*
126	Maigue (River)	Threatened with loss	*	*									*							
128	Shannon River	Threatened with loss	*		*							*	*	*			*			*
130	Owenagarney (River)	Not Threatened with loss											*							
131	Fergus (River)	Not Threatened with loss																		
133	Doonbeg (River)	Threatened with loss													*					
134	Skivileen (River)	Threatened with loss													*					
135	Annageeragh (River)	Threatened with loss			*										*					
142	Inagh (River)	Not Threatened with loss		*								*	*							
143	Aughyvackeen (River)	Not Threatened with loss																		
144	Aille (River)	Threatened with loss											*		*					

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
145	Kilcolgan (River)	Not Threatened with loss	*	*			*						*						*	
146	Clarinbridge (River)	Not Threatened with loss	*				*						*						*	
147	Corrib (River)	Not Threatened with loss	*	*			*						*			*			*	
148	Knock (River)	Threatened with loss													*					
149	Owenboliska	Threatened with loss		*											*					*
152	Cashla (River)	Not Threatened with loss		*					*											
154	stream (L. Nafurnace)	Threatened with loss							*						*				*	
155	Screeb	Threatened with loss	*	*					*						*		*			
161	Owenmore (River)	Not Threatened with loss		*					*							*				
163	Owenglin (River)	Not Threatened with loss		*					*											
166	Dawros (River)	Not Threatened with loss							*							*				
167	Culfin (River)	Not Threatened with loss		*					*							*		*		
168	Erriff (River)	Not Threatened with loss		*					*							*		*		
169	Bundorragha (River)	Not Threatened with loss		*					*							*				
171	Carrownisky (River)	Not Threatened with loss				*										*				
172	Bunowen (River)	Not Threatened with loss		*									*			*				
173	Owenwee (River)	Not Threatened with loss		*													*			
178	Newport (River)	Threatened with loss	*	*					*											
179	Srahmore (River)	Not Threatened with loss		*					*							*				
181	Owengarve (River)	# Threatened with loss		*					*						*	*				
185	Owenduff	Not Threatened with loss																		

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
186	Owenmore (River)	Not Threatened with loss	*	*												*	*			
187	Glenamoy (River)	Not Threatened with loss	*	*							*									
188	Muingnabo (River)	Not Threatened with loss		*																
193	Ballinglen (River)	Not Threatened with loss	*	*													*			
194	Cloonaghmore (River)	Not Threatened with loss	*														*			
195	Moy (River)	Not Threatened with loss	*				*						*	*						
196	Brusna (River)	Not threatened with loss																		
198	Leaffony (River)	Not threatened with loss	*																	
200	Easky (River)	Not threatened with loss																		
202	Ballysadare (River)	Not Threatened with loss										*								
203	Garvogue (River)	Not Threatened with loss	*															*	*	
205	Drumcliff (River)	Not Threatened with loss		*												*				
207	Grange (River)	Not Threatened with loss											*	*		*				
208	Duff (River)	Not Threatened with loss					*				*									
209	Drowes (River)	Not Threatened with loss		*									*						*	
210	Erne	Maintained										*	*							
211	Abbey (River)	Not Threatened with loss	*															*		
212	Ballintra (River)	Not Threatened with loss		*									*							
213	Laghy (Stream)	Not Threatened with loss																		
214	Eske (River)	Not Threatened with loss	*	*					*											
215	Eany (Water)	Not Threatened with loss		*					*										*	

FB_CODE (Wetted area code no.)	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
216	Oily (River)	Not Threatened with loss							*		*								*	
217	Bungosteen (River)	Not Threatened with loss												*	*					
219	Glen (River)	Not Threatened with loss					*							*						
220	Owenwee (River)	Not Threatened with loss		*												*	*			
221	Bracky (River)	Not Threatened with loss									*			*						
222	Owentocker (River)	Not Threatened with loss	*	*							*									
223	Owenea (River)	Not Threatened with loss		*							*		*							
225	Gweebarra (River)	Not Threatened with loss																		
226	Owennamarve (River)	Threatened with loss													*					
228	Gweedore (River)	Not Threatened with loss																		
229	Clady (River)	Not Threatened with loss										*								
234	Glenna (River)	Not Threatened with loss																	*	
235	Tullaghobegly (River)	Not Threatened with loss						*												
236	Ray (River)	Threatened with loss									*			*						
240	Lackagh (River)	Not Threatened with loss																		
248	Leannan (River)	Not Threatened with loss	*	*					*					*						
249	Swilly (River)	# Threatened with loss	*	*									*							
250	Isle (Burn)	Threatened with loss	*				*													
253	Crana (River)	Not Threatened with loss		*	*														*	
256	Clonmany (River)	Threatened with loss	*	*			*								*					
257	Straid (River)	Lost	*																	

FB_CODE (Wetted	OS_RIV_NAM	NASCO category	Agricultural enrichment	Afforestation	Artificial barriers / fish passage problems	Bank erosion / braiding	Drainage / channel modification	Fish farming - freshwater	Fish farming - marine	Flash flooding / excessive substrate displacement	Gravel removal	Hydropower	Inadequate sewage treatment	Industrial discharges	Inadequate nos. of spawning fish (unknown cause)	Overgrazing/bank trampling/riparian damage	Peat harvesting/other siltation	Quarrying/Suspended solids run-off	Urbanisation/road development	Water abstraction
258	Donagh (River)	Not Threatened with loss											*	*						
259	Glennagannon (River)	Not Threatened with loss	*				*													
261	Culoort (River)	Not Threatened with loss	*																	

1106 Atlantic salmon (*Salmo salar* L.)

National Level	
Species code	1106
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)

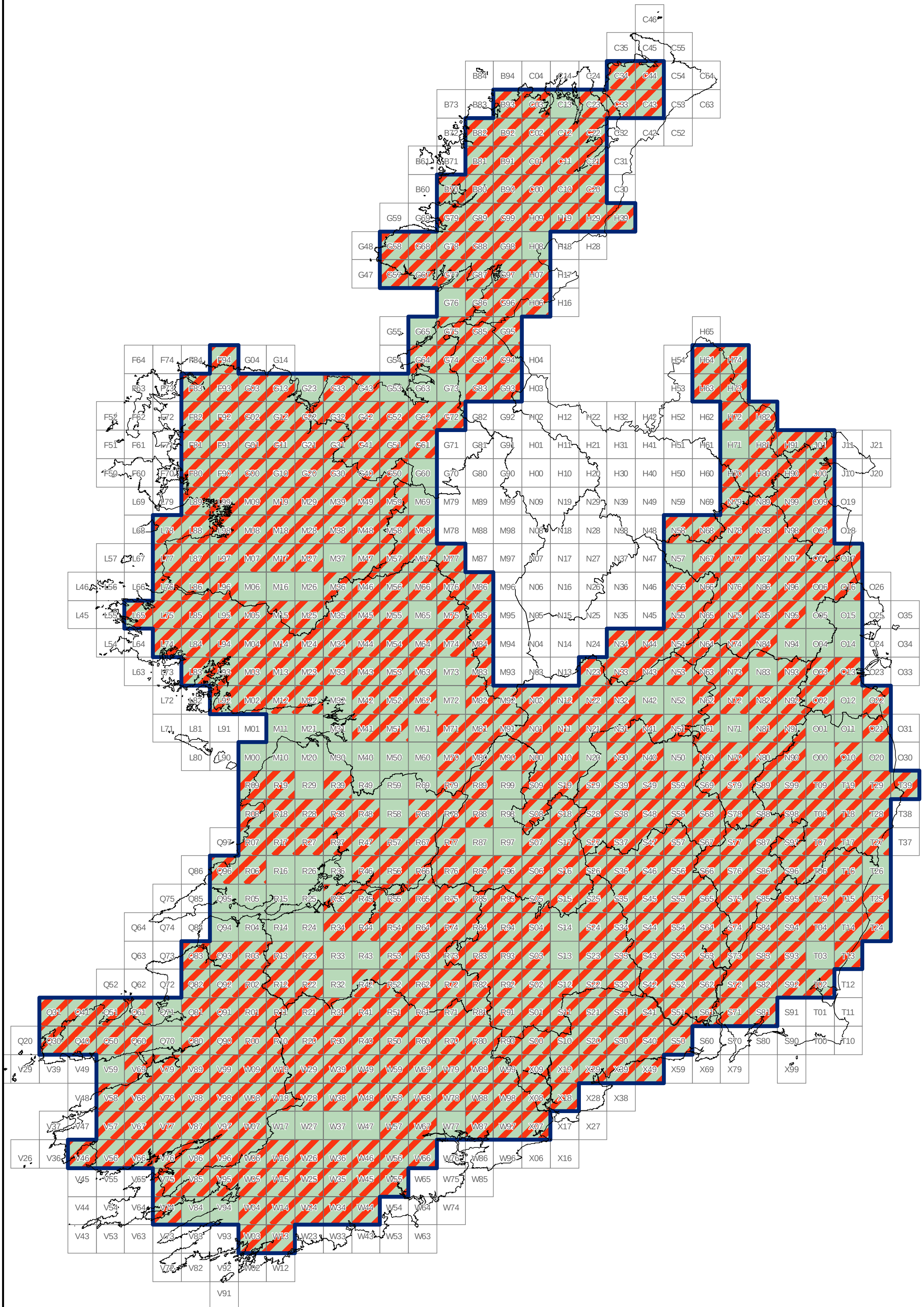
Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	McGinnity, P., Gargan, P.,Roche, W.,Mills, P. & McGarrigle, M., 2003. Quantification of the Freshwater Salmon Asset in Ireland using data interpreted in a GIS platform. Irish Freshwater Fisheries Ecology and Management Series: Number 3, Central Fisheries Board, Dublin, Ireland. Report of the Standing Scientific Committee of the National Salmon Commission – The Status of Irish Salmon Stocks in 2005 and Precautionary Catch Advice for 2006 NASCO 2005 CNL (05) 45. Development of the NASCO Database of Irish Salmon Rivers. Report on Progress, May 2005. NASCO, Edinburgh.
Range	
Surface area	63.000 km^2
Date	1990-2006
Quality of data	3 = good
Trend	0 = stable
Trend-Period	1990-2006
Reasons for reported trend	
Population	
Distribution map	NPWS
Population size estimation	43 populations meeting Conservation Limit (see Other Relevant Information below)
Date of estimation	2006
Method used	2 = extrapolation from surveys of part of the population, sampling
Quality of data	3 = good
Trend	-ve, extrapolated from other measurements e.g. marine survival, but extent of decrease unknown
Trend-Period	1994-2006
Reasons for reported trend	2 = climate change 3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence 6 = other (specify) - reduced marine survival associated with climate change
Justification of % thresholds for trends	N/a

Main pressures	100 Cultivation 110 Pesticides 120 Fertilization 140 Grazing 160 General Forestry management 161 Forestry planting 200 Fish & Shellfish aquaculture 210 Professional fishing 211 Fixed location fishing 213 Drift net fishing 220 Leisure fishing 243 Trapping/poisoning/poaching 300 Sand & gravel extraction 301 Quarries 310 Peat extraction 312 Mechanical removal of peat 330 Mining 331 Open cast mining 332 Underground mining 400 Urbanisation areas/human habitation 420 Discharges 421 Disposal of household waste 422 Disposal of industrial waste 502 Routes, auto routes 700 Pollution 701 Water pollution 720 Trampling/overuse 810 Drainage 811 Management of aquatic & bank vegetation for drainage purposes 850 Modification of hydrographic functioning. 852 Modifying structures of inland water courses 900 Erosion 910 Silting up 920 Drying out 950 Biocenotic evolution 951 Accumulation of organic material 952 Eutrophication 953 Acidification 954 Invasion by a species 960 Interspecific faunal relations 961Competition 962 Parasitism 963 Introduction of disease 964 Genetic pollution 965 Predation

Threats	100 Cultivation 110 Pesticides 120 Fertilization 140 Grazing 160 General Forestry management 161 Forestry planting 200 Fish & Shellfish aquaculture 210 Professional fishing 243 Trapping/poisoning/poaching 300 Sand & gravel extraction 301 Quarries 310 Peat extraction 312 Mechanical removal of peat 330 Mining 332 Underground mining 331 Open cast mining 400 Urbanisation areas/human habitation 420 Discharges 421 Disposal of household waste 422 Disposal of industrial waste 502 Routes, auto routes 507 Bridges 700 Pollution 701 Water pollution 720 Trampling/overuse 810 Drainage 811 Management of aquatic & bank vegetation for drainage purposes 850 Modification of hydrographic functioning. 852 Modifying structures of inland water courses 900 Erosion 910 Silting up 920 Drying out 950 Biocenotic evolution 951 Accumulation of organic material 952 Eutrophication 953 Acidification 954 Invasion by a species 960 Interspecific faunal relations 961 Competition 962 Parasitism 963 Introduction of disease 964 Genetic pollution 965 Predation
Habitat for the species	
Area estimation	Accessible fluvial habitat = 113 km^2 (river wetted area) Accessible lacustrine habitat = 446 km^2 (lake surface area)
Date of estimation	2003
Quality of data	3 = good
Trend	0 = stable
Trend-Period	2002-2006
Reasons for reported trend	
Future prospects	2 = poor prospects

Complementary information	
Favourable reference range	63.000 km^2
Favourable reference population	148 rivers meeting Conservation Limit
Suitable Habitat for the species	Accessible fluvial habitat = 113 km^2 (river wetted area)
Other relevant information	Various measurements of Population (and Favourable reference population) were considered. **e.g. One-sea winter (1 SW) salmon** - total estimated national population is 236,764 of which 126,652 comprise the spawning stock **Multi-sea winter (MSW) salmon -** total estimated national population is 35,763 of which 25,269 comprise the spawning stock. However, following discussions between the Central Fisheries Board and NPWS the unit of measurement chosen as the most suitable measurement for Population (and consequently for Favourable reference population) for the purposes of the conservation assessment was the number of recognised salmon rivers meeting their Conservation Limit (CL). There are 148 identified salmon rivers in Ireland (subdivision of some catchments gives a total of 151 rivers) and their status is as follows: • 43 rivers are meeting and exceeding their CL (= favourable reference condition) • 34 rivers are not meeting their CL • 74 small rivers are unassessed to date due to lack of data Although there is no trend data for the number of rivers meeting their CL, an enhanced programme of surveillance is being established by the CFB to specifically address this issue. This programme will ensure that robsut trend data is available for this parameter in time for the next Article 17 report. There is trend data, however, for other aspects of the Irish salmon population: Total **1SW returns** (to the coast) have fallen from 1.1 million in 1971 to 240,000 in 2006 i.e. - 79 % = net loss by 79 % . Since 1981 the 1SW salmon **spawning stock** has fluctuated around the national conservation limit (= favourable reference condition) with periods during the 1990's where it consistently failed to achieve the spawning requirement only exceeding it in one year (2000). The spawning stock has largely remained stable since 1990 although there has been some decrease since 2003. Since 1990 the **total stock** has averaged approximately 300,000 fish. Since 2000 there has been a consistent decrease in the total population with the most recent estimate of total stock at 236,764 1SW and 35,763 MSW fish. 1990 – 2006 national trend analysis is - 11 % = net loss by 11 %.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Bad (U2)
Habitat for the species	Inadequate (U1)
Future prospects	Inadequate (U1)
Overall assessment of CS[1]	Bad (U2)

[1] A specific symbol (e.g. arrow) can be used in the unfavourable categories to indicate recovering populations



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1:1,800,000

0 12.5 25 50 Kilometers

Salmo salar

1106

Current Distribution (546 cells)
Current Range (630 cells)
Favourable Reference Range (630 cells)
W48 10km grid squares

Date: August 2007

Conservation Assessment of Sandbanks slightly covered by seawater at all times (Habitat Code: 1110)

Habitat characteristics in Ireland

Sand banks in Irish water comprises distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) that may arise from horizontal or sloping plains of sediment that ranges from gravel to fine sand. They are primarily composed of sandy sediments permanently covered by water, at depths of less than 20 m below chart datum (though the banks may extend to water depths greater than 20 m. The diversity and types of community associated with this habitat are determined particularly by sediment type together with a variety of other physical, chemical and hydrographical factors. These include geographical location (influencing water temperature), the relative exposure of the coast, topographical structure of the habitat, and differences in the depth, turbidity and salinity of the surrounding water.

Habitat mapping

Most information relating to the shape and composition of sandbanks has been derived from Admiralty Charts. Offshore banks in Dublin Bay were characterised by side-scan sonar as rounded mounds with "stippled bank crest facies" (Wheeler *et al*., 2000). These surveys produced evidence of seabed mobility on, and adjacent to, the banks in Dublin Bay. The observation that sand-waves increased in amplitude approaching the edge of the banks is indicative that currents are highest closer to the banks. Therefore, the influence of banks on bottom current is one that tends to increase current experienced over banks beyond what is experienced in the adjacent areas.

Habitat Range

The greatest resource of sandbanks are found in the Irish Sea. These banks are from north to south: Bennet, Burford, Kish, Frazer, Bray, Codling, India, Arklow, Seven Fathom Bank, Glassgorman, Rusk, Blackwater/Moneyweights, Lucifer, Long and Holdens Banks. To date only 2 sandbanks the Ballybunion and Turbot/Kilstiffin Banks have been identified along the western seaboard at the mouth of the Lower River Shannon cSAC between Counties Kerry and Clare. No sandbanks are found on the southern coast of Ireland. A small bank occurs on the north coast of Donegal called Hempton's Turbot Bank. As far as it has been possible to determine the habitat range from the Admiralty Charts there has not been any change in the distribution in the last 50 years. Any changes that may have occurred are due to natural causes. The range has been calculated to encompass 21 sites and cover an area of 211 km^2. The sandbanks fall within 28 x 10km^2.

Conservation Status of Habitat Range

Favourable: The conservation status of the habitat range is considered to be stable as there is no evidence of any significant overall habitat loss in the last 15 years. The current range is considered to be equal to the total historical range and is therefore regarded as the Favourable Reference Range

Habitat Area
Using the Admiralty Charts a total of 21 banks have been identified within national jurisdiction and cover 211 km^2. Of this total approximately 69km^2 is designated or in the process of designation. The construction of 7 wind turbines on the Arklow Bank.has impacted on a small area (approx. 700-800 $m^{2)}$ has been impacted by the construction of a series of 7 wind-turbines from

Conservation Status of Habitat Area
There is no evidence of a decline in the area of sandbanks since the Directive came into force. The current area is considered sufficient to ensure the long-term survival of the habitat and is therefore regarded as equal to the Favourable Reference Area.

Area is therefore assessed as Favourable, in the absence of any significant habitat reduction events (e.g. aggregate extraction, wind farm development)

Structure and Function
Seismic profiling has interpreted the origin of near-shore Irish Sea sandbanks as moraines formed during de-glaciation (Hanna, 2002). Although there have been changes to the topography in the recent past, these are considered to have had a much smaller effect in shaping the sandbanks than glacial events. In particular, near-shore hydrodynamics were identified as a major control on sandbank morphology and coastal configuration. Soft glacial coastal sediments have little resistance to wave and hydrodynamic action and on the eastern seaboard of Ireland are slowly eroding on a geological time scale (Hanna, 2002). This erosion of coastal sediments is partially arrested by a supply of sediments from offshore banks in deep water and underlies the importance of the banks in sediment transport to shores along the east coast of Ireland. Soft sediment (sand & mud) is in-turn fed to the south-eastern banks from deeper banks in the Celtic Sea. Therefore a dynamic relationship, which is largely tide-driven, has evolved to create a transport chain into, and along the coasts of, the western Irish Sea. Coastal protection structures can alter the natural erosion and deposition of sediments along the coast and has in some areas lead to increased erosion of coastal land. Granulometric analysis and Admiralty records over Irish sandbanks have found that they were dominated by sand, slightly-gravelly-sand and very occasional patches of muddy-sand and gravel (Wheeler *et al*., 2000). These sandy sediments are formed into sand-waves under the influence of tide and wind forces (Irish Hydrodata Ltd., 1996).

Of the benthic faunal surveys undertaken in the Irish Sea, few have been completed directly over or immediately adjacent to sandbank habitat.

North Kish Bank: A survey commissioned by the National Parks and Wildlife Service in 2005 sampled the north Kish Bank.

Arklow Bank: The sediment of Arklow Bank was found to consist predominantly of sand, cobbles, shells and pebbles on the northern end tending towards to fine sand at the southern end. The benthic surveys, conducted using a benthic dredge, showed that epibenthic species diversity and abundance were highest in the areas of “sandy shells” and “gravel with cobbles”. The species richness was highest at the north-west of the bank where reef building polychaetes (*Sabellaria alvelota*) were recorded (Fehily & Timoney & Co. 2001).

Glasgorman Bank: A benthic site investigation survey Aqua-Fact (2005) of a site located south/southeast of the Glasgorman Bank, off the east coast of County Wexford. This survey showed moderate diversity from benthic dredges.

Blackwater Bank: A survey commissioned by the National Parks and Wildlife Service in 2005 sampled the Blackwater.

Long Bank: Aqua-Fact International Services Ltd. (Aqua-Fact, 1989) were contracted by Bord Iascaigh Mhara (BIM) to analyse samples collected over Long Bank.

A benthic faunal study of the Blackwater and north Kish Bank in the Irish Sea during 2005 (Roche *et al*. 2007) indicated these banks exhibited the marine habitat biotopes: *Glycera lapidum* in impoverished infralittoral mobile gravel and sand (SS.SCS.ICS.Glap); infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.ImoSa); *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (SS.SSA.CFiSa.ApriBatPo); *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand biotope (SS.SSA.IFiSa.NcirBat) and *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSA.CMuSa.AalbNuc) although in some cases the species composition varied (Roche *et al.* 2007). Roche et al (2007) compared all the data for Irish sand banks with data for UK sandbanks in the Irish Sea and found the overall diversity to similar.

Typical species

Shallow sandy sediments are typically colonised by a burrowing fauna of worms (*Glycera lapidum*, *Nephtys* sp, *Spiophanes bombyx* etc.) crustaceans (*Pontocrates arenarius*, *Bathyporeia elegans* etc.), bivalve molluscs (*Abra alba*, *Fabulina fabula* etc.) and echinoderms. Mobile epifauna at the surface of the sandbank may include mysid shrimps, gastropod molluscs, crabs and fish. Sand-eels *Ammodytes* spp., an important food for birds, also live in sandy sediments. Where coarse stable material, such as shells, stones is present on the sediment surface species, hydroids, bryozoans and ascidians are present

Shallow sandy sediments are often important nursery areas for fish and consequently can provide feeding grounds for seabirds (especially puffins *Fratercula arctica*, guillemots *Uria aalge* and razorbills *Alca torda*) and sea-duck (e.g. common scoter *Melanitta nigra*) (Coveney Wildlife Consulting Ltd., 2004). A recent EIS over the Arklow Bank has shown that there is a far greater avian diversity (25-30 species) over those shallow waters than surrounding waters (5-10 species) and has been shown to be important for feeding and resting (Fehily & Timoney & Co., 2001). Therefore, these banks are also likely to represent an important feeding area for diving-bird species. A survey undertaken upon the habitat of terns in the Irish Sea showed that Kish Bank had significant numbers of auks (guillemots, razorbills etc.) and terns in the area. Roseate, Common and Arctic Terns were recorded roosting on the Kish Lighthouse and peaked in numbers during late August and early September (Newton & Crowe, 2000). The presence of these bird species is indicative of feeding resources in the area. There is also a substantial population of wintering common scoter in the waters off the Wexford Coast in the waters adjacent to the Blackwater Bank (Coveney Wildlife Consulting Ltd, 2004).

The Irish Sea supports a relatively large population of both grey and harbour seals (Kiely *et al.*, 2000). The main haul-out sites are the Saltees and several near-shore islands in Dublin Bay. There are no records of seals hauling out on Irish offshore sandbanks because most are completely immersed at all times. However, it is likely that the areas over and adjacent to sandbanks form an important feeding resource.

Cetaceans are relatively abundant in Irish Coastal waters (IWDG, 2004) and it is likely that there are greater feeding resources over sandbanks due to the hydrodynamic effects than surrounding waters. The area where greatest cetacean recording effort has been concentrated, on sandbanks within Irish waters, has shown a significant and consistent concentration of bottlenose dolphins. The resident bottlenose dolphin (*Tursiops truncatus*) population found within the Lower River Shannon cSAC is closely associated the Ballybunion and Turbot/Kilstiffin Banks. This species has been shown to have a moderate increase in population at these sites in recent years (Englund *et al.* 2007) which is indicative of habitat quality. This concentration of cetaceans around sandbanks may not be typical since a study at the Arklow Bank showed no relative increase in Harbour Porpoise compared to surrounding waters (Fehily & Timoney & Co., 2001). However, recording at other sites has been generally low.

Conservation Status of Habitat Structure and Function: Favourable
Based on the species and overall diversity present and the lack of any significant impacts on the habitat the structure and function of the habitat Sandbanks Slightly Covered by Seawater at All Times is considered to be Favourable.

Impacts and Threats
212, Demersal Fisheries: A whelk fishery takes place on sandbanks but is considered to have a low impact.

300, Aggregate extraction: the impacts of aggregate extraction will be high should this takes place on sandbanks in the future. Currently there is no aggregate extraction from Irish sandbanks however there is a growing interest in potential for sand and gravel extraction in the Irish Sea and this was the topic of an EU funded project IMAGINE.

320, Oil, as and coal extraction. Interest has been expressed in this activity for one sand bank.

490, Construction and maintenance of windfarms: The installation of turbines will result in some loss of habitat and the presence of hard structures are likely to change the biodiversity on the banks. To date only one wind farm has been constructed at the north end of the Arklow bank. However interest has been expressed in developing wind farms on most of the east coast banks and licenses have been granted for exploration prior to development.

860, Dredge disposal: This is known to have taken place adjacent to Long Bank but the impacts have not been assessed.

Future Prospects

The potential aggregate extraction, coal extraction and windfarm development remain a threat the integrity of sandbanks.

Overall Future Prospects: Unfavourable - Inadequate

Overall Assessment: Unfavourable - Inadequate

- There is no evidence of any significant overall loss of the sandbank habitat since the Directive came into force, therefore the range and area of the habitat is regarded as favourable.
- From the limited data available concerning the structure of estuarine sites in Ireland, and best expert judgement using proxy pressure indicators the structure and functions have been assessed as Favourable.
- From the large number of sand banks that have been investigated for their suitability for wind farms and their potential as sites for aggregate extraction the future prospects are considered to be Unfavourable - Inadequate
- Nationally, the overall conservation status of the habitat Sand banks cover by water al all times is Unfavourable - Inadequate.

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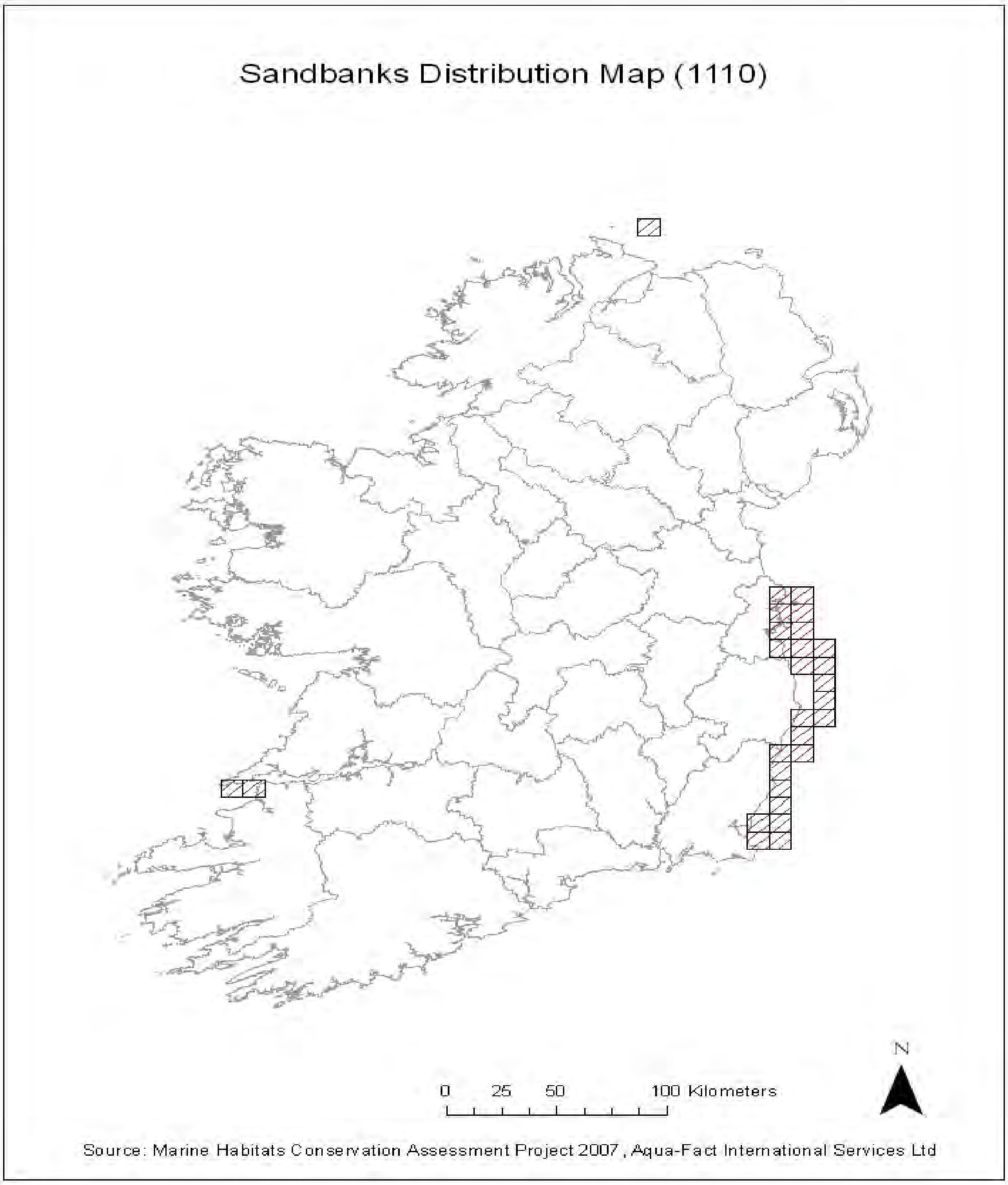


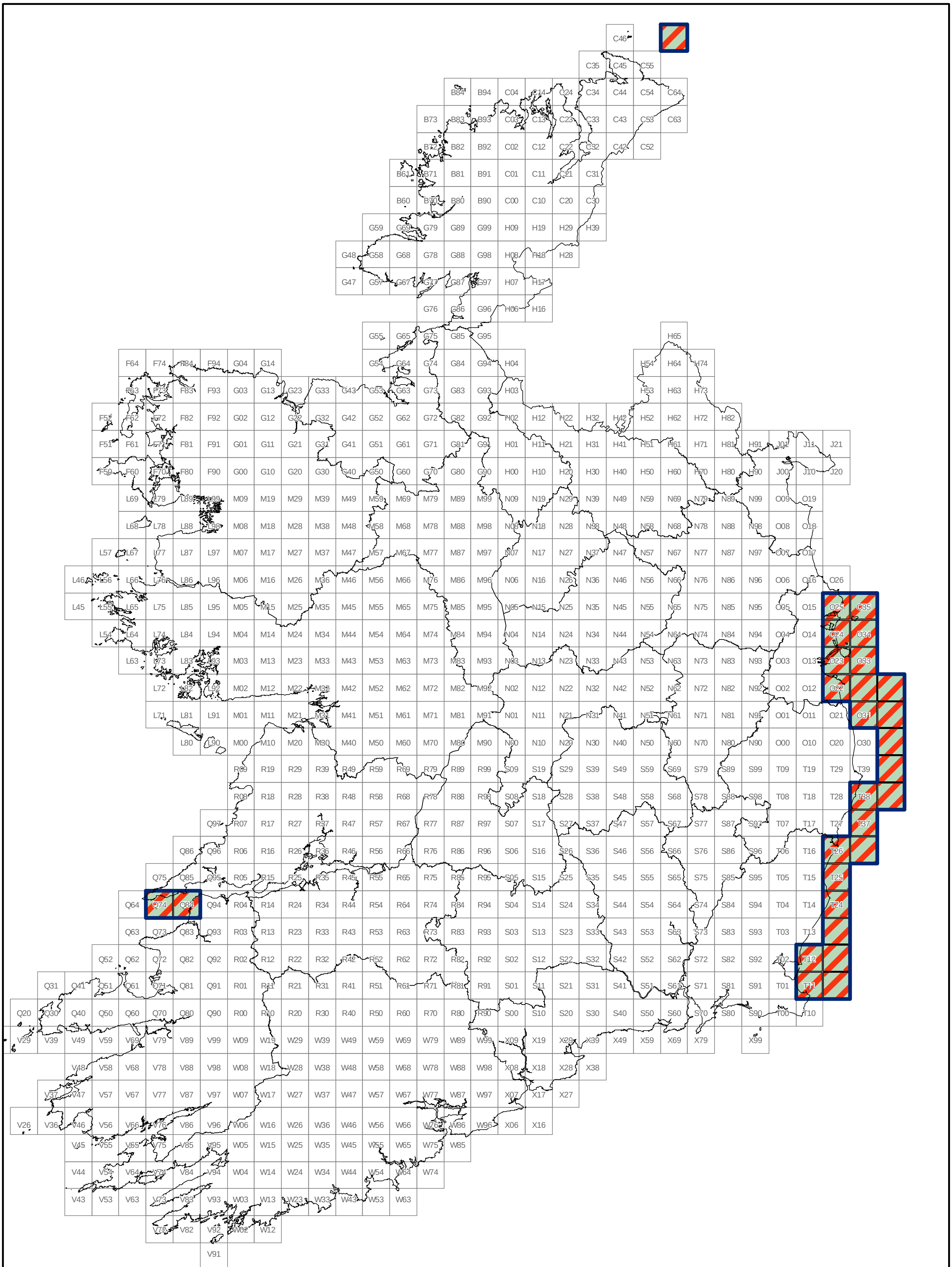
Figure 1. Sandbanks distribution in Irish Waters

1110 **Sandbanks slightly covered by seawater at all times**

National Level	
Habitat Code	1110
Member State	Ireland, IE
Biogeographic region concerned within the MS	Marine Atlantic (MATL)
Range	Marine Atlantic (MATL)

Biogeographic level	
Biogeographic region	Marine Atlantic (MATL)
Published sources	▪ Aqua-Fact International Services Ltd. (1989). Benthic studies off the Wexford coast. Faunal and sedimentological studies at Long Bank and Ballyteigue Bay. 48pp. ▪ Aqua-Fact International Services Ltd. (2005). Courtown beach re-nourishment project, Courtown, Co. Wexford. pp. 56 plus appendices. ▪ Coveney Wildlife Consulting Ltd. (2004). Seabird & Marine Mammal Survey of the Arklow Bank to Assess the Effects of the Windfarm Being Built There. A report for Airtricity Ltd. ▪ Englund, A., Ingram, S. & Rogan, E. (2007). Population assessment of bottlenose dolphins within Lower River Shannon cSAC, 2006-2007. National Parks & Wildlife Service. Irish Wildlife Manual Series (in press). ▪ Fehily & Timoney & Co. (2001). Environmental Impact Statement: Arklow Bank Wind Park (Final Report). A report prepared for Sure Partners Ltd., 29 Lower Leeson St., Dublin 2. ▪ Hanna, J. (2002). Dynamics of coastal and nearshore morphology in southeast Ireland. Ph.D. Thesis. University of Ulster, Coleraine. ▪ Irish Hydrodata Ltd. (1996). Codling Bank site investigation. A report to the Department of the Marine. ▪ IWDG. (2004). A review of cetacean sighting records in candidate Marine Special Areas of Conservation. Irish Whale and Dolphin Group: 7 pp. ▪ .Kiely, O., Lidgard, D. et al. (2000). Grey seals: status and monitoring in the Irish and Celtic Seas. Marine Institute, Dublin. ▪ Newton, S.F. & Crowe, O. (2000). Roseate Terns – The Natural Connection. Maritime reland/Wales Intereg Report No. 2. ▪ Roche, C., Lyons, D.O., Fariňas Franco, J. & O'Connor, B. (2007). Benthic surveys of sandbanks in the Irish Sea. National Parks & Wildlife Service. Irish Wildlife Manual Series (in press). ▪ Saorgus Energy Ltd. (2005). Environmental Impact Statement: Kish/Bray Wind Park. Saorgus Energy Ltd, Tralee, Co. Kerry. ▪ Wheeler, A.J., Walshe, J. & Sutton, G.D. (2000). Geological appraisal of the Kish, Burford, Bray and Fraser Banks, Outer Dublin Bay Area. Marine Resource Series No. 13: pp. 35.
Range	
Surface area	2800 km² (28 x 100 km²)
Date	June 2007
Quality of data	2 = moderate
Trend	Stable
Trend-Period	1852 - 2005

Reasons for reported trend	N/A
Area covered by habitat	
Surface area	211 km²
Date	June 2007
Method used	1= based on expert opinion & 3 = ground based survey
Quality of data	2 = moderate
Trend	Stable
Trend-Period	1852 - 2005
Reasons for reported trend	N/A
Justification of % thresholds for trends	N/A
Main pressures	490, construction and maintenance of windfarms, 212, dermsal fisheries, 220, recreational fishing, 860, dredge disposal
Threats	490, construction and maintenance of windfarms, 944, increased storms, 900, erosion, 954, invasion of a non-native species, 300, sand & gravel extraction, 320, oil, gas and coal extraction
Complementary information	
Favourable reference range	28 x 100 km² = Current Range
Favourable reference area	211.0km2 = Current Area
Typical species	**Polychaeta**, e.g., *Ophelia borealis, Sabellaria alveolata, Sabellaria spinulosa* **Mollusca**: *Chamelea gallina, Fabulina fabula, Magelona mirabilis, Spisula elliptica, Nephtys cirrosa, Glycimeris spp, Astarte sulcata* and *Venus* spp.; *Abra prismatica, Abra alba, Nucula nitidosa, Mytilus edulis, Parvicardium minimum, Mediomastus fragilis;* **Crustacea,** e.g. *Pagurus bernhardus, Liocarcinus depurator, Carcinus maenas, Urothoe elegans, Bathyporeia elegans; Echinodermata e.g.Spantangus purpureus, Asterias rubens, Ophiothrix fragilis*; **Demersal fish** e.g., *Pleuronectes platessa, Limanda limanda, Ammodytes* spp.
Other relevant information	A monitoring programme commenced in 2007 starting with Long Bank and Holden Bank and the Ballybunion bank and Turbot Bank in the mouth of the Shannon Estuary. The presence of windfarms on the sandbanks should be monitored for any adverse affects on the habitats in the future. 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
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	**Unfavourable – Inadequate (U1)**
Overall assessment of CS	**Unfavourable – Inadequate (U1)**



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1:1,800,000

0 12.5 25 50 Kilometers

Sandbanks which are slightly covered by sea water all the time

1110

- Current Distribution (28 cells)
- Current Range (28 cells)
- Favourable Reference Range (28 cells)
- W48 10km grid cells

Date: August 2007

Conservation Assessment of Estuaries (1130)

EU Definition

The EU interpretation manual describes the habitat Estuaries as the downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and sea water and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sand and mud flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.

Habitat Characteristics in Ireland

An estuary is a coastal embayment that comes under the influence of a large river. At low water, there can be extensive areas of mudflats or sandflats. Typically, estuaries are long narrow seaward parts of river valleys, e.g., the Barrow, the Nore, the Blackwater, and areas where the river enter the sea directly with no inlet being present were not considered as an estuary habitat. Only that section of the coastal embayment or inlet that experiences reduced salinities, i.e., ≤ 30S is regarded as estuarine, e.g., in the Shannon, only that area that was affected by reduced salinity was considered estuarine and the rest was classified as Large Shallow Inlet and Bay. Estuarine sediments are typically soft muds with a shallow redox depth due to the sheltered nature of the system and the large freshwater inputs. Where stones or shells occur the green algae *Enteromorpha* sp. and *Ulva* sp., and, the brown algae *Fucus ceranoides* and other fucoids are generally present. Salt marshes are also characteristic of estuaries. Infaunal species numbers are generally low with oligochaetes dominating.

Habitat mapping

The Annex I habitat of Estuary as it occurs in Ireland was mapped by analysing Admiralty Charts and 1:50,000 Ordnance Survey maps and plotting relevant areas in a GIS. As such it is likely that the national habitat map and thus the area of the habitat may be significantly refined with improving local experience and data in the future.

Habitat Range

Estuaries are located on all parts of the coastline. The largest located in the mid-west (Shannon Estuary) and constitutes approximately 50% of the national resource.

From an analysis of Admiralty Charts and Ordnance Survey maps, the range has been calculated to be 15,100 km^2 (151 X 100 km^2 squares).

Conservation status of habitat range

The range is considered to be stable and the conservation status favourable. There is no evidence of any significant overall habitat loss in the past 15 years. The current range is considered to be equal to the total historical habitat range and is therefore also regarded as the Favourable Reference Range.

Habitat Area

The habitat encompasses 324 km^2.

Conservation Status of habitat extent.

The status is assessed as Favourable, in the absence of any recent significant habitat reduction events (infilling, reclamation, etc). Estuaries of the Rivers Shannon, Lee, Liffey and the Boyne all have port developments. While the extent of estuaries in urban areas and in particular for the River Liffey and River Lee is unknown due to the cumulative impacts of coastal development, the area is considered to be stable since 1990.

Structures and Function

Estuaries have been poorly sampled in the past and the planned monitoring programme is due to commence in 2008. Thus there is insufficient data to determine the present structure and function of the habitat across Ireland.

Typical Irish estuarine species include:

Wildfowl including Little Tern, Cormorant, Brent goose, Oystercatcher, Dunlin, Bar-tailed Godwit, Redshank, Turnstone, Pale-bellied brent goose, Great Crested Grebe, Ringed plover, Black guillemots, Sandwich tern, Common tern, Shelduck, Scaup, Goldeneye, Red-breasted merganese, Teal, Greenshank, Mallard, Knot, Golden plover, Greylag goose, Pintail, Grey plover, Wigeon, Black-tailed Godwit, Curlew, Lapwing, Sanderling;

Invertebrate communities including bivalves (*Mytilus edulis*), Polychaeta (*Capitella* spp., *Malacoceros* spp., *Hediste diversicolor, Nereis* spp, *Spio* spp., *Magelona* spp), Oligochaetes (*Tubificoides benedii*), Crustacea (*Corophium* spp.).

Algal communities including *Ulva* spp., *Enteromorpha* spp., the brown algae *Pelvetia canaliculata*, *Fucus cerinoides*, other fucoids, and *Ascophyllum nodosum*.

Mammals include the harbour seal, grey seal and otter.

Impacts and Threats

The following activities are considered to have the greatest impacts:
200 Aquaculture, 220 Recreational fishing, 400 Housing development, 420 Sewage outflow, 490 Industrialisation, 502 Autoroutes, 504 Port/Marina, 623 Motorised sports including boating, 701 Water pollution, 802 Reclamation of land, 810 Drainage, 820 Dredging, 954 Invasion of species.
Of these, adverse impacts arising from aquaculture, fishing, coastal development and water pollution are considered the principal threats.

Future Prospects

Some 80 estuaries are regarded as having favourable future prospects. However this figure does not reflect area, and some larger estuaries are considered to face significant pressures. The future prospects of some 16 sites could not be established at this time as the significance of existing site usage has not been ascertained. The future prospects of three sites (Arklow Estuary, Corrib Estuary and Clifden Estuary) are regarded as unfavourable arising from poor water quality issues and proposed coastal developments. These estuaries are small, constituting <0.5% of the national resource as currently mapped.

On a positive note, water quality is expected to improve as the Water Framework Directive is fully implemented.

Overall Assessment

- There is no evidence of any significant overall loss of estuarine habitat since the time of designation and the **range** and **area** of the habitat is regarded as **favourable**.
- There is currently insufficient information available concerning the **structure and function** of estuarine sites in Ireland. Thus their conservation status is **Unknown.**
- Future prospects are considered **Unfavourable – Inadequate.**

- Nationally, the overall conservation status of the habitat Estuary is **Unfavourable – Inadequate.**

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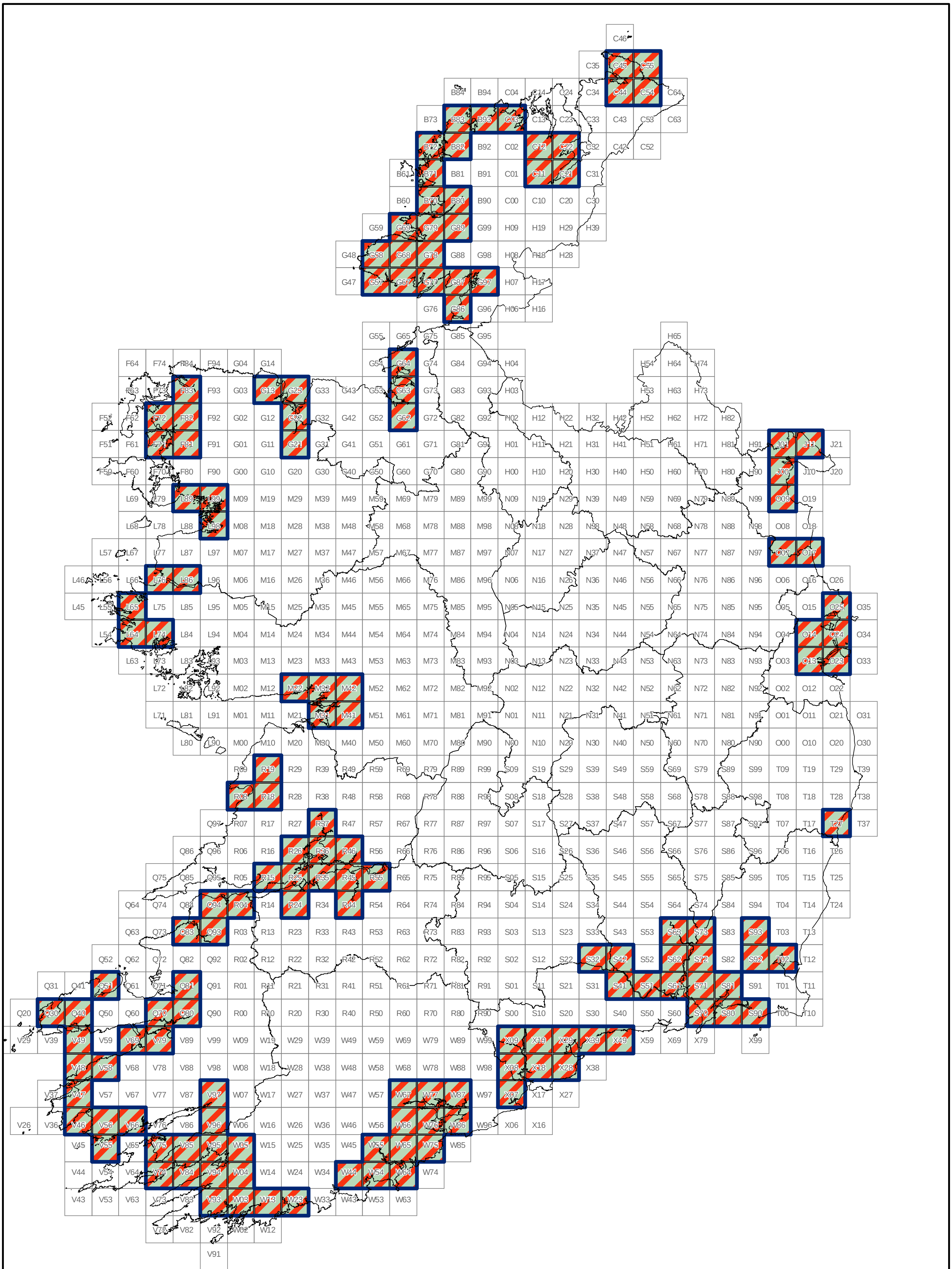
1130 Estuaries

National Level	
Habitat Code	1130
Member State	Ireland, IE
Biogeographic region concerned within the MS	Marine Atlantic (MATL)
Range	Marine Atlantic (MATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Marine Atlantic (MATL)
Published sources	▪ Bailey, M. & J. Rochford. 2006. Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & C. O' Keeffe. 2004. Harbour seal population assessment in the Republic of Ireland: August 2003. Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Crowe, O. 2005. Ireland's wetlands and their waterbirds: status and distribution. Birdwatch Ireland, Newcastle, Co. Wicklow. ▪ EPA. 2007. Bathing waters 2006. An EPA publication. ▪ Falvey, J.P., Costello, M.J. & S. Dempsey. 1997. A survey of intertidal mudflats. Unpublished report to the National Parks & Wildlife Service, Dublin. 258 pp. ▪ Healy, B., Lyons, J. & P. Galvin. 1993. Environmental impact on the aquatic fauna of the Inner Malahide Estuary. Department of Zoology, UCD. ▪ Pettitt, E.G. & Co. Status report on the strategy report for a water quality management plan for Dungarvan Harbour. ▪ Tobins, P.J. 1994. Dundalk waste water treatment works, Environmental Impact Statement. ▪ Yau, H. & N.F. Gray. 2005. Riverine sediment metal concentrations of the Avoca/Avonmore catchment, southeast Ireland: a baseline assessment. Biology & Environment: Proceedings of the Royal Irish Academy, Vol: 105B, No.2, 95/106.
Range	
Surface area	15,100km^2 (151 x 100 km^2)
Date	08/2007 : 1990 - 2007
Quality of data	2= moderate
Trend	stable
Trend-Period	1990 - 2007
Reasons for reported trend	N/A
Area covered by habitat	
Distribution map	See attached map
Surface area	324 km^2
Date	08/2007 : 1990 - 2007
Method used	1 = expert opinion
Quality of data	2= moderate
Trend	Stable
Trend-Period	1990 - 2007
Reasons for reported trend	N/A

Justification of % thresholds for trends	N/A
Main pressures	200 Aquaculture 220 Recreational fishing 400 Housing development 420 Sewage outflow 490 Industrialisation 502 Autoroutes 504 Port/Marina 701 Water Pollution 802 Reclamation of land 810 Drainage 820 Dredging 954 Invasion of species.
Threats	200 Aquaculture 220 Recreational fishing 400 Housing development 420 Sewage outflow 490 Industrialisation 502 Autoroutes 504 Port/Marina 701 Water Pollution 802 Reclamation of land 810 Drainage 820 Dredging 954 Invasion of species.
Complementary information	
Favourable reference range	15,100km^2 (151 x 100 km^2)= current Range
Favourable reference area	324 km ^{2} = current Area
Typical species	Typical Irish estuarine species include: Birds: Wildfowl including *Sterna albifrons, Phalacrocorax carbo). Haematopus ostralegus, Calidris alpina, Limosa limosa,Tringa totanus, Branta bernicla hrota, Charadrius hiaticula, Sterna sandvicensis, Sterna hirundo, Tadorna tadorna, Aythya marila, Bucephala clangula,Mergus serrator, Anas crecca, Tringa nebularia, Anas platyrhynchos, Calidris canutus, Pluvialis apricaria, Anas acuta, Pluvialis squatarola , Anas penelope, Limosa limosa, Numenius arquata, Vanellus vanellus*. Invertebrates include Bivalvia (*Mytilus edulis, Thyasira* spp.), Polychaeta (*Capitella spp., Malacoceros spp.*, *Hediste diversicolor, Nereis* spp, *Spio* spp., *Magelona* spp), Oligochaetes (*Tubificoides benedii*), Crustacea (*Corophium* spp.). Algal communities including *Ulva* spp., *Enteromorpha* spp., *Zostera marina*, *Pelvetia canaliculata, Fucus cerinoides* and other fucoids, and *Ascophyllum nodosum.* Mammals *Lutra lutra, Phoca vitulina* and *Halichoerus grypus*

Other relevant information	There is inadequate baseline information on estuaries due to the lack of a systematic survey of estuaries. A programme to monitor the infaunal communities of estuaries is due to start in 2008. Information also needs to be generated to determine the outer limits of estuarine influence with the embayments/inlets. There are no detailed baseline data or Irish estuaries. A monitoring programme of infauna will be started in 2008.Until there is evidence that the WFD has been fully implemented and good water quality status is achieved the future prospects are assessed as Unfavourable-inadequate. In addition the level of development/industrialisation needs to be monitored to assess the threats to this habitat. 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 conservation status: Unknown
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Area	Favourable (FV)
Specific structures and functions (incl. typical species)	Unknown (XX)
Future prospects	Unfavourable – Inadequate (U1)
Overall assessment of CS	Unfavourable – Inadequate (U1)



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1:1,800,000

0 12.5 25 50 Kilometers

Estuaries

1130

- Current Distribution (151 cells)
- Current Range (151 cells)
- Favourable Reference Range (151 cells)
- W48 10km grid cells

Date: August 2007

Conservation Assessment of Mudflats & Sandflats not covered by seawater at low tide. (Code 1140)

EU Definition

The EU interpretation manual describes the habitat mudflats and sandflats not covered by seawater at all times as ‘sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms’. They are of particular importance as feeding grounds for wildfowl and waders.

Habitat characteristics in Ireland

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide and are normally associated with inlets, estuaries or shallow bays. The physical structure of these intertidal flats ranges from mobile, coarse-sand beaches on wave exposed coasts to stable, fine-sediment mudflats in estuaries and other marine inlets. For the purpose of this review, a minimum size of 0.5 km^2 was used. They support diverse communities of invertebrates, algae and eel grass (*Zostera* sp). Mudflats are usually located in the most sheltered areas of the coast where large quantities of silt from rivers are deposited in estuaries. In sheltered areas communities are typically dominated by polychaete worms, e.g., *Arenicola* and bivalve molluscs and may support very high densities of the mud-snail *Hybrobia ulvae*. Sand flats occur on open coast beaches and bays where wave action or strong tidal currents prevent the deposition of finer silt. On more exposed coasts the biodiversity may be lower and the communities dominated by crustaceans such as *Bathyporeia*. The strand line on most shores is characterised by Talitrid amphipods. Where *Zostera* occurs, faunal diversity is higher. The high biomass of invertebrates in such sediments often provides an important food source for waders and wildfowl, such as Knot *Calidris canuta* and Dunlin *Calidris alpine* and Sanderling. Intertidal mudflats and sandflats can be part of a mosaic of habitats that occur in estuaries and shallow inlets and bays.

Habitat mapping

All “sand flats and mudflats not covered by seawater at low tide” greater than 0.5 km^2 were identified from Admiralty charts and the 1:50,000 Ordnance Survey of Ireland Discovery Series maps and mapped using the I:50,000 maps. Expert judgement was used to exclude rocky areas, which are not distinguished from sand/mud in the mapping. Ground truthing of this element will be needed in the future Where narrow channels were present in the mudflats and sandflats they have been included in the habitat.

Habitat Range

The range has been calculated as 15,900 km^2.

Conservation status of habitat range is considered to be favourable as there is no evidence of any significant overall habitat loss since the Directive came into force. The current range is considered to be close to the total historical habitat range and is therefore also regarded as the Favourable Reference Range.

Habitat Area

The area of mudflats and sandflats encompasses 566.72km^2. The two largest sites are located in the mid-west (Shannon Estuary) and north-east (Dundalk Bay).

Conservation Status of habitat area
In the absence of any significant habitat reduction events (infilling, reclamation, etc), and acknowledging the physical constraints to increasing the habitat area, the current habitat area is considered to be equal to the Favourable Reference Area. However, it is also acknowledged that accuracy of the mapping needs to be improved with ground truthing and that the area covered may change with improved data. The habitat area is considered Favourable.

Structures and Function
There has been little work to date on habitat structure and function, although a number of initiatives commenced near the end of this reporting period.

A selected number of Intertidal mudflats and sand flats were surveyed by the BioMar project between 1993 and 1996 which generated point source data for the strand line, high and mid and low shore stations. In 2006, NPWS commenced a monitoring programme looking at eight areas. In addition, an all-Ireland survey of the distribution, extent and condition of intertidal *Zostera* communities on sand flats was undertaken in 2005.

Typical species include invertebrate communities such as Polychaeta: *Tubificoides*, *Capitella*, *Malacoceros*; *Arenicola marina*, *Hediste diversicolor*, *Lanice conchilega*; Bivalvia Molluscs: *Abra alba*, *Mytilus edulis*, *Cerastoderma edule, Scrobicularia plana*, *Macoma balthica*, *Mya arenaria*; Crustaceans: *Talitrus sp, Bathyporeia Corophium* spp Echinodermata: *Echinocardium cordatum.* Algal species: *Ulva* sp., *Enteromorpha* sp., Angiosperm: *Zostera* spp. Birds: Pale-bellied Brent Goose (*Branta bernicla hrota*), Oystercatcher (*Haematopus ostralegus*), Dunlin (*Calidris alpina*), Sanderling (*Calidris alba);* Sandwich Tern (*Sterna sandvicensis*), Common Tern (*Sterna hirundo*), Ringed plover (*Charadrius hiaticula*), Bar-tailed Godwit (*Limosa limosa*), Redshank (*Tringa totanus*), Knot (*Calidris canutus*), Golden plover (*Pluvialis apricaria*) may use the areas for either roosting or feeding.Mammals: Harbour seal (*Phoca vitulina),* Grey seal (*Halichoerus grypus*).

Conservation status of structure and function
Using best expert judgement on the current levels of impacts on the habitat and the limited biological information available, the structure and function of the habitat is considered Unfavourable - Inadequate.

Impacts and Threats
The following activities are causes of some negative impact on mudflats and sand flats:
200 Aquaculture; 210 Professional fishing; 221 Bait digging; 244 Removal of fauna; 300 Aggregate extraction;(removal of beach material; 490 Industrialisation; 504 Port/Marina; 509 Communications networks; 701 Water Pollution; 802 Reclamation of land; 870 Coastal protection works; 954 Invasion by a species;

Of these the most serious threats are considered to b the following;
200 Aquaculture; 210 Professional fishing; 221 Bait digging; 244 Removal of fauna; 802 Reclamation of land; 870 Coastal protection works; 954 Invasion by a species;

In the Irish context, “Invasion by a species” is not taken to mean through natural causes, rather is considered to be caused by human activities.

Future Prospects
The future prospects of a number of sites could not be established at this time as the significance of existing site usage and the change in usage since the Directive came

into force has not been ascertained. Of particular concern is the encroachment of *Spartina*, increasing development of aquaculture, the unknown extent of professional fishing and the removal of fauna. In addition, there is some concern at the potential impact that hard coastal defence structures may have in combination with seawater rise for the long-term extent of this habitat. Overall the future prospects are considered as Unfavourable – Inadequate due to ongoing activities that are likely to negatively impact the structure & functions of the habitat.

Overall Assessment

- There is no evidence of any significant overall loss of the intertidal mudflats and sandflats habitat since the Directive came into force, therefore the **range** and **area** of the habitat are regarded as **Favourable** and the current range is considered to be the Favourable Reference Range. The current area is considered to be the Favourable Reference Area.

- Using best expert judgement on the current levels of impacts on the habitat and the limited biological information available the structure and function of the habitat is considered **Unfavourable – Inadequate**.

- The future prospects of the habitat mudflats and sandflats not covered by water at low tide are uncertain, however the habitat is assessed as **Unfavourable – Inadequate** due to ongoing activities that are likely to negatively impact the structure & functions of the habitat.

Nationally, the overall conservation status of is assessed to be **Unfavourable – Inadequate.**

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1140 Mudflats and sandflats not covered by seawater at low tide

National Level	
Habitat Code	1140
Member State	Ireland, IE
Biogeographic region concerned within the MS	Marine Atlantic (MATL)
Range	Marine Atlantic (MATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Marine Atlantic (MATL)
Published sources	▪ Aqua-Fact. 1993. Kinsale sewage scheme. Survey and study of harbour waters Vol. 1a. Intertidal, subtidal and water quality surveys ▪ Aqua-Fact. 1995. A survey of the flora and fauna of the Barrow estuary. ▪ Aqua-Fact. 1997. Environmental data recorded at a number of selected sites in Waterford Estuary. ▪ Aqua-Fact. 2001. An assessment of marine biological conditions in the River Boyne, Drogheda, Co. Louth ▪ Aqua-Fact, 2004a. A report on the assimilative capacity of Dundalk Bay, Co. Louth. ▪ Aqua-Fact. 2004b. A macrofaunal and sedimentological survey of a section of Ballymacoda Bay, Co. Cork. ▪ Aqua-Fact. 2006. A survey of intertidal sandflats and mudflats in Ireland. Report on behalf of the National Parks and Wildlife Service ▪ Aqua-Fact. 2007a. Marine intertidal and terrestrial surveys, Dungarvan Harbour, Co. Waterford. ▪ Aqua-Fact. 2007b.Marine intertidal survey in Courtstown, Little Island, Co. Cork ▪ Bailey, M. & J. Rochford. 2006. Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Colhoun, K., Bearhop, S., Inger R. and Wilkes, R. (In prep.) An assessment of the status and distibution of intertidal Zostera in Ireland. Report to NPWS and EHS. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & C. O' Keeffe. 2004. Harbour seal population assessment in the Republic of Ireland: August 2003. Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Crowe, O. 2005. Ireland's wetlands and their waterbirds: status and distribution. Birdwatch Ireland, Newcastle, Co. Wicklow ▪ Duchas. 1999. A survey of selected littoral and sublittoral sites in Clew Bay, Co.Mayo. A report prepared by Aqua-Fact International Ltd for Dúchas, Department of Arts Heritage and the Gaeltacht, Ireland, pp33. ▪ EPA. 2007. Bathing waters 2006. An EPA publication ▪ Falvey, J.P., Costello, M.J. & S. Dempsey. 1997. A survey of intertidal sediment biotopes in estuaries in Ireland. Unpublished report to the National Parks & Wildlife Service, Dublin. 258 pp. ▪ Healy, B., Lyons, J. & P. Galvin. 1993. Environmental impact on the aquatic fauna of the Inner Malahide Estuary. Department of Zoology, UCD.

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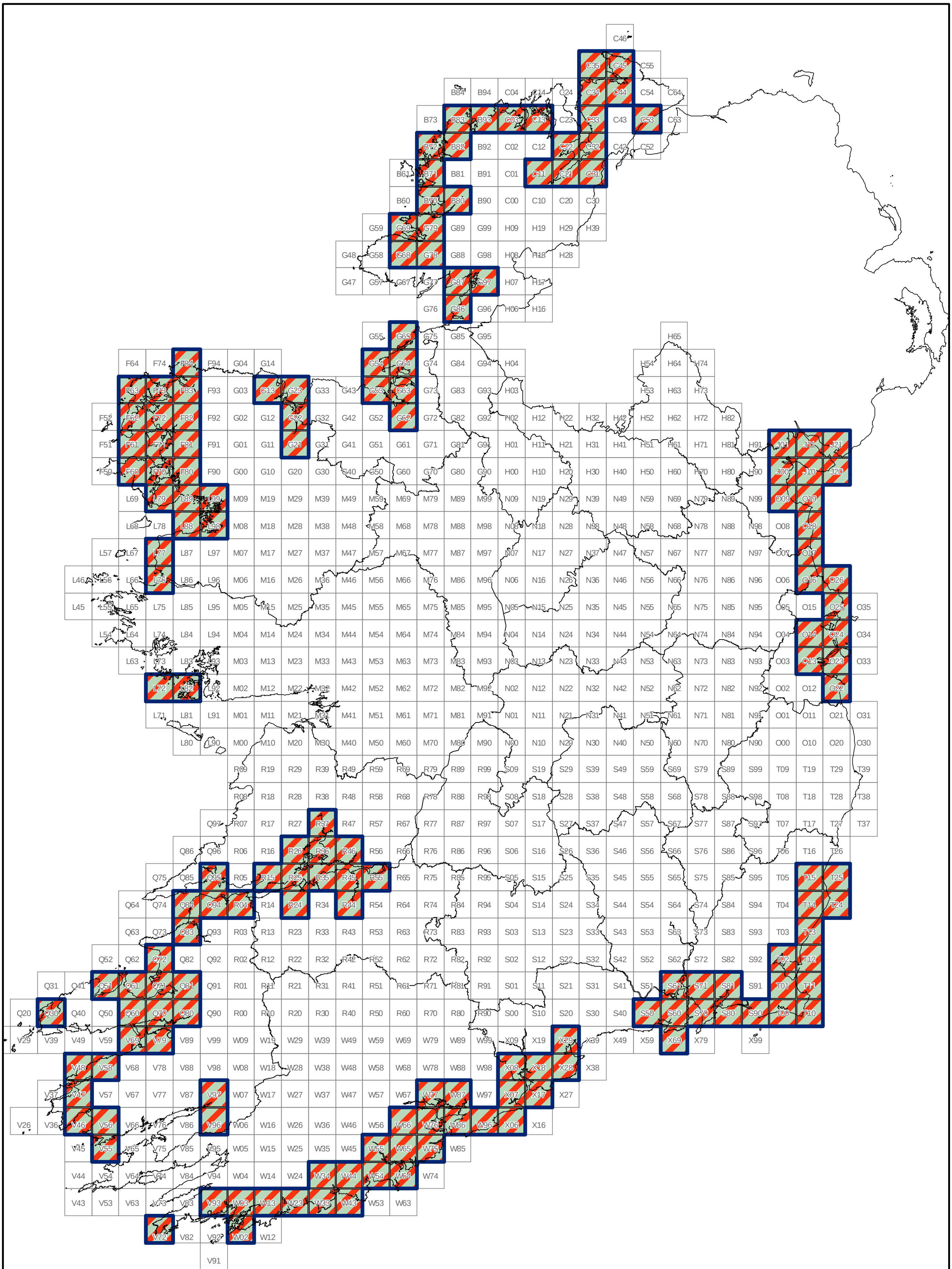
Range	
Surface area	16,000km^2 (160 x 100 km^2)
Date	08/2007 : 1990 - 2007
Quality of data	2= moderate
Trend	stable
Trend-Period	1990 - 2007
Reasons for reported trend	N/A
Area covered by habitat	
Distribution map	See attached map
Surface area	566.72 km^2
Date	08/2007 : 1990 - 2007
Method used	1 = expert opinion & 2 =based on remote sensing data
Quality of data	2= moderate
Trend	Stable
Trend-Period	1990 - 2007
Reasons for reported trend	N/A
Justification of % thresholds for trends	N/A
Main pressures	200 Aquaculture 210 Professional fishing 221 Bait digging 244 Removal of fauna 300 Aggregate extraction (removal of beach material) 422 Disposal of industrial waste 490 Industrialisation 504 Port/Marina 509 Communications networks 701 Water Pollution 802 Reclamation of land 870 Coastal protection works 954 Invasion by a species
Threats	200 Aquaculture 210 Professional fishing 221 Bait digging 244 Removal of fauna 300 Aggregate extraction (removal of beach material) 422 Disposal of industrial waste 490 Industrialisation 504 Port/Marina 509 Communications networks 802 Reclamation of land 870 Coastal protection works 954 Invasion by a species
Complementary information	
Favourable reference range	16,000km^2 (160 x 100 km^2)
Favourable reference area	566.72 km ^{2}

Typical species	Polychaeta: Tubificoides spp, *Capitella* spp, *Malacoceros* spp. *Arenicola marina, Hediste diversicolor, Lanice conchilega*; Bivalve Molluscs: *Abra alba, Mytilus edulis, Cerastoderma edule, Scrobicularia plana, Macoma balthica, Mya arenaria.* Crustaceans: *Talitrus* spp, *Bathyporeia spp. Corophium* spp. Echinodermata: *Echinocardium cordatum*. Algal species: *Ulva* sp., *Enteromorpha* sp., Angiosperm: *Zostera* spp. Birds : *Branta bernicla hrota, Haematopus ostralegus, Calidris alpina, Calidris alba; Sterna sandvicensis, Co Sterna hirundo, Charadrius hiaticula, Limosa limosa, Tringa totanus, Calidris canutus, Pluvialis apricaria* Mammals: *Halichoerus grypus.*
Other relevant information	Information on the intensity of current past and future impacts is poor. The structure & functions of mudflats are assessed as Unfavourable – Inadequate due to the fact that a significant proportion of the habitat are estuarine mudflats (see the 1130 assessment).
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)



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1:1,800,000

0 12.5 25 50 Kilometers

Mudflats and sandflats not covered by seawater at low tide

1140

Current Distribution (160 cells)

Current Range (160 cells)

Favourable Reference Range (160 cells)

W48 10km grid cells

Date: December 2007

CONSERVATION STATUS ASSESSMENT REPORT

COASTAL LAGOONS (1150)

March 2007

Geoff Oliver
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Skibbereen
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028 39193
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CONSERVATION STATUS ASSESSMENT REPORT
TABLE OF CONTENTS

Executive Summary

1. Surveys of coastal lagoon habitat were funded by the National Parks and Wildlife Service (NPWS) and carried out from 1996 to 2006. At the time of writing 87 lagoon sites are recognised in the Republic, though some of these sites comprise clusters of very small lagoons (totalling 100 lagoons), covering an area of 23.7 km^2. All of these sites have now been surveyed but many were only visited once or twice giving a "snapshot" of lagoonal conditions and conservation status.

2. Five main morphological types of lagoon were recognised:

- Classic "sedimentary" lagoons found on all parts of the coastline (21 lagoons, 41.4% of habitat area.
- Artificial lagoons found on all parts of the coastline (30 lagoons, 35.2% of habitat area).
- "Rock/peat" lagoons on the west coast, similar to lagoons in Scotland, but otherwise rare in Europe (18 lagoons, 20% of habitat area).
- "Karst" lagoons found in parts of Counties Clare and Galway, and within Europe, possibly unique to Ireland (11 lagoons, 4.5% of habitat area).
- "Saltmarsh" lagoons (6 lagoons, 1.5% of habitat area).

3. There is no evidence of any significant loss of coastal lagoon habitat range in the last 100 years and status of habitat range is regarded as Favourable. The southern part of the east coast of Ireland from just north of Wicklow town to Wexford Harbour once consisted of a series of stream catchments, each with a coastal barrier behind which small ephemeral lagoons may have existed. All of these were drained in the nineteenth century and many other parts of the coast, especially around Cork and Dublin harbours were also reclaimed which may also have included lagoons. However, some of these historical losses have been balanced by creation of artificial lagoons and there is no evidence of any significant overall loss of coastal lagoon habitat range in the last 100 years.

4. The most damaging impact affecting habitat extent is the deliberate drainage of the previously largest lagoon in the country (Tacumshin Lake) for largely agricultural reasons and a smaller lagoon (Shannon airport) for safety reasons. Further loss of habitat has occurred as a result of natural silting-up. In total it is estimated that 3.7% of habitat area (88ha) has been lost during the reporting period 1996-2006 (0.4%/year) and Habitat Extent is regarded as Unfavourable-Inadequate (U1).

5. The major impact affecting the quality of the habitat is water pollution in the form of excessive nutrient enrichment mostly from agricultural sources, but also due to domestic effluents from an increase in urbanisation and commercial/industrial activities. Over 61% of habitat area is regarded as eutrophic and this impact is particularly severe in three lagoons (Lady's Island, L. Gill, Kilkeran L.) representing 21.7% of the habitat. However, in a significant number of small lagoons covering less than 2%of habitat nutrient enrichment is believed to be due to natural causes. Modification of hydrography has also contributed to a short-term deterioration in habitat quality. All other impacts are relatively minor. As a result of these various impacts, specific structures and functions of coastal lagoons are regarded as Unfavourable-Bad (U2).

6. Approximately 90% of lagoon habitat is now designated as, or lies within a Special Area of Conservation (SAC) under the Habitats Directive and all designated sites are listed as "Transitional Water Bodies" and are included in the Register of Protected Areas under the Water Framework Directive. Deliberate drainage of lagoons is a Notifiable Action in SACs and is therefore illegal without the permission of the Minister. The obligation under the water framework directive that all water bodies should achieve "good status" by 2015 should result in an improvement in the quality of water in, and entering, lagoons. However, it is unclear as to how effective these designations will be in improving the status of impacted sites within the next reporting period and how rapidly the sites will respond to restoration attempts. Therefore, overall future prospects are regarded as Unfavourable-Inadequate (U1).

7. The extent and quality of coastal lagoon habitat in Ireland is impaired and future prospects are uncertain. Therefore the overall assessment of Conservation Status is regarded as Unfavourable-Bad (U2).

1. Habitat characteristics in Ireland

Coastal lagoons are referred to by Barnes (1980, 1994) as **"shallow, virtually tideless, pond- or lake-like bodies of coastal saline or brackish water that are partially isolated from the adjacent sea by a sedimentary barrier, but which nevertheless receive an influx of water from that sea"**. This is essentially a geographers' definition based on hydro-geomorphology. Similar definitions have been used by other authors which describe in a classical sense the coastal lagoons that are common and extensive in many parts of the world. However, it is difficult to define precisely even a simple coastal lagoon and, according to Mee (1978), no clear distinction can be drawn between lagoons, estuaries and bays. Pritchard's (1967) definition of an estuary as "a semi-enclosed coastal body of water which has a free connection with the open sea and within which seawater is measurably diluted with fresh water from land drainage" could equally apply to many of the classic sedimentary lagoons, hence the terms "lagoonal estuary" and "estuarine lagoon" used in some descriptions.

One of the major complications in defining lagoons and estuaries is that these systems may be quite different in one part of the world to another. In macro-tidal regions, such as the Atlantic coast of Europe, the essential difference between an estuary and a coastal lagoon in this classical sense is that estuaries are subject to extreme diurnal changes in water level, such that estuaries are drained almost completely of water at low tide, whereas lagoons are subject to a restricted tidal influence and contain permanent water. In microtidal parts of the world, which includes the Mediterranean and Baltic Seas of Europe, these tidal differences are far less noticeable and the essential thing about lagoons is the presence of a sedimentary barrier which restricts the tidal exchange in a lagoon to a greater degree than in an estuary, coupled with the fact that estuaries in general are the parts of rivers which come into contact with the sea, whereas lagoons are "pond- or lake-like" bodies of water.

The interpretation manuals of the Habitats Directive (CEC 1999, 2003) define coastal lagoons as: **"expanses of shallow coastal salt water, of varying salinity or water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding by the sea in winter or tidal exchange. With or without vegetation from *Ruppietea maritimae, Potametea, Zosteretea* or *Charetea* (CORINE 91:23.21 or 23.22)."**

It was realised that certain lagoon types in Europe were not covered by the definitions which refer only to the classic sedimentary lagoons, and which have become known as "true" lagoons. The definition proposed by the Habitats Directive has a slightly broader meaning than previously in that the barrier may be composed of shingle and rock. Amended versions of the interpretation manual also allowed inclusion of artificial lagoons such as **"salt basins and salt ponds…providing that they had their origin on a transformed old natural lagoon or on a salt marsh, and are characterised by a minor impact from exploitation"**. Unusual types, such as the Baltic **"flads and gloes"** were also included as the European Union was enlarged. Member States may interpret the definition as they think best in the interests of nature conservation, and for this reason, the brackish 'rocky' water bodies in Western Scotland known as "obs" have been accepted as coastal lagoons in the U.K (e.g. Covey 1999), as have similar lagoons on the west coast of Ireland during the Irish lagoon surveys. With the extra interest in coastal lagoons and brackish water ecology stimulated by the Habitats Directive it has become increasingly apparent that while a coastal lagoon may harbour characteristic lagoonal biota, similar equally interesting lagoonal biota may exist in many other habitats still not covered by the Habitats Directive definition (Barnes 1991, Healy 2003). The “true” sedimentary coastal lagoons are worthy of protection as interesting and valuable coastal landforms in themselves but the Directive was intended to give protection to the biological community which the habitat contains. For this reason, certain “lagoonal habitats” recognised by characteristic fauna and flora, though not strictly covered by the official definition, have been regarded as coastal lagoons in Ireland and other Member States in order to give protection to rare and threatened, otherwise unprotected, lagoonal communities. In order to overcome this problem in the UK, Bamber *et al.* (2001) proposed the following definition:

“areas of typically (but not exclusively) shallow, coastal saline water, wholly or partially separated from the sea by sandbanks, shingle or less frequently, rocks or other hard substrata. They retain a proportion of their water at low tide and may develop as brackish, fully saline or hypersaline water bodies.”

The essential parts of this definition are the presence of a barrier “of some sort”, weak tidal influence (low hydrodynamics), and permanent brackish water. Brackish in this context means any combination of fresh and seawater, including concentration above normal sea water levels, owing to evaporation in a water body containing seawater with restricted tidal influence. This definition distinguishes coastal lagoons from freshwater coastal lakes on one hand and estuaries and tidal pools on the other, but where exactly to draw the line is not defined.

Irish lagoon surveys

Before the Habitats Directive, only four lagoons were at all well known in Ireland (Lady’s Island Lake, Tacumshin Lake, Lough Murree, Furnace Lough) and very few biological studies had been published. Under the obligations of the Directive, the National Parks and Wildlife Service (NPWS) of the Irish Government commissioned a series of surveys of coastal lagoons in Ireland in order to compile an inventory of lagoons in the country for selection of representative examples for designation as, or within, SACs.

Surveys were carried out in 1996 (Good and Butler 1998, Hatch and Healy 1998, Healy and Oliver 1998, Oliver and Healy 1998), and 1998 (Healy 1999a,b; Oliver 1999, Roden 1999, Good and Butler 2000). An inventory of approximately 100 lagoons was compiled as a result of these surveys and 36 of the higher conservation value lagoons were sampled over a 1-4 day period, depending on the size of the lagoon. Subsequently, all lagoon sites in the country were surveyed and sampled (Oliver 2005, 2007; Roden 2004), making coastal lagoons one of the most completely surveyed habitats in the country. The current inventory of lagoons in the Republic of Ireland lists 87 lagoon sites (Table 1), covering a total area of 2366.5ha.

As landforms, coastal lagoons are highly dynamic and are transitional between open coast, tidal estuary and freshwater lake. Within a lagoon, environmental conditions (in particular salinity but also such factors as pH, temperature and turbidity) can also vary considerably both spatially and temporally and data collected from lagoons during the surveys may be less representative for such a variable habitat than for more stable ones where results of one visit are more likely to reflect "normal" conditions. Therefore, though many were visited on two or more occasions, given the dynamic nature of lagoons, this may only give a “snapshot” impression of biota and environmental conditions.

Table 1. Coastal Lagoons recorded in Ireland, with year of survey, grid reference (Discovery 1:50,000 map) and County. (Numbers in brackets refer number of small lagoons within a group)

Code No.	Year of Survey	Site	County	Size (ha)	Grid Ref
1	2003	Greenore Golf Course (4)	Louth	2.5	J 215 102
2	2003	Broadmeadow	Dublin	280	O 215 473
3	2003	Kilcoole (3)	Wicklow	5	O 312 061
4	2002	North Slob channel	Wexford	50	T 090 248
5	2002	South Slob channel	Wexford	50	T 072 183
6	1996	Lady's Island Lake	Wexford	350	T 099 065
7	1996	Tacumshin	Wexford	257	T 050 065
8	1998	Ballyteige channels	Wexford	8	S 955 060
9	2002	Rostellan Lake	Cork	50	W 871 660
10	2005	Ballyvodock lagoon	Cork	2	W 868 708
11	2002	Cuskinny Lake	Cork	4	W 839 674
12	2006	Raffeen Lake, Shanbally	Cork	4	W 758 647
13	2005	Lough Beg. Curraghbinny	Cork	2	W 778 627
14	2006	Bessborough Pond, Blackrock	Cork	1	W 717 700
15	2002	Oysterhaven Lake, Clashroe	Cork	3	W 699 501
16	2003	Commoge Marsh, Kinsale	Cork	12	W 630 498
17	2003	Clogheen/White's Marsh (2)	Cork	3	W 398 394
18	2002	Inchydoney	Cork	2	W 384 393
19	1996	Kilkeran Lake	Cork	20	W 338 344
20	2002	Rosscarbery Lake	Cork	20	W 290 367
21	2005	Toormore lagoon	Cork	1.5	V 844 306
22	1996	Lissagriffin Lake	Cork	15	V 775 265
23	1996	Farranamanagh Lake	Cork	6	V 830 378
24	2005	Reen Point Pools	Cork	1	V 888 399
25	1998	Kilmore Lake	Cork	6.5	V 958 489
26	2002	Reenydonegan Lake	Cork	25	W 000 514
27	2006	Lauragh	Kerry	20	V 768 577
28	1996	Drongawn Lake	Kerry	20	V 731 640
29	1996	Lough Gill	Kerry	144	Q 606 142
30	2006	Blennerville lakes (2)	Kerry	3	Q 806 133
31	2003	Quayfield/Poulaweala (2)	Limerick	2.5	R 297 527
32	2002	Shannon Airport Lagoon	Clare	2	R 350 620
33	2002	Scattery lagoon	Clare	10	Q 974 527
34	1996	Cloonconeen Pool	Clare	7	Q 836 497
35	1996	Lough Donnell	Clare	25	R 002 707
36	2006	Muckinish Lake	Clare	1	M 276 087
37	1996	Lough Murree	Clare	13	M 255 119
38	1996	Aughinish	Clare	8	M 286 134
39	2006	Rossalia	Clare	3	M 310 116
40	1998	Loch Mór, Inish Oírr	Galway	6	L 989 019
41	2006	Port na Cora, Inis Meain	Galway	0.5	L 937 066
42	2006	Loch an tSaile, Arainn	Galway	0.5	L 878 081
43	1998	L. Phort Chorruch, Arainn	Galway	4	L 857 112
44	1998	Loch an Chara, Arainn	Galway	5	L 887 009
45	2006	Loch Dearg, Arainn	Galway	4	L 808 126
46	2006	Rincarna pools (2)	Galway	0.5	M 370 166
47	1996	Bridge Lough, Knockakilleen	Galway	3	M 342 128
48	2006	Doorus Lakes (2)	Galway	2	M 357 117
49	2006	Mweeloon pools (2)	Galway	1	M 335 196

Continued…

Table 1 cont.. Coastal Lagoons recorded in Ireland, with year of survey, grid reference (Discovery 1:50,000 map) and County. (Numbers in brackets refer number of small lagoons within a group).

Code No.	Year of Survey	Site	County	Size	Grid Ref
50	2006	Ardfry Oyster pond	Galway	1	M 351 211
51	2006	Turreen Lough (Rinvile)	Galway	3	M 363 232
52	2006	L. Atalia	Galway	50	M 308 251
53	1996	Lettermullen	Galway	1	L 827 213
54	1998	Loch Fhada upper pools (2)	Galway	2	L 930 300
55	1998	L. an Ghadai	Galway	5	L 934 299
56	1998	L. Fhada	Galway	8	L 939 305
57	1996	L. Tanaí	Galway	11	L 950 305
58	1998	L. an Aibhnín	Galway	55	L 947 315
59	1998	Loch Cara Fionnla	Galway	14	L 963 290
60	2006	L. Cara na gCaorach	Galway	30	L 964 305
61	2002	L. Doire Bhanbh	Galway	1.5	L 961 384
62	1998	Loch an tSaile (L. Ahalia)	Galway	90	L 954 390
63	1996	L. Conaorcha (Aconeera)	Galway	28	L 875 369
64	1996	L. an Mhuilinn (Mill L.)	Galway	5	L 754 331
65	2006	L. Ateesky	Galway	2	L 781 307
66	2006	L. an Chaorain	Galway	1	L 784 315
67	2002	L. Ballyconneely	Galway	20	L 620 437
68	1998	L. Athola	Galway	11	L 626 484
69	2002	Lough Anillaun	Galway	15	L 613 581
70	1996	L. Bofin	Galway	12	L 525 656
71	1996	Corragaun Lough	Mayo	10	L 748 698
72	1996	Roonah Lough	Mayo	55	L 755 765
73	1996	Furnace Lough	Mayo	125	L 965 975
74	2006	Claggan lagoon	Mayo	1	L 941 888
75	2005/6	Dooniver Lough, Achill Is.	Mayo	3	F 738 074
76	2005/6	Cartoon L., Killala Bay	Mayo	4	G 197 319
77	2005	Portavaud, Ballysadare Bay (2)	Sligo	6	G 582 341
78	2003	Tanrego	Sligo	2.5	G 615 298
79	1996	Durnesh Lake	Donegal	83	G 878 695
80	1998	Maghery Lough	Donegal	19	B 723 094
81	1998	Sally's L.	Donegal	6	B 728 168
82	1998	Kincas L.	Donegal	6	B 752 197
83	1998	Moorlagh	Donegal	10	B 790 187
84	2005/6	L. O Dheas, Tory Is.	Donegal	3	B 844 464
85	2003	Carrick Beg Lough	Donegal	2	C 157 366
86	2003	Blanket Nook Lough	Donegal	40	C 307 194
87	1998	Inch Lough	Donegal	160	C 352 230

There is, however, an underlying persistency in the "lagoonal element" of the biological community of those lagoons that have been visited several times over a number of years. Though many species are temporary colonists that may, or may not, be recorded on subsequent visits, it is expected that unless the environmental conditions of the lagoon have altered considerably, the basic lagoonal element of the biota may vary in abundance of any one particular species, but will remain the same from one reporting period to the next.

Morphological types of lagoon.

The most common type of lagoon (31.0% of sites, Table 2) is artificial (Appendix I, VII) and these can occur on any part of the coastline (Figure 1), but the highest proportion of habitat area is occupied by classic "sedimentary" lagoons with a sedimentary barrier (41.4% of lagoon habitat in 21 lagoons, 24.1% of sites, Figure 2). These may or may not have a permanent tidal inlet but more than half of these have a barrier of cobbles (e.g. L. Donnell, Kilmore L., L. Anillaun, L. Bofin) rather than sand or shingle, and this is considered unusual in Europe.

Eighteen lagoons (20% of habitat area) are referred to as the "rock/peat" lagoons. These "rock/peat" lagoons are high salinity lagoons with rock barriers similar to the Scottish "obs" which are found on the west coast (Figure 3) and are a particularly unusual type in European terms.

Eleven relatively small lagoons (4.5% of habitat area) are referred to as "karst" lagoons. These are found in the limestone areas of Counties Clare and Galway (Figure 4) and may have a permanent tidal inlet (Bridge Lough) and even a cobble barrier (L. Murree, Phort Chorruch) but many are some distance from the sea with no visible connection to it and all receive both fresh and seawater through subterranean fissures in the bedrock. Finally there are a small number (6 lagoons, 1.5% of habitat area) referred to as "saltmarsh" lagoons and these are very much like very large permanent saltmarsh pools.

Photographs of examples these lagoons are presented in Appendix VII. The different morphological types of lagoon are interesting in themselves as coastal landforms but the type may also determine to a certain extent the typical species found in the lagoon (see section 5.2).

Table 2. Five different lagoon types based on morphology found in Ireland
(* = sedimentary lagoons with a cobble barrier)

Sedimentary lagoons *=cobble barrier	"Rock/peat" lagoons	Karst lagoons	"Saltmarsh" lagoons	Artificial lagoons
Lady's Island L.	Drongawn	Quayfield/Poulaweala	Carna	Greenore
Tacumshin L.	Lettermullen	Muckinish	Claggan	Broadmeadow
Kilkeran	L. an Ghadai	L. Murree	Lauragh	Kilcoole
Farranamanagh*	L. Tanaí	L. Mór	L. Fhada	North Slob
Reen Point*	L. an Aibhnín	Phort na Cora	Turreen L.	South Slob
Kilmore L.*	L. Cara Fionnla	L. an tSaile (Aran)	Doire Bhanbh	Ballyteige
Reenydonegan*	Cara na gCaorach	L. an Chara	Portavaud	Rostellan
L. Gill	L. an tSaile	L. Phort Chorruch		Ballyvodock
Scattery*	L. Aconeera	L. Dearg		Cuskinny
Clooncooneen*	Mill Lough	Bridge L.		Raffeen
L. Donnell*	L. Keeraun	Doorus Lakes		L. Beg
Aughinish*	L. Athola			Bessborough
Rincarna*	Furnace L.			Oysterhaven
Ballyconneely	Maghery			Kinsale
L. Anillaun*	Sally's			White's M. /Clogheen
L. Bofin*	Kincas			Inchydoney
Corragaun	Moorlagh			Rosscarbery
Roonah*				Toormore
Dooniver L.*				Lissagriffin
Durnesh L.				Blennerville
L. O Dheas*				Shannon
				Rossalia
				Mweeloon
				Ardfry Oyster pond
				Atalia
				Cartoon L.
				Tanrego
				Carrick Beg
				Blanket Nook
				Inch L.

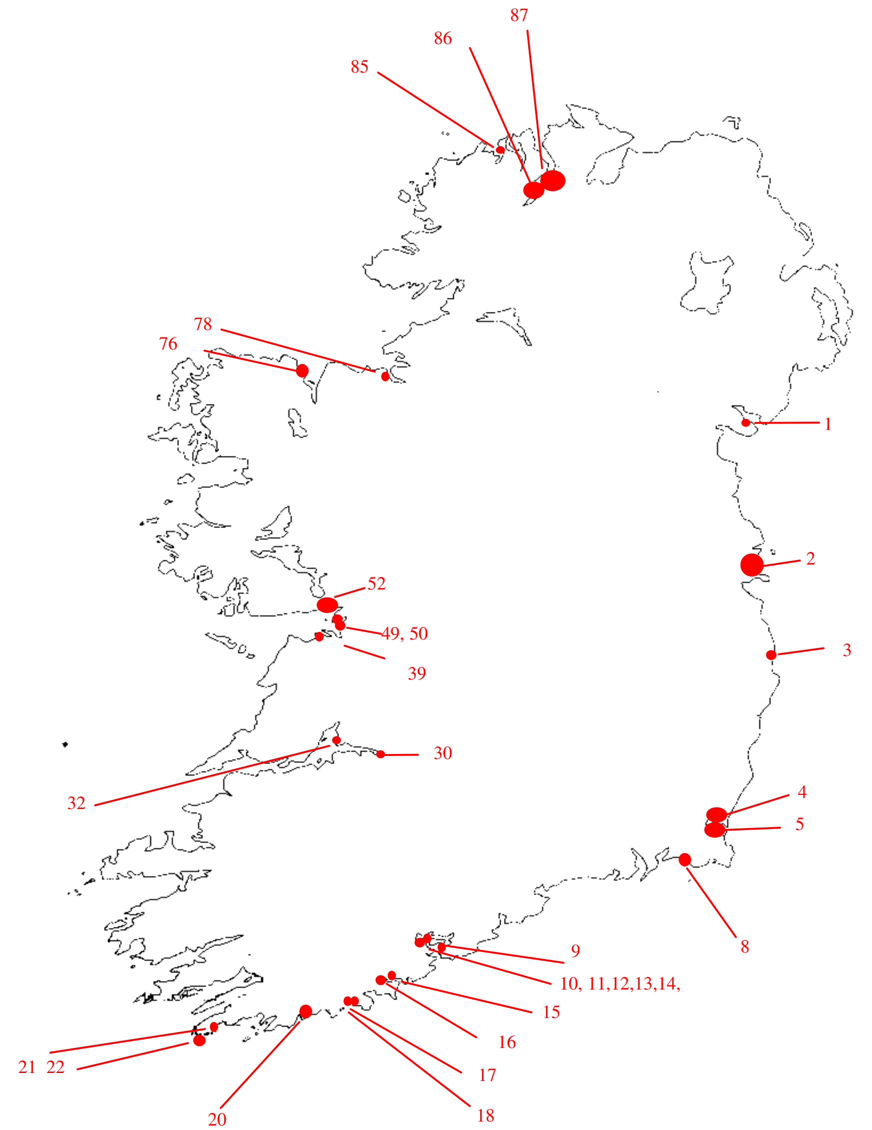

Figure 1. Distribution of artificial coastal lagoons in Ireland (Republic).
(Circles represent size of lagoons • = 0.5 - 5ha, ● = 6 - 20ha, ● = 21 - 100ha, ● = >100ha:
Code numbers refer to those used in Table 2)

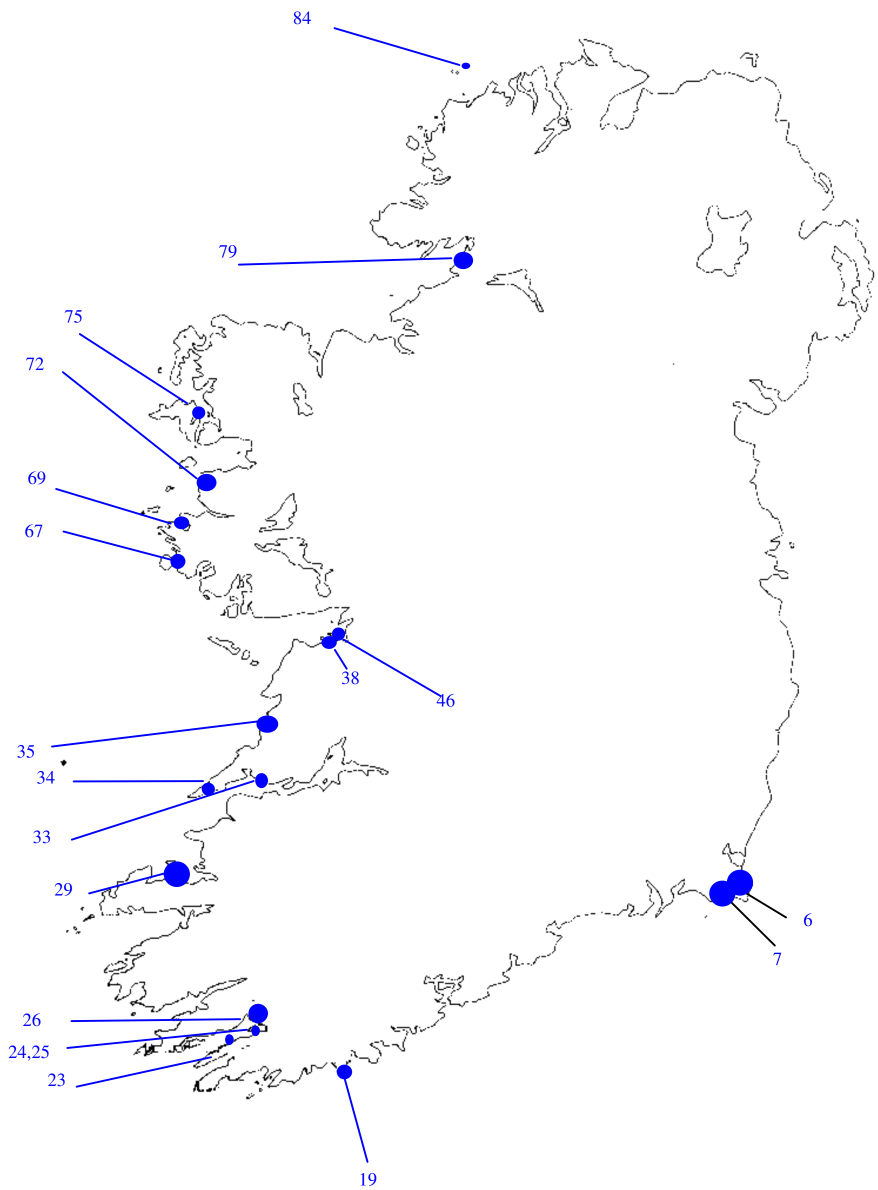

Figure 2. Distribution of sedimentary coastal lagoons in Ireland (Republic). (Size of circles indicate size of lagoon: • = 0.5 - 5ha, ● = 6 - 20ha, ● = 21 - 100ha, ● = >100ha: Code numbers refer to those used in Table2)

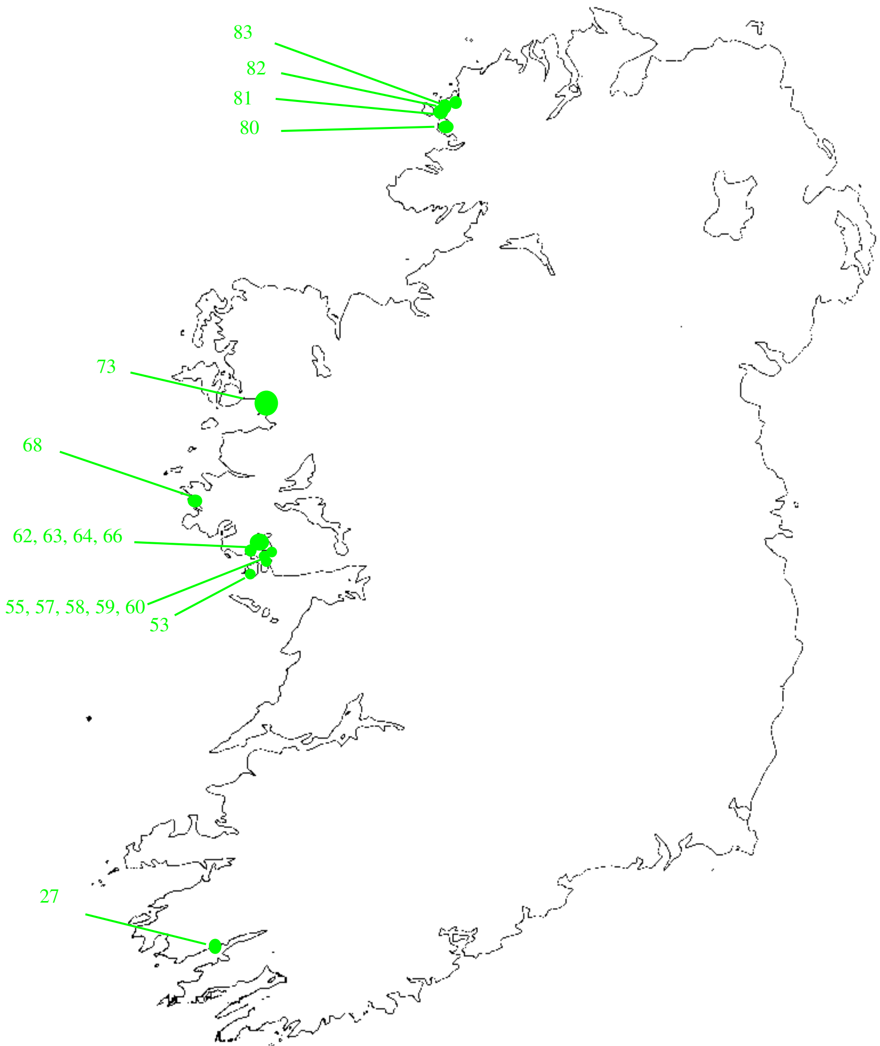

Figure 3. Distribution of "rock/peat" coastal lagoons in Ireland (Republic).
(Size of circles indicate size of lagoon: • = 0.5 - 5ha, ● = 6 - 20ha, ● = 21 - 100ha, ● = >100ha:
Code numbers refer to those used in Table 2)

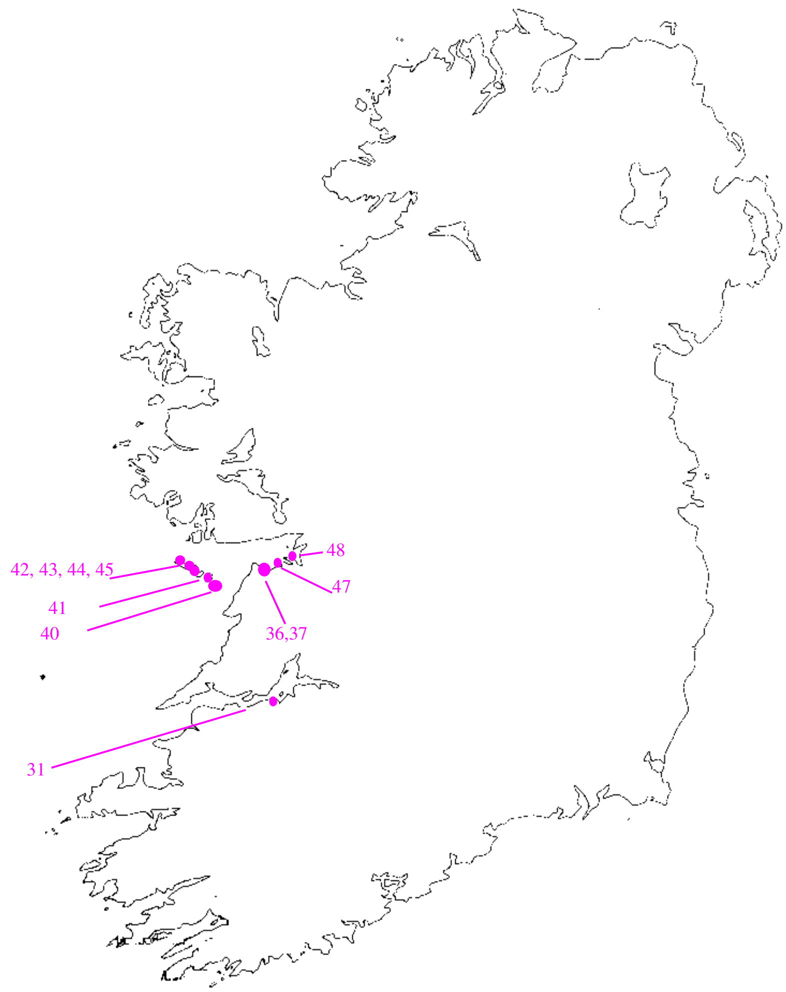

Figure 4. Distribution of "karst" coastal lagoons in Ireland (Republic).
(Size of circles indicate size of lagoon: • = 0.5 - 5ha, • = 6 - 20ha, • = 21 - 100ha, • = >100ha:
Code numbers refer to those used in Table 2)

2. Habitat Mapping

The mapping of Coastal Lagoon distribution and range is based on National Parks and Wildlife Service (NPWS) surveys carried out from 1996 and 2006.

- Surveys carried out in 1996 co-ordinated by B. Healy.
- Surveys carried out in 1998 co-ordinated by B. Healy.
- Surveys carried out in 2002 and 2003 by G. Oliver as part of a PhD study.
- Surveys carried out in 2005 and 2006 in order to complete the surveys of all known lagoons in the Republic of Ireland (RoI).

The initial part of the first survey (1996) consisted of a desktop study of 6" O.S. survey maps and aerial photographs to identify possible lagoons. This was followed by an extensive field survey of the entire coastline, visiting all known potential sites. Twenty of the best examples of known lagoons were selected for more intensive sampling of aquatic fauna (Oliver 1996, Oliver & Healy 1998), aquatic and marginal vegetation (Hatch 1996, Hatch & Healy 1998) and ecotonal Coleoptera (Good & Butler 1996, 1998). During this 1996 survey marginal vegetation was mapped but aquatic vegetation in deeper water was not surveyed. Mapping of lagoon sites was based on 6" O.S. maps with the 1:50,000 grid overlayed so that positions of sampling stations, relevant features and changes in shorelines could be marked using GPS co-ordinates recorded in the field, and area of lagoon calculated. In 1998 the same survey and sampling methods were followed for aquatic fauna (Oliver 1999) and ecotonal Coleoptera (Good & Butler 1999, 2000) but as well as mapping marginal vegetation, deeper water aquatic vegetation was also surveyed by snorkelling and subsequently mapped (Roden 1999). Results of the 1996 survey are summarised by Healy *et al*. (1997a, b, c) and both the 1996 and 1998 surveys by Healy (1999a, 1999b, 2003).

Aquatic fauna and flora were surveyed in another 34 lagoon sites in 2002-3 as part of a PhD study (Oliver 2005, Roden 2004) and the remaining 29 sites were surveyed in 2005-6 (Oliver in prep.). In these latter surveys the remaining lagoons were small and were sampled for aquatic fauna using original methods developed in the 1996-1998 surveys. Positions of sampling stations and notable features were recorded using GPS, but no vegetation mapping or sampling of ecotonal Coleoptera was carried out.

3. Habitat Range

Lagoons of different morphological types are scattered all along the Irish coastline. Many parts of the coastline especially along the east and south coast were drained in the eighteenth century and some of these areas may have contained small short-lived lagoons which no longer exist. There are no data available for historical loss of habitat but many artificial lagoons have been created, some quite large (Inch, Blanket Nook, S. Slob), which probably has compensated for any such losses.

Artificial lagoons are located on all parts of the coastline (Figure 1). The two largest "sedimentary" lagoons (Lady's Island L., Tacumshin L.) are located in the southeast (Figure 2), but many are also found on the west coast. "Rock/peat" lagoons are only found on the west coast (Figure 3) and "karst lagoons are found on the west coasts, only in Clare and Galway (Figure 4).

Based on the surveys, coastal lagoons were found in sixty-two 10km grid squares, giving the current habitat distribution of 6,200 km^2 (62 x 100km^2). Using the 'minimum convex polygon' rule, where gaps of less than two squares between squares containing lagoons are closed, then the Current Range is 8,500 km^2 (85 grid squares x 100 km^2).

3.1 Conservation Status of Habitat Range

Conservation status of habitat range is considered to be stable as there is no evidence of any overall habitat loss in the last 100 years. The current range of 8,500 km^2 is considered to be equal to the total historical habitat range and therefore also regarded as the Favourable Reference Range.

- **Habitat Range Area:** 8,500 km^2 (85 grid cells x 100 km^2)
- **Favourable Reference Range:** 8,500 km^2 (85 grid cells x 100 km^2) (Stable, no change in Habitat Range)

4. Habitat Extent

Based on the 1996-2006 surveys, an inventory of eighty-seven lagoonal sites, some of which comprise groups of small lagoons, has been compiled. The current list differs from earlier ones with new sites being added and some deleted because additional visits revealed that they were more tidal than previously thought or were in fact freshwater lakes. The current list of coastal lagoons (Table 1) comprises 87 lagoon sites containing a total of 100 lagoons covering an area of 2366.5ha. Details of habitat area and morphological type are provided for each lagoon in Appendix I.

4.1 Conservation Status of Habitat Extent

Drainage was recorded at 6 lagoons during the reporting period, and although no lagoons were drained completely, it is estimated that 10.6% of habitat extent was affected, the most serious of which was the deliberate drainage Tacumshin Lake in Wexford, which was previously the largest lagoon in the country.

In Tacumshin it is difficult to be precise about the figures for the area affected by drainage as the flooded area varies greatly between summer and winter and between years depending on rainfall, summer temperatures and occasional breaching of the barrier. This variation in area is extreme because it has a very flat bed and is very shallow (never more than a metre) so that a small change in lagoon depth results in a large change in lagoon area. Tacumshin was calculated to be 450ha (17.6% of the total habitat area) based on the same methodology for estimating area used at all other lagoon sites, that is the maximum flooded area recorded on the 6" Ordnance Survey maps except where there had been major morphological changes to the barrier. Much of the former lagoon bed is now taken over by reed beds and the area of open water, even in winter, is now considerably reduced. According to the NPWS Conservation plan for Tacumshin for 1998-2003 only 26.5% of the SAC area of 559ha consists of lagoon habitat, which gives an area of only 117ha. If the figure for current area of 117ha is accepted, then 333ha (65%) of the lagoon has been lost through drainage in the last 100 years (representing 13% of lagoon habitat in the country), and often in the summer the open water area is far less than this.

At present a water level modelling project is underway to determine optimal winter and summer water levels which will allow the lagoon to function in a more natural way, yet will protect the surrounding farmland from exceptionally high water levels in winter. As a result of water level monitoring for this project it has been estimated that over the past 7 years, the area of the lagoon has varied from a maximum of approximately 257ha reached on several occasions in winter down to as low as 2ha in summer (N.B. lower estimate of area very approximate) and that the area flooded has only exceeded 95ha on average for only 6% of the year. It is estimated that if the drainage pipes installed since 1996 caused a drop of 0.3m from Ordnance Datum (Malin), that drop in water level would be equivalent to a reduction in maximum area from 333ha before installation to a maximum area of 257ha which would mean a loss in area of 76ha over the last 10 years (Pat Parle pers. comm.). However, it also appears that maximum levels are reached less often and for shorter periods than before installation.

For the purposes of this report it is assumed that although the area of lagoon during the year was often far less, the maximum size of 257ha recorded over the last 7 years represents the current area of the lagoon (as was done for all other lagoons). The current area is therefore estimated as 257ha for further calculations and a loss in area of 76ha from 333ha is estimated for the last 10 years. However, given that lagoons are defined as areas of permanent brackish water, the fact that this lagoon now dries out almost completely in the summer indicates that the impacts on the ecology of the lagoon are extremely severe and raises the question as to whether this site can still be regarded as a lagoon.

Given the international status of this lagoon (SPA, SAC, Ramsar Site, CORINE Biotope Site, Important Bird Area, Area of Outstanding Landscape) and its contribution to the extent of lagoonal habitat in Ireland it is essential that the site be fully restored to its former glory.

In addition to Tacumshin, a small lagoon (2ha) at Shannon Airport was also drained deliberately but more justifiably for safety reasons, to discourage waterfowl (especially swans) from flying close to the airport and risking collision with aircraft. Negotiations with the management of Shannon Airport are ongoing and it is likely that in mitigation for this loss of habitat that new lagoons will be created further away from the airport. Temporary partial drainage also occurred at Clogheen/White's Marsh, Commoge Marsh, and Inchydoney L. as a result of maintenance work on the sluices. In all cases there were complaints from local inhabitants and future maintenance work will probably be carried out more carefully in order not to drain the areas to such an extent that aquatic biota was endangered. Part of the North Slob near The Raven was also drained during this period, presumably for maintenance work, and may account for the apparent disappearance of the crustacean *Cyathura carinata* from this site. It is essential that any future maintenance work in this site take into account its importance as a lagoon and the sensitivity of its biota.

At least one lagoon (Corragaun) has decreased in area (-10ha) due to the natural process of siltation and onshore movement of the barrier.

Most sites affected by drainage have recovered but with the loss of most of Shannon airport lagoon (2ha), the natural loss of 10ha in Corragaun and an estimated loss of 76ha from Tacumshin in the last 10 years, it is estimated that 88ha of lagoon habitat has been lost in the last 10 years (3.7%), which is equivalent to 0.4% loss of lagoon habitat/year. As this figure lies between 0 and 1% per year over the last 10 years, Conservation Status of Habitat Extent is considered to be Unfavourable-Inadequate.

Conservation Status of Habitat Extent: -0.4% loss =	**Unfavourable Inadequate**

5. Structures and Functions

5.1 Habitat Structures and Functions

Perhaps more worrying than the loss in habitat extent which could be relatively easily rectified is the deterioration in quality of the habitat. The various impacts and threats are listed in section 6 and summarised in Appendices II and III. Of these, water pollution due to excessive nutrient inputs, urbanisation and industrial/commercial activities are the most serious threats to the structure and functions of lagoon habitat (section 6, Appendices II and III).

Of the 87 lagoon sites listed, 46 sites are regarded as polluted with nutrients representing 52.9% of the total number and 61.6% of total area (see section 6.1). An additional small percentage (2%) recorded in 11 lagoons is regarded as natural eutrophication due to accumulations of marine algae washed into the lagoon during storms and overtopping of the barrier (e.g. L. Murree, Kilmore L., L. Bofin). However, apart from lagoons near major cities (e.g. Broadmeadow, L. Atalia, Blennerville lakes) in most cases, it is generally assumed that runoff from agricultural land is the major source of nutrient enrichment.

Lagoonal biota is characteristically tolerant of extreme variations in environmental conditions and can tolerate the stresses caused by nutrient enrichment and deoxygenation better than many other non-lagoonal species. However there are limits to such tolerance and damaging algal blooms and fish-kills have been reported from several of the largest, most important lagoons. In particular, Lady's Island Lake, L. Gill and Kilkeran Lake, which together represent 21.7% of current lagoon area. Despite the apparent eutrophication in such places as L. Murree and the North Slob, there is no evidence of any of the previously recorded rare species (especially Charophytes) having disappeared, but this is not the case in Lady's Island Lake where large areas of aquatic macrophytes have disappeared, together presumably with the fauna associated with them. It is possible that in many other eutrophic lagoons the vegetation community still survives but is not as healthy as it might be, and equally possible that the level of nutrient enrichment is approaching a critical level at which these taxa can no longer survive. As part of a recent compilation of water beetle records, it appears that "brackish-water" beetles have declined considerably in Ireland (A.O'Connor, pers. comm.) and this may include brackish water beetles found in lagoons. Recently, (Moorkens, 2006) two lagoon molluscs, *Ventrobia ventrosa* and *Hydrobia acuta s. neglecta* have also been described as "Vulnerable" and "Endangered" respectively, due to tourism and development pressure and potentially by long-term climate change. Most of the other impacts and threats are relatively minor and relatively easy to control (section 6).

5.1.1 Conservation Status of Habitat Structures and Functions

The decrease in habitat extent due to drainage is relatively minor except in one notable case (Tacumshin L.) but partial temporary drainage in others may have caused deterioration in habitat quality. Of greater impact on habitat structures and functions is water pollution in the form of excessive nutrient enrichment, affecting 61.6% of current habitat area. It is possible that the blooms seen in some of the smaller lagoons may have been part of some natural cycle, but the areas involved are so small that they make very little difference to the overall figure. Urbanisation and Industrial/commercial activities affect 38% and 14.8% of total habitat, respectively which result in water pollution and increased disturbance. Only 23 lagoon sites, covering less than 20% (467.5ha) of total habitat area are regarded as being in Favourable Conservation Status (Appendix II). Most of these are on the west coast in what are still relatively natural, undeveloped areas. As a result, more than 80% of habitat area is unfavourable and therefore conservation status of Habitat Structures and Functions is assessed as **Unfavourable-BAD.** This is an extremely serious situation, as according to EU guidelines it only requires 25% for the assessment to be Unfavourable-Bad.

Conservation Status of Habitat Structures and Functions =	Unfavourable Bad

5.2 Typical Species

Typical species of coastal lagoons varies somewhat according to geographic distribution and lagoon type. The list of typical species in the interpretation manual (EC 1996, 2003) is not very useful for Ireland as many of the species referred to in those documents do not occur in Ireland and many of the others are common freshwater species that may occur in low salinity coastal lagoons but are not necessarily typical of lagoons anywhere in Europe (Table 3). At present, the list includes such animals as tree frogs and terrapins, and very rare species recorded only in the U.K. and can be completely misleading when trying to assess the conservation value of a lagoon site in Ireland. Unfortunately the list of typical species in the interpretation manual has been referred to in management plans by private consultants for lagoon sites in Ireland (e.g. Commoge Marsh), stating that none of the species on the list occur at a particular site which is therefore not "typical" or is a "good representative" of coastal lagoon habitat. It is assumed that the European list was compiled at an early stage of describing typical species of coastal lagoon habitat and that it will be modified and improved eventually.

Table 3. Plants and animals listed in the interpretation manual as "typical" of coastal lagoon habitat in Europe, together with presence/absence and their assessment of lagoonal status in the Republic of Ireland (only taxa in red are regarded as characteristically lagoonal in Ireland)

Taxa	Present in Ireland (RoI)	"typically lagoonal"
Plants		
Callitriche spp.	YES	NO
Chara canescens	YES	YES
C. baltica	YES	YES
C. connivens	YES	YES
Eleocharis parvula	YES	NO
Lamprothamnion papulosum	YES	YES
Potamogeton pectinatus	YES	NO
Ranunculus baudotii	YES	NO
Ruppia maritima	YES	YES
Tolypella n. nidifica	uncertain	YES
Animals		
Edwardsia ivelli	NO	YES
Armandia cirrhosa	NO	YES
Victorella pavida	NO	YES
Brachionus sp.	??	YES
Abra sp.	YES	NO
Murex sp.	NO	??
Artemia sp.	NO ?	YES
Cyprinus sp.	YES	NO
Mullus barbatus	NO	??
Testudo sp.	NO	??

Hyla sp.	NO	??

Additional species are listed for Baltic countries which include *Phragmites australis* which is a pan-global species found in almost all wetlands, regardless of salinity. Rare charophytes are well represented in this list but the list of animals is particularly unhelpful for Ireland as only two of the taxa are found in Ireland, one of which is a common estuarine mollusc in Ireland (*Abra*), not found in any of the 87 lagoon sites and one is a freshwater fish (*Cyprinus sp*) found in only one lagoon (S. Slob), where it was introduced for recreational fishing.

Lists of typical species, most often referred to as "lagoonal specialists" have been compiled in the U.K. (e.g. Barnes 1989, Smith & Laffoley 1992, Covey 1999, Bamber *et al*. 2001) and similar lists have been compiled for Ireland (Oliver & Healy 1998, Healy 2003, Oliver 2005), based originally on the U.K. lists, with modifications, with species much more "typical" of lagoons, many of which are rare or threatened and rely almost entirely for their survival on coastal lagoon habitat (Table 4). The conservation value of lagoons in the U.K. and Ireland is based on the species in these national lists rather than those listed in the interpretation manual.

Table 4. Proposed list of lagoonal specialist flora and fauna for Ireland.
(from Oliver 2005, **?** = proposed specialists, pending further information)

Flora	
Non-charophyte algae	Charophyte algae
Chaetomorpha linum	*Chara baltica*
Cladophora battersii **?**	*Chara canescens*
Spermaphyta	*Chara connivens*
Ruppia cirrhosa	*Lamprothamnion papulosum*
Ruppia maritima	*Tolypella nidifica*
Fauna	
Cnidaria	Insecta
Cordylophora caspia **?**	Coleoptera
Gonothyraea loveni	*Agabus conspersus*
Crustacea	*Enochrus bicolor*
Idotea chelipes	*Enochrus halophilus*
Jaera nordmanni?	*Enochrus melanocephalus* **?**
Lekanesphaera hookeri	*Ochthebius marinus*
Allomelita pellucida ?	*Ochthebius punctatus*
Corophium insidiosum	Hemiptera
Gammarus chevreuxi	*Notonecta viridis?*
Leptocheirus pilosus?	*Sigara stagnalis*
Palaemonetes varians	*Sigara selecta*
Mollusca	Diptera (Chironomidae)
Hydrobia ventrosa	*Glyptotendipes barbipes* **?**
Littorina tenebrosa	Bryozoa
Onoba aculeus	*Conopeum seurati*
Rissoa membranacea var. **?**	
Cerastoderma glaucum	

The lists of "specialists" vary according to author and will change as more ecological information becomes available for the taxa concerned and therefore likely to be subjected to continual reappraisal (e.g. Gilliland and Sanderson 2000).

For example, the water boatman, *Sigara concinna* is regarded as a lagoonal specialist in the U.K. as it is restricted to coastal brackish water bodies but it is found at many inland sites in Ireland and therefore cannot be regarded as a lagoonal specialist in this country. On the other hand, the crustacean *Corophium insidiosum* was not included in earlier lists for Ireland, as it has only recently been recorded in this country.

Other typical species

Other typical species found in lagoons are several normally freshwater species which can tolerate a certain amount of salt water or marine species which can tolerate salinities lower than seawater. Many of these species can survive, for sometimes long periods, in water different to their normal environment but most are unable to reproduce in the different environment. Healy (2003) listed the most commonly occurring faunal species in the 38 lagoons surveyed up to that time (Table 5). Chironomid larvae are the most commonly occurring taxa (89.5%), but these are not identified to species. Although many chironomid species are highly tolerant of wide ranges in environmental conditions, many others have clearly defined salinity and substrate preferences. The next five most commonly occurring species comprise three fish species (Eel *Anguilla anguilla*, Three-spined Stickleback *Gasterosteus aculeatus*, and Common Goby *Pomatoschistus microps*) and two crustaceans ("lagoon" prawn *Palaemonetes varians* and Shore crab *Carcinus maenas*). These are typically euryhaline species, which can survive extreme ranges in salinity from fresh to fully marine conditions and even hypersaline water and regularly enter and leave lagoons with permanent tidal inlets.

The remaining species comprise eight crustaceans, two molluscs, two annelids and two other fish which are euryhaline marine species and three insects and one mollusc that are freshwater species which can tolerate a certain amount of salt. Of this list, eight species regarded as lagoonal specialists as listed in Table 3 (3 crustaceans, 2 molluscs, 2 insects, 1 bryozoan).

Similarly with the plants, in the 60 lagoons surveyed up to 2003 (Oliver 2005, Table 6), the two most commonly occurring taxa are the green filamentous algas *Enteromorpha* and *Cladophora* and though not identified to species, both taxa are regarded as euryhaline. More typically lagoonal are the two species of *Ruppia*, which were found in 81.7% of the 60 lagoons. It is only possible to identify flowering plants of this genus so the two species found in Ireland are combined with indeterminate plants found at some sites. However, of the plants identified, it is interesting to note that *R. maritima* was found in 46.7% of sites and *R. cirrhosa*, which is generally regarded as much rarer in Ireland was recorded at 35% of sites and both species were found together in some lagoons. Three marginal, emergent plants were commonly found in lagoons, the Common Reed *Phragmites australis* (70%) Sea Club-rush *Bolboschoenus maritimus* (65%) and another Club-rush *Schoenoplectus* (63.3%) which is most likely to have been the Common Club-rush *S. lacustris* but was not on most occasions distinguished from the Grey Club-rush *S. tabernaemontana*. The lagoonal specialist form of *Chaetomorpha linum* was found in 55.5% of sites at salinities from 10-40 psu and the generally freshwater Fennel Pondweed *P. pectinatus* in 53.3% of sites (below 14 practical salinity units (psu), formerly referred to as parts per thousand)

The remaining species are made up of the euryhaline *Ulva* (15%), four intertidal fucoids, one red alga, and three freshwater species tolerant of low salinities (*Chara aspera 25% Myriophyllum spicatum* and *Lemna minor* 15%) and two rare, red data book, charophytes (*Lamprothamnion papulosum* 12%, *Chara canescens* 8%) regarded as lagoonal specialists.

Table 5. The most frequently occurring faunal taxa in 38 lagoons sampled up to 1998 (From Healy 2003, * denotes proposed lagoonal specialist).

Taxa	Higher taxonomic group	Number of lagoons where found (n = 38)	% occurrence in 38 lagoons
Chironomidae (larvae)	Insecta	34	89.5
Anguilla anguilla	Pisces	33	86.8
Gasterosteus aculeatus	Pisces	31	81.6
Palaemonetes varians	Crustacea	27	71.1
Carcinus maenas	Crustacea	26	68.4
Pomatoschistus microps	Pisces	24	63.2
Potamopyrgus antipodarum	Mollusca	24	63.2
Gammarus duebeni	Crustacea	24	63.2
Neomysis integer	Crustacea	24	63.2
Pleuronectes flesus	Pisces	21	55.3
**Jaera nordmanni*	Crustacea	20	52.6
**Conopeum seurati*	Bryozoa	20	52.6
Ischnura elegans	Insecta	19	50.0
Crangon crangon	Crustacea	17	44.7
Melita palmata	Crustacea	16	42.1
Praunus flexuosus	Crustacea	16	42.1
Gammarus zaddachi	Crustacea	16	42.1
**Lekanesphaera hookeri*	Crustacea	15	39.5
Arenicola marina	Annelida	15	39.5
**Sigara stagnalis*	Insecta	14	36.8
Corophium volutator	Crustacea	14	36.8
**Cerastoderma glaucum*	Mollusca	13	34.2
Hediste diversicolor	Annelida	13	34.2
Hydrobia ulvae	Mollusca	13	34.2
**Idotea chelipes*	Crustacea	12	31.6
Mytilus edulis	Mollusca	12	31.6
Mugilidae	Pisces	12	31.6
**Hydrobia ventrosa*	Mollusca	12	31.6
Palaemon elegans	Crustacea	11	28.9
Sigara dorsalis	Insecta	10	26.3
Corixa panzeri	Insecta	10	26.3
**Enochrus bicolor*	Insecta	10	26.3

Table 6. The most frequently occurring taxa in 60 lagoons sampled up to 2002 (From Oliver 2005, * denotes proposed lagoonal specialist).

Taxa	Higher taxonomic group	Number of lagoons where found (n=60)	% occurrence in 60 lagoons
Enteromorpha sp.	Chlorophyta	56	93.3
Cladophora sp.	Chlorophyta	52	86.7
Ruppia spp.*	Angiosperma	49	81.7
Phragmites australis	Angiosperma	42	70.0
Bolboschoenus maritimus	Angiosperma	39	65.0
Schoenoplectus sp.	Angiosperma	38	63.3
*Chaetomorpha linum**	Chlorophyta	33	55.5
Potamogeton pectinatus	Angiosperma	32	53.3
*Ruppia maritima**	Angiosperma	28	46.7
*Ruppia cirrhosa**	Angiosperma	21	35.0
Chara aspera	Charophyta	15	25.0
Ulva sp.	Chlorophyta	15	25.0
Fucus vesiculosus	Phaeophyta	14	23.3
Fucus ceranoides	Phaeophyta	13	21.7
*Lamprothamnion papulosum**	Charophyta	12	20.0
Fucus serratus	Phaeophyta	12	20.0
Chondrus crispus	Rhodophyta	12	20.0
Myriophyllum spicatum	Angiosperma	11	18.3
Zostera sp.	Angiosperma	9	15.0
Ascophyllum	Phaeophyta	9	15.0
Lemna minor	Angiosperma	9	15.0
*Chara canescens**	Charophyta	8	13.3

Ecological variations

The "typical species" found in lagoons is determined primarily by salinity with many more freshwater species found in the low salinity lagoons and many more marine species found in higher salinity sites. Because of the naturally wide range of salinities encountered in lagoons, the number of typical species varies much more than in other habitats. Substratum also varies considerably between lagoons and a lagoon with a soft muddy substratum will have a very different fauna (many more burrowing species) from a lagoon containing hard surfaces for attachment (many more sessile species).

Morphological type of lagoon

The morphological type of lagoon can determine to a certain extent the species found in any particular lagoon, but the most relevant factor is whether or not the lagoon has a permanent tidal and/or freshwater inlet which allows colonisation from marine or freshwater sources. Any of the five morphological types described for Ireland (section 1) may have such inlets, and although a "saltmarsh" lagoon is likely to contain a larger proportion of typically estuarine 'soft-bottom' species such as annelids and molluscs, a sedimentary lagoon could easily have a similar fauna to a "karst" or even artificial lagoon. The "rock/peat" lagoons on the west coast of Ireland are high salinity lagoons with rock barriers, usually with permanent tidal inlets similar to the Scottish "obs" and typical species in these lagoons may include lagoonal specialist species such as *Lamprothamnion papulosum, Chaetomorpha linum, Ruppia* spp., *Gonothyraea loveni, Idotea chelipes,* and *Cerastoderma glaucum* but also *Zostera* and large numbers of tunicates (*Ciona intestinalis, Clavelina lepadiformis, Ascidiella aspersa*), cnidarians (*Anemonia viridis, Anthopleura ballii*) and many other species more typical of a temperate rocky coastline.

Even apparently very similar lagoons in terms of substratum and salinity can have a quite different biota and a frequently discussed feature of lagoons is the large degree of difference in faunal composition between apparently similar systems. Long-term observations on Lady's Island Lake, which experiences wide fluctuations in conditions due to periodic breaching of the barrier followed by occasional mass mortalities, demonstrated the presence of three components of the fauna which respond differently to major disturbance: (a) a variable contingent of marine species which colonise through the temporary inlet but cannot breed in the lagoon and are only temporary inhabitants, (b) freshwater and oligohaline species which colonise during low salinity phases and disappear when conditions become highly saline, and (c) a suite of brackish water species whose populations fluctuate but are never fully extinguished (Healy 1997). Species turnover in this lagoon, therefore, only affects a section of the community while the true resident species are more or less constant and persistent. Persistent differences between communities of neighbouring lagoons have been noted elsewhere in Ireland and have also been recorded in England (Barnes and Heath, 1980, Barnes 1987).

Biological (ecological) classification of coastal lagoons

Twenty-eight Irish lagoons were statistically classified using presence/absence and abundance data for all floral and faunal taxa and for also for a restricted list of lagoonal specialist fauna and flora, and in nearly all analyses there was a consistently recurrent pattern (Oliver 2005).

Certain lagoon types clearly grouped together, although more clearly in some analyses than others. The abundance data identified four main groups, of which the "high salinity west coast rock and peat" lagoons are generally quite separate from all other sites. In addition to this type is a low salinity type, a "semi-isolated mid-salinity" and an "estuarine" type. Generally, these four types can be recognised using both faunal and floral species but grouping is somewhat clearer using floral abundance. Using only lagoonal specialist flora and fauna tends to confuse the pattern by overemphasizing rare species and to group ecologically different lagoons together based on paucity of faunal specialist species.

When presence/absence data from 32 additional lagoons was combined with that from the 28 lagoons, statistical analyses identified the same four types described above, plus a fifth type of lagoon, which is referred to as a "mixed community". The mixed community type was found either in large lagoons, or in clusters of small lagoons which possess a wide range a range of environmental conditions; primarily a range of salinity regimes, but also of depth and substratum.

As a result of the analyses the following classification of five lagoon types was proposed, as in the model presented in Figure 5:

1. *Ruppia/Potamogeton* lagoons (low salinity)
2. *Ruppia/Chaetomorpha* lagoons (mid-salinity, semi-isolated)
3. "Estuarine" lagoons (high salinity mean and range, high tidal and FW flow)
4. *Ruppia/Zostera* lagoons (high salinity, "clean, rock, west coast")
5. "Mixed community" lagoons (combination of the above – large sites, or mosaics).

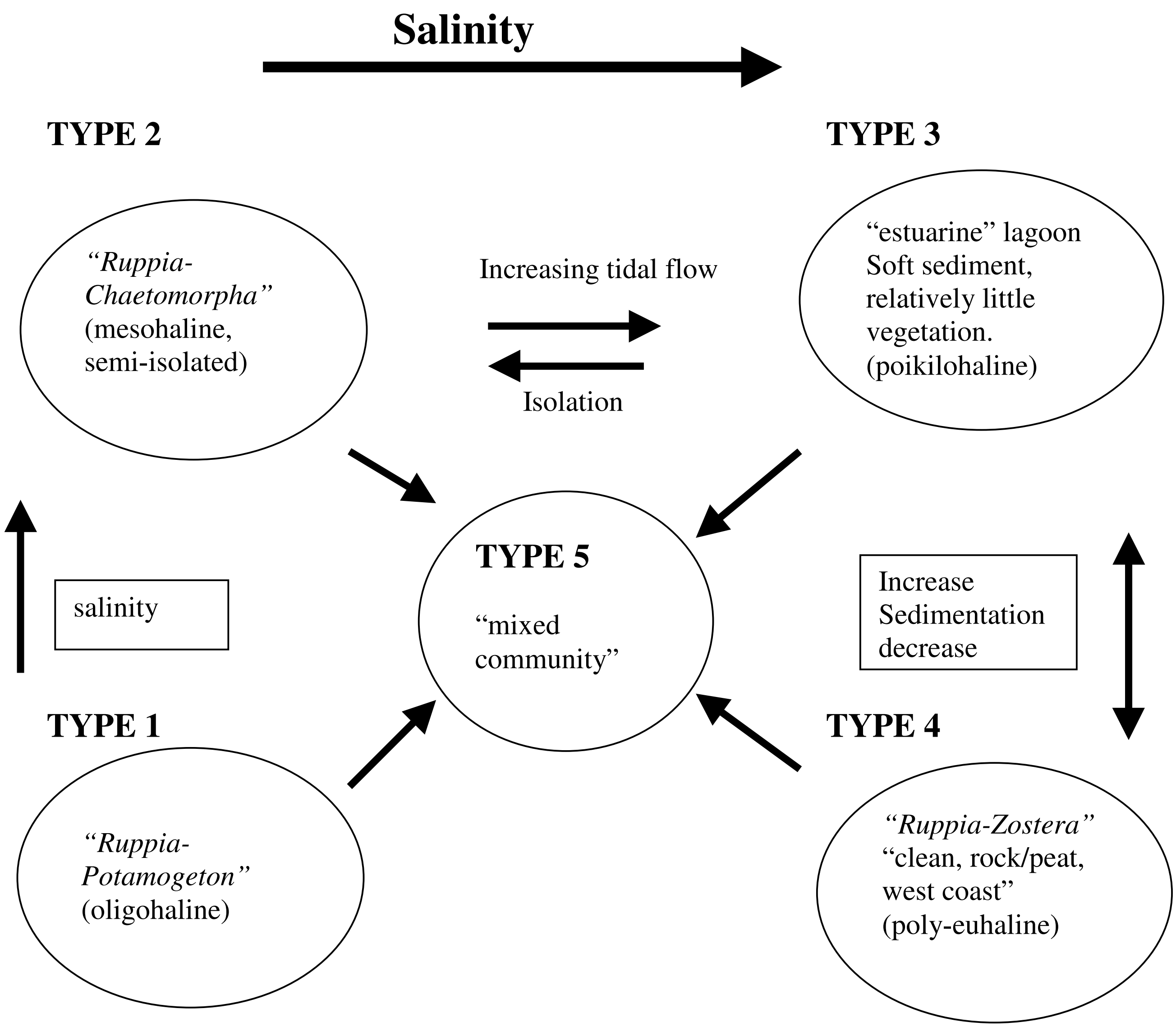

Figure 5. Irish coastal lagoon model.

Temporal variability

The different morphological and biological types of lagoon in Ireland also vary spatially and temporally in species composition. Variability is one of the most characteristic features of lagoons. Variations in water volume, temperature, water chemistry, and especially salinity, and the consequent changes in flora and fauna, are all greater than in most other aquatic environments (Healy 2003). The principal causes are tides, climate, and exceptional events such as storms or floods. Seasonal changes in water volume and salinity are generally tolerated by the inhabitants, most of which are adapted to gradual fluctuations. Daily incursions of tidal water, and the larger amounts at spring tides, have their greatest impact near the inlets and on the central lagoon bed, and in the larger lagoons may hardly reach the more distant parts of the system unless there are strong winds to cause mixing. It is sudden large influxes of sea water that have the greatest effect on fauna and flora as they are largely unpredictable and species may be unable to adjust to such rapid changes. Small, homogeneous systems are the most vulnerable as there may be no refuge areas where sections of populations may survive. Periodic mass mortalities associated with tidal exchange following breaching of the barrier at Lady's Island Lake have been observed (Healy 1997), and it is believed that unknown events may have caused extreme depletion of benthic communities in some other lagoons (the "shock" lagoons).

Most lagoons were only sampled in the summer and many species, most notably the plants, vary considerably with the season and many of the algal species go through cycles of "blooms". Seasonal variations due to differences in rainfall and evaporation between summer and winter are most noticeable in isolated lagoons. Such changes take place gradually allowing resident organisms to adapt, but more dramatic, unpredictable events such as sea waves entering during storms or exceptional, "unseasonal" rainfall may cause abrupt changes throughout a lagoon which are less easily tolerated. Healy (1997) recorded extended periods of high salinity in Lady's Island Lake following breaching of the barrier to relieve flooding which sometimes caused heavy mortalities of the invertebrate fauna. Smaller lagoons with tidal inlets and substantial freshwater input may experience semidiurnal (twice daily) fluctuations in salinity which is wide enough to limit the diversity of the flora and fauna. In this respect they resemble estuaries. A good example is Farranamanagh Lake in Co. Cork where salinity measurements in the main body of the lagoon varied between 16-29 at high tide and 1-6 at low tide. Situations like this were described by den Hartog (1974) as "shock systems". Few species of plant or animal can withstand such rapid changes and "shock lagoons" undergoing regular wide fluctuations due to alternation of tidal and freshwater flow (Lissagriffin Lough, Farranamanagh Lough, Mill Lough, Moorlagh), or receiving occasional large influxes (Lough Bofin) are usually poor in species (Healy 2003). The presence of inlets also increases the chance of accidental invasion by species from either the sea or fresh water which are poorly adapted to lagoonal environments but which might nevertheless survive for short periods. Most of the insects recorded in lagoons are only temporary residents, colonising during favourable conditions or only during larval phases. As most lagoons were not sampled in all seasons, some seasonally occurring species were probably missed during surveys, notably Trichoptera (caddis larvae).

However, the permanent residents of lagoons, the lagoonal "specialists", have ways of surviving major disturbance and in most cases the communities probably recover within a short period. *Ruppia* species regenerate from rhizomes or seeds, while charophytes have resistant spores which can lie on the lagoon bed for many years, and other algae can recolonise by way of spores. Faunal species (generally) have no resistant phases but fragments of populations may survive in refuges (Healy 1997) or may recolonise from neighbouring lagoons or other similar brackish habitats. Consequently, of the few Irish lagoons which have received frequent visits, most of the lagoonal specialists recorded appear to be persistent. On the other hand, in what appear to physically similar lagoons, often very close to each other, there are persistent differences in the lagoonal specialist biota found in each lagoon.

5.2.1 Conservation Status of Habitat Typical Species

Most lagoons were only visited on one or two occasions, often for only a few hours and the assessments are based on only "snapshot" impressions. "Lagoonal specialist" species are characteristically resistant to changes in environmental conditions and most of the typical species appear to be surprisingly persistent (although their levels of abundance may change considerably). In the few sites that were revisited several times, the same species were found, even when the visits were separated by a decade or more. However, for most sites there is no historical information relating to typical species and there are very few reference sites on which to base any assessment.

There is direct evidence of repeated algal blooms and fish kills in at least three lagoons (Lady's Island L., Lough Gill, Kilkeran L.) which represent 21.7% of the current habitat area and 63.6% of lagoon habitat in Ireland is regarded as eutrophic. The affects of this impact are largely unknown except in the obvious cases. Large areas of aquatic vegetation have disappeared from Lady's Island Lake over the last 25 years, presumably due to eutrophication and charophytes such as *Chara canescens* are no longer found in certain parts of Tacumshin due to deliberate drainage. In 1996, during a hot dry summer, large specimens of the lagoon cockle, *Cerastoderma glaucum* were found dead and decaying in three lagoons in Co. Cork. In one lagoon (Inchydoney) water levels may have been lowered deliberately, although in the other two only natural processes were occurring. Temporary drainage of other lagoons for maintenance work to be carried out on sluices is likely to have caused extreme stress to animals and plants due to exposure, desiccation, over-heating and possible predation. There are recent indications of a general decline in brackish water coleopteran and molluscan species but no precise information for lagoons.

The Conservation Status of Habitat Structures and Functions was assessed as Unfavourable-Bad (Section 5.1) and although precise information concerning any change is unavailable for the majority of lagoon sites and species, a decline in habitat quality also suggests a decline in the presence of typical species. However, given the known variability in abundance of typical species in this highly variable habitat type, it is considered more appropriate assess status as Unfavourable-Inadequate rather than Unfavourable -BAD. Given the high level of uncertainty due to lack of precise information concerning typical species it might be argued that the conservation status be assessed as Uncertain. However, given the impacts on typical species definitely known to have occurred in Lady's Island and Tacumshin alone, the assessment as Unfavourable-Inadequate is regarded as more appropriate.

Conservation Status of Habitat Typical Species =	Unfavourable-Inadequate

6. Impacts and Threats

Of the various threats/impacts affecting Irish coastal lagoons, many could be regarded as co-variables and some may be synergistic. For example, many lagoons that are regarded as eutrophic due to excessive use of fertilisers on agricultural land may also receive nutrients from human effluents, while others may be naturally eutrophic due to an accumulation of marine algae in a relatively closed system from tidal inflows or overtopping of the barrier during storms. Similarly, removal of beach materials increases the risk of natural erosion of the barrier.

There is relatively little information available from NPWS concerning impacts on coastal lagoon habitat contained in Site Impact Reports. What information that is available (Table 7) lists a total of 16 impact reports relating to lagoon habitat (Code no. 1150) over the last six years, concerning eleven different types of impact.

Table 7. Information compiled from NPWS Site Impact Reports since 2001.

Impact code number	Impact	SAC Site name	Year of Impact	Area impacted (ha)	Degree of influence	Purpose
230	Hunting	Tacumshin L.	2001	559	0	Recreation
230	Hunting	Lady's Island L.	2001	557	0	Recreation
501	Paths, tracks	Lady's Island L.	2001	2	-1	Agriculture
530	Improved access to site	Clew Bay complex	2003	0.1	-1	Development
620	Outdoor sports, leisure	Lower River Shannon	2001	0	0	Recreation
701	Water pollution	Lady's Island L.	2001	500	-1	Unknown
701	Water pollution	Kilkeran	2001	20	-1	Agriculture
802	reclamation	Lower River Shannon	2003	0ther	-1	
810	Drainage	Cross Lough	2001	0.2	-1	Agriculture
810	Drainage	Termon Strand		0.4	-1	Other
850	Modification of hydrography	Lady's Island L.	2001	500	0	Agriculture
853	Management of water levels	Gweedore Bay	2001	1	0	Development
853	Management of water levels	Termon Strand	2001	22.5	0	Recreation
853	Management of water levels	Termon Strand	2003	22	-1	Development
951	Accumulation of organic material	Tacumshin L.	2001	250ha	-1	Natural event
952	Eutrophication	Lower River Shannon	2001	0	0	?

Of these impacts, hunting is reported in Tacumshin L. and Lady's Island L. in 2001, but the influence of this impact on 559ha and 557ha, respectively, is reported as having zero influence, which is an unusual way to describe an impact. Seven of the sixteen reports (44%) regard the impact as having zero influence on the lagoon. Although a few of the reports are easy to understand, such as the water pollution incidents in Lady's Island L. and Kilkeran L. in 2001, others are difficult to interpret without further information. For example, the impact of eutrophication on the Lower River Shannon SAC, affecting 0ha but having no influence. It is unfortunate that a grid reference for the precise area affected is not included in the report as this SAC site is very large, and from the information available it is not possible to determine what lagoon habitat was affected. The management of water levels (Code 853) in Gweedore Bay apparently affected only one hectare but there are no lagoons in that SAC of such small size. Without more information, these site impact reports are of limited use in assessing impacts on coastal lagoon habitat.

The following assessments are based mostly on field assessments made during the various lagoon surveys over the last 10 years. Note that these are subjective opinions formed sometimes as a result of only occasional short visits to many of the sites. Very little scientific evidence is available for any of the sites which directly link the impact on a lagoon with its probable cause. Impacts and threats are listed for each site in Appendices II and III and summarised in Table 8. The EU Impact Code numbers are given wherever possible, but some impacts in lagoons are not accurately described by the code numbers available. Some impacts such as eutrophication affect the entire lagoon whereas an impact such as infilling or dumping may only affect a small part of each site. When assessing the effects of various impacts an attempt has been made to estimate the area of each lagoon affected before summing the total area for all lagoons, though this is sometimes difficult.

6.1 Water pollution (Impact Code 701)

Water pollution due to human activities appears to be the major threat to Irish coastal lagoons at the present time, affecting 52.9% of lagoon sites and 61.6% of the current area of habitat in the country (Table 8) and is found on all parts of the coastline (Figure 5). This is mostly in the form of **eutrophication**, which is the process of nutrient enrichment of a water body due to inputs resulting from human activities anywhere in the catchment area which causes changes in water quality and biological community. This process, through water circulation of the water, generally affects the entire lagoon though it may be more concentrated in some sheltered areas or areas close to a direct nutrient input and the effects will depend on the concentration of nutrients, water circulation and resilience of biota. The effects of eutrophication are generally manifested in algal blooms which may blanket other aquatic vegetation and can cause depletion of oxygen from the water, noxious odours, outcompeting of other vegetation and in severe cases the death of fish and invertebrate fauna. It is difficult, however, to distinguish between entirely natural processes of nutrient enrichment and those caused by human activities, especially in lagoons, which are naturally variable, especially in terms of salinity, but also many other environmental variables. The following assessment is based on personal or anecdotal evidence of algal blooms, noxious odours, anoxia and fish kills. The inflow of nutrients is generally regarded to be from agricultural sources, though some is undoubtedly from other human activities which have increased recently due to an increase in housing and the increase in the use of detergents in modern homes.

The impacts of eutrophication affect the entire lagoon though in large lagoons this impact may be less severe than in a small lagoon due to dilution in a large water body. Undoubtedly, excessive nutrient enrichment is the major impact affecting coastal lagoon habitat in Ireland and this is mostly from agricultural activities but it can also be a natural process (EU Impact Code 952) resulting especially in lagoons from the accumulation of marine algae washed into the lagoon during storms through tidal inlets or by overtopping the barrier. These natural accumulations of marine algae were recorded at 11 lagoons during the reporting period and can in small lagoons have a major, even if only temporary, impact (e.g. Kilmore L., L. Murree, L. Bofin). However, these 11 lagoons represent less than 2% of the lagoon habitat in the country compared with 61.6% attributed to human activities. Other forms of water pollution in the form of heavy metals and toxins are likely to affect lagoons near the major cities and ports (e.g. L. Atalia, Broadmeadow, Blennerville) but no chemical analyses were performed as part of the lagoon surveys and no distinction is made between the different forms of water pollution.

Table 8. Impacts and threats affecting Irish coastal lagoons during reporting period 1996-2006, in order of relative importance affecting habitat area. (Based on information in Appendices II and III. Entries in red refer to "natural" processes).

Impacts/Threats	No. of sites impacted	% of sites impacted	Total area of sites impacted (ha)	% of area of habitat impacted.
701 Water pollution (not incl. natural eutrophication)	46	52.9	1458	61.6
850-853 Modification of hydrography	12	13.8	1059	44.7
220 Leisure fishing	10	11.5	911	38.5
400 Urbanisation	14	16.1	899.5	38.0
910 Silting up (920 Drying out)	**23**	**26.4**	**495.5**	**20.9**
951 Accumulation of organic material	**25**	**28.7**	**460.6**	**19.5**
410 Industrial/commercial activities	8	9.2	350.5	14.8
810 Drainage	6	6.9	251	10.6
200 Aquaculture	2	2.3	215	9.1
601 Golf course	3	3.4	150.5	6.4
608 Camping and caravans	2	2.3	150	6.3
900 Erosion	**11**	**12.6**	**106.5**	**4.5**
954 Invasion by exotics	**4**	**4.6**	**84**	**3.5**
190 Poaching by cattle	28	32.2	30.2	1.3
860 Dumping	9	10.3	9.7	0.4
302 Removal of beach material	1	8.0	6	0.3
604 Circuit, track	1	1.1	5	0.2
800 Landfill, reclamation	5	5.7	1.3	0.1

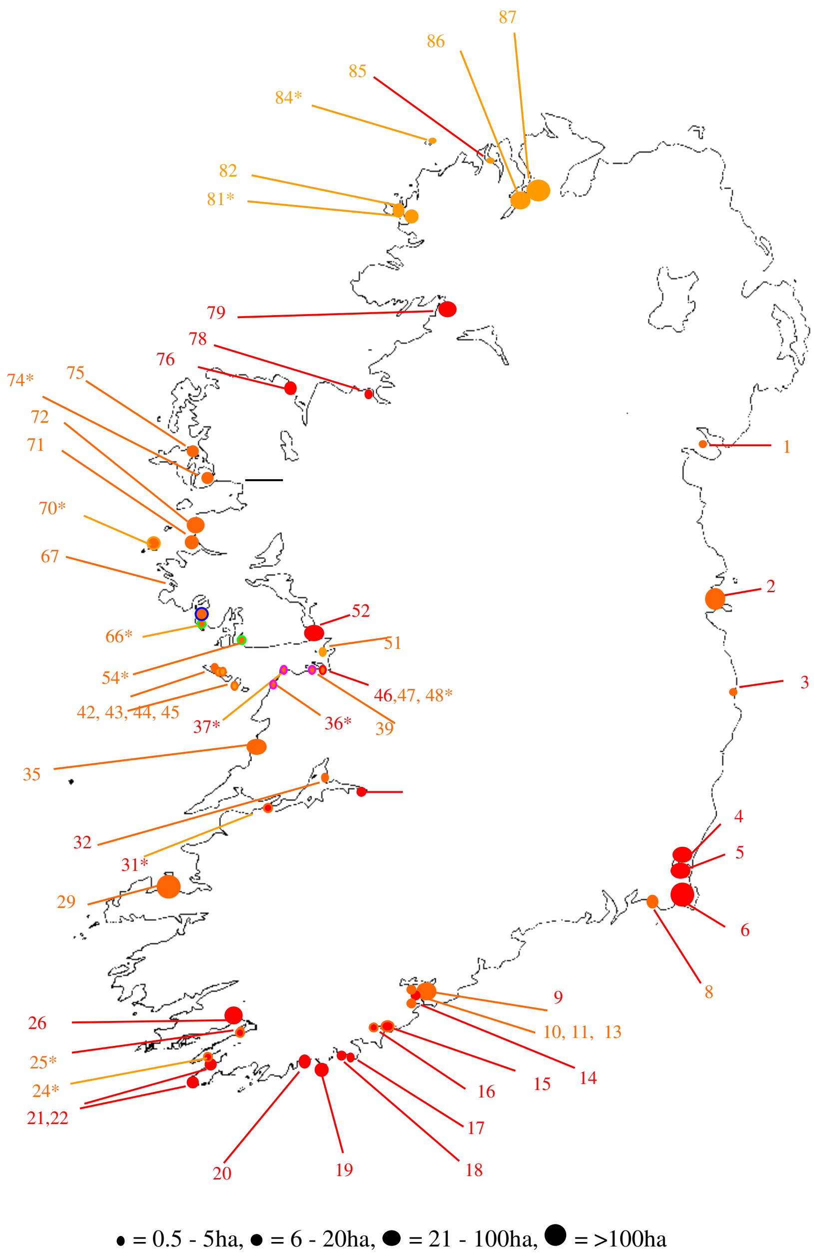

Figure 5. Distribution of coastal lagoons in Ireland regarded as eutrophic (red dots indicate highly eutrophic lagoons, amber dots indicate moderately eutrophic lagoons; asterisks indicate probably natural eutrophism).

Lagoon biota is characteristically resistant to major changes in environmental conditions, not only of salinity but also to associated factors such as temperature, pH turbidity and nutrients. It is this ability to resist environmental variability that distinguishes the "typical species" found in lagoons from other marine and freshwater organisms that may colonise the lagoon temporarily, but are unable to survive for longer periods. Algal blooms in lagoons may be an entirely natural process especially in response to a change in salinity and the addition of a limiting nutrient, such as phosphate in seawater, which may trigger a bloom when mixed with nitrate rich river water. However, in many sites these blooms and sometimes obvious fish-kills appear to be a much more recent phenomenon associated with changes in land use within the catchment of watercourses entering the lagoon.

Two of the largest lagoons in the country (Lady's Island Lake and Lough Gill) and at least one smaller one (Kilkeran) have suffered from repeated algal blooms and fish kills. The two larger lagoons are both protected as an SPA and an SAC and are both Ramsar sites but are still very much under threat due to excessive nutrients which cause smothering with blanket weed (*Cladophora* spp.) and death of invertebrates and fish.

Many of the other sites are small and the effects appear more obvious, but some of the sites affected appear to recover quickly or go through cycles of dominance by different plant and algal species. Lough Murree, for example, was described as eutrophic in 1980 (Pybus and Pybus 1980), but this appears to be a natural phenomenon. Very often the water of the lagoon is a thick "pea soup", but this is often quickly replaced by filamentous algae, or clears completely to reveal luxuriant growths of both *Chara canescens* and *Lamprothamnion papulosum*. This site is one of the best in the country for these two rare charophytes. The latter species has been described as "susceptible" to high phosphate concentrations but still grows well in this "eutrophic" site. Both species are also found on the North Slob which is also a eutrophic site due to high levels of fertiliser applications on grassland to increase the forage available to the wintering goose flock.

Water pollution trend

A programme is being undertaken by Wexford County Council to reduce nutrient inputs into Lady's Island Lake. All lagoon sites designated as SACs are also listed as "transitional waters" and in the Register of Protected Areas under the Water Framework Directive. This Directive requires that all waters reach "good status" by 2015, which theoretically means that water quality should improve before that date. However, it is unclear as to how effectively this process will be in improving the status of impacted sites within the next reporting period and how rapidly the sites will respond to a reduction in nutrient inputs. Considerably more work is needed to be carried out on the precise causes of algal blooms in lagoons in order to distinguish those caused by human activities from those due to entirely natural processes.

6.2 Modification of hydrographic functioning, general (850-853)

This includes modification of marine currents (851), modifying structures of inland water course (852) and management of water levels (853) under the one heading, as in nearly all cases it involves management of a non-return valve to allow freshwater to exit and prevent seawater to enter the lagoon, which affects all three elements. Historically, nearly all the lagoons in the country have been modified to some extent and in some cases to extremes. Many of the most natural lagoons in the country have modified inlets, others are completely artificial. Lady's Island Lake, the second largest sedimentary lagoon in the country, is deliberately breached annually in order to lower water levels, which also allows marine currents to enter.

Only modifications to hydrography during the reporting period are described in this section. During this period, modifications to hydrography were recorded in 12 lagoons, representing only 13.8% of sites and 44.7% of habitat area. Most notable of these modifications was the installation of pipes in the barrier of Tacumshin Lake, the largest lagoon in the country, as part of a deliberate drainage attempt and the lagoon at Shannon airport was deliberately drained (discussed under drainage, Section 6.8). At one lagoon (L. Beg) the sluice was manipulated to increase salinity in order (apparently unsuccessfully) to control the growth of *Scirpus*. At another (Moorlagh) the sluice was repaired in order to prevent salt-water entry to improve conditions for a trout fishery, and then removed completely following public objections. Unfortunately, many lagoons with non-return valves rely on the malfunctioning of the valve for seawater entry, and during the reporting period several were repaired which resulted in excessive drainage of the lagoon (Inchydoney, Commoge, Clogheen). This is likely to become an increasing threat to lagoons as sluices are maintained, and the use of a new type of valve with rubber seals, which prevents seawater entry more efficiently, has been mentioned.

At L. Gill, a channel was dredged, apparently successfully, in order to increase flushing and reduce the build up of nutrients, though the implications for the ecology of the lagoon are still a little uncertain.

Modification of hydrography trend

The trend is increasing, for various management requirements. A new approach, in the interests of nature conservation, might call for better designs in order to maintain the brackish nature of the lagoon while preventing excessive entry of seawater during high spring tides or storms. In the more natural lagoons it may be acceptable to remove sluices altogether and adopt the "soft approach" and "managed retreat", whereas in artificial lagoons, especially with an expected rise in sea level, the management of flood controls and coastal protection is likely to become more and more necessary.

6.3 Leisure fishing (220)

Leisure fishing was recorded in 10 lagoons in the country, mostly the larger, less saline sites, representing only 11.5% of sites but 38.5% of the area of habitat. The activity of leisure fishing has very little direct impact on the functioning of lagoon ecosystems in Ireland, and generally affects only a very small part of any individual lagoon, but in some cases there has been a desire to alter the hydrodynamics of the lagoon completely (section 6.2) by changing the lagoon into a freshwater lake in order to improve it for trout fishing (e.g. Moorlagh). On the other hand a desire to improve the trout fishery in Lough Gill led to a much greater need for a general improvement in water quality, which was beneficial to the lagoon as a whole. The introduction of exotic fish species is a potential threat in low salinity lagoons and is known for two lagoons with introductions of rainbow trout (Kilkeran) and Carp (South Slob) (see Invasion by exotics, section 6.12).

Leisure fishing trend

Likely to increase with the increase in population, urbanisation, wealth and desire for recreational activities. Fishing is carefully regulated by the inland fisheries section of the Department of Marine, especially in salmonid rivers and is not likely to have any serious impact on coastal lagoons.

6.4 Urbanisation (400)

Urbanisation has increased in Ireland and affects both urban and rural areas and was recorded during the reporting period at 14 lagoons, representing 16.1% of sites and 38.0% of the habitat area. This process may affect the lagoon directly by involving a probably negligible, amount of infilling/reclamation (section 6.19) of the lagoon area and also indirectly by reducing water quality (section 6.1) and increasing disturbance and possible damage to near-shore areas and therefore though highly localised, can in most situations affect the entire lagoon. The population of Ireland is increasing and not only are towns increasing in size but more houses are being built in rural areas. Generally, there is very little loss of lagoon area involved, but there are threats of increased effluents from housing developments (despite planning regulations for better treatment) and a higher demand for amenity areas which may conflict with nature conservation ideals. Some lagoons close to urban areas have become nature reserves (Commoge Marsh, Cuskinny, Rostellan, L. Beg) with the emphasis on birdwatching, which in general is a good thing, but in some cases this has led to an extreme lowering of water levels in order to attract wading birds which has led to mortality of lagoon biota. Until recently it was suggested by some environmental consultants to change a brackish lagoon to a freshwater lake in order to improve the habitat for birds in certain newly urbanised areas.

Urbanisation trend

The process of urbanisation will undoubtedly increase with the growth in population, desire for second homes and with an expected increase in tourism. The effect on lagoons theoretically should diminish with greater public awareness of the conservation value of this "priority" habitat, controls on the water quality of domestic effluents and the fact that designated sites have legal protection. However, any legislation needs enforcement and it may take some time for new regulations and water standards to become effective. In one situation (Commoge Marsh) it would appear that the scale of urbanisation surrounding the lagoon on three sides is too great that it may be difficult to ensure the long-term survival of this undesignated lagoon habitat.

6.5 Silting up (910), Drying out (920),

Silting up and drying out are two inter-related natural processes in lagoons leading eventually to the formation of dry land. This is a complex process which includes the deposition of sediments either from rivers or from the sea, or both, the accumulation of organic material from within the lagoon itself, encroachment of marginal vegetation which encourages the increase in the trapping of sediments and also by onshore movement of the barrier. Lagoons are essentially ephemeral systems forming a temporary component of the dynamic interaction of river and coastal landforms. This natural process was recorded in 23 sites representing 26.4% of the number of sites and 20.9% of the area of habitat, and though concentrated in certain areas can effect the entire lagoon by drying out shallow areas and reducing the depth of water in others. The process may have been accelerated in some situations by direct human interference through the damming up of an area by the construction of a causeway (e.g. Lissagriffin, Commoge Marsh, L. Beg, Ballyconneely). In these circumstances, silting -up may encourage deliberate drainage for reclamation purposes. In a few cases the process has been actively encouraged by deliberate drainage (e.g. Tacumshin, as discussed below).

Silting up, drying out trend

This is a natural process (as at Roonagh, Corragaun, Poulaweala, Dooniver) and is likely to continue resulting in a gradual loss in lagoon habitat. It is difficult to decide how to combat the threat on an individual site basis. In theory, in order to prevent any net loss of lagoon habitat, measures should be taken to encourage the creation of new habitat adjacent to the lost one. With an increase in human population and land prices it may be difficult to convince public opinion that this is a worthwhile activity but the risk of sea level rise may encourage people to move away from increasingly vulnerable low lying coastal areas, which may then be suitable for lagoon creation. Another alternative is to or to consider the idea of removing accumulated sediments by dredging as in Lough Gill.

The effects of a predicted sea level rise on coastal lagoons is not known but may offset the natural process of silting up/drying. Where silting up continues to be a problem and jeopardises the conservation value of the lagoon, there may need to be direct intervention. The decision to intervene may be determined by the nature conservation importance of the site. For example an only known site for a particular species or community in the country will be considered as more in need of preservation than a small site with relatively common species found in a large number of other sites.

6.6 Accumulation of organic material (951)

Accumulation of organic material is a process often resulting from natural eutrophication but appears to be becoming more frequent and more severe due to nutrient enrichment resulting from human activities.

The natural process results from a build up of plant material within the lagoon or as a result of large amounts of marine algae being dumped in the lagoon following overtopping of the barrier during storms and onshore winds. This was recorded in 25 lagoons, representing 28.7% of sites and 19.5% of the habitat in the country. Although the accumulation is often concentrated in certain areas, floating vegetation and nutrients are easily spread by water currents throughout the lagoon. Rafts of material, especially the filamentous algas *Cladophora* spp., *Enteromorpha* spp. and the lagoon form of *Chaetomorpha linum* are often blown by the wind to all parts of the lagoon and the impact affects the entire water body. These algas can also "blanket" the water surface preventing light penetration to lower levels and aquatic fauna reaching the surface, thereby threatening both the photosynthesis of benthic vegetation and respiration of aquatic fauna.

Similar impacts can be caused by stimulation of biomass production due to nutrient enrichment resulting from human activities. For example, rafts of *Cladophora* in L. Gill blanketed large areas of the lagoon negatively impacting on other lagoonal species and resulting in fish kills.

Accumulation of organic material trend

The natural process is likely to continue but could be reduced by manual removal of material if the lagoon is considered to be threatened. Accumulation of organic material due to human activities should decrease as a result of required improvement of water quality under the Water Framework Directive in streams and rivers entering the lagoon.

6.7 Industrial/commercial activities (410)

With increasing development of coastal areas, industrial and/or commercial activities were recorded at 8 lagoons, representing 9.2% of sites and 14.8% of habitat area, mostly associated with urban concentrations (Dublin, Cork, Limerick, Galway). As with urbanisation (section 6.4.) these activities affect the lagoon directly by infilling/reclamation and indirectly by increasing inflows of effluent pollutants. Away from the larger ports and cities, in more rural areas one instance relates to a caravan park (Kincas) and one to historical damage to the barrier during construction of an oil terminal (Kilmore L.).

Industrial or commercial areas trend

The trend for this threat is likely to increase with development of coastal areas, but impact should remain low due to water quality and planning regulations.

6.8 Drainage (810)

Deliberate drainage was recorded at 6 lagoons during the reporting period, and although no lagoons were drained completely, it is calculated that 10.6% of habitat extent was affected, the most serious of which was the drainage Tacumshin Lake in Wexford, which was previously the largest lagoon in the country.

It is difficult to be precise about the figures for the area affected, especially in Tacumshin, as seasonal water levels vary considerably, depending on rainfall, summer temperatures and occasional breaching of the barrier. This lagoon also has a very flat bed and is very shallow (never more than a metre) so that a small change in lagoon depth results in a large change in lagoon area. Based on the 6" Ordnance Survey maps, the area of Tacumshin was calculated to be 450ha, which represents nearly 17.6% of the total habitat area in the country, but much of the former lagoon bed is now taken over by reed beds and the area of open water, even in winter, is now much less. According to the NPWS Conservation plan for Tacumshin for 1998-2003 only 26.5% of the SAC area of 559ha consists of lagoon habitat, which gives an area of only 117ha. If the figure for current area of 117ha is accepted, then 333ha (65%) of the lagoon has been lost through drainage in the last 100 years (representing 13% of lagoon habitat in the country), and often in the summer the open water area is far less than this.

As a result of water level monitoring in Tacumshin over the last 7 years it has been estimated that the area of the lagoon has varied from a maximum of approximately 257ha reached on several occasions down to as low as 2ha (N.B. lower estimate of area very approximate) and that the area inundated covers 95ha for only 6% of the year on average. It is estimated that if the installed pipes caused a drop of 0.3m from Ordnance Datum (Malin), that drop in water level would be equivalent to a reduction in maximum area from 333ha before installation to a maximum area of 257ha which would mean a loss in area of 76ha over the last 10 years (Pat Parle pers. comm.). However, it also appears that maximum levels are reached less often and for shorter periods than before installation.

For the purposes of this report it is assumed that although the area of lagoon during the year was often far less, the maximum size of 257ha recorded over the last 7 years represents the current area of the lagoon (as was done for all other lagoons). The current area is therefore estimated as 257ha for further calculations and a loss in area of 100ha is estimated for the last 10 years.

This lagoon is, in theory, protected by a number of conservation initiatives (SPA, SAC, Ramsar Site, CORINE Biotope Site, Important Bird Area, Area of Outstanding Landscape) and it is hard to imagine how the largest lagoon in the country, and one of the best examples of a sedimentary lagoon, could have been allowed to be so extensively drained.

The lagoon at Shannon Airport was drained, but for safety reasons to discourage waterfowl (especially swans) from flying close to the airport and risking collision with aircraft. Drainage also occurred at Clogheen/White's Marsh, Commoge Marsh, and Inchydoney L. as a result of maintenance work on the sluices. In all cases there were complaints from local inhabitants and future maintenance work will probably be carried out more carefully in order not to drain the areas to such an extent that aquatic biota was endangered. Part of the North Slob near The Raven was also drained during this period, presumably for maintenance work, and may account for the apparent disappearance of the crustacean *Cyathura carinata* from this site. It is unfortunate in this last case that work was carried out by NPWS staff, apparently without considering the implications for lagoonal biota.

Drainage trend

At present a water level modelling project is underway in Tacumshin L. to determine optimal winter and summer water levels which will allow the lagoon to function in a more natural way, yet will protect the surrounding farmland from exceptionally high water levels in winter. Negotiations with the management of Shannon Airport are ongoing and it is likely that in mitigation for this loss of habitat that new lagoons will be created further away from the airport.

Drainage is a "notifiable activity" in a designated SAC and therefore illegal without the Minister's consent. Lagoon biota is basically subtidal and cannot survive desiccation and presumably with increasing awareness of the importance of lagoons the impacts/threats of inadvertent temporary drainage should decrease.

6.9 Fish and Shellfish aquaculture (200)

Ongoing aquacultural activities were only recorded in 2 lagoons in the country. Both of these lagoons were large (L. Ahalia, Furnace L.) and represent 9.1%. Both involved production of salmonids in cages and appeared to be well monitored and controlled. However, there is always the risk of hybrid fish escaping into the wild, of other species being introduced and pollution/eutrophication occurring as a result of the activity. Signs of abandoned attempts to cultivate oysters and mussels in several other lagoons were found.

Fish and Shellfish aquaculture trend

Despite a general trend in coastal areas for this activity to increase, it would probably not be given planning permission in areas of conservation interest. In addition, while it may be tempting to initiate aquaculture in lagoons they are probably not suitable due to salinity variations and occasional high water temperatures and anoxia.

6.10 Golf courses (601)

Golf courses have become increasingly popular in Ireland recently and the desire for new courses or to extend existing courses in areas of conservation interest has become more contentious. During the reporting period impacts/threats were recorded in 3 lagoons, representing 3.4% of sites, one of which is a large lagoon (L. Gill) and subsequently represents 6.4% of habitat area. An application to build a golf course at Clogheen Marsh was prevented by NPWS following a court case. Two other lagoons bordered by golf courses (Greenore and Raffeen Lake) may receive nutrient runoff from fertilised fairways but appear not to be impacted greatly. At Lough Gill, the desire for improved water quality to support the local trout fishery is likely to make owners of the golf course more aware of any impact the golf course may have on the lagoon.

Golf courses trend

The desire to build more golf courses may increase but any threat/impact on lagoons should be decreased by new water quality and planning regulations and awareness of the value of the habitat.

6.11 Camping and caravans (608)

Camping and caravanning only appears to impact/threaten 2 lagoons in the country. A campsite at Lissagriffin has now been removed. Water runs from a campsite into Kincas Lough and appears to have caused eutrophication of this lagoon, but water may now be treated.

Camping and caravans trend

This activity is likely to increase, but any impacts/threats are likely to be small. The building of permanent housing is probably more of a threat.

6.12 Erosion (900)

Erosion is a natural process affecting 11 mostly small lagoons in the country, representing 12.6% of sites but only 4.5% of habitat area. Most of the impact was at one lagoon (Roonagh) and in some cases it was exacerbated by damage to the barrier (Farranamanagh, Kilmore L.).

Erosion trend

It is not known what effect predicted sea level rise will have on coastal lagoons. In many cases this is a natural process which would be difficult to prevent but could easily be reduced by reworking barrier material. However, lagoons are dynamic landforms and losses due to erosion may be compensated by natural formation of others.

6.13 Invasion by exotic species (954)

Invasive species have been recorded in 4 lagoons in the country and may represent a serious threat especially in small lagoons. Soft hornwort, *Ceratophyllum submersum*, has been recorded in the South Slob and Tacumshin and one or two other brackish ditches in the country and is a potential problem in low salinity lagoons. Pondweed, *Elodea* sp., and *Gunnera tinctoria were* found in Farranamanagh L. close to an ornamental garden. A dead terrapin was found in White's Marsh, presumably released while still alive.

Invasive species trend

It is becoming more common to find plants taken from ornamental ponds dumped illegally in rural areas and with an increasing desire for ornamental gardens this activity is likely to continue. Many of these plants can be carried into lagoons in watercourses from more distant areas. More publicity is now being given to the potential threat/impacts of these species and the Wildlife Act has a provision to control such threats.

6.14 Poaching by cattle (190)

Poaching by cattle was recorded in 28 lagoons, representing 32.2% of the sites but generally only affects a small area of each lagoon. Therefore the total habitat area affected is estimated as only 1.3% and is much more noticeable in the smaller, more remote sites, where perhaps it should be controlled a little better. A certain amount of poaching is probably a good thing, and in many situations, grazing of emergent vegetation is an important part of lagoon management in order to control encroachment of marginal vegetation and loss of open water areas. Complete absence of grazing by livestock is generally regarded as detrimental to the biodiversity of aquatic ecosystem margins.

Poaching by cattle trend

Though the trend in poaching appears to be unchanged during the reporting period it is a minor impact compared with other threats. In some small lagoons it is highly significant though relatively easy to rectify by fencing off parts of the lagoon, allowing access for drinking only in certain areas. Only in some situations where there are obviously too many cattle in a small lagoon is it likely to have a serious impact at the site level.

6.15 Dumping (860)

Dumping was recorded at 9 lagoons, representing 10.3% of sites but only affects a small area of the lagoon, estimated as 0.4% of total habitat area. Mostly this involved small scale "fly-tipping" near cities or in remote areas and is regarded as of low impact. At two small sites it involved deliberate infilling with building rubble (Mweeloon, Blennerville).

Dumping trend

With the volume of waste increasing and the parallel increase in the cost of disposal, the temptation to dump material illegally is likely to increase, but this increase may be offset by increasing awareness, vigilance and increasing fines for an illegal activity.

6.16 Removal of beach material (302)

Deliberate removal of beach material was only recorded at one lagoon (Farranamanagh L.) during the reporting period.

Removal of beach material trend

This was a traditional activity but is now illegal due to the potential damage that it can do to coastal defences. With increasing awareness, vigilance and increasing fines for an illegal activity it is decreasing.

6.17 Circuits, tracks (604)

This threat/impact was only recorded in one lagoon (Tacumshin L.) where attempts to drain the lagoon have been followed by the exercising of race horses and leisure activities such as motor bike and quad bike racing, which can also damage the barrier protecting the lagoon.

Circuits, tracks trend

The pressure for such activities is likely to increase but unlikely to be permitted especially on the barrier. Such uses are "Notifiable Actions" in designated areas, and therefore require permission from the Minister. Such permissions are unlikely to be granted in the future.

6.18 Landfill and land reclamation (800)

Landfill and reclamation was recorded at 5 lagoons in the country, representing 5.7% of sites, and affecting only 0.1% of the habitat. One case (Commoge Marsh) was for an access road to a housing estate which, despite installation of underpass pipes, restricted the flow of water from a freshwater stream into the lagoon and potentially has created a stagnant lifeless pool. All other cases were carried out on a small scale by landowners presumably unaware of the importance of lagoon habitat.

Landfill and land reclamation trend

This activity is likely to decrease with increasing awareness of the value of the habitat and increasing regulation of dumping. In designated sites it is a Notifiable Action and requires permission from the Minister, which is unlikely to be given.

6.19 Boating and leisure activities (621)

Pleasure boating and wind surfing are not really listed in the EU codes for impacts/threats, and are treated in this report as "nautical sports". In general it is not a big problem in lagoons but there may be a disturbance to birds. Large lagoons are more likely to be impacted (Lady's Island L., L. Gill) than small ones.

Boating and leisure activities trend

This activity generally is likely to increase but is a notifiable action in designated sites and therefore can be regulated as necessary

7. Future Prospects

7.1 Negative Future Prospects

In total it is estimated that 3.7% of habitat area has been lost during the reporting period 1996-2006, mostly due to drainage of Tacumshin Lake for agricultural reasons but also to drainage of Shannon airport lagoon for safety reasons and a small percentage (0.4%) due to natural siltation of Corragaun. More losses might be expected in the future due to the natural processes of siltation/drying out and erosion of barriers, especially with the predicted rise in sea level. Over 61% of habitat area is regarded as eutrophic, largely resulting from agricultural activities but also due to domestic and industrial activities impacting lagoons near the major cities. With expected improvement in water quality, this situation should improve, but it is not known how long this improvement will take. The impact of urbanisation and the desire to develop coastal areas for domestic, commercial and industrial, and leisure activities is likely to increase with the predicted increase in human population and increasing wealth. Another major problem facing coastal lagoon habitat is the adoption of inappropriate controls of hydrographic functioning of the lagoon water regimes. With an increasing desire to prevent coastal flooding, it is likely that more emphasis will be placed on the maintenance of non-return valves, and possible reduction in salt-water inflow and the therefore in the salinity of lagoons.

7.2 Positive Future Prospects

Approximately 90% of lagoon habitat is now designated as, or lies within a Special Area of Conservation (SAC) under the Habitats Directive and all designated sites are listed as "transitional waters" and in the Register of Protected Areas under the Water Framework Directive.

Deliberate drainage of lagoons is a Notifiable Action in designated sites and under the Habitats Regulations and the Wildlife Act, and therefore subject to legal controls. Following the loss in habitat over the last 10 years, a water level monitoring project is underway in Tacumshin L. to determine optimal winter and summer water levels which will allow the lagoon to function in a more natural way, yet will protect the surrounding farmland from exceptionally high water levels in winter. Negotiations are also underway to mitigate the loss of Shannon airport lagoon. Natural processes of siltation/drying out and erosion of barriers could be reduced by dredging sediment from lagoons and reworking of barrier material where appropriate, thus reducing future losses. Coastal defence is becoming increasingly expensive, and in some cases less effective, and with the predicted rise in sea level it is possible that some parts of the coastline will be allowed to take a natural course, so that new areas may be flooded and new lagoons created.

Although a high percentage of the habitat has suffered from water pollution, the Water Framework Directive requirement that all water bodies should acquire good status by 2015 should help to improve the quality of water in, and entering, lagoons. Nutrient inputs into Lady's Island Lake are being reduced and the effectiveness of these actions is being closely monitored. Several other lagoons are now being managed as non-statutory nature reserves which should help to maintain their nature conservation value.

Most other past impacts such as aquaculture, leisure fishing, removal of beach materials, golf courses, landfill, poaching by cattle, dumping and camping/caravans appear to be either relatively minor, illegal or easy to control and are not considered to be major threats.

7.3 Overall Future Prospects

Over 90% of lagoon habitat is now designated as, or lies within a Special Area of Conservation (SAC) under the Habitats Directive and all designated sites are listed as "transitional waters" and included in the Register of Protected Areas under the Water Framework Directive.

Attempts are being made to improve the quality of water entering lagoons and to at least partially restore lagoon habitat lost through deliberate drainage. All other impacts are relatively minor or easy to control.

However, despite these conservation measures it is unclear as to how effectively they will be in improving the status of impacted sites within the next reporting period and how rapidly the sites will respond to restoration attempts.

Therefore, although there is considerable cause for optimism, Overall Future Prospects are regarded as Uncertain.

Overall Future Prospects	**Uncertain**

8. Overall Assessment

- There is no evidence of any significant overall loss of coastal lagoon habitat range in the last 100 years and status of habitat range is regarded as Favourable.
- The most damaging impact affecting habitat extent is the drainage of the previously largest lagoon in the country (Tacumshin Lake) for largely agricultural reasons and a smaller lagoon (Shannon airport) for safety reasons. Further loss of habitat has occurred as a result of natural silting-up. In total it is estimated that 3.7% of habitat area has been lost during the reporting period 1996-2006 and Habitat Extent is regarded as Unfavourable-Inadequate (U1).

- The major impact affecting habitat structures and functions is water pollution in the form of excessive nutrient enrichment mostly from agricultural sources, but also due to effluents resulting from domestic and commercial/industrial activities. Over 61% of habitat area is regarded as eutrophic and is particularly bad in three lagoons (Lady's Island, L. Gill, Kilkeran) representing 21.7% of the habitat, although a small percentage (<2%) of this figure is believed to be mostly natural. Deterioration in habitat quality has also been caused by modification of hydrography. All other impacts are relatively minor. In conclusion, as the status of more than 25% of the habitat is regarded as unfavourable, specific structures and functions of coastal lagoons are regarded as Unfavourable-Bad (U2).
- The extent and quality of coastal lagoon habitat in Ireland is impaired and future prospects are uncertain. Therefore the overall assessment of Conservation Status is regarded as Unfavourable-Bad (U2).

Overall assessment of Conservation Status =	**Unfavourable-Bad**

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Appendix I. Number and area (ha) of five morphological lagoon types in Ireland.

Code No.	Lagoon	Size (ha)	Sedimentary	"Rock/peat"	"Karst"	"Saltmarsh"	Artificial
1	Greenore Golf Course	2.5					2.5
2	Broadmeadow	280					280
3	Kilcoole	5					5
4	North Slob channel	50					50
5	South Slob channel	50					50
6	Lady's Island Lake	350	350				
7	Tacumshin	117	117				
8	Ballyteige channels	8					8
9	Rostellan Lake	50					50
10	Ballyvodock lagoon	2					2
11	Cuskinny Lake	4					4
12	Raffeen Lake, Shanbally	4					4
13	Lough Beg. Curraghbinny	2					2
14	Bessborough Pond, Blackrock	1					1
15	Oysterhaven Lake, Clashroe	3					3
16	Commoge Marsh, Kinsale	12					12
17	Clogheen/White's Marsh	3					3
18	Inchydoney	2					2
19	Kilkeran Lake	20	20				
20	Rosscarbery Lake	20					20
21	Toormore lagoon	1.5					1.5
22	Lissagriffin Lake	15					15
23	Farranamanagh Lake	6	6				
24	Reen Point Pools	1	1				
25	Kilmore Lake	6.5	6.5				
26	Reenydonegan Lake	25	25				
27	Lauragh	20				20	
28	Drongawn Lake	20		20			
29	Lough Gill	144	144				
30	Blennerville lakes (2)	3					3
31	Quayfield/Poulaweala	2.5			2.5		
32	Shannon Airport Lagoon	2					2
33	Scattery lagoon	10	10				
34	Clonconeen Pool	7	7				
35	Lough Donnell	25	25				
35	Muckinish Lake	1			1		
37	Lough Murree	13			13		
38	Aughinish	8	8				
39	Rossalia	3					3
40	Loch Mór, Inish Oírr	6			6		
41	Port na Cora, Inis Meain	0.5			0.5		
42	Loch an tSaile, Arainn	0.5			0.5		
43	L. Phort Chorruch, Arainn	4			4		
44	Loch an Chara, Arainn	5			5		
45	Loch Dearg, Arainn	4			4		
46	Rincarna pools	0.5	0.5				

Continued…………..

Appendix I cont.. Number and area (ha) of five morphological lagoon types in Ireland.

Code No.	Lagoon	Size (ha)	Sedimentary	"Rock/peat"	"Karst"	"Saltmarsh"	Artificial
47	Bridge Lough, Knockakilleen	3			3		

48	Doorus Lakes (4)	2			2		
49	Mweeloon pools (2)	1					1
50	Ardfry Oyster pond	1					1
51	Turreen Lough (Rinvile)	3				3	
52	L. Atalia	50					50
53	Lettermullen	1		1			
55	L. an Ghadai	5		5			
56	L. Fhada	8		8			
54	Loch Fhada upper pools	2				2	
57	L. Tanaí	11		11			
58	L. an Aibhnín	55		55			
59	Loch Cara Fionnla	14		14			
60	L. Cara na gCaorach	30		30			
61	L. Doire Bhanbh	1.5				1.5	
62	Loch an tSaile (L. Ahalia)	90		90			
63	L. Conaorcha (Aconeera)	28		28			
64	L. an Mhuilinn (Mill L.)	5		5			
65	L. Ateesky	2				2	
66	L. an Chaorain	1		1			
67	L. Ballyconneely	20	20				
68	L. Athola	11		11			
69	Lough Anillaun	15	15				
70	L. Bofin	12	12				
71	Corragaun Lough	10	10				
72	Roonah Lough	55	55				
73	Furnace Lough	125		125			
74	Claggan lagoon	1					
75	Dooniver Lough, Achill Is.	3	3				
76	Cartoon L., Killala Bay	4					4
77	Portavaud, Ballysadare Bay (2)	6				6	
78	Tanrego	2.5					2.5
79	Durnesh Lake	83	83				
80	Maghery Lough	19		19			
81	Sally's L.	6		6			
82	Kincas L.	6		6			
83	Moorlagh	10		10			
84	L. O Dheas, Tory Is.	3	3				
85	Carrick Beg Lough	2					2
86	Blanket Nook Lough	40					40
87	Inch Lough	160					160
	No. of sites	87	21	18	11	6	30
	%of sites		24.1	20.7	12.6	6.9	34.5
	Total area	2226.5	921	445	41.5	34.5	783.5
	% of habitat		**41.4**	**20.0**	**4.5**	**1.5**	**35.2**

Appendix II. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

Code No.	Site Name	Impacts	Conservation Status
1	Greenore Golf course	Eutrophication in one of the 4 lagoons (5% of area). Other 3 flushed by tides. Golf course.	Unfavourable-Inadequate
2	Broadmeadow	Eutrophication from sewage at upper end. Otherwise flushed by tides. Urbanisation. Industrial/commercial activities. Dumping. Boating/leisure activities.	Unfavourable-Inadequate
3	Kilcoole	Eutrophication from surrounding farmland. Modification of hydrology. Silting up. Poaching by cattle.	Unfavourable-Inadequate
4	North Slob channel	Eutrophication from surrounding farmland. Drainage. Modification of hydrology	Unfavourable-BAD
5	South Slob	Eutrophication from surrounding farmland. Leisure fishing. Invasion by exotics. Accumulation of organic material.	Unfavourable-BAD
6	Lady's Island Lake	Eutrophication from surrounding farmland, farmyards, septic tanks and sewage treatment plant resulting in repeated algal blooms and fishkills. Disturbance from recreational activities. Leisure fishing. Modification of hydrology. Urbanisation. Boating/leisure activities.	Unfavourable-BAD
7	Tacumshin Lake	Severe drainage and major modification of hydrology. Disturbance from recreational activities. Invasion by exotics.	Unfavourable-BAD
8	Ballyteige channels	Moderate eutrophication from surrounding farmland. Poaching by cattle	Unfavourable-Inadequate
9	Rostellan Lake	Eutrophication from surrounding farmland and domestic dwellings but significant tidal flushing.	Unfavourable-Inadequate
10	Ballyvodock	Moderate eutrophication from surrounding farmland but significant tidal flushing. Poaching by cattle. Landfill.	Unfavourable-Inadequate
11	Cuskinny	Moderate eutrophication from surrounding farmland and domestic housing but significant tidal flushing	Unfavourable-Inadequate
12	Raffeen Lake	Minimal eutrophication from surrounding golf course and small tern colony but significant tidal flushing	Favourable.
13	Lough Beg	Mild eutrophication from surrounding farmland. Die-back of *Scirpus* and presence of high-tide roost for waders may increase natural eutrophication moderated by significant tidal flushing. Poaching by cattle. Ind/commercial activities. Modification of hydrology. Silting up. Accumulation of organic material.	Unfavourable-Inadequate

Appendix II cont.. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

Code No.	Site Name	Impacts	Conservation Status
14	Bessborough Pond	Natural accumulation of leaf litter in isolated (stagnant) pool. Accumulation of organic material.	Unfavourable-BAD
15	Oysterhaven Lake	Moderate eutrophication from surrounding farmland but significant tidal flushing. Boating/leisure activities.	Unfavourable-Inadequate
16	Commoge Marsh	Moderate eutrophication from surrounding farmland and sewage from housing estate but significant tidal flushing. Occasional low water levels. Drainage. Urbanisation. Landfill. Modification of hydrology. Dumping. Silting up.	Unfavourable-Inadequate
17	Clogheen/White's Marsh	Moderate eutrophication from surrounding farmland but significant tidal flushing. Drainage. Poaching by cattle. Modification of hydrology. Invasion by exotics.	Unfavourable-Inadequate
18	Inchydoney	Moderate eutrophication from surrounding farmland but significant tidal flushing. Occasional low water levels. Drainage. Landfill. Modification of hydrology.	Unfavourable-Inadequate
19	Kilkeran Lake	Extreme eutrophication at times due to agricultural activities resulting in algal blooms and fishkills. Relieved by almost annual breaching. Modification of hydrology. Leisure fishing, Accumulation of organic material.	Unfavourable-BAD
20	Rosscarbery L.	Moderate eutrophication from surrounding farmland and effluents from town but significant tidal flushing. Urbanisation. Leisure fishing. Boating/leisure activities	Unfavourable-Inadequate
21	Toormore lagoon	Moderate eutrophication in small, shallow lagoon but significant tidal flushing.	Unfavourable-Inadequate
22	Lissagriffin L.	Moderate eutrophication in small, shallow lagoon but significant tidal flushing. Increasingly shallow due to siltation. Poaching by cattle.	Unfavourable-Inadequate
23	Farranamanagh L.	Small natural lagoon. Potential impact from exotic plants. Removal of beach materials. Erosion.	Favourable
24	Reen Point pools	Small natural pools on dynamic gravel spit. Naturally eutrophic. Accumulation of organic material.	Favourable
25	Kilmore L.	Natural eutrophication from decaying seaweed. Weakening of barrier by machinery from oil terminal aggravated by storms. Erosion. Ind/commercial activities. Accumulation of organic material.	Unfavourable-Inadequate

Appendix II cont.. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

Code No.	Site Name	Impacts	Conservation Status
26	Reenydonegan L.	Eutrophication from surrounding farmland. Urbanisation. Accumulation of organic material.	Unfavourable-BAD
27	Lauragh	Natural eutrophication from decaying reeds but significant tidal and freshwater flushing. Accumulation of organic material.	Unfavourable-Inadequate
28	Drongawn	NO IMPACTS	Favourable
29	Lough Gill	Extreme eutrophication at times due to agricultural activities causing algal blooms and fishkills. Relieved by modification of hydrology. Accumulation of organic material. Considerably improved. Poaching by cattle. Leisure fishing. Golf course.	Unfavourable-Inadequate
30	Blennerville Lakes	Eutrophication from town effluents and waterfowl (amenity area). Urbanisation. Ind/commercial activities. Dumping. Landfill.	Unfavourable-BAD
31	Quayfield-Poulaweala	Natural eutrophication in small, shallow lagoons. Poulaweala becoming drier and "choked" by emergents. Silting up.	Unfavourable-Inadequate
32	Shannon Airport lagoon	Eutrophication from airport effluents. Deliberate drainage to discourage waterfowl which pose potential threat to safety of aircraft. Ind/commercial activities. Modification of hydrology.	Unfavourable-BAD
33	Scattery lagoon	Natural damage to cobble barrier may destroy lagoon habitat. Erosion.	Unfavourable-Inadequate
34	Clooncononeen pool.	Natural damage to cobble barrier may destroy lagoon habitat. Erosion.	Unfavourable-Inadequate
35	Lough Donnell	Moderate eutrophication in shallow lagoon but significant tidal flushing. Appears to be becoming increasingly shallow due to siltation. Poaching by cattle.	Unfavourable-Inadequate
36	Muckinish Lake	Naturally subjected to low water levels in dry summers. Accumulation of organic material.	Unfavourable-Inadequate
37	Lough Murree	Accumulation of organic material causing natural eutrophication. Poached by cattle in some areas. Dumping.	Unfavourable-Inadequate
38	Aughinish lagoon	Natural damage to barrier may destroy lagoon. Accumulation of organic material. Naturally eutrophic. Erosion. Silting up.	Unfavourable-Inadequate
39	Rossalia	Moderate eutrophication in shallow lagoon but significant tidal flushing. Poaching by cattle. Silting up.	Unfavourable-Inadequate

Appendix II cont.. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

Code No.	Site Name	Impacts	Conservation Status
40	Loch Mór	Natural deep lagoon. Stratified.	Favourable
41	Port na Cora	Moderate eutrophication in small, shallow lagoon. Erosion. Accumulation of organic material.	Unfavourable-Inadequate
42	Loch an tSaile	Very shallow. Mild eutrophication but significant tidal flushing. Urbanisation. Silting up.	Unfavourable-Inadequate
43	L. Phort Chorruch	Moderate eutrophication in small, shallow lagoon. Poaching by cattle in some areas. Accumulation of organic material.	Unfavourable-Inadequate
44	Loch an Chara	Moderate eutrophication in small, shallow lagoon. Poaching by cattle in some areas. Urbanisation. Silting up.	Unfavourable-Inadequate
45	Loch Dearg	Natural damage to cobble barrier may destroy lagoon habitat. Poaching by cattle in some areas. One pool highly eutrophic. Erosion. Accumulation of organic material.	Unfavourable-Inadequate
46	Rincarna pools	Natural damage to cobble barrier may destroy lagoon habitat. One pool highly eutrophic. Accumulation of organic material. Erosion.	Unfavourable-Inadequate
47	Bridge Lough	Moderate eutrophication in shallow lagoon but significant tidal flushing. Silting up.	Unfavourable-Inadequate
48	Doorus Lakes	Moderate eutrophication in shallow lagoons. Cattle poaching in some areas. Very low water levels in dry summers.	Unfavourable-Inadequate
49	Mweeloon pools	Natural eutrophication. Poached by cattle in some areas. Small area of infilling	Unfavourable-Inadequate
50	Ardfry Oyster pond	Artificial but no major impacts.	Favourable
51	Turreen Lake	Moderate eutrophication in shallow lagoon but significant tidal flushing. Poaching by cattle in some areas. Silting up.	Unfavourable-Inadequate
52	L. Atalia	Eutrophication and pollution from city effluents. Urbanisation. Ind/commercial activities. Dumping. Silting up.	Unfavourable-BAD
53	Lettermullen	No impacts	Favourable
54	L. Fhada upper pools	Moderate eutrophication from decaying algae in small pool, otherwise adequately flushed by tides. Accumulation of organic material. Urbanisation. Dumping. Silting up.	Unfavourable-Inadequate
55	L. an Ghadai	No significant impacts.	Favourable

Appendix II cont.. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

Code No.	Site Name	Impacts	Conservation Status
56	L. Fhada	No significant impacts.	Favourable
57	L. Tanaí	No significant impacts. Dumping in small area near the road.	Favourable
58	L. an Aibhnín	No significant impacts. Natural eutrophication in parts.	Favourable
59	L. Cara Fionnla	No significant impacts.	Favourable
60	L. Cara na gCaorach	No significant impacts.	Favourable
61	L. Doire Bhanbh	Natural eutrophication in small lagoon but significant tidal flushing. Accumulation of organic material.	Favourable
62	Loch an tSaile	Salmonid cages, but significant flushing. Leisure fishing. Cattle poaching in some areas.	Favourable
63	L. Conaorcha (Aconeera)	No major impacts.	Favourable
64	L. an Mhuilinn (Mill L.)	Dumping in small areas.	Favourable
65	L. Ateesky	Mostly very shallow. Natural eutrophication. Temperatures may be high in summer, resulting in death and decay. Silting up.	Unfavourable-Inadequate
66	L. an Chaorain	Poaching by cattle in some areas.	Favourable
67	L. Ballyconneely	Poaching by cattle. Eutrophication from surrounding farmland and dwelling houses in very shallow isolated lagoon. Urbanisation. Silting up.	Unfavourable-Inadequate
68	L. Athola	No major impacts.	Favourable
69	L. Anillaun	Poaching by cattle.	Favourable
70	L. Bofin	Natural eutrophication from decaying algae. Cattle poaching in areas. Urbanisation. Accumulation of organic material.	Unfavourable-Inadequate
71	Corragaun	Natural siltation and eutrophication in lagoon which is rapidly diminishing in size.	Unfavourable-Inadequate
72	Roonah L.	Natural siltation and eutrophication and increasing threat of damage to barrier. Erosion. Siltation. Poaching by cattle.	Unfavourable-Inadequate
73	Furnace Lough	Deep stratified lagoon with natural periodic overturns and anoxia. Salmonid farms but significant flushing. Leisure fishing.	Favourable

Appendix II cont.. Main impacts and conservation status of individual coastal lagoon sites in Ireland. 2007.

74	Claggan lagoon.	Natural eutrophication in very shallow lagoon. Accumulation of organic material.	Unfavourable-Inadequate
75	Dooniver Lough	Moderate eutrophication from surrounding farmland. Poaching by cattle in places. Risk of natural damage to barrier. Erosion. Silting up.	Unfavourable-Inadequate
76	Cartoon L.	Moderate eutrophication from surrounding farmland. Poaching by cattle in places.	Unfavourable-Inadequate
77	Portavaud (E & W)	One pool naturally eutrophic. Accumulation of organic material. Erosion.	Unfavourable-Inadequate
78	Tanrego	Significant eutrophication from surrounding farmland in small lagoon. Accumulation of organic material. Poaching by cattle. Silting up.	Unfavourable-Inadequate
79	Durnesh Lake	Significant eutrophication from surrounding farmland in some areas. Poaching by cattle. Leisure fishing. Silting up.	Unfavourable-Inadequate
80	Maghery L.	At present no major impacts but interest from local anglers in manipulating sluice. Leisure fishing. Modification of hydrology. Urbanisation.	Favourable
81	Sally's L.	Natural eutrophication in small lagoon. Accumulation of organic material.	Unfavourable-Inadequate
82	Kincas L.	Eutrophication in small lagoon both naturally and due to effluents from upstream caravan park. Ind/commercial activities. Caravans.	Unfavourable-Inadequate
83	Moorlagh	"Shock lagoon" but no significant impacts. Leisure fishing.	Favourable
84	L. O'Dheas	Poaching by cattle. Eutrophication from surrounding farmland, roosting waterfowl and dwelling houses in very shallow lagoon. Dumping.	Unfavourable-Inadequate
85	Carrick Beg Lough	Poaching by cattle. Eutrophication from surrounding farmland in small lagoon.	Unfavourable-Inadequate
86	Blanket Nook	Eutrophication from surrounding farmland but significant tidal flushing. Silting up.	Unfavourable-Inadequate
87	Inch Lough	Eutrophication from surrounding farmland but significant tidal flushing.	Unfavourable-Inadequate

Appendix III. Major impacts/threats affecting Irish coastal lagoons, 1996-2006. (* indicates natural impacts)

Code	Lagoon	Size (ha)	Water pollution	Drainage	Poaching by cattle	Aquaculture	Boating/leisure	Leisure fishing	Removal of beach material	Urbanisation	Industrial/commercial activities	Golf course	Circuit, track	Camping, caravans	Landfill, reclamation	Modification of hydrography	Dumping	Erosion	Silting up	Accumulation of organic material	Invasion by exotics
1	Greenore Golf Course	2.5	1									2.5									
2	Broadmeadow	280	280				280			280	280						2				
3	Kilcoole	5	5		5											5			5		
4	North Slob channel	50	50	40												50					
5	South Slob channel	50	50					50												25	50
6	Lady's Island Lake	350	350				350	350								350				175	
7	Tacumshin	257		200			257			450			5			450					25
8	Ballyteige channels	8	8		1																
9	Rostellan Lake	50	50																		
10	Ballyvodock lagoon	2	2		0.5										0.1						
11	Cuskinny Lake	4	4																		
12	Raffeen Lake, Shanbally	4	1									4									
13	Lough Beg. Curraghbinny	2	2		0.5						2					2			2	2	
14	Bessborough Pond, Blackrock	1	1							1	1									1	
15	Oysterhaven Lake, Clashroe	3	3				3													3	
16	Commoge Marsh, Kinsale	12	12	8						12					0.5	12	0.5		12		
17	Clogheen/White's Marsh	3	3	1	0.5											3					3
18	Inchydoney	2	2	1											0.1	2					
19	Kilkeran Lake	20	20					20								20					
20	Rosscarbery Lake	20	20				20	20		20											
21	Toormore lagoon	1.5	1.5																		
22	Lissagriffin Lake	15	15		1														15		
23	Farranamanagh Lake	6							6									6			6
24	Reen Point Pools	1	1*																	1	
25	Kilmore Lake	6.5	6.5*								6.5							6.5		6.5	

Appendix III cont.. Major impacts/threats affecting Irish coastal lagoons, 1996-2006. (* indicates natural impacts)

Code	Lagoon	Size (ha)	Water pollution	Drainage	Poaching by cattle	Aquaculture	Boating/leisure	Leisure fishing	Removal of beach material	Urbanisation	Industrial/commercial activities	Golf course	Circuit, track	Camping, caravans	Landfill, reclamation	Modification of hydrography	Dumping	Erosion	Silting up	Accumulation of organic material	Invasion by exotics
26	Reenydonegan Lake	25	25							25										25	
27	Lauragh	20																		20	
28	Drongawn Lake	20																			
29	Lough Gill	144	144		2		144	144				144		144		144			144	144	
30	Blennerville lakes (2)	3	3							3	3				0.5		0.5				
31	Quayfield/Poulaweala	2.5	2.5*																2.5		
32	Shannon Airport Lagoon	2	2	1							2					2					
33	Scattery lagoon	10																10			
34	Clonconeen Pool	7																7			
35	Lough Donnell	25			1														25		
35	Muckinish Lake	1	1*																		
37	Lough Murree	13	13*		0.5												0.1			13	
38	Aughinish	8																8	8		
39	Rossalia	3	3		0.5														3		
40	Loch Mór, Inish Oírr	6																			
41	Port na Cora, Inis Meain	0.5	O.5															0.5		0.5	
42	Loch an tSaile, Arainn	0.5	0.5							0.5									0.5		
43	L. Phort Chorruch, Arainn	4	4		0.5															1	
44	Loch an Chara, Arainn	5	5		1					5									5		
45	Loch Dearg, Arainn	4	4		0.5													4		4	
46	Rincarna pools	0.5	0.5															0.5		0.5	
47	Bridge Lough, Knockakilleen	3	3																3		
48	Doorus Lakes (4)	2	2*		0.5																
49	Mweeloon pools (2)	1			0.1										0.1						
50	Ardfry Oyster pond	1																			

Appendix III cont.. Major impacts/threats affecting Irish coastal lagoons, 1996-2006. (* indicates natural impacts)

Code	Lagoon	Size (ha)	Water pollution	Drainage	Poaching by cattle	Aquaculture	Boating/leisure	Leisure fishing	Removal of beach material	Urbanisation	Industrial/commercial activities	Golf course	Circuit, track	Camping, caravans	Landfill, reclamation	Modification of hydrography	Dumping	Erosion	Silting up	Accumulation of organic material	Invasion by exotics
51	Turreen Lough (Rinvile)	3	3		0.5														3		
52	L. Atalia	50	50							50	50						5		50		
53	Lettermullen	1																			
54	Loch Fhada upper pools	2	2							2							0.5		2	2	
55	L. an Ghadai	5																			
56	L. Fhada	8																			
57	L. Tanaí	11															0.5				
58	L. an Aibhnín	55																			
59	Loch Cara Fionnla	14																			
60	L. Cara na gCaorach	30																			
61	L. Doire Bhanbh	1.5	1.5*																	1.5	
62	Loch an tSaile (L. Ahalia)	90			1	90		90													
63	L. Conaorcha (Aconeera)	28																			
64	L. an Mhuilinn (Mill L.)	5															0.1				
65	Carna	2																	2		
66	L. an Chaorain	1			0.1															0.1	
67	L. Ballyconneely	20	20		2					20									20		
68	L. Athola	11																			
69	Lough Anillaun	15			1.5																
70	L. Bofin	12	12*		0.5					12										12	
71	Corragaun Lough	10	5																10		
72	Roonah Lough	55			5													55	55		
73	Furnace Lough	125				125	125	125													
74	Claggan lagoon	1	1*																	1	
75	Dooniver Lough, Achill Is.	3	3		1													3	3		

Appendix III cont.. Major impacts/threats affecting Irish coastal lagoons, 1996-2006. (* indicates natural impacts)

Code	Lagoon	Size (ha)	Water pollution	Drainage	Poaching by cattle	Aquaculture	Boating/leisure	Leisure fishing	Removal of beach material	Urbanisation	Industrial/commercial activities	Golf course	Circuit, track	Camping, caravans	Landfill, reclamation	Modification of hydrography	Dumping	Erosion	Silting up	Accumulation of organic material	Invasion by exotics
76	Cartoon L., Killala Bay	4	4		0.5															1	
77	Portavaud, Ballysadare Bay (2)	6	3															6		3	
78	Tanrego	2.5	2.5		0.5														2.5	2.5	
79	Durnesh Lake	83	83		1		83	83											83	10	
80	Maghery Lough	19						19		19						19					
81	Sally's L.	6	6*																	6	
82	Kincas L.	6	6								6			6							
83	Moorlagh	10						10													
84	L. O Dheas, Tory Is.	3	3*		1												0.5				
85	Carrick Beg Lough	2	2		0.5																
86	Blanket Nook Lough	40	40																40		
87	Inch Lough	160	160																		
	No. of sites affected		46	6	28	2	8	10	1	14	8	3	1	2	5	12	9	11	23	25	4
	%of sites under impact		52.9	6.9	32.2	2.3	9.2	11.5	1.1	16.1	9.2	3.4	1.1	2.3	5.7	13.8	10.3	12.6	26.4	28.7	4.6
	Total area	2366.5	1458	251	30.2	215	1262	911	6	899.5	350.5	150.5	5	150	1.3	1059	9.7	106.5	495.5	460.6	84
	% Habitat affected		**61.6**	**10.6**	**1.3**	**9.1**	**53.3**	**38.5**	**0.3**	**38.0**	**14.8**	**6.4**	**0.2**	**6.3**	**0.1**	**44.7**	**0.4**	**4.5**	**20.9**	**19.5**	**3.5**

APPENDIX IV

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

COASTAL LAGOONS - are defined in the Interpretation Manual of the Habitats Directive as: "expanses of shallow coastal salt water, of varying salinity or water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding by the sea in winter or tidal exchange. With or without vegetation from *Ruppietea maritimae, Potametea, Zosteretea* or *Charetea* (CORINE 91:23.21 or 23.22)." See section I for further explanation.

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

DESICCATION - The drying out of organic material by loss of water content due to evaporation.

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.

EUTROPHICATION - The pollution of a water body by sewage or fertilisers. This stimulates excessive growth of algae (see algal bloom); the death and subsequent decomposition of these increases the biological oxygen demand and thus depletes the oxygen content of the water resulting in the death of fish and other animals. N.B. In certain situations a water body may be "naturally eutrophic", but "eutrophication" is regarded as a process caused by human activities.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as favourable when: its natural range and area 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 area 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 range 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 specie's 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 which are important at the European level. 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.

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – The section of the Environment Infrastructure and Services Division, 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 under natural conditions.

NHAs - Natural Heritage Areas. These are areas that are nationally 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, Department of Environment, Heritage and Local Government.

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. Coastal lagoons are the only marine habitat listed in Annex I as a "Priority Habitat".

REGISTER OF PROTECTED AREAS - To meet the requirements of the Water Framework Directive (2000/60/EC) Ireland must establish and maintain a register of protected areas. These are areas requiring special protection under a number of EC directives, either to protect their surface water or groundwater or to conserve habitats and species that directly depend on those waters. The register will help to ensure that water bodies are managed to achieve the protected area objectives in so far as they relate to water. The areas on the Register designated for the protection of habitats or species currently comprise the water dependant parts of Natura 2000 sites designated under the Birds Directive (79/409/EEC) and the Habitats Directive (92/43/EEC) and include lagoons. As the NHA network develops appropriate water dependant sites will be added to the Register.

SACs - Special Areas of Conservation are sites of European importance selected to conserve habitats and species listed in annexes 1 and 2 of the Habitats Directive. 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 migratory and Annex I species of wild birds under the Birds Directive (Council Directive 79/ 409/ 2nd April 1979). The NPW is responsible for ensuring that such areas remain or are restored to favourable conservation status.

TRANSITIONAL WATER BODIES - are defined under the Water Framework Directive as waterbodies, other than groundwater, in the vicinity of river mouths which are partly saline in character due to their proximity to coastal waters but which are substantially influenced by fresh water inflows. They include lagoons and the brackish portions of estuaries.

Appendix V. Notifiable Actions relevant to coastal lagoons

NOTICE OF NOTIFIABLE ACTIONS

HABITAT TYPE 1.5

HABITAT TYPE
BRACKISH LAKES, LAGOONS

Under STATUTORY INSTRUMENT 94 of 1997, made under the EUROPEAN COMMUNITIES ACT 1972 and in accordance with the obligations inherent in the COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 (the Habitats Directive) on the conservation of the natural habitats and species of wild fauna and flora, all persons must obtain the written consent, (in circumstances prescribed at section A and B below) of the Minister for The Environment and Local Government before performing any of the operations on, or affecting, the following habitats where they occur on lands / waters within the candidate Special Area of Conservation.

Please note that where a landowner has a current approved plan under the Rural Environmental Protection Scheme or any scheme which the Minister considers to be equivalent s/he need only notify the Minister of activities not covered in the plan.

SECTION A	**SECTION B**
Please note that the activities listed in *Section A overleaf* are required to be notified to the Minister for The Environment and Local Government (see attached form) and should not be undertaken before consent.	**Please note that the activities listed in *Section B* overleaf may, and in most cases do, require a license or consent from another statutory authority (e.g. the local planning authority, the Minister for the Marine and Natural Resources, or the Minister for Agriculture and Food).** **If so, these notifiable actions do not apply.** **However, if such activities are not regulated by another statutory authority, the said activities are required to be notified to the Minister for The Environment and Local Government (see attached form).**

Appendix V cont.. Notifiable Actions relevant to coastal lagoons.

Section A	Section B
THE MINISTER FOR THE ENVIRONMENT AND LOCAL GOVERNMENT IS REQUIRED TO BE NOTIFIED IN RELATION TO THE FOLLOWING ACTIVITIES AND SUCH ACTIVITIES SHOULD NOT PROCEED WITHOUT PRIOR CONSENT	**(NO REQUIREMENT TO NOTIFY IF ALREADY LICENSED BY ANOTHER MINISTER/BODY)**
undermining or altering the structure of any shingle barrier or other barrier between the lake and the sea	any activity which might pollute the lake
blocking or altering the flow of water into or out of the lake	cutting or harvesting growing algae (seaweeds)
restocking with fish	removal of soil, mud, gravel, sand or minerals
grazing by livestock treated within the previous week with a pesticide which leaves persistent residues in the dung within 50m of the lake	dumping or disposal of wastes
reclamation, infilling, ploughing or land drainage within 50m of the lake	use of anti-fouling paints containing organic tin
application of fertiliser, lime or organic materials within 50m of the lake	operation or extension of aquaculture facilities
reseeding, planting of trees or any other species within 50m of the lake	fishing by any type of nets
operation of commercial recreation facilities (e.g. sailing schools, jet ski hire)	fishing by pots for lobster, crab, whelk, shrimp and other species
introduction (or re-introduction) into the wild of plants or animals of species not currently found in the area	dredging whether for fishing or for other purposes
any other activity of which notice may be given by the Minister from time to time	use of hydraulic or suction systems for removing fish or sediments
	placement of any structures or devices on the soil or bed of the sea seaward of high water mark
	use of the soil or bed of the sea for any activity

Appendix VI. Coastal lagoons in Ireland (RoI) and those designated as, or within Special Areas of Conservation (SACs, in red) as of March 2007.

Code No.	Lagoon	SAC name	SAC code	size(ha)
1	Greenore Golf Course			2.5
2	Broadmeadow	Malahide Estuary	205	280
3	Kilcoole	The Murragh Wetlands	2249	5
4	North Slob channel			50
5	South Slob channel			50
6	Lady's Island Lake	Lady's Island Lake	704	350
7	Tacumshin	Tacumshin Lake	709	257
8	Ballyteige channels	Ballyteige Burrows	696	8
9	Rostellan Lake			50
10	Ballyvodock lagoon	Great Island Channel	1058	2
11	Cuskinny Lake			4
12	Raffeen Lake, Shanbally			4
13	Lough Beg. Curraghbinny			2
14	Bessborough Pond, Blackrock			1
15	Oysterhaven Lake, Clashroe			3
16	Commoge Marsh, Kinsale			12
17	Clogheen/White's Marsh	Clonakilty Bay	91	3
18	Inchydoney	Clonakilty Bay	91	2
19	Kilkeran Lake	Kilkeran Lake and Castlefreke Dunes	1061	20
20	Rosscarbery Lake	Rosscarbery Estuary	1075	20
21	Toormore lagoon			1.5
22	Lissagriffin Lake	Barley Cove to Ballyrissode Pt.	1040	15
23	Farranamanagh Lake	Farranamanagh Lough	2189	6
24	Reen Point Pools	Reen Point Shingle	2281	1
25	Kilmore Lake			6.5
26	Reenydonegan Lake			25
27	Lauragh	Kenmare River	2158	20
28	Drongawn Lake	Drongawn Lough	2187	20
29	Lough Gill	Tralee Bay and Magharies	2070	144
30	Blennerville lakes (2)			3
31	Quayfield/Poulaweala	Lower River Shannon	2165	2.5
32	Shannon Airport Lagoon	Lower River Shannon	2165	2
33	Scattery lagoon	Lower River Shannon	2165	10
34	Cloonconeen Pool	Lower River Shannon	2165	7
35	Lough Donnell	Carrowmore Pt. To Spanish Pt.	1021	25
35	Muckinish Lake	Moneen Mountain	54	1
37	Lough Murree	Galway Bay Complex	268	13
38	Aughinish	Galway Bay Complex	268	8
39	Rossalia	Galway Bay Complex	268	3
40	Loch Mór, Inish Oírr	Inisheer Island	1275	6
41	Port na Cora, Inis Meain	Inishmaan Island	212	0.5
42	Loch an tSaile, Arainn ??	Inishmore Island	213	0.5
43	L. Phort Chorruch, Arainn	Inishmore Island	213	4
44	Loch an Chara, Arainn	Inishmore Island	213	5
45	Loch Dearg, Arainn	Inishmore Island	213	4

Appendix VI.cont.. Coastal lagoons in Ireland (RoI) and those designated as, or within Special Areas of Conservation (SACs, in red) as of March 2007.

Code No.	Lagoon	SAC name	SAC code	size(ha)
46	Rincarna pools	Galway Bay Complex	268	0.5
47	Bridge Lough, Knockakilleen	Galway Bay Complex	268	3
48	Doorus Lakes (4)	Galway Bay Complex	268	2
49	Mweeloon pools (2)	Galway Bay Complex	268	1
50	Ardfry Oyster pond	Galway Bay Complex	268	1
51	Turreen Lough (Rinvile)	Galway Bay Complex	268	3
52	L. Atalia	Galway Bay Complex	268	50
53	Lettermullen	Kilkieran Bay and Islands	2111	1
54	Loch Fhada upper pools	Kilkieran Bay and Islands	2111	2
55	L. an Ghadai	Kilkieran Bay and Islands	2111	5
56	L. Fhada	Kilkieran Bay and Islands	2111	8
57	L. Tanaí	Kilkieran Bay and Islands	2111	11
58	L. an Aibhnín	Kilkieran Bay and Islands	2111	55
59	Loch Cara Fionnla	Kilkieran Bay and Islands	2111	14
60	L. Cara na gCaorach	Kilkieran Bay and Islands	2111	30
61	L. Doire Bhanbh	Connemara Bog Complex	2034	1.5
62	Loch an tSaile (L. Ahalia)	Connemara Bog Complex	2034	90
63	L. Conaorcha (Aconeera)	Connemara Bog Complex	2034	28
64	L. an Mhuilinn (Mill L.)	Kilkieran Bay and Islands	2111	5
65	L. Ateesky	Kilkieran Bay and Islands	2111	2
66	L. an Chaorain			1
67	L. Ballyconneely	Slne Head Peninsula	2074	20
68	L. Athola	Slne Head Peninsula	2074	11
69	Lough Anillaun			15
70	L. Bofin	Inishbofin and Inishark	278	12
71	Corragaun Lough	Mweelrea/Sheefrey/Erriff complex	1932	10
72	Roonah Lough	L. Cahasy, L. Baun and Roonah L.	1529	55
73	Furnace Lough	Clew Bay Complex	1482	125
74	Claggan lagoon	Clew Bay Complex	1482	1
75	Dooniver Lough, Achill Is.			3
76	Cartoon L., Killala Bay			4
77	Portavaud, Ballysadare Bay (2)	Ballysadare Bay	622	6
78	Tanrego	Ballysadare Bay	622	2.5
79	Durnesh Lake	Durnesh L.	138	83
80	Maghery Lough	Termon Strand	1195	19
81	Sally's L.	Rutland Island and Sound	2283	6
82	Kincas L.	Gweedore Bay and Islands	1141	6
83	Moorlagh	Gweedore Bay and Islands	1141	10
84	L. O Dheas, Tory Is.	Tory Island Coast	2259	3
85	Carrick Beg Lough			2
86	Blanket Nook Lough	Lough Swilly	2287	40
87	Inch Lough	Lough Swilly	2287	160
		Total number of lagoon sites within SACs	68	
		Area of habitat within SACs	2130	
		%Total number of lagoon sites within SACs	**78.16%**	
		%Area of lagoon habitat within SACs	**90.01%**	

Appendix VII. Photographs of typical morphological types of lagoon in Ireland

Plate 1. View of L. Athola, North Mannin Bay, County Galway, showing islands of peat and granite outcrops in a typical rock/peat lagoon on the west coast of Ireland.

Plate 2. View of L. an Aibhnín, County Galway. Typical rock/peat lagoon showing tidal inlet and water flowing from lagoon at ebb tide.

Appendix VII continued.
Photographs of typical morphological types of lagoon in Ireland.

Plate 3. Looking along the barrier of L. Phort Chorrúch, Inishmore, Aran Islands. A "karst" lagoon on the west coast with cobble barrier. Lagoon to the left of the photograph, Atlantic Ocean to the right.

Plate 4. Looking along the barrier of L. Bofin, Inish Bofin, Co. Galway. A typical west coast sedimentary lagoon with cobble barrier. Lagoon to the left of the photograph, Atlantic Ocean to the right.

Appendix VII continued.
Photographs of typical morphological types of lagoon in Ireland.

Plate 5. One of Doorus Lakes. A "karst" lagoon with no visible connection to the sea.

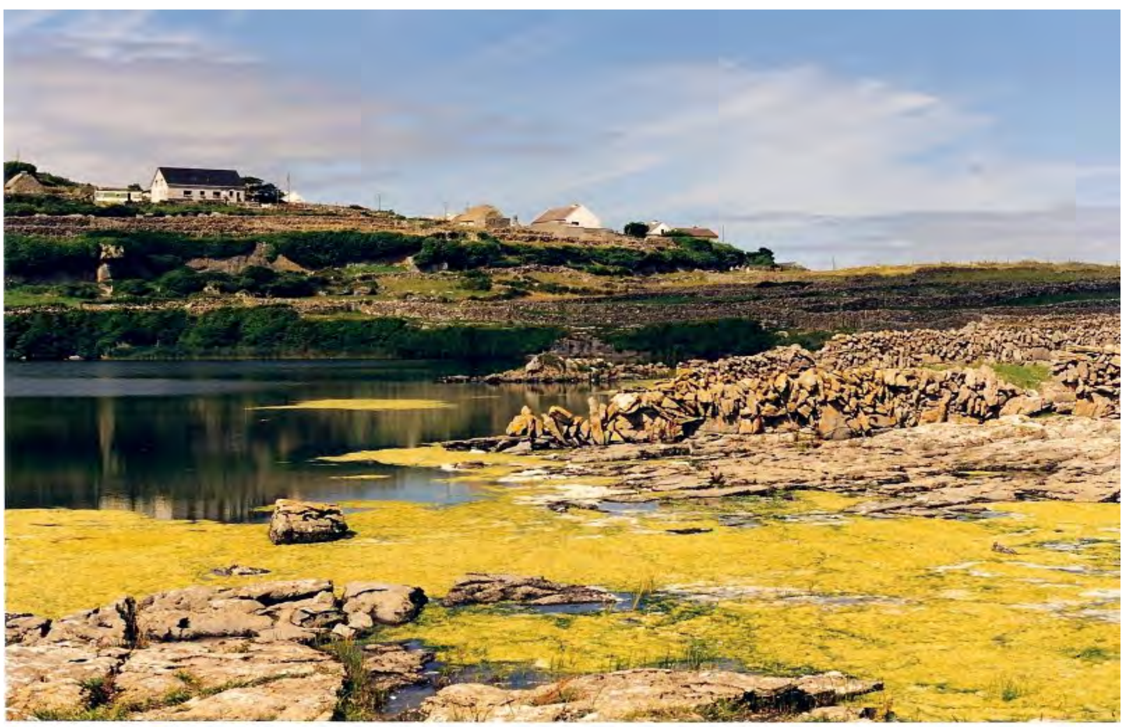


Plate 6. Loch Mór, a "karst" lagoon on Inishmore, Aran Islands.

Appendix VII continued.
Photographs of typical morphological types of lagoon in Ireland.

Plate 7. A "saltmarsh" lagoon at Lauragh, Co. Kerry.

Plate 8. Turreen, a "saltmarsh" lagoon in Co. Galway.

Appendix VII continued.
Photographs of typical morphological types of lagoon in Ireland.

Plate 9. Artificial lagoon at Greenore Golf course, Co. Louth.

Plate 10. Inch Lough, County Donegal, an artificial lagoon. Showing the barrier and non-return valves.

1150 Coastal Lagoons

National Level	
Habitat Code	1150
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	▪ Good, J.A. & Butler, F.T. 1996. A survey of *Irish coastal lagoons. Ecotonal Coleoptera (Staphylinidae and Carabidae)*. Dúchas, Dublin. ▪ Good, J.A. & Butler, F.T. 1998. Coastal lagoon shores as a habitat for Staphylinidae and Carabidae (Coleoptera) in Ireland. *Bulletin of the Irish Biogeographical Society*. **21:** 22-65. ▪ Good, J.A. & Butler, F.T. 1999. A survey of *Irish coastal lagoons. Vol V. Ecotonal Coleoptera (Staphylinidae and Carabidae)*. Dúchas, Dublin. ▪ Good, J.A. & Butler, F.T. 2000. Coastal lagoon and saline lake shores as a habitat for Staphylinidae, Carabidae and Pselaphidae (Coleoptera) in Ireland. Part 2. *Bulletin of the Irish Biogeographical Society*. **24:** 111-41 ▪ Hatch, P. & Healy, B. 1998. Aquatic vegetation of Irish coastal lagoons. *Bulletin of the Irish Biogeographical Society*. **21:** 2-21. ▪ Healy, B. 1994. *Lagoons and other enclosed brackish waters in the Republic of Ireland*. Department of Zoology, UCD, Dublin. 50pp. ▪ Healy, B. 1997. Long-term changes in a brackish lagoon, Lady's Island Lake, south-east Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* **97B:** 33-51. ▪ Healy, B. 1999a. *Survey of Irish coastal lagoons. 1996 and 1998. Vol. 1 Part 1. Background, description and summary of the surveys*. Dúchas, Dublin. ▪ Healy, B. 1999b. *Survey of Irish coastal lagoons. 1996 and 1998. Vol. 1 Part 2. Lagoons surveyed in 1998*. Dúchas, Dublin. ▪ Healy, B. 2003. Coastal Lagoons. In: *Wetlands of Ireland.* R. Otte (ed). Chapter 4. University College Dublin Press. Dublin. 44-78. ▪ Healy, B., Bates, R. & McGrath, D. 1982. Marine Fauna of Co. Wexford - 5. Lady's Island Lake. *Irish Naturalists' Journal 20*: 509-560. ▪ Healy, B. & Oliver, G.A. 1998. Irish coastal lagoons: summary of a survey. *Bulletin of the Irish Biogeographical Society.* **21:** 116-50. ▪ Healy, B., Oliver, G.A., Hatch, P. & Good, J.A. 1997a. *Coastal lagoons in the Republic of Ireland. Vol. 1. Background, outline and summary of the survey.* Report to the National Parks and Wildlife Service, Dublin. ▪ Healy, B., Oliver, G.A., Hatch, P. & Good, J.A. 1997b. *Coastal lagoons in the Republic of Ireland. Vol. 2. Inventory of lagoons and saline lakes.* Report to the National Parks and Wildlife Service, Dublin. ▪ Healy, B., Oliver, G.A., Hatch, P. & Good, J.A. 1997c. *Coastal lagoons in the Republic of Ireland. Vol. 3. Results of site surveys Parts 1-20*. Report to the National Parks and Wildlife Service, Dublin. ▪ Oliver, G.A. 1996. *A survey of Irish coastal lagoons: Aquatic Fauna.* Unpublished report for Dúchas, The Heritage Service. Dublin. ▪ Oliver, G.A. 1999. *A survey of Irish coastal lagoons. Vol. IV: Aquatic Fauna.* ▪ Unpublished report for Dúchas, The Heritage Service. Dublin. ▪ Oliver, G.A. 2005. *Seasonal changes and Biological Classification of Irish* ▪ *Coastal Lagoons.* PhD Thesis. U.C.D., Dublin ▪ **Continued..**

Published sources cont..	▪ Oliver, G.A. (in prep.) *Surveys of Coastal Lagoons in Ireland, 2002-2006.* Report to the National Parks and Wildlife Service, Dublin. ▪ Oliver, G.A. and Healy, B. 1998 Records of aquatic fauna from coastal lagoons in Ireland. *Bulletin of the Irish Biogeographical Society*. **21**: 66-115. ▪ Roden, C. 1999. *Irish coastal lagoon survey, 1998. Vol. III, Flora.* Dúchas, Dublin. ▪ Roden, C. 2004. *Irish coastal lagoon survey, 2003.* Dúchas, Dublin.
Range	Lagoons of different morphological types can be found on all parts the coastline. Much of the eastern and southern coastline was embanked to carry roads and railways and large areas of saltmarsh were reclaimed. These areas may have included small, short-lived lagoons which no longer exist but there is no historical evidence of any large lagoons anywhere in the country that have been completely drained. Classic "sedimentary" lagoons are concentrated in the southeast but not exclusively. "Rock/peat" lagoons and "karst" lagoons are found on the west coasts, especially in Clare and Galway. Artificial lagoons are located on almost any part of the coastline.
Surface Area	8,500km^2 (85 grid cells x 100km^2)
Date	February 2007
Quality of data	3 = good (Based on extensive surveys)
Trend	0 = Stable No evidence of any significant change since 1910 6" O.S. maps.
Trend period	1996 - 2006
Reasons for reported change	No change.

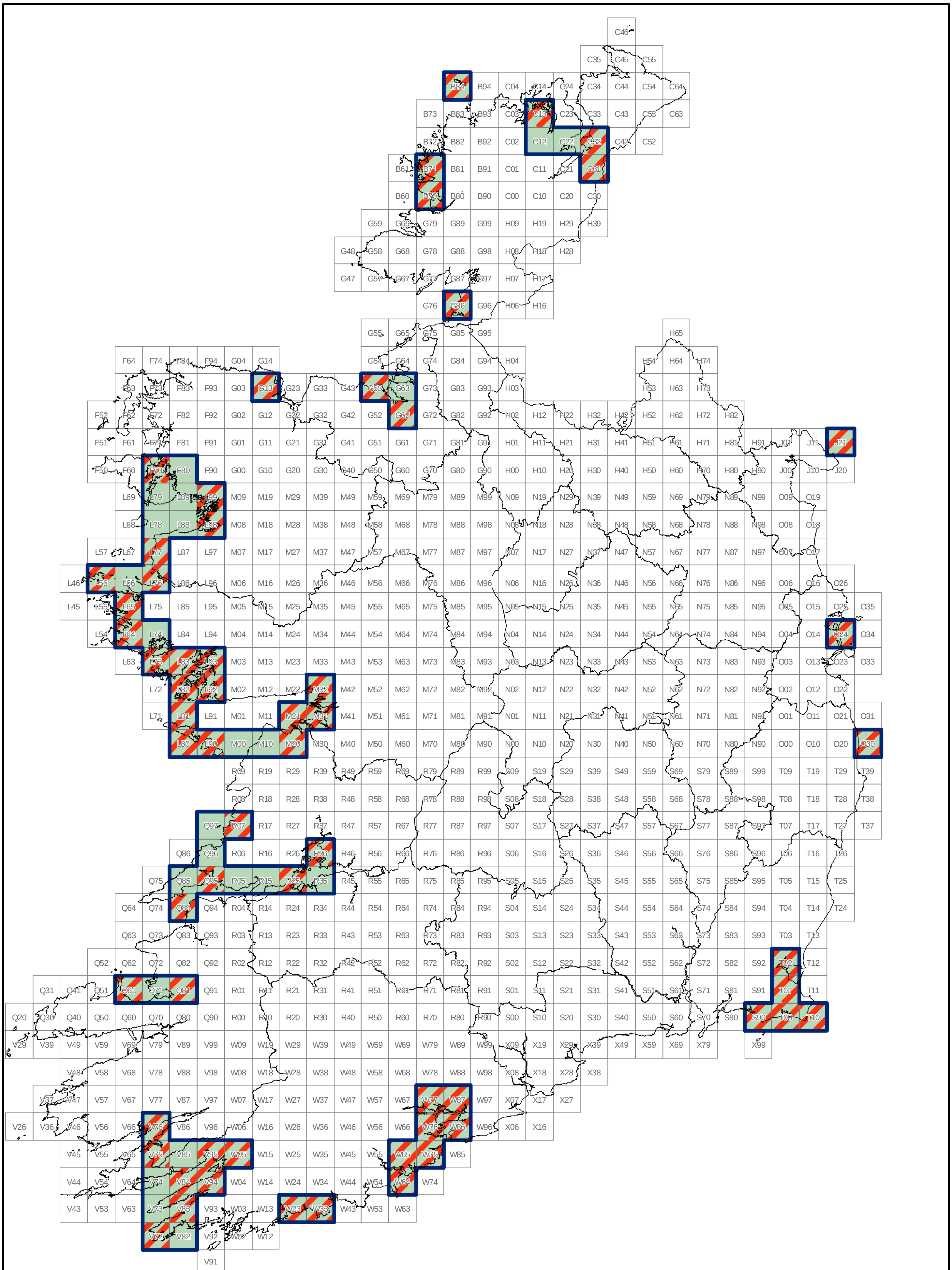
Area covered by habitat	
Distribution map	See attached map
Surface Area	23.7km^2 Area calculated from 1910 6" O.S. survey maps, modified following field ground-truthing surveys.
Date	1996-2006
Method used	3 = ground based surveys
Quality of data	3 = good (based on ground based surveys of all sites, although only on one or a few occasions)
Trend	-0.4% per year loss during reporting period
Trend period	1996-2006
Reasons for reported change	3 = direct human influence (drainage of two sites- Tacumshin 76ha, Shannon 2ha). 4 = natural processes (Corragaun 10ha)
Justification of % thresholds for trends	1% thresholds used
Main pressures	190 Poaching by cattle 200 Fish and Shellfish Aquaculture 220 Leisure fishing 302 Removal of beach materials (damage to barrier) 400 Urbanised areas, human habitation 410 Industrial or commercial areas 601 Golf course 604 Circuits, tracks 608 Camping and caravans 701 Water pollution 800 Landfill, land reclamation and drying out, general 810 Drainage 850 - 853 Modification of hydrographic functioning (sluices, weirs, prevention of saline influence). 860 Dumping, depositing of dredged deposits **Natural processes** 900 Erosion 910 Silting up

	920 Drying out 951 Accumulation of organic material 952 Eutrophication 954 Invasion by exotics
Threats	400 Urbanised areas, human habitation 410 Industrial or commercial areas 701 Water pollution 810 Drainage 850 - 853 Modification of hydrographic functioning (sluices, weirs, prevention of saline influence). 860 Dumping **Natural processes** 900 Erosion 910 Silting up 920 Drying out 951 Accumulation of organic material 952 Eutrophication 954 Invasion by exotics

Complementary information	
Favourable reference range	8,500 km^2 (85 grid cells x 100 km^2)
Favourable reference area	25.6 km^2
Typical species	The following are regarded as "lagoonal specialists" in Ireland: Plants *Chaetomorpha linum, Cladophora battersii, Chara baltica, C. canescens, C. connivens, Lamprothamnion papulosum, Tolypella nidifica, Ruppia* spp. Animals *Cordylophora caspia, Gonothyraea loveni, Idotea chelipes, Lekanesphaera hookeri, Allomelita pellucida, Corophium insidiosum, Gammarus chevreuxi, Leptocheirus pilosus, Palaemonetes varians, Hydrobia ventrosa, Littorina tenebrosa, Onoba aculeus, Rissoa membranacea* var., *Cerastoderma glaucum, Agabus conspersus, Enochrus bicolor, E. halophilus, E. melanocephalus, Ochthebius marinus, O. punctatus, Notonecta viridis, Sigara stagnalis, S. selecta, Glyptotendipes barbipes, Conopeum seurati.* The following species are commonly found in lagoons but are more widespread in other freshwater or marine habitats and not characteristic of lagoons: Plants *Cladophora* spp, *Enteromorpha* spp., *Ulva* spp., *Potamogeton pectinatus, Myriophyllum spicatum, Ranunculus baudotii, Phragmites australis, Bolboschoenus maritimus, Schoenoplectus tabernaemontana, Zostera marina, Fucus ceranoides.* Animals *Neomysis integer, Praunus flexuosus* Gammaridae, *Melita palmata*, *Corophium volutator*, *Carcinus maenas*, *Crangon crangon*, *Palaemon elegans*, *Hydrobia ulvae, Potamopyrgus antipodarum*, Chironomid larvae, *Ischnura elegans*, *Sigara dorsalis*, *Corixa panzeri*, *Enochrus bicolor*, *Anguilla anguilla*, *Gasterosteus aculeatus* *Mugilidae, Pleuronectes flesus, Pomatoschistus microps* Methods: All the above taxa are typical of coastal lagoons, but not all are found in all lagoons. Only the "lagoonal specialists" were used as indicators of habitat quality.
Other relevant information	Wexford County Council is undertaking a programme to reduce nutrient inputs to Lady's Island Lake. NPWS is funding a modelling project, which aims to identify optimal summer and

	winter water levels in Tacumshin. Several lagoons are now managed as non-statutory nature reserves (Commoge Marsh, Clogheen/White's Marsh, Cuskinny, Lough Beg) but this does not give them any legal protection. The species list given in 2.5.3 is a combination of species regarded as lagoonal specialists and species commonly found in lagoons, but these species are also widespread in other freshwater and marine habitats, and not characteristic of lagoons. 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.

Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV). No evidence of significant change in last 100 years. It is not known what effect projected sea-level rises are likely to have on range of coastal lagoon habitat.
Area	Unfavourable-Inadequate (U1). -3.7% loss over 10 year reporting period 1996-2006 (0.4%/year)
Specific structures and functions (incl. Typical species)	Unfavourable-Bad (U2). Water pollution in the form of excessive nutrient enrichment affecting more than 61% of habitat, and is particularly bad in three lagoons (Lady's Island, L. Gill, Kilkeran) representing 21.7% of the current habitat. Deterioration in habitat quality also caused by drainage, urbanisation, industrial/commercial activities and modification of hydrography. Only 23 lagoons covering less than 20% of habitat area is considered as Favourable. As 80% (more than 25%) of habitat is assessed as unfavourable, then Habitat Structures and Functions is assessed as Unfavourable-Bad.
Future prospects	Unfavourable-Inadequate (U1). Approximately 90% of habitat is designated as, or lies within a Special Area of Conservation (SAC) under the Habitats Directive and all designated sites are listed as "transitional water bodies" and in the Register of Protected Areas under the Water Framework Directive. Under these Directives it is a requirement to maintain the brackish nature of coastal lagoon habitat and protect it from drainage and pollution. All other threats appear to be minimal now that lagoon sites are listed and their priority status better understood. However, it is unclear as to how effectively these designations will be in improving the status of impacted sites within the next reporting period and how rapidly the sites will respond to restoration attempts.
Overall assessment of CS	Unfavourable-Bad (U2). Extent and quality of habitat impaired and future prospects uncertain.



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

Coastal lagoons

1150

- Current Distribution (62 cells)
- Current Range (85 cells)
- Favourable Reference Range (85 cells)
- W48 10km grid cells

Date: October 2007

Conservation Assessment of Large Shallow Inlets & Bays (Code 1160)

EU Definition

The EU interpretation manual describes large shallow inlets and bays as large indentations of the coast where, in contrast to estuaries, the influence of freshwater is generally limited. These shallow indentations are generally sheltered from wave action and contain a great diversity of sediments and substrates with a well-developed zonation of benthic communities. These communities have generally a high biodiversity. The limit of shallow water is sometimes defined by the distribution of the Zosteretea associations. Several physiographic types may be included under this category providing the water is shallow over a major part of the area: embayments, fjards, rias and voes.

Habitat characteristics in Ireland

Shallow bays and inlets are indentations of the coastline that have no freshwater input or only a low level, i.e. small streams and/or local rainfall runoff. They experience coastal salinities (+30S) continuously. Average water depth is *c*. 30 metres with at least half of the inlet/bay shallower than 30 metres. Their linear lengths exceed 2km and the length to width ratio is generally greater than 2:1. The levels of exposure to wave action vary from sheltered through semi-exposed to exposed. This is reflected in the sediment type with mud or sandy mud occurring in the sheltered sites to mixed sediments on semi-exposed sites to coarser sediments in exposed sites. The inner parts of some large inlets may be estuarine where the innermost area is strongly influenced by freshwater and are considered as the Annex I habitat Estuary, but the rest of the area is not. The variation in sediment types is reflected in the organic carbon content and numbers of species with maximum biological diversity in softer sediments and lowest diversity occurring in coarse material.

Large shallow inlets and bays are a physiographic unit that host a great variety of habitats including, the Annex I habitats of the Directive, reefs, mudflats and sandflats not covered by seawater al all times. The sediment habitats and their communities within large shallow inlets are very varied reflecting the broad sediment types.

Habitat mapping

Large shallow inlets and bays were mapped using the Ordnance Survey of Ireland 1:50,000 Discovery Series maps. Only bays whose linear lengths exceed 2km and the length to width ratio is generally greater than 2:1 were mapped.

Habitat Range

Large shallow Inlets and Bays are located on all parts of the coastline. The two largest sites are located in the mid-west (Shannon Estuary) and south-west (Dingle Bay). From an analysis of Admiralty Charts and Ordnance Survey maps, the range has been calculated to encompass 80 sites within a range of 22,800 km^2 (i.e. falling within 228 X 100 km^2 squares).

Conservation status of habitat range
Conservation status of habitat range is considered to be stable as there is no evidence of any significant overall habitat loss in the past. The current range is considered to be equal to the total historical habitat range and is therefore also regarded as the Favourable Reference Range.

Habitat Area
The current list of 80 inlets and bays encompasses 4,929 km2. In the absence of any significant habitat reduction events (infilling, reclamation, etc), and acknowledging the oceanographic, geological and physical constraints to increasing the habitat area, the current habitat area is considered to be equal to the potential area within the range.

Conservation status of habitat area
There is no evidence of significant decline in habitat area since the Directive came into force the current area is considered Favourable. The current area of the habitat and is considered to be the Favourable Reference Area.

Structures and Function
There is little current information on the structure and function of benthic habitats in Large Inlets and Bays. Prior to the designation of SACs, point source information was collected by the BioMar project from 1993 to 1996 for many shallow inlets and bays. Since then subtidal broadscale habitat mapping has occurred in 5 SACs: Kilkieran Bay & Islands and Valentia Island/Portmagee Channel in 2001; Clew Bay Complex, Kenmare River and Roaringwater Bay in 2002. Benthic communities were identified using interpretation of single beam Acoustic Beam Discrimination System, which was further ground-truthed using grab sampling, drop-down video and diving. The latter concentrated on reefs and generated detailed habitat descriptions and species lists for a number of communities in each SAC.

In 2005, NPWS commenced a national programme to survey benthic habitats in Large Shallow inlets & Bays in Ireland. Phase I of this programme involves mapping (using a team of divers) the distribution, extent and condition of a range of biologically diverse and environmentally sensitive communities that occur in many Irish inlets and bays including

- *Zostera* communities
- Maërl communities
- Sea pen communities
- *Nephrops*
- Burrowing brittle star beds
- *Lanice conchilega* communities

And the less frequent to very rare communities

- *Sabella pavonina* communities,
- Ostrea edulis reefs,
- Sea cucumber beds

The mapping of the distribution of the following rare species is also part of the programme

- *Edwardsia delapiae*
- *Limaria hians* reefs
- *Pachycerianthus*

Kilkieran Bay & Islands cSAC and Kingstown bay cSAC were mapped in 2005 and Galway Bay Complex cSAC, Clew Bay Complex cSAC and Slyne Head Peninsula cSAC were mapped in 2006. Phase I of the survey is scheduled for completion in 2010. Phase II commenced in 2007 in Galway Bay Complex cSAC and involves traditional benthic baseline survey of areas not mapped by Phase I.

In 2006, the Irish National Seabed Survey also commenced a programme including detailed bathymetric mapping which will survey 26 inlets and bays in the Irish inshore sector (the INFORMAR Project).

As the NPWS programme to baseline map Large Shallow Inlets & Bays in Ireland only commenced in 2005, it is considered that it is too early to provide an overview of structure and function for this habitat.

Typical species, will vary depending on the depth, substrate and degree of exposure to wave action but in general will include the following:
Coelenterates: *Virgularia mirabilis, Cerianthus llodyii, Sargartiogeton* spp., Polycheates: *Arenicola spp., Nephtys hombergii, Hediste diversicolor, Magelona mirabilis, Spio spp., Scoloplos armiger, Lanice conchilega*. Crustacea: *Pagurus bernhardus*, *Liocarcinus depurator, Cancer pagurus, Nephrops norvegicus*. Bivalves *Clausinella fasciata, Pecten maximus, Dosinia exoleta, Lutraria lutraria.* Echinoderms: *Echinocardium cordatum. Asterias rubens, Astropecten irregularis, Amphiura filliformis, Amphiura brachiata Ampyiura chiajei, Ophiura albida.* Fish: *Callionymus lyra, Pomatoschistus minutus*. Algae: *Phymatolithon calcareum, Lithothamnion corallioides*. Angiosperms: *Zostera* spp.

Conservation Status of structure and function
Given known impacts below, but in the absence of recent data, the structure at all sites is categorised Unknown.

Impacts and Threats
The following activities cause an impact on inlets and bays:
200 Aquaculture; 210 Professional Fishing; 220 Recreational fishing; 244 Removal of fauna; 400 Housing development; 420 Discharges; 502 Autoroutes; 504 Port/Marina; 701 Water Pollution; 802 Reclamation of land,; 820 Dredging; 860 Dumping of dredged material; 954. Invasion of species.

Of these, impacts arising from aquaculture, fishing, dumping of wastes and water pollution are considered the principal threats.

Future Prospects
Some 50 of the 80 inlets and bays were regarded as having favourable future prospects based on expert knowledge and limited information on water quality aquaculture activities, professional fishing and coastal developments. The future prospects of some 25 other sites could not be established at this time as the significance of existing site usage (fisheries, aquaculture, coastal development) has not been determined. Five sites (Dundalk Bay, Lough Swilly, Carlingford Lough, Crookhaven and Wexford Harbour) are regarded as having negative future prospects on the basis of existing aquaculture and/or fishing activities.

Conservation status of future prospects
Based on expert judgement the status of future prospects is considered Unfavourable - Inadequate

Overall Assessment

- There is no evidence of any significant overall loss of the Large Shallow Inlet and Bay habitat **range** or **area** since the Directive came into force and both are assessed as **Favourable.**

- As the national programme to baseline map Large Shallow Inlets & Bays in Ireland only commenced in 2005, the structure at all sites is categorised as **unknown** at present.

- The future prospects of the habitat is considered **Unfavourable – Inadequate** as the structure and function of 25 sites could not be established and four sites (Dundalk Bay, Lough Swilly, Carlingford Lough, Wexford Harbour and Crookhaven) are considered as unfavourable due to the level of aquaculture and fisheries activities.

- Nationally, the overall conservation status of the habitat Large Shallow Inlets and Bays is **Unfavourable – Inadequate**.

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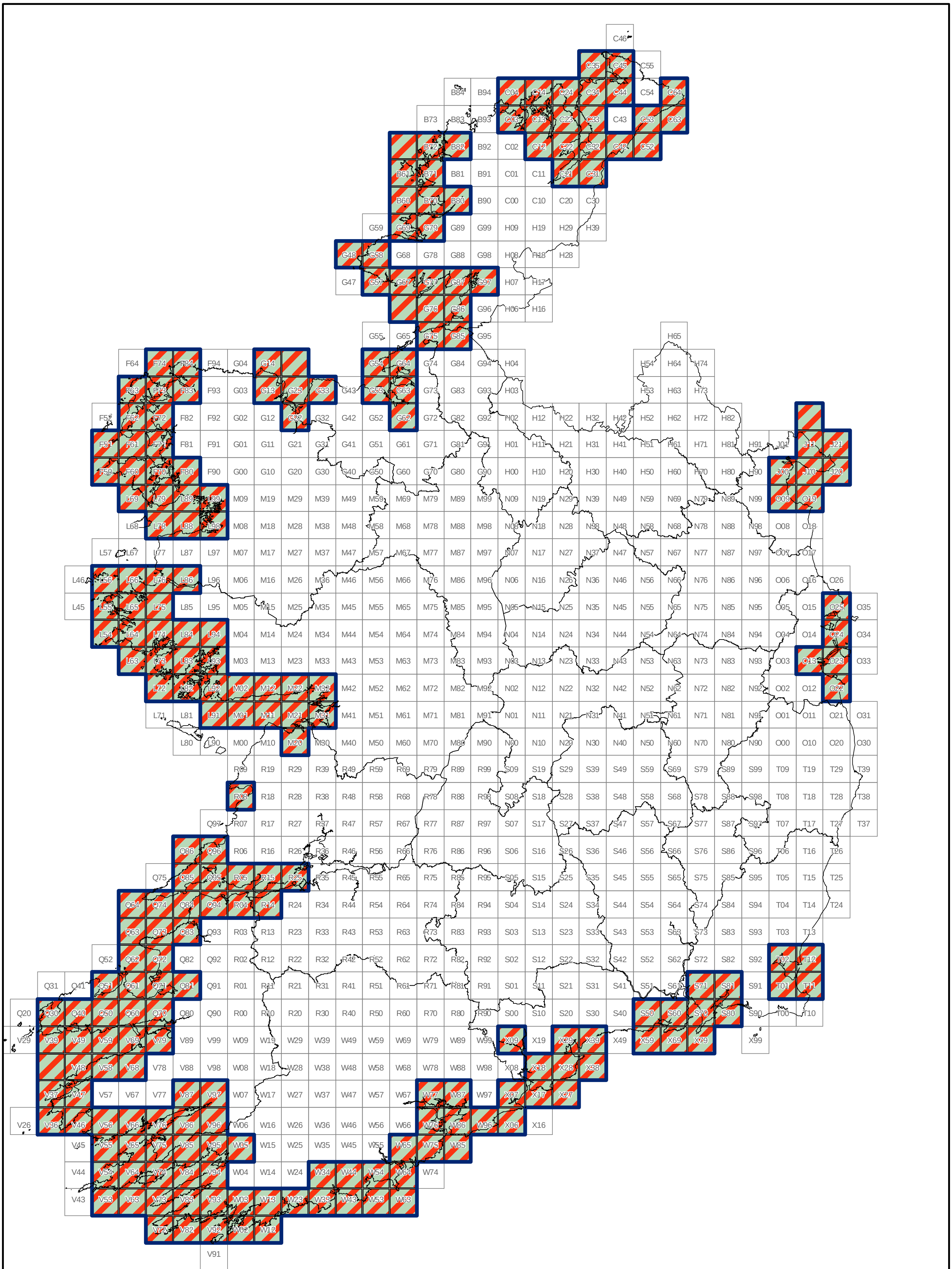
1160 Large shallow inlets and bays

National Level	
Habitat Code	1160
Member State	Ireland, IE
Biogeographic region concerned within the MS	Marine Atlantic (MATL)
Range	Marine Atlantic (MATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Marine Atlantic (MATL)
Published sources	▪ Bailey, M. & J. Rochford. 2006. Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & C. O' Keeffe. 2004. Harbour seal population assessment in the Republic of Ireland: August 2003. Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Crowe, O. 2005. Ireland's wetlands and their waterbirds: status and distribution. Birdwatch Ireland, Newcastle, Co. Wicklow. ▪ Duchas. 1999. A survey of selected littoral and sublittoral sites in Clew Bay, Co.Mayo. A report prepared by Aqua-Fact International Ltd for Dúchas, Department of Arts Heritage and the Gaeltacht, Ireland, pp33. ▪ EPA. 2C07. Bathing waters 2006. An EPA publication Falvey, J.P., Costello, M.J. & S. Dempsey. 1997. A survey of intertidal sediment biotopes in estuaries in Ireland. Unpublished report to the National Parks & Wildlife Service, Dublin. 258 pp. ▪ Lyons D. O. 2004. Summary of National Parks & Wildlife Service surveys for common (harbour) seals (Phoca vitulina) and grey seals (Halichoerus grypus), 1978 to 2003. Irish Wildlife Manuals, No. 13. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government. Dublin, Ireland ▪ NPWS. (2002). Broadscale mapping of Valentia Harbour and Portmagee Channel cSAC (Site code 2262) Final Report. ▪ NPWS. 2003 Broadscale mapping of Kilkieran Bay cSAC (Site code 2111) Final Report. ▪ NPWS (2003) Broadscale mapping of Kenmare River cSAC (Site code 2185) Final Report. ▪ NPWS (2003) Broadscale mapping of Roaringwater Bay and Islands cSAC (Site code 101) Final Report. ▪ NPWS (2003) Broadscale mapping of Clew Bay Complex cSAC (Site code 1482) Final Report ▪ O'Connor, B., McGrath, D. Keegan, B.F. & G. Konnecker. 1993. Macrobenthic assemblages in Galway Bay. Proceedings of the Royal Irish Academy 93B: 127-136. Ordnance Survey of Ireland 1:50,000 Discovery Series maps. ▪ Picton, B.E. & Costello M. J. (1997) The BioMar biotope viewer: a guide to marine habitats, fauna and flora in Britain and Ireland, Environmental Sciences Unit, Trinity College, Dublin.
Range	
Surface area	22,800km^2 (228 x 100 km^2)

Date	08/2007
Quality of data	2= moderate
Trend	stable
Trend-Period	08/2007 : 1990 - 2007
Reasons for reported trend	N/A
Area covered by habitat	
Distribution map	See attached map
Surface area	4929 km^2
Date	08/2007 : 1990 - 2007
Method used	1 = expert opinion & 3 = ground based surveys
Quality of data	2= moderate
Trend	Stable
Trend-Period	N/A
Reasons for reported trend	N/A
Justification of % thresholds for trends	N/A
Main pressures	200 Aquaculture 210 Professional Fishing 220 Recreational fishing 244 Removal of fauna 400 Housing development 420 Discharges 502 Autoroutes 504 Port/Marina 701 Water Pollution 802 Reclamation of land 820 Dredging 860 Dumping of dredged material 954 Invasion of species.
Threats	200 Aquaculture 210 Professional Fishing 220 Recreational fishing 244 Removal of fauna 400 Housing development 420, Discharges 502 Autoroutes 504 Port/Marina 701 Water Pollution 802 Reclamation of land 820 Dredging 860 Dumping of dredged material 954 Invasion of species.
Complementary information	
Favourable reference range	22,800km^2 (228 x 100 km^2)
Favourable reference area	4929 km^2

Typical species	Colentrates: *Virgularia mirabilis, Cerianthus llodyii, Sargartiogeton* spp. Polycheates: *Arenicola spp., Nephtys hombergii, Hediste diversicolor, Magelona mirabilis, Spio spp., Scoloplos armiger, Lanice conchilega*. Crustacea: *Pagurus bernhardus, Liocarcinus depurator , Cancer pagurus, Nephrops norvegicus.* Bivalves: *Clausinella fasciata, Pecten maximus, Dosinia exoleta, Lutraria lutraria*. Echinoderms: *Echinocardium cordatum. Asterias rubens, Astropecten irregularis, Amphiura filliformis, Amphiura brachiata, Amphiura chiajei, Ophiura albida*. Fish: *Callionymus lyra Pomatoschistus minutus*. Algae: *Phymatolithon calcareum ,Lithothamnion corallioides*. Angiosperms: *Zostera* spp.
Other relevant information	Shallow inlets and Bays are pysiographic units that comprise a very wide range of both sedimentary habitats and rocky habitats. A wide variety of biological communities are associated with the different substrata. Impacts arising from aquaculture, fishing, dumping of wastes and water pollution are considered the principal threats. 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 conservation status: Unknown
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Area	Favourable (FV)
Specific structures and functions (incl. typical species)	Unknown
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

Large shallow inlets and bays

1160

- Current Distribution (228 cells)
- Current Range (228 cells)
- Favourable Reference Range (228 cells)
- W48 10km grid cells

Date: August 2007

Conservation Assessment of Reefs (Code 1170)

Habitat characteristics in Ireland

Reefs may have a rocky substrate (non-biogenic reefs) or be constructed by animals (biogenic reefs).

Non-biogenic reefs

In Ireland non-biogenic reefs are found both intertidally and subtidally, from sheltered waters through areas moderately exposed to swell and wave action, to waters exposed to the full forces of Atlantic waves. Across this range reefs may be subjected to strong tidal currents. The structure of reefs varies from bedrock to boulders or cobbles. Topography ranges from horizontal to vertical and the reefs may have numerous ledges and crevices. The geology includes limestone, shale, granite, schists and gneiss.

All of these factors affect both the species present and their abundance.

The depth range for reefs is unknown but is likely to extend below 1200m. Typical species change with increasing depth. Brown fucoid algae generally dominate the intertidal down to shallow subtidal areas. The latter are characterised by kelp species, frequently with an understory of red foliose algae. Below the kelp and down to about 30 m, red algae characterise the substratum with very few brown algae. Below this, the habitat is characterised by faunal species and is known as the circalittoral. Very few foliose or filamentous red algae occur, though encrusting red algae may be common.

Biogenic reefs

The shallowest reefs are intertidal, including honeycomb reefs made by the polychaete worm *Sabellaria alveolata* and reefs made by mussel *Mytilus edulis*.

Sublittoral biogenic reefs in Ireland include

1) Serpula Reefs
The polychaete worm *Serpula vermicularis* secretes a calcareous tube and is common as a solitary worm. However under sheltered conditions with a very gentle tidal stream the worms aggregate and form structures which may be up to 1m in height and about 2 m in diameter. The spaces between the worm tubes are inhabited by a wide variety of species such as brittlestars and crabs but will vary from place to place. In Ireland such reefs have a very limited distribution and are only know from three localities and occur from depths of 2 – 19 m,

2) Sabellaria reefs. These are constructed by the polychaete worm *Sabellaria spinulosa*, except at Wicklow Head where the subtidal reef is recorded as

being constructed by *S. alveolata.* The reefs are constructed of sand grains by the worm and form a substrate for many other species that would not normally be present in the area in the absence of the reefs. The reefs can be up to a meter in thickness.

3) Mussels occur intertidally on rocky shores, particularly on exposed coastlines where they occur in large patches and can be a characterising species but generally remain small. Mussels also form reefs on sediment where there is some hard substratum for them to attach to, They may also occur in sheltered, tideswept areas where they reach a much larger size. Oyster *Ostrea edulis* beds, when undisturbed, form reef-like structures.

4) Cold water coral reefs
Coldwater coral reefs are from 200 – 1600 m, where the water temperature is 4 – 8 ºC and the salinity is 32 – 36 %. Coral reefs found to date are generally associated with carbonate mounds, features that rise up to 300-500 m above the sea floor. These are found close to the continental shelf slope and on the Rockall Bank. Corals are also recorded on the Hatton Bank.
The typical reef forming species are *Lophelia pertusa and Madrepora oculata*. They create a complex 3-dimensional structure and provide a habitat for many other species which live both on live and dead coral or in the spaces between the coral branches.

Habitat mapping
Reefs have not been systematically mapped in Ireland and the information available from the Admiralty Charts is not sufficient to map the habitat.

Subtidal habitat mapping has been carried out in 5 SACs: In Kilkieran Bay and Valentia Harobur/ Portmagee Channel in 2001, and Clew Bay, Kenmare River and Roaringwater Bay in 2002. Reefs were identified using single beam Acoustic Beam Discrimination System, and ground truthing was carried out using video and a dive survey.

The Irish National Seabed Survey carried out an extensive multi-beam survey of Irish waters to the 100m contour and identified a number of areas of high relief where the carbonate mounds are concentrated. However because of the limited biological ground truthing analysis of the multibeam backscatter it is not possible to determine the distribution of reef communities versus sedimentary communities.

Cold water corals
The requirements for cold water corals are still poorly understood and the potential range cannot be estimated. Records from the mid 1970s suggest that *Lophelia* was largely confined for the areas towards the continental shelf slope. The shallow Continental shelf area has been intensively fished since then and so the potential range for *Lophelia* should be taken as the area between the 500 – 1200m contours but this can only be substantiated with a considerable amount of further research.

Our knowledge of the distribution of the coldwater coral *Lophelia pertusa* is constantly being improved. While this shows the distribution of *Lophelia*, it does not necessarily show the distribution of reefs, as corals may occur as discrete colonies and not in densities that are considered to be reefs.

Other biogenic reefs
The distribution is currently incompletely known.
To date, only three locations for *Serpula* reefs are known.
Intertidal *Sabellaria alveolata* reefs are recorded from a number of localities around the coast and are dependant on the presence of sand. To date they have been recorded from the South coast to Lough Swilly in Donegal. It is highly likely that they are also present on the East coast.

Subtidal *Sabellaria.* The reef structures found in Wicklow Reef SAC are recorded as *S. alveolata* but this has not been confirmed. Subtidal reefs are usually formed *by S. spinulosa* which has been recorded at 6 sites around Ireland. It is likely that *Sabellaria* reefs are more widespread than currently known.

Mussel reefs
The distribution of mussel reefs has not been documented.

Native Oyster reef
Many oyster beds were fished out in the late 1800s and early 1900s. The remaining beds are confined to the SW and W coasts.

Habitat Range
Non biogenic Reefs: Admiralty charts show that non biogenic reefs are present throughout the Irish near-shore coast with only one county (Kilkenny) not having any rock. Neilson and Costello (1999) estimated that 42% of the coastline (including islands) and 90% of cliffs were also rock, giving a total length of 3,172.4km that could be considered as reef or 46% of the coastline.

The distribution of non-biogenic reefs beyond the coast is unknown but are they are likely to occur throughout much of the EEZ.

Biogenic reefs: Although the range of biogenic reefs is poorly known, they occur around much of the Irish coast and may be widespread throughout the EEZ.

Conservation status of habitat range
Using the data available and expert judgement, reefs are estimated to have a range of 620 x 100 km^2.
This should also be considered the Favourable Reference Range as there is no current evidence of a decline in the range.

It should be noted that with improved information on the distribution of reefs the range of the habitat reefs is likely to change.

Habitat Area
There is insufficient data to assess the area of reefs as they have not been mapped and it will be a long time before the full area covered by reefs is determined.

Conservation Status of Habitat Area
Non biogenic reef : The habitat area for non biogenic reefs habitat is considered to be stable as there are no known human impacts that are likely to significantly reduce the habitat extent.

Biogenic reefs: The area of biogenic reefs has to be considered as unknown although it is likely that the area of habitat has decreased as reefs may have suffered considerable damage from fishing since the Directive came into force.

The overall conservation assessment for reef habitat is “Unknown” due to the lack of data.

Habitat Structure and Function of Reefs
The biological communities of reefs were surveyed by the BioMar project from 1993 to 1996 generating point source data for 532 reef locations around the coast of Ireland. Additional data were collected for 5 SACs during the NPWS broadscale mapping project from 2001-2002.

Non biogenic reefs
The greatest threats to the habitat structure and functions of non biogenic reefs in the near shore coastal areas include water quality, fishing and harvesting of flora and fauna.

Biogenic reefs

One of the *Serpula* reefs suffers from occasional die back due to oxygen depletion in the summer, a naturally occurring phenomenon at the site (Salt Lake). The population at Killary may also have suffered from a widespread toxic algal bloom in 2005.

The greatest threat to biogenic reefs is fishing (i.e. bottom trawling/dredging and bottom set gillnets) which can break and crush the biogenic reefs and remove fauna. In particular, coldwater coral reefs will take a very long time to recover but the length of time is unknown. Some reefs have been dated as being at least 4,000 years old. The other forms of reef are likely to recover in the short to medium term, as long as there are sufficiently large populations of reef-building organisms available to re-locally populate the area.

Conservation Status of Habitat Structures and Function
Non-biogenic reefs: The conservation status of non-biogenic reefs is considered to be favourable over all as the human activities are unlikely to

have increased since the time of designation and some activities are managed on a sustainable basis.
Biogenic reefs :The conservation status of biogenic reefs is considered to be unfavourable due to the destructive nature and intensity of pressure fishing pressure.

The conservation status of reef structure and function s is considered Unfavourable – inadequate.

Typical species
Porifera: *Scypha ciliata, Grantia compressa, Halichondria panicea, Hymeniacidon perleve, Cliona stellata, Pachymatisma johnstonia,Dysidea fragilis*.
Cnidaria: *Nemertesia antennina, Haliceum halecinum, Anemonia viridis, Actinia equina*
, Sagartia elegans, Actinothoe sphyrodeta, Corynactis viridis, Alcyonium digitatum, Caryophyllia smithii.
Polychaeta: *Spirobis spp. Pomatoceros triqueter*
Crustacea: *Balanus spp., Semibalanus balanoides; Carcinus maenas, Cancer pagurus, Necora puber*
Mollusca: *Gibbula spp, Littorina spp., Nucella lapillus, Patella spp., Calliostoma zizyphinum, Aplysia punctata, Mytilus edulis*
Bryozoa; *Parasmitina spp., Alcyonidium diaphanum*
Echinodermata: *Antedon bifida, Echinus esculentus, Marthasterias glacialis, Holothuria forskali, Aslia lefevrei, Pawsonia saxicola*
Tunicata: *Botryllus schlosseri, Ascidia mentula, Dendrodoa grossularia*

Green algae: *Ulva spp, Chaetomorpha spp*.
Brown algae: *Fucus spp., Laminaria spp., Dictyota dichotoma.*
Red algae: *Coralline crusts, Corallina officinalis, Porphyra spp. Chondrus crispus, Mastocarpus stellatus, Delesseria sanguinea, Cryptopleura ramosa, Lomentaria articulata, Polysiphonia spp., Ceramiun spp.*

Conservation status of Habitat of Typical Species
The conservation status of the typical species of all reefs is considered to be favourable. All species are widespread, including those capable of forming reef structures when the damaging human activities are removed. However, it is not known if there is a threshold below which recovery is unlikely, particularly for species that are very long lived and slow growing.

Impacts and Threats
210, Professional Fishing: There is evidence that fishing has damaged coldwater coral reefs. The impacts of the removal of lobsters and crayfish has not been documented for Irish waters. In other parts of the world, their removal has caused an increase of sea urchins, leading to decline of kelp forests. This has not been recorded however in Ireland. Potting in waters deeper than 30m may have an impact on fragile species such sponges and the Ross Coral *Pentapora foliacea* but impacts have not been well documented.

There is extensive fishing for mussel seed for the aquaculture industry. In the past few years there has been a shortage of seed due to low recruitment. Mussels are also collected from the low shore for aquaculture.

In 2006 large quantities of mussel seed were scraped off the shores at Killkee SAC and although returned the damage has been done. This activity may be more widespread than is currently known. Steps are being taken to ensure that this activity does not happen in the future in SACs

240, Taking for fauna: Winkle (*Littroina littorea*) picking has been carried out in Ireland for over a century. Currently it occurs on a great many shores, carried out by individuals but sold to commercial companies for export. This appears to be a sustainable fishery. The intensity of the picking is unlikely to have increased significantly in recent years. The removal of these herbivores is likely to impact on the community structure of the shore as has been demonstrated for rocky shores in the UK and USA.

In some extensive shore areas e.g. Murles Point some collection activities have a considerable impact through over turning boulders and not replacing them to their original position and also by driving vehicles over the shore that crushes many species.

250, Taking of flora: Harvesting of fucoids on rocky shores occurs in a number of areas. *Ascophyllum nodosum* is the main commercial species, though *Fucus vesiculosus* and *Fucus serratus* are also harvested. It is carried out on a 3-5 year cycle depending on the area and is an activity that has been carried out for at least a century. In addition, some algae are harvested for human consumption, particularly in the W and NW regions. Neither of these activities are likely to have increased in the period 2000 – 2006. Little Kelp is harvested in Ireland at present.

701, Water pollution: Increase in nutrients can lead to an increase in ephemeral species such as the green seaweed *Ulva* and *Enteromorpha sp.* Where there is an increase in the sediment load or an increase in turbidity the depth to which kelp and other foliose and filamentous algae grow is reduced but such changes have not been documented.

990 Climate change: *Invasive alien species*: The impacts of climate change through the spread of invasive alien species has the potential to impact on the structure and function of reef habitats. The invasive alga *Sargassum muticum,* first recorded in Strangford Lough (N. Ireland) in 1995, has spread around Ireland and is now recorded as far north as Donegal Bay. The invasive alien species recorded to date have arrived in Irish waters as a result of human activities.

Change in species composition: With climate change there is likely to be shifts in the distribution of a number of species. If Irish waters become warmer then an expected a shift in the distribution of southern species is likely to occur and the southern limits of northern species will likewise move northwards. There is some evidence form gastropods (snails) and barnacles that southern species have increased their distribution northwards.

Future Prospects

Negative Future Prospects

Non biogenic reefs: An increase in the variety of harvested species the intensity of harvesting and the lack of regulation could have a significant impact on Reef habitat.

While many of the native oyster (*Ostrea edulis*) beds are managed, they are self-sustaining as along as they are not over fished. The introduction of the parasite *Bonamia* had serious implications for the commercial viability of the beds. There has been a widespread move to cultivation of Pacific oyster *Crassostrea gigas*. In addition the introduction of mussels close to native oysters has led to intense settlement of mussels on the oyster beds, threatening to suffocate the oysters.

Biogenic reefs: Continued fishing with gear that that impacts on the seabed without any management will result in further destruction and will be a significant negative pressure and impact.

Positive Future Prospects

Evidence of full implementation of the Water Framework Directive will ensure that water quality of coastal waters either improves or remains high.

Conservation Assessment of Future Prospects

The future prospects of coastal non biogenic Reefs are considered to be favourable but the prospects for biogenic reefs are considered Unfavourable - Inadequate .

Overall Assessment

- The range of reefs is unknown but has the potential to be much of the EEZ and is considered Favourable and the current range is considered to be the Favourable Reference Range based on expert judgement. I
- The area of habitat is unknown and for biogenic reefs is likely to have decreased so the status is Unknown
- The conservation status of reef structure and function s is considered Unfavourable – inadequate.
- Future prospects are considered Unfavourable – Inadequate as the impacts in fishing on reefs in the offshore area are unknown.

Overall the status of the habitat Reefs is considered to be Unfavourable – Inadequate.

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1170 Reefs

National Level	
Habitat Code	1170
Member State	Ireland, IE
Biogeographic region concerned within the MS	Marine Atlantic (MATL)
Range	Marine Atlantic (MATL)
Map	See attached map

Biogeographic level	
Biogeographic region	Marine Atlantic (MATL)
Published sources	▪ Bailey, M. & J. Rochford. 2006. Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Bosence, (1973). Recent serpulid reefs, Connemara, Eire. Nature, 242: 40-41. ▪ Collie, J. S., Hall, S. J., Kaiser, M. J., and Poiner, I. R. 2000. A quantitative analysis of fishing impacts on shelf-sea benthos. Journal of Animal Ecology, 69: 785–798. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & C. O' Keeffe. 2004. Harbour seal population assessment in the Republic of Ireland: August 2003. Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Crowe, O. 2005. Ireland's wetlands and their waterbirds: status and distribution. Birdwatch Ireland, Newcastle, Co. Wicklow. ▪ Deegan, B. 2004. Irish Cold-Water Coral Metadata Report. Marine Institute and Department of Environment, Heritage and Local Government. ▪ de Mol, B. 2002. Investigation into the development of coral banks in the Porcupine Seabight-. Phd Thesis University of Ghent ▪ Duchas. 1999. A survey of selected littoral and sublittoral sites in Clew Bay, Co.Mayo. A report prepared by Aqua-Fact International Ltd for Dúchas, Department of Arts Heritage and the Gaeltacht, Ireland, pp33. ▪ Eno, N. C., MacDonald, D. S., Kinnear, J. A. M., Amos, S. C., Chapman, C. J., Clark, R. A., Bunker, F. P. D., and Munro, C. 2001. Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science, 58: 11–20. ▪ EPA. 2C07. Bathing waters 2006. An EPA publication ▪ Falvey, J.P., Costello, M.J. & S. Dempsey. 1997. A survey of intertidal sediment biotopes in estuaries in Ireland. Unpublished report to the National Parks & Wildlife Service, Dublin. 258 pp. ▪ Freiwald, A, Fossa, J. H., Grehan, A. Koslow, T. and Roberts, J. M., 2004 Cold-water coral Reefs. UNEO-WCMC, Cambridge, UK. ▪ Hall, S.J. 1999. The effects of fishing on marine ecosystems and communities. Oxford, Blackwell Science. ▪ ICES. 2002a. Report of the ICES Advisory Committee on Ecosystems, 2002. ICES Cooperative Research Report, 254. 129 pp. ▪ ICES. 2002b. Study Group on Mapping the Occurrence of Cold Water Corals. ICES CM 2002/ACE:05. ▪ ICES. 2003. Report of the ICES Advisory Committee on Ecosystems, 2003. ICES Cooperative Research Report, 262. 229 pp.

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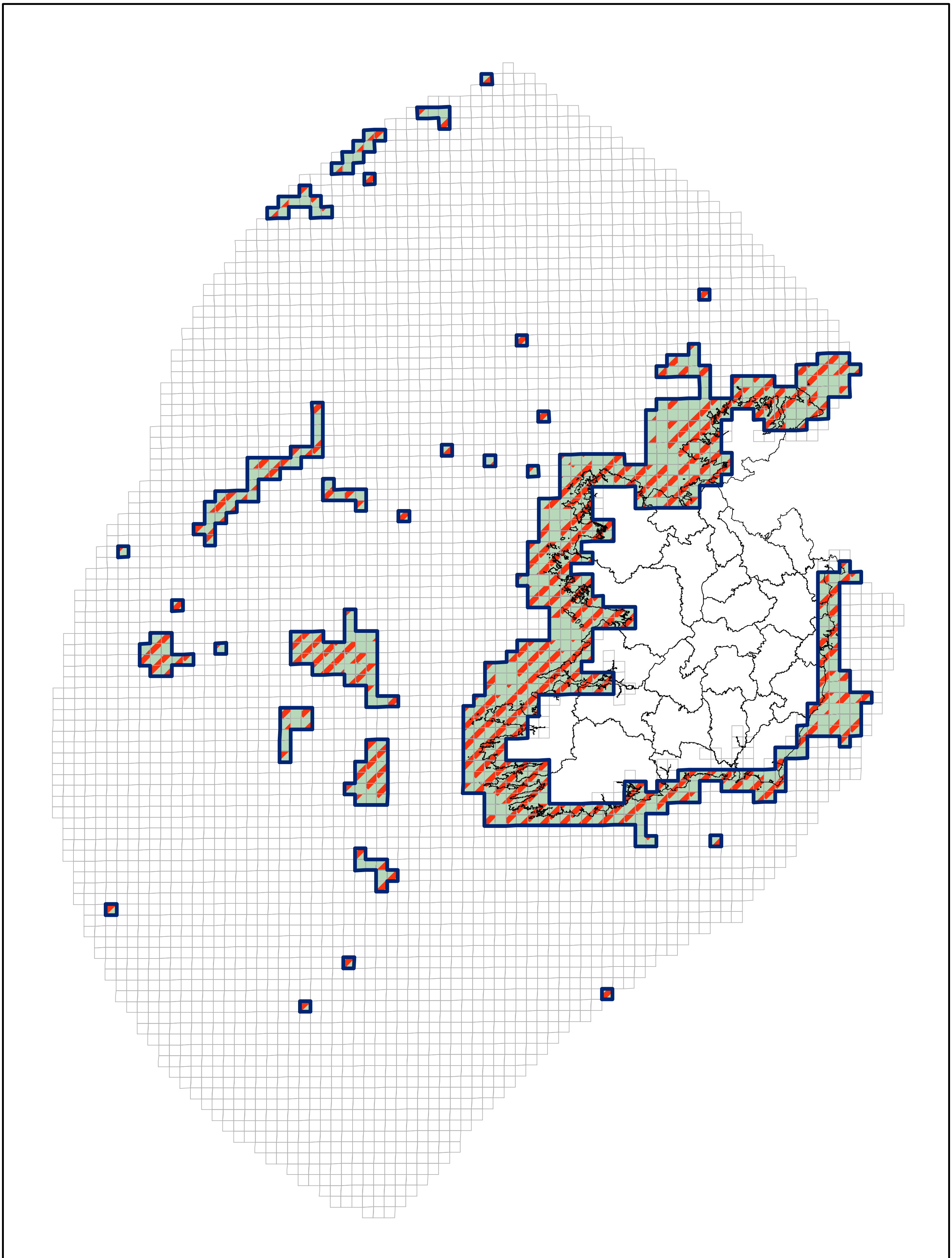
Range	
Surface area	62,000km^2 (620 x 100 km^2)
Date	04/2007 : 1852 - 2007
Quality of data	1= poor
Trend	stable
Trend-Period	1990 - 2007
Reasons for reported trend	N/A
Area covered by habitat	
Distribution map	See attached map
Surface area	Unknown
Date	04/2007
Method used	1 = expert opinion and 3=ground based surveys
Quality of data	1= poor
Trend	Unknown
Trend-Period	N/A
Reasons for reported trend	N/A
Justification of % thresholds for trends	N/A
Main pressures	210 Professional fishing 240 Taking of Fauna 250 Taking of Flora 701 Water Pollution 990 Climate change 954 invasion of a non-native species.

Threats	210 Professional fishing 240 Taking of Fauna 250 Taking of Flora 701 Water Pollution 990 Climate change 954 invasion of a non-native species.
Complementary information	
Favourable reference range	62,000km^2 (620 x 100 km^2)
Favourable reference area	Unknown
Typical species	Typical species includes Porifera: *Scypha ciliata, Grantia compressa, Halichondria panicea, Hymeniacidon perleve, Cliona stellata, Pachymatisma johnstonia,Dysidea fragilis*. Cnidaria: *Nemertesia antennina, Haliceum halecinum, Anemonia viridis, Actinia equina, Sagartia elegans, Actinothoe sphyrodeta, Corynactis viridis, Alcyonium digitatum, Caryophyllia smithii.* Polychaeta: *Spirobis spp. Pomatoceros triqueter* Crustacea: *Balanus spp., Semibalanus balanoides; Carcinus maenas, Cancer pagurus, Necora puber* Mollusca: *Gibbula spp, Littorina spp., Nucella lapillus, Patella spp., Calliostoma zizyphinum, Aplysia punctata, Mytilus edulis* Bryozoa; *Parasmitina spp., Alcyonidium diaphanum* Echinodermata: *Antedon bifida, Echinus esculentus, Marthasterias glacialis, Holothuria forskali, Aslia lefevrei, Pawsonia saxicola* Tunicata: *Botryllus schlosseri, Ascidia mentula, Dendrodoa grossularia* Green algae: *Ulva spp, Chaetomorpha spp*. Brown algae: *Fucus spp., Laminaria spp., Dictyota dichotoma.* Red algae: *Coralline crusts, Corallina officinalis, Porphyra spp. Chondrus crispus, Mastocarpus stellatus, Delesseria sanguinea, Cryptopleura ramosa, Lomentaria articulata, Polysiphonia spp., Ceramiun spp.* 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	"Invasion of non native species" is taken here to be the result of human activities and not as a result of climate change. Data on non-biogenic reef comes largely from a series of UK Admiralty Charts for the Republic of Ireland, the Ordnance Survey of Ireland 1/4 inch maps and the 1:50,000 Discovery Series. The assessment of reefs has been made extremely difficult as the assessment covers both biogenic and non-biogenic reefs in the coastal and offshore waters. Ireland's offshore area is very large and little is known about the distribution of non-biogenic reefs or the extent of either reef type.
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)

Area	Unknown (XX)
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

1:4,500,000

0 25 50 100 Kilometers

Reefs

1170

- Current Distribution (496 cells)
- Current Range (620 cells)
- Favourable Reference Range (620 cells)
- 10km grid cells of the EEZ

Date: October 2007

Background to the conservation assessment of the natterjack toad (Bufo calamita)

1 Range

1.1 Actual range

Range is taken to be *the outer limits of the overall area in which a habitat or species is found to be present. Range can be considered as an envelope that encompasses habitat that would be suitable for a species of interest. Not all such habitats are likely to be occupied and so the range commonly is larger than the area occupied by a given species* (EC 2006). When defining the range of species or habitats, the European Commission (2006) recommends using 10 x 10 km^2 polygons drawn around cells occupied by the species. These polygons can be smaller depending on the ecology of the species or the size of the country. Previous studies report that adult natterjacks remain within a radius of less than 1 km around the breeding ponds (Denton 1991, Miaud *et al.* 2000, Sinsch 1992), although some females have occasionally been observed up to 2.6 km from the nearest breeding pond in Germany (Sinsch 1997). For many amphibian species, most of the dispersal occurs at the juvenile stage (Semlitsch 2002), and natterjack toad subadults are thus likely to migrate over greater distances than the adults (e.g. 3-5 km). The European Commission (2006) also indicates that the estimate of range must allow the detection of possible changes from one reporting period to another, and so in the present study it was decided to establish the range of natterjack toads in Ireland by considering 2 x 2 km^2 polygons drawn around each breeding ponds. The range of the species in Ireland is thus estimated at 76 km^2 (see map 1).

1.2 Trend

Based on available records (irregular and incomplete) of toad breeding activity, Beebee synthesized the historical status of the species in Ireland since they were first discovered in early 1800s (Beebee 2002). It was only possible to provide an overall distribution map for the period 1805-1971. Before the 1970s, a substantial range contraction seems to have occurred, in particular around Castlemaine Harbour. However since there are no records of the dynamics (including any potential local extinctions) of the toad populations over that period, it is not possible to assess population trends accurately. Beebee (2002) further reports that no natterjack breeding sites have been lost since a survey of natterjacks in Ireland by Gresson and O'Dubhda in 1974. It appears that prior to the 1970s toads are likely to have disappeared from approximately half of their historical range in Ireland (Beebee 2002). The historical range (for the period 1805-1971) represents a total area of 188 km^2 (more than twice the area of the current range). It corresponds to the favourable reference range plus two additional areas (Rosbeigh (8 km^2) and Ballycarbery (2 km^2)).

In the early 1990s, there were two successful translocations of natterjack toad populations (a reintroduction at Caherdaniel, Co. Kerry and an introduction at the Raven dunes in Co. Wexford). A 3-year monitoring study between 2004-2006 (Bécart *et al.*, in press) indicated that the range of the species is at risk of contracting further, with very poor and irregular breeding activity recorded at the most westerly part of their current range on the Dingle peninsula (Fermoyle) where a maximum of 6 toads were recorded breeding in 2004, and no toads have been observed since, despite the creation of two additional pools in 2003.

To conclude, it is likely that during the period 1800-1970, the range of natterjack toads in Ireland decreased substantially (by half), and it has remained at a stable but low level since. However some populations are now isolated and it is necessary to try and link these populations by establishing new breeding ponds. Such measures would further the ongoing process of habitat creation and remediation taking place at a limited number of sites (e.g. in 2006, 9 ponds were created under the Heritage Council's Biodiversity Fund (Shaw 2006)).

1.3 Reasons for reported trend

The range of the toad in Ireland has been stable since 1974. However this was preceded by a period of significant range contraction. The contraction during the early and mid twentieth century was caused predominantly by the loss of breeding ponds, following land drainage for agricultural purposes and housing developments.

1.4 Favourable reference range

Natterjack toads have a coastal distribution in the British Isles, and were first reported in Ireland in 1805. In Ireland, they continue to be restricted to coastal sites in County Kerry (except for the introduction site at Raven). The naturally restricted distribution of natterjack toads in County Kerry is likely to result from climatic conditions specific to this region and also from the rocky nature of the coastline in this part of the country, which would have restricted dispersion of the toads (Beebee 1984).

A favourable reference range (FRR) must be *sufficiently large to allow the long term survival of the species* (EC 2006). To ensure the long-term survival of the species, it is important to allow for migration between breeding sites, in order to ensure genetic diversity and thus avoid local inbreeding and population extinctions. Currently, there are only two metapopulations (North Dingle and North Iveragh peninsulas), and the four remaining populations are isolated (Fermoyle, Inch, Roscullen, Caherdaniel, and possibly Glenbeigh). Beebee (2002) states that the ideal way of achieving the long-term safe-guard of the species in Ireland would be to restore the continuity of the recent historical range around Castlemaine Harbour. Thus, the FRR is based on the maintenance of the current range ($76km^2$) plus the reinstatement of toads around Castlemaine Harbour (approx $100km^2$), thereby providing linkages between the isolated Inch and Roscullen populations on the south side of the Dingle peninsula, with the existing populations on the north side of the Iveragh peninsula. It excludes two areas present in the historical range but not currently used by the toads (Rosbeigh and Ballycarbery) and not deemed essential for the maintenance of the long-term viability of the species. We therefore consider the FRR as 176 km^2.

Species range area: 76 km^2
Favourable reference range: 176 km^2

2 Population

2.1 Distribution map

The current distribution of natterjack toads in Ireland is represented in Map 1. Each dot represents a breeding site, where toad breeding activity has been recorded during the period 2002-2006.

2.2 Population size estimation

The Irish natterjack toad population appears to be comprised of two metapopulations and four isolated populations. During an intensive 3 year monitoring study, a total of 1,329, 3,667 and 4,099 egg strings were recorded in 2004, 2005 and 2006 respectively (Bécart *et al*., in press). There is very little evidence for possible double clutching among the Irish populations, possibly due to the relatively low fecundity levels compared to other European populations (Bécart *et al*., in press). We have estimated that 65% of adult females breed each year, although in a good year a higher proportion of females is likely to breed. In the absence of more detailed information on the Irish toad populations, we assumed a 1:1 sex ratio.

The study estimated adult toad numbers as 4,089 in 2004, 11,283 in 2005 and 12,612 in 2006 (Bécart *et al*., in press). These estimates reflect important inter annual variability in toad breeding success, mainly explained by weather conditions at critical periods in the breeding cycle. We have estimated the Irish population of adult natterjack toads to be 9,328, the average of the 2004-2006 figures.

2.3 Trend over the last century

The recent monitoring programme of natterjack toad populations in Ireland represents a complete assessment of the toad breeding activity at all known breeding sites (except one on the Inch Peninsula) over three consecutive years (2004-2006). Our current estimates are similar to previously suggested population sizes in Ireland (in the range of 3,000 – 10,000, see McCarthy *et al.* [1983] and Beebee [2002]), which would suggest that the toad populations have remained relatively stable over the past three decades. The fact that there have been no reported breeding sites losses in recent decades would also support this. There are no equivalent historical data available to allow the accurate assessment of population trends before that. However, it seems likely that the present stability in numbers was preceded by a period of decline, matching the reduction in the range of the species over the past century (see above). The most significant loss in range has occured around Castlemaine Harbour. It seems clear from historic records that the species has previously been found right around this coastal strip. However, there is no evidence that the coastal marshes and grassland habitats in this area would have supported large metapopulations and it seems more reasonable to infer, given the pioneering nature of the natterjack, that small numbers would have bred dynamically in this area, responding to the availability of suitable breeding sites along a naturally changing coastline.

2.4 Reasons for reported trend

Numbers appear to have held stable since the 1970s. Habitat destruction, natural succession, agricultural improvement and other land use changes would have been the major reasons for the reduction in population size before that, during the period 1800-1970.

2.5 Main pressures and threats

The major pressures (past and present) and threats (future and foreseeable impacts), which are likely to affect the long term viability of the species or its habitats are listed in Table 5.1.

Table 5.1: Main pressures and threats affecting the Irish natterjack toads and their habitats. In particular, the pressure 890 refers to the increasing water resource utilisation for human consumption and industrial purposes, which is likely to reduce the water table levels and thus the hydroperiod of toad breeding ponds. The pressure 954 refers to the increasing spread of sea buckthorn in sand dunes.

Codes		Main pressures (past and present)	Threats (future and foreseeable impacts)
101	Modification of cultivation practices	√	√
120	Fertilisation	√	√
141	Abandonment of pastoral systems	√	√
403	Dispersed habitation	√	√
608	Camping and caravans	√	√
803	Infilling of ditches, dykes, ponds, pools, marshes or pits	√	√
810	Drainage	√	√
853	Management of water levels	√	√
890	Other human induced changes in hydraulic conditions	√	√
920	Drying out	√	√
951	Accumulation of organic material	√	√
954	Invasion by a species		√

2.6 Favourable reference population

The Favourable Reference Population (FRP) is *the population in a given biogeographical region considered to be the minimum necessary to ensure the long-term viability of the species* (EC 2006). Based on the 2004 to 2006 survey, we estimate that the FRP should reflect a situation where all sites on the North Dingle peninsula and all sites around Castlemaine harbour are connected to form two large metapopulations. Considering the rocky nature of the area on the Iveragh Peninsula, Caherdaniel will remain isolated from these two main metapopulations. The long term viability of Caherdaniel would require the establishment of at least another breeding population less than 2 km from the present breeding ponds. The estimated "viable" distribution corresponds to the FRR presented above (176 km^2).

Currently, the breeding ponds tend to be concentrated within small areas, in particular on the North Dingle Peninsula where five out of the six 2 x 2 km^2 polygons (many of which include part of the sea) each encompass at least 3 ponds. The additional breeding areas (i.e. 176 – 76 = 100 km^2) necessary to achieve connectivity in between the existing sites could maintain toad populations at significantly lower population densities and still ensure long term viability of the species. We can therefore consider a FRP of:

9,328 (average current population size) + (100 km^2 x *density*)

where *density* would be less than half of the current population density of 9238 / 76 = 122 adults per km^2. A conservative estimate of *density* would equal 40 individuals per km^2 and thus the FRP is estimated to be 13,000 adult toads.

Species population: 9,328 (3 year average for 2004-2006)
Favourable reference population: 13,000 breeding adults (on average)

3 Habitats for the species

3.1 Suitable habitats

During the breeding season (April-July) natterjacks require unshaded, shallow ponds (or shallow lakes) with gradually shelving sides. Ideally, every few years, ponds should dry out late in the summer after metamorphosis is complete (as this reduces the number of multi-voltine predators). Water quality is important – there should be little organic pollution, a pH above 5 and a salinity less than 15% of seawater (Beebee 2002). Outside the breeding season, natterjacks generally require an open unshaded habitat with short vegetation, over which they can hunt their invertebrate prey. They also need a soft sandy substrate to construct burrows, piles of rocks or dry-stone walls, in which they can hibernate from November to early March. Within the natterjacks current range, the habitats suitable for natterjack toads to breed, forage and hibernate (and thus meeting the requirements mentioned above) are all located in coastal areas (to a maximum of 4km inland) and include:

Coastal sand dunes
Pastures (including improved grasslands with dry stone walls)
Marsh (including upper saltmarshes)
Bogs and heathlands
Riparian zones (of lakes)
Reed beds
Quarry sites

3.2 Area estimation (suitable and currently occupied)

Most of the 2 x 2 km^2 polygons used in the present assessment to define the range of natterjack toads in Ireland are located along the coast and thus include a substantial proportion of adjacent sea. In Co. Kerry, urbanisation is still relatively low and toad breeding habitat is mostly comprised of natural (or semi natural) areas and farmlands. Based on a GIS analysis (using Corine 2000 landcover), it is possible to provide a percentage cover of suitable terrestrial and aquatic habitat. We estimate that within the current range of the species, suitable terrestrial and aquatic habitats cover 39 km^2 (51 %). Within the additional 100km^2 included in the favourable reference range, there is already probably sufficient suitable terrestrial habitat; estimates obtained from Corine (2000), suggest that 83 km^2 (47%) of the additional area contains the following potentially suitable habitat types:

Beaches, dunes, sand
Coastal lagoons
Inland marshes
Lowland blanket bogs

Pastures
Stream courses
Water bodies

What is required to make these areas suitable for toads is intermittent breeding ponds. There are 13 key 2x2km squares around Castlemaine Harbour where toads do not occur. The provision of 4 ponds across each one of these, i.e. one pond per 500m (as recommended by Beebee, 2002) would provide a dispersal corridor from Inch in the north-west around to Glenbeigh in the south-west. Some efforts in this regard have already started in 2006 (Shaw, 2006).

3.3 Trend

Human activities (in particular drainage) led to the loss of a substantial amount of breeding habitat and ponds in the first half of the 20th century. In Co. Kerry, terrestrial habitat is now threatened mainly by one-off building developments for tourist, private and commercial purposes. However, since the early 1990s there has been significant investment in improving habitat for the natterjack. Pond creation has occurred in a number of locations, notably in Caherdaniel where a re-introduction programme took place in the early 1990s, and in Tullaree. In 2006 funding was provided by the Heritage Council and 9 new ponds were created in four separate areas. Overall, we estimate that the extent of suitable habitat for the species has stabilised (following the same pattern as the range of the species). The findings of Bécart *et al.* (in press) concur with Beebee and Denton's (1996) suggestion that natterjack population size is usually limited by the number of suitable breeding ponds available, rather than by the extent of the terrestrial habitat. Conservation measures should therefore focus primarily on improving the suitability and number of breeding ponds.

4 Future prospects

4.1 Negative impacts and threats

Drainage of land for pasture and housing developments are still a major threat to natterjack populations in Ireland (Gresson and O'Dubhda, 1974; Beebee, 2002), leading to habitat loss and fragmentation.

The lowering of the water table in some areas can also reduce the amount of water available for toads to breed. In the Maharees dune system for instance, historically up to 25 ponds have formed. Over the last decade, however, fewer ponds have formed (Beebee 2002; Bécart *et al*., in press). Dessication has also tended to occur earlier in the season, severely reducing the probability that tadpoles will survive to metamorphosis (Bécart *et al*., in press). The reasons for this reduced hydroperiod are not clear. Annual precipitation has not declined in the last 30 years (Aubry and Emmerson, 2005; European Climate Assessment and Dataset (ECAD), Valentia observatory database) and local temperatures have not risen exceptionally (ECAD). Therefore, a recent change in climate is unlikely to explain the reduction in the number of ponds. A lowering of the water table through changes in water resource utilisation could be a possible explanation. Increased cattle density and housing developments such as caravan parks (affecting coastal areas such as the Maharees dune system) can lead to significant increases in water consumption (see also Korky and Webb, 1999) and thus a reduction in water table levels.

Paradoxically other parts of the county have been experiencing or are at risk of agricultural abandonment (e.g. removal of cattle and sheep) in particular at Glenbeigh, Fermoyle, Tullaree and Roscullen Island. The absence of grazing ultimately leads to encroachment by tall vegetation and shrubs, which reduces the suitability of the natterjack toad's terrestrial habitat. It also leads to the infilling of breeding ponds with vegetation and the accumulation of organic matter, which thus limits the extent of open water available for the toads to breed and increase the predation pressure on toad tadpoles by insect larvae (e.g. dragonfly larvae).

Over the past decade, there has been growing concern regarding the spread of sea buckthorn (*Hippophae rhamnoides*), in particular on the Maharees dune peninsula (Beebee 2002). If this spread is not controlled, it can have serious long term impacts on the dune flora and fauna.

Housing and industrial developments are also threatening some populations, in particular at Glenbeigh. Any further development will almost certainly lead to local population extinctions unless remedial action at these sites is taken.

4.2 Positive effects

All of the existing natterjack toad breeding areas in Ireland have been designated as Special Areas of Conservation (SACs). Conservation management actions are also being implemented by NPWS at these sites (e.g. fencing of breeding ponds to allow grazing). These measures will help to maintain suitable conditions and limit any further habitat destruction. NPWS have also funded a three-year (2004-2006) monitoring programme of all the toad populations in County Kerry (Bécart et al, in press). The 2004-2006 survey provides a more accurate estimate of population sizes and breeding success, and a better understanding of the biotic and abiotic factors that can influence natterjack toad breeding activity and success. The present study also documents the annual fluctuations in toad populations over the period 2004-2006. The study provides a solid baseline and a point of reference for future monitoring and conservation assessments of the species in Ireland.

A recent project funded by the Heritage Council under the Biodiversity Fund 2006 scheme resulted in the creation of 9 new potential breeding ponds (1 at Caherdaniel, 4 at Roscullen, 2 at Tullaree and 2 at Glenbeigh) as well as the improvement of 3 existing pools (2 at Tullaree and 1 at Caherdaniel) (Shaw 2006). These 9 new pools represent a potential increase in the number of breeding ponds for natterjacks by 20%.

Negotiations are presently underway between NPWS and the Department of Agriculture to incorporate amphibian (and natterjack toads in particular) conservation measures in the phase 4 of the Rural Environment Protection Scheme (REPS) to be launched in 2007. If successful, such a measure would help to ensure the maintenance of existing natterjack habitat, and the creation of new areas of suitable habitat on farmed land between the current sites (Shaw 2006). In Ireland, such agri-environment funding schemes have the potential to reverse the decline of this species in many parts of its historical range, and are particularly important for encouraging the re-instatement of the traditional forms of grazing (especially by cattle) that can sustain the habitat of this species.

5 Conclusion: overall assessment of conservation status

The overall assessment of the conservation status of the species is based on the general evolution matrix presented in the European guidance documents (EC 2006).

Since the current range represents approx half of the Favourable Reference Range (and thus more than 10% below), the status is Unfavourable (Bad). Similarly the current population size (average of just over 9000 adults) is more than 25% below the Favourable Reference Population (on average 13,000 adults), and thus the status is also Unfavourable (Bad).

Since many existing populations are not connected (in particular around Castlemaine Harbour) primarily due to the lack of breeding ponds, we consider that the current area of breeding habitat is not sufficiently large to ensure the long term survival of the species. Therefore, the status is also Unfavourable (Inadequate). Recently, and especially in 2006, new ponds have been created in areas of suitable terrestrial habitat, and early reports from 2007 suggest that at least some of these are already being used by toads. This therefore indicates an improving status.

Lastly, based on the review of the existing threats and future prospects, we feel that there is the potential for improvements of the natterjack toad propsects in Ireland. There are still important pressures (e.g. reduction in water availability, increase in land use intensity) and therefore the future prospects are in an Unfavourable (Inadequate) status. However, concerted progress has been made in recent years; range and population declines have been halted and prospects appear to be improving.

Parameter	**Conservation status**
Range	Unfavourable (Bad)
Population	Unfavourable (Bad)
Habitat for the species	Unfavourable (Inadequate +)
Future prospects	Unfavourable (Inadequate +)
General Assessment of CS	Unfavourable (Bad)

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1202 Natterjack Toad (*Bufo calamita*)

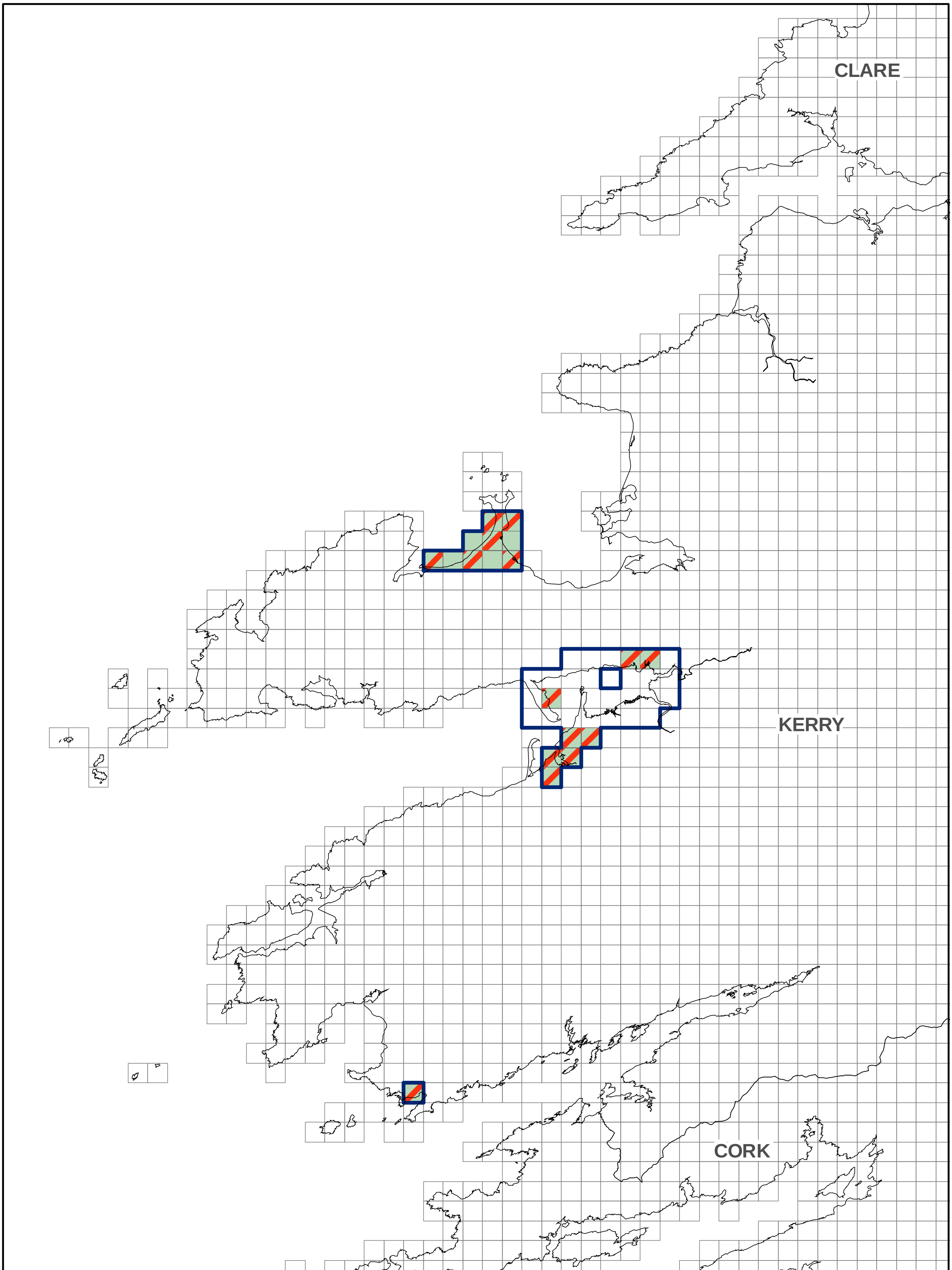
1. National Level	
Species code	1202
Member State	IE
Biogeographic regions concerned within the MS	ATL
1.1 Range	76 km^2

2. Biogeographic level	
2.1 Biogeographic region	ATL
2.2 Published sources	**Beebee, T.J.C. (2002)** The Natterjack Toad (*Bufo calamita*) in Ireland: current status and conservation requirements. *Irish Wildlife Manuals* No. 10. Dúchas the Heritage Service, Dublin. **Beebee, T. J. C. (1984)** Possible origins of Irish natterjack toads (*Bufo calamita*). *British Journal of Herpetology,* 6: 398-402. **Bécart, E., Aubry, A. and Emmerson, M. (in press)** Monitoring and conservation assessment of natterjack toad (*Bufo calamita*) in Ireland, Breeding seasons 2004, 2005 and 2006. *Irish Wildlife Manuals*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland. **Gresson, R.A.R. & O'Dubhda, S. (1974)** The distribution of the Natterjack toad, *Bufo calamita* Laur, in County Kerry. *The Irish Naturalists' Journal*, 18: 97-103. **Korky, J.K. & Webb, R.G. (1999)** Resurvey, biogeography and conservation of the Natterjack toad *Bufo calamita* Laurenti (Anura: bufonidae) in the Republic of Ireland. *Irish Biogeographical Society Bulletin*, 23: 2-52. **McCarthy, T. K. , Staunton, M. , Hassett, D. & Gibbons, M. (1983)** Observations on the distribution, and demography of breeding colonies of natterjack toads (*Bufo calamita*) in Ireland. Report to the Forest and Wildlife Service. **Miaud, C., Sanuy, D. and Avrillier, J.N. (2000)** Terrestrial movements of the natterjack toad *Bufo calamita* (Amphibia, Anura) in a semi-arid, agricultural landscape. *Amphibia-Reptilia*, 21: 357-369. **Semlitsch, R.D. (2002)** Critical elements for biologically based recovery plans of aquatic-breeding amphibians. *Conservation Biology*, 165: 619-629. **Shaw, W. (2006)** Conservation of natterjack toad (*Bufo calamita*) breeding habitats in County Kerry, Ireland. A project funded by the Heritage Council's Biodiversity Fund 2006. The Herpetological Conservation Trust, UK and Environmental Research Institutute, Cork, Ireland.
2.3 Range	
2.3.1 Surface area	76 km^2
2.3.2 Date	December 2006
2.3.3 Quality of data	3 = good
2.3.4 Trend	0 = stable since 1974 following a period of significant range contraction
2.3.6 Trend-Period	1974-2006
2.3.7 Reasons for reported trend	N/A
2.4 Population	
2.4.1 Population size estimation	9,328 breeding adults (average from 3 years' monitoring data). Calculated on the basis that 65% of adult females breed each year and using a male:female ratio of 1:1.
2.4.2 Date of estimation	Jan 2007 based on monitoring data from 2004-2006
2.4.3 Method used	3 = from complete inventory
2.4.4 Quality of data	3 = good
2.4.5 Trend	0 = stable despite important inter-annual fluctuations depending on the weather conditions of the year

2.4.7 Trend-Period	1974-2006 (extrapolated from 2004-06 data)
2.4.8 Reasons for reported trend	N/A
2.4.9 Justification of % thresholds for trends	Important natural fluctuations depending on the weather conditions of the year.
2.4.10 Main pressures	101 – modification of cultivation practises 120 – fertilisation 141 – abandonment of pastoral systems 403 – dispersed habitation 608 – camping and caravaning 803 – infiling of ditches, ponds, pools or marshes 810 – drainage 890 – other human induced changes in hydraulic conditions 920 – drying out 951 – accumulation of organic material
2.4.11 Threats	As 2.4.10 plus 954 – invasion by a species (Hippophae rhamnoides)
2.5 Habitat for the species	
2.5.2 Area estimation	39 km² available within the species current range Suitable habitat within the Range area (as estimated from Corine 2000) is located in coastal areas to a maximum of 4km inland and is comprised of coastal sand dunes, pastures and improved grasslands (with stone walls preferentially), marshes and upper salt marshes, bogs and heathlands, lake riparian zones, reed beds, quarries.
2.5.3 Date of estimation	2007
2.5.4 Quality of data	3 = good
2.5.5 Trend	0 = stable since 1974 following a period of significant range contraction
2.5.6 Trend-Period	1974-2006
2.5.7 Reasons for reported trend	
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	176 km² - based on re-establishment of the historic range of the species around Castlemaine Harbour.
2.7.2 Favourable reference population	13,000 individuals (on average over 3 year period). Estimate based on the maintenance of existing large metatpopulations, plus the addition of smaller populations in “stepping-stone” ponds around Castlemaine Harbour. Significant natural inter-annual fluctuations expected to continue, largely dictated by weather conditions (in turn determining breeding pond levels during critical months of April – July),
2.7.3 Suitable Habitat for the species	Approx 52 km² - based on the maintenance of the suitable habitat within the existing range (39km²) plus the provision of a corridor of suitable aquatic and terrestrial habitat around Castlemaine Harbour (c13km²)
2.7.4 Other relevant information	- Positive Impacts: Recent and on going conservation measures in place in the country e.g. all breeding sites designated as SACs, conservation management plan in place, monitoring programmes, pond creations and terrestrial habitat management, inclusion of management measures in Agri-environmental schemes. - Negative Impacts: Fragmentation and loss of habitat, infrastructure and housing development, loss of breeding waters and lowering of water tables, change in land use practices and natural succession
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Bad (U2)
Population	Bad (U2)
Habitat for the species	Inadequate (U1+)

Future prospects	Inadequate (U1+)
Overall assessment of CS	Bad (U2)



1:500,000

0 2.5 5 10 Kilometers

Natterjack Toad
Bufo calamita

1202

- Current Distribution (15 cells)
- Current Range (19 cells)
- Favourable Reference Range (44 cells)
- 2km grid cells

Date: July 2007

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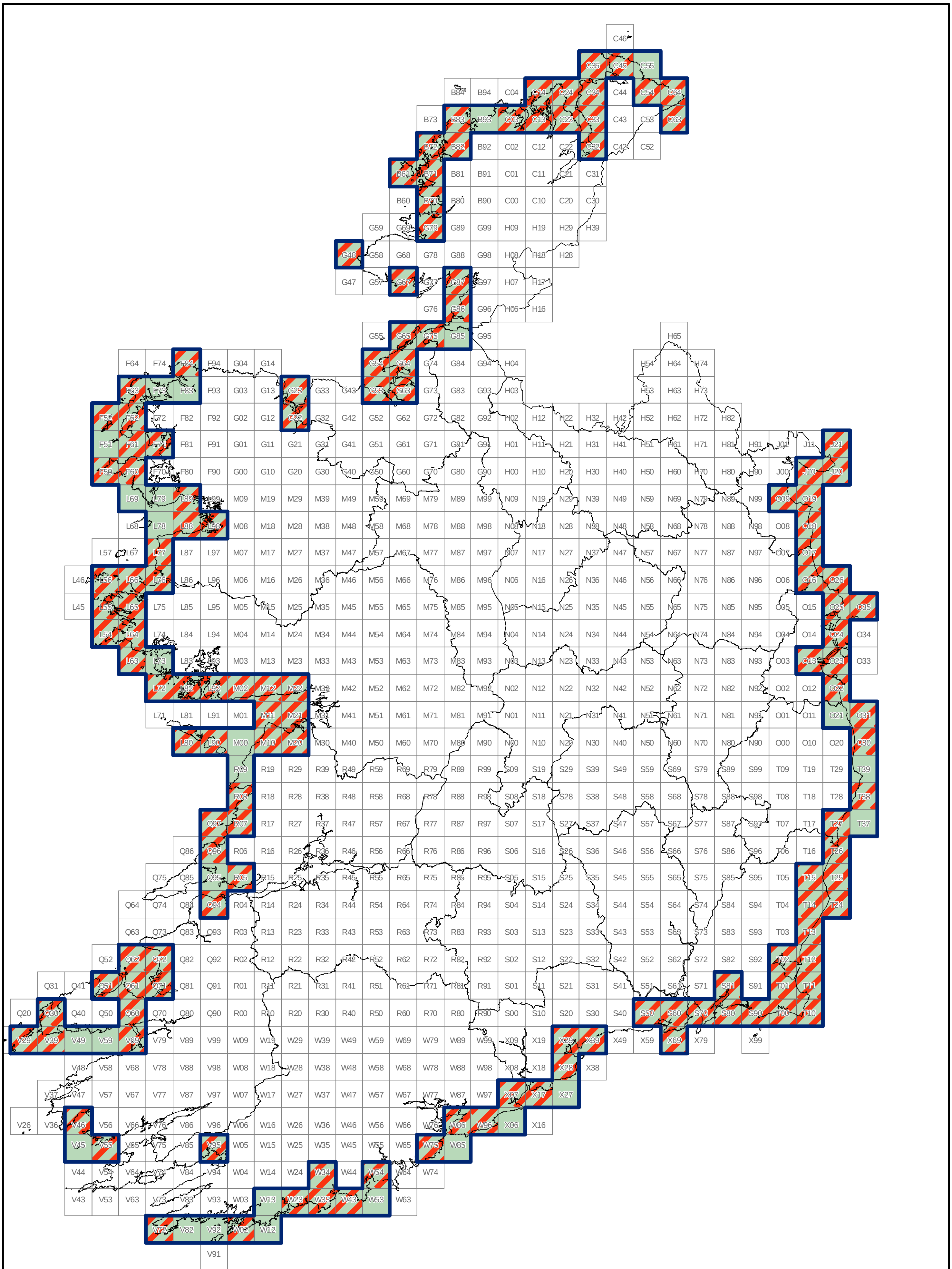
1210 Annual vegetation of drift lines

National Level	
Habitat Code	1210
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	▪ 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. ▪ 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. ▪ GAYNOR, K. (Unpublished). *The phytosociology and ecology of Irish sand dunes*. Unpublished thesis submitted to the National University of Ireland. ▪ 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). ▪ MOORE, D. and WILSON, F. (1999). *National Shingle Beach Surve*y. Unpublished report to the National Parks and Wildlife Service, Dublin.
Range	The habitat shows a continuous distribution along the coast of the country with a more dispersed pattern along the north of county Mayo, as well as counties Cork and Kerry. County Donegal contains the highest concentration of habitat records, followed by Galway. County Wexford has the highest number of habitat records along the east coast.
Surface area	16,300km² (163 grid cells x 100km²)
Date	08/2007
Quality of data	2 = moderate (e.g. based on extensive surveys)
Trend	0 = stable
Trend-Period	1996 – 2007
Reasons for reported trend	
Area covered by habitat	1 km²
Distribution map	See attached map
Surface area	1 km²
Date	08/2007
Method used	3 = ground based survey
Quality of data	2 = moderate (e.g. based on partial data with some extrapolation)
Trend	Decrease of <1%.
Trend-Period	1996 – 2007
Reasons for reported trend	3 = direct human influence
Justification of % thresholds for trends	Based on conservation status assessment results from the Coastal Monitoring Project (Ryle *et al.,* 2007) and best expert judgement.

Main pressures	140 Grazing 302 Sand and gravel extraction –removal of beach materials 622 Walking, horse riding and non-motorised vehicles 623 Outdoor sports and leisure activities - motorised vehicles 690 Other leisure and tourism impacts (beach cleaning) 720 Trampling, overuse 871 Sea defence or coastal protection works
Threats	140 Grazing 302 Sand and gravel extraction –removal of beach materials 622 Walking, horse riding and non-motorised vehicles 623 Outdoor sports and leisure activities – motorised vehicles 690 Other leisure and tourism impacts (beach cleaning) 720 Trampling, overuse 871 Sea defence or coastal protection works
Complementary information	
Favourable reference range	16,300km² (see Map III – Favourable Range 1220)
Favourable reference area	1km² (based on current habitat extent estimate)
Typical species	**Species**: *A. prostrata, A. laciniata, Cakile maritima, Honckenya peploides* and *Salsola kali.* **Method**: all the species above are a combination of those species listed as characteristic species under the Habitats Directive, the CMP (Ryle *et al*. 2007) characteristic species and the British National Vegetation Classification - **SD2** *Cakile maritima–Honckenya peploides* strandline vegetation community species (Rodwell, 2000). Typical species were assessed as favourable by Ryle *et. al*. (2007)
Other relevant information	
Conclusions ***(assessment of conservation status at end of reporting period)***	
Range	Favourable (FV)
Area	Unfavourable - Inadequate (U1)
Specific structures and functions (incl. typical species)	Favourable (FV)
Future prospects	Unfavourable-Inadequate (U1)
Overall assessment of CS	Unfavourable-Inadequate (U1)



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1:1,800,000

0 12.5 25 50 Kilometers

Annual vegetation of drift lines

1210

Current Distribution (136 cells)
Current Range (163 cells)
Favourable Reference Range (163 cells)
W48 10km grid cells

Date: August 2007

Background to conservation assessment for Common Frog *Rana temporaria*

1. Introduction

The common frog *Rana temporaria* is the only frog found in Ireland and is one of only three amphibian species present in the country. Despite being a cold tolerant species, found within the Arctic Circle, no archaeological evidence has been found in Ireland to support its arrival here by natural colonisation. It is presumed that is was introduced, possibly by the Normans 1000 years ago or so, although there is documentary evidence of more recent introductions as well.

2. Range

Frogs are found throughout Ireland. Records from 1950-1978 collated by Ní Lamhna (1979) shows the species to be widely distributed. She notes that it is even recorded from some offshore islands. In 1993 and 1994 Marnell (1999) surveyed a stratified sample of fifty 10km squares and found frogs in 73% of them. Marnell recognised that the true figure was probably higher as the principal target of his survey work was the smooth newt and some of the fieldwork was probably done too late in the year to find aquatic frogs (early July). Two further frog surveys, mainly aimed at school children, have been conducted by the Irish Peatland Conservation Council [IPCC]. The first was in 1997, the second from 2003-2007. The combined data from the three surveys carried out between 1993 and 2007 suggests that the species is present in every 10km square in the country. Any gaps are likely to be the result of poor recorder effort. **Range is equal to 873 10km squares.**

2.1 Trends

There have been significant changes to the habitat available to the frog over the last century, with extensive pond losses and fragmentation of the frog's terrestrial habitat (see 4. Habitat below for further details). Many local extinctions must have occurred as a result. However, frogs are extremely adaptable in their choice of breeding site and can rapidly colonise new water bodies including fire ponds, drainage ditches, gardens and golf course ponds. Consequently, at the 10km level there is no evidence that there has been any decline in the range of the frog since 1994, when the Directive came into effect. There is not sufficient information to allow any detection of trends at a finer scale.

2.2 Favourable reference range

The current range, encompassing the entire country, is sufficiently large to allow the long-term survival of the species. **Hence the favourable reference range is equal to the current range - 873 10km squares**

3. Population

A small survey in March 1998 provides the only basis for estimating actual frog numbers in the wild in Ireland [Marnell and O'Donnell, unpublished data]. A total of 74.5 ha spread over four areas [Killyconny Bog and Fartagh South in Co. Cavan and Crosswood Bog and Tristernagh Demesne in Co. Westmeath] were surveyed for spawn clumps. A total of 1,420 spawn clumps were recorded giving an average of 19 females / ha or 38 frogs / ha. It should be noted that the habitats surveyed – raised bog, and rushy pastures with wet ditches – are particularly suited to frogs, so a simple extrapolation of this figure across the entire country would not be sound. However, it does give an idea of the population density that frogs can reach in areas where there are suitable breeding sites surrounded by appropriate terrestrial habitats.

In the absence of any reliable figures, **the number of occupied 10km squares (525) is used as a proxy for population** in this conservation assessment. More extensive surveys in the future, targeting various habitat types across the country, could provide the basis for more accurate population figures.

3.1 Trends

The distribution atlas published by An Foras Forbartha in 1979 (Ní Lamhna, 1979) collated frog records from 1950-1978 (with a handful of records pre-dating 1950). The map showed frogs to be present in 356 10km squares. The collated data from 1993 - 2007 shows frogs to be present in 525 10km squares. In simple terms this would suggest an increase of 47%. However, this trend is likely to be explained almost entirely by improved knowledge and increased recording effort in recent years.

3.2 Threats / pressures

Amphibians are subject to impacts in both the aquatic and the terrestrial environments. The main threats and pressures are the same for this species and relate for the most part to the reduced availability of breeding sites, or the reduced quality of the surrounding terrestrial habitats:

103 – Agricultural improvement

110 – Use of pesticides

151 – Removal of hedges & copses

152 – Removal of scrub

161 – Forestry planting

312 – Mechanical removal of peat

401 – Continuous urbanisation

410 – Industrial or commercial areas

502 – Routes / autoroutes

701 – Water pollution

803 – Infilling of ponds, ditches, pools, marshes

920 – Drying out

951 – Accumulation of organic material

3.3 Favourable reference population

This species is known to be widespread and, where habitat is suitable, it is often abundant. However, more detailed information is required before meaningful targets can be set for favourable reference population. In the meantime, the population should occupy no less than the current estimate of 525 10km squares.

4. Habitat

Frogs occur in a wide variety of habitats in Ireland: upland, lowland, woodland, farmland, marsh, bog, coastal and urban. Frogs are adaptable breeders and can be found spawning in all types of water bodies from puddles to lakes. However, discriminant analysis has shown that some ponds are favoured over others (Marnell, 1998a). Features of the surrounding terrestrial habitats are also important. In particular, it has been shown that the availability of suitable microhabitats (e.g. deadwood, patches of scrub) around a pond make it more likely that frogs will breed there. Although the habitat requirements of this species have been well documented it is difficult, given the small scale of the habitat features, to provide an accurate area estimate for the country. In lieu of an accurate figure and given the widespread nature and broad range of habitats used by the animal, the extent of distribution is used as a surrogate – 52,500 square kilometers.

4.1 Trends

Estimates in the UK suggest that as many as 75% of ponds were lost there during the 20th century (Oldham and Swan, 1993). Although the situation in Ireland has not been documented in detail, it is clear that widespread pond losses have occurred in Ireland over the same period. Marnell (1998b) estimated that approximately 50% of ponds had disappeared since 1900, with some areas incurring a much higher rate of loss. Extensive programmes of land drainage have been carried out in Ireland. In the Land Project, which ran from 1944 to 1974, over one million hectares were subject to field drainage, arterial drainage or land reclamation. The Farm Modernisation Scheme (1974 – 1985) provided aid to 100,000 farmers for field drainage and scrub clearance. In addition, during 1979-1988, farmers involved in the Western Drainage scheme received 70% funding towards field drainage over a further 250,000 hectares (Marnell 1998b). Wetland losses have also occurred as a result of active in-filling and drainage associated with peat cutting and afforestation. Furthermore, numerous man-made ponds (e.g. drinking holes for cattle, marl pits, quarry ponds) have been lost due to passive neglect leading to natural terrestrialisation.

Intensive urban and suburban development, particularly around our main cities, has also removed terrestrial and aquatic habitats once used by frogs.

Many local extinctions must have occurred as a result of the loss of these habitats. However, frogs are extremely adaptable in their choice of breeding site and can rapidly colonise new water bodies. The proliferation of drainage ditches throughout the agricultural landscape will have offset, to some extent, the loss of natural marshes and ponds. Equally, the inclusion of fire ponds and drainage channels in newly forested areas will have allowed breeding continuity in those landscapes. Garden ponds are becoming more popular and, together with park ponds and golf course ponds, they provide breeding sites for frogs within our urban and suburban areas. However, garden ponds are far from common in Irish suburbia and are very unusual in the rapidly expanding suburban fringes of our main cities.

Consequently, there is good evidence of ongoing habitat loss and not even the frog's plasticity in breeding site choice can have offset this completely. The extent of the decline is unknown however and there is no evidence of it at the 10km level.

4.2 Suitable habitat for the species

There is not enough information to determine the extent of habitat loss over the past decade; it does not appear to have affected the frog's range, which is still nation-wide, and there is probably sufficient suitable habitat still occupied to ensure the long-term survival of the species. As we are using the extent of known distribution as the current extent of habitat, this figure will also apply to suitable habitat.

5. Future prospects

REPS, Ireland's main agri-environmental scheme, now requires farmers to maintain existing ponds on their holdings and new incentives to create amphibian ponds will be included in the scheme from 2007. Large-scale drainage schemes are no longer carried out in Ireland and even field drainage is less common that it once was. The frog is a widespread and common species, with broad habitat preferences. Despite some local losses, frogs are expected to persist and thrive in Ireland.

6. Conclusions

6.1 Range

As range is stable and not smaller than the favourable reference range, this parameter is considered to be Favourable.

6.2 Population

The population is stable and not smaller than the favourable reference population. Reproduction, mortality and age structure are considered to be normal. This parameter is considered to be Favourable.

6.3 Habitat

Although there is probably sufficient suitable habitat still occupied to ensure the long-term survival of the species, the area of habitat is decreasing and so this parameter must be considered Unfavourable/Inadequate.

6.4 Future prospects

Despite some local losses, frogs are expected to persist and thrive in Ireland over the long term. Favourable.

6.5 Overall assessment

Amber – Unfavourable / Inadequate

7. References

Crichton, M. (1974) *Provisional distribution maps of amphibians, reptiles & mammals in Ireland*. Folens/An Foras Forbartha, Dublin.

Ní Lamhna, E. (1979) (ed.) *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland* (2nd edition). An Foras Forbartha, Dublin.

Korky, J. K. and Webb, R. G. (1993) Breeding habitats of the common frog, *Rana temporaria* L. (Anura: Ranidae), in the Republic of Ireland. *Bulletin of the Irish Biogeographical Society* **16**: 18-29.

Marnell, F. (1998a) Discriminant analysis of the terrestrial and aquatic habitat determinants of the smooth newt (*Triturus vulgaris*) and the common frog (*Rana temporaria*) in Ireland. *J. Zoology* **244**: 1-6

Marnell, F. (1998b) The distribution of the smooth newt, Triturus vulgaris L., in Ireland. *Bulletin of the Irish Biogeographical Society* **22**: 84-96.

Marnell, F. (1999) The distribution of the Common Frog *Rana temporaria* L. in Ireland. *Bulletin of the Irish Biogeographical Society* **23**: 60-70.

IPCC (1997 and 2003) Hop to it! Irish frog survey reports. **www.ipcc.ie**

1213 Common Frog (*Rana temporaria*)

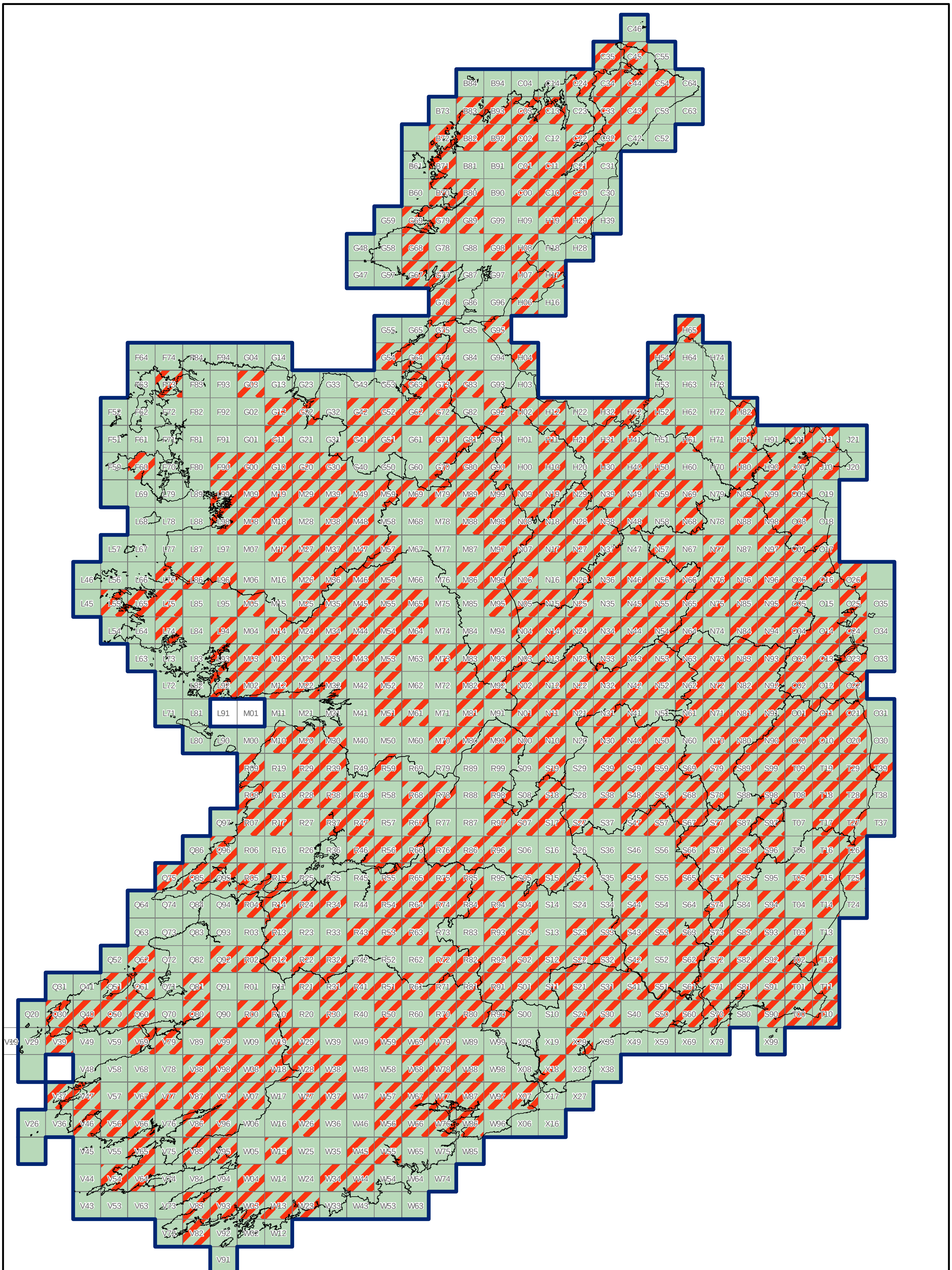
1. National Level	
Species code	1213
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Crichton, M. (1974) *Provisional distribution maps of amphibians, reptiles & mammals in Ireland*. Folens/An Foras Forbartha, Dublin. ▪ IPCC (1997 and 2003) Hop to it! Irish frog survey reports. www.ipcc.ie ▪ Korky, J. K. and Webb, R. G. (1993) Breeding habitats of the common frog, *Rana temporaria* L. (Anura: Ranidae), in the Republic of Ireland. *Bulletin of the Irish Biogeographical Society* 16: 18-29. ▪ Marnell, F. (1998) Discriminant analysis of the terrestrial and aquatic habitat determinants of the smooth newt (*Triturus vulgaris*) and the common frog (*Rana temporaria*) in Ireland. *J. Zoology* 244: 1-6 ▪ Marnell, F. (1999). The distribution of the Common Frog *Rana temporaria* L. in Ireland. *Bulletin of the Irish Biogeographical Society* 23: 60-70. ▪ Ní Lamhna, E. (1979) (ed.) *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland* (2nd edition). An Foras Forbartha, Dublin.
2.3 Range	
2.3.1 Surface area	87,300 km^2 (873 –10km grids)
2.3.2 Date	1993-2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys)
2.3.4 Trend	Stable
2.3.6 Trend-Period	1993 - 2007
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	In the absence of a detailed national population estimate, the number of occupied 10km squares is taken as a proxy for population. There are recent records from 525 10k grid cells.
2.4.2 Date of estimation	April 2007
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	net increase by 47% - from 356 10km squares pre-1980 to 525 10km squares post-1980.
2.4.7 Trend-Period	1950-1978 records versus 1993-2007 records
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 110 – Use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 161 – Forestry planting 312 – Mechanical removal of peat 401 – Continuous urbanisation 410 – Industrial or commercial areas 502 – Routes / autoroutes 701 – Water pollution 803 – Infilling of ponds, ditches, pools, marshes 920 – Drying out 951 – Accumulation of organic material
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	52,500 km^2
2.5.3 Date of estimation	May 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	− = net loss, but extent of loss is unknown
2.5.6 Trend-Period	1900 – 2006
2.5.7 Reasons for reported trend	3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence 5 = natural processes
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	87,300 km^2 (873 –10km grids)
2.7.2 Favourable reference population	525 10km grid cells
2.7.3 Suitable Habitat for the species	52,500 km^2
2.7.4 Other relevant information - see background doc.	

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 CS1	Inadequate (U1)



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1:1,800,000

0 12.5 25 50 Kilometers

Rana temporaria

1213

- Current Distribution (525 cells)
- Current Range (873 cells)
- Favourable Reference Range (873 cells)
- W48 10km grid cells

Date: October 2007

1220 Perennial vegetation of stony banks

CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. Habitat characteristics in Ireland

Irish vegetated shingle may support two habitat types on Annex I of the Habitats Directive, *Annual vegetation of drift lines*, which is mainly associated with sandy substrate (EU Code 1210) and *Perennial vegetation of stony banks* (EU Code 1220) (see Appendix I for further detail on the NSBS project).

According to the Interpretation Manual of the Habitats Directive (Commission of the European Communities, 2003*), Perennial vegetation of stony banks* is characterised by the presence of perennial species such as *Crambe maritima* and *Honckenya peploides*. However, a wide range of vegetation types may be found on large shingle structures inland of the upper beach. On more mature, stable shingle, coastal forms of grassland, heath and scrub vegetation may develop. This type of shingle vegetation was not considered neither on the Coastal Monitoring Project (CMP) (2004-007) or the NSBS (1999). The CMP only mapped and assessed Perennial vegetation of stony banks (1220) as defined in the Habitats Directive vegetation corresponding with the pioneer phase of the habitat classified by the Great Britain National Vegetation Classification (NVC) as SD1 (*Rumex crispus-Glaucium flavum* shingle beach community). The CMP adapted the Common Standards Monitoring (CSM) methodology established by Joint Nature Conservation Council (JNCC, 2004). The NSBS (1999) also recorded species from more stable stages of the successional sequence (e.g. grassland). Some areas of unusual vegetation dominated by lichens and bryophytes are found on more stable shingle. [1] The NSBS (1999) provided a list of associated habitats with the shingle beach. Shingle based grassland (i.e. shingle substrate) was one of these habitats. It may be grazed or not, typically dry and dominant species are *Festuca rubra, Lotus corniculatus* and *Trifolium repens*. A list of sites where this associated habitat was recorded in given in Annex III.

Fossit (2000), defined "shingle and gravel banks – CB1", which corresponds to the Annex I habitat "Perennial vegetation of stony banks", as coastal areas where shingle (cobbles and pebbles) and gravel have accumulated to form elevated ridges or banks above the high tide mark. Most of the rocky material should be less than 256 mm in diameter for inclusion in this category. Additionally, the National Shingle Beach Survey (hereafter NSBS) (Moore and Wilson, 1999) deemed shingle beaches as containing pebbles larger in diameter than 2mm and smaller than 250mm (see Appendix I). Shingle and gravel banks, also known as storm beaches, are subject to intermittent disturbance during storms.

According to the habitat description given by the Joint Nature Conservation Council (JNCC, 2004). Three years of stable shingle are considered necessary for the establishment of short-lived perennials (Scott, 1963). Other communities on stable shingle include grasslands where *Arrhenatherum elatius*, *Festuca rubra* or *Agrostis stolonifera* are dominant with lichens or mosses. These communities are superseded by wet or dry heaths and scrub communities (JNCC, 2004). Further work is needed to establish whether Irish sites follow the same pattern.

The NSBS is the most comprehensive survey of shingle areas of conservation interest on the Irish coast (Moore and Wilson, 1999). Six broad categories are suggested in this survey for shingle systems, that take into account differnet types of topography and associated habitats: 1) fringing beach, 2) shingle spit, 3) lagoonal system 4) multiridged raised beach 5) shingle ridge and 6) shingle based dune system.

Alternatively, Doody and Randall (2003) recognised five categories of shingle structures: a) fringing beaches, b) shingle spits, c) bars or barriers, d) cuspate forelands and e) offshore barrier islands. The first four types correspond to the first four categories given by the NSBS. An offshore barrier island is a form of shingle ridge that forms under conditions of shallow water and in low energy environments. Fringing beaches are narrow strips of shingle in contact with the land behind. They usually occur along the foot of sedimentary cliffs, but may also occur in front of coastal dunes or salt-marsh cliffs. Shingle spits in general grow out from the coast where there is an abrupt change in direction of the coastline. Spit may display recurved hooks at their distal ends. Ecologically bars, which are spits that have formed across estuary mouths or indentations in the coast, differ from spits in having a less maritime environment. Cuspate forelands develop when shingle is available in large quantities and piles up in front of beaches or spits. If the process is repeated, a series of roughly parallel ridges may develop and an extensive area of stable shingle results.

The ecological variation in shingle beaches depends on the stability of the beach, the nature of the substrate, particle size distribution, climatic conditions and hydrology (Packham, 1997). Stability influences species composition of shingle beaches more than any other factor. Packham (1997), summarised shingle beaches into five stability classes for Great Britain that could be applied for

Ireland. 1) Unstable and bare of vegetation; 2) stable between spring and autumn with summer annuals such as *Galium* sp.; 3) stable for 3-4 years with short-lived perennials containing *Suaeda* spp.. Scot (1963) also mentions that when the beach is stable for more than 3 years; short-lived perennials can establish (e.g. *Glaucium flavum, Rumex crispus, Beta maritima* and *Silene vulgaris.* 4) Stable shingle for 5-20 years with long-lived perennials such as *Crambe maritima, Rumex crispus* and *Silene* and 5) shingle stable for a very long period dominated by heath or grass heath vegetation[1] (e.g. *Festuca rubra, Rubus fruticosus, Calluna* and *Erica spp).* Furthermore, according to the nature of the fine particles present as a matrix within the shingle the shingle beaches are divided into five classes. a) Beaches consisting entirely of shingle where the vegetation composition is poor and limited to encrusting lichens and small number of pioneer angiosperm (e.g. *Lathyrus japonicus*); b) shingle with a sand matrix and where *Lotus corniculatus, Plantago lanceolata, Honckenya peploides* and *Armeria maritima* are common; c) shingle with an organic matrix (fundamentally rotting seaweed) which increases nutrients levels and enables *Beta vulgaris, Atriplex* spp and other species to occur and d) shingle with silt/clay matrix where vegetation ecologically related to salt marshes is found. In many locations shingle is mixed with sand, silt, clay or organic debris. This fact makes the classification of the habitat more complicated.

The width of the foreshore and past management actions are also likely to influence the ecological variation on shingle beach habitats. The ridges and lows formed also influence the vegetation patterns, resulting in characteristic zonations of vegetated and bare shingle (JNCC, 2004).

There is not a specific classification of the Irish shingle vegetation. However, Sneddon and Randall (1993) provided a comprehensive classification system for shingle vegetation of Great Britain (Appendix II), of which a numbr of communities can be observed on Irish sites.

Although it is acknowledge that shingle also supports grassland and scrub communities, this assessment is limited to the pioneer stage, the typical species of which are listed in section 5.2. Consideration is given to the transitions where known.

Most of the following assessment is based primarily on the results of the National Shingle Beach Survey - NSBS (Moore and Wilson, 1999) and the Coastal Monitoring Project - CMP (Ryle *et al*. 2007), details of which can be found in Appendix I.

2. Habitat mapping

The following data sources were used to map the habitat distribution and range in Ireland on a 10km square basis (see Maps 1 and 2):

- Biomar Survey of Irish Machair (Crawford *et al*., 1996)
- National Single Beach Survey (Moore & Wilson, 1999)
- Coastal Monitoring Project (Ryle *et al*., 2007)
- NPWS – Management Planning Support Unit Maps (MPSU) (2006)

The occurrence of the habitat was also confirmed through other sources (e.g. NPWS Habitat Assignment Project, NPWS Enquiries database, etc) listed in Annex I.

The CMP specifically identified, mapped and assessed the habitat as defined in the Habitats Directive Interpretation Manual. Individual site habitat maps were produced and these have been used to produce a 10km habitat distribution map by intersection of the habitat's GIS shapefile with a National 10km Grid.

Neither the Biomar Survey of Irish Machair, nor the National Shingle Beach Survey (NSBS), specifically map 'Perennial vegetation of stony banks'. The former mapped vegetation communities according to the British National Vegetation Classification (NVC) that have direct correspondence with Annex I habitats (e.g. SD1). Although detailed vegetation community maps were produced, these were not available on a digital format and thus the location of the habitat has only been depicted by a dot-record within this project. Conversely, only a linear representation of the whole shingle site was produced as part of the NSBS and thus due to the difficulty to generate more accurate habitat's map just one dot have been generated to depict habitat's records. The NSBS presented a physical, geomorphological and botanical description of the site but does not classify the vegetation or identify the habitat present. The dot-records generated for both surveys have been used to intersect the 10km grid and thus complete the habitat distribution map.

The use of dot records was considered sufficient to illustrate the habitat location and produce habitat distribution maps as generally the extent of the habitat is rather small and a more detailed map would generally not add extra grid squares to the map. However, in order to avoid the omission of squares a visual validation of squares selected was carried out and thus the final 10km distribution map is deemed the to be the most comprehensive representation of the distribution of the habitat in Ireland.

The presence of Perennial vegetation of stony banks habitat on a site record described by the NSBS has been determined by the following attributes:

- Type of substrate: stony substrate is more likely to correspond with shingle supporting the habitat than sandy substrate, which support other habitats such as Annual vegetation of drift lines.
- The presence or absence of vegetation on the shingle.
- The occurrence of characteristic species (see section 5.2).
- Presence of Lichens, which indicate stability.
- Conservation value that was defined by the botanical or geomorphological interest of the site. Shingle sites with high conservation value are likely to hold the habitat.
- Beach classification: Perennial vegetation of stony banks frequently develops on shingle ridges, shingle based dune systems and shingle spits.
- The associated habitat was also considered indicative of the presence of the habitat. Thus, shingle based grasslands may correspond with stable stages on the habitat.

Habitat maps from the Management Plan Support Unit (MPSU) were available in digital format for six SACs that support vegetated shingle habitat. The extent of the habitat provided by these maps was taken into account when estimating the overall national habitat resource.

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 vegetated shingle 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. Habitat Range

According to the results of the NSBS (1999), considered the most comprehensive inventory of shingle beach formations in the country, there is a widespread distribution of these structures along the coast of the country, with records of shingle beach in all coastal counties. Similarly, the habitat distribution map and inventory produced as part of this assessment also illustrate an almost continuous distribution pattern, with a more scattered distribution along the coasts of county Cork and north Mayo (see Map I Distribution 1220). Counties Donegal and Galway are those with the highest number of sites recorded; County Louth contains the highest concentration of habitat records along the east coast. Table 3.1 summarises all the habitat records compiled as part of this assessment.

Vegetated fringing beach and vegetated shingle ridges were reported as the most common shingle structures supporting perennial vegetation of stony banks habitat (1220) by the NSBS (1999). County Donegal contains huge areas of shingle and is noted for its raised beaches. Inishowen peninsula and Doagh Isle are deemed as the areas within the county with the best shingle beaches. Donegal also contains the highest concentration of multi-ridged raised beaches supporting habitat 1220, such as Whitestrand Bay, Whitestrand Culoort, Pollan Bay, Tullagh Bay - Tullagh Point and Rockstown Harbour all part of North Inishowen Coast (SAC 2012). A very large and extensive multi-ridged system is also present at Trawmore at Keel (Achill Island) county Mayo (SAC 1513 - Keel Machair - Menaun Cliffs). The other three remaining multi-ridged beaches supporting habitat 1220 are part of Dundalk Bay site (SAC - 0455) in county Louth.

According to table 3.1, only 10 habitat sites are present at Co. Mayo. The county, however, contains one of the most extensive examples of shingle structures in the country, within Clew Bay complex (SAC 1482). This site was not comprehensively surveyed as part of the NSBS and a higher number of sites is expected to be present within this large complex of islands. This would considerably increase the number of records and the habitat's extent. Another area that was not extensively surveyed was The Mullet peninsula, where only two records of the habitat were reported within this assessment (SAC 470 - Mullet/ Blacksod Bay Complex).

Vegetated shingle spits supporting habitat 1220 were reported at Ardmore - Clifden Bay (Co. Galway), Pallas Harbour (SAC 2158 - Kenmare River) which corresponds with an unusual tombolo/spit and Reen Point Shingle (SAC 2281) Co. Cork, Ferry Point (SAC 2170 - Blackwater River) and Cunnigar Point (SAC 663 - Dungarvan Harbour) Co. Waterford, Barranagh Island (SAC 470 - Mullet/ Blacksod Bay Complex) Co. Mayo, Rinville Point (SAC 268 - Galway Bay Complex) Co. Galway, Rossdohan Island (SAC 2158 - Kenmare River), Ballinskelligs (SAC 335 - Ballinskellings Bay & Inny Estuary) and Cromane Point (SAC 343 - Castlemaine Harbour) Co. Kerry.

The NSBS only reported three shingle based dune systems in the country: Streedagh Point Dunes (SAC 1680) Co. Sligo, Bartraw Strand part of Clew Bay Complex (SAC 1482) Co. Mayo and Ballyteigue Burrow (SAC 696) Co. Wexford. The latter was considered the most impressive example of shingle based dune system. The presence of habitat 1220 has been confirmed on SACs 696 and 1482. Additional shingle-based sites are known to occur at Inch and Rosbeigh (Co. Kerry) and Strandhill (Co. Sligo). A large number of sites along the southeast coast are associated with shingle.

Nine records of habitat 1220 associated with vegetated lagoonal systems were also recorded: Coastline from Black Head to Carrickada (SAC 268 - Galway Bay Complex) and Cleggan Strand (Lough Anilaun) Co. Galway, Cloonconeen Lough and Rinevella Bay (SAC 2165 - Lower River Shannon) Co. Clare, Reenydonagan Lough (Co. Cork), An Gleannachan and Port Chorruch (SAC 213 - Inishmore Island) Co. Galway, White Strand (SAC 2012 - North Inishowen Coast) Co. Donegal, Tacumshin Lake (SAC 709) and Lady's Island Lake (SAC 704) Co. Wexford.

Table 3.1. Number of sites where the habitat has been recorded in each county from various sources, sorted by county, moving clockwise from east to west

County	Number of sites
Louth	15
Meath	3
Dublin	3
Wicklow	6
Wexford	10
Waterford	9
Cork	21
Kerry	13
Clare	11
Galway	24
Mayo	12
Sligo	5
Donegal	29
Totals	**161**

3.1. Conservation Status of Habitat Range

- **Habitat Range Area:** 11,500km² (115 grid cells x 100km²).
- **Favourable Reference Range** 11,500km² (115 grid cells x 100km²). Similar to current range (see Map 3).

There is not enough evidence to suggest that there has been any change in the habitat range during the reporting period (1996 –2007). Although, the NSBS (1999) mentioned the absence of the habitat from some sites as a result of impacting activities, its hypothetical presence prior to their survey would not make any major change in the reported current range. The conservation status of the habitat range is assessed as **Favourable**. As the current range encompasses all ecological variation and there is no evidence of recent declines in range, the current range has been set as the favourable reference range (FRR).

4. Habitat Area

Only two sources of data provided information on the extent of the habitat. These were the CMP (Ryle *et al*., 2007) with 77 habitat records mapped (of which 47 sites were also assessed) and the vegetation maps provided by MPSU (13 records). The total extent of habitat reported by these two sources is 80.56ha (see Appendix IV). A total of 161 habitat records have been reported for the entire country (Table 3.1). As 90 sites have been mapped, the extent of 55.9% of the records is known. By extrapolating the known habitat extent, it is estimated that the overall extent of the national resource of perennial vegetation of stony banks is approximately 144ha.

The CMP (Ryle *et al*., 2007), however, only calculated the extent of the habitat for those areas associated with dune systems and did not include unvegetated shingle. Those areas of vegetated shingle not directly associated with dunes systems within sites surveyed by the CMP were not mapped. Additionally, there are large shingle structures such as Clew Bay complex SAC (1482), Inishmore island SAS (213), North Inishowen coast SAC (2012) and Lower River Shannon SAC (2165) that contain large areas of shingle likely to support habitat 1220, for which the total extent of the habitat is not available. All this indicates that the actual extent of the habitat may be greater than the current estimation. Therefore, it seems reasonable to assume that the current area may be closer to 200ha. This highlights the need for further surveys, as well as the development of a more concise definition of the habitat's vegetation communities, as the figures given only correspond with the pioneer phase of the habitat.

Ordnance Survey Ireland (OSI) Discovery Series geo-database as generated by ESRI produced a category for sand and shingle banks (sand_shin). Although, originally it was considered a possible mapping source for shingle banks, eventually it was decided not to use it, as shingle and sand sediment are not differentiated. In addition, taking the whole set of data as indicative of shingle structures would definitely overestimate its extent. Furthermore, the Perennial vegetation of stony banks is a rather restricted habitat type and not all shingle structures are suitable for the habitat.

4.1. Conservation Status of Habitat Area

One of the objectives of the CMP (Ryle *et al*. 2007) was to evaluate the variation on the extent of the habitat in order to determine its condition, the target being to maintain the original extent at least, unless the habitat was subject to natural changes. It is assumed that the vegetation may be subject to periodic and seasonal variation as a result of natural processes that re-distribute shingle sediments and change sediment composition. Such changes are usually acceptable. The CMP survey is considered a baseline survey for those habitats surveyed, mapped and for which a conservation status assessed has been carried out. Thus, although a conservation status assessment has been given for the habitat extent for many of habitat's records, the variation in habitat extent has not been systematically calculated and the overall change on national habitat' extent can not be ascertained. According to these survey results, which only assessed the habitat's conservation status of the habitat at 47 sites, the extent was assessed as Favourable at 37 sites (78%) and Unfavourable-Inadequate at 10 sites (38.8%) (see Table 8.1).

Furthermore, Ryle *et al*. (2007) estimated that an area of approx. 0.5ha, representing 1.4% had been lost during the reporting period.

The NSBS (1999) recorded the destruction of shingle beach at Rossbehy part of SAC 343 (Castlemaine Harbour) as a result of the development of a car park. At Pebble Strand (North Inishowen Coast – SAC 2012), which was described as un-vegetated, to extraction; Rosheenduff Lough (Co. Galway) to rock armoury construction. Quilty (Carrowmore Point to Spanish Point - SAC 1021) to car park construction and rock armoury and Doolin (Black Head / Poulsallagh Complex - SAC 0020). The actual presence of the habitat prior to the impacts could not be confirmed.

The exact extent of the habitat is unknown and only a habitat extent range value is given. The habitat's favourable reference area value is considered to be similar to the current are, as it is considered sufficient to ensure the long term survival of the habitat. Taking into account the results provided by the CMP, which only represent a fraction of the sites identified as supporting the habitat (47 out of 161) and considering the possible habitat losses as indicated by the NSBS due to impacting activities, it seems reasonable to give an **Unfavourable-Inadequate** assessment for the habitat extent.

- **Area covered by the habitat:** 1.44 - 2km^2
- **Favourable Reference Area:** 2km^2. This is based on the estimated current habitat extent.

5. Structures and Functions

5.1. Habitat Structures and Functions

Shingle beaches are largely characterised by their constant dynamism and thus, shingle features are rarely stable in the long term. Waves determine the position of the sediments on the beach. Deposits may be reworked in front of the shore or moved parallel to the shore by longshore drift, before being thrown up onto the shore by storm waves. Many structures exhibit continuous morphological change causing landward and longshore reworking of a finite sediment volume. Ridges lying parallel to the shoreline tend to be rolled over towards the land by storm events. This natural landward movement of shingle banks is likely to be accelerated by sea level rise and increased storminess caused by climate change. Such movement has a knock-on effect on low-lying habitats behind the shingle. A fundamental aim of shingle conservation is to facilitate natural mobility (JNCC, 2004).

The health and ongoing development of the habitats present on a shingle beach depends on a continuing supply of shingle. This may occur sporadically as a response to storm events rather than on a continuous basis. Sediment supply is frequently lacking, owing to interruption of coastal processes by coast defence structures, offshore aggregate extraction or artificial redistribution of material within the site (beach recharge). Thus, attempts to rectify the situation by mechanical reprofiling are likely to fail in the long term, as these do not address the lack of new material (JNCC, 2004).

5.1.1. Conservation Status of Habitat Structures and Functions

The CMP (2004-07) assessed the conservation status of the physical structure and functionality of the habitat based on the sediment supply. Thus, the main target was to ensure the natural mobility of the sediments and organic matter through the absence of anthropogenic factors that may change the natural circulation. According to JNCC (2004) the shingle deposits are dynamic and will adjust and respond to climatic changes (such as rise in sea level) or local changes in wind and wave energy in an attempt to reach "geomorphological equilibrium", which may include landward progression. A constraint by anthropogenic constructions such as fixed sea defence or infrastructures is considered as failure in the extent, as the feature is prevented reaching a natural equilibrium. However, if landward migration is prevented by a feature such as higher ground, the condition is considered favourable as the shingle deposits are free to respond and reach a natural equilibrium. A reduction in the availability of offshore sediments by activities such as dredging is also considered unfavourable.

The presence of typical and negative indicator species, listed below, was also used as an attribute to assess the conservation status of the habitat. The percentage of lichen cover and presence and extent of elements of local distinctiveness was also considered to assess the habitat status.

According to the results provided by the CMP, the structure and function of Perennial vegetation of stony banks was assessed as Favourable at 38 sites (77.6%) and Unfavourable Inadequate at 11 sites (18.65%) (see table 8.1). The CMP only assessed the conservation status at 49 sites out of 161 where the habitat has been reported. Thus, they only represent 30% of the habitat records, and specifically those areas associated with a sand dune systems. Only a single monitoring stop failed for Structure and Funtions owing to the presence of excessive amounts of *Senecio jacobaea*, which is considered a negative indicator. There is no assessment for large shingle areas, which were not surveyed as part of the CMP. The summary of impacts recorded by the NSBS (table 6.1), which reported 96 habitat's records, indicate that 39.58% of the habitat's sites were impacted by developments, 27.08% by rock armoury, 18.75% by extraction of shingle, 14.11% by the construction of a car park, 12.5% by sea wall construction (see table 6.1). All these activities as well as those reported by the CMP negatively affect the structure and functions of the habitat. Therefore, the conservation status of the habitat's structure and functions are deemed to be **Unfavourable-Inadequate**.

5.2. Typical Species

The 2003 Interpretation Manual of the Habitats Directive describes three habitat subtypes within the *Perennial vegetation of stony banks* habitat:

1. Baltic sea kale communities: *Elymo-Crambetum* (Palaearctic habitat code (Pal.Class) - 17.31)
2. Channel sea kale communities: *Lathyro-Crambetum* (Pal.Class - 17.32)
3. Atlantic sea kale communities: *Crithmo-Crambetum* (Pal.Class - 17.33)

The following plant species are given as characteristic species: *Crambe maritima, Honckenya peploides, Leymus arenarius* (17.31), *Lathyrus japonicus* (17.32) and *Crithmum maritimum* (17.33).

The National Vegetation Classification (NVC) for the UK only describes a pioneer phase of Perennial vegetation of stony banks, namely SD1 *Rumex crispus-Glaucium flavum* shingle beach community, which is an important component of this habitat type at some sites. But a wide range of other vegetation types are also included in this habitat (JNCC, 2004). Species included in the most stable stages of Perennial vegetation of stony banks include scrub and heath species *Cytisus scoparius, Prunus spinosa, Calluna vulgaris* and *Empetrum nigrum*. However, they are not listed as typical species of the habitat assessed within this assessment, which is restricted to pioneer c ommunities.

SD1 displays some affinity *with Honckenyo-Crambion maritimae* J.-M. et J. Géhu (1961) according to Gaynor (unpublished).

The NSBS (1999)[2], which is the most comprehensive survey of shingle beaches in Ireland, provided information on plant species (see table 5.1). This survey reported the less diverse vegetation on fringing beaches as a result of the lack of stability on these areas, which are likely to correspond to *Annual vegetation of drift lines* (1210)**.** Front or fringe vegetation was typically limited to *Tripleurospermum maritimum, Rumex crispus, Atriplex prostrata, Beta vulgaris, Sonchus arvensis* and some summer populations of *Potentilla anserina* and *Galium aparine*. More diverse flora was reported in those more stable areas, where lichens encrusting the stones on the plateau or the back of the ridge are found. Species found in these more stable areas include *Plantago lanceolata, Festuca rubra, Lotus corniculatus, Rubus fruticosus, Geranium robertianum* and more occasionally *Silene vulgaris* ssp. *maritima, Daucus carota* and *Rumex acetosella.* The richest sites from a botanical perspective contained shingle based *Festuca rubra* dominated grasslands, which also contained many of the species listed previously along with *Crepis capillaris, Anthyllis vulneraria, Achilea millefolium, Hypochoeris radicata* and *Pilosella officinarum*.

Lathyrus japonicus was only recorded in one site in county Cork during the NSBS survey. See Preston *et al*. 2002). *Crambe maritima,* which although only recorded in two sites during the survey due to the time of the year the survey was carried out, is considered to be more abundant. *Glaucium flavum*, more frequent in the east coast, Co. Louth and curiously in disturbed regions, where extraction has taken place, was found to be less endangered than expected. In addition the latter is found in other coastal habitats especially disturbed areas of sandy substrate. The species was reported from Galway at Tawin Point, Cork, Waterford at Ferrypoint (SAC 2170 - Blackwater River); Wicklow at The Murrough

[2] The nature and time scale of the survey constrained the accuracy of species listed per site as highlighted by the authors.

Wetlands (SAC 2249). The largest population of *Crithmum maritimum* was noted at Black Head/Poulsallagh Complex (SAC 20) Co. Clare.

The CMP (2004 – 07) devised a list of characteristic species for the habitat: *Honckenya peploides*, *Beta vulgaris* ssp. *maritima, Crithmum maritimum, Tripleurospermum maritimum, Rumex crispus* and *Glaucium flavum* (see table 5.1). The presence of lichens was also noted as an indicator of lack of disturbance.

A list of negative indicator species was also devised and included *Senecio jacobaea, Cirsium vulgare* and *Centranthus ruber*, as well as presence of other non-native species, icluding agricultural grasses.

Crambe maritima and *Lathyrus japonicus* are listed in the Interpretation Manual of the Habitats Directive, were not include in the list of typical species of the CMP (Ryle *et al*., 2007). They are also added to the list of typical species for Irish sites despite their low occurrence according to the NSBS (1999).

Otanthus maritimus, perennial herb of sand dunes and stabilised, is only present in two sites in County Wexford. According to Preston *et al*. (2002) has undergone a major decline since the 1850's.

Table 5.1 Habitat's species list

Species	**Habitats Directive Interpretation Manual characteristic species for habitat 1220**	**Habitat 1220 characteristic species – The CMP (2005)**	**Most commonly found species during the National Shingle Survey (1999)**	**NVC – SD1 *Rumex crispus-Glaucium flavum* shingle beach community**	**Overall list of habitat 1220 typical species**
Agrostis stolonifera			Yes		
Ammophila arenaria			Yes	Yes	Yes
Arrhenatherum elatius				Yes	Yes
Atriplex prostrata			Yes	Yes	Yes
Beta maritima		Yes	Yes	Yes	Yes
Cerastium fontanum				Yes	Yes
Cirsium sp.			Yes	Yes	Yes
Cochlearia officinalis			Yes		
Crambe maritima * **R**	Yes			Yes	Yes
Crepis capillaris			Yes		
Crithmum maritimum	Yes	Yes		Yes	Yes
Daucus carota			Yes		
Elytrigia atherica				Yes	Yes
Elytrigia juncea				Yes	Yes
Euphorbia paralias				Yes	Yes
Festuca rubra			Yes	Yes	Yes
Galium aparine			Yes		
Geranium robertianum			Yes	Yes	Yes
*Glaucium flavum**		Yes		Yes	Yes
Glaux maritima			Yes		
Holcus lanatus				Yes	Yes
Species	**Habitats Directive Interpretation**	**Habitat 1220 characteristic species – The**	**Most commonly found species during the**	**NVC – SD1 *Rumex crispus-Glaucium***	**Overall list of habitat 1220 typical species**

	Manual characteristic species for habitat 1220	**CMP (2005)**	**National Shingle Survey (1999)**	***flavum* shingle beach community**	
Honckenya peploides	Yes	Yes	Yes	Yes	Yes
Hypochaeris radicata				Yes	Yes
Lathyrus japonicus * **R**	Yes			Yes	Yes
Leontodon saxatilis				Yes	Yes
Lolium perenne				Yes	Yes
Lotus corniculatus			Yes		
Plantago coronopus			Yes	Yes	Yes
Plantago lanceolata			Yes	Yes	Yes
Plantago maritima			Yes		
Potentilla anserina			Yes	Yes	Yes
Ranunculus repens			Yes		
Raphanus raphanistrum ssp. *Maritimus*			Yes		
Rubus fruticosus			Yes		
*Rumex crispus**		Yes	Yes	Yes	Yes
Sagina apetala eercta				Yes	Yes
Sedum acre				Yes	Yes
Senecio jacobea **Ng**			Yes	Yes	
Senecio vulgaris **Ng**			Yes		
*Silene uniflora**		Yes			Yes
Silene vulgaris ssp. Maritima			Yes	Yes	Yes
Solanum dulcamara				Yes	Yes
Sonchus arvensis			Yes	Yes	Yes
Sonchus asper				Yes	Yes
Trifolium repens			Yes		
Tripleurospermum maritimum		Yes	Yes	Yes	Yes
Urtica dioica **Ng**			Yes		

*Deemed typical spp. for the habitat (1220) by Sneddon &Randall (1993)
Ng - Negative indicators in habitat 1220
R – rare, but found in habitat 1220
Nomenclature follows Stace 1997

The following species that are listed as typical of the SD1 habitat in Rodwell (2000) have been omitted from the list, as they are not native to Ireland: *Senecio viscosus, Lactuca serriola, Picris echioides*.

5.2.1.Conservation Status of Habitat Typical Species

Crambe maritima and *Lathyrus japonicus* are becoming increasingly rare according to Curtis & McGough (1988) and Ryle (2000). The latter was also considered rare by the NSBS (1999) whereas the former was considered less endangered.

Glaucium flavum is rare and declining in Ireland as reported by Gaynor (unpublished). The species is also found in other coastal habitats especially disturbed areas of sandy substrate and thus is considered characteristic of Annual vegetation of drift lines (EU Code 1210).

None of the mentioned surveys specifically targeted the distribution or conservation status of the habitat typical species. There is no strong basis to provide an accurate assessment of the species conservation status, although all monitoring stops in the CMP passed the target for typical species. Therefore, the conservation status of typical species of vegetated shingle is tentatively assessed as **favourable**.

6. Impacts and Threats

The main impacts that continue to affect vegetated shingle habitat in Ireland are listed in the NSBS (Table 6.1 & Appendix V) and the CMP (Table 6.2).

Table 6.1. Percentage of sites containing habitat 1220 affected by impacts (NSBS, 1999)

Impacts	Percentage of sites affected (%)
Development	39.58
Rock Armoury	27.08
None	20.83
Extraction / Movement of shingle	18.75
Dumping	17.71
Car Park	14.11
Sea Wall	12.5
Groynes	1.04

Table 6.2. Coastal Monitoring Project (Ryle *et al.*, 2007). Activities recorded in 'Perennial vegetation of stony banks'

Activities Code	Activities	Number of records
900	Erosion	13
622	Walking, horse riding and non-motorised vehicles	10
302	Sand and gravel extraction -removal of beach materials	6
871	Sea defence or coastal protection works	6
623	Outdoor sports and leisure activities - motorised vehicles	4
720	Trampling, overuse	4
423	Disposal of inert materials	2
101	Cultivation	1
411	Factory	1
421	Discharges -disposal of household waste	1
422	Discharges -disposal of industrial waste	1
502	Paths, tracks, cycling tracks	1
811	Management of aquatic and bank vegetation for drainage purposes	1
Total		51

Shingle beaches by their nature are ephemeral and prone to sometimes massive and rapid change. The main impact on the habitat is the disruption of sediment supply, owing to interruption of coastal processes by developments, car park construction and coastal defence structures such as rock armoury and sea walls. These activities are widespread, so plants and animals that survive are therefore usually tolerant of periodic disturbance. However, once the ridges become stabilised and out of reach of storm waves, a gradual build-up of interstitial sediment takes place and with it the development of more mature and stable vegetation. At this stage the communities, which become established are adapted to highly stressful conditions involving lack of water and substantial temperature fluctuations, not dissimilar to those of some deserts. Although such species are highly tolerant of such conditions they are much more sensitive to disturbance (Doody and Randall, 2003).

The removal of gravel is still one of the most widespread and damaging activities directly affecting the habitat. Gravel extraction alters the morphology and destroys the vegetation and associated fauna.

Shingle vegetation is fragile and trampling caused by access on foot, horse riding, and particularly by vehicles, still damages many sites. Simply driving a vehicle across a series of mature shingle ridges can cause damage that remains visible for many years.

Other frequently recorded activities known o impact on the habitat include dumping and disposal of various types of waste, drainage and cultivation.

Climate change and sea level rise will further exacerbate the above mentioned problems.

In common with Annual vegetation of driftlines, the two most commonly noted impacts recorded during the CMP were *erosion* and *walking*, *horseriding and non-motorised vehicles*, although in this case the order of frequency was reversed, with erosion the most commonly listed impact. Also included in the list of commonly recorded impacts were *sea defence or coastal protection works* and *trampling*, *overuse*, the two other impacts noted at more than a single site in annual vegetation of driftlines.

When access to the beach area is not controlled, shingle zones can, particularly when they are adjacent to access points and because of the relatively stable nature of the substrate, be damaged by the use of motorised vehicles. There are even recorded instances, such as that observed at Rossbehy (Co. Kerry), of the material in shingle banks being levelled and re-worked for use as car parking areas, leading to the effective destruction of part or all of the habitat.

There were several recorded instances - included under a number of different impacts - in which damage to the habitat was considered to be irreparable. Those under which more than a single example were recorded were *removal of beach materials*, which was deemed to represent irreparable damage at four sites and *sea defence or coastal protection works* at two of the survey sites. Most of the areas associated with irreparable damage were either very small, or were considered as ‘unknown’. Included under *sea defence or coastal protection works* was the presence of walls or other artificial impediments to the natural mobility of shingle. Their presence was regarded as an irreparable negative influence, as they represent an interruption to the natural movement of shingle.

The total areas affected by each impact included in Table 6.2 are all understated, as at least half of the individual estimated affected areas of each impact (with the exception of *Motorised vehicles*) were recorded as ‘unknown’. In some cases, such as that of *erosion*, this may be explained by the fact that there are no substantial baseline data on habitat extent, with which apparent recent losses may be compared. Future monitoring surveys and reports will be able to utilise the habitat extent data generated in the present survey to produce more refined estimates of areas affected by impacts and threats, although some difficulties in distinguishing between the areas of damage resulting from human interference and the areas attributable to natural erosion will probably persist.

5.3. Sand and gravel extraction -removal of beach materials

Gravel is a rare material highly desired by the construction industry. As a result, large quantities are obtained by extraction from both onshore and offshore deposits. Onshore material provides a ready source of easily accessible material but can cause long term damage to the surface shingle. The latter is more difficult to exploit and impacts on the marine environment can also be significant. Knock-on effects, on coastal shingle beaches and structures in particular, should also be considered. The onshore removal of gravel can be carried out by individuals who remove small quantities for personal use or larger scale operations for sale.

Onshore extraction was recorded by the NSBS on a large-scale at Rockstown Harbour (North Inishowen Coast – SAC 2012). The occurrence of extraction was reported at many other sites, such as Pebble Strand also part of North Inishowen Coast (SAC 2012) where the habitat is considered not to be present according to the NSBS site's descriptions. This activity may be the reason for the absence of the habitat. Extraction or movement of gravel was reported during the NSBS at 26 (18.75%) sites where habitat 1220 was recorded (see table 6.1 and Appendix V). In addition, the CMP reported sand and gravel extraction -removal of beach materials at 6 of the 49 sites where impacting activities were reported.

Offshore aggregate extraction is not an obvious and direct pressure on coastal shingle formations. However, the extent of gravel extraction offshore posses a potential threat if it diminishes the supply of material onshore. No licence has been given to any offshore gravel extraction. Thus it is assumed that this activity does not occur in Ireland.

Removal of beach materials trend

According to the results from the NSBS (Moore & Wilson, 1999) and the CMP (Ryle *et al*., 2007) gravel extraction frequently occur on shingle structures supporting the habitat. Although this activity is a "Notifiable action" within cSACs (see Appendix VI) and in most cases requires license from a statutory authority it continues to occur. The occurrence of this activity is expected to continue in the future particularly considering the increasing pressure for development.

5.4. Infrastructure development

Infrastructure development, including buildings such as housing, caravans, recreational facilities, car parks, access roads, etc., directly destroy the shingle surface. According to the NSBS results (Moore & Wilson, 1999) results, different types of developments affected 39.58% of the sites where the habitat was recorded; while car parks where recorded at 14.11% (see table 6.1) of the sites. This survey also reported these activities in many other sites where the habitat was expected but was not present, and these activities may have been the reason for the absence of the habitat as suggested in some cases in the report.

Infrastructure development trend

These activities have negatively impacted the habitat within the reporting period and are expected to continue in the future particularly considering the increase on development pressure by the coast and the demand for recreational activities and infrastructures related to these activities. These activities are likely to have a considerably negative impact on the most stable stages of the Perennial vegetation of stony bank communities (i.e. grasslands, scrub), which may be more suitable for developments, and which distribution and floristic composition is unknown in Ireland and require further surveys (see section 1).

5.5. Sea defence and coastal protection

The construction of coastal defences can have potentially serious implications for shingle habitats. Defence works may result in changes to the movement of material both on and offshore and alongshore. This has important consequences for the natural dynamics of the habitat. The structures themselves can also lead to a loss of overall extent in habitat. Some of these activities include:

- Beach nourishment, feeding and reprofiling.
- Rock armoury, which consists of an artificial deposited or constructed boulder to reduce erosion. The construction of this structure was recorded by the NSBS at 27.08% of the sites containing the habitat (see table 6.1).
- Groynes that consist of small rocks sealed in wire mesh to reduce erosion. The NSBS reported this structure type at 1.04% of the habitat's sites.
- Sea wall, which are constructed of cement along the back of the shore. Reported at 12.5% of the habitat's sites by the NSBS.

The NSBS also indicates a higher pressure from urban development and seacoast protection structures along the coast in those sites near large urban areas such as Dublin (e.g. Bray, Killiney Bay, Skerries, etc). These activities have undoubtedly affected the shingle deposit dynamics and this is likely to explain the absence of the habitat in some of the sites. The CMP reported sea defence or coastal protection works at 6 of the 49 sites where the habitat was present as having certain influence on the habitat.

Sea defence and coastal protection trend

These activities have been reported by both the NSBS and the CMP as negatively affecting the habitat. An increasing demand for development of coastal areas and possible sea level rise (as a result of global warming) may exacerbate the impact of these types of constructions.

5.6. Recreational use

Recreational activities impacting shingle beaches include trampling, boat mooring and vehicle access. Some of these impacts can be cumulative, leading to long term and irreparable damage to the shingle surface. Recreational activities may also have an impact on other important features, such as bird nesting survival and behaviour.

Trampling caused by human circulation may affect the most susceptible communities on shingle structures. Compaction of the surface may also affect the seed bank making it more difficult for some species to germinate (Doody and Randall, 2003). Driving vehicles onto the shingle causes considerable disruption to the surface.

The impact of these activities depends upon the intensity of the activity and nature of the shingle beach.

Recreational use trend

The NSBS (1999) did not directly recorded these activities as part of the survey. However in some case the presence of car parks would facilitate the access to the site and would indicate the occurrence of these impacting activities. In contrast, the CMP (2004-07) directly recorded this sort of activity including walking, horse riding, non-motorised vehicles, motorised vehicles, trampling, paths and tracks (see table 6.2). The frequency, influence and intensity of these activities are likely to increase in the future as a result of an increasing demand on recreational activities.

5.7. Dumping

Shingle beaches are frequently used as dumping grounds. The use of the ecosystem as dumping of farm organic waste causes local eutrophication.

Dumping trend

The NSBS recorded dumping at 17.71% of the sites where the habitat was recorded (see table 6.1 and Appendix V). Additionally the CMP (2004-07) also reported disposal of inert material, household or industrial disposal in some of the sites surveyed (see table 6.2). An increase in the influence and intensity from this activity is expected in the future related to increase in development pressures.

5.8. Grazing

Grazing of domestic stock is a relatively restricted activity. The sparseness of the vegetation and limited growth rates combine to make the available herbage limited.

This activity not only directly damages the vegetation but also has the indirect effect of the fertilisation it supplies to an otherwise nutrient poor environment.

Grazing trend

Neither of the main surveys recorded this activity and thus the influence on the habitat is either small or non-existent.

5.9. 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.

The Research Branch Monitoring Section (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.

Impact records for the habitat from the SIR reporting programme are only available since 2001. The information collected is rather limited and may not be comprehensive. Thus, it cannot be taken as a summary of the overall picture of activities impacting the habitat nationwide. Sea defence and coastal protection works (871) and removal of beach materials(302) were reported as the most impacting activities on the habitat.

Activity	Code	Site Code	Site Name
▪ Removal of beach materials	302	2012	North Inishowen Coast
		2189	Farranamanagh Lough
▪ Disposal of household waste	421	2259	Tory Island Coast
▪ Storage of materials	440	1195	Termon Strand
▪ Dumping, depositing of dredged deposits	860	1090	Ballyness Bay
▪ Sea defence or coastal protection works	871	2249	The Murrough Wetlands

5.10. Other Impacting Activities

Other impacting activities affecting shingle beaches and their fauna and flora include arable cultivation, management of aquatic and bank vegetation for drainage purposes.

6. Future Prospects

6.1. Negative Future Prospects

The results given by the main surveys indicate that impacting activities have negatively affected many of the sites where the habitat has been recorded. Overall, an increasing trend is expected on the main activities negatively impacting the habitat is expected in the future: disruption of the sediment supply as a result of coastal defence already built will continue in the future. In addition new structures are likely to be built as a result of the increase of development pressures. Removal of gravel sediments has not been controlled and both legal and illegal extractions are likely to occur in the future unless stricter measures are put into place. Furthermore, development and recreational pressures are likely to increase, risking the viability of the habitat, particularly in sites close to urban areas.

6.2. Positive Future Prospects

Statutory site designation plays and important part in the conservation of the habitat through the designation of Special Areas of Conservation (SAC), under the Habitats Directive (92/43/EEC) and Natural Heritage Areas (NHAs), under Irish legislation. Certain activities including gravel extraction, Notifiable actions have been set for sand dune habitats within SACs, covering certain activities including gravel extraction, which require consent from the Department of Environment, Heritage and Local Government (Appendix IV).

As illustrated in Appendix IV, 117 (73.6%) of the habitat records are contained within a SAC designation and 22 (13.8%) within a NHA, while the remaining records 20 (12.6%) are outside any designation. As there is no accurate figure for the extent of the habitat, thus the extent of designated habitat is unknown, the percentage of the sites designated (87.4%) indicates that a large proportion of the known habitat sites should be theoretically protected. Notifiable actions, which require consent from the Department of Environment, Heritage and Local Government, have been set for vegetated shingle within SACs.

However, it is unclear how effective these designations are in terms of protecting vegetated shingle, until an appropriate program is specifically designed to monitor the habitat.

6.3. Overall Habitat Future Prospects

An increasing trend in the most negative impacting activities indicates an overall negative future prospect for the habitat.

Although designation has provide statutory protection to many of the habitat's records (87.4%) and many of the activities impacting the habitat require licence or consent, both the NSBS and CMP surveys indicate that activities continue to occur within designated sites, risking the long-term viability of the habitat.

The CMP (2004-07) specifically assessed the conservation status at 47 sites, each assessment including as assessment of the habitat's future prospects. They were deemed Favourable at 29 sites, Unfavourable Inadequate at 8 sites and Unfavourable Bad at 1 site (see table 8.1). Thus, overall an Unfavourable assessment was given to 17.8% of the sites.

Doody and Randall (2003) highlights the influence of climate changes on shingle communities as it will increase sea levels and the frequency of storms. They report a median estimate of 0.8m sea-level rise over the next 100 years on Great Britain. Some areas of shingle, particularly those below 5m OD, may be lost and the frequency of saline intrusions will lead to loss of heath species on terrestrial shingle.

Indeed, sea level raise as a result of global warming may be one of the major threats and exacerbate the impact of other activities. One of the main long-term threats is as a result of man's intervention in natural coastal processes. Occasionally trapped between urban development on the landwards side and rising sea levels on the seaward side. Vegetated shingle is also threatened by "Coastal squeeze" (Doody and Randall, 2003).

Thus, considering the above the overall future prospects of the habitat are poor and **Unfavourable Inadequate** assessment is given to this attribute.

7. Overall Assessment of the Habitat Conservation Status

The CMP assessed the conservation status of 47 of the 77 habitats records reported by this survey (see table 8.1). An assessment was not carried out for sites with minor areas of shingle. In addition, this survey only focused on habitat's areas associated with sand dune systems and thus large areas of shingle not related to these systems have not been assessed. A total of 161 habitat's records have been reported within this assessment. Thus, an overall assessment based on the results of the CMP survey can not be directly extrapolated and other information such as activity impacts has been used to carry out assessments for the four main habitat's attributes: range, extent, structure and functions and future prospects.

Table 8.1. Coastal Monitoring Project (2004-07) Conservation Status Assessments presented as number of sites

	Favourable	Unfavourable Inadequate	Unfavourable Bad
Extent EU rating	37	10	0
Structure and function EU rating	41	6	0
Future prospects EU rating	28	18	1
Overall EU rating	26	20	1

It should be mentioned that Perennial vegetation of stony banks is a particular habitat, which as a result of its ephemeral nature is prone to sometimes massive and rapid changes. The plants and animals associated with the habitat are usually tolerant of periodic disturbance. However, permanent impacts such as coastal defence constructions or even temporal impacts (e.g. gravel removal, trampling) may considerably negatively affect the conservation status of the habitat as reported by the NSBS.

The habitat conservation status of three of the four main attributes has been assessed as Unfavourable Inadequate at national level.

- The habitat range for vegetated shingle is considered to be **Favourable**. It was not possible to accurately calculate the area of the habitat, but is considered to range from 1.42 to 2km^2.The favourable reference range is deemed to be similar to the current range.
- The extent of the habitat is assessed as **Unfavourable-Inadequate** based on the results provided by the CMP (Ryle *et al*., 2007), who reported a loss of 1.4% of the area of vegetated shingle (approx. 5ha).
- An **Unfavourable-Inadequate** assessment is given to vegetated shingle in terms of structure and functions. The assessment is based on the results given by the CMP and the NSBS.
- The habitat's future prospects are considered to be poor and thus an **Unfavourable-Inadequate** assessment is given to this attribute. The main impacting activities have negatively impacted the habitat in the reporting period and are considered likely to continue into the future, in spite of statutory protection to the majority of the habitat's records.

Thus, considering the Unfavourable-Inadequate assessments for three of the four main habitat attributes, the overall conservation status for Perennial vegetation of stony banks habitat is **Unfavourable-Inadequate**.

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APPENDICES

APPENDIX I

SOURCES OF DATA

The following is a summary of the main sources of information employed to produce the habitat's distribution map (map 1), to evaluate its current range (map 2) and to carry out its conservation status assessment:

A. National Single Beach Survey (NSBS) (1999)

The aim of the project was to carry out an inventory of shingle areas of conservation value on the Irish Coast and to record data relating to the rare species and vegetation of the same. A total of 153 sites were surveyed as part of the project, the survey of which spanned a six-month period in 1999. The sites (i.e. beach) were classified according to their conservation value (based on representativity, species diversity, habitat diversity and the presence of rare or scarce plant species (e.g. *Mertensia maritima, Lathyrus japonicus, Crambe maritima* and *Glaucium flavum*). 37 sites were ranked as high conservation value, 51 as medium and 65 as low.

This project did not differentiate between habitat 1220 "Perennial vegetation of stony banks" and 1210 "Annual vegetation of drift lines" listed in Annex 2 of the Habitats Directive and a broader definition of the "shingle habitat" was considered as part of the project. Thus, "shingle habitat" was defined as areas of coastal beaches, above the mean high water mark, rich in stones of approximately 2mm to 250mm in diameter which have been worked by the sea, giving them a rounded or smoothed shape. Beaches dominated by larger particles (up to 1.5m in diameter) were termed boulder deposits and were include in the survey**.**

The survey concentrated on large shingle systems, those smaller than 100m in length were omitted unless they held particular interest (i.e. presence of a rare plant or unique shingle formation). A description of the beach, its conservation value, grid reference, beach classification (1-Fringing beach, 2- Shingle ridge, 3 - Shingle based dune system, 4- Lagoonal system, 5- Shingle spit and 6- Multiridged raised beach) was given. A list of impacts and alterations at the site (e.g. extraction/ movement of shingle, dumping, rock armoury, groynes, sea wall, car park, etc) was also given for each site. Profile drawings were also produced for each site including information on substrate, topography and occasionally plant communities.

Some sites had one grid reference and these were mapped as points whereas some had two grid reference; for the start and end of the beach. Errors on the geographical location of the shingle were noted at: Rinville Point (NHA 268) Co. Galway; Ballybunion (NHA 1340) and Maherabeg, Co. Kerry; North Beach, Skerries, Co. Dublin; Carricknola/Tromcastle Strand, (cSAC 1021) and Doonbeg and Rinnagonaght Strand, Co. Clare.

B. Biomar Survey of Irish machair sites (1996)

This project, the survey of which took place in the summer of 1996, aimed to identify Annex I habitats present on a selection of sites containing machair habitat. The identification and mapping of vegetation communities was based on the British National Vegetation Classification (NVC). The project's authors deemed this classification compatible with the Braun-Blanquet phytosociological system, traditionally used in Ireland. Only one vegetation community was identified, which was deemed to correspond with the Annex I Perennial vegetation of stony banks: SD1 *Rumex crispus-Glaucium flavum* shingle beach community.

Only hard copies of their vegetation maps were produced, a radon dot within the relevant vegetation community was mapped in digital format as part of this assessment in order to produce the habitat distribution map. A list of sites containing the habitat as recorded by this survey is included in Annex IV. Occasionally the record was also reported by the National Shingle Beach Survey (Moore & Wilson 1999)

C. Coastal Monitoring Project (CMP) (2004-07)

This project was carried out on behalf of the National Parks and Wildlife Service (NPWS). The main objective was to assess the conservation status of habitats associated with sand dune systems in Ireland listed in Annex I of the Habitats Directive (92/43/ECC). The project spanned three field seasons (2004 to 2006). The final report and assessments were completed in 2007 (Ryle *et* al. 2007). The methodology employed was adapted from the Habitats monitoring methodology developed by Joint Nature Conservation Council (JNCC), which was conveyed in a series of Common Standards Monitoring (CSM) guidance documents. This system is based on vegetation surveys, measurements of habitat areas and assessments of threats and management practises. Both habitats *Perennial vegetation on stony banks* (1220) and *Annual vegetation of drift lines* (1210) are occasionally associated with sand dune systems and thus included in the project scope. However, the project only surveyed and assessed the conservation status of these habitats in this particular case (i.e. associated to sand dune systems). The Habitats Directive overall objective is to achieve and maintain favourable conservation status for all habitats and species of community interest. Thus, the EU member states obligation to assess the conservation status of habitats and species is not restricted to Natura 2000 sites (i.e. SACs and SPAs), but the whole national resources, both within and outside of the Natura 2000 network.

D. NPWS – Management Planning Support Unit Maps (MPSU) (2006)

MPSU provided digitised vegetation maps for a series of SACs. The relevant Site's Management Plans were produced at different time and two different vegetation classifications (i.e. NPWS habitat classification and Fossit, 2000) were employed for the production of the Plans. The maps provided also included the equivalence between these classifications and the EU habitat (1220). Thus, the CO7 "shingle beach" NPWS vegetation type (Lockhart et. al., 1993) corresponds to the Perennial vegetation of stony banks and LS1 and CB1 (Fossit, 2000) are deemed be also equivalent to the EU habitat. It should be highlighted that according to Fossit (2000) and as mentioned in section 1 of the report, only CB1 corresponds to habitat 1220.

A total of six SACs containing the habitat were provided by MPSU in digital format. These are: Dundalk Bay (455), Bray Head (714), Buckroney-Brittas Dunes and Fen (729), Ballyhoorisky Point To Fanad Head (1975), Farranamanagh Lough (2189) and Dunbeacon Shingle (2280). The habitat section of Ballyhoorisky Point to Fanad Head sites corresponding with Fanad Head record (NSBS, 1999) is considered to overestimate the actual extent of the habitat and thus is not taken into account to estimate the overall habitat extent.

E. Year 2000 aerial photographs

The year 2000 orthorectified aerial imagery (Ordnance Survey of Ireland) was used to aid mapping the habitat distribution.

F. Habitat Assignment Project (NPWS 2006)

This desktop project was undertaken by NPWS and the main aim was classifying sites according to habitats listed in the Annex I of the Habitats Directive (92/43/EEC). Sites were obtained from a series of sources. These sources included NHA site files, MPSU Plans, Natura 2000 Forms, NPWS surveys, NGOs shadow lists inter alia.

G. NPWS Enquiries Database

This is a comprehensive NPWS internal database, which includes data on habitats and sites designated. Appendix IV specifies which habitat records are included in this database.

APPENDIX II

SHINGLE VEGETATION CLASIFICATION
(Sneddon and Randall, 1993)

Table II.1 Divisions are listed in order broadly from the most landward to the most seaward vegetation types (from Sneddon and Randall, 1993)

1. Scrub communities	la. *Prunus spinosa* communities lb. *Rubus fruticosus* communities lc. *Ulex europaeus* communities	
2. Heath communities	2a. Wet heaths 2b. Dry heaths	2b.i. *Pteridium aquilinum* 2b.ii. *Calluna vulgaris* communities 2b.iii Moss-rich communities
3. Grassland communities	3a. Saltmarsh-influenced grasslands 3b. *Agrostis stolonifera* grasslands 3c. *Arrhenatherum elatius* grasslands 3d. *Festuca rubra* grasslands 3e. Mixed grasslands 3f. Sandy grasslands	
4. Mature grassland communities	4a. Mature grasslands	4a.i. Mature grasslands - *Festuca rubra* 4a.ii. Mature grasslands - *Dicranum scoparium* 4a.iii. Mature grasslands - *Arrhenatherum elatius*
	4b. Less mature grasslands	4b.i. Less mature grasslands pure shingle 4b.ii. Less mature grassland saltmarsh influence
5. Secondary pioneer communities		
6. Pioneer communities	6a. *Honkenya peploides* dominated communities 6b. *Senecio viscosus* dominated communities 6c. *Beta vulgaris maritima* dominated communities 6d. *Raphanus maritimus* dominated communities 6e. Herb-dominated pioneer communities 6f. *Silene maritima* dominated pioneer communities	

APPENDIX III

SITES WITH SHINGLE BASED GRASSLAND ASSOCIATED

Vegetated shingle beach sites where associated shingle beach grassland was recorded as part of the NSBS (1999). This vegetation community represents one of the most stable stages of the habitat.

Table II.1 Single beach sites with associated shingle based grassland (from Wilson & Moore, 1999)

Beach Name	NHA Code	County
Tramone Bay/White Strand	2012	Donegal
Bulbin	2012	Donegal
Whitestrand Bay	2012	Donegal
Doaghmore Point	2012	Donegal
Fanad Head	1975	Donegal
Ballyhiernan Bay	1975	Donegal
Coastline from Port ui Chuirean to Bunaninver	1141	Donegal
Illancrone and Iniskeeragh Island.	152	Donegal
Roishin Point	197	Donegal
Doonbeg and Rinnagonaght Strand	1007	Clare
Reenydonagan Lough.	No designated in 1999	Cork
Ballinskelligs	335	Kerry
Streedagh	1680	Sligo
Standalone Point	127	Sligo
Sruhir Strand	1529	Mayo
Ferrypoint	72	Waterford
Eggleston Point to Dundalk	455	Louth
Castlebellingham to Annagassan Pier	445	Louth
Michelstown and Lurganboy	No designated in 1999	Louth

APPENDIX IV

HABITAT INVENTORY

Record N°	Site Name	Site Code	Designation	**Shingle Beach Name** (CMP Name)	County	National Shingle Beach Survey record - 1999	Coastal Monitoring Project - 2004 /05/06	MPSU map of habitat	Biomar survey of Irish machair sites - 1996	NPWS Habitat Assignment Project - 2006	NPWS Enquiries database (habitat recorded)	Geographical location recorded	Habitat present	Habitat extent mapped by CMP or MPSU (ha)	Extent Conservation Status (CS)	Structure and function CS	Future prospects CS	Overall Conservation Status
1	**Black Head/Poulsallagh Complex**	**000020**	**SAC**	Fanore	Clare		Yes/06				1220	Yes	Yes	0.525	F	F	F	F
2	**Black Head/Poulsallagh Complex**	**000020**	**SAC**	Poulsallagh	Clare	Yes						Yes	Yes	N/A	N/A			
3	**Inagh River Estuary**	**000036**	**SAC**	Lahinch	Clare	Yes	Yes/06					Yes	Yes	0.138	F	F	F	F
4	**Ballycotton, Ballynamona and Shanaga**	**000076**	**NHA**	Shanagarry	Cork		Yes/05			Yes		Yes	Yes	1.175	U1	U1	F	U1
5	**Ballymacoda**	**000077**	**SAC**		Cork		Yes/05					Yes	Yes	1.178	U1	F	U1	U1
6	**Roaringwater Bay and Islands**	**000101**	**SAC**	Calf Island Middle	Cork	Yes						Yes	Yes	N/A	N/A			
7	**Roaringwater Bay and Islands**	**000101**	**SAC**	Castle Island	Cork	Yes						Yes	Yes	N/A	N/A			
8	**Roaringwater Bay and Islands**	**000101**	**SAC**	Long Island East	Cork	Yes						Yes	Yes	N/A	N/A			
9	**Roaringwater Bay and Islands**	**000101**	**SAC**	Long Island West	Cork	Yes						Yes	Yes	N/A	N/A			
10	**Roaringwater Bay and Islands**	**000101**	**SAC**	Rosbrin Point	Cork	Yes						Yes	Yes	N/A	N/A			
11	**Donegal Bay (Murvagh)**	**000133**	**SAC**	Mullanasole	Donegal		Yes/06					Yes	Yes	0.64	F	F	F	F
12	**Donegal Bay (Murvagh)**	**000133**	**SAC**	Mount Charles	Donegal		Yes/06					Yes	Yes	0.108	F	U1	U2	U2
13	**Durnesh Lough**	**000138**	**SAC**	Rossnowlagh	Donegal		Yes/06			Yes		Yes	Yes	1.030	F	F	F	F
14	**Erne Estuary/Finner Dunes**	**000139**	**NHA**	Finner	Donegal		Yes/06				1220	Yes	Yes	0.352	F	F	F	F

15	**Slieve Tooey / Tormore Island / Loughros Beg Bay**	**000190**	**SAC**	Maghera	Donegal		Yes/06					Yes	Yes	0.1	F	F	F	F
16	**West of Ardara/Maas Road**	**000197**	**SAC**	Roshin Point	Donegal	Yes	Yes/06					Yes	Yes	0.259	F	F	F	F
17	**West of Ardara/Maas Road**	**000197**	**SAC**	Clooney	Donegal		Yes/06					Yes	Yes	0.070	F	F	F	F
18	**Inishmore Island**	**000213**	**SAC**	Eararna	Galway		Yes/06				1220	Yes	Yes	0.416	F	F	F	F
19	**Inishmore Island**	**000213**	**SAC**	Portmurvy	Galway	Yes	Yes/06				1220	Yes	Yes	0.143	N/A			
20	**Inishmore Island**	**000213**	**SAC**	An Gleannachan	Galway	Yes						Yes	Yes	N/A	N/A			
21	**Inishmore Island**	**000213**	**SAC**	Clochan	Galway	Yes						Yes	Yes	N/A	N/A			
22	**Inishmore Island**	**000213**	**SAC**	Port Chorruch	Galway	Yes						Yes	Yes	N/A	N/A			
23	**Inishmore Island**	**000213**	**SAC**	Tra na bhFrancach	Galway	Yes						Yes	Yes	N/A	N/A			
24	**Galway Bay Complex**	**000268**	**SAC**	Bishopsquare	Clare		Yes/06				1220	Yes	Yes	0.179	F	F	U1	U1
25	**Galway Bay Complex**	**000268**	**SAC**	Barna	Galway		Yes/06				1220	Yes	Yes	1.087	F	F	F	F
26	**Galway Bay Complex**	**000268**	**SAC**	Coastline from Black Head to Carrickada.	Clare	Yes	Yes/06				1220	Yes	Yes	0.18	N/A			
27	**Galway Bay Complex**	**000268**	**SAC**	Rinville Point	Galway	Yes						Yes	Yes	N/A	N/A			
28	**Galway Bay Complex**	**000268**	**SAC**	Tawin Point	Galway	Yes					1220	Yes	Yes	N/A	N/A			
29	**Inishbofin and Inishshark**	**000278**	**SAC**	Inishbofin	Galway		Yes/06					Yes	Yes	0.14	N/A			
30	**Ballinskellings Bay & Inny Estuary**	**000335**	**SAC**	Waterville - Inny Strand	Kerry		Yes/05					Yes	Yes	0.322	F	F	U1	U1
31	**Ballinskellings Bay & Inny Estuary**	**000335**	**SAC**	Ballinskelligs	Kerry	Yes						Yes	Yes	N/A	N/A			
32	**Castlemaine Harbour**	**000343**	**SAC**	Rossbehy	Kerry		Yes/05				1220	Yes	Yes	0.05	N/A			
33	**Castlemaine Harbour**	**000343**	**SAC**	Cromane Point	Kerry	Yes						Yes	Yes	N/A	N/A			
34	**Dundalk Bay**	**000455**	**SAC**	Annagassan Pier to Ardsallagh	Louth	Yes					1220	Yes	Yes	N/A	N/A			
35	**Dundalk Bay**	**000455**	**SAC**	Blackrock	Louth			Yes				Yes	Yes	1.649	N/A			
36	**Dundalk Bay**	**000455**	**SAC**	Castlebellingham to Annagassan Pier.	Louth	Yes		Yes			1220	Yes	Yes	8.111	N/A			
37	**Dundalk Bay**	**000455**	**SAC**	Eggleston Point to Dundalk	Louth	Yes		Yes			1220	Yes	Yes	15.555	N/A			
38	**Dundalk Bay**	**000455**	**SAC**	Giles Quay	Louth	Yes		Yes			1220	Yes	Yes		N/A			
39	**Dundalk Bay**	**000455**	**SAC**	Lurgan White House	Louth	Yes					1220	Yes	Yes	N/A	N/A			
40	**Dundalk Bay**	**000455**	**SAC**	River Foot	Louth	Yes		Yes			1220	Yes	Yes	1.92	N/A			
41	**Dundalk Bay**	**000455**	**SAC**	Salterstown to Dunany Point	Louth	Yes		Yes				Yes	Yes	0.319	N/A			

42	**Mullet/ Blacksod Bay Complex**	**000470**	**SAC**	Termoncarragh Lough	Mayo		Yes/06		Yes	Yes		Yes	Yes	0.424	F	F	U1	U1
43	**Mullet/ Blacksod Bay Complex**	**000470**	**SAC**	Barranagh Island	Mayo	Yes						Yes	Yes	N/A	N/A			
44	**Laytown Dunes/Nanny Estuary**	**000554**	**NHA**	Laytown	Meath	Yes	Yes/04					Yes	Yes	0.175	U1	F	U1	U1
45	**Aughris Head**	**000620**	**NHA**	Aughris Head	Sligo	Yes						Yes	Yes	N/A	N/A			
46	**Ballysadare Bay**	**000622**	**SAC**	Strandhill/ Cullemore Strand	Sligo		Yes/06					Yes	Yes	0.46	U1	F	F	U1
47	**Cummeen Strand/Drumcliff Bay (Sligo)**	**000627**	**SAC**	Strandhill/ Cullemore Strand	Sligo		Yes/06					Yes	Yes	1.07				
48	**Cummeen Strand/Drumcliff Bay (Sligo)**	**000627**	**SAC**	Raghly	Sligo	Yes						Yes	Yes	N/A	N/A			
49	**Cummeen Strand/Drumcliff Bay (Sligo)**	**000627**	**SAC**	Standalone Point	Sligo	Yes						Yes	Yes	N/A	N/A			
50	**Dungarvan Harbour**	**000663**	**NHA**	Cunnigar Point	Waterford	Yes	Yes/05			Yes		Yes	Yes	0.381	N/A			
51	**Dungarvan Harbour**	**000663**	**NHA**	Spit Bank	Waterford		Yes/05					Yes	Yes	0.347	N/A			
52	**Tramore Dunes And Backstrand**	**000671**	**SAC**		Waterford	Yes	Yes/05				1220	Yes	Yes	0.211	F	F	U1	U1
53	**Ballyteigue Burrow**	**000696**	**SAC**	Ballyteigue Burrow	Wexford	Yes	Yes/04				1220	Yes	Yes	0.51	F	F	F	F
54	**Bannow and Grange Bay**	**000697**	**SAC**	Grange	Wexford		Yes/04				1220	Yes	Yes	0.054	N/A			
55	**Lady's Island Lake**	**000704**	**SAC**	Lady's Island Lake barrier	Wexford	Yes					1220	Yes	Yes	N/A	N/A			
56	**Saltee Islands**	**000707**	**SAC**	Kilmore Quay	Wexford	Yes						Yes	Yes	N/A	N/A			
57	**Tacumshin Lake**	**000709**	**SAC**		Wexford	Yes	Yes/04				1220	Yes	Yes	0.785	N/A			
58	**Raven Point Nature Reserve**	**000710**	**SAC**		Wexford		Yes/04					Yes	Yes	0.204	N/A			
59	**Ballynaclash –Curracloe (Wexford Slobs and Harbour)**	**000712**	**NHA**	Ballynaclash	Wexford		Yes/04			Yes		Yes	Yes	0.009	N/A			
60	**Bray Head**	**000714**	**SAC**	Greystones Beach	Wicklow	Yes		Yes				Yes	Yes	3.878	N/A			
61	**Buckroney-Brittas Dunes and Fen**	**000729**	**SAC**	Pennycomequick	Wicklow		Yes/04	Yes			1220	No	Yes	1.451	N/A			
62	**Carrowmore Point to Spanish Point**	**001021**	**SAC**	Carricknola/Tromracastle - Lurga Point	Clare	Yes	Yes/06				1220	Yes	Yes	0.216	F	U1	U1	U1
63	**Carrowmore Point to Spanish Point**	**001021**	**SAC**	Caherrush, Spanish Point and Travaun Bay.	Clare	Yes						Yes	Yes	N/A	N/A			
64	**Barleycove to Ballyrisode Point**	**001040**	**SAC**	Barley Cove	Cork	Yes	Yes/05				1220	Yes	Yes	0.962	F	F	F	F
65	**Barleycove to Ballyrisode Point**	**001040**	**SAC**	Cannawee	Cork		Yes/05					Yes	Yes	0.104	N/A			

66	**Barleycove to Ballyrisode Point**	**001040**	**SAC**	South of Spanish Point, Crookhaven.	Cork	Yes						Yes	Yes	N/A	N/A			
67	**Kilkeran Lake and Castlefreke Dunes**	**001061**	**SAC**		Cork		Yes/05					Yes	Yes	0.023	N/A			
68	**Ballyness Bay**	**001090**	**SAC**	Dooey	Donegal		Yes/06					Yes	Yes	0.370	F	F	F	F
69	**Gweedore Bay and Islands**	**001141**	**SAC**	Gola Island	Donegal		Yes/06					Yes	Yes	0.022	F	F	F	F
70	**Gweedore Bay and Islands**	**001141**	**SAC**	Port bun an Inbhir	Donegal	Yes			Yes			Yes	Yes	N/A	N/A			
71	**Termon Strand**	**001195**	**NHA**	Maghery Bay and Termon Strand	Donegal	Yes						Yes	Yes	N/A	N/A			
72	**Dalkey Coastal Zone and Killiney Hill**	**001206**	**NHA**	Killiney South	Dublin	Yes	Yes/04					Yes	Yes	0.878	F	F	F	F
73	**Augrusbeg Machair and Lake**	**001228**	**SAC**	Augrusbeg	Galway		Yes/06					Yes	Yes	0.065	F	F	F	F
74	**Courtmacsherry Estuary**	**001230**	**SAC**	Broadstrand bay	Cork	Yes					1220	Yes	Yes	N/A	N/A			
75	**Dog's Bay**	**001257**	**SAC**	Dog's Bay & Gorteen Bay	Galway		Yes/06		Yes			Yes	Yes	0.161	F	F	F	F
76	**Omey Island Machair**	**001309**	**SAC**	Omey Island	Galway		Yes/06					Yes	Yes	0.155	F	F	F	F
77	**Cashen River Estuary**	**001340**	**NHA**	Ballybunion	Kerry	Yes	Yes/05					Yes	Yes	0.018	N/A			
78	**Doulus Head to Cooncrome Harbour**	**001350**	**NHA**	Cooncrome Harbour	Kerry	Yes						Yes	Yes	N/A	N/A			
79	**Valencia River Estuary**	**001383**	**NHA**	Doulus Bay	Kerry	Yes				Yes		No	Yes	N/A	N/A			
80	**Cruisetown**	**001460**	**Dedesig.**		Louth		Yes/04					Yes	Yes	0.773	N/A			
81	**Clew Bay Complex**	**001482**	**SAC**	Rosmurrevagh	Mayo	Yes	Yes/06					Yes	Yes	0.01	U1	U1	F	U1
82	**Clew Bay Complex**	**001482**	**SAC**	Bartraw	Mayo	Yes	Yes/06				1220	Yes	Yes	0.48	F	F	F	F
83	**Clew Bay Complex**	**001482**	**SAC**	Clew Bay Complex	Mayo	Yes						Yes	Yes	N/A	N/A			
84	**Clew Bay Complex**	**001482**	**SAC**	Mallaranny Beach	Mayo	Yes						Yes	Yes	N/A	N/A			
85	**Clew Bay Complex**	**001482**	**SAC**	Thornhill Strand and surrounds	Mayo	Yes						Yes	Yes	N/A	N/A			
86	**Cloghmoyle Dunes**	**001483**	**NHA**	Cloghmoyle (Carrowmore Quay)	Mayo		Yes/06					Yes	Yes	0.082	F	F	F	F
87	**Cooraun Point Machair/Dooreel Creek**	**001488**	**NHA**		Mayo		Yes/06			Yes		Yes	Yes	0.017	F	F	U1	U1
88	**Keel Machair/Menaun Cliffs**	**001513**	**SAC**	Trawmore, Keel	Mayo	Yes					1220	Yes	Yes	N/A	N/A			
89	**Ballyvoile Killmure Annestown**	**001693**	**NHA**	Annestown	Waterford	Yes						Yes	Yes	N/A	N/A			
90	**Ballyvoile Killmure Annestown**	**001693**	**NHA**	Ballyvoyle	Waterford	Yes						Yes	Yes	N/A	N/A			
91	**Ballyvoile Killmure Annestown**	**001693**	**NHA**	Killmurren	Waterford	Yes						Yes	Yes	N/A	N/A			

92	**Donaghmore Sandhills**	**001737**	**NHA**		Wexford		Yes/04					Yes	Yes	0.052	U1	F	U1	U1
93	**Kilmuckridge –Tinnaberna Sandhills**	**001741**	**SAC**	Tinnaberna	Wexford		Yes/04				1220	Yes	Yes	0.004	U1	F	F	U1
94	**Arklow Sand Dunes**	**001746**	**NHA**	Arklow South	Wicklow	Yes	Yes/04					Yes	Yes	0.018	N/A			
95	**Dunrany Point**	**001856**	**NHA**	Michelstown and Lurganboy	Louth	Yes					1220	Yes	Yes	N/A	N/A			
96	**Wicklow Town Sites**	**001929**	**NHA**		Wicklow						1220	No	Yes	N/A	N/A			
97	**Boyne Coast and Estuary**	**001957**	**SAC**	Baltray	Louth		Yes/04					Yes	Yes	0.287	N/A			
98	**Boyne Coast and Estuary**	**001957**	**SAC**	Mornington	Meath	Yes	Yes/04					Yes	Yes	0.582	N/A			
99	**Ballyhoorisky Point To Fanad Head**	**001975**	**SAC**	Maheradrumman	Donegal		Yes/06				1220	Yes	Yes	0.297	U1	U1	U1	U1
100	**Ballyhoorisky Point To Fanad Head**	**001975**	**SAC**	Ballyhiernan Bay	Donegal	Yes		Yes				Yes	Yes	4.778	N/A			
101	**Ballyhoorisky Point To Fanad Head**	**001975**	**SAC**	Rinboy Point to Ballyhoorisky Island	Donegal	Yes		Yes				Yes	Yes	6.386	N/A			
102	**Ballyhoorisky Point To Fanad Head**	**001975**	**SAC**	The Seven Arches	Donegal			Yes				Yes	Yes	0.689	N/A			
103	**North Inishowen Coast**	**002012**	**SAC**	Doagh Isle - Pollan Bay	Donegal	Yes	Yes/06					Yes	Yes	1.206	U1	F	U1	U1
104	**North Inishowen Coast**	**002012**	**SAC**	White Strand	Donegal	Yes	Yes/06					Yes	Yes	2.14	U1	U1	U1	U1
105	**North Inishowen Coast**	**002012**	**SAC**	Culdaff	Donegal		Yes/06					Yes	Yes	0.015	N/A			
106	**North Inishowen Coast**	**002012**	**SAC**	Lag	Donegal		Yes/06					Yes	Yes	0.091	N/A			
107	**North Inishowen Coast**	**002012**	**SAC**	Lennankeel	Donegal		Yes/06				1220	Yes	Yes	0.009	N/A			
108	**North Inishowen Coast**	**002012**	**SAC**	Bulbinbeg	Donegal	Yes						Yes	Yes	N/A	N/A			
109	**North Inishowen Coast**	**002012**	**SAC**	Esky Bay	Donegal	Yes						Yes	Yes	N/A	N/A			
110	**North Inishowen Coast**	**002012**	**SAC**	Rockstown Harbour	Donegal	Yes						Yes	Yes	N/A	N/A			
111	**North Inishowen Coast**	**002012**	**SAC**	Slievebane	Donegal	Yes						Yes	Yes	N/A	N/A			
112	**North Inishowen Coast**	**002012**	**SAC**	Tullagh Bay and Tullagh Point	Donegal	Yes						Yes	Yes	N/A	N/A			
113	**North Inishowen Coast**	**002012**	**SAC**	Whitestrand Bay - Culoort	Donegal	Yes						Yes	Yes	N/A	N/A			
114	**The Twelve Bens / Garraun Complex**	**002031**	**SAC**	Gowlaun	Galway		Yes/06					Yes	Yes	0.010	N/A			
115	**Carlan Isles (Murloy Bay)**	**002055**	**NHA**		Donegal						1220	No	Yes	N/A	N/A			

116	**Tralee Bay and Magharees Peninsula**	**002070**	**SAC**	Derrymore Island	Kerry		Yes/05				1220	Yes	Yes	2.784	F	U1	F	U1
117	**Tralee Bay and Magharees Peninsula**	**002070**	**SAC**	Castlegregory - Fermoyle	Kerry		Yes/05					Yes	Yes	0.057	N/A			
118	**Slyne Head Peninsula**	**002074**	**SAC**	Ballyconeely	Galway		Yes/06				1220	Yes	Yes	0.338	F	F	F	F
119	**Slyne Head Peninsula**	**002074**	**SAC**	Doonloughan	Galway		Yes/06				1220	Yes	Yes	0.032	N/A			
120	**Slyne Head Peninsula**	**002074**	**SAC**	Mannin Bay	Galway		Yes/06					Yes	Yes	0.024	N/A			
121	**Kilkieran Bay and Islands**	**002111**	**SAC**	Mweenish Island	Galway		Yes/06					Yes	Yes	0.331	F	F	F	F
122	**Kenmare River**	**002158**	**SAC**	Pallas Harbour	Cork	Yes					1220	Yes	Yes	N/A	N/A			
123	**Kenmare River**	**002158**	**SAC**	Rossdohan Island	Kerry	Yes					1220	Yes	Yes	N/A	N/A			
124	**Lower River Shannon**	**002165**	**SAC**	Beal Point (NHA 1335)	Kerry		Yes/05				1220	Yes	Yes	0.079	N/A			
125	**Lower River Shannon**	**002165**	**SAC**	Carrigaholt Bay	Clare	Yes						Yes	Yes	N/A	N/A			
126	**Lower River Shannon**	**002165**	**SAC**	Cloonconeen Lough and Rinevella Bay.	Clare	Yes						Yes	Yes	N/A	N/A			
127	**Lower River Shannon**	**002165**	**SAC**	Ross Bay.	Clare	Yes						Yes	Yes	N/A	N/A			
128	**Blackwater River (Cork/Waterford)**	**002170**	**SAC**	Ferry Point	Waterford	Yes					1220	Yes	Yes	N/A	N/A			
129	**Farranamanagh Lough**	**002189**	**SAC**		Cork	Yes		Yes			1220	Yes	Yes	2.146	N/A			
130	**Irelands Eye**	**002193**	**SAC**		Dublin	Yes	Yes/04				1220	Yes	Yes	0.129	F	F	F	F
131	**The Murrough Wetlands**	**002249**	**SAC**	Kilcoole	Wicklow	Yes	Yes/04				1220	Yes	Yes	2.678	F	F	F	F
132	**The Murrough Wetlands**	**002249**	**SAC**	Ballybla	Wicklow		Yes/05					Yes	Yes	1.252	U1	F	U1	U1
133	**Carrowmore Dunes (Formerly White Str**	**002250**	**SAC**	Doonbeg and Rinnagonaght Strand	Clare	Yes				Yes		Yes	Yes	N/A	N/A			
134	**Tory Island Coast**	**002259**	**SAC**	Tory Island	Donegal	Yes				Yes	1220	Yes	Yes	N/A	N/A			
135	**Carnsore**	**002269**	**SAC**		Wexford		Yes/04					Yes	Yes	1.206	F	F	F	F
136	**Dunbeacon Shingle**	**002280**	**SAC**	Rossmore	Cork	Yes		Yes			1220	Yes	Yes	2.177	N/A			
137	**Reen Point Shingle**	**002281**	**SAC**	Reen Point	Cork	Yes					1220	Yes	Yes	N/A	N/A			
138	**Carlingford Shore**	**002306**	**SAC**	Balana Point	Louth	Yes					1220	Yes	Yes	N/A	N/A			
139	**Carlingford Shore**	**002306**	**SAC**	Fore	Louth	Yes					1220	Yes	Yes	N/A	N/A			
140	**Carlingford Shore**	**002306**	**SAC**	Whitestown and Cooley Point	Louth	Yes					1220	Yes	Yes	N/A	N/A			
141	**Whiting Bay**	**N/A**	**No desig.**		Waterford		Yes/05					Yes	Yes	0.123	U1	F	U1	U1
142	**Ballydonegan**	**N/A**	**No desig.**		Cork		Yes/05					Yes	Yes	0.29	N/A			
143	**Bunmahon**	**N/A**	**No desig.**		Waterford		Yes/05					Yes	Yes	0.011	N/A			

144	**Ventry Dunnes and Marsh**	**N/A**	**No desig.**		Kerry		Yes/05					Yes	Yes	0.048	N/A			
145	**Inver (Donegal)**	**N/A**	**No desig.**		Donegal		Yes/06					Yes	Yes	0.257	F	U1	U1	U1
146	**Doolan (Murvey)**	**N/A**	**No desig.**		Galway		Yes/06					Yes	Yes	0.093	N/A			
147	**Owenahincha & Little Island Strand**	**N/A**	**No desig.**		Cork	Yes						Yes	Yes	N/A	N/A			
148	**Fenit**	**N/A**	**No desig.**	Fenit	Kerry	Yes						Yes	Yes	N/A	N/A			
149	**Adrigole Harbour, West**	**N/A**	**No desig.**		Cork	Yes						Yes	Yes	N/A	N/A			
150	**Ardmore, Clifden Bay**	**N/A**	**No desig.**		Galway	Yes						Yes	Yes	N/A	N/A			
151	**Carraroe**	**N/A**	**No desig.**		Galway	Yes						Yes	Yes	N/A	N/A			
152	**Cleggan Strand (Lough Anilaun)**	**N/A**	**No desig.**		Galway	Yes						Yes	Yes	N/A	N/A			
153	**Laytown Strand**	**N/A**	**No desig.**		Meath	Yes						Yes	Yes	N/A	N/A			
154	**Loughaunbeg to Cora na Ceibhe**	**N/A**	**No desig.**		Galway	Yes						Yes	Yes	N/A	N/A			
155	**Opposite Horse Island**	**N/A**	**No desig.**		Cork	Yes						Yes	Yes	N/A	N/A			
156	**Rathcor Lower and Johns Town**	**N/A**	**No desig.**		Louth	Yes						Yes	Yes	N/A	N/A			
157	**Reenydonagan Lough**	**N/A**	**No desig.**		Cork	Yes						Yes	Yes	N/A	N/A			
158	**Skerries (north beach)**	**N/A**	**No desig.**		Dublin	Yes						Yes	Yes	N/A	N/A			
159	**Spiddal Beach to Ballymoneen**	**N/A**	**No desig.**		Galway	Yes						Yes	Yes	N/A	N/A			
160	**Lough Cahasy, Lough Baun and Roonah Lough**	**001529**	**SAC**	Sruhir Strand	Mayo						Yes	Yes	Yes	N/A	N/A			
161	**Lough Cahasy, Lough Baun and Roonah Lough**	**001529**	**SAC**	White Strand	Mayo						Yes	Yes	Yes	N/A	N/A			

Occasionally the habitat recorded by the NSBS (1999) falls into a site designated as both NHA and SAC. In this case, the habitat is only listed within the SAC to avoid duplication.

- **Not covered by any designation (No desig.)**
- **EU Conservation Status Assessment rating: Favourable (F) / Unfavourable- Inadequate (U1) / Unfavourable-Bad (U2)**
- **N/A (Not Applicable)**

APPENDIX V

NATIONAL SHINGLE BEACH SURVEY IMPACTS SUMMARY

Identifier	Report ID	Name	Car Park	Dumping	Extraction / Movement of shingle	Groynes	Sea Wall	Rock Armoury	Development	None
0001	0001	North-western shoreline of Lough Foyle.					1		1	
0003	0003	Slievebane.		1	1					
0006	0006	Bulbinbeg.		1					1	
0007	0007	Esky Bay.		1	1		1			
0010	0010	Whitestrand Bay.		1	1				1	
0011	0011	Whitestrand Bay - Culoort.		1	1				1	
0015	0015	Pollan Bay.			1					
0016	0016	Tullagh Bay and Tullagh Point.		1	1					
0017	0017	Rockstown Harbour.			1					
0024	0024	Tory Island.		1						
0026	0026	Port bun an Inbhir.			1					
0027	0027	Maghery Bay and Termon Strand.			1			1	1	
0029	0029	Roishin Point.								1
0101	0076	Coastline from Black Head to Carrickada.								
0103	0078	Poulsallagh.								1
0105	0080	Lahinch.	1	1			1	1	1	
0106	0081	Caherrush, Spanish Point and Travaun Bay.							1	
0111	0086	Doonbeg and Rinnagonaght Strand.							1	
0112	0087	Ross Bay.							1	
0114	0089	Cloonconeen Lough and Rinevella Bay.		1						
0115	0090	Carrigaholt Bay.	1							
0201	0105	Pallas Harbour.							1	
0202	0107	Reenydonagan Lough.								1
0203	0120	Broadstrand Bay.	1							
0301	0092	Bunaclugga Bay.								1
0305	0096	Fenit.	1						1	
0307	0098	Cromane Point.		1	1		1	1	1	
0309	0100	Cooncrome Harbour.	1						1	
0311	0102	Ballinskelligs.								1
0313	0104	Rossdohan Island.								1
0401	0068	An Gleannachan, Inishmore.			1		1		1	
0402	0069	Clochan, Inishmore.								1
0403	0070	Port Mhuirbhigh, Inishmore.					1		1	
0405	0072	Port Chorruch, Inishmore.								1
0408	0075	Tra na bhFrancach, Inishmore.					1		1	
0410	0067	Tawin Point.		1	1					
0501	0133	The Murrough.					1	1	1	
0502	0134	Greystones Beach.						1	1	
0604	0035	Raghly.			1			1	1	
0605	0036	Standalone Point.								1
0607	0038	Aughris Head.								1
1004	0042	Barranagh Island.		1				1		
1010	0048	Trawmore, Keel.	1		1			1		
1011	0049	Mallalranny Beach.							1	
1012	0050	Rossmurrevagh.						1	1	1
1013	0052	Bartraw Strand.	1					1		
1014	0053	Thornhill Strand and surrounds.								

1018	0051	Clew Bay Complex.								1
1101	0128	Ballyteigue Burrow.								
1102	0130	Tacumshin Barrier.								
1103	0129	Kilmore Quay.		1			1	1	1	
1104	0131	Lady's Island Lake barrier.			1					
1105	0132	Arklow.	1					1	1	
1201	0121	Ferrypoint.	1						1	
1202	0122	The Cunnigar.						1		
1203	0123	Ballyvoyle.							1	
1204	0124	Killmurren.								
1205	0125	Annestown.					1			
1207	0127	Tramore dunes and Backstrand.	1					1	1	
1301	0112	Barley Cove.								1
1302	0111	Opposite Horse Island.								1
1303	0110	Rossmore.								1
1304	0109	Reen Point.								1
1305	0108	Farranamagh Lough.			1				1	
1306	0119	Ownahinchy.						1		
1307	0113	South of Spanish Point, Crookhaven.								
1308	0116	Castle Island.								
1309	0117	Rossbrin Point.								
1310	0118	Calf Island Middle.								
1311	0114	Long Island West.								
1312	0115	Long Island East.								1
1313	0106	Adrigole Harbour, West.								
1401	0153	Greenore.						1	1	
1402	0152	Balagan Point.						1		
1403	0151	Whitestown to Cooley Point.	1							
1404	0150	Rathcor Lower and Johns Town.		1						
1405	0149	River Foot.								
1406	0148	Giles Quay.					1	1	1	
1407	0147	Eggleston Point to Dundalk.		1				1	1	
1408	0146	Lurgan White House.		1				1		
1409	0145	Castlebellingham to Annagassan Pier.		1	1				1	
1410	0144	Annagassan Pier to Ardsallagh.					1	1	1	
1411	0143	Salterstown to Dunany Point.			1			1		
1412	0142	Michelstown and Lurganboy.	1							
1501	0141	Mornington.								
1502	0140	Laytown Strand.						1	1	
1602	0138	Ireland's Eye.								
1604	0136	Killiney Bay, South.						1	1	
1704	0060	Cleggan Strand (Lough Anilaun).							1	
1706	0062	Ardmore, Clifden Bay.								1
1707	0063	Carraroe.								1
1708	0064	Loughaunbeg to Cora na Ceibhe.						1		
1709	0065	Spiddal Beach to Ballymoneen.	1						1	
0409	0066	Rinville Point								1
1601	0139	Skerries (north beach)				1		1	1	
0108	0083	Carricknola/Tromracastle							1	
		Totals	**13**	**17**	**18**	**1**	**12**	**26**	**38**	**20**

APPENDIX VI

SHINGLE BEACHES NOTIFIABLE ACTIONS

HABITAT TYPE 1.2

Under STATUTORY INSTRUMENT 94 of 1997, made under the EUROPEAN COMMUNITIES ACT 1972 and in accordance with the obligations inherent in the COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 (the Habitats Directive) on the conservation of the natural habitats and species of wild fauna and flora, all persons must obtain the written consent, (in circumstances prescribed at section A and B below) of the Minister for The Environment and Local Government before performing any of the operations on, or affecting, the following habitats where they occur on lands / waters within the candidate Special Area of Conservation.

HABITAT TYPE

MUDFLATS AND SANDFLATS, SANDY COASTAL BEACHES, SHINGLE BEACHES, BOULDER BEACHES, BEDROCK SHORES, MARINE CAVES

SECTION A	**SECTION B**
Please note that the activities listed in *Section A overleaf* are required to be notified to the Minister for The Environment and Local Government (see attached form) and should not be undertaken before consent.	**Please note that the activities listed in *Section B* overleaf may, and in most cases do, require a license or consent from another statutory authority (e.g. the local planning authority, the Minister for the Marine and Natural Resources, or the Minister for Agriculture and Food).** **If so, these notifiable actions do not apply.** **However, if such activities are not regulated by another statutory authority, the said activities are required to be notified to the Minister for The Environment and Local Government.**

Section A	*Section B*
THE MINISTER FOR THE ENVIRONMENT AND LOCAL GOVERNMENT IS REQUIRED TO BE NOTIFIED IN RELATION TO THE FOLLOWING ACTIVITIES AND SUCH ACTIVITIES SHOULD NOT PROCEED WITHOUT PRIOR CONSENT **operation of commercial recreation activities (e.g. sailing schools, diving tours, jet ski hire, dolphin watching tours)** **introduction (or re-introduction) into the wild of plants or animals of species not currently found in the area** **collection of species for aquaria** **collection of biological samples or organised educational activities where they occur on bedrock shores or boulder beaches** **driving vehicles over the area, except over rights of way or over access to licensed aquaculture facilities** **digging, ploughing or otherwise disturbing the substrate** **alteration of the banks, bed or flow of watercourses** **any other activity of which notice may be given by the Minister from time to time**	**(NO REQUIREMENT TO NOTIFY IF ALREADY LICENSED BY ANOTHER MINISTER/BODY)** **use of anti-fouling paints containing organic tin** **commercial harvesting of sea urchins, winkles, or other marine invertebrates.** **removal of soil, mud, gravel, sand or minerals** **use of pesticides or antibiotics** **operation or extension of aquaculture facilities** **dumping or disposal of wastes** **fishing by any type of nets** **fishing by pots for lobster, crab, whelk, shrimp and other species** **dredging whether for fishing or for other purposes** **use of hydraulic or suction systems for removing any species or sediments** **placement of any structures or devices on the soil or bed of the sea seaward of high water mark** **use of the soil or bed of the sea for any activity** **cutting or harvesting growing algae (seaweeds)**

APPENDIX VII

GLOSSARY

ANNEX I - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

COASTAL DEFENCE - a combination of both Coast Protection (generally to prevent erosion – where the land is higher than sea level) and Sea Defence (to prevent flooding- where the land is lower than sea level).

COASTAL SQUEEZE - the shrinking of coastal habitats caught between rising sea level and fixed coastal defences.

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

DISTAL - the point furthest from origin.

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as Fourable 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 Fourable.

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. Fourable reference value must be at least the surface area when the Habitats Directive (92/43 EEC) came into force.

FOURABLE 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. Fourable reference value must be at least the range (in size and configuration) when the Habitats Directive (92/43 EEC) came into force.

GROYNE - A projecting (often wooden) structure to stop sand shifting along a beach

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.

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. 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 Fourable conservation status is maintained.

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). 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.

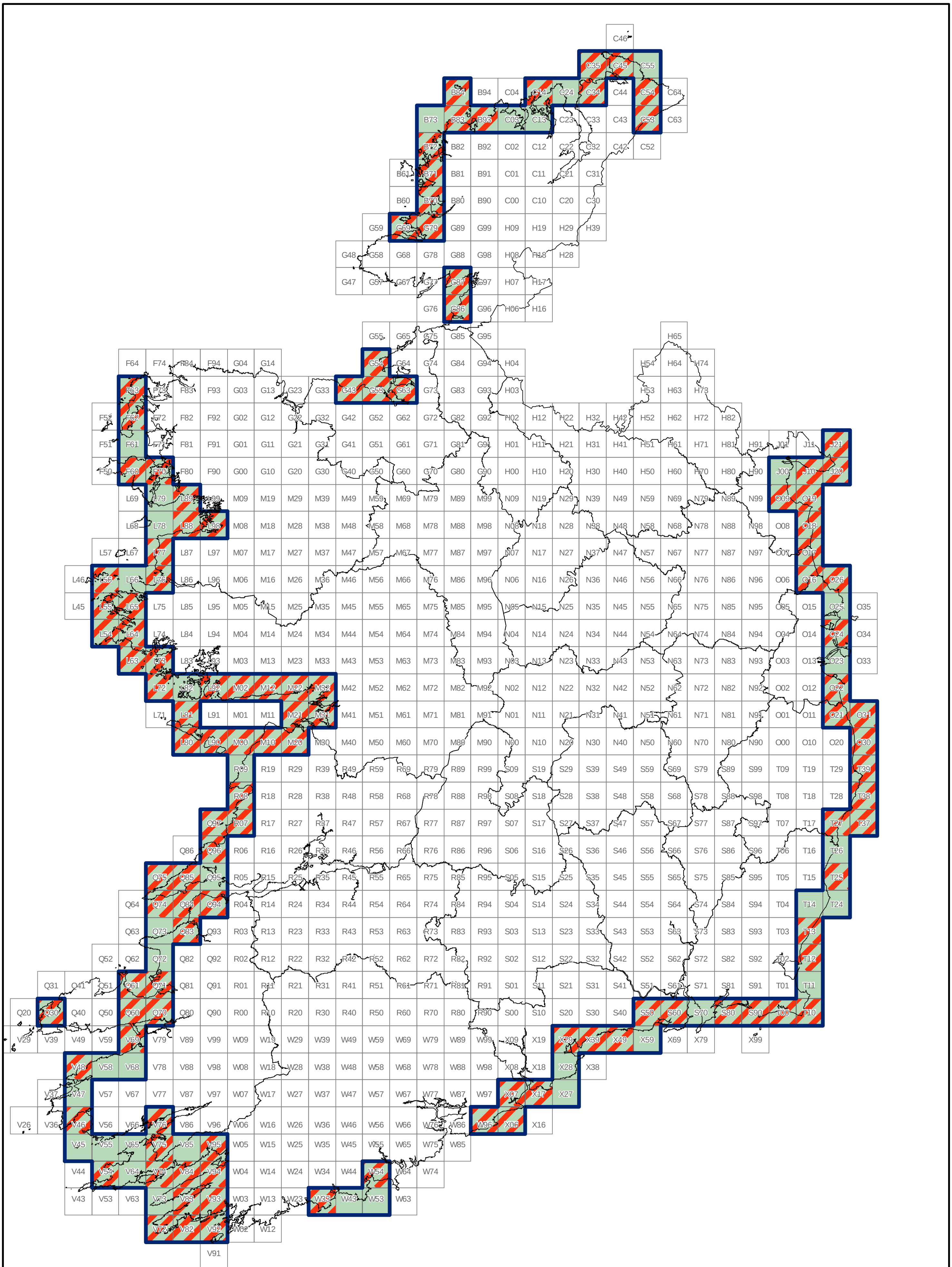
SPECIES - The lowest unit of classification normally used for plants and animals.

1220 Perennial vegetation of stony banks

National Level	
Habitat Code	1220
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	▪ 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. ▪ 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). ▪ MOORE, D. and WILSON, F. (1999). *National Shingle Beach Surve*y. Unpublished report to the National Parks and Wildlife Service, Dublin.
Range	The habitat shows a widespread distribution along the Irish coastline with a more dispersed distribution along the coasts of County Cork and north County Mayo. County Donegal contains the highest concentration of records, followed by Galway. County Louth has the highest number of records along the east coast.
Surface area	15,200km² (152 grid cells x 100km²)
Date	08/2007
Quality of data	3 = good (e.g. based on extensive surveys)
Trend	0 = stable
Trend-Period	1996 – 2007
Reasons for reported trend	
Area covered by habitat	2km²
Distribution map	See attached map
Surface area	2km²
Date	08/2007
Method used	3 = ground based survey
Quality of data	2 = moderate (e.g. based on partial data with some extrapolation)
Trend	Decrease of 1.4%
Trend-Period	1996 – 2007
Reasons for reported trend	3 = direct human influence
Justification of % thresholds for trends	Based on the habitat conservation status assessment results from the Coastal Monitoring Project (2004-2007) and the National Shingle Beach Survey (1999).

Main pressures	302 - Sand and gravel extraction -removal of beach materials 423 – Disposal of inert materials 530 – Improved access to site (car park) 622 – Walking, horse riding and non-motorised vehicles 623 – Outdoor sports and leisure activities – motorised vehicles 720 – Trampling, overuse 871 - Sea defence or coastal protection works 900 – Erosion
Threats	302 - Sand and gravel extraction –removal of beach materials 423 – Disposal of inert materials 530 – Improved access to site (car park) 622 - Walking, horse riding and non-motorised vehicles 623 - Outdoor sports and leisure activities – motorised vehicles 720 - Trampling, overuse 871 - Sea defence or coastal protection works 900 – Erosion
Complementary information	
Favourable reference range	15,200 km²
Favourable reference area	2km²
Typical species	*Ammophila arenaria*, *Arrhenatherum elatius, Atriplex prostrata, Beta maritima, Cerastium fontanum., Crambe maritima, Crepis capillaris, Crithmum maritimum, Elytrigia atherica, Euphorbia paralias, Festuca rubra, Geranium robertianum, Glaucium flavum, Holcus lanatus, Honckenya peploides, Hypochaeris radicata, Lathyrus japonicus, Leontodon saxatilis, Lolium perenne, Plantago coronopus, P. lanceolata, Potentilla anserina, Rumex crispus, Sagina apetala erecta, Sedum acre, Silene uniflora, Silene vulgaris ssp. maritima, Sonchus arvensis, S. asper, Tripleurospermum maritimum.* Methods: all the species above are a combination of the Habitats Directive habitat's characteristic species for 1220, the CMP (Ryle *et al*. 2007) characteristic species and the British National Vegetation Classification - SD1 *Rumex crispus-Glaucium flavum* shingle beach community species. Characteristic species were assessed as favourable by Ryle *et al*.
Other relevant information	
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)



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

Perennial vegetation of stony banks

1220

Current Distribution (116 cells)

Current Range (152 cells)

Favourable Reference Range (152 cells)

W48 10km grid cells

Date: January 2008

Background to the Conservation Assessment for the leatherback turtle, *Dermochelys coriacea*

1. Range

The leatherback sea turtle (*Dermochelys coriacea* Vandelli 1761) is the most widely distributed living reptile species, being found in all oceans except the Southern Ocean (Davenport 1998). Within the North Atlantic their range extends from the tropics to the high latitudes of Newfoundland right across to Europe's northwesterly fringe (Ferraroli *et al.* 2004, Hays *et al.* 2004a, James *et al.* 2005a). They are a widely roaming epipelagic (< 200 m) species (Hays *et al.* 2004a), with individuals making extensive pan-oceanic movements. Importantly, they are reproductively confined to warm tropical regions because of thermal constraints on egg incubation (Pritchard 1997, Dutton *et al.* 1999), yet have many unique anatomical and physiological adaptations that permits them to forage seasonally into cooler temperate waters that are largely inaccessible to other sea turtles. As such, leatherback populations have a very dynamic range that expands and contracts depending on the season. During the summer months their range is at its greatest extent with individuals probably located throughout the entire north Atlantic, whereas during the winter months their range is restricted to areas where the sea surface temperature (SST) is > 15 °C (McMahon & Hays 2006).

Recent studies have shown that after nesting in the tropics the majority of Atlantic female leatherbacks head north towards cooler temperate waters (Ferraroli *et al.* 2004, Hays *et al.* 2004a). Some of these individuals head north towards the northwest Atlantic (NWA), some towards the Northmid Atlantic (NMA), and others towards the Northeast Atlantic (NEA) which includes Europe's westerly fringe (Ferraroli *et al.* 2004, Hays *et al.* 2004a, James *et al.* 2005a, Eckert 2006). These movements are associated with animals moving from a nesting area where food is scarce to distant areas where food is more abundant (Hays *et al.* 2004b). Declining sea temperatures and food availability are thought to drive these individuals south (McMahon & Hays 2006) where they over-winter in the tropics before returning to high latitude foraging grounds again the following spring / summer (James *et al.* 2005a). Leatherbacks may carry out this round trip movement until enough resources are gathered prior to expending them during bouts of reproduction. In the north Atlantic female leatherbacks take between 2-3 years before enough resources are gathered (Rivalan *et al.* 2005), whereas males may mate every year (James *et al.* 2005b, Doyle *et al.* in review). Therefore every couple of years, females will interrupt this shuttling between northern foraging areas and southern over-wintering areas and return to their natal nesting beaches located off South America and the Caribbean.

In their recent review of marine turtle records in Irish waters, King & Berrow (in press) documented 868 sightings/strandings of leatherbacks turtles. This dataset represents the second largest leatherback sightings/strandings dataset in Europe, after France (N =1176, see Witt *et al.* in press). As such, a considerable responsibility of ensuring their protection within European waters may lie with Ireland. However, caution must be stressed when attempting to elucidate any patterns from this dataset, as there are many inherent biases. For example, most turtles were sighted within 12 nautical miles (~ 22 km) of the coastline, with a strong bias towards three counties: Cork (N = 378), Kerry (N = 113), and Donegal (N = 109). The coastal bias probably reflects the 'distribution of observers rather than turtles' (King & Berrow in press), as it very probable that large numbers of leatherbacks occur further offshore (James *et al.* 2005a, Eckert 2006, James *et al.* 2006, Witt *et al.* in press, Doyle *et al.* in review). Furthermore, the observer effort varies greatly between counties i.e. 60 % (N = 229) of leatherback sightings in county Cork came from a single observatory (i.e. Cape Clear Observatory) that has an almost constant 'sea watch'. No other county has comparable observer effort. Another important consideration is that 'many of the leathery turtle records reported were observed by fishermen and most [of these] were of turtles entangled in fishing gear' (King & Berrow in press). Subsequently, the large numbers observed in counties Cork, Kerry and Donegal may reflect the large fishing effort in these areas. A fourth bias may stem from the actual sourcing of records, i.e. the vast majority of leatherback records were actively sought by Gabriel King who approached fishing communities around Ireland. Indeed, many peaks in sightings reported are evident: 1984-1985, 1990, 1993, most of which can be attributed to an increase in recording effort by King rather than actual peaks in the abundance of turtles in Irish coastal waters.

Nevertheless, the high number of leatherback sightings reported by King & Berrow (in press) and others documents the importance of Irish neritic waters for foraging individuals, from which some general statements can be drawn. Essentially, sightings of leatherbacks can occur anywhere in Irish coastal waters, but are more likely to occur in higher numbers off the south and west coasts of Ireland because of their facing aspects (Witt *et al.* 2007). Underlying this general pattern (and accounting for various biases e.g. fishing effort, coastal population and boating activity) there is a greater probability of occurrence in areas where jellyfish regularly occur in high concentrations e.g. off Sauce Creek (Brandon Head) and Rosslare Harbour (see Houghton *et al.* (2006a) for the importance of jellyfish hotspots). In terms of Irish oceanic waters, a recent study has suggested that the European continental shelf edge (particularly the Rockall Area and Porcupine Bank and Porcupine Bight) may potentially support appreciable densities of foraging leatherbacks because of the high abundance of gelatinous zooplankton located there (Witt *et al.* 2007).

Current range is based on recent (post 1980) records from King & Berrow (in press). These individual records are overlain with the 50km National grid to give an inshore area estimate of 112,500 km^2. The limited number of known offshore records add an additional area of approximately 30,000 km^2 to the current range. This gives a total estimate for the current range of 142,500 km^2

2. Population

In the Atlantic, the largest nesting populations of leatherbacks are located in French Guiana and Surinam along the northern coastline of South America, in the southern Caribbean islands of Trinidad and Tobago, and in Gabon on the coast of West Central Africa (Rivalan *et al.* 2005, Eckert 2006, Georges *et al.* 2006). Many smaller populations of leatherbacks are located throughout the wider Caribbean. It is estimated that the current Atlantic population lies somewhere between 26,000 and 43,000 female leatherbacks (Spotila *et al.* 1996, Dutton *et al.* 1999), with very little known about the male population as they do not come ashore at any stage.

Comparison of the distance between different foraging areas has provided useful insights on the population dynamics of the different foraging grounds (Doyle *et al.* in review). For example, as the NEA is almost twice the distance from the breeding sites as comparable NWA foraging areas, fewer leatherbacks are more likely to visit the NEA region (i.e. assuming similar foraging environments there would be a greater energetic investment in commuting to the NEA than the NWA for a similar reward). This conclusion is reinforced by aerial surveys for leatherbacks carried out in these respective areas e.g. Shoop & Kenney (1992) found 6.85 leatherbacks per 1000 km of track flown over continental shelf waters of Nova Scotia to Cape Hatteras (NWA); Murphy *et al.* (2006) found 40.00 leatherbacks per 1000 km of track, in nearshore waters off South Carolina (NWA); Brown and Tobin (1999) (from James (1999)) found 5.11 leatherbacks per 1000 km of track off Nova Scotia (NWA); whereas Doyle *et al.* (in review) found only 0.25 leatherbacks per 1000 km (or 0.06 leatherbacks per 100 km^2) of track flown within the Irish Sea (NEA). Considering these values, the density of leatherbacks in the NEA is probably less than that of the NWA. This difference may be attributable to the higher energetic cost of migrating to Irish waters.

Providing an actual estimate of the number of leatherbacks foraging within Irish waters is difficult as their numbers may be extremely low (Houghton *et al.* 2006a, Houghton *et al.* 2006b) and the inherent variability between years as a result of climate, long-term population cycles (Rivalan *et al.* 2006), and variation in gelatinous zooplankton biomass and distribution. Also, many animals may simply be passing through Irish waters whereas others may reside for longer periods (Doyle *et al.* in review). Using leatherback sightings as an index of abundance can be informative, however, variability in the reporting mechanisms, their consistency and effort, can mask any real trends. Determining if two sightings were of the same animal or two different animals can also add confusion to this index. The aerial survey estimates provided by Doyle *et al.* (in review) may represent the most realistic estimate of leatherback activity in Irish waters to date. However, their value may be an underestimate of actual leatherback abundance, as their surveys primarily focused on the Irish Sea where leatherbacks may not be as numerous as other areas (King & Berrow in press, Witt *et al.* in press) and submerged animals would not have been spotted (Houghton *et al.* 2006a). However, with the above caveats in mind, and using the density estimate provided by Doyle *et al.* (in review), the number of leatherbacks in Irish territorial waters (12 nautical miles from coastal baseline) during a summer day is probably around 25 (i.e. [39,000 x 0.06]/100)[1]. However, it you extend this calculation to include Ireland's marine territory (652,000 km^2, which includes Ireland's continental shelf waters) (Bartlett 2004), the number of leatherbacks during a summer day may be as many as 400. However, there will be much variation around this estimate considering population estimates for other species that occur in low densities (i.e. many beaked whales have CV (coefficient of variation) values of 0.80 and up, which basically means that any estimate will have huge errors associated with it). If we apply the same CV value of 0.80 to our estimate of 400 animals this will give a range between 80 and 720 leatherbacks during a summer day.

In terms of the actual number of leatherbacks that pass through or use Irish waters each year, there is great uncertainty. How long individual turtles remain resident in Irish waters and how much time they spend at the surface are important criteria for estimating population abundance, yet these data are scarce (Doyle *et al.* in review). However, considering that individuals may spend periods of two months or more in coastal/shelf waters and other areas (James *et al.* 2005a, Eckert 2006, Doyle *et al.* in review), and that turtles spend as much as 50 % of their time at the surface (James *et al.* 2005c), **the number of leatherbacks passing through or residing in Irish waters each year is probably in the low thousands - ~2,500 - which may be equivalent to 2-5 % of the Atlantic population**[2]. Future aerial surveys and more dedicated observations from ships of opportunity in-conjunction with concerted coastal observations may improve these estimates.

2.1.1 Pressures and threats

211 – fixed location fishing – bi-catch on long lines; entanglement in lobster/crab pot ropes
213 – drift net fishing (probably not a signifcant cause of mortality, but now banned in Irish waters, so no longer any threat)
241 – collection of eggs from tropical nesting beaches
290 – fishing not referred to above – full impact of various marine fishing techniques on migrating leatherbacks is unknown.
621 – nautical sports - in particular boating disturbance and collisions
701 – water pollution - ingestion of plastic bags has been shown to be a significant cause of mortality among marine turtles

1 Area of Irish Territorial waters (km^2) x density estimate of leatherbacks (Doyle et al in review)/100
2 If number of leatherbacks passing through or residing in Irish waters each year is ~2500 individuals. This value may be a considerable underestimate.

3. Habitat

The entire North Atlantic can be considered as habitat for leatherback sea turtles. However, within this broad geographical region certain areas have been identified as high-use areas (or important habitats) e.g. James *et al.* (2006) identified the waters off Nova Scotia (Canada) as critical habitat for leatherback sea turtles, and Eckert (2006) has documented four high-use areas in the north Atlantic where individuals (or many individuals) resided for long periods. One of these high-use areas (the Iberian Peninsula and the Bay of Biscay areas) is within the NEA. More recently the first tracking results for turtles tagged off Ireland lend support to the suggestion that the Bay of Biscay region within the northeast Atlantic is a high-use area that plays a central role in the feeding ecology and trajectory of body condition for some individuals (Doyle *et al.* in review). This study also demonstrated the first protracted 'summer' residence of a leatherback in the northeast Atlantic that was previously asserted from turtle sightings and strandings data (Brongersma 1972, Duron 1978, Duguy *et al.* 1980, Pierpoint & Penrose 1999, Houghton *et al.* 2006a, Witt *et al.* 2007, King & Berrow in press). Furthermore, analysis of these first European tracks also demonstrated the individual differences in space utilisation by leatherback turtles in the NEA. For example, Houghton *et al.* (2006a) revealed that distinct coastal 'jellyfish hotspots' in the Irish Sea provide important foraging habitat for leatherbacks in coastal waters, with foraging behaviour in more open-water habitats associated with mesoscale features such as those found in the Bay of Biscay region (Doyle *et al.* in review). A novel approach of using CPR data to map gelatinous zooplankton distribution in the NEA was carried out by Witt *et al.* (2007). They identified the European continental shelf-break and the Rockall Bank as probable foraging grounds for leatherback turtles based on the abundance of gelatinous zooplankton in these areas (Witt *et al.* 2007).

However, given extraordinary diving capabilities leatherback turtles, a full assessment of habitat utilisation can only be made in three dimensions. For example, leatherbacks are capable of diving to depths > 1000 m (Hays *et al.* 2004a) although long-term studies have shown the species to normally restrict dives to epipelagic waters (Hays *et al.* 2004ba). Overlying this general trend of epipelagic diving, leatherbacks at the northern range limit also tend to perform shallower dives and for shorter periods (Eckert 2006, Hays *et al.* 2006) which may reflect the continuous near surface distribution of gelatinous prey at such latitudes (Hays *et al.* 2006). Importantly, while turtles occasionally slow down and show residence in specific areas, simply protecting turtles at these times from fishing induced mortality will be insufficient, because turtles spend long periods travelling between these hotspots (Hays *et al.* 2006).

In the absence of more complete information on migration patterns and habitat utilisation, the current range of the leatherback (based on post 1980 records) is also taken as the extent of habitat – c142,500 km^2.

4. Future prospects

Leatherback turtles are listed in Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) 1975, Appendix II of the Bern Convention 1979, Appendices I and II of the Bonn Convention 1979, and Appendix IV of the Habitats Directive. It is also protected under the Irish Wildlife Acts (1976 & 2000). However, it is not yet clear what impact, if any, these protections are having on the conservation status of the leatherback. The situation in the Pacific appears grave with as few as 2,300 adult females leatherbacks remaining (Crowder 2000, Spotila *et al.* 2000). This alarming decline may be largely attributed to the negative interaction of leatherback turtles with pelagic long-line fisheries, with recent studies (Lewison *et al.* 2004) suggesting that the annual bycatch probability of leatherbacks in the Pacific is 0.63, which roughly equates to every single turtle being caught and released once every two years (note: the probability of mortality per take was 0.08-0.27 based on the largest bycatch data set available that accounts for immediate and delayed mortality). Clearly the well-documented decline of Pacific leatherbacks raises serious concerns for the Atlantic population where bycatch rates are thought to be even higher (Lewison *et al.* 2004, Carranza *et al.* 2006). However, and somewhat surprisingly, there has been no observed decline of nesting populations in the Atlantic to date, and even in some cases there has been a dramatic increase probably due to an aggressive program of beach protection and egg relocation (Dutton *et al.* 2005). Nevertheless, the international nature of this problem means that the species' survival will depend on cross border collaborations focused not only on the tropical nesting beaches, but also on the more temperate feeding grounds that lie thousands of kilometres away (Crowder 2000, Hays *et al.* 2004a, Lewison *et al.* 2004, James *et al.* 2005a, Hays *et al.* 2006).

The immediate threats in Irish waters are from fixed fisheries such as lobster pot fisheries where leatherbacks become entangled in the pot ropes, and if not discovered early may drown with the next rising tide (King & Berrow in press). The recently banned salmon drift net fisheries had a very low mortality (if any) of individuals bycaught, although several turtles may have been caught in a season. It is uncertain what impact other fisheries in Irish waters may have on leatherbacks. Considering recent trends of warming seas, leatherback sea turtles are likely to increase in abundance and occupancy in Irish waters (Kintisch 2006, McMahon & Hays 2006) with a probable concomitant increase in interactions with fisheries (particularly fixed fisheries).

Given that numbers do not appear to be declining, but that continued intervention will be required to protect breeding sites and to reduce fisheries related mortality, the future prospects for the leatherback are considered to be Poor.

5. Complementary information

5.1 Favourable reference range

The recent review of the distribution of leatherback records (King & Berrow, in press) gives some indication of the widespread nature of the animal around Irish coastal waters. However, as discussed above, there are several biases in this data. Our information about the offshore range of the species is extremely limited and it is likely to be much more widespread than our records suggest. Recent efforts to track leatherback movements in Irish water using satellite tags have produced valuable data, but much of it does not relate to behaviour in Irish waters.

There is no evidence to suggest that the range of this species is anyway limited in Irish waters or that it has declined in extent in recent years. Nonetheless, it is clear that we are only starting to understand the migration patterns and seasonal behaviour of leatherbacks in the Northeast Atlantic. More work is required before a definitive statement can be made on Favourable Reference Range. Consequently, this parameter is considered at present to be Unknown.

5.2 Favourable reference population

Best expert opinion puts the number of leatherbacks using Irish waters at ~2,500 per annum - approximately 2-5% of the North Atlantic leatherback population. However, it must be recognised that the confidence intervals for this estimate would be very large and that figures will vary annually for natural reasons.

Given concerns about the global decline of this species, further work is required throughout the North Artlantic and at the turtle's nesting beaches in the Tropics to establish the true conservation status of this animal. Arising from that work a meaningful estimate of

favourable reference population should be possible for the north Atlantic and for Irish waters. In the meantime, this parameter is considered to be Unknown.

5.3 Habitat for the species

Recent work has provided some insight into habitat ues by leatherbacks in the North Atlantic (e.g. Doyle *et al*. in review). However, we are still some way from fully understanding the migration patterns and feeding behaviour of this animal. Further work is required before we can assess the extent of suitable habitat. This parameter is considered to be Unknown.

6. Summary of conclusions

	Leatherback turtle
Range	Unknown (XX)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Inadequate (U1)
Overall assessment of status	**Inadequate (U1)**

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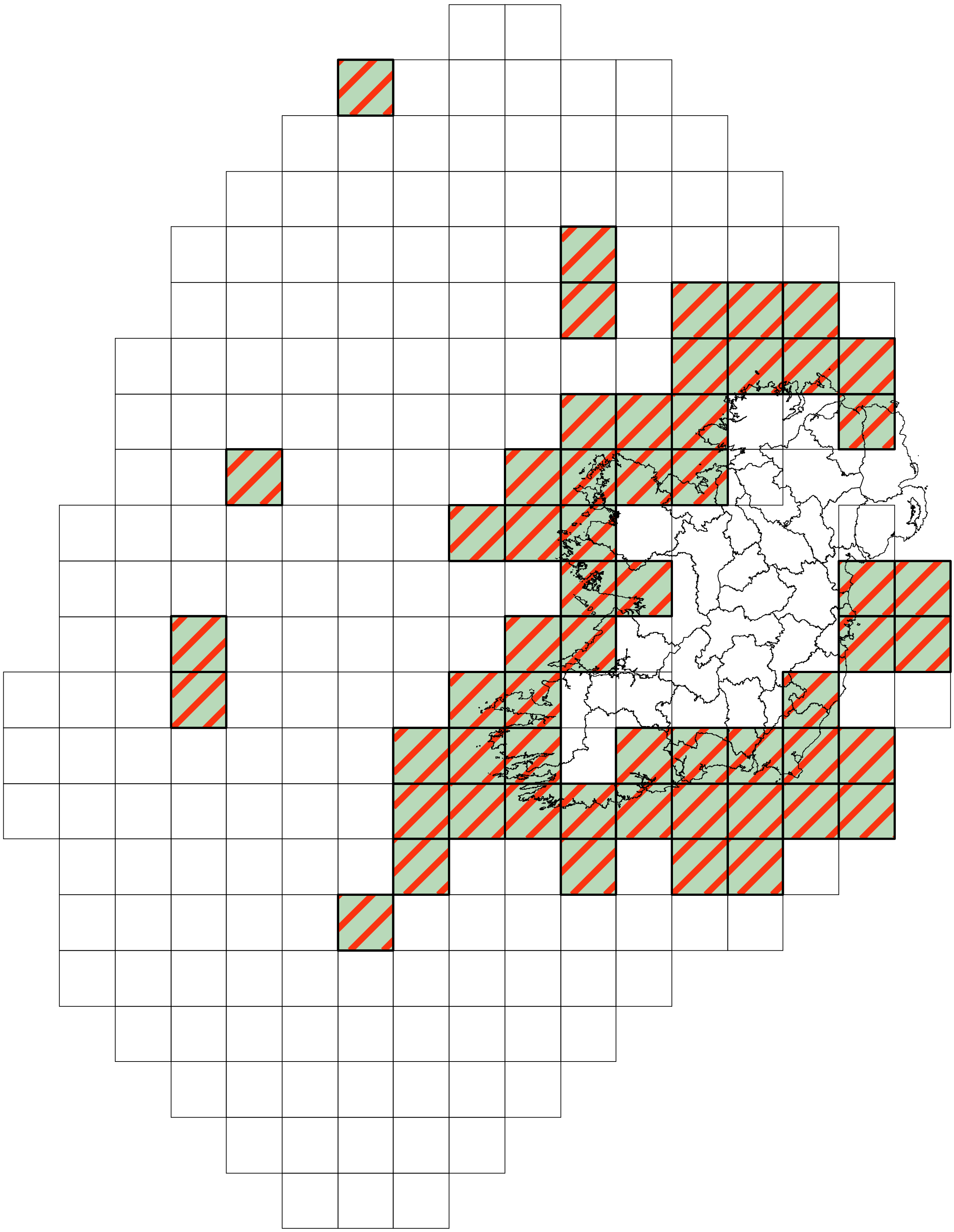
1223 Leatherback turtle – *Dermochelys coriacea*

Data	***Comments/Guidelines for reporting data***
1. National Level	
Species code	1223
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	**Bartlettt, D (2004)** http://www.marineadministration.org/countrydata/ir.htm **Doyle T, Houghton JDR, O'Súilleabháin PF, Hobson V, Marnell F, Davenport J & Hays GC (in review)** Summer residence of leatherback turtles in the northeast Atlantic. *Biological Conservation* **Dutton DL, Dutton PH, Chaloupka M & Boulon RH (2005)** Increase of a Caribbean leatherback turtle *Dermochelys coriacea* nesting population linked to long-term nest protection. Biological Conservation 126:186-194 **Eckert SA (2006)** High-use oceanic areas for Atlantic leatherback sea turtles (*Dermochelys coriacea*) as identified using satellite telemetered location and dive information. Marine Biology 149:1257-1267 **Hays GC, Hobson VJ, Metcalfe JD, Righton D & Sims DW (2006)** Flexible foraging movements of leatherback turtles across the North Atlantic Ocean. *Ecology* 87:2647-2656 **Houghton JDR, Doyle TK, Wilson MW, Davenport J & Hays GC (2006)** Jellyfish aggregations and leatherback turtle foraging patterns in a temperate coastal environment. *Ecology* 87:1967-1972 **James MC, Eckert SA & Myers RA (2005)** Migratory and reproductive movements of male leatherback turtles (*Dermochelys coriacea*). *Marine Biology* 147:845-853 **King GL & Berrow SD (in press)** Marine turtles in Irish waters. *Irish Naturalist's Journal* **McMahon CR & Hays GC (2006)** Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. *Global Change Biology* 12:1330-1338 **Pierpoint C & Penrose R (1999)** TURTLE: A Database of marine turtle records for the United Kingdom & Eire **Rivalan P, Dutton PH, Baudry E, Roden SE & Girondot M (2006)** Demographic scenario inferred from genetic data in leatherback turtles nesting in French Guiana and Suriname. *Biol. Conservation* 130:1-9 **Witt MJ, Broderick AC, Johns DJ, Martin C, Penrose R, Hoogmoed MS & Godley BJ (in press)** Prey landscapes help identify potential foraging habitats for leatherback turtles in the NE Atlantic. *Marine Ecology Progress Series.*
2.3 Range	Range within the biogeographical region concerned (for definition, see Annex F, further specifications on how to measure range will be developed in the frame of the guidance document of ETC-BD)
2.3.1 Surface area	c142,500 km^2
2.3.2 Date	July 2007
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Unknown but probably 0 = stable
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	N/a
2.4 Population	
1.2 Distribution map	Presence/absence, use GIS based map – vector format or grid map
2.4.1 Population size estimation	c 2,500 individuals passing through Irish water p.a.
2.4.2 Date of estimation	May 2007

2.4.3 Method used	1 = based on expert opinion
2.4.4 Quality of data	1 = poor
2.4.5 Trend	Unknown but probably 0 = 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	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field
2.4.10 Main pressures	211 – fixed location fishing 213 – drift net fishing 241 – collection (eggs from nesting beaches) 290 – fishing not referred to above 621 – nautical sports (boating disturbance and collisions) 701 – water pollution (ingestion of plastic bags)
2.4.11 Threats	211 – fixed location fishing 241 – collection (eggs from nesting beaches) 290 – fishing not referred to above 621 – nautical sports (boating disturbance and collisions) 701 – water pollution (ingestion of plastic bags)
2.5 Habitat for the species	
2.5.2 Area estimation	c142,500 km^2
2.5.3 Date of estimation	July 2007
2.5.4 Quality of data	1 = poor
2.5.5 Trend	Unknown, but probably stable
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	N/a
2.6 Future prospects	2 = poor 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	
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	Inadequate (U1)
Overall assessment of CS	Inadequate (U1)



1:5,000,000

0 25 50 100 Kilometers

Dermochelys coriacea

1223

Projected Coordinate System:
ETRS_1989_LAEA

Current distribution (57 grid squares)

Current range (57 grid squares)

50km grid squares of EEZ range

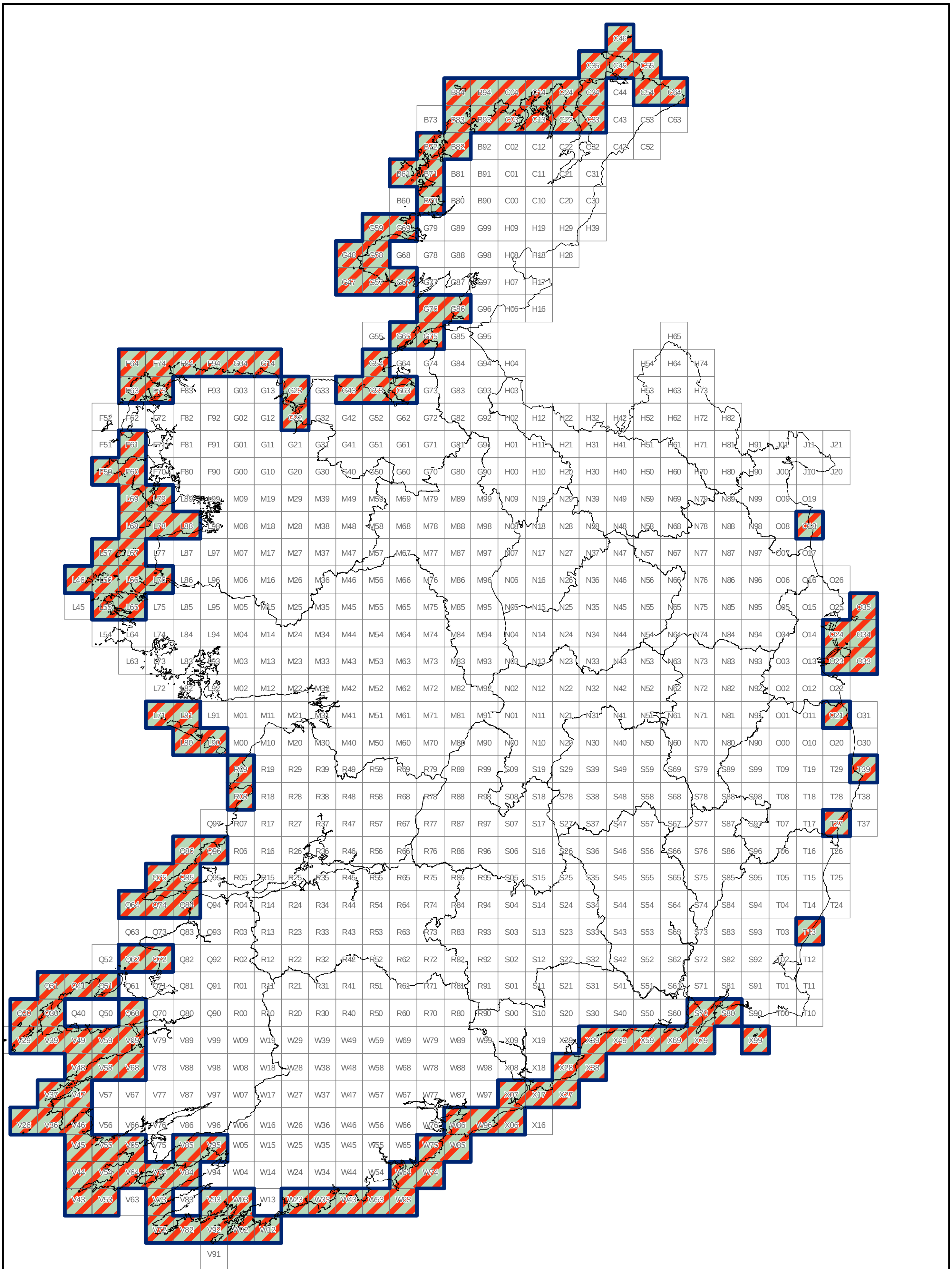
Date: August 2007

1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

1. National Level	
Habitat Code	1230
Member State	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	▪ BROWNE, A. (2000) *National inventory of sea cliffs and coastal heaths*. Report for the National Parks and Wildlife Service, Dublin. ▪ 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 maritime cliff and slope 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. ▪ RODWELL, J.S. (ed.) (2000) *British Plant Communities,* Volume 5: *Maritime communities and vegetation of open habitats.* Cambridge University Press, Cambridge.
2.3 Range	Widespread geographical distribution, with a greater frequency of soft cliffs along the eastern seaboard.
2.3.1 Surface area	15,300 km^2 (153 grid cells x 100 km^2)
2.3.2 Date	08/2007
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	Stable
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	
2.4 Area covered by habitat	
2.4.1 Distribution map	See map I attached
2.4.2 Surface area	52.5 km^2
2.4.3 Date	08/2007
2.4.4 Method used	1 = best expert judgement
2.4.5 Quality of data	2 = moderate
2.4.6 Trend	Stable
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	120 - Fertilisation 140 – Grazing 142 – Overgrazing by sheep 146 – Overgrazing by hare, rabbbits and small mammals 150 – Restructuring agricultural land holding 180 – Burning 311 – Hand cutting of peat 403 – Dispersed habitation 420 – Disposal of household waste 502 – Routes, autoroutes 601 – Golf course 608 – Camping and caravans 720 – Trampling, overuse

	871 – Sea defence/coastal protection works 900 – Erosion
2.4.11 Threats	120 - Fertilisation 140 – Grazing 142 – Overgrazing by sheep 146 – Overgrazing by hare, rabbits and small mammals 150 – Restructuring agricultural land holding 180 – Burning 311 – Hand cutting of peat 403 – Dispersed habitation 420 – Disposal of household waste 502 – Routes, autoroutes 601 – Golf course 608 – Camping and caravans 720 – Trampling, overuse 871 – Sea defence/coastal protection works 900 – Erosion
	2.5 Complementary information
2.5.1 Favourable reference range	15,300 km^2
2.5.2 Favourable reference area	52.5 km^2
2.5.3 & 2.5.4 Typical species	**Species:** *Crithmum maritimum, Armeria maritima, Limonium* spp., *Brassica oleracea, Cochlearia officinalis, Plantago maritima, Festuca rubra, Daucus* spp., *Tripleurospermum mariitimum, Asplenium marinum, Spergularia rupicola, Inula crithmoides, Sedum anglicum, Rhodiola rosea, Lavatera arborea, Scilla verna, Beta maritima, Daboecia cantabrica, Calluna vulgaris, Empetrum nigrum, Festuca ovina, Galium saxatile, Potentilla erecta, Rumex acetosella, Juniperis communis.* **Method:** the species above are characteristic of vegetated sea cliffs as defined by the Common Standards Monitoring guidance documents (JNCC 2004) and modified for use in Ireland (Browne 2005).
2.5.5 Other relevant information	
	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

Vegetated sea cliffs of the Atlantic and Baltic coasts

1230

Current Distribution (153 cells)
Current Range (153 cells)
Favourable Reference Range (153 cells)
W48 10km grid cells

Date: September 2007

Background to the conservation assessment of lesser horseshoe bat (*Rhinolophus hipposideros*) (Bechstein) in Ireland

May, 2007

1.0 Ecology of the lesser horseshoe bat in Ireland

The lesser horseshoe bat is the only member of the Rhinolophidae occurring in Ireland (O' Sullivan, 1994) and was first recorded in Ireland in 1858 (McAney, 1994). It is confined to the west coast of Ireland in the counties of Cork, Kerry, Limerick, Clare, Galway and Mayo (McAney, 1994) and a single animal was recorded in Co. Roscommon in 2004 (Roche, *pers. comm.,* 2006). Co. Kerry is the main stronghold for this species, followed by Co. Clare, then Galway, Cork, Mayo and Limerick in turn (Kelleher, 2004). Ireland represents the most northerly and westerly limits of the species' distribution (Roche, 2001).

Unlike other bat species, lesser horseshoe bats are unable to crawl and must be able to fly directly into a roost through an open window, door or chimney. At summer roosting sites, females gather in large numbers forming maternity colonies where they give birth to just one young every second year. They are faithful to a roost site and will return to the same site each year (Biggane, 2005b). From September to November, the bats leave the maternity roost and go to hibernation sites for the winter. These hibernation sites are structures that maintain a constant low temperature throughout the winter, typically caves, souterrains, cellars and icehouses (Biggane, 2005b, O' Sullivan, 1994). However, in Ireland the lesser horseshoe bat does not hibernate throughout the entire winter but will arouse and feed during mild winter nights when temperatures reach 10^{o}C and insects are active (Biggane, 2005b).

They rely on linear landscape features such as treelines, stonewalls and hedgerows to navigate and commute from roosts to feeding sites, because, unlike other bat species, they do not fly out in the open (Motte & Libois, 2002, Biggane, 2005b). The bats forage predominantly in deciduous woodland and riparian vegetation normally within c. 3km of the maternity roost (Bontadina *et al.,* 2002, Motte & Libois, 2002).

Lesser horseshoe bats are very sensitive to disturbance and normally do not occupy the same buildings as humans (Biggane, 2005b).

2.0 Mapping assessment data

2.1 Extent

Regular observations of summer and winter colonies in Ireland have been ongoing since the 1970s as part of an ongoing monitoring programme for maternity and hibernation roosts (Kelleher & Marnell, 2006a). It is thought that all major roost sites for the lesser horseshoe bat in Ireland have been located (McAney, *pers. comm,* 2006) but smaller roosts are still being identified (Biggane *pers. comm.,* 2006). A database of all the data gathered over time was compiled in 2003 by the [1]National Parks and Wildlife Service (Kelleher, 2004).

Roost location information derived from this database was mapped using ArcView GIS 3.2. Easting and Northing co-ordinates were calculated from the roost grid references and these Eastings and Northings were mapped as points thus creating a comprehensive extent map of roosts.

2.2 Range

[1] National Parks and Wildlife Service; a division of the Department of the Environment, Heritage and Local Government that manages the Irish State's nature conservation responsibilities under national and European law.

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'* (EC, 2006). The Range of the lesser horseshoe bat in Ireland was mapped using ArcView GIS 3.2. The Irish 10km^2 grid was overlaid with the lesser horseshoe bat roost locations. The range outline was drawn following IUCN guidelines and was 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). The resulting range polygon is the smallest polygon containing all grid squares where species' roost are present, drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps (i.e. non-occupied squares) in the habitat distribution of 3 or more grid squares (10-km side) or oblique gaps of 2 or more squares are deemed enough as to justify a break in the range. Although not containing an identified roost, these non-occupied grid squares were deemed to represent part of the species' range although no records for occurrence exist for those grid square ([2]expert opinion, 2006).

2.3 Habitat

A list of typical habitats used by the lesser horseshoe bat for roosting, foraging and commuting (see 5.0. below) was derived from a number of information sources:

- NPWS lesser horseshoe bat database where adjacent habitat for each roost is recorded
- Published papers (Appendix I)
- [2]Expert opinion
- NPWS Natura 2000 Management Plans' digitised Indicative Habitat Maps for Lesser
- Horseshoe Bat Special Areas of Conservation

Once this list was created these habitats were mapped for the Range of the lesser horseshoe bat in Ireland from the following data sources:

a) [3]CORINE 2000 and CLC 1990-2000 Change dataset Level 3 categories:

- 231 Pastures (only unimproved pastures were selected)
- 311 Broadleaved forest
- 312 Coniferous forest
- 313 Mixed forest
- 321 Natural grassland
- 324 Transitional woodland-scrub
- 511 Stream courses
- 512 Water bodies

[2] In October, 2006, a meeting was held between NPWS Research staff and Irish published bat experts and bat workers; Dr. Kate McAney (Vincent Wildlife Trust), Dr. Niamh Roche (Bat Conservation Ireland [BCI]), Dr. Tina Aughney (BCI), Dr. Sinéad Biggane (BCI and NPWS), Enda Mullen (NPWS) and Conor Kelleher (BCI and Irish Wildlife Trust [IWT]. This meeting was held to verify the content of this Conservation Assessment and to gather any additional information deemed to be of use for assessing the conservation status of the Lesser Horseshoe Bat in Ireland
.

[3] CORINE: In 1985, Co-Ordination of Information on the Environment (CORINE) was established by the EU to create databases of landcover, biotopes, soil maps and acid rain. The CORINE land cover (CLC) project provides a pan-European inventory of biophysical land cover using 44 classes and a minimum mapping unit of 25ha at 1:10000,000 scale. This land cover was interpreted from satellite images using a common methodology throughout Europe. In Ireland, CLC 1990 was the first complete land cover database for the country. This has since been updated (2000) and any mapping errors or habitat classification errors identified from the 1990 dataset have been updated into this CLC 2000 for Ireland. A number of datasets (products 1-3) were created as part of the CORINE Land Cover Project 1990-2000. Product 1; the most up to date 2000 data were used to map available habitat for the Lesser Horseshoe Bat in Ireland. Product 3 mapped changes in land cover larger than 5ha between CLC 1990 and CLC 2000, in geographical co-ordinates, in vector format. This dataset was used to estimate change in landcover of habitats used by Lesser Horseshoe Bat.

These habitats were identified from the CORINE database vector files and copied into an ArcView 3.2. lesser horseshoe bat habitat project.

b) NPWS Natura 2000 Management Plan Indicative Habitat Maps for Special Areas of Conservation within the lesser horseshoe bat range in Ireland. Relevant habitat shapefiles were identified from these digitised Management Plan habitat maps and these shapefiles were copied into an ArcView 3.2. lesser horseshoe bat habitat project. Habitats selected were combined into the following categories:

- Broadleaved woodland
- Commercial forestry
- Grassland
- Rivers and streams
- Drainage ditches
- Scree/exposed rock
- Scrub/woodland
- Turloughs
- Lakes and ponds
- Non-marine caves
- Artificial underground habitats

c) [4]FIPS data
The most recent FIPS dataset (1998) was incorporated into the habitat project in ArcView 3.2. Landcover classes mapped were:

- Broadleaved forest
- Conifer forest
- Mixed forest
- Other forest

The shapefiles for the four sources of habitat information (CORINE 2000, CORINE Change dataset, NPWS and FIPS) were intersected to avoid overlap of habitats.

3.0 Range

The area of the lesser horseshoe bat Range in Ireland was calculated in ArcView GIS 3.2. as 12,400 km^2. See 2.2 above for detailed information on how Range was calculated.

The Range of the lesser horseshoe bat in Ireland, for the most part, follows a long narrow linear pattern. It extends from Mayo at its most northern point, through Galway, Clare, Limerick, Kerry and down to Cork at its most southern range.

3.1 Range Conservation Status

[4] FIPS: Forestry Inventory and Planning System, is a GIS based planning tool, which has been developed by Coillte (the Irish forestry board) for the Forest Service of the Department of Marine and Natural Resources. FIPS provides the most up to date inventory of the national forest resource. All forest parcels greater than 0.2 ha (0.5 acres) have been mapped and classified using multiple sources of geographic data including satellite imagery, aerial photography and Ordnance Survey maps. Combined with digital records of all forest grant applications, FIPS provides the most accurate and detailed information available on the national forest estate.

The Favourable Reference Range (FRR) for the lesser horseshoe bat in Ireland is taken to be its present range which is 12,400 km^2 ([2] expert opinion, 2006) as there is not thought to be a significant change in the species range over historical time (McAney, *pers. comm., 2006*).

As the Range of the species is stable and not less than the FRR, it is allocated a Favourable conservation status.

Species Range Area: The area of the polygon which contains all of the grid cells of the roost range : 12,400 km^2

Favourable Reference Range: 12,400km^2 i.e. The present range is sufficiently large to maintain the population; there is no evidence that this species ever occupied a larger range.

4.0 Population

4.1 Population estimation

Regular observations of summer and winter colonies have been ongoing in Ireland since the 1970s (see Appendix II). As a result, a detailed inventory of at least all the major roosts has been prepared and a database of all roost types and bat counts developed (Kelleher, 2004). Ad hoc counting of summer and winter roosts has been taking place since the 1970s. The first concentrated effort to count lesser horseshoe bats at all 153 identified major maternity roosts in the country was undertaken in June 2006. Lesser horseshoe bats are summer roost faithful which allows counts at summer roosts to be used to monitor populations (Warren and Witter, 2002). The maternity roost counts taken during the intensive survey in 2006 were used to extrapolate the population of lesser horseshoe bats in Ireland at the present time

The following methods were agreed by lesser horseshoe bat [2]experts to estimate the size of the population:

- 153 known major LHS maternity roosts were visited in summer 2006 and counts taken at each (total 7565 bats). These roosts are now part of an ongoing monitoring programme in the country.
- 183 maternity roosts are identified in the NPWS database (Kelleher, 2004).
- Thus 7565 bats equate to 83.6% of known maternity roosts in Ireland.
- Peak counts from all roosts in the NPWS database were used to calculate the average number of bats per roost as 20.
- This average number per roost was assigned to the 30 unsurveyed maternity roosts identified from the NPWS database to give a figure of 600 bats for these 30 sites.
- Thus the total number of bats in identified maternity roosts in the country was 7565 (summer 2006 at 153 roosts) + 600 (estimated at 30 unmonitored maternity roosts) to give a total of 8165 bats in maternity roosts.
- It is understood that males represent about 25% of a maternity roost's population (Schofield, *pers. comm.*2006, Knight, *pers. comm.*, 2006). Thus 25% (2040) of the total maternity roost number (8165) was subtracted to give an estimated total female number for maternity roosts (6125).

- It is thought that there is roughly a 1:1 ratio of males : females for lesser horseshoe bat populations (Bels, 1952; Bontadina *et al*., 2002,). The only Irish data comes from a winter ringing study in 1997 (McAney, 1997). In a random sample of 39 bats, 21 were female and 18 were male, a female : male ratio of 1.17, effectively 1:1.
  Using this 1:1 ratio, the number of calculated females in known maternity roosts in Ireland was doubled to give an estimated total number of lesser horseshoe bats in the country: 12,250.

- A number of provisos must be considered when using this 12, 250 figure:
  - The 1:1 ratio requires further confirmation. It does not consider that perhaps males are more prone to predation and mortality due to their solitary nature.
  - The final figure is based on an assumption that 25 % of the bats in maternity roosts are male. Further research is needed to quantify the actual percentage of males in Irish lesser horseshoe bat maternity roosts.

4.2 Population trends

From the database, all roosts that had ≥ 5 annual counts were identified. Internationally Important maternity roosts (>100 bats) and Internationally Important hibernation roosts (>50 bats) (F. Marnell pers. comm.) were selected from this subset. Population trends for 19 large maternity roosts and 16 large hibernation roosts were plotted to illustrate trends at large roosts (see Figures 1 and 2). Trends were also illustrated for 33 roosts with low bat numbers (Figure 3).

Fluctuations occurred in the populations over time. One possible factor for the fluctuation is climatic. Populations at monitored hibernation sites dramatically fell from 1979-1982 during a period when the lowest mean minimum winter temperatures were recorded (McAney, 1994). Disturbance to roosts, bats moving to larger roost, large colonies splitting into smaller groups and roost deterioration are also factors leading to a decline in numbers at individual roosts. Subsequent increases could be related to roost protection measures and increased temperatures (see Section 6.0 for positive and negative impacts).

Only 1 out of 19 known large maternity roosts showed an overall decline in population (from 1983-2006) (Bat site 244) (Figure 1).

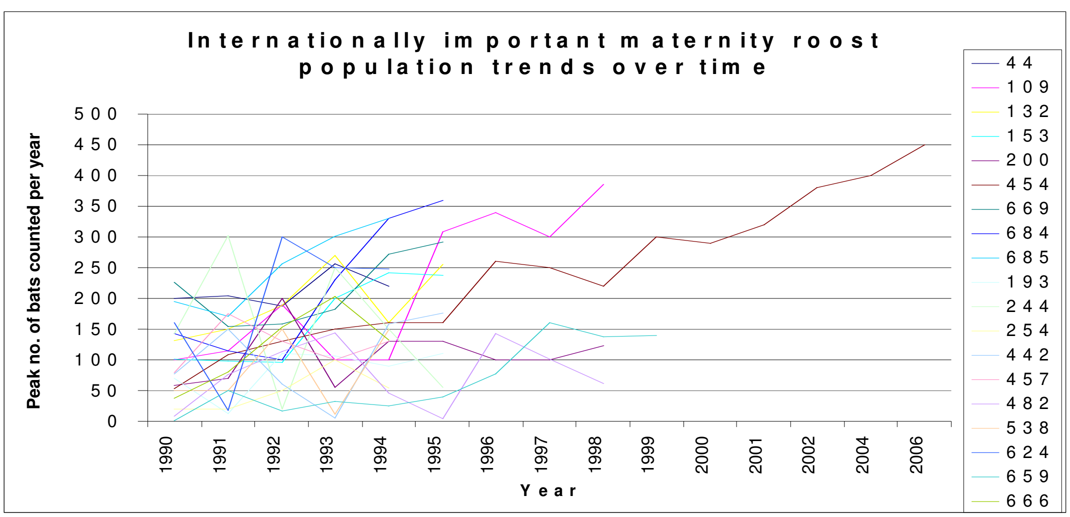


Figure 1: Population trends across 19 large maternity roosts (with ≥ 5 annual counts).

Only 1 out of 16 known large hibernation roosts showed a decline over time (from 1983-2006) (Bat site 219) (Figure 2).

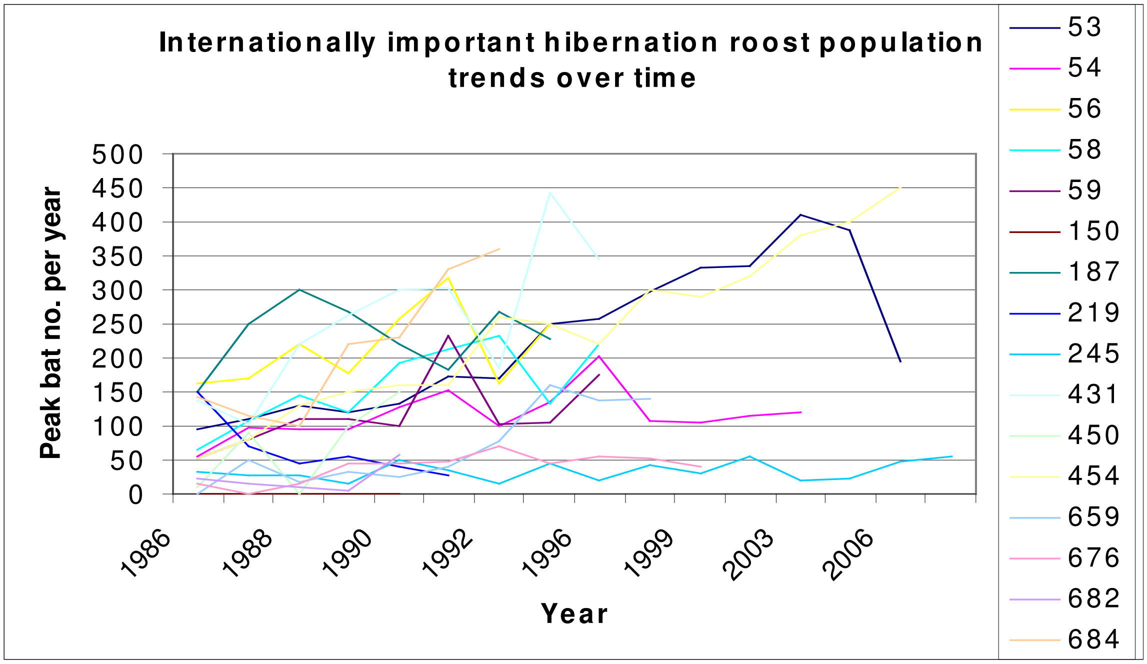


Figure 2: Population trends across 16 large hibernation roosts with ≥ 5 annual counts

Out of 33 bat roosts with low numbers, 52% showed an increase over time, 40% showed a decrease and 9% remained the same (Figure 3).

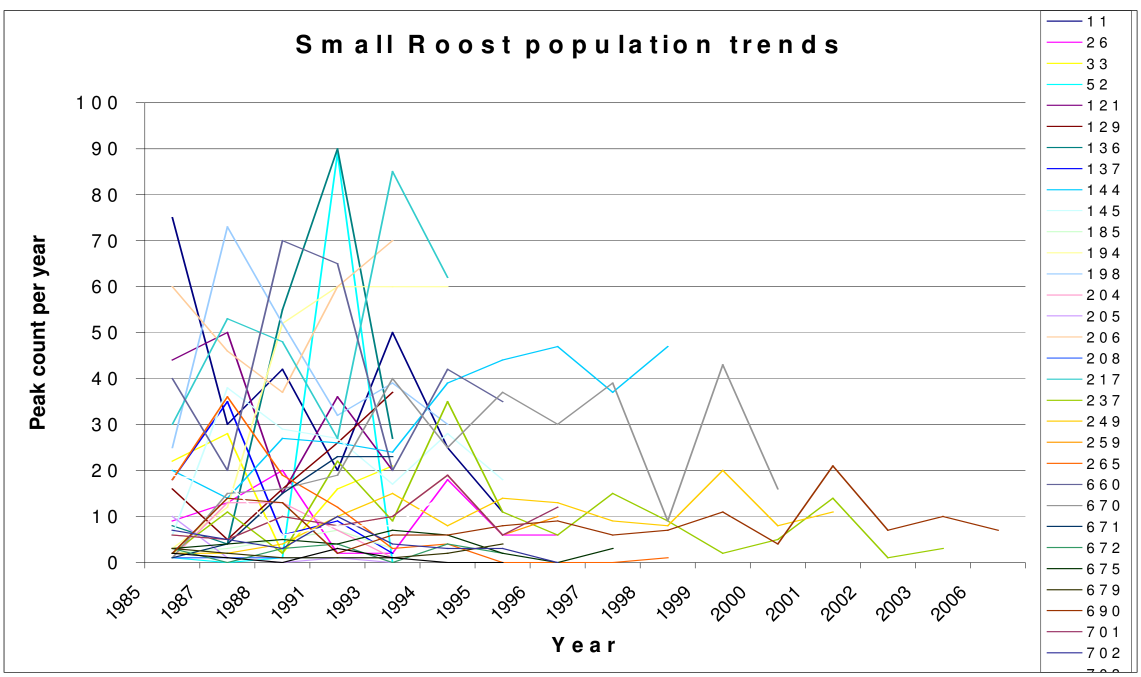


Figure 3: Population trends across 33 small roosts with ≥ 5 annual counts

A Least Squares Linear Regression was carried out for each of the 68 sites selected with ≥ 5 annual counts. However, due to the limited data, that is, a third of roosts had only 5 annual counts, a 'Not-Significant' result was obtained for most roosts. However, 7 large maternity roosts and 7 large hibernation roosts showed a significant (p≥0.01) increase in population over time and 3 small roosts showed a significant increase over time. When more annual count data are available in the future, further statistical analysis can be carried out using time series analysis following smoothing as this will allow for the fluctuating nature of the data.

Overall, the trends show a small increase, with an average figure for the 67 roosts sampled between 1973 and 2006 of +6%.

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). Expert opinion[2] considers that the population figure derived from the NPWS lesser horseshoe bat database by Kelleher (2004) was an underestimate and that the more detailed approach taken above has provided a more accuarate assessment. It was also agreed that the present population is at a favourable level, probably having increased in recent years. Although there is some further potential for expansion, the present population is taken as the FRP.

The present population estimate is 12,250 (see 4.0 above).

Species population: 12,250 extrapolated from known maternity roost bat count data.

Favourable Reference Population: as above, 12,250.

Following the General Evaluation Matrix for assessing the Conservation Status of Annex II Species (EC, 2006); because the Estimated Present Population is equal to the Favourable Reference Population and reproduction, mortality and age structure are not deviating from normal (see 4.2. above), the Conservation Status of the lesser horseshoe bat Population in Ireland is Favourable.

5.0 Habitat

See 2.3. above for a detailed list of sources of Habitat information and habitats mapped.

Evidence for the correlation between presence of the lesser horseshoe bat in an area and availability of suitable habitat is suggested by the distribution of the species in Co. Mayo. This county has the second lowest population of lesser horseshoe bats for a county in its range in Ireland. The species distribution in Mayo is confined to the south of the county in close proximity to broadleaved woodland and lake habitat. It is therefore probable that the scarcity of suitable foraging habitat in Mayo has limited its distribution to its current status (Biggane, 2005b). McGuire (1998) illustrated the strong relationship in Co. Clare between high number of roosts in an area with good cover of tall hedgerows (surrounding pasture) and very high cover of woodland/scrub. Thus the availability of suitable habitat is essential to the presence of the lesser horseshoe bat in an area.

The habitats used by the lesser horseshoe bat are:

- Riparian
- Scrub woodland
- Deciduous woodland
- Mixed woodland
- Hazel woodland
- Lake
- Grassland
- Conifer plantation
- Limestone pavement
- Coastal
- Pasture
- Parkland
- Turlough
- Caves (sea and non-marine)
- Artificial underground habitats

These habitats were mapped for the Range of the lesser horseshoe bat using data from [1]NPWS (4.17km^2), [3]CORINE datasets (3, 358km^2)and [4]FIPS (118km^2)

The area of relevant habitat available to the lesser horseshoe bat in its Range is 3,480 km^2 which is 30% of its Range.

5.1 Habitat Conservation Status

At present, the only available data in relation to habitat extent show that 30 % of the species range has suitable habitat. Lesser horseshoe bats in Ireland rely on linear landscape features such as treelines, stone walls and hedgerows to navigate and commute from roosts to feeding sites, as unlike other bat species, they cannot fly out in the open (Biggane, 2004b). Thus the extent of habitat needed is limited and they do not require the large open expanse of agricultural fields.

Product 3 of the CORINE Land Cover Project 1990-2000 shows land cover changes between 1990 and 2000. Using these data, it can be seen that relevant feeding habitats for the lesser horseshoe bat in Ireland have slightly increased in this ten year period. In the range of this species, there is an additional 0.3km^2 of broadleaved forest, 1.55km^2 of transitional woodland scrub, 0.8km^{2}of conifer forestry and 0.9km^2 of unimproved pasture.

Also, a number programmes and initiatives are now in place that should, in theory, have a positive impact on available habitat. These are recent initiatives and should increase the habitat available to the lesser horseshoe bat in Ireland. These are:

- REPS 3

REPS is the Rural Environment Protection Scheme which is an initiative of the Department of Agriculture in Ireland to reward farmers for carrying out their farming activities in an environmentally friendly manner. It is in its third phase at present and this came into force on June 1st, 2004. There are up to 18 ‘Measures’ to which a farmer can subscribe. A Plan is written for that farm which incorporates these Measures and the farmer is compensated accordingly. Examples of Measures that should at least maintain habitat for the lesser horseshoe bat are Measures 4 and 5.

Measure 4 is 'Retain Wildlife Habitats'. This includes options such as broadleaved tree planting, creation of a new habitat for wildlife and protection and enhancement of nature corridors.
Measure 5 is 'Maintain farm and field boundaries. These boundaries are listed as stonewalls, earth or stone banks, hedgerows and mature trees. These are habitats used by lesser horseshoe bats for commuting and foraging (McAney, 1994, Walsh *et al,* 1995, Maguire, 1998, JNCC, 2001, Roche, 2001, Motte & Libois, 2002, Schofield *et al*., 2002, Biggane, 2004a, 2004b and Biggane 2005a, 2005b).

- Common Agriculture Policy (CAP)

26 June 2003, EU farm ministers adopted fundamental reforms of the Common Agricultural Policy (CAP) known as the Fischler Reforms. These reforms completely changed the way the EU supported its farm sector. New 'single farm payments' were introduced and were linked in respect of environmental, food safety and animal welfare standards. More money was made available to farmers for environmental, quality or animal welfare programmes by reducing direct payments for bigger farms. The single farm payment entered into force in 2005. (http://ec.europa.eu/agriculture/capreform/index_en.htm)
This single farm payment is subject to cross-compliance with a variety of EU environmental, animal welfare and food safety standards.

Farmers are now encouraged to participate in extensive farming methods and the emphasis has been taken from quantity of output and production.

These extensive farming methods should enhance available habitat for the Lesser Horseshoe Bat.

- Coillte Biodiversity Areas

Coillte's Nature Conservation Strategy was initiated in 1999, as part of the company's Sustainable Forest Management (SFM) Initiative. It was formulated to take account of the requirements of Forest Stewardship Council (FSC) Certification, EU Habitats and Birds Directives and National policies in relation to biodiversity and nature conservation. One of the focuses of its Nature Conservation Strategy is the conservation of habitats at landscape or Forest Management Unit (FMU) Level. Under FSC guidelines, Coillte is required to identify a minimum of 15% of each Forest Management Unit that will be managed with nature conservation as a primary management objective.
In 2000, Coillte commenced the process of identifying suitable areas for inclusion in this 15%. As a first step, Coillte inventory data and local staff knowledge provided a full list of "potential biodiversity areas" on the estate. It developed a system to ensure that these areas would be protected during forest operations. Between 2001 and 2005, these potential biodiversity areas in all Coillte FMUs were surveyed by independent ecologists and reviewed for inclusion in the 15%. From these ecological surveys to date, a series of biodiversity areas have been identified and management objectives written for these areas (http://www.coillte.ie/managing_our_forests/cert/cert.htm.).

These biodiversity areas in Coillte owned land will be of benefit as potential habitat to the Lesser Horseshoe Bat.

Thus, considering the increase in available habitat calculated by CORINE between 1990 and 2000 and taking into account the initiatives that should enhance available habitat for the lesser horseshoe bat that already has an increasing population trend, it can be said that the area of habitat of the species is sufficiently large (and stable or increasing) and habitat quality is suitable for the long term survival of the species. Thus, the Conservation Status of Habitat is Favourable.

6.0 Future Prospects

6.1 Negative impacts and threats

Loss of suitable summer and winter roosting sites due to the demolition or renovation of derelict buildings for human occupation, loss of commuting routes linking roosts to foraging sites, and loss of suitable foraging sites are the major threats to this species (Biggane, 2004b). The use of insecticides is also thought to have a negative effect on the lesser horseshoe bat (McGuire, 1998). Habitat destruction such as felling of trees and scrub clearance are significant pressures (Roche, 2001). A number of references are made to the loss of roosts through deterioration of old buildings (McAney, 1994, McGuire, 1998 and Roche, 2001).

McGuire (1998) and Biggane (2005b) clearly illustrated the limiting effect that habitat has on the lesser horseshoe bat (see Section 5.0). Its presence is restricted to areas with suitable foraging and commuting habitats. This suggests that the lesser horseshoe bat is extremely vulnerable to loss of habitat.

When compiling the lesser horseshoe bat database for the NPWS, Kelleher found that several known roosts that had been submitted for the database no longer existed. He also noticed that several of the larger roost sites from the early period of the study (1970s and 1980s) had reduced in numbers through neglect and the colonies had split into smaller units in less favourable breeding conditions. There was also evidence that colonies had abandoned traditional sites for unknown reasons. Some of these sites remain suitable for continued bat use, so it is unknown why the species abandoned these roosts (Kelleher, 2004).

6.2 Positive Impacts

A number of these threats are being addressed through national legislation. All bats in Ireland are protected under the Wildlife Acts (1976 and 2000). It is an offence to deliberately kill or injure any bat species or to damage or disturb its roost. In order to handle or capture a bat, a license is required under the Wildlife Acts. The Habitats Directive (which specifically protects the lesser horseshoe bat in Annex II) 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 and roosts of all bat species as well as the bats themselves.

Under Annex II, each member state must designate Special Areas of Conservation for the Lesser Horseshoe Bat. Ireland to date has 41 SACs designated for the lesser horseshoe bat (Appendix III). Recent estimates suggest that over 60% of the national population of lesser horseshoe bat is protected within Special Areas of Conservation in Ireland (Kelleher & Marnell, 2006a). Many conservation sites designated for the presence of the lesser horseshoe bat have had grilles put in place to protect the winter hibernation roost of the bat (O' Sullivan, 1994). Hibernacula have been specially built and roofs repaired in some instances. NPWS has an active programme of repairing and restoring lesser horseshoe bat roosts within cSACs.

The Irish Government is a signatory to The Convention on the Conservation of European Wildlife and Natural Habitat (Bonn Convention) (1979) and this lead to The Agreement on the conservation of Bats in Europe (EUROBATS, 1992). Ireland signed the EUROBATS Agreements in June 1993 and became a fully ratified member in June 1995. This Agreement aims to protect all 45 species of bats identified in Europe. Article III outlines the 'Fundamental Obligations' on the signatory countries e.g. section 3 states that "*each Party shall give due weight to habitats that are important for bats*" and section 8 states that "*each Party shall…consider the potential effects of pesticides on bats*…" Ireland is also a signatory to The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), 1982.

An ongoing monitoring programme for lesser horseshoe bat has been established by the NPWS and focuses on maternity and hibernation roosts throughout the species range. The NPWS has commissioned surveys of foraging areas and commuting routes at a number of lesser horseshoe bat roosts since 2004 and diet analysis has been carried out at two winter roosts (Biggane, 2004a, 2004b, 2005a, 2005b and Kelleher, 2004). The results of these surveys will allow quantification of habitat needed by the lesser horseshoe bat and thus should increase the area of protected habitat for the species.

Hedgerows are very important to the species for both commuting routes and feeding habitats and their removal for agricultural intensification, road building and increased house building in the countryside could have a serious impact on the population. The National Biodiversity Plan places emphasis on protection of natural habitats and refers specifically to the protection of hedgerows. A number of Local Authorities have commenced hedgerow surveys of their counties, the results of which will be used to advise in the planning process.

The National Roads Authority (NRA) brought out guidelines in 2006 in relation to the treatment of bats during the planning and design of national road schemes. The guidelines are not mandatory but are recommended to ensure appropriate protection of bats. These guidelines recommend identifying bat roosts and habitat along a potential road scheme and implementing appropriate mitigation to protect the bats (National Roads Authority, 2006). NPWS have produced guidelines for the protection of bats in development in general (Kelleher & Marnell, 2006b). These guidance documents will help ensure a greater level of understanding of the legal measures in place for bats; they also provide advice on practical mitigation measures which developers and bat roost owners can adopt to avoid impacting on bats.

REPS 3, a programme co-ordinated by the Department of Agriculture and Food, had over 45,000 participants in 2005 and rewards farmers for extensive sustainable farming practices. In 2005, participants had signed up for participation in the following biodiversity measures (farmers may participate in more than one measure hence percentages do not add up to 100): 30% in Nature Corridor, 17% in Tree Planting, 4% in Watercourse margin maintenance, 30% in New hedgerow establishment, 28.1% in Hedgerow rejuvenation, 10.9% in Stonewall maintenance and 29.2% in New habitat creation (Rice, 2005).

The Vincent Wildlife Trust (VWT) in Ireland employs a permanent Field Officer whose focus is lesser horseshoe bat protection. Additional staff are employed on short contracts to conduct intensive surveys to locate new lesser horseshoe bat roosts. The VWT currently protects 12 lesser horseshoe roosts as Reserves. Nine have been completely gutted and renovated for the bats, one has been re-roofed and minor works have taken place at two others. Of these 12, eight are owned outright by the VWT and the other four are leased long term. The VWT has spent in the region of €600,000 in purchasing these eight sites and has spent another €600,000 renovating at all 12 sites. Thus, the VWT alone has spent over €1m protecting the lesser horseshoe bat in Ireland. It has 19% of the national population at its sites (McAney, *pers.comm.*, 2006).

Bat Conservation Ireland (BCI), a non-governmental organisation, was launched in Ireland in 2004 as an umbrella organisation for the country's bat groups. The main aim of the organisation is the conservation of bats and their habitats in Ireland. This is achieved through education, monitoring, research and site protection. With funding from the NPWS, BCI co-ordinates a number of bat surveys in the country and is responsible for updating the bat database.

6.3. Future Prospects Conservation Status

The Range of the lesser horseshoe bat is stable and is not considered to have changed historically. It has a Favourable Conservation Status.

Population trends of the lesser horseshoe bat in Ireland are increasing (see 4.2 above) in both large and small roosts. Population has a Favourable Conservation Status.

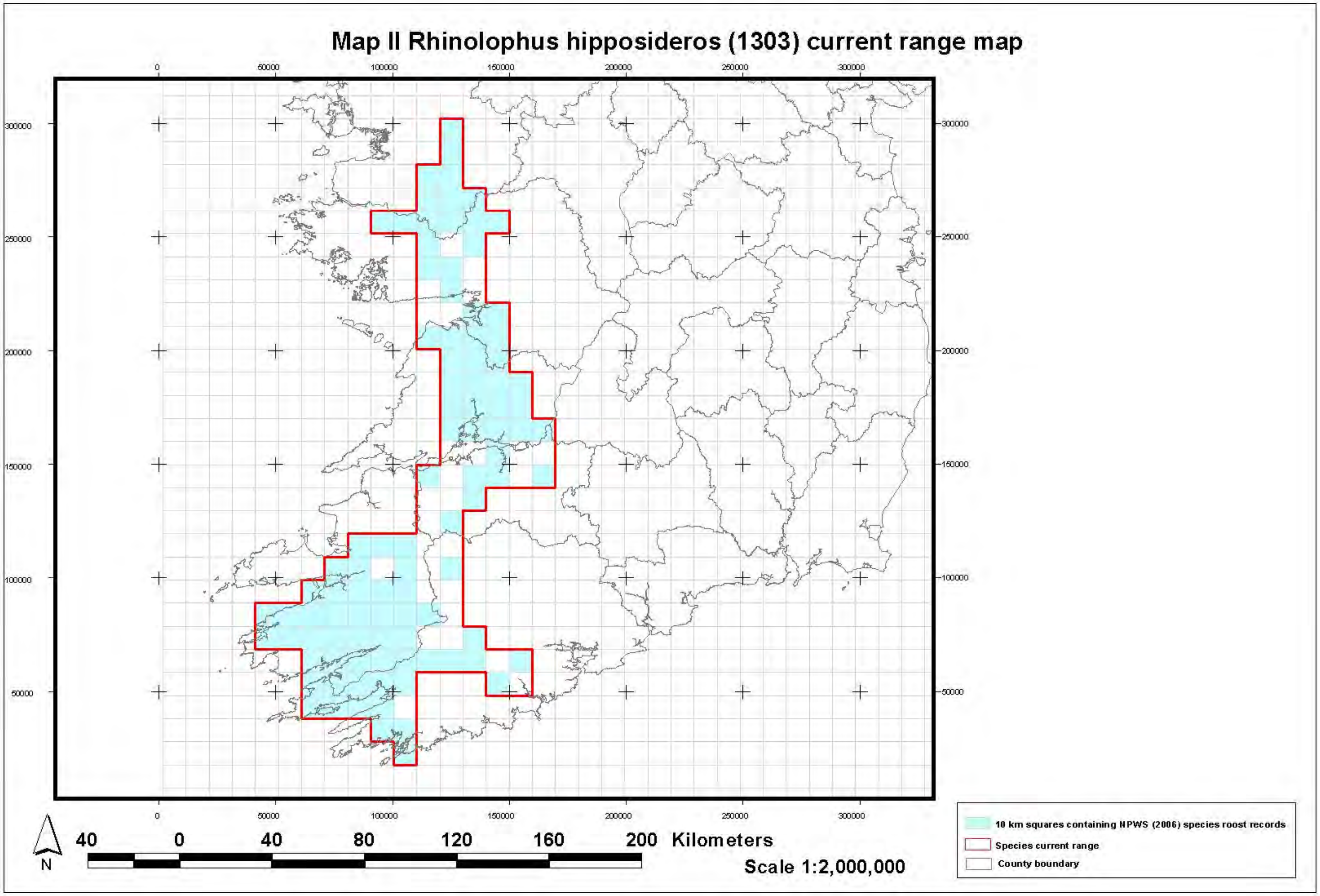
The Habitat extent of the species represents 30% of its Range. This is considered to be a good coverage of habitat considering that the lesser horseshoe bat uses linear habitats. There is a slight increasing trend in available habitat over time. It is thought that with various incentives in place in Ireland (see 5.0 above) this should increase or at least remain stable. Habitat has a Favourable Conservation Status.

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

Range of Lesser Horseshoe Bat:	**Favourable**
Population of Lesser Horseshoe Bat:	**Favourable**
Habitat for Lesser Horseshoe Bat:	**Favourable**
Future Prospects for Lesser Horseshoe Bat:	**Favourable**
Overall Assessment:	**Favourable Conservation**

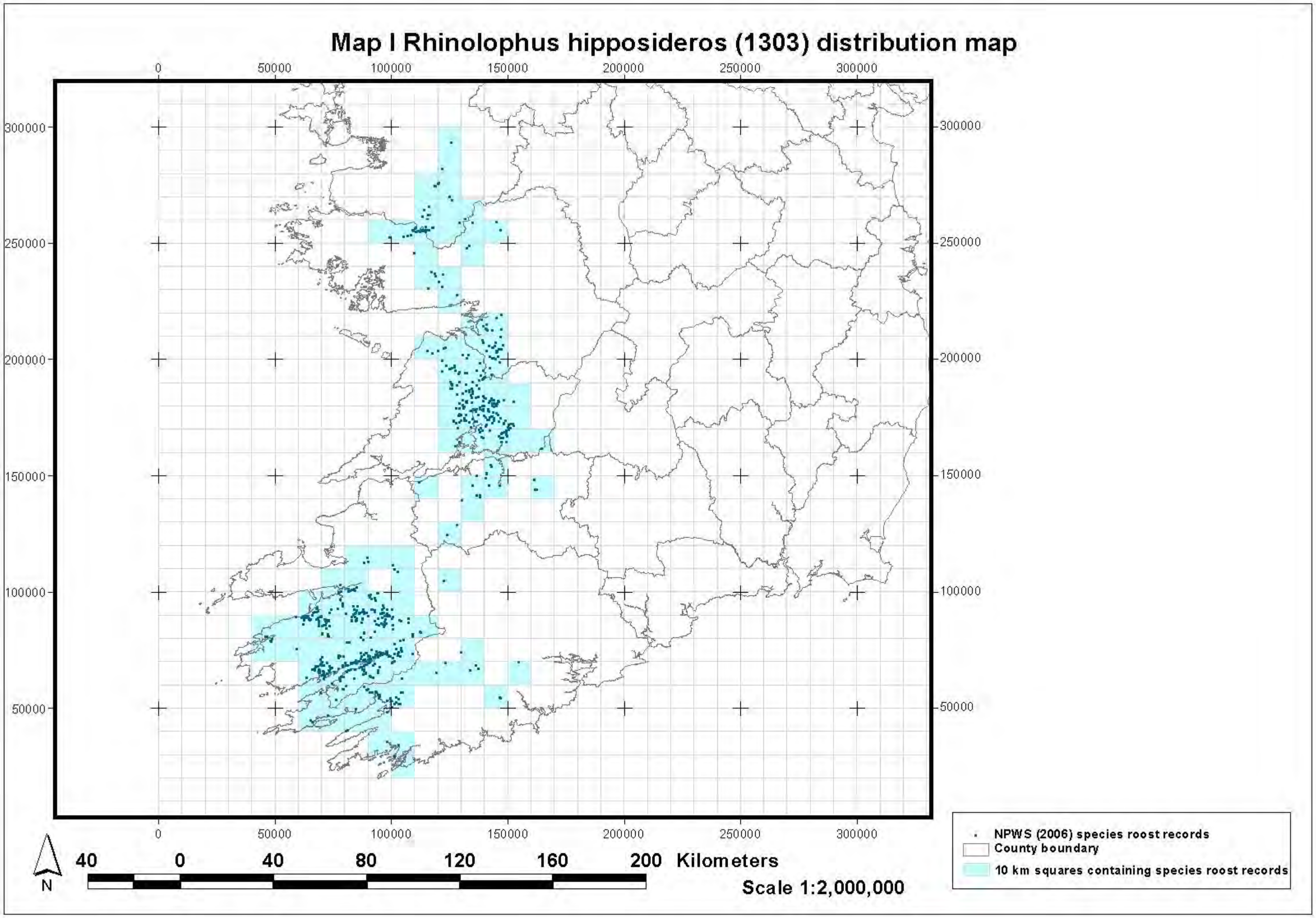
Appendix I

Current range of lesser horseshoe bat in Ireland (2006)

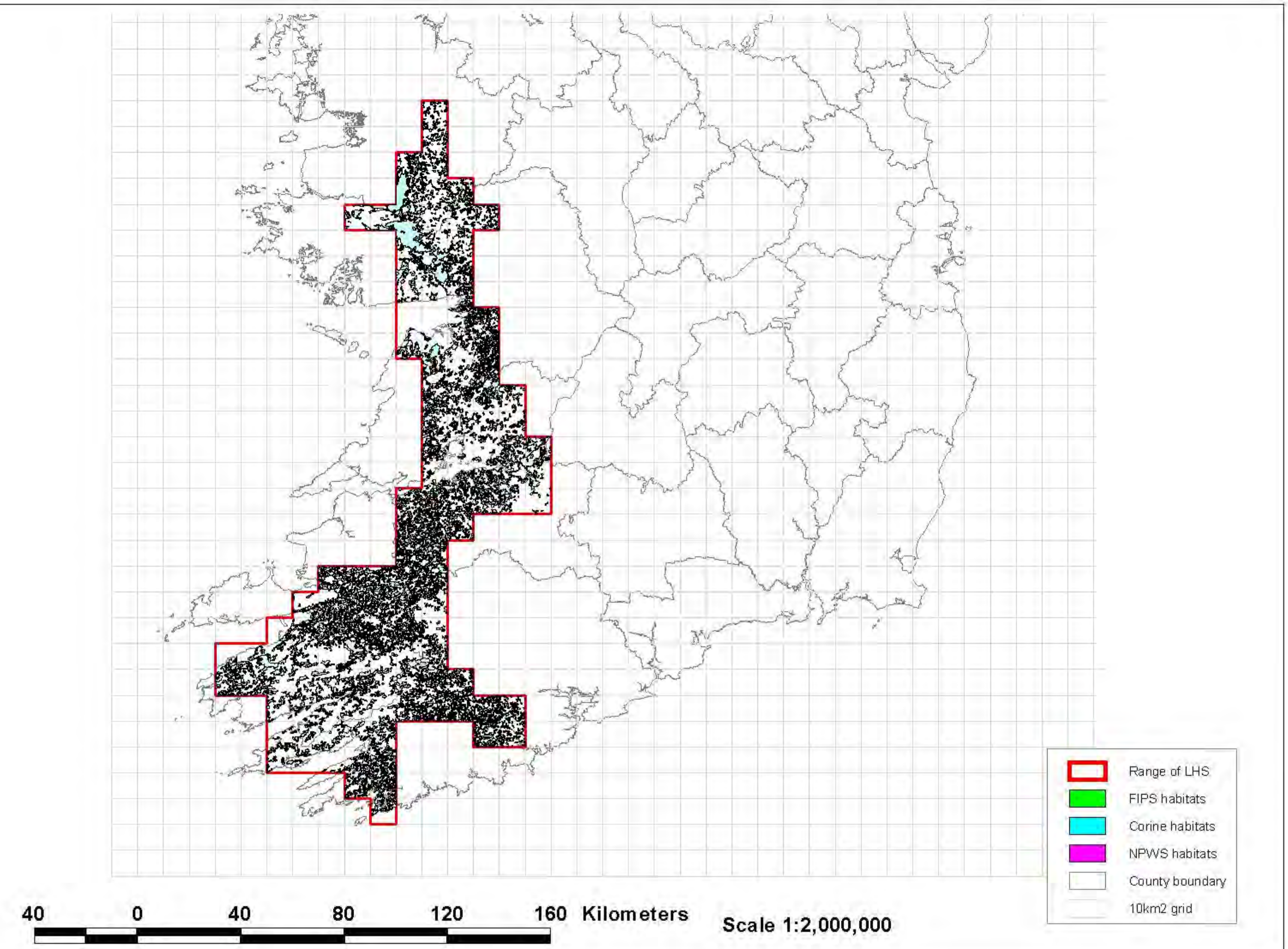


Appendix II

Distribution of lesser horseshoe bat roost in Ireland (2006)



Appendix III
Habitat available to lesser horseshoe bat within its Range (2006)



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Appendix VI

Special Areas of Conservation (SACs) designated for lesser horseshoe bat in Ireland

Site Code	Name of site	County
000030	Danes Hole, Poulnalecka	Clare
000032	Dromore Woods and Loughs	Clare
000037	Pouladatig Cave	Clare
000054	Moneen Mountain	Clare
000057	Moyree River System	Clare
000064	Poulnagordon Cave (Quin)	Clare
000090	Glengarriff Harbour and Woodland	Cork
000174	Curraghchase Woods	Limerick
000238	Caherglassaun Turlough	Galway
000286	Kiltartan Cave (Coole)	Galway
000297	Lough Corrib	Galway
000299	Lough Cutra	Galway
000353	Old Domestic Building, Dromore Wood	Clare
000364	Kilgarvan Ice House	Kerry
000365	Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment	Kerry
000474	Ballymaglancy Cave, Cong	Mayo
000527	Moore Hall (Lough Carra)	Mayo
000606	Lough Fingall Complex	Clare
001312	Ross Lake and Woods	Galway
001342	Cloonee and Inchiquin Loughs, Uragh Wood	Kerry
001774	Lough Carra/Mask Complex	Mayo
001926	East Burren Complex	Clare
002010	Old Domestic Building (Keevagh)	Clare
002041	Old Domestic Building, Curraglass Wood	Kerry
002081	Ballinafad	Mayo
002091	Newhall and Edenvale Complex	Clare
002098	Old Domestic Building, Askive Wood	Kerry
002157	Newgrove House	Clare
002158	Kenmare River	Kerry
002173	Blackwater River (Kerry)	Kerry
002179	Towerhill House	Mayo
002245	Old Farm Buildings, Ballymacrogan	Clare
002246	Ballycullinan, Old Domestic Building	Clare

002247	Toonagh Estate	Clare
002314	Old Domestic Building, Rylane	Cork
002315	Glanlough Woods	Kerry
002316	Ratty River Cave	Clare
002317	Cregg House Stables, Crusheen	Clare
002318	Knockanira House	Clare
002319	Kilkishen House	Clare
002320	Kildun Souterrain	Mayo

Appendix VII

Population trends over time in roosts with ≥ 5 annual counts

Roost category	Bat sitecode	Starting count	Finishing count	Difference
hibernation	53	94	194	100
hibernation	54	54	120	66
hibernation	56	162	250	88
hibernation	58	65	219	154
hibernation	59	52	176	124
hibernation	150	130	154	24
hibernation	187	150	227	77
hibernation	219	150	28	122
hibernation	245	32	54	22
hibernation	431	137	345	208
hibernation	450	9	151	142
hibernation	454	53	450	397
hibernation	659	1	140	139
hibernation	676	29	41	12
hibernation	682	23	58	35
hibernation	684	143	359	216
No category	11	75	11	-64
No category	26	9	6	-3
No category	33	22	21	-1
No category	52	1	0	-1
No category	121	44	20	-24
No category	129	16	37	21
No category	136	8	27	19
No category	137	18	2	-16
No category	144	20	47	27
No category	145	6	18	12
No category	185	2	3	1
No category	194	3	60	57
No category	198	25	30	5
No category	204	1	1	0
No category	205	10	0	-10
No category	206	60	70	10
No category	208	1	1	0
No category	217	30	62	32
No category	237	2	3	1
No category	249	2	11	9
No category	259	6	10	4
No category	265	18	1	-17
No category	660	40	35	-5
No category	670	1	16	15
No category	671	1	23	22
No category	672	3	2	-1
No category	675	3	3	0
No category	679	3	4	1
No category	690	2	7	5
No category	701	6	12	6

No category	702	7	0	-7
No category	703	2	0	-2
No category	704	19	15	-4
maternity	454	53	450	397
maternity	669	226	292	66
maternity	684	143	359	216
maternity	685	195	220	25
maternity	109	100	385	285
maternity	132	131	255	124
maternity	153	101	238	137
maternity	200	58	123	65
maternity	193	70	110	40
maternity	244	143	55	-88
maternity	254	20	54	34
maternity	442	77	176	99
maternity	457	79	130	51
maternity	482	8	61	53
maternity	538	50	149	99
maternity	624	160	248	88
maternity	659	1	140	139
maternity	666	38	132	94

1303 Lesser horseshoe bat (*Rhinolophus hipposideros*)

1. National Level	
Species code	1303
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	12,400km^2

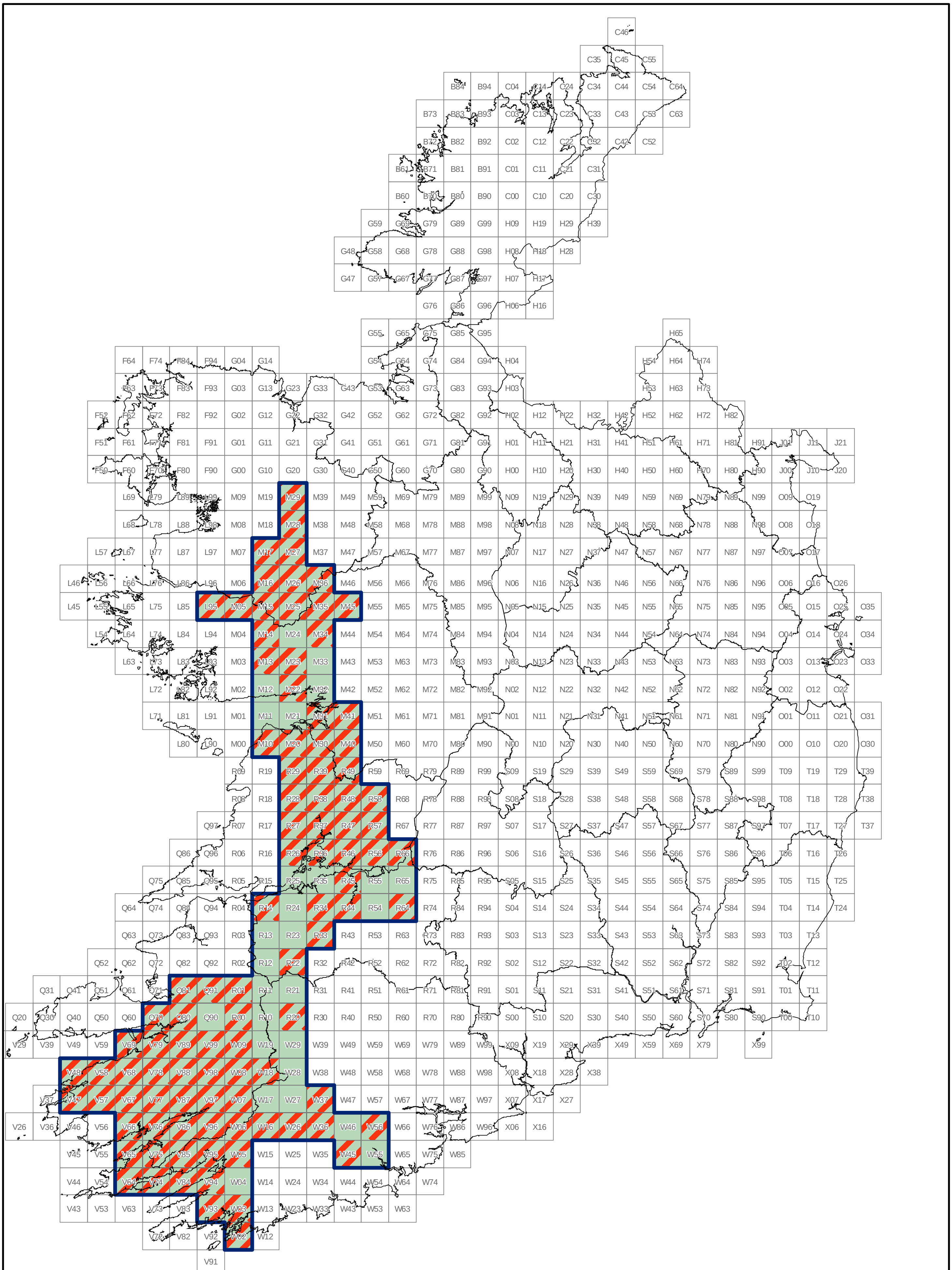
2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. (2004) Thirty years, six counties, one species – an update on the lesser horseshoe bat *Rhinolophus hipposideros* (Bechstein) in Ireland. *Irish Naturalists' Journal* 27: 387-392 ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McGuire, C. (1998) Survey of lesser horseshoe bats *Rhinolophus hipposideros* (Bechstein) and other bat species in north Co. Clare, Ireland. *Irish Naturalists' Journal* 26: 43-50. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Roche, N. (2001) The status of lesser horseshoe bats *Rhinolophus hipposideros* (Bechstein) and other bat species in Co. Limerick. *Irish Naturalists' Journa*l 26: 43-50.
2.3 Range	
2.3.1 Surface area	12,400km^2 (area of the polygon that contains all grid cells of bat roost range)
2.3.2 Date	November 2006
2.3.3 Quality of data	3 = good
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	1973-2006
2.3.7 Reasons for reported trend	N/a
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	12,250 individuals (Calculated by extrapolating maternity roost female numbers and using a population level ratio of male:female of 1:1)
2.4.2 Date of estimation	November 2006

2.4.3 Method used	3 = from complete inventory
2.4.4 Quality of data	3 = good
2.4.5 Trend	+ 6%(derived by calculating % change over time for 67 large and small roosts that have ≥ 5 annual counts per roost)
2.4.7 Trend-Period	1973-2006
2.4.8 Reasons for reported trend	1 = improved knowledge/more accurate data 3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence 5 = natural processes
2.4.9 Justification of % thresholds for trends	N/A
2.4.10 Main pressures	110 – use of pesticides 141 – abandonment of pastoral systems 151 – removal of hedges & copses 152 – removal of scrub 160 – gereral forestry management 400 – urbanised areas 502 – communication routes: roads 624 – spieleology 740 - vandalism
2.4.11 Threats	As 2.4.10 plus 941 – natural inundation
2.5 Habitat for the species	
2.5.2 Area estimation	Approximately 3,481km^2 Suitable habitat within the Range area was mapped from Corine (1990 and 2000), Natura 2000 digitised habitat information and FIPS (1998) (See Appendix III of Conservation Assessment Report for map).
2.5.3 Date of estimation	November 2006
2.5.4 Quality of data	3 = good
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	1990-2006
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	12,400km^2
2.7.2 Favourable reference population	12,250 individuals
2.7.3 Suitable Habitat for the species	3,481 km^2

2.7.4 Other relevant information
- Positive Impacts: Significant conservation measures in place in the country e.g. 41 cSACS, VWT owned and leased sites, NPWS and NRA Guidelines, updated legislation, active national NGO, Monitoring programmes, Coillte Sustainable Forest Management Initiative, REPS 3.
- Negative Impacts: Fragmentation of habitat, continuing infrastructural development as part of National Development Plan, loss of roosts, insecticides, roost deterioration, housing developments in countryside.
- see also background doc.

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 CS1	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

Rhinolophus hipposideros

1303

- Current Distribution (97 cells)
- Current Range (124 cells)
- Favourable Reference Range (124 cells)
- W48 10km grid cells

Date: October 2007

SALICORNIA AND OTHER ANNUALS COLONISING MUD AND SAND (1310) CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. HABITAT CHARACTERISTICS IN IRELAND

Salicornia and other annuals colonising mud and sand (1310) (from here known as 1310 *Salicornia* flats) are 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. 1310 *Salicornia* flats form part of the pioneer zone of established saltmarsh and are generally found seaward of Atlantic salt meadows (1330). *Spartina* swards (1320) can also form extensive swards to the seaward side of the Atlantic salt meadows and may extend further seaward of *Salicornia* flats. 1310 *Salicornia* flats and *Spartina* swards may form mosaics when they occur at the same site. Mediterranean salt meadows (1410) are generally situated between the landward side of Atlantic salt meadows and the terrestrial boundary. Transitional communities between these Annex I habitats may occur and these habitats may also form mosaics with each other.

The Interpretation Manual of EU Habitats (Commission of the European Communities 2003) defines *Salicornia* and other annuals colonising mud and sand (1310) as annuals belonging mainly to the genus *Salicornia* that colonise periodically inundated muds and sands of marine or interior salt marshes and belong to the phytosociological classes: Thero-Salicornietea, Frankenietea pulverulentae and Saginetea maritimae. Only vegetation from the first and third class is known in the Republic of Ireland. There are several sub-types listed and four British National Vegetation Classification plant communities (Rodwell 2000) are listed: "SM7 *Arthrocnemum perenne* stands", "SM8 Annual *Salicornia* saltmarsh", "SM9 *Suaeda maritima* saltmarsh" and "SM27 Ephemeral saltmarsh vegetation with *Sagina maritima*". In Ireland, the first plant community "SM7 *Arthrocnemum perenne* stands" is characteristic of a different Annex I saltmarsh community; Mediterranean and thermo-Atlantic Halophilous scrubs (1420). This habitat has a very restricted distribution and area, and is not considered part of the 1310 *Salicornia* flats habitat. 1310 *Salicornia* flats vegetation belongs to the Fossitt (2000) Irish saltmarsh habitat class, lower saltmarsh (CM1).

Mono-specific swards of *Salicornia* spp. growing on muddy sediments are the most common plant community belonging to this Annex I habitat type found in Ireland. These swards of *Salicornia* spp. are pioneer saltmarsh communities and may occur on muddy sediment seaward of established saltmarsh. They may also form patches isolated from other saltmarsh on mudflats within a suitable elevation range. Clumps of *Spartina anglica* are commonly associated with this habitat where this species is present. *Salicornia* flats may form small patches on mud adjacent to *Spartina* swards. At some sites a natural transition between Atlantic salt meadows and 1310 *Salicornia* flats is present along an accreting ridge and species typical of lower zone Atlantic salt meadow communities such as *Suaeda maritima*, *Puccinellia maritima*, *Limonium humile* and *Spergularia media* may occur in small quantities within this habitat. Small patches of 1310 *Salicornia* flats can also occur in a mosaic with Atlantic salt meadows where *Salicornia* spp. vegetate small patches within creeks and pans. This habitat is important for wintering wildfowl and other wildlife.

This habitat is ephemeral in places, as it is so vulnerable to erosion and accretion cycles and storms. Some sand or sediment banks can move or disappear quickly and the habitat can move or disappear in response to these processes. This habitat varies significantly in area with one site having a large sward over 25 ha in size (McCorry 2007). Small patches several metres in diameter were more commonly found at several other smaller saltmarsh sites.

Patches of vegetation dominated by *Suaeda maritima* are much less common or extensive. This vegetation community may occur on muddy substrate and on stonier substrate where muddy sediments transition to shingle, pebbles and cobbles. Patches of *Suaeda maritima* may also occur on shingle, pebbles and cobble banks along the shore but this type of vegetation was not considered as part of this Annex I habitat (1310) because the substrate is not mud or sand.

The third sub-type (Ephemeral saltmarsh vegetation with *Sagina maritima*) is also much less extensive compared to swards of *Salicornia* sp. This plant community (Sagino maritimae-Cochlearietum danicae) is generally associated with the transition from saltmarsh to sand-dune and has been recorded in Ireland (Wymer 1984). This transition is usually very narrow (< 1 m wide but sometimes up to 5 m wide) and this plant community is associated with unstable substrate that is affected by erosion or accretion. .

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 1310 *Salicornia* flats 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)
- Distribution data for *Salicornia europaea* and *Salicornia* spp. from Preston *et al.* (2002)
- Aerial photographs (OSI (Ordnance Survey Ireland) 2000 series)
- 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 1310 *Salicornia* flats 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). These data were used to plot the distribution of sites known to have 1310 *Salicornia* flats.

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. Each mapped polygon was assigned to a potential saltmarsh habitat using the available data sources and best expert opinion. Many polygons were assigned a generic saltmarsh habitat category (e.g. mosaic of Atlantic and Mediterranean salt meadows) where there was no information to identify the specific Annex I habitat present.

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. 1310 *Salicornia* flats could not be identified from these aerial photos.

Wymer (1984) mapped the distribution of different saltmarsh communities around the Irish coast and these data were used to identify additional saltmarsh sites with *Salicornia* spp., *Suaeda maritima*-dominated communities and Ephemeral saltmarsh vegetation with *Sagina maritima* plant communities. These data were also used to plot the distribution of saltmarsh sites known to have 1310 *Salicornia* flats.

Some data was also available from NPWS files and databases about the relative distribution of 1310 *Salicornia* flats. This habitat is listed as a qualifying interest for 23 SACs in Ireland. Distribution data for *Salicornia* spp. from Preston *et al.* (2002) was used to estimate the distribution of 1310 *Salicornia* flats in these SACs and to eliminate those grid squares were *Salicornia* has not been recorded. Grid squares in these SACs were also eliminated using a data set prepared from the GIS – aerial survey of general saltmarsh habitat. Grid squares where saltmarsh was not identified during the survey of aerial photos were also eliminated from SACs with 1310 *Salicornia* flats as a qualifying interest. Grid squares with both saltmarsh (identified from the GIS – aerial survey) and records for *Salicornia* spp. (from Preston *et al.* 2002) were also included in the national distribution of 1310 *Salicornia* flats.

These data were used to plot the distribution of sites known to have 1310 *Salicornia* flats. The distribution of this habitat is illustrated on a 10km square grid by selecting those squares where the habitat is present. See Section 4 for estimation of the current national area of 1310 *Salicornia* flats.

This data set was also used to plot the range of 1310 *Salicornia* flats. 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

1310 *Salicornia* flats are distributed around the coastline of Ireland. This habitat has a more restricted distribution compared to Atlantic salt meadows. 1310 *Salicornia* flats are generally associated with sheltered estuaries and bays where extensive mud and sandflats are more common. Gaps in the range of this habitat along the coastline contain other coastal habitats typical of more exposed environments or contain saltmarsh sites where 1310 *Salicornia* flats has not been confirmed.

Salicornia spp. have a more wide-spread distribution in Ireland (Preston *et al.* 2002) compared to the distribution of 1310 *Salicornia* flats as estimated for this report. *Salicornia* spp. may be found in other Annex I saltmarsh habitats, particularly in the lower zone of Atlantic salt meadows and this accounts for some of this more widespread distribution of *Salicornia* spp. However the distribution of 1310 *Salicornia* flats may expand as more information becomes available from future ground surveys of saltmarshes.

The range of 1310 *Salicornia* flats may have contracted slightly in the past due to the infilling, reclamation and embankment of some former saltmarsh and intertidal areas for agricultural purposes at many sites around the country. Most of this reclamation occurred in the 18-19th century. Former saltmarsh was also infilled and reclaimed in most of the major estuaries for port, urban and industrial purposes (Curtis 2003). 1310 *Salicornia* flats may have particularly suffered from the embankment and restoration of intertidal mud flats. This is likely to have contracted the historical range of the habitat by several grid squares at some locations around the coast, but its overall impact on the range is likely to be negligible. While reclamation may destroy saltmarsh habitat it may also create conditions for the development of 1310 *Salicornia* flats. This habitat can occur along the edges of sea-walls and embankments where sediment is allowed to accumulate and create suitable conditions for this habitat.

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 habitat is still widespread around the coast of Ireland and all sub-types of saltmarsh (Curtis & Sheehy-Skeffington 1998) are still present. The historical habitat range was likely to be been somewhat greater compared to the FRR but probably only by several grid squares. Historical losses of 1310 *Salicornia* flats 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 in urban areas, industrial areas and ports, as these areas are protected by sea walls and will be maintained.

The spread of *Spartina anglica* in many estuaries and bays around the coast is likely to have significantly reduced the area of 1310 *Salicornia* flats in Ireland, as this species occupies the same niche as *Salicornia* spp. and out-competes it (McCorry 2007). *Spartina anglica* is considered an alien invasive species in Ireland (McCorry *et al.* 2003) and the conservation status of this species is currently under review. Much of this 1310 *Salicornia* flats habitat loss probably occurred prior to the current reporting period. However, the spread of *S. anglica* is not likely to have the same impact on habitat range of 1310 *Salicornia* flats. There are no reported losses of the entire area of 1310 *Salicornia* flats at any sites in the Republic of

Ireland due to the spread of *S. anglica*, although the habitat area at many sites may have been significantly reduced.

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

4. HABITAT AREA

The current national area of 1310 *Salicornia* flats was estimated by extrapolating from data in McCorry (2007). This survey mapped 1310 *Salicornia* flats and Atlantic salt meadows at 31 sites around the coast of Ireland and found that when the two habitats were compared, 1310 *Salicornia* flats made up 8.7% of the area of Atlantic salt meadows. The total national resource of Atlantic salt meadows has been estimated to be 2,700 ha from the GIS aerial survey of the entire coastline of the Republic of Ireland for these assessments of conservation status of Annex I saltmarsh habitats. Using the proportion of 1310 *Salicornia* flats taken from McCorry (2007), this gives an estimated national area for this habitat of 230 ha. 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 be treated with caution. The area of 1310 *Salicornia* flats is probably somewhat under-estimated as small patches that could not be mapped were not taken into account for the measurement of area during McCorry (2007). This habitat can also occur on mudflats and sandflats in isolation from other Annex I saltmarsh habitats and these patches are probably not accounted for. There was no estimation of the habitat area of the other sub-types of 1310 *Salicornia* flats but it is likely to be quite small. The ephemeral nature of this habitat should also be considered, as it can disappear and re-appear depending on natural coastal cycles.

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 1310 *Salicornia* flats and has the capacity to sustain this habitat in Ireland. As described above, historical losses of saltmarsh and intertidal habitat have probably reduced the area of 1310 *Salicornia* flats. However, there are virtually no prospects for the restoration of former habitat destroyed in the 18th and 19th centuries for urban, industrial and agricultural purposes.

4.1. Conservation Status of Habitat Area

1310 *Salicornia* flats were assessed at 15 of the 31 sites surveyed in 2006 (McCorry 2007). The conservation status of habitat area at 14 sites was assessed as favourable (on a site by site basis). One site was assessed as unfavourable-bad as no 1310 *Salicornia* flats were mapped during the ground survey (this site was within an SAC with this habitat as a qualifying interest). However, there was no base-line data to quantitatively show that the area of 1310 *Salicornia* flats had decreased during the assessment period.

Spartina anglica is present in association with 1310 *Salicornia* flats at many of the sites ground-surveyed in 2006 (McCorry 2007). While the spread of this species is likely to have significantly affected the area of 1310 *Salicornia* flats, there is no quantitative data to indicate that the area of this habitat was affected by the spread of this species within the reporting period. There is little quantitative base-line data available for accurate comparisons of area, although at a national level it can be assumed that there are some losses of 1310 *Salicornia* flats.

There are no reported losses of habitat area of 1310 *Salicornia* flats within cSACs by NPWS site inspections during the current reporting period.

The conservation status of current habitat area is assessed as **unfavourable-inadequate (UI)** due to the reported loss of habitat at one site in 2006 and the probable loss of some habitat within the reporting period by the spread of *Spartina anglica* (McCorry 2007). The loss of habitat is estimated to be less than 1%.

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.

- Vegetation structure: zonation
- 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.

Most of the attributes all had a favourable status. Zonation and characteristic species were favourable at all the sites visited. Monitoring stops for one site failed due to disturbance and trampling from cattle poaching, where 1310 *Salicornia* flats occurred on patches within grazed Atlantic salt meadows.

Spartina anglica is a negative indicator and the main target for this attribute was no evidence of recent expansion of *S. anglica* (< 1% per year). For sites with no previously known *S. anglica* cover the target was no new sites with this species. This species was present in some of the monitoring stops but there was no evidence of the expansion of this species, so monitoring stops still passed. There was no evidence of recent expansion of this species at the expense of 1310 *Salicornia* flats at any of the sites visited in 2006 (McCorry 2007), but this is mainly due to poor base-line data.

5.1.1. Conservation Status of Habitat Structures and Functions

On a site-by site basis two sites were assessed as having an unfavourable-bad conservation status with thirteen other sites having a favourable conservation status. When the individual site data is combined McCorry (2007) found that only 3% of the monitoring stops had an unfavourable conservation status.

The conservation status of the habitat structure and functions of 1310 *Salicornia* flats is assessed as **unfavourable inadequate**.

5.2. Typical Species

All of the species found in the various sub-types of 1310 *Salicornia* flats may be found in other saltmarsh communities, particularly those of the Atlantic salt meadows and in *Spartina* swards (Table 1). The key habitat attribute of the first two sub-types is the development of a mono-specific sward of either *Salicornia* sp. or *Suaeda maritima* on mud or sand flats. The taxonomic status of several *Salicornia* sp. in Ireland is uncertain due to taxonomic difficulties with this genus.

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 Saltmarsh Monitoring Project 2006. Typical species for this habitat are listed in Table 1. The conservation status of typical species of 1310 *Salicornia* flats is assessed as **favourable,** considering that targets were reached for typical species for all monitoring stops.

Table 1. Typical species for 1310 *Salicornia* flats in Ireland.

Species	**Listed in Interpretation Manual of EU Habitats (Commission of the European Communities 2003)**	**Most common species listed in Wymer (1984) as belonging to Thero-Salicornietea (Salicornietum strictae[1] & Suaedetum maritimae[2]) and Saginetea maritimae (Sagino maritimae-Cochlearietum danicae[3])**	**Most common species recorded in 1310 *Salicornia* flats recorded during McCorry (2007)**
Agrostis stolonifera		* [3]	
Armeria maritima		* [3]	
Atriplex portulacoides		* [1,2]	
Cochlearia danica	*	* [3]	
Festuca rubra		* [3]	
Glaux maritima		* [3]	
Limonium humile		* [1]	*
Parapholis incurva	*		
Parapholis strigosa	*	* [3]	
Plantago coronopus	*	* [3]	
Puccinellia maritima		* [1,2,3]	*
Sagina maritima	*	* [3]	
Sagina nodosa	*	* [3]	
Salicornia dolichostachya		* [1]	
Salicornia europaea	*	* [1,2]	
Salicornia fragilis		* [2]	
Salicornia pusilla		* [1]	
Salicornia ramosissima		* [2]	
Salicornia sp.	*	* [1,2]	*
Spartina anglica		*[1,2]	*
Spergularia media			*
Suaeda maritima	*	*[1,2]	*

6. IMPACTS AND THREATS

McCorry (2007) summarised the main impacts affecting 1310 *Salicornia* flats surveyed at 15 sites in 2006. There were few impacts or activities that affect this habitat and this is probably due to its position in the lower zone of the saltmarsh, which may be quite inaccessible. Disturbance of the Atlantic salt meadow saltmarsh zones can provide a bare substrate niche that 1310 *Salicornia* flats can develop in as it is a pioneer habitat (Boorman 2003).

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). 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. Invasive species

The main impact affecting this habitat is the spread of the invasive species *Spartina anglica* (954) (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 has formed areas of dense swards in many of the larger estuaries, but mainly on mudflats to the seaward of Atlantic salt meadows. There are several reports in Ireland that indicate that *Spartina* swards have replaced *Salicornia* flats in Dublin (Fahy *et al.* 1975, McCorry 2007) during its spread into Irish estuaries. The 2006 survey did not find *Spartina anglica* at any sites where it was not already known to be present. There were also few signs of significant spread of *Spartina anglica* into 1310 *Salicornia* flats in the current assessment period, though it was difficult to assess if *Spartina anglica* had spread recently without accurate and detailed baseline data.

Many older reports and reviews about the management of saltmarsh and invasive species state that *Spartina anglica* can have a negative impact on the conservation value of saltmarshes (Gray & Benham 1990). Adam (1990) noted that extensive stands of *Salicornia* spp. are now rare in estuaries with abundant *S. anglica.* However, Boorman (2003) noted that the threat of *S. anglica* on saltmarsh in Britain is now less than originally perceived.

Current trends

The impact of the spread of *S. anglica* is possibly reducing due to the reduction in rate of spread of this species.

6.2. Erosion and accretion

Erosion (900) and accretion (910) were also noted as affecting this habitat. Both of these are natural processes and 1310 *Salicornia* flats as a coastal habitat will attempt to adjust or reach equilibrium in response to climatic and local changes. However, both these processes may create bare substrate for colonisation by *Salicornia* sp. Erosion of established saltmarsh can provide sediment for pioneer saltmarsh communities such as 1310 *Salicornia* flats (JNCC 2004). This habitat is likely to be ephemeral in places as it is quite vulnerable to erosion and accretion cycles and storms.

Current trends

Unknown.

6.3. Other impacts

Several other impacts and activities were recorded as affecting this habitat including grazing by cattle and sheep (140) and over-grazing by cattle (143). Some patches of habitat located along the seaward side of established saltmarsh may be grazed or trampled by livestock infrequently. Patches of this habitat located in large pans on established saltmarsh at one site were badly poached and disturbed by cattle grazing (143). There were no recorded instances of infilling and reclamation (402, 800, 802) affecting this habitat during the current reporting period, although these impacts and activities have affected this habitat in the past.

SAC site inspections during the current reporting period by NPWS staff also indicate there are few impacts affecting this habitat. Horse-riding (622) was noted to be affecting this habitat at one site.

Current trends

Unknown.

7. FUTURE PROSPECTS

7.1. Negative Future Prospects

McCorry (2007) reported that the future prospects of 1310 *Salicornia* flats at 8 individual sites out of 15 surveyed sites (53%) were unfavourable-inadequate or unfavourable-bad, where *Spartina anglica* occurred in association with this habitat. This assessment is an arbitrary one and is based on the assumption that as *Salicornia* flats and *Spartina* swards occupy similar zones or niches in the saltmarsh, the patches of *Salicornia* sp. are vulnerable to invasion by Common Cordgrass. The development of *Spartina* swards have reduced the area of *Salicornia* flats in several Dublin estuaries (McCorry 2007), although much of this occurred prior to the current reporting period. However, there is very little quantitative data in Ireland to show that this habitat is currently being replaced by *S. anglica* in the current reporting period. Quantitative data from one site shows that *S. anglica* is spreading quite slowly within the *Salicornia* flats area.

Spartina anglica has the capacity to spread to new sites, particularly along the west coast, possibly further reducing the area of 1310 *Salicornia* flats. Cooper *et al.* (2006) predict that *Spartina* swards will increase in area on mudflats at their lower boundaries at sites in Northern Ireland. This prediction is based on the fact that *Spartina* swards have not reached their potential niche limit in most of the sites in Northern Ireland. *Spartina* swards present in the Republic of Ireland are likely to follow the same trends, particularly swards that have established more recently. Some research has indicated that *S. anglica* may respond positively to the impacts of climate change due to changes in its competitive interactions with *Puccinellia maritima* and to increased temperatures (Long 1990, Loebl *et al.* 2006). The probable increase in the area of *S. anglica* will probably have some impact on the area of 1310 *Salicornia* flats. Many relevant NPWS Conservation plans list *Spartina* control measures as one of their objectives.

7.2. Positive Future Prospects

There are few other common impacts on this habitat. 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 only 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. Un-sustainable grazing levels should also be controlled within SACs by NPWS Conservation plans but this does not always occur in practise on many coastal sites.

Some restoration works at one site are mitigating for the loss of saltmarsh habitat due to large-scale development within a SAC (Robertson & Associates 2005). These restoration works may redevelop 1310 *Salicornia* flats habitat.

Natural disturbance is likely to continue to provide suitable bare substrate for this habitat to develop. This can take the form of erosion and accretion cycles along rivers flowing through saltmarshes and erosion and accretion of blown sand along the transition between sand dunes and saltmarshes.

There have been some attempts to control the spread of *Spartina anglica* at one site in the Republic of Ireland but with little success (McCorry *et al.* 2003). This species has been controlled intermittently using herbicides and other methods at one site in a large area mapped as 1310 *Salicornia* flats. The cover of *S. anglica* is still increasing in this area but at a slow rate. Many NPWS Conservation plans of SACs list the monitoring and control of *S. anglica* as one of the primary objectives to maintain the conservation status of other species and saltmarsh habitats of conservation importance.

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. This is predicted to increase the area of lower saltmarsh communities such as 1310 *Salicornia* flats and reduce the area of upper saltmarsh communities (JNCC 2004). So future climate change may actually increase the area of *Salicornia* flats but at the expense of Atlantic salt meadows, another Annex I saltmarsh habitat.

7.3. Overall Habitat Future Prospects

The potential spread of *Spartina anglica* is probably the biggest factor affecting this habitat in the future. The negative future prospects for this habitat probably dominate the positive prospects. The long-term viability of this habitat is not assured. The overall future prospects for 1310 *Salicornia* flats are **infavourable-inadequate.**

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 1310 *Salicornia* flats is considered to be **Favourable**. The Favourable Reference Range is defined by the current range of 1310 *Salicornia* flats.
- The Area of 1310 *Salicornia* flats habitat has decreased somewhat in an eleven year reporting period (1995-2006). This attribute was assessed as **Unfavourable Inadequate**.
- The habitat Structure and Functions have been assessed as **Unfavourable-Inadequate**. About 3% of monitoring stops were disturbed by over-grazing (McCorry 2007).
- The Future Prospects are assessed as **Unfavourable-Inadequate**. *Spartina anglica* has the potential to increase its area in the future and this is likely to have some negative impact on the area of 1310 *Salicornia* flats.

The overall conservation status for 1310 *Salicornia* flats habitat is **Unfavourable-Inadequate**.

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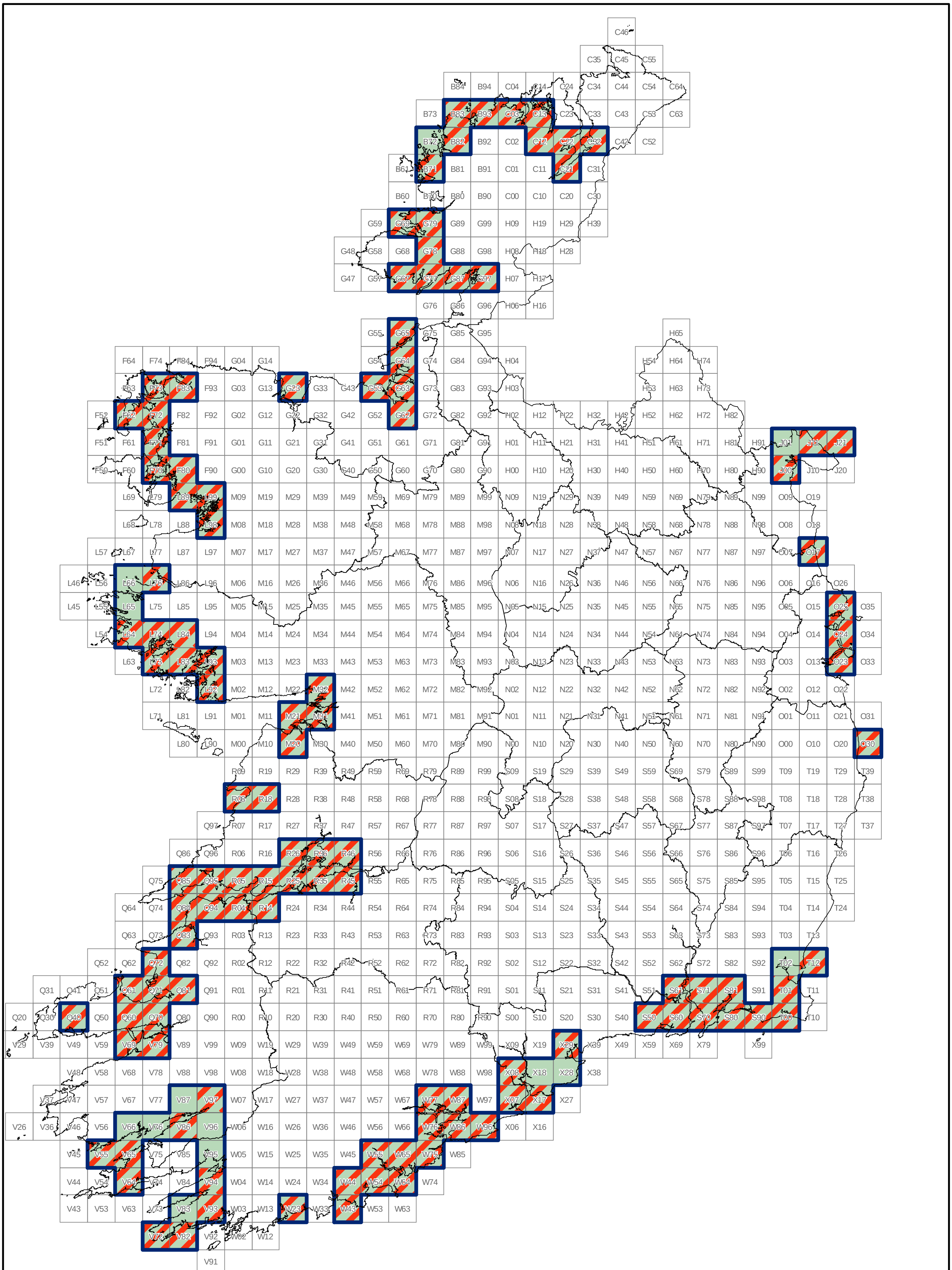
1310 Salicornia and other annuals colonising mud and sand

National Level	
Habitat Code	1310
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. ▪ Preston, C.D. Pearman, A. & Dines, D. (2002). *New atlas of the British and Irish Flora*. Oxford University Press. ▪ Wymer, E.D. (1984). *The phytosociology of Irish saltmarsh vegetation*. M.Sc. Thesis, National University of Ireland, Dublin.
Range	Scattered around the coastline of Ireland with a widespread distribution
Surface area	12,900 km² (129 grid cells x 100 km²)
Date	05/2007
Quality of data	2 = moderate
Trend	0 = stable
Trend-Period	1995-2006
Reasons for reported trend	No changes
Area covered by habitat	
Distribution map	See attached map
Surface area	2.3 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	- < 1% (estimation)
Trend-Period	1995-2006
Reasons for reported trend	6 = other (spread of invasive *Spartina anglica*)
Justification of % thresholds for trends	
Main pressures	140 Grazing 142 Overgrazing by sheep 143 Overgrazing by cattle 402 discontinuous urbanization (development) 622 walking, horseriding and non-motorised vehicles (amenity) 800 Landfill, land reclamation and drying out, general 802 reclamation of land from the sea, estuary or marsh 954 Invasion by species (*Spartina anglica*)
Threats	142 Overgrazing by sheep 143 Overgrazing by cattle 402 discontinuous urbanization (development) 622 walking, horseriding and non-motorised vehicles (amenity) 900 erosion 954 Invasion by species (*Spartina anglica*)

Complementary information	
Favourable reference range	12,900 km² (129 grid cells x 100 km²)
Favourable reference area	2.3 km²
Typical species	*Agrostis stolonifera, Armeria maritima*, *Atriplex portulacoides*, *Cochlearia danica*, *Festuca rubra*, *Glaux maritima*, *Limonium humile*, *Parapholis incurva, Parapholis strigosa, Plantago coronopus, Plantago maritima, Sagina maritima, Sagina nodosa, Salicornia dolichostachya, Salicornia europaea, Salicornia fragilis, Salicornia pusilla, Salicornia ramosissima, Spartina anglica, Spergularia media, Suaeda maritima* Methods: all the species above are characteristic of Salicornia and other annuals on mud or sand 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-Inadequate (U1). Small reduction in area during the current reporting period.
Specific structures and functions (incl. typical species)	Unfavourable-Inadequate (U1). About 3% of monitoring stops were disturbed by over-grazing (McCorry, 2007).
Future prospects	Unfavourable-Inadequate (U1). *Spartina anglica* has the potential to increase its area in the future and this is likely to have some negative impact on the area of 1310 *Salicornia* flats.
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

Salicornia and other annuals colonising mud and sand

1310

- Current Distribution (116 cells)
- Current Range (129 cells)
- Favourable Reference Range (129 cells)
- W48 10km grid cells

Date: October 2007

SPARTINA SWARDS (1320) CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. HABITAT CHARACTERISTICS IN IRELAND

Spartina swards (Spartinion maritimae) (1320) 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. *Spartina* swards (1320) dominated by *S. anglica* generally form extensive swards in the lowest zone of the saltmarsh. Atlantic salt meadows (1330) generally occupy the widest part of the saltmarsh gradient. Stands of *Salicornia* on mud and sand (1310) can occur as a pioneer zone to the seaward side of the Atlantic salt meadows, but generally do not extend as far seaward as *Spartina* swards and to the landward side of *Spartina* swards. Mediterranean salt meadows (1410) are generally situated closer to the terrestrial boundary of the saltmarsh but can in some instances be found lower in the saltmarsh and adjacent to the *Spartina* swards. Transitional communities between these Annex I habitats may occur and these habitats may also form mosaics with each other.

The Interpretation Manual of EU Habitats (Commission of the European Communities 2003) describes *Spartina* swards (1320) as pioneer grasslands that colonise coastal saline muds and belong to the phytosociological order, Spartinion maritimae, (which belongs to the class Spartinetea maritimae). There are several sub-types listed that are dominated by *S. alterniflora, S. anglica, S. maritima* and *S. x townsendi*. However only two British National Vegetation Classification (BNVC) (Rodwell 2000) plant communities are listed: 'SM4 *Spartina maritima*' saltmarsh and 'SM5 *Spartina alternifora*' saltmarsh. The BNVC community, SM6 '*Spartina anglica* saltmarsh,' is not listed. *Spartina* swards are part of the Fossitt (2000) Irish habitat category, lower saltmarsh (CM1).

Spartina anglica (fertile) is the result of allopolyploid hybridization of S. x *townsendi* (infertile). This latter species developed from the natural diploid hybridization of *S. alternifora* (a non-native American species) and *S. maritima* (a native British and European species) which occurred in Southampton Water, southern England. The first forms of *S. anglica* were noticed around 1892, when it began to spread vigorously over previously unvegetated mudflats.

Irish *Spartina* swards are generally made up of *S. anglica* (McCorry *et al.* 2003). This is a non-native species in Ireland. *Spartina* was planted in the early 20th century at locations in Cork Harbour and Fergus Estuary, Co. Clare for the purposes of land reclamation. It was subsequently planted at other locations in Co. Dublin, Co. Donegal and Co Mayo. It has since spread naturally (or with the help of some further planting) to many other locations along the coast. It has mainly spread on unvegetated mudflats seaward of previously established saltmarsh, but has also spread on previously established Atlantic salt meadows, areas formerly vegetated by *Salicornia* flats (1310) and areas formerly vegetated by *Zostera* spp.

There are frequent older records of *S.* x *townsendii* in Ireland but most of these are now considered to be dubious. Older records of *Spartina* were generally classified as *S. townsendi.* This was the original species name given to the new form of *Spartina* and incorporated both the incorporated the fertile and infertile forms. The fertile *S. anglica* and infertile *S. x townsendi* were not separated as species until the 1960s (Gray & Benham 1990) and it took some time for the name of the fertile form, *S. anglica*, to be widely used. The uncertain nature of the taxonomic status of *Spartina* probably lead to some of these records of *S.* x *townsendi* in Ireland. *Spartina* x *townsendii* was present at one site in Ireland (Bull Island) and was confirmed using cytological techniques (Boyle 1977). Boyle (1977) carried out a comparison of *S.* x *townsendi* and *S. anglica* and found that morphological differences between these species in Ireland were indistinct. The most recent Irish flora (Webb *et al.* 1996) also lists both *S. anglica* and *S.* x *townsendi* as present in Ireland and this has probably added to the taxonomic uncertainly of *Spartina* species.

There are also several records of *Spartina maritima* in Ireland in County Dublin (Boyle 1976, 1977) but these have not been relocated recently (Doogue *et al.* 1998). The origin of this species is not known.

The Commission of the European Communities (2003) stated that when selecting sites, preference should be given to rare or local *Spartina*. During the initial site selection process, several sites in Ireland with extensive *Spartina* stands (dominated by stands of *S. anglica*) were put forward for selection. At a subsequent NPWS meeting it was decided only to list sites with *S. maritima* or other rare species (Internal NPWS memo 1999). However, sites with stands of *S. anglica* remain listed and *Spartina* stands remain a qualifying interest for 3 SACs in Ireland, with a further 12 SACs assigned a rating D (non-significant presence). Sites where *S. maritima* and *S.* x *townsendi* were recorded are included in this list. This conservation assessment considers all forms of *Spartina* in Ireland as *Spartina* swards even though they may not all qualify according to the criteria outlined in the Interpretation Manual of EU Habitats (Commission of the European Communities 2003).

Spartina anglica is considered to be an invasive alien species in Ireland (McCorry *et al.* 2003), even through Preston *et al.* (2002) classes it as a native endemic species in Britain. Stands of *S. anglica* have been considered of low intrinsic value to wildlife and as a threat to mudflats used as feeding grounds by wintering waders and wildfowl (Nairn 1986). There have been some attempts to control the spread of *S. anglica* at one site in the Republic of Ireland but with little success (McCorry *et al.* 2003). Many NPWS conservation plans of SACs containing *Spartina* swards list the monitoring and control of *S. anglica* as one of the primary objectives to maintain the conservation status of other species and habitats of conservation importance. The spread of *S. anglica* is likely to have significantly reduced the area of the Annex I habitat *Salicornia* and other annuals on mud and sand (1310) in Ireland (McCorry 2007).

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. *Spartina anglica* was present in 11 of the 31 sites surveyed in 2006. 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.

The conservation status of *Spartina anglica* and the designation of sites with *Spartina* swards will be the subject of a review at the end of this national survey.

2. HABITAT MAPPING

The following data sources were used to map the occurrence of *Spartina* swards 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)
- Distribution data for *Spartina anglica* from Preston *et al.* (2002)
- Aerial photographs (OSI (Ordnance Survey Ireland) 2000 series)
- OSI 6 inch maps
- National saltmarsh inventory (Curtis & Sheehy-Skeffington 1998)
- Information on designated sites, (c)SACs and (p)NHAs held on file by the National Parks and Wildlife Service (NPWS)

McCorry (2007) mapped the area of each Annex I habitat including *Spartina* swards 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). These data were used to plot the distribution of sites known to have *Spartina* swards.

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. Each mapped polygon was assigned to a potential saltmarsh habitat using the available data sources and best expert opinion. Many polygons were assigned a generic saltmarsh habitat category (e.g. mosaic of Atlantic and Mediterranean salt meadows) where there was no information to identify the specific Annex I habitat present.

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 area 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.

Wymer (1984) mapped the distribution of different saltmarsh communities around the Irish coast and these data were used to identify additional saltmarsh sites with *Spartina* swards. Nairn (1986) also described the distribution of *S. anglica* in Ireland. Some data was also available from NPWS files and databases about the relative distribution of *Spartina* swards. These data were also used to identify saltmarsh sites known to have *Spartina* swards.

These data were used to plot the distribution of sites known to have *Spartina* swards. The distribution of this habitat is illustrated on a 10km square grid by selecting those squares where the habitat is present. The national habitat area was calculated by summing the area of polygons from the GIS – aerial survey estimated to contain this habitat (see Section 4).

This data set was also used to plot the range of *Spartina* swards. 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

Spartina swards are distributed around the Irish coastline and are mainly associated with saltmarsh and mudflats in estuaries and bays along the eastern, southern and south-west coasts (from Dundalk Bay clockwise to the Shannon Estuary). 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 contain fewer saltmarsh sites (such as the eastern Wicklow and Wexford coasts), 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. There is only one confirmed record of *Spartina* swards along the coast from Co. Clare (north of the Shannon Estuary) to County Mayo. There are several isolated records of *Spartina* swards in various estuaries and bays around the Sligo and Donegal coastlines in the northwest of Ireland.

The distribution of *Spartina anglica* in Ireland (Preston *et al.* 2002) is quite similar to that of *Spartina* swards. There are several records of *S. anglica* in grid squares where the presence of *Spartina* swards could not be confirmed from the survey of aerial photos. The presence of *Spartina* swards was noted from several grid squares in the survey of aerial photos where there was no record of *S. anglica* in Preston *et al.* (2002).

Gaps in the range of *Spartina* swards around the coastline contain other coastal habitats typical of more exposed environments and may also contain sheltered bays and estuaries containing a suitable environment for *S. anglica,* but remain uncolonised by this species. The range of *Spartina* swards is still significantly less than Atlantic salt meadows (1330).

3.1. Conservation Status of Habitat Range

The habitat range at the beginning of the reporting period (i.e. 1995 when the Irish Ordnance Survey first produced a nationwide series of aerial photos) is taken as the favourable reference range. The further spread of this species within the reporting period and in the future is considered unfavourable, as *S. anglica* is considered an undesirable species. The conservation status of *S. anglica* is currently under review, as it is an invasive alien species.

Spartina swards have been unaffected by historical reclamation of saltmarsh in the 18^{th}-19^{th} centuries as they are only a recent development on Irish saltmarsh (since 1920s). An examination of the records of *S. anglica* indicate that it has continued to be recorded in new 10 km^2 grid squares in the Republic of Ireland since records began. *Spartina anglica* was present in 13 grid squares prior to 1962, in 31 grid squares prior to 1987 and in 56 grid squares up to 1999 (Preston *et al.* 2002). The spread of *S. anglica* can be correlated with the spread of *Spartina* swards. This gives some indication of its spread in Irish estuaries even though records from Preston *et al.* (2002) may be somewhat under-recorded. The current habitat distribution is estimated to cover 67 grid squares and this estimation is mainly based on 2000 series aerial photos (compared to 56 in 1999 from Preston *et al.* 2002)).

The range of *Spartina* swards may expand in the future, as there are sheltered sites containing saltmarsh and mudflats along the western coast where *S. anglica* is currently absent, but are suitable for future colonisation by this species. However, McCorry (2007) did not record this habitat at any sites where it was not already known to be present. Some increases in habitat on mudflats were noted at some of the sites visited in 2006 (McCorry 2007) but these small increases are not likely to affect the range of this habitat.

The habitat range of *Spartina* swards is assessed as **favourable**.

4. HABITAT AREA

The current habitat area of *Spartina* swards has been estimated to be 20.8 km^2. This is the total sum of polygons estimated from the GIS – aerial survey to contain this habitat. This takes into account swards of *S. anglica* on mudflats (generally relatively easy to pick out from aerial photos) and mosaics of *S. anglica* clumps and mudflats. Two mosaic categories were used. The first was a *Spartina* sward/mudflat mosaic with 50% of the area being *Spartina* sward. The second mosaic contains scattered isolated clumps of *S. anglica* on mudflats and only 5% of the area is considered to be *Spartina* swards. *Spartina* swards that had developed on previously established Atlantic salt meadows were also considered by also taking a proportion of these polygons (a proportion of these polygons were used such as 50% of the *Spartina* sward/Atlantic salt meadow mosaics). The current national area of *Spartina* swards may be somewhat under-estimated as much of this habitat was mapped using aerial photos only. The area of this habitat may be greater than indicated by the aerial photos as general saltmarsh that was considered to be Atlantic salt meadows may actually be *Spartina* swards.

4.1. Conservation Status of Habitat Area

The favourable reference area is taken as the habitat area at the beginning of the reporting period (1995). The further spread of this species within the reporting period and in the future is considered unfavourable, as *S. anglica* is considered an undesirable species. The conservation status of *S. anglica* is currently under review, as it is an invasive alien species. The favourable reference area is likely to be somewhat less than the current area, as *S. anglica* is still spreading. The favourable reference area is set at 98% of the current area. This assumes the national area of *Spartina* swards has increased by 2% within the current reporting period. The favourable reference area is set at 20.4 ha but this is likely to change as more accurate information about the spread of *S. anglica* and the national area of *Spartina* swards becomes available after future ground surveys in 2007-2008.

Rates of spread of *Spartina* swards are variable and range from exponential growth at the beginning of a developing population to much slower rates in an established population (McCorry 2002). Cooper *et al.* (2006) calculated rates of spread of an established population in Northern Ireland at about 0.5% per year in recent times. McCorry (2002) estimated that the area of *Spartina* clumps had increased at a rate of 0.8% per year at one site in Dublin. A 2% growth in the national area of *Spartina* swards in an 11 year period may be somewhat conservative, but this takes into account the various ages of populations of *Spartina* swards and the fact that some swards may not be increasing or may actually be decreasing due to die-back or habitat transformation. This is only an estimate and it is likely to change as more accurate information about the spread of *S. anglica* and the national area of *Spartina* swards becomes available.

The habitat area of *Spartina* swards is likely to be still increasing, although probably at a relatively slow rate. Nairn (1986) stated that *S. anglica* was still spreading in some estuaries prior to 1986. McCorry (2007) noted that the cover of *Spartina* swards and clumps increased on mudflats at several sites during the current reporting period. Several NPWS conservation plans of SACs not visited during this survey (McCorry 2007) also indicate that this species has increased its cover in recent years.

Spartina swards have mainly developed in Ireland at the expense of intertidal mud and sandflats (also an Annex I habitat - 1140) (McCorry *et al.* 2003). There have also been replacements of *Salicornia* and other annuals on mud and sand (1310) (McCorry 2007) and *Zostera* beds (1140) (Madden *et al.* 1993) by *Spartina* swards. There were no increases in the area of *Spartina* swards at the expense of Atlantic salt meadows at any of the sites visited during the current reporting period (McCorry 2007). There have also been several reports of natural die-back of *Spartina* swards in Ireland (McCorry 2007). Die-back of *Spartina* swards is quite common on many older established sites in Britain (Lacambra *et al.* 2004). Die-back is thought to be an indication that this habitat is still adjusting to its environment. NPWS site inspections have not reported any examples of *Spartina* swards being affected by erosion. There are indications that some *Spartina* sward is being transformed into Atlantic salt meadow at some sites visited in 2006 (McCorry 2007).

There have been several attempts at control of *S. anglica* in Ireland. Clumps of this species have been controlled using herbicides in a large area vegetated by *Salicornia* (1310) at one site. Attempts were also made to eradicate *Spartina* swards at a second site as part of measures to mitigate the environmental impact of using an area of mudflats to store sediment produced by dredging. These attempts were largely unsuccessful.

The habitat area of *Spartina* swards is assessed as **favourable**.

5. STRUCTURES AND FUNCTIONS

McCorry (2007) surveyed the Annex I habitats at 31 saltmarsh sites around the Irish coast in 2006. This survey assessed the structure and functions of Atlantic salt meadows (1330), Mediterranean salt meadows (1410), *Salicornia* on mud and sand (1310) and Halophilous scrubs (1420) using pre-defined attributes. These attributes were 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. However, the structure and functions of *Spartina* swards were not assessed during that survey, as targets could not be set for an alien invasive species.

Stands of *Spartina* in Ireland are likely to all be *S. anglica*. Clumps of *S.* x *townsendi* that occurred at one site in County Dublin were destroyed during attempts to control *S. anglica* in the 1970s, prior to this reporting period. Records of *S. maritima* at two saltmarsh sites in County Dublin (Boyle 1976, 1977) have not been reconfirmed in the recent past (Doogue *et al.* 1998). So it is likely that all the *Spartina* in Ireland is the common type and non-native *S. anglica*.

This habitat is still adjusting to its environment. These more established *Spartina* swards have developed a complicated creek structure. At some sites where *S. anglica* is established for a longer period, there are indications that other saltmarsh species are spreading into the *Spartina* sward and there is a transition to Atlantic salt meadows (McCorry *et al.* 2003). This also indicates that some zonation of saltmarsh species can be observed and there are several sites where there is a natural seaward transition from Atlantic salt meadow with low cover of *S. anglica*, through a transitional mosaic of *Spartina* sward and Atlantic salt meadow, to mono-specific swards of *S. anglica*. There are reports of die-back of *Spartina* swards from some sites but more commonly there are reports that *S. anglica* cover is still increasing on mudflats. At most sites with *Spartina* swards visited during 2006 (McCorry 2007) seedlings were recorded, although rates of the spread of *S. anglica* are variable. Several small patches of *Spartina* swards and clumps have been present in Clew Bay, County Mayo for a relatively long time with no indications that this species in increasing its cover or spreading to other uncolonised sites within the bay.

The structure and functions of *Spartina* swards are assessed as **favourable**.

5.1. Typical species

Other saltmarsh species found in *Spartina* swards are also typical of *Salicornia* on mud and sand (1310) and Atlantic salt meadows (1330). *Spartina* stands are generally characterised by dense swards or clumps of *S. anglica* with few other species. Typical species for *Spartina* swards are listed in Table 1.

The typical species of *Spartina* swards are assessed as **favourable**.

Table 1. Typical species for *Spartina* swards in Ireland.

Species	Most common species listed in Wymer (1984) as belonging to Spartinetum townsendii	Most common species recorded during McCorry (2007)
Armeria maritima	*	
Aster tripolium	*	
Atriplex portulacoides	*	*
Limonium humile	*	*
Plantago maritima	*	
Puccinellia maritima	*	*
Salicornia sp.	*	*
Spartina anglica	*	*
Spergularia media	*	*
Triglochin maritima	*	

6. IMPACTS AND THREATS

There are few impacts and threats that are directly affecting *Spartina* swards. During the survey carried by McCorry (2007) some signs of erosion (900) were noted at the seaward edge of *Spartina* swards. This erosion seems to be part of natural dynamic geomorphological cycles that are occur in these saltmarshes. Natural transition to other saltmarsh habitats (990) and natural die-back of *Spartina* swards has been noted (950) (McCorry *et al.* 2003). This habitat may be affected by reclamation of mudflats and saltmarsh or coastal protection works in the future (802 and 871). This habitat is also likely to be affected by any future measures to control *S. anglica*.

Some 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. However, there were few impacts or activities that were reported to be directly affecting *Spartina* swards within SACs.

7. FUTURE PROSPECTS

Spartina anglica is an alien invasive species and the conservation objectives for this species and for *Spartina* swards as a habitat are under review and likely to change. It is difficult to assess the positive and negative future prospects in the light of this probable change in conservation objectives. For the purpose of this assessment it is assumed that *Spartina* swards should be maintained at its favourable reference area, the area of habitat at the beginning of the reporting period. However, increases in habitat at the expense of other Annex I habitats are considered unfavourable.

7.1. Negative Future Prospects

There are some negative prospects for this habitat (prospects for the increase of the habitat area). *Spartina anglica* has still not spread to all suitable sites around the coast and it is probable that this species will spread to other uncolonised sites, particularly along the western coast of Ireland. Cooper *et al.* (2006) also predict that *Spartina* swards will increase in area on mudflats at their lower boundaries at sites in Northern Ireland. This prediction is based on the fact that *Spartina* swards have not reached their potential niche limit in most of the sites in Northern Ireland. *Spartina* swards present in the Republic of Ireland are likely to follow the same trends, particularly swards that have established more recently.

Some research has indicated that *S. anglica* may respond positively to the impacts of climate change due to changes in its competitive interactions with *Puccinellia maritima* and to increased temperatures (Long 1990, Loebl *et al.* 2006). Existing *Spartina* swards are not likely to come under threat from the more common activities that affect other saltmarsh habitats, such as over-grazing by livestock, small scale infilling and reclamation, and amenity activities.

7.2. Positive Future Prospects

There are few positive prospects for this habitat. This habitat is still adjusting to its environment and many stands are still quite young (< 50 years). There may be natural reductions in area of mature swards due to die-back at the seaward edge and natural transition to other saltmarsh at its landward edge (Gray *et al.* 1995).

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 including *Spartina* swards 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.

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 only within NHAs (7%), and therefore should be partially protected from activities 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. *Spartina* swards would be affected by any measures in the future to control *S. anglica* in response to potential negative impacts on other habitats and species of conservation value, including other Annex I saltmarsh habitats.

7.3. Overall Habitat Future Prospects

Overall, increases in the area of *Spartina* swards are likely in the near future. This assessment is based on the fact that *Spartina* swards in the Republic of Ireland are likely to follow similar population changes to swards of *S. anglica* in Britain (Lacambra *et al.* 2004) and Northern Ireland (Cooper *et al.* 2006). This habitat is still relatively immature in Ireland and at many sites *S. anglica* has not realised its potential niche. There is potential for further increases in area at the seaward edge of many less mature swards. More mature swards may be prone to reductions in area due to transformation to other saltmarsh and natural die-back. Site-specific variation is also likely to be important with *Spartina* swards having different characteristics or dynamics due to variable environmental characteristics of different sites. Some *Spartina* swards may remain relatively dormant while this habitat at other sites is likely to change significantly in the near future. It is difficult to predict with any accuracy how climate change and potential sea-level rise with affect *Spartina* swards in the future. Increased temperatures may benefit *Spartina anglica* in the future but increased erosion may reduce the area of *Spartina* swards.

Further increases in habitat area and range of *Spartina* swards are considered unfavourable for the purposes of this conservation assessment. The overall future prospects for *Spartina* swards are **unfavourable-inadequate.**

8. OVERALL ASSESSMENT OF THE HABITAT CONSERVATION STATUS

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

- The Natural Range of *Spartina* swards is considered to be **Favourable**.
- The Area of *Spartina* swards habitat is likely to have increased somewhat in an eleven year reporting period (1995-2006). Increases in the area of this habitat are considered to be unfavourable as *S. anglica* is an alien invasive species. This attribute was assessed as **Unfavourable Inadequate**.
- The habitat Structure and Functions have been assessed as F**avourable**.

- The Future Prospects are assessed as **Unfavourable-Inadequate**. Future increases in area are likely in the future but this is considered unfavourable for the purposes of this conservation assessment.

The overall conservation status for *Spartina* swards is **Unfavourable-Inadequate**.

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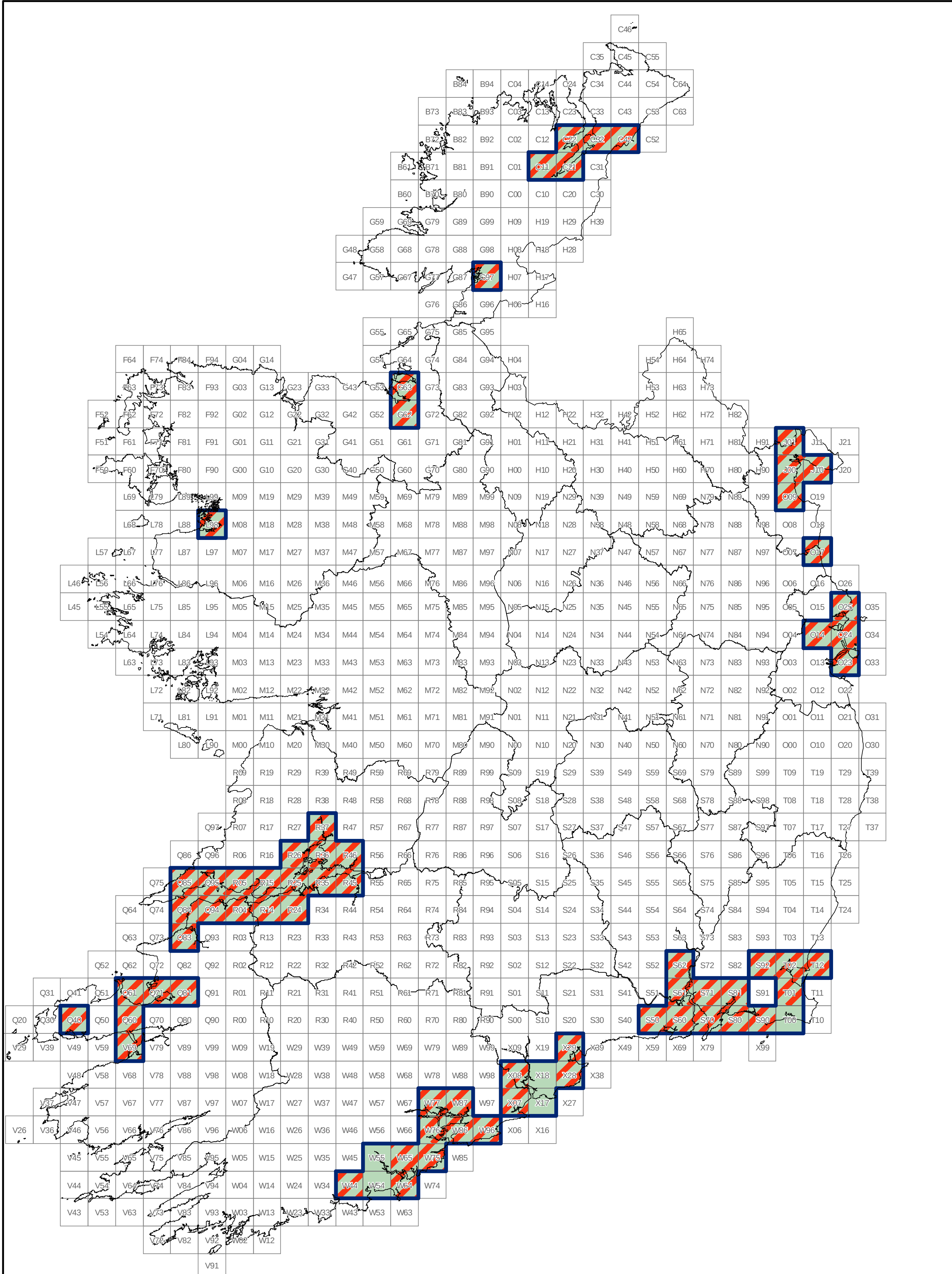
1320 Spartina swards

National Level	
Habitat Code	1320
Member State	Ireland, IE
Biogeographic region concerned within the MS	Atlantic (ATL)
Range	Widespread around the eastern, southern and south-western coasts of Ireland. Less-frequent along western and north-western coastline.
Map	See attached map

Biogeographic level	
Biogeographic region	Atlantic (ATL)
Published sources	▪ 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. ▪ McCorry, M.J., Curtis, T.G.F. & Otte, M.L. (2003). *Spartina* in Ireland. In: *Wetlands in Ireland*, (ed. M.J. Otte). UCD Press, Dublin. ▪ Nairn, R.G.W. (1986). *Spartina anglica* in Ireland and its potential impact on wildfowl and waders - a review. *Irish Birds*, 3, 215-258. ▪ Preston, C.D. Pearman, A. & Dines, D. (2002). *New atlas of the British and Irish Flora*. Oxford University Press. ▪ 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, but absent from a large section of the western coast.
Surface area	7200 km² (72 grid cells x 100 km²)
Date	05/2007
Quality of data	3 = good (based on extensive survey)
Trend	Increasing
Trend-Period	1995-2006
Reasons for reported trend	4 = natural processes
Area covered by habitat	
Distribution map	See map attached
Surface area	20.8 km² (current area of polygons estimated to contain this habitat)
Date	05/2007
Method used	2 = mainly based on remote sensing data with some ground surveys
Quality of data	2 = moderate
Trend	(+) Increasing
Trend magnitude	Unknown
Trend-Period	1995-2006
Reasons for reported trend	4 = natural processes
Justification of % thresholds for trends	
Main pressures	900 erosion 950 Biocœnotic evolution 990 Other natural processes (transition of *Spartina* sward to other saltmarsh)
Threats	802 reclamation of land from the sea, estuary or marsh 871 sea defence or coastal protection works 890 other human induced changes in hydraulic conditions (dredging) 900 erosion 950 Biocœnotic evolution 990 Other natural processes (transition of *Spartina* sward to other saltmarsh)
Complementary information	
Favourable reference range	7200 km² (72 grid cells x 100 km²)

Favourable reference area	20.4 km² (The estimated area of this habitat beginning of this reporting period is taken as the favourable reference area. The favourable reference area is set at 98% of the current national area but this is likely to change in the future as more accurate information becomes available.)
Typical species	Vascular species: *Atriplex portulacoides, Limonium humile, Puccinellia martima, Salicornia* spp., *Spartina anglica* and *Spergularia media.* McCorry (2007) assessed characteristic species as favourable.
Other relevant information	The status of *Spartina* swards in Ireland is currently under review. *Spartina anglica* is considered an invasive alien species. The favourable reference area is set at the area of the habitat at the beginning of the reporting period. Increases in this area are unfavourable.
Conclusions* *(assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable – inadequate (UI). Increases in the area of this habitat are considered to be unfavourable as *S. anglica* is an alien invasive species.
Specific structures and functions (incl. typical species)	Favourable (FV)
Future prospects	Unfavourable – inadequate (UI). Future increases in area are likely in the future but this is considered unfavourable for the purposes of this conservation assessment.
Overall assessment of CS	Unfavourable – inadequate (UI)



1:1,800,000

0 12.5 25 50 Kilometers

Spartina swards

1320

- Current Distribution (67 cells)
- Current Range (72 cells)
- Favourable Reference Range (72 cells)
- W48 10km grid cells

Date: October 2007

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

ATLANTIC SALT MEADOW (1330) CONSERVATION STATUS ASSESSMENT REPORT

TABLE OF CONTENTS

1. HABITAT CHARACTERISTICS IN IRELAND

Atlantic salt meadows (1330) are 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. Atlantic salt meadows (from here known as ASM) generally occupy the widest part of the saltmarsh gradient. 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 the ASM. *Spartina* swards (1320) can also form extensive swards to the seaward side of the ASM. Mediterranean salt meadows (1410) are generally situated between the landward side of ASM and the terrestrial boundary. Transitional communities between these Annex I habitats may occur and these habitats may also form mosaics with each other. Atlantic salt meadows are generally restricted to the area between mid neap tide level and high water spring tide level (Curtis 2003).

Irish saltmarshes have been classified according to their morphology (Curtis and Sheehy-Skeffington 1998) with five major types identified (estuary, bay, sandflats, lagoon and fringe). Some regional differences in saltmarsh vegetation have also been identified (Sheehy-Skeffington and Curtis 2000) and these have been related to variation in climatic and management factors. *Atriplex portulacoides* is both mainly confined to the eastern and south-eastern coastlines and is largely absent from many of the saltmarshes along the western coastline and this is thought to be linking to the predominance of grazing of along the western coastline. Turf fucoids are thought to be confined to the west coast of Ireland due to climatic factors, with greater rainfall affecting salinity (Sheehy-Skeffington and Curtis 2000). Atlantic salt meadows occur regularly on submerged blanket peat (fringe type saltmarshes) along the west coast.

Atlantic salt meadows contain several distinctive zones that are related to elevation and submergence frequency. The lowest communities of ASM may be flooded by most tides while the highest communities may only be infrequently flooded by high spring tides. The definition of 1330 Atlantic salt meadows as outlined in the Interpretation Manual of EU Habitats (Commission of the European Communities 2003) are classified as belonging to the phytosociological order Glauco-Puccinellietalia (which belongs to the class Asteretea tripolii). The ASM plant associations belong to the Puccinellion maritimae, Armerion maritimae and Halo-Scirpion alliances. Atlantic salt meadow vegetation may vary significantly within and between sites due to the factors outlined above. The lowest zone of this habitat along the tidal zone is generally dominated by *Puccinellia martima* with species like *Salicornia* sp., *Suaeda maritima*, *Spartina anglica* and *Limonium humile* also important. The mid marsh zones are generally dominated by a characteristic community dominated by *Armeria maritima* and or *Plantago maritima*. This zone generally transitions into an upper marsh herbaceous community with *Festuca rubra*, *Juncus gerardii* and *Agrostis stolonifera*. Atlantic salt meadow vegetation overlaps both Fossitt (2000) Irish saltmarsh habitat categories (Lower saltmarsh - CM1 & Upper saltmarsh - CM2).

Atlantic salt meadows also contain a distinctive topography with an intricate network of creeks and salt pans occurring on the medium to large sized saltmarshes. This habitat is also important for wintering waders and wildfowl and other wildlife.

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)
- Aerial photographs (OSI (Ordnance Survey Ireland) 2000 series)
- 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 ASM 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.

Wymer (1984) mapped the distribution of different saltmarsh communities around the Irish coast and these data were used to identify saltmarsh sites with ASM plant communities. Some data was also available from NPWS files and databases about the distribution of various Annex I saltmarsh habitats in designated areas. 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 ASM. The distribution of this habitat is illustrated on a 10km square grid by selecting those squares where the habitat is present. The current national area of ASM may be somewhat over-estimated (at the expense of other saltmarsh habitats) as much of this habitat was mapped using aerial photos only.

This data set was also used to plot the range of ASM. 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. Breaks in the distribution of ASM were re-examined to confirm the presence of these other coastal habitats and the likely absence of saltmarsh habitats.

3. HABITAT RANGE

Atlantic salt meadows are distributed around most of the coastline of Ireland. The intricate 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 current range of this habitat along the coastline contain these other coastal habitats that are typical of more exposed environments.

The range of ASM 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, but generally most sites still maintain some saltmarsh, so the impact on the habitat range was negligible. 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 habitat is still widespread around the coast of Ireland and all sub-types of saltmarsh (Curtis & Sheehy-Skeffington 1998) 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. At some sites, some large sea walls are deteriorating and formerly restored land is reverting back to ASM. 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 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 ASM are likely to have been reclaimed so the current habitat area is less compared to the historical habitat area.

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. This habitat area is similar to the current habitat area and still encompasses all the ecological variation of ASM and has the capacity to sustain this habitat in Ireland. The current national habitat area is estimated to be 2,670 ha from a GIS survey of aerial photos (see Section 2). This may be somewhat over-estimated at the expense of other Annex I saltmarsh habitats. The historical losses of habitat are not considered. As described above, there are virtually no prospects for the restoration of former habitat destroyed in the 18th and 19th 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 habitat area of Atlantic salt meadows has decreased slightly with a reported loss of 14.3 ha mainly within cSACs by NPWS site inspections during the current reporting period. This includes 2.5 ha that has been lost during the current reporting period from sites surveyed by McCorry (2007). The most significant losses were caused by developing a car park at one site and by developing a marina at a second site. Other minor losses were caused by infilling and restoration of minor areas at several other sites. There are likely to be other unreported losses of habitat during the current reporting period. The reported losses represent 0.5% of the FRA (2,670 ha).

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 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. McCorry (2007) reported that there were very few measurable losses of habitat due to erosion within the current reporting period at any of the 31 sites visited. At several sites there were measurable losses of habitat due to changes in positions of river channels, but this has largely been compensated by accretion in other areas of the site. There were no indications of any overall erosional trends when comparing current area to older maps, although this was a small sample (McCorry 2007). Erosion and accretion was site specific and in most cases the two trends compensated each other. Saltmarsh is being transformed to sand dune habitats (also Annex I) due to natural geomorphological coastal processes at several 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 zone of several sites and in some cases has transformed portions of former Atlantic salt meadow into *Spartina*-dominated swards (1320). However, McCorry (2007) survey did not find *S. anglica* at any sites where it was not already known to be present. There were also few signs of significant spread of *S. anglica* into Atlantic salt meadows, though it was difficult to assess if *S. anglica* had spread in the current assessment period without more detailed baseline data.

The conservation status of habitat area was assessed at 31 sites in 2006 (McCorry 2007). Twenty-eight sites had a favourable habitat area. Three sites had an unfavourable-bad habitat area due to losses of habitat by infilling and reclamation at two sites and erosion at one site.

The conservation status of the habitat area is assessed as **unfavourable-inadequate (UI)** because about 0.5% of the favourable reference area has been lost in the current reporting period.

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 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. Reverse zonation with pioneer plant communities in the upper marsh may be a sign of coastal squeeze and erosion of saltmarsh. 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 17% 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. The main guideline is to maintain a 25%:75% ratio of tall/short sward height. The usual status of some western saltmarshes is a very low closely-cropped sward height and this was considered. 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 pioneer ASM salt marsh and mid-marsh areas during the current monitoring period. For sites with no previously known *Spartina anglica* cover the target was less than 5% cover. While *Spartina anglica* was a prominent feature of the lower ASM at several sites visited in 2006 (McCorry 2007) there was no evidence that it had spread significantly within the current reporting period (although the baseline data is poor). *Spartina anglica* was not recorded at any sites where it was not already known to be present. This attribute is assessed as **favourable**. (This attribute only assessed the impact of *Spartina anglica* within the current reporting period. As most of the current extent of *Spartina anglica* on ASM probably developed prior to the current reporting period, this was not considered in the assessment.)

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 vehicles using the saltmarsh for amenity use or agricultural vehicles. 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 ASM included the presence of uncommon (but not rare) species such as *Seriphidium maritimum*, *Inula crithmoides, Limonium binervosum* and *Blymus rufus* or species that have a distunct distribution around the coast line, such as the presence of *Atriplex portulacoides* (McCorry 2007). Sites with previously recorded features of local distinctiveness maintained those features. This attribute was assessed as **favourable**.

5.1.9. Conservation Status of Habitat Structures and Functions

Twelve sites (39%) surveyed during 2006 (McCorry 2007) were assessed as having favourable structure and functions, 7 sites (22%) had an unfavourable-inadequate conservation status and 12 sites (39%) were assessed as having an unfavourable-bad conservation status.

When individual site data is combined, McCorry (2007) found that 17.5% of monitoring stops carried out in 2006 failed (attributes did not reach their targets). (However, only 39% of sites had a favourable habitat structure and functions indicating 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 ASM. McCorry (2007) estimated by overgrazing affected about 10% of the surveyed area. 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 17% of ASM saltmarsh 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

Most common species found in Atlantic salt meadows may be found in other coastal habitats including other Annex I saltmarsh habitats. Some saltmarsh species may be found in 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. Wymer (1984) commented that Irish saltmarshes had a depauperate flora compared to Britain and Europe.

Atlantic salt meadows are defined by the Commission of the European Communities (2003) as belonging to the phytosociological order Glauco-Puccinellietalia (which belongs to the class Asteretea tripolii). The ASM plant associations belong to the Puccinellion maritimae, Armerion maritimae and Halo-Scirpion alliances. Species such as *Armeria maritima, Plantago maritima* and *Aster tripolium* act as character species for the class (Asteretea tripolii) and order (Glauco-Puccinellietalia) (Table 1). Nomenclatuture follows Stace (1997). Species such as *Glaux maritima, Armeria maritima, Spergularia media*, *Puccinellia maritima, Juncus gerardii, Agrostis stolonifera and Festuca rubra* are character species of the Puccinellion maritimae and Armerion maritimae alliances. Atlantic salt meadow habitat contains several different plant communities that are mostly related to shore-line zonation (related to elevation), the saltmarsh topography and geographical variation (climatic and management factors).

5.2.1. Geographical variations

Several species found on Irish saltmarshes display distinctive geographical variations. *Atriplex portulacoides* is found along the eastern and south-eastern coastline of Ireland and is only found at several locations along the west coast (Sheehy-Skeffington & Curtis 2000). The presence of minute algal turf fucoids in many western saltmarsh swards has been related to lower salinities caused by greater rainfall along the western coast of Ireland. *Blysmus rufus* is mainly distributed along the north-west shore-line (Cross 2006).

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. Only one monitoring stop failed to reach the target for characteristic species out of 251 stops carried out over 31 sites (McCorry 2007). This monitoring stop was on a site that was so significantly over-grazed that species diversity was affected. The conservation status of typical species of ASM is assessed as **favourable** considering that targets were generally reached for typical species.

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

Species	Listed in Interpretation Manual of EU Habitats (Anon 2003)	Listed in White and Doyle (1982) Character species of ASM syntaxa	Most common species recorded during McCorry (2007)
Agrostis stolonifera	*		*
Armeria maritima	*	*	*
Aster tripolium	*	*	*
Atriplex littoralis	*		
Atriplex prostrata	*	*	
Atriplex portulacoides	*	*	*
Beta vulgaris spp. maritima	*		
Blysmus rufus	*	*	
Bolboschoenus maritimus		*	
Carex distans		*	
Carex extensa	*	*	*
Carex punctata		*	
Cochlearia anglica		*	
Cochlearia officinalis		*	*
Eleocharis spp.	*		
Elytrigia atherica	*		
Elytrigia repenss	*		
Festuca rubra	*	*	*
Glaux maritima	*	*	*
Juncus gerardii	*	*	*
Limonium binervosum		*	
Limonium humile		*	*
Parapholis strigosa		*	
Plantago maritima	*	*	*
Potentilla anserina	*		*
Puccinellia fasciculata	*		
Puccinellia distans	*		
Puccinellia maritima	*	*	*
Salicornia sp.			*
Seriphidinm maritimum	*	*	
Spartina anglica			*
Suaeda maritima			*
Spergularia marina	*		
Spergularia media		*	*
Triglochin maritimum	*	*	*
Tripleurospermum maritimum	*		

6. IMPACTS AND THREATS

There are several sources of information about impacts and activities affecting saltmarshes in Ireland. McCorry (2007) summarised the main impacts affecting ASM 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 sheep (143) or cattle (142). Many sites are also subject to erosion (800) and accretion (810). *Spartina anglica* is also present on many Irish saltmarshes and is considered an invasive species (954). There have 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). Curtis (2003) also discusses the motivations for historical infilling and reclamation of saltmarshes most prevalent in the 18^{th} and 19^{th} centuries and the pressure of development in more recent times.

6.1. Grazing

Grazing was the most common impact with 55% of the total ASM area surveyed in 2006 grazed by sheep and or cattle (includes sustainable and unsustainable grazing levels) (McCorry 2007). ASM is also naturally grazed by rabbits, hares and wintering wildflowl. Over-grazing creates a very low close-cropped sward with the highest intensities of grazing also stripping the vegetation from the surface of the saltmarsh. Various levels of over-grazing were recorded during the survey. The very highest intensities of grazing were also noted to affect plant diversity at one site. Few sites were completely affected by overgrazing and it was more common to have a portion of the site affected. When grazing involves cattle there was usually some level of poaching of the saltmarsh surface. McCorry (2007) also stated that overgrazing by cattle affected about 10% of the total ASM area surveyed in 2006, and by sheep also affected a similar area (10%), and these areas overlapped. (About 17% of monitoring stops were affecting by over-grazing.)

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. Cattle grazing was most frequent. Natural grazing levels can also be significant and Curtis and Sheehy-Skeffington (1998) noted several sites where grazing by geese had closely cropped the sward.

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 diversity leaving only Common Saltmarsh grass. 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

Small portions of several sites were infilled (800) and reclaimed (802) during the current assessment period. These reclaimed areas can then be used for development (400, 402, 419 & 490). The 2006 survey found that 0.55% of the total surveyed ASM had been destroyed by infilling and reclamation since the beginning of the reporting period (McCorry 2007). Some patches of ASM had been infilled with construction waste (422, 423). Infilling has two roles, the elimination of unwanted waste material and reclamation of poorer land. 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). The largest area of saltmarsh infilled during the assessment period had been infilled to build a marina (McCorry 2007). Site inspection reports of SACs by NPWS staff also list several sites where there has been infilling and reclamation or ASM habitat has been used for development of housing or for industrial purposes.

About 14 ha of habitat has been destroyed during the current monitoring period (using data from NPWS Site Inspection Reports) and this accounts for an estimated 0.5% of the national ASM resource. (Other losses of undesignated saltmarsh may be unreported.) These impacts were much more widespread in the past when significant areas of saltmarsh were reclaimed for agricultural, urban and industrial purposes.

Current trend

Level of activities to be reducing.

6.3. Invasive species

The only invasive species that was recorded on ASM 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 has formed areas of dense swards in many of the larger estuaries, but mainly on mudflats to the seaward of ASM. It is distributed widely over the lower ASM at many sites, where it is present. It has the capacity to dominate in parts of the lower ASM zone and has replaced *Puccinellia maritima* as the dominant species in this zone, significantly altering the sward structure (sward height is higher and denser). Overall plant diversity of the lower zone is generally not affected. However, the area of ASM saltmarsh with higher *Spartina anglica* cover values (20-40%), ASM/*Spartina* mosaic and patches of *Spartina* swards (> 40% *Spartina anglica* cover) was quite small at most sites surveyed in 2006 in relation to the rest of the saltmarsh.

The 2006 survey did not find *Spartina anglica* at any sites where it was not already known to be present. There were also few signs of significant spread of *Spartina anglica* into ASM in the current assessment period, though it was difficult to assess if *Spartina anglica* had spread recently without accurate and detailed baseline data.

Many older reports and reviews about the management of saltmarsh and invasive species state that *Spartina anglica* can have a negative impact on the conservation value of saltmarshes (Gray & Benham 1990). However, Boorman (2003) noted that the threat of *Spartina anglica* on saltmarsh in Britain is now less than originally perceived. It is still a common colonist of mudflats but its survival and persistence into later saltmarsh communities is generally limited. Many of the concerns expressed in the 1960s on the possible loss of large areas of mixed species-rich saltmarsh to stands dominated by *Spartina anglica* have proved to be unfounded (Boorman 2003).

Current trend

Unknown.

6.4. Erosion and accretion

Erosion (900) and accretion (910) also affects this habitat. Both of these are natural processes and ASM as a coastal habitat will attempt to adjust or reach equilibrium in response to climatic and local changes. These processes can be affected by human activities that limit the volume of sediment entering or moving about in the system, such as the construction of hard sea defences.

Signs of water-induced erosion such as a saltmarsh cliff and mud balls at the seaward edge of the ASM were frequently observed during the 2006 survey (McCorry 2007). However, there has been no measurable loss of area at many of these sites. Erosion may be occurring at these sites but the rate is either very low or there is no current erosion at present and the measurable geomorphological cycles are currently neutral. There was little significant or measurable erosion or accretion in the current assessment period. Erosion and accretion is site specific and in most cases the two processes compensate each other. There were no significant indications of any erosional trends on saltmarshes due to sea level rise at the sites visited. (However, an overall trend may not have been identified due to the relatively small sample size of the survey in 2006.)

Other natural processes that affect saltmarsh include the transition of saltmarsh to sand dune habitats due to natural geomorphological coastal processes (990).

Current trend

Unknown

6.5. Other impacts

Some saltmarshes are also used for amenity use (622). This includes walking, horse-riding and the use of all-terrain vehicles and motorbikes. Some saltmarshes are used for camping (608) and for parking caravans (during low tide). The impact of amenity use is generally minor although at some individual sites, heavy use was damaging the surface of parts of the saltmarsh.

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.

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 ASM at 19 individual sites out of 31 surveyed sites (61%) 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 predicted to increase erosion of saltmarsh in Ireland including ASM (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. The supply of sediment plays an important role in the vulnerability of saltmarsh to inundation (Devoy 2003). 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 ASM.

Spartina anglica, an invasive species, has the capacity to spread to new sites, particularly along the west coast and establish on ASM, possibly transforming this habitat to *Spartina*-dominated swards (1320). Some research has indicated that *S. anglica* may respond positively to the impacts of climate change due to changes in its competitive interactions with *Puccinellia maritima* and to increased temperatures (Long 1990, Loebl *et al.* 2006) leading to changes in relative area of Spartina swards and ASM. Many relevant NPWS management plans list *Spartina* control measures as one of their objectives.

A significant portion of the saltmarsh visited during 2006 was located within SACs. It is notable that two of the sites affected by infilling and reclamation in 2006 were located outside SAC and other nature conservation designations and as such were more vulnerable to reclamation.

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 for future prospects.

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.

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 2002). Some restoration works at one site are also mitigating for the loss of saltmarsh habitat due to large-scale development within an SAC (Robertson & Associates 2005). These restoration works may redevelop ASM habitat.

Atlantic salt meadows have the capacity to re-develop on land previously reclaimed by agriculture. Some reclaimed sites have been abandoned and embankments that previously prevented these areas from being flooded by the tide are deteriorating and eroding.

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 10% 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. The future impact of *Spartina anglica* on ASM in Ireland is difficult to predict with any accuracy.

Overall, the habitat future prospects are assessed as **unfavourable inadequate,** as less than 25% of monitoring stops were affected by over-grazing and 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 Atlantic salt meadow is considered to be **Favourable**. The Favourable Reference Range is defined by the current range of ASM.
- The Area of Atlantic salt meadow habitat has decreased by about 0.5% in an eleven year reporting period (1995-2006). This attribute was assessed as **Unfavourable Inadequate**.
- The Habitat Structure and Functions have been assessed as **Unfavourable-Inadequate**. About 10% of ground-surveyed area (or 17% of monitoring stops) had a damaged sward cover with < 5% bare ground and 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 Atlantic Salt Meadow habitat is **Unfavourable-Inadequate**.

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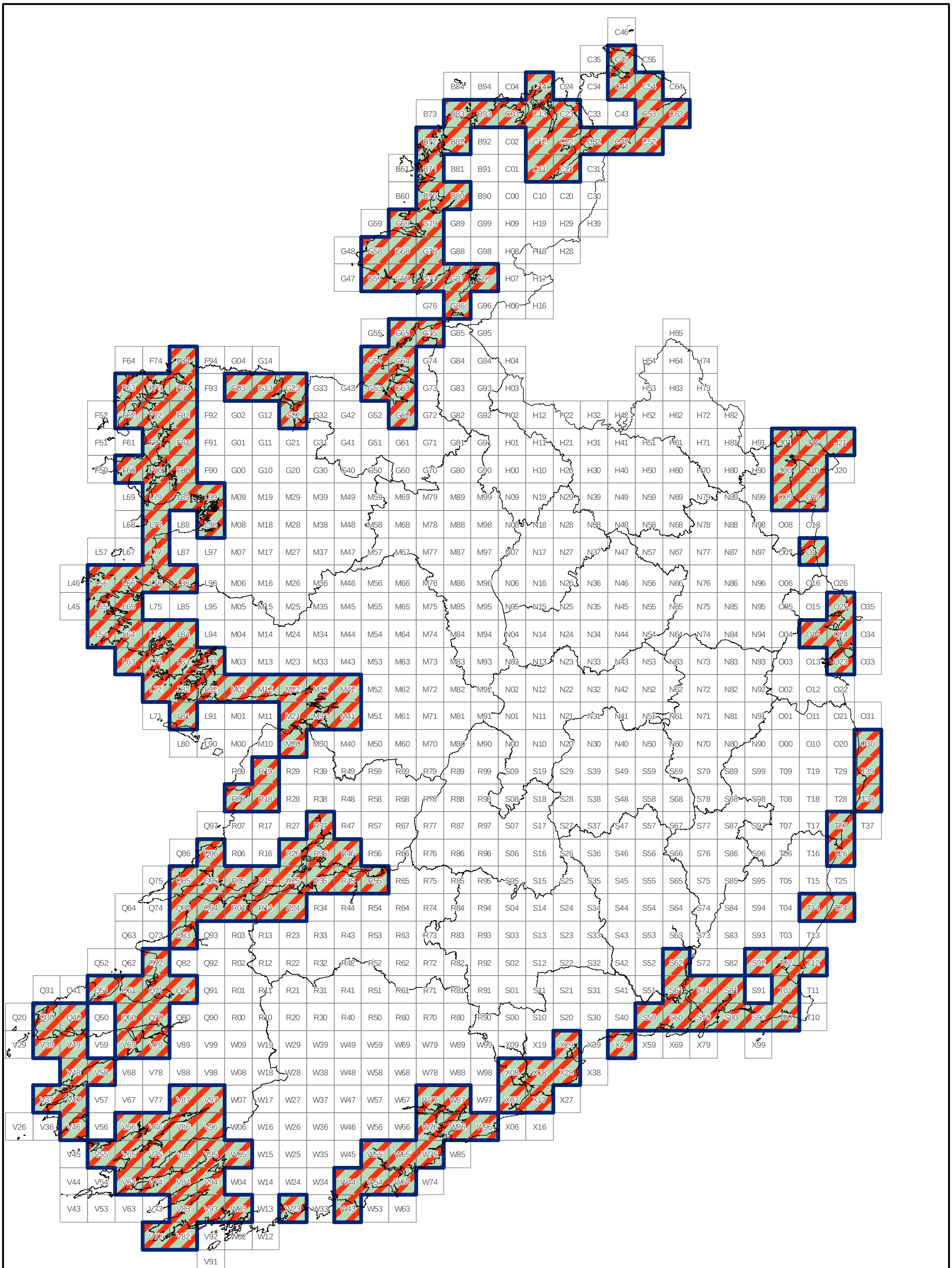
1330 Atlantic salt meadow

National Level	
Habitat Code	1330
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	20,400 km² (204 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	26.7 km² (current area of polygons estimated to contain this habitat)
Date	05/2007
Method used	2 = mainly based on remote sensing data with some ground surveys
Quality of data	2 = moderate
Trend	Decrease
Trend magnitude	-0.5% (based on the area of lost habitat reported within SACs from 2001-2003 and area of lost habitat reported from McCorry 2007)
Trend-Period	1995-2006
Reasons for reported trend	3 = direct human influence
Justification of % thresholds for trends	

Main pressures	140 Grazing 142 Overgrazing by sheep 143 Overgrazing by cattle 400 Urbanised areas, human habitation (development) 402 discontinuous urbanization (development) 419 other industrial/commercial areas (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 622 walking, horseriding and non-motorised vehicles (amenity) 800 Landfill, land reclamation and drying out, general 802 reclamation of land from the sea, estuary or marsh 871 sea defence or coastal protection works 900 erosion 954 Invasion by species (*Spartina anglica*)
Threats	142 Overgrazing by sheep 143 Overgrazing by cattle 402 discontinuous urbanization (development) 422 disposal of industrial waste (dumping) 423 disposal of inert materials (dumping) 800 Landfill, land reclamation and drying out, general 802 reclamation of land from the sea, estuary or marsh 871 sea defence or coastal protection works 900 erosion 954 Invasion by species
Complementary information	
Favourable reference range	20,400 km² (204 grid cells x 100 km²)
Favourable reference area	26.7 km² (The estimated area of this habitat beginning of this reporting period is taken as the favourable reference area).
Typical species	Vascular species: *Agrostis stolonifera*, *Armeria maritima*, *Aster tripolium*, *Atriplex portulacoides, Blysmus rufus, Carex distans, Carex extensa, Cochlearia officinalis, Cochlearia anglica, Festuca rubra, Glaux maritima, Juncus gerardii, Leontodon autumnalis, Limonium humile, Oenanthe lachenalii, Plantago coronopus, Plantago maritima, Puccinellia martima, Puccinellia distans, Parapholis strigosa, Salicornia europaea, Spartina anglica, Spergularia marina, Spergularia media, Suaeda maritima, Triglochin maritimum.* Methods: all the species above are characteristic of Atlantic salt meadow habitat in Ireland. McCorry (2007) assessed characteristic species as favourable.
Other relevant information	Reported loss of habitat during the current reporting period is negligible.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Area	Unfavourable-Inadequate (U1) 0.5% loss of habitat within the current reporting period
Specific structures and functions (incl. typical species)	Unfavourable-Inadequate (U1). About 10% of ground-surveyed area (or 17% of monitoring stops) 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

Atlantic salt meadows

1330

Current Distribution (204 cells)

Current Range (204 cells)

Favourable Reference Range (204 cells)

W48 10km grid cells

Date: October 2007

Background to the conservation assessments for the nine vesper bat species in Ireland [adapted from McAney, 2006]

1. Introduction

There are currently nine vesper bats known in Ireland: the common, soprano and Nathusius pipistrelles, whiskered, Brandt's and Natterer's bats, Daubenton's bat, Leisler's bat and the brown long-eared bat. All these bats lack the complex nose-leaf that characterises the horseshoe bats, of which Ireland has one species, the lesser horseshoe *Rhinolophus hipposideros* (discussed separately). All the vespertilionid bats are widely distributed throughout the country. Although maternity roosts of Nathusius' pipistrelle have so far only been confirmed in Northern Ireland, it is expected that these will be found in due course in the Republic, because its distinctive echolocation call has been recorded in several locations (McAney pers. comm.). It has now been confirmed that Brandt's bat occurs in Ireland, on the basis of identifications that have been made of hand-held specimens and DNA samples taken from bats caught in Wicklow (E. Mullen pers. comm.) and Kerry (C. Kelleher pers. comm.).

The whiskered and Natterer's bats are listed as '*Threatened in Ireland'*, while the other species are listed as '*Internationally Important'* in the Irish Red Data Book 2: Vertebrates (Whilde, 1993). The population status of both the whiskered and Natterer's bats was considered '*indeterminate'* because of the small numbers known of each, a few hundred and approximately a thousand respectively. Ireland is considered to be an international stronghold for Leisler's bat, whose global status was described as being at 'low risk, near threatened' (LR; nt) by the IUCN (Hutson, *et al.,* 2001); their 2007 assessment for this species is "Least concern" [http://ec.europa.eu/environment/nature/conservation/species/ema/].

The descriptions of the common and soprano pipistrelles below have been merged, as much of the data refer to the time before these bats were known to be separate species. Brandt's bat and whiskered bat are considered to be cryptic species, very difficult to distinguish in the field. As the former has only recently been identified in Ireland and some older records of whiskered bats are thought likely to refer to Brandt's, these two species are assessed together.

Note on habitat

Certain bat species are associated with specific habitat types e.g. Daubenton's and waterways; whiskered and woodlands, whereas others are known to be generalists e.g. common pipistrelle. However, when roosting and commuting habitats for each species are also considered, it becomes clear that in Ireland all bat species rely on a wide variety of habitats during their life cycle. This is further facilitated by the extensive network of linear, connecting habitats (e.g. treelines, hedgerows, waterways) in the Irish landscape. The ubiquity of hedgerows, in particular, in effect means that even ostensibly unsuitable habitat, such as areas of intensive arable farmland, may still be used by bats. Furthermore, most bat species in Ireland rely to some extent on man made structures for summer and / or winter roosting, with some species roosting exclusively in buildings. In light of this and in the absence of comprehensive habitat studies, no distinction is made in these assessments between the extent of range and the area of habitat.

Because this approach is taken with habitat, a similar broad-scale approach is also taken with habitat trend. Again a number of common factors are apparent, with two key foraging habitat types common to all species identified: woodland and wetland.

The area of broad-leaved and coniferous woodlands are both increasing across the Irish landscape, with an average afforestation rate of c. 12,000ha per annum between 1980 and 2005. The area of woodland habitat has effectively doubled in the last 30 years and Government policy is for a continuation of planting at similar of even higher rates in the coming years with a target of 17% woodland across Ireland by 2030. It is considered that this level of ongoing afforestation is more than compensating for the loss of hedgerows arising from roadway development and agricultural improvement. Scrub can also be an important component of a bat's habitat and while there is evidence of scrub clearance in some areas, again mainly associated with agricultural improvement, there are also significant areas with increasing scrub encroachment due to abandonment. Although detailed statistics are not available on these changes it is considered that they are, at present, balancing each other out.

Wetlands, because of the high number of invertebrates they support, provide important feeding areas for many bat species. In general severe pollution of waterways is becoming less common in Ireland as evidenced by the results of our 2006 waterways survey which recorded Daubenton's bat at 91% of all sites surveyed (Aughney *et al.* 2007). And while extensive arterial and field drainage was practised in the past, this does not take place now on any significant scale. Overall, the availability of this habitat to bats is considered to be stable or increasing.

Note on distribution data

The distribution data for the maps is largely derived from the Bat Conservation Ireland database, supplemented, where necessary, with data from O'Sullivan (1994).

Note on range

NPWS organised a two day meeting of Irish chiroptera specialists in October 2006 to discuss the conservation assessments for the ten Irish bat species. It was recognised at that meeting that while the distribution data held for most species was indicative of their national range, in all cases the species were more widespread than was apparent from the available data. Where it was clear that the data held by BCI was particularly inadequate, records from O'Sullivan (1994) were used as well. For most species the distribution / range data is presented at the 20km grid level. Where distribution data is particularly scarce, the 50km grid is used.

2. Common pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774) & Soprano pipistrelle *Pipistrellus pygmaeus* (Leach, 1825)

2.1 Introduction

There are three resident pipistrelle species in Ireland. The relatively recent discovery that the species formerly known as the pipistrelle (*Pipistrellus pipistrellus*) was in fact two separate but cryptic species, the common pipistrelle and the soprano pipistrelle (*P. pygmaeus),* has been well documented (Barratt *et al.*, 1997; Barratt & Jones, 1999). Nathusius' pipistrelle (*P. nathusii*) is a relatively new arrival in Ireland (Russ *et al.*, 2001).

2.2 Range

Previous distribution maps refer to pipistrelle rather than common and soprano pipistrelles (e.g. Mitchell-Jones 1999; Hayden & Harrington 2000). These bats occur sympatrically across much of Europe, although the common pipistrelle is more frequent at central latitudes while the soprano pipistrelle is reported to be associated more with Scandinavia and countries bordering the Mediterranean (Barratt *et al.*, 1997). Russ (1999) found that the common pipistrelle was the most abundant and widespread species in Northern Ireland, and although the soprano pipistrelle is both common and widespread, it was less regularly recorded than the common pipistrelle. Data from the Irish, car-based monitoring scheme show both species to be widespread throughout the country, although the common pipistrelle is more common in the east and the soprano appears to be more abundant in the west.

2.3 Population

O'Sullivan (1994) found 584 pipistrelle bat roosts during the National Bat Survey, the highest number for any species, and described it as the most abundant in Ireland and widely distributed. We now know that two separate species were being recorded. Nonetheless, from 2003 – 2005 in the the car-based monitoring scheme, the common and soprano pipistrelles were the commonest and second commonest encountered species respectively (Roche *et al.*, 2007). Encounter rates vary between years and it not possible to derive poulation estimates frrom this data. However, it has been calculated that, over an 11-year period, sufficient data should be accumulated to enable the detection of reliable population trends for both species.

2.4 Habitat

2.4.1 Roosting habitat

Common pipistrelles appear to form smaller colonies within buildings than soprano pipistrelles. Barlow & Jones (1999) found a median colony size of 76 (n = 33 roosts) for the common pipistrelle compared to 203 (n = 40 roosts) for the soprano pipistrelle; roosts of >1000 individuals are known for this species (McAney pers. comm.). The National Bat Survey was undertaken before the separation of the species and the figure of 584 roosts must represent a mix of sites for both, although as many of the roosts found were large, it is possible that a large percentage were soprano pipistrelle roosts. In a survey of 100 houses by Bat Conservation Group Dublin (1999), the common pipistrelle was only the fourth commonest species encountered, present in only seven houses and in very small numbers, but the soprano pipistrelle was the most commonly encountered bat, present in 54 houses. Oakley & Jones (1998) found that there was significantly more water (especially that with woodland or hedgerow on banks), and continuous hedgerow with trees within 2 km of maternity roosts of the soprano pipistrelle than expected by chance. This supports the results of diet studies showing the importance of aquatic insects to this species.

O'Sullivan (1994) describes pipistrelle summer roosts in very confined spaces, such as behind window sashes, under tiles and weather-boards, behind fascia and soffits, and within the cavities of flat roofs. Roche (1998) surveyed 42 churches in Cos. Laois, Kildare, Wicklow, Dublin, Westmeath, Meath and Louth, 27% of which had pipistrelle bats present, none identified as common pipistrelle. The bats were found in a variety of situations, in vestry and nave attics, crevices inside the nave and a small belfry. She also found two more pipistrelle roosts in other types of buildings, in the wall cavities and attic space of a rectory and under the flat roof of a pump house. Pipistrelles were the most abundant species recorded from churches in the UK National Bats in Churches Survey (Sargent, 1995).

McGuire (1998) found 21 roosts of pipistrelle bats during a survey for lesser horseshoe bats in Co. Clare; 12 were located in dwelling houses, two in churches and the remainder in unoccupied structures such as sheds and garages. Roche (2001), in a similar search for lesser horseshoe roosts in Co. Limerick, found 11 pipistrelle roosts in primarily old, disused dwellings or large mansions. She comments that this is in contrast to the view that these bats prefer modern, well insulated or heated structures. In the UK, the average age of pipistrelle roosts has been estimated at 15.4 years (Wardhaugh, 1992). The Northern Ireland Bat Group has recorded 480 pipistrelle bat roosts (most not identified to either the soprano or common pipistrelle), all of which were located in buildings, the great majority in the eaves or the roof space (Allen *et al.*, 2000).

Feyerabend & Simon (2000) reported frequent roost switching by a common pipistrelle colony during the course of two summers in Germany, with eight different roosts being used. As householders often describe the presence of small numbers of small bats for short periods of time during the summer in Ireland, it is possible that this species also exhibits roost switching here (K. McAney, pers. obs.).

There are a few records of pipistrelle bats (species not identified) roosting under bridges. Smiddy (1991) found up to two bats under three bridges during his systematic search of 364 bridges in mid and east Co. Cork and west Co. Waterford. Shiel (1999) found only one pipistrelle under a bridge during her study in Cos. Leitrim and Sligo, although both the soprano and common pipistrelles were recorded regularly foraging over water during emergence watches conducted at bridges.

Little is known about where pipistrelle species hibernate. None were recorded during intensive winter surveys of a variety of underground sites along the west coast of Ireland (McAney, 1994 & 1997). It is assumed that pipistrelles hibernate in buildings and trees. The only reported hibernation record for Ireland is of several bats discovered in the crevices of a small stone building in the grounds of Connemara National Park in January 1996 (G.O'Donnell, pers. comm.). It is possible that small numbers hibernate in underground sites but go unnoticed as they squeeze into tight spaces. A small group of pipistrelle bats was discovered in a crevice of a pillar of rock in a disused limestone mine in Scotland in March 1994 and again in March 1995 (Herman & Smith, 1995). However, of the 3077 bats trapped swarming at underground sites in autumn in the UK, only 16 were identified as soprano or common pipistrelles (Parsons, *et al*., 2003).

Pipistrelle bats (species not always identified) were amongst the first bats, along with brown long-eareds, to begin roosting in Schwegler bat boxes erected in two woodlands in Co. Galway in March 1999 (K. McAney, pers. obs.). Pipistrelle bats were present by May 1999 and have been recorded during 63 out of 68 visits that have been made since. The bats roost singly and in groups, the latter varying in size from two to three to approximately 25.

2.4.2 Foraging habitat

Two studies have been undertaken on the diet of pipistrelle bats in Ireland (species not identified) and both point to an aerial hunting strategy of insects associated with aquatic or damp habitats. Sullivan *et al*. (1993) analysed 160 droppings from a roost in a house near the River Slaney and found 46% of the diet comprised insects associated with aquatic habitats (30% midges, 16% caddis flies), with other flies making up 36% of the remainder of the diet. Guillot (2003) analysed 202 droppings collected from Schwegler bat boxes during the summer months in 1999 and 2000 in three woodlands in Co. Galway; Knockma Wood (without a water body nearby), Portumna Wood (on the shores of Lough Derg) and Coole/Garryland Wood (an area with turloughs). She found that thread-horned flies comprised 85.5%, 82% and 60% of the diet in each of the woods respectively. Window midges were the most frequently taken thread-horned flies in Knockma Wood, followed by midges, whereas the opposite case pertained in Portumna Wood, but window midges, craneflies and midges, were almost equally represented in the droppings from Coole/Garryland. Much of the remainder of the diet in Coole/Garryland was made up of caddis flies, beetles, the wasp-waisted insects and harvestmen. Barlow (1997) studied the diet of the two species and found a greater range of prey in the droppings of the common pipistrelle (non-biting midges, biting midges and dung flies) than those of the soprano pipistrelle (non-biting midges).

Shiel (1999) observed both the soprano and common pipistrelles regularly foraging over water during emergence watches conducted at bridges. Russ (1999) reports that the common pipistrelle is very general in its habitat preference, foraging in woodland/riparian/parkland, along linear features in farmland, and in towns and cities. Russ & Montgomery (2003) studied the seasonal pattern in activity and habitat use of common and soprano pipistrelles in general in Northern Ireland from April to October 1998 using a car-driven transect. They found that there was significant variation in habitat use by the pipistrelles, with more bats found along roads with tree lines, cut hedges and deciduous woodlands. In the UK Davidson-Watts & Jones (2006) radio tracked both species to investigate whether there were any differences in foraging behaviour between them during summer. Their results suggest that the common pipistrelle makes more flights to a greater number of foraging locations than the soprano pipistrelle, and that these locations are closer to the day roosts. In contrast, the soprano pipistrelle spends less time flying, makes fewer foraging trips but travels farther, suggesting that it is selecting specific foraging habitats.

2.5 Future prospects

Both of these species are widespread and common in Ireland. They are adaptable in their use of roosting and foraging habitat and their future prospects are considered good.

3. Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling & Blasius, 1839)

3.1 Introduction

The Nathusius' pipistrelle is one of three resident pipistrelle species in Ireland. Nathusius' pipistrelle is recognised as a resident bat species in Ireland following the discovery in 1997 of a maternity colony of 150 bats in Co. Antrim, Northern Ireland (Russ *et al.*, 1998). Up to then it was described as a migrant species in the British Isles based on a number of autumn and spring records during the 1980s and 1990s (Russ *et al.*, 2001). The first bat detector record in Northern Ireland was made in Derry in August 1996, with detector records from Dublin in July 1997 and from Co. Laois in August 1998, (Russ *et al.*, 2001). Fairley (2001) describes how L. Rendle & A. Ross identified the first live specimen in Belfast in September 1996. He also makes a strong case for Nathusius' pipistrelle being a recent arrival in Ireland, as opposed to it having been previously overlooked. A website has been set up to aid the identification of this species in Britain and Ireland and to collect records (www.nathusius.org.uk).

3.2 Range

This species is widely distributed throughout Europe, where it is highly migratory, with most migrations in a NE-SW direction as bats leave areas with severe winters in the autumn, returning in spring to rear young. Little can be said as yet about this species' distribution in the Republic of Ireland, but there are bat detector records from Cos.Wicklow (I. Ahlen & H. Baggoe, pers. comm.), Cavan, Longford and Tipperary (B. Keeley, pers. comm.), Westmeath (Roche, 1998), Dublin and Laois (Russ *et al.*, 2001), and Kerry (Kelleher, 2005). The species was detected during the car-based bat monitoring programme for the first time in 2005 from an area covering parts of Cos. Louth and Monaghan. In 2006 it was recorded from 8 survey squares including 2 in the south-west of the country (Roche *et al.* 2007) suggesting that this species is spreading rapidly south and west across Ireland.

3.3 Population

Although no breeding sites have yet been discovered for this species in the Republic of Ireland, some are known from Northern Ireland. It seems likely that a resident population is being supplemented by seasonal migrants. If records of the species continue to be collected at increasing frequencies in the car-based monitoring scheme then it will become possible to conduct statistical analyses on population trends over the coming years.

3.4 Habitat

3.4.1 Roosting habitat

In Europe Nathusius' pipistrelle uses hollow trees, bat and bird boxes, wooden churches and buildings during summer and crevices in cliffs, hollow trees and buildings in winter. In Northern Ireland it was found roosting in a mid-19th century farm stable block and storehouses that had undergone extensive renovation. The bats were using crevices in stone and brickwork, as opposed to roof spaces. The property was situated 50 m from a river.

3.4.2 Foraging habitat

Dietary analysis has yet to be conducted in Ireland for this species. Vaughan (1997) reports that it feeds on insects associated with water, such as non-biting midges. Russ (1999) describes it as feeding along rides, paths, woodland edge (both deciduous and conifer), meadows, and water, but avoiding built up areas, such as towns, in contrast to the common and soprano pipistrelles.

3.5 Future prospects

This species is expanding across Ireland, perhaps as a result of population expansion in other parts of its range, although the reasons for this are unclear. It appears to have found a niche in Ireland and its prospects are considered to be good.

4. Whiskered bat *Myotis mystacinus* (Kuhl, 1817) & Brandt's bat *Myotis brandtii* (Eversmann, 1845)

4.1 Introduction

The whiskered bat is one of four *Myotis* species found in Ireland. It has bristles on the lips, chin and forehead, which give it its name. It was classified as a threatened species in the *Irish Red Data Book 2: Vertebrates* (Whilde, 1993) based on the lack of records and the small numbers of bats known at that time. This situation has generally remained unchanged. The whiskered bat was separated from Brandt's bat in 1970 (Baggoe, 1973) and these two species have been described as cryptic, but a recent genetic study revealed that they had different evolutionary histories and are more closely related to other *Myotis* species than to each other (Ruedi & Mayer, 2001).

Brandt's bat is the most recently discovered bat species in Ireland, with two records of single animals in 2003 from Wicklow National Park (E. Mullen, pers. comm.) and from Co. Meath (B. Keeley, pers. comm.). Three female bats were found in Co. Clare in 2004 (B. Keeley, pers. comm.). The most recent discovery was of a nulliparous adult female trapped in Killarney National Park in August 2005 during an international bat fieldcraft workshop (Kelleher, 2005). Brandt's bat holds the longevity record for a free-living mammal, with a 41 year-old male recorded in Siberia (Podlutsky *et al.*, 2005).

4.2 Range

Although the whiskered bat is widely distributed throughout Ireland, there are relatively few records. It occurs throughout Europe, but is absent from northern Scotland and most of Denmark. Worldwide it is found in Korea, Japan, the western Himalayas and southern China (Mitchell-Jones *et al*., 1999).

Brandt's bat has been recorded from Cos. Wicklow, Meath, Clare and Kerry. It occurs throughout northern and central Europe, is absent from south-western France, Spain and Portugal and the distribution extends to Korea and Japan (Mitchell-Jones *et al.*, 1999).

4.3 Population

The whiskered bat is described as rare in southern Europe and Ireland (Mitchell-Jones *et al*., 1999). Whilde (1993) considered it to be the rarest bat in Ireland. O'Sullivan (1994) reported only 34 roosts during the National Bat Survey, with 22 having less than five bats though he did comment that it was the only species found roosting regularly with other species and hence may be overlooked. N. Roche (pers. comm.) states that the Irish Car-based Bat Monitoring Programme cannot monitor this species, primarily because its echolocation calls are more quickly attenuated compared to those of pipistrelles and Leisler's bats. A few individuals were caught during mist netting studies near Lough Corrib in June 1997 and in Portumna Wood in 1998 (K. McAney, pers. obs.) and five were caught in Killarney National Park during a bat detector workshop in August 2005 (Kelleher, 2005). Nothing can yet be said about the population size of Brandt's. A pilot project of woodland bat survey techniques, which began in Ireland in 2006 and is continuing in 2007, will inform the future monitoring of these two species.

4.4 Habitat

4.4.1 Roosting habitat

Whiskered bats are found in houses during the summer, roosting in small numbers in the roof space, often between the rafters and felt or in narrow slits where timbers meet, where they are difficult to observe (O'Sullivan 1994). All eight known roost sites in Northern Ireland were in the roof spaces of dwellings, five in houses dating from the late 18^{th} to 19^{th} centuries (Allen *et al*., 2000). Buckley (2005) studied a maternity colony of 45 whiskered bats from July to October 2004. The roost was located in a 100-year old house and the bats roosted in the attic, between the eaves and the chimney column. The roost was only discovered in June 2004, so no information was available on when the bats took up residence, but they abandoned the building in October 2004. Emergence was observed on seven nights, giving a mean emergence time of 34.7 minutes after sunset.

Smiddy (1991) found two female and one male whiskered bats roosting under bridges during a survey in mid and east Co. Cork during 1988 and 1989. One of the females was heavily infested with a flea species new to Ireland and this may have accounted for her being found roosting in the open as opposed to tucked away in a crevice. Shiel (1999) found three whiskered bats in crevices of three different masonry arch bridges in Co. Leitrim in September, October and November 1998.

Four of the five Irish Brandt's records have been in houses. Summer roosts are nearly always in buildings, but it is also found in bird and bat boxes (Mitchell-Jones *et al.*, 1999). One female whiskered/Brandt's bat was found in a Schwegler bat box in Garryland Nature Reserve in May 2000 (K. McAney, pers. obs.). Only nine maternity colonies of whiskered/Brandt's bats are known in England (L. Berge, pers. comm.).

Whiskered bats hibernate in a range of underground sites in winter. One was found hibernating in a cave in Co. Galway in 1994 (McAney, 1994) and another in a cave in Co. Kilkenny in 1997 (McAney, 1997). Whiskered and Brandt's bats were the third and fourth commonest species respectively recorded swarming in late summer and autumn at underground sites in the UK, yet only small numbers of either species are ever seen hibernating at these same sites (Parsons, *et al*., 2003).

4.4.2 Foraging habitat

Nothing is currently known about the diet of either species in Ireland, as no faecal analysis has been undertaken. In a study of the diet of whiskered and Brandt's bats from southern England, while there were many prey in common, there were significant differences in the percentages of prey items eaten by two species, with window midges comprising 30% of the diet of the whiskered bats, but only 15% of Brandt's (L. Berge, pers. comm.).

Due to the difficulty in distinguishing *Myotis* species in the field, little is known about the flight or foraging behaviour. However, Buckley (2005) used a bat detector set to 45kHz to pick up the echolocation calls of this and other species along a transect through a variety of habitats in a 2 km square adjacent to a known whiskered bat maternity roost over 10 nights between July and September 2004. He found that 12.7% of the bat passes recorded were from whiskered bats, and that this species used a narrow range of habitats, with tree lines, the centres of broadleaf woods, mixed woodland edges and rivers the most important. The bats avoided conifer woodlands, intensively managed grasslands and lakes. L. Berge (pers. comm.) radio tracked a number of whiskered bats in southern England and found they foraged in different types of grassland (improved, semi-improved and semi-natural) surrounded by hedgerows. These areas were often used as horse or cattle pastures. Russ (1999) describes whiskered bat habitat as parkland, meadows, flowing water, woodland and gardens.

L. Berge (pers. comm.) radio tracked a number of Brandt's bats in southern England and found they foraged in woodland and along woodland edge, often in close proximity to water.

4.5 Future prospects

Despite their rarity in Ireland and the limited data on their numbers, the future prospects of these two species are considered good. There are no overwhelming threats facing these species and the area of their main foraging habitat – woodland – is increasing across Ireland.

5. Brown long-eared bat *Plecotus auritus* (Linnaeus, 1758)

5.1 Introduction

The brown long-eared bat is the only member of the Genus *Plecotus* in Ireland and offers the non-specialist no difficulty with identification. A pilot monitoring programme for this species based on summer roost counts begins in 2007.

5.2 Range

The species is widespread throughout Ireland (Richardson, 2000). It has also been recorded on several islands off the coast of Cos. Donegal, Mayo and Kerry, and at Tuskar Lighthouse, Co. Wexford (Fairley, 2001). It is widespread in Europe and found across Asia (Mitchell-Jones *et al*., 1999).

5.3 Population

O'Sullivan (1994) describes the brown long-eared bat as the second most abundant bat species in Ireland and widely distributed; 294 roosts were recorded during the National Bat Survey although most contained less than 50 bats. In Northern Ireland, most of the 77 nursery roost sites of this species discovered there since 1985 contained around 20 bats. In a survey of 100 houses by the Bat Conservation Group Dublin (1999), the brown long-eared bat was also considered widespread but forming small colonies. A pilot monitoring programme for this species, commissioned by NPWS, run by Bat Conservation Ireland and based on summer roost counts begins in 2007. This approach has provided robust monitoring data in other countries (e.g. U.K.).

5.4 Habitat

5.4.1 Roosting behaviour

In Ireland, this species roosts in large open attics where the bats cluster together, often in the angle created by the rafters where they join the ridge beam (K. McAney, pers. obs). Entwistle *et al*. (1997) found that tree holes and farm buildings were used as temporary roosts at times when food was in short supply and bats became torpid to save energy, but nursery roosts were almost always in houses. Brown long-eared bats show a high degree of fidelity to nursery roosts and they have been shown to be selective in picking houses in which to roost.

Brown long-eared bats were amongst the first, along with pipistrelles, to begin roosting in Schwegler bat boxes erected in two woodlands in Co. Galway in March 1999 (K. McAney, pers. obs.). The long-eared bats were present by May 1999, and have been recorded during 66 out of 68 visits that have been made since. The bats generally roost in groups varying in number from five to ten, with singletons found less frequently.

Only four long-eared bats were recorded during a hibernating survey in west and south west Ireland, two from caves and two from ruined buildings (McAney, 1994, 1997).

5.4.2 Foraging habitat

This species has broad habitat preferences. It forages in broad-leaved woodlands and along tree lines, but also uses scrub, conifer plantations, gardens with mature trees, parkland and orchards. It will commute along hedgerows and tree lines. Shiel *et al*. (1991) studied the diet in Ireland from droppings collected in Co. Clare and found that the main prey items belonged to four categories: flies (craneflies and window-midges) comprising 30.4%; moths (26.5%); caddis flies (11%); and earwigs, centipedes and harvestmen (16.8%). The latter three categories represent non-flying arthropods and support the view that the brown long-eared bat often gleans its prey from foliage.

Entwistle *et al.* (1996) found that it is strongly associated with tree cover and selects roosts within 0.5 km of deciduous woodland but also uses a variety of habitats such as birch scrub, gardens with large trees, scattered woodland, orchards and parkland among meadows.

5.5 Future prospects

This species is widepsread and common. It has adapted to roosting in buildings and has broad habitat preferences. Its future prospects are considered to be good.

6. Natterer's bat *Myotis nattereri* (Kuhl, 1817)

6.1 Introduction

Natterer's bat is one of four *Myotis* bat species to occur in Ireland. It was classified as a threatened species in the *Irish Red Data Book 2: Vertebrates* (Whilde, 1993) based on the lack of records and the small numbers of bats found at that time. Little has changed in the interim.

6.2 Range

Although this species is widely distributed throughout Ireland, it is one of the least recorded bat species. It occurs throughout Europe and worldwide it is found in the Urals, the Near East, Turkmenia and north western Africa (Mitchell-Jones *et al.*, 1999).

6.3 Population

O'Sullivan (1994) found only 44 roosts during the National Bat Survey, with 20 containing single bats, and only seven with more than 50 bats. A number of authors have reported the difficulty in making accurate counts when it emerges from a roost site, primarily because it leaves relatively late after sunset and also because it can make return flights back into the roost or fly repeatedly outside, making it difficult to establish actual numbers leaving (Haddow, 1995; Ahlen *et al.*, 2000). Four males were caught in Killarney National Park during a bat field craft workshop in August 2005 (Kelleher, 2005). A pilot project of woodland bat survey techniques, which began in Ireland in 2006 and is continuing in 2007, will inform the future monitoring of these two species.

6.4 Habitat

6.4.1 Roosting habitat

Natterer's bat is found in buildings during the summer, roosting in small numbers in the roof space, often between the rafters and felt, or in narrow slits where timbers meet, and where they are difficult to observe (O'Sullivan 1994). Only one roost was found during a survey of 100 houses by the Bat Conservation Group Dublin (1999). A number of large colonies (>50 bats) have been recorded in Church of Ireland churches and other old buildings in Cos. Galway, Limerick and Cavan (K. McAney, pers. obs.). All eight known roost sites in Northern Ireland were in the roof spaces of dwellings, five in houses dating from the late 18^{th} to 19^{th} centuries (Allen *et al.*, 2000).

Smiddy (1991) found four single bats in four bridges during a survey in mid and east Co. Cork and west Co. Waterford during 1988 and 1989. It was the second most frequently encountered during a bridge survey of Co. Leitrim, when 66 individuals were recorded in 31 bridges (Shiel, 1999). It has not yet been recorded from bat boxes that have been in place in three woodlands in Co. Galway since 1999 (K. McAney, pers. obs.), although it is found in boxes in the UK (Mortimer, 2005; C. Morris, per. comm.).

Smith & Racey (2005) used the term 'itinerant' to describe the roosting behaviour of Natterer's bat arising from the results of their radio tracking study on the borders of England and Wales. Two maternity colonies studied each used between 21 and 31 roosting locations distributed across 15 to 25 roost sites. Temperature was considered to be the most important factor determining the use of roost sites, with the bats appearing to need access to a large number of roosts offering a range of temperatures. Although a variety of day roost sites were located within buildings, trees comprised 67% of all roost sites. Mortimer (2005) found this species using natural cavities in predominantly mature Corsican pines, the first record of Natterer's bats using commercial conifer plantations for roost sites.

Only 14 Natterer's bats were recorded during hibernation surveys in west and south west Ireland; 10 in caves, two in ruined buildings and one each in a mine and bridge (McAney, 1994, 1997). In all cases the bats were tucked away in crevices and required careful searching to discover them. This species was the commonest recorded swarming in late summer and autumn at underground sites in the UK, but, because of its habit of concealment in cracks and crevices, only small numbers were ever seen hibernating at these sites (Parsons *et al*., 2003).

6.4.2 Foraging habitat

Shiel *et al.* (1991) analysed droppings from a Natterer's colony in Co. Limerick and found that 68% of the prey eaten consisted of diurnal insects, insects which rarely fly, and non-flying arthropods. These results support the general view that this bat gleans or removes most of its prey from foliage or other surfaces, rather than catching it in the air.

Smith (2000) discovered by radio tracking this species that it selected semi-natural broad leaved woodland and tree-lined river corridors, ponds and grassland. However, a more recent study has shown that Corsican pines (*Pinus nigra)* were the most preferred foraging habitat for this species in Scotland (Mortimer, 2005).

6.5 Future prospeects

This species is known to be widely distributed in Ireland, but, because of its secretive roosting habits, it is one of the least recorded bats in the country. Given that its preferred foraging habitats are increasing the prospects for this species are considered good.

7. Daubenton's bat *Myotis daubentonii* (Kuhl, 1817)

7.1 Introduction

Daubenton's bat is one of four *Myotis* species found in Ireland, but is probably the easiest to recognise in flight due to its habit of flying just a few inches above the surface of water when feeding.

7.2 Range

The waterways survey which was carried out across the Republic of Ireland and Northern Ireland in 2006 showed this species to be widely distributed throughout the island (Aughney *et al*. 2007). It occurs throughout Europe, although scarce in the southwest and is absent from northern Scandinavia (Mitchell-Jones *et al.*, 1999).

7.3 Population

Daubenton's bat was the second commonest species recorded during the National Bat Survey; 213 roosts were discovered, the majority in bridges with only one to ten individuals present (O'Sullivan, 1994). There is little information on numbers at nursery roosts as these are rarely discovered. It is regularly recorded using bat detectors in the field but these records are of individual bats. In the all-Ireland waterways survey, whereby a 1 km stretch of river or canal is walked after sunset in August and the number of bat passes heard during a 40 minute period is recorded, Daubenton's were reported at 91% of the 134 sites surveyed (Aughney *et al*. 2007). This survey will be repeated annually to provide the basis for future assessment of population trends.

Elsewhere in Europe, Daubenton's bat is considered to be one of the most abundant species, with populations showing an increase in several locations (Mitchell-Jones *et al.,* 1999). Kokurewicz (1995) suggested that the observed increase in the Polish population could be attributed to eutrophication, which resulted in an increase in non-biting midges, a major prey item. It has been recorded in mist nets set up close to the shores of Lough Corrib in Co. Galway; 11 bats were caught in June 1997, and five and three were caught in June 1997 and September 2000 respectively (K.McAney, pers. comm.).

7.4 Habitat

7.4.1 Roosting habitat

Most of the published information on the roosting behaviour in Ireland relates to roosts in bridges. In addition to the bridge roosts discovered during the National Bat Survey, two other surveys have shown that it is the commonest species using bridges. Smiddy (1991) found Daubenton's bats at 38 bridges in mid and east Co. Cork and west Co. Waterford, although only a mean number of 1.76 bats per bridge. The largest number recorded at one site was seven, although it was suggested that bats may use bridges as hibernation sites, as a single torpid bat was found at a bridge in December. Shiel (1999) recorded 180 Daubenton's bats in bridges in Cos. Leitrim and Sligo between late April and mid November 1998. While most bridges held small numbers of bats, two different bridges each had approximately 20 bats using one crevice - these were thought to be nursery colonies due to the presence of young.

Daubenton's bats can also be found in buildings during the summer, generally those located close to water. Fairley (2001) cites just one nursery roost of more than 100 in Co. Waterford. There are a number of unpublished records of bats using crevices in the walls of large, usually unoccupied or partially occupied, buildings such as castles and mansions during the summer months, although there is one colony roosting near heating pipes in the cellar of a busy West of Ireland hotel (K. McAney, pers.obs.). Only three roosts were found during a survey of 100 houses by the Bat Conservation Group Dublin (1999); all were in old buildings located close to water. This group believe that Daubenton's bat is rarely found in modern buildings and hence is under reported. All eight known roost sites in Northern Ireland were in the roof spaces of dwellings, of which five were in houses dating from the late 18^{th} to 19^{th} century (Allen *et al*., 2000).

Elsewhere in Europe, Daubenton's bat is considered to be a woodland species, using tree roosts as nursery sites (Schober & Grimmberger, 1989). In a Dutch study, it was found to prefer natural cavities in oak trees, close to the edge of woodland (Boonman, 2000). However, it is extremely difficult to survey trees for roosting bats, although the use of radio tracking has proved very useful, as in the study of Natterer's bats by Smith & Racey (2005). Daubenton's bats began to occupy Schwegler bat boxes in deciduous woodland in Co. Galway in 2002; three years after the boxes were erected, and continue to do so. A colony was also found roosting in an old beech tree close to water in east Galway during summer 2005 (K. McAney, pers. obs.).

Only one Daubenton's bat was recorded during a hibernation survey of the west and south west of Ireland, but as it roosts in cracks and crevices, it is undoubtedly overlooked (McAney, 1994, 1997). Two Daubenton's bats were recorded from caves in the northwest of Ireland (Hopkirk, 1996). This species was the second commonest recorded swarming in late summer and autumn at underground sites in the UK, yet only small numbers were ever seen hibernating at these sites (Parsons *et al.*, 2003).

7.4.2 Foraging habitat

The Daubenton's bat is known as the water bat, because of its association with wetlands and the 2006 All-Ireland Waterways survey recorded this species at 91% of sites surveyed including streams as small as 2m wide (Aughney *et al.* 2007). The two dietary studies of this species undertaken in Ireland also support this aquatic association. Sullivan *et al*. (1993) analysed droppings from a colony using a dry arch of a bridge in Co. Galway. The diet consisted primarily of insects associated with water, with 33% caddis flies and 33% thread-horned flies, mainly midges. Flavin *et al.* (2001) obtained similar results in their study; 24% of the diet consisted of midges and 26% caddis flies. In the latter study, pre-adult forms of the insects were discovered in the diet. A quarter of the diet was deemed to have been caught from the water's surface. These results support the general view that Daubenton's bats gaff insects from the water or catch them in the air using the tail membrane. Shiel (1999) ran a statistical test on data from her bridge survey and found that there was a significant positive association between the presence of Daubenton's bats and the presence of slow-flowing water/pools. This was also found to be the case in a UK study by Warren *et al.* (2000), who found that Daubenton's bats also preferred sections of river with trees on both banks. However, although strongly associated with water, Daubenton's bat can also forage in other habitats, such as woodland (Russ, 1999).

7.5 Future prospects
This is one of our commonest species, recorded at 91 % of all sites surveyed for it in 2006. As large-scale wetland drainage has ceased and water quality is generally improving, its future prospects are considered to be good.

8. Leisler's bat *Nyctalus leisleri* (Kuhl, 1817)

8.1 Introduction
Leisler's bat is the only member of the Genus *Nyctalus* in Ireland. It has been described as a 'typically Irish bat' (Fairley, 2001) due to its abundance in Ireland compared to the rest of the Europe, where it is considered to be vulnerable (Mitchell-Jones *et al.*, 1999). Its abundance in Ireland has been attributed to the absence of larger competing species, such as the closely

related noctule *Nyctalus noctula*. It is the only vespertilionid bat species that has been studied in detail, with seven published papers on varying aspects of its ecology in southern Ireland. In Northern Ireland its pre-hibernal and hibernation behaviour has been studied (Hopkirk & Russ, 2004) and there is ongoing research into its roosting behaviour (I. Forsyth, pers. comm.) and molecular ecology and conservation genetics (E. Boston, pers. comm.).

8.2 Range

Data from the car-based monitoring scheme shows that this species is found throughout Ireland (Roche *et al*. 2007). It is also recorded from Western Europe to south western Asia, north western Africa and east to India (Mitchell-Jones *et al.*, 1999).

8.3 Population

It is impossible at present to estimate the Leisler's bat population in Ireland, although this country is generally considered to be the world stronghold for this species, and at one time held the largest known summer colony (O'Sullivan, 1994). It is currently being monitored by means of the Irish Car-based Bat Monitoring Programme that began in 2003 and it is believed that sufficient data will be accumulated by this method over a 14-year period to enable the detection of a 'Red Alert Population Decline' for this species (the IUCN term to describe a 50% or greater decline in population within 25 years). On the basis of data collected in 2004 and 2005, Leisler's bat is the third most commonly encountered species. In 2006, however, it overtook the soprano pipistrelle to become the second most frequently encoutered species after the common pipistrelle (Roche *et al.*, 2007).

8.4 Habitat

8.4.1 Roosting habitat

In Ireland, Leisler's bats form nursery colonies in buildings (many inhabited) during the summer. O'Sullivan (1994) recorded 71 roosts in buildings and Allen *et al.* (2000) 106. Fourteen roosts were recorded during a survey of 100 houses by the Bat Conservation Group Dublin (1999). However, roost records from Europe indicate that trees are preferred, particularly holes created by woodpeckers (Ohlendorf, in press). A few tree roosts have been found in Ireland, some of which have been described by Fairley (2001). A group of juvenile Leisler's bats were found in a beech tree in Co. Galway in July 1996 (K. McAney, pers. obs.) and two tree roosts were reported by Allen *et al*. (2000), in an oak and an ash. Singletons and small groups of bats are regularly recorded during the summer from Schwegler bat boxes in woods at three locations in Co. Galway (K. McAney, pers. obs.). This species has also been found using Schwegler bat boxes erected as part of mitigation measures following tree removal during a road improvement scheme in Co. Mayo (T. Aughney, pers. comm.).

Nursery roosts begin to form in April, the young are born in June and are on the wing a month later. There is a dramatic decrease in the number of bats at the nursery roost once the young are independent, as the adult females leave at this time, followed some weeks later by the juveniles (Shiel & Fairley, 2000). Leisler's bats emerge early in the evening, often leaving the roosts before sunset; they emerge earlier on overcast nights (McAney & Fairley, 1990; Shiel & Fairley, 2000). Forsyth (I. Forysyth, pers. comm.), in a study of a maternity roost in the Lagan Valley in Northern Ireland using passive identification transponders and an infrared video camera found that females moved between 20 roost sites a total of 120 times during a 6-year period; also, up to a quarter of the bats using the roost would often not emerge on a given night.

Little is known about where Leisler's bats hibernate. Two bats were found under roof slates during repair work in Connemara National Park in February 1994 (S. Hassett, pers. comm.) and one bat was found on roof beams of an old building, also in the National Park, in January 1996 (G. O'Donnell, pers. comm.).

Hopkirk & Russ (2004) studied pre-hibernation and hibernation behaviour in Northern Ireland by fitting small temperature sensitive radio transmitters to 29 bats. These bats were subsequently tracked from July – November in 2002 and from August 2002 - January 2003. Harems (consisting of a lone male and several females) were found in bat boxes up to mid-October. Both trees and buildings were used from August until the beginning of November and after that, only trees. The most important tree species used were oaks and beeches. All the roosts used were within 200m of a path or a forest edge. Bats became torpid once ambient temperature dropped below 6^0 C and there was evidence to suggest that some males migrated to the coast in October. Shiel & Fairley (1998) also suggested that Leisler's bats in Wexford migrated, in this case from the coast to inland areas, as bats was never detected at known summer foraging sites during the winter. Long distance migration has been reported for this species; Ohlendorf *et al.* (2000) reported the discovery of a female Leisler's bat ringed in Germany in May 1998, recaptured in May 1999, and subsequently found 1,567 km away in Spain in September of that year.

8.4.2 Foraging habitat

Foraging behaviour has been studied using bat detectors and radio tracking (Shiel & Fairley, 1998; Shiel *et al.*, 1999). The detector study revealed little indication of habitat preference, with bats found in a wide variety of habitats, including canals, estuary/open water, roadsides, street lamps, orchards, mature trees, pasture, farmland, railway embankments and streams. However, the radio tracking study revealed that two thirds of the recorded foraging time was over pasture or drainage canals, while foraging in other habitats, particularly lakes and conifer forests, was greatest before the bats gave birth. Bats commuted directly from the day roosts to foraging sites up to 13.4 km away at speeds often exceeding 40 km per hour. Except during lactation, individuals sometimes day-roosted in buildings or hollow trees away from the nursery roost. These alternative day roosts were also sometimes used as night roosts, especially during rain, which also caused the bats to return to the day roost. Most activity was observed during the early part of the night and, on most nights, the first flight lasted the longest.

Although the largest bat species in Ireland, its prey is composed primarily of small to medium-sized insects, many of which form swarms. Both Sullivan *et al*. (1993) and Shiel *et al*. (1998) found that the major prey items were true flies, moths and caddis flies. Of the flies eaten, small insects such as midges were eaten more than larger insects such as craneflies, and the yellow dung fly was also important. The only other food item of significance was beetles, mainly scarabids.

8.5 Future prospects

This species is widespread across Ireland and shows considerable flexibility in habitat use. It has adapted to roosting in buildings and its future prospects are considered to be good.

Species	Roosts & Foraging habitats
Common & Soprano pipistrelles	Buildings: aquatic places, woodland edge, tree lines, farmland, hedges, gardens, urban areas.

Nathusius' pipistrelle	Buildings: Aquatic places, along rides, paths, woodland edge, meadows, avoids urban areas.
Whiskered	Buildings, bridges and underground sites: Along tree lines, centres of broad leaved woodland, edges of mixed woodland, rivers.
Brandt's	Buildings: Woodland and along woodland edge with water.
Brown long-eared	Buildings: Woodland, birch scrub, gardens with large trees, orchards, parkland with meadows.
Natterer's	Buildings and underground sites: Semi-natural broad leaved woodland, tree-lined rivers, grassland.
Daubenton's	Buildings, bridges & trees: Rivers with slow moving water and bankside vegetation, also woodland.
Leisler's	Buildings and trees: Pasture, drainage canals, over lakes and conifer forests.

Table 1. *Summary of the habitats used by the nine vesper bats in Ireland*

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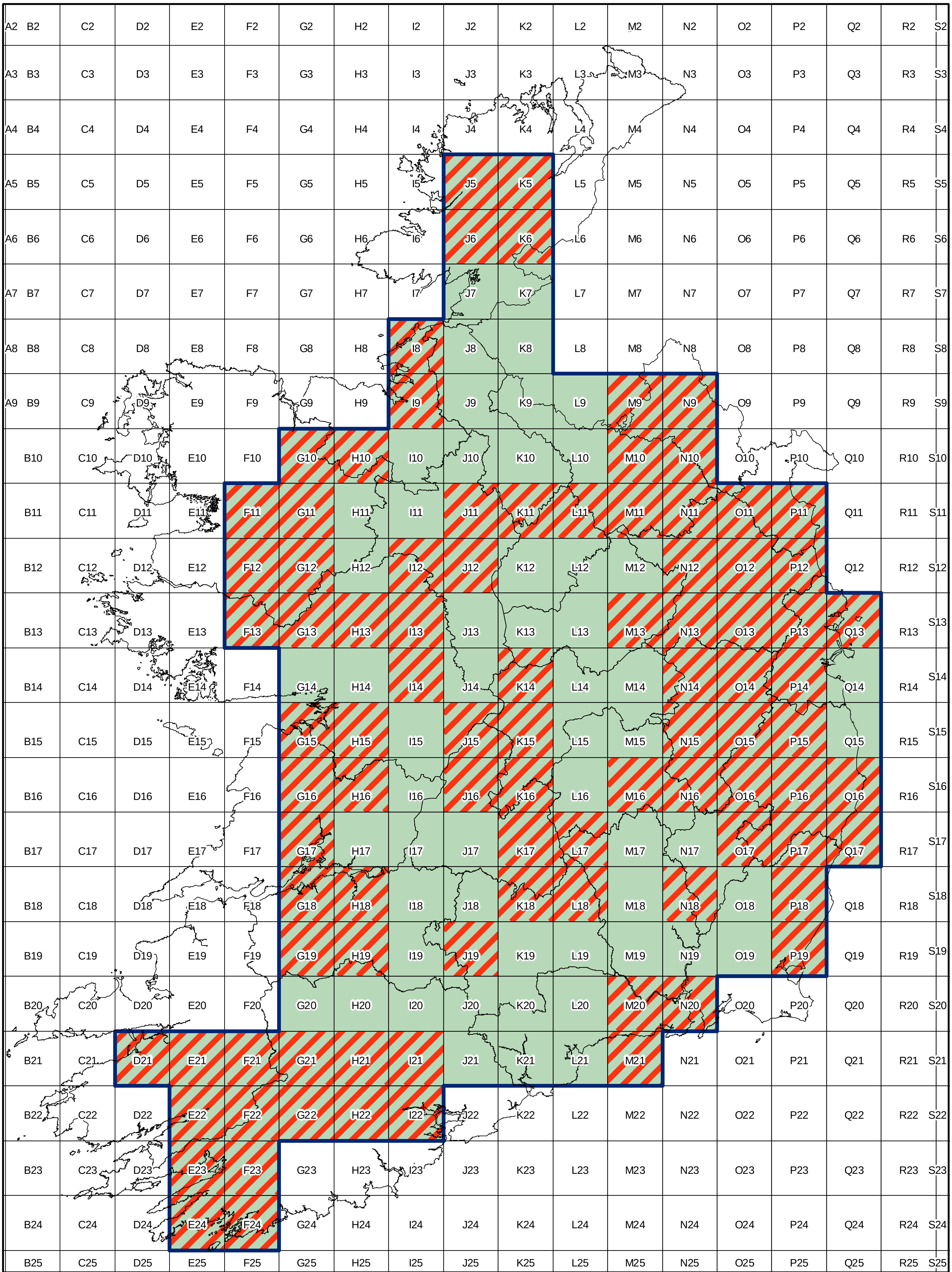
1309 Common pipistrelle (*Pipistrellus pipistrellus*)

1. National Level	
Species code	1309
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Roche, N., Catto, C., Langton, S., Aughney, T. & Russ, J. (2005) Development of a Car-Based Bat Monitoring Protocol for the Republic of Ireland. *Irish Wildlife Manuals*, No. 19. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
2.3 Range	
2.3.1 Surface area	59,200 km^2
2.3.2 Date	Extrapolated from records collated between 2000-2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys)
2.3.4 Trend	0 = stable
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	In the absence of more detailed information 20 km squares are taken as a proxy for population – all 20km squares within the range are thought to be positive for this species - 148 20km grid cells
2.4.2 Date of estimation	June 2007
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	0 = 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	This is a very adaptable species. Regularly found roosting in suburban houses and feeding in urban parks. However, its tendency to form roosts in domestic houses can lead to conflict with house owners. 110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings)
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	59,200 km^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	N/A
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	59,200 km^2
2.7.2 Favourable reference population	148 20km grid cells
2.7.3 Suitable Habitat for the species	59,200 km^2
2.7.4 Other relevant information - see background doc.	
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 CS1	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

Pipistrellus pipistrellus

1309

- Current Distribution (92 cells)
- Current Range (148 cells)
- Favourable Reference Range (148 cells)
- W48 20km grid cells

Date: October 2007

1314 Daubenton's bat (*Myotis daubentoni*)

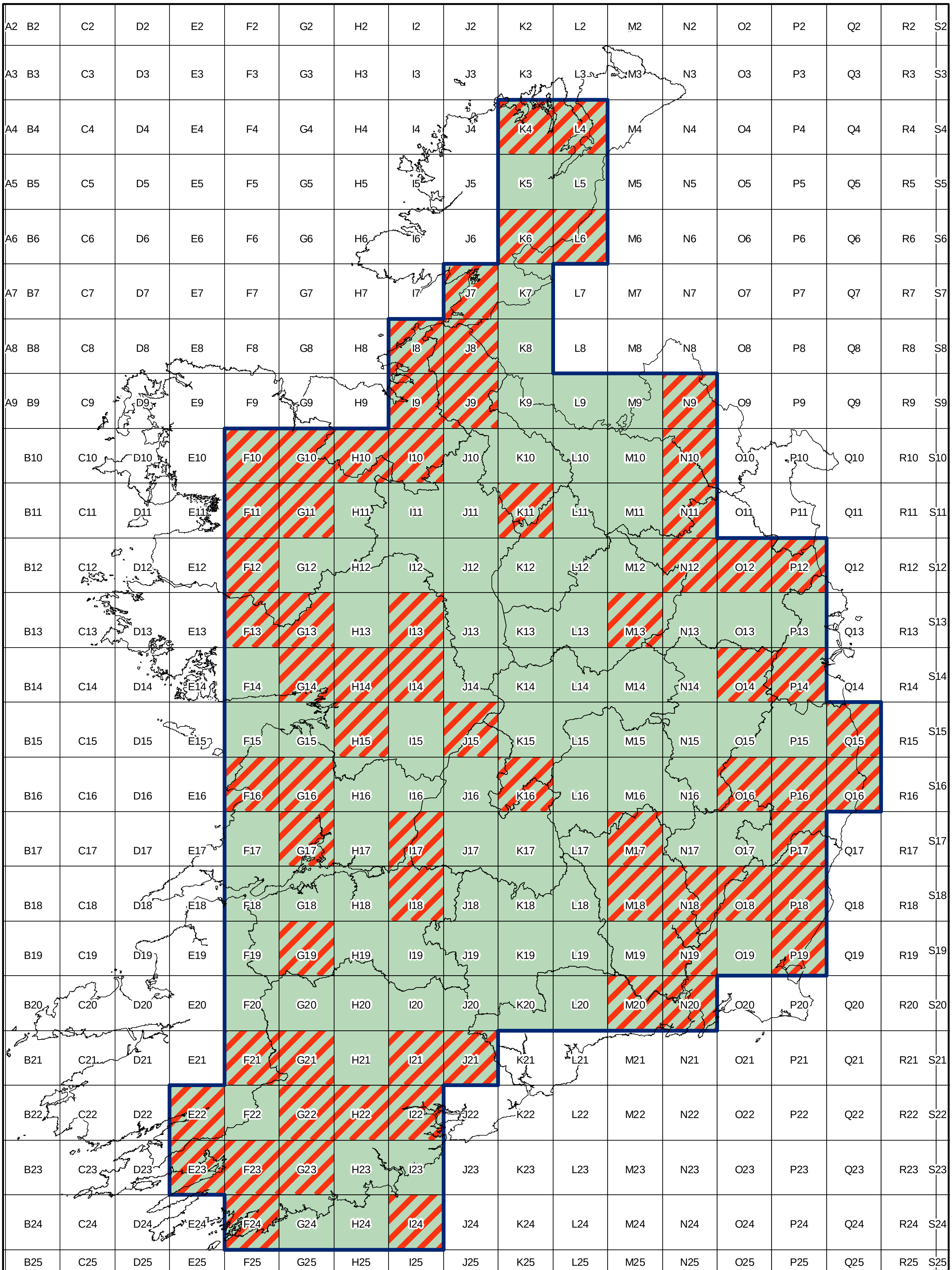
1. National Level	
Species code	1314
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Aughney, T., Langton, S., Roche, N. Russ, J. & Briggs, P. (2007) All-Ireland Daubenton's bat waterways survey 2006. Unpublished report to NPWS, Dublin. ▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Shiel C.B. (1999) *Bridge usage by bats in County Leitrim and County Sligo*. A report prepared for the Heritage Council. ▪ Smiddy, P. (1991) Bats and bridges. *Irish Naturalists' Journal* 23: 425-426.
2.3 Range	
2.3.1 Surface area	61,200 km^2
2.3.2 Date	June 2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys)
2.3.4 Trend	0 = 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	In the absence of more detailed data, 20 km squares are taken as a proxy of population. The species is considered to be present in 153 20km grid

	cells.
2.4.2 Date of estimation	June 2007
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	110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 400 – Urbanised areas 507 – bridge, viaduct (specifically insensitive bridge repair works, as this species roosts in cracks & crevices under bridges) 701 – water pollution 790 – other pollution or human impacts / activities (i.e. this species is particularly sensitive to light pollution) 803 – infilling of ditches, dykes, ponds, pools, marshes 811 – management of aquatic and bank vegetation for drainage purposes
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	61,200 km^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	N/A
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	61,200 km^2
2.7.2 Favourable reference population	155 20km grid cells
2.7.3 Suitable Habitat for the species	61,200 km^2

2.7.4 Other relevant information - see background doc.	
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 CS1	Favourable (FV)



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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Myotis daubentonii

1314

- Current Distribution (68 cells)
- Current Range (153 cells)
- Favourable Reference Range (153 cells)
- W48 20km grid cells

Date: October 2007

1317 Nathusius pipistrelle (*Pipistrellus nathusii*)

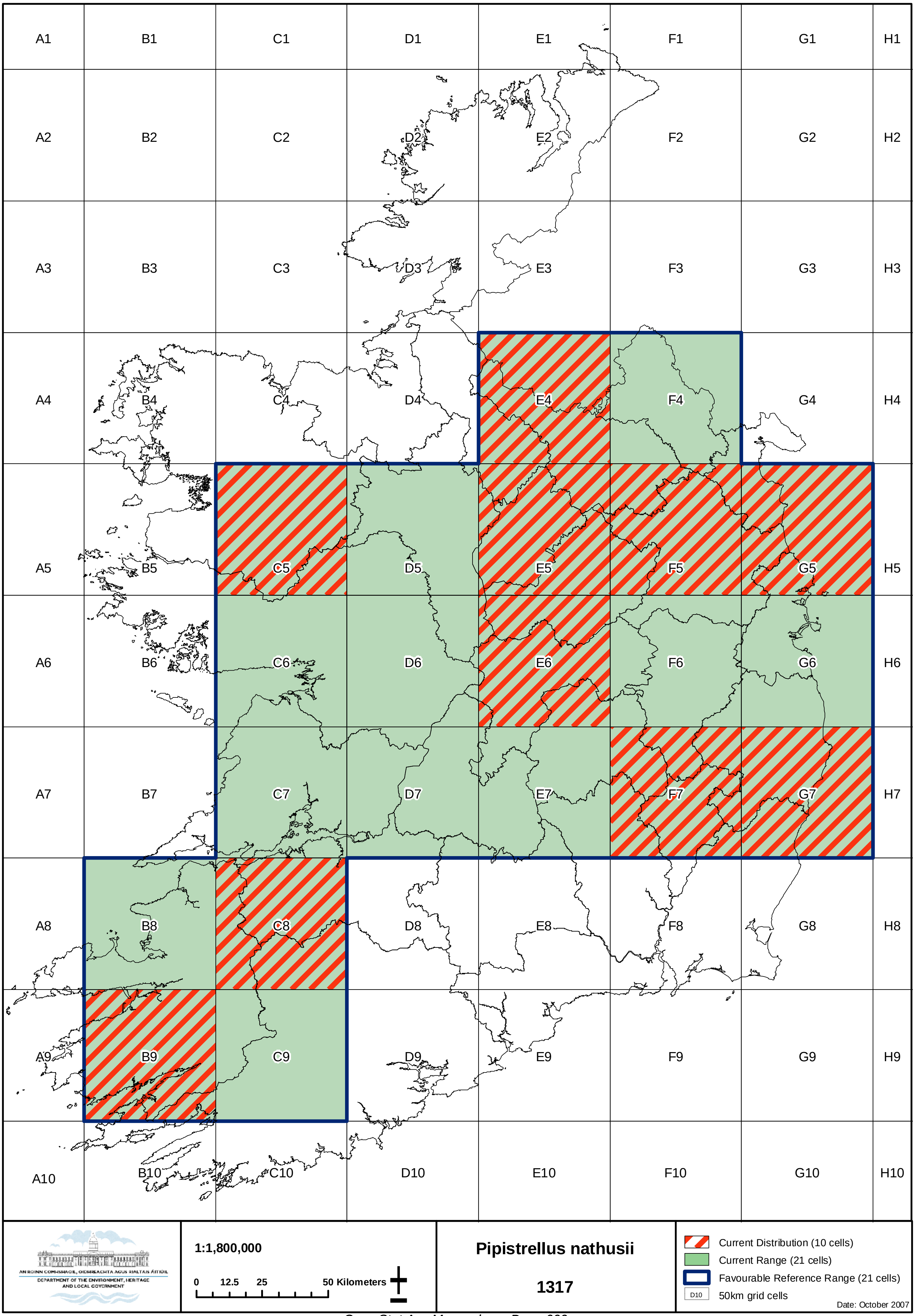
1. National Level	
Species code	1317
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Roche, N., Catto, C., Langton, S., Aughney, T. & Russ, J. (2005) Development of a Car-Based Bat Monitoring Protocol for the Republic of Ireland. *Irish Wildlife Manuals*, No. 19. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Russ, J., Hutson, A.M., Montgomery, W.I., Racey, P.A. & Speakman, J.R. (2001) The status of Nathusius' pipistrelle in the British Isles. *J. Zool, Lond*. 254: 91-100. ▪ Russ, J. (2006) www.nathusius.org.uk
2.3 Range	Based on BCIreland database and car transect map.
2.3.1 Surface area	52,500 km^2
2.3.2 Date	June 2007
2.3.3 Quality of data	1 = poor
2.3.4 Trend	net increase This species appears to be rapidly expanding its range across Ireland, spreading south and south-west from Northern Ireland, where it was first recorded in 1996. The 2006 car transect bat survey recorded the species in 8 survey squares, compared with just 1 square in 2005. We do not have sufficient data to estimate the actual rate of increase.
2.3.6 Trend-Period	1996 - 2007
2.3.7 Reasons for reported trend	0 = Unknown

2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	In the absence of more detailed data, 50 km squares are taken as a proxy of population. The species is considered to be present in 21 50km squares.
2.4.2 Date of estimation	June 2007
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	Based on the range increase, a population increase is inferred, but we have no data on actual numbers.
2.4.7 Trend-Period	1996-2007
2.4.8 Reasons for reported trend	0 = unknown
2.4.9 Justification of % thresholds for trends	In case a MS is not using the indicative suggested value of 1% per year when assessing trends, this should be duly justified in this free text field
2.4.10 Main pressures	This species feeds largely on chironomids and as such is likely to be affected by water quality. This species is also migratory, with resident populations probably being augmented in winter by migrant animals – these animals are particularly vulnerable to wind farm collisions. 110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings and wind farms) 803 – Infilling of ditches, dykes, pools etc.
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	52,500 km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	1 = poor
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	N/A
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	52,500 km^2

2.7.2 Favourable reference population	21 50km grid cells
2.7.3 Suitable Habitat for the species	52,500 km^2
2.7.4 Other relevant information - see background doc.	
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 CS1	Favourable (FV)


A1
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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT
1:1,800,000
0
12.5
25
50 Kilometers
Pipistrellus nathusii
1317
Current Distribution (10 cells)
Current Range (21 cells)
Favourable Reference Range (21 cells)
D10
50km grid cells
Date: October 2007

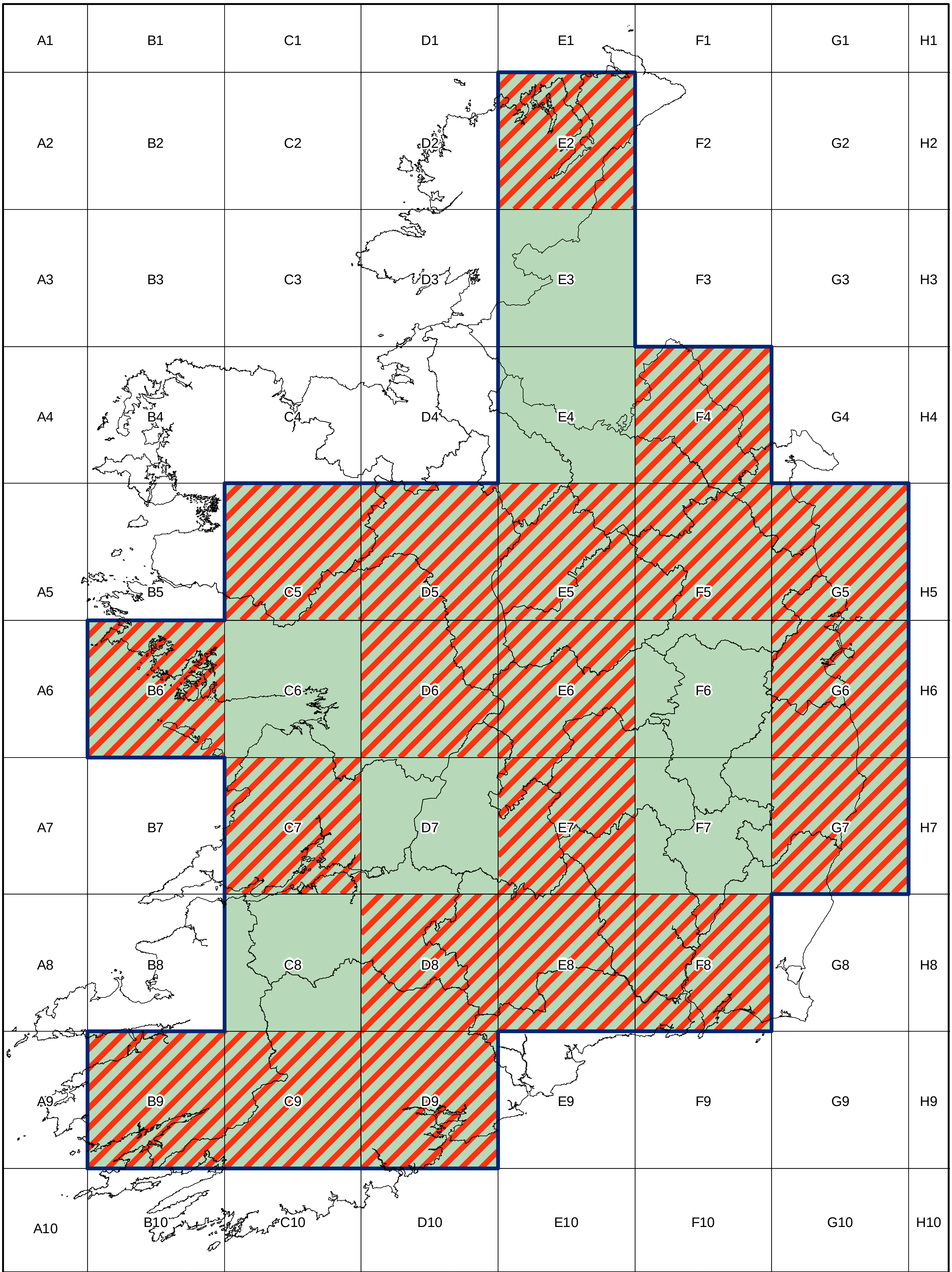
1330 Whiskered bat (*Myotis mystacinus*)& 1320 Brandt's bat (*Myotis brandti*)

Data Comments/Guidelines for reporting data	
1. National Level	
Species code	1330 / 1320
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	**Buckley, D.J. (2005).** The emergence behaviour and foraging habitat preferences of the Whiskered bat (*Myotis mystacinus)* in a lowland landscape in mid-Cork. B.Sc. Thesis, National University of Ireland Cork. **Hayden, T. & Harrington, R. (2000)** *Exploring Irish Mammals*. Town House, Dublin. **Kelleher, C. & Marnell, F. (2006)** Bat mitigation guidelines for Ireland*. Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. **McAney, K. (2006)** A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. **O'Sullivan, P. (1994)** *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal.
2.3 Range	
2.3.1 Surface area	67,500 km^2
2.3.2 Date	May 2007
2.3.3 Quality of data	1 = poor
2.3.4 Trend	Unknown, but thought 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	In the absence of more detailed data, 50 km squares are taken as a proxy of population. The species are considered to be present in 27 50km grid cells.
2.4.2 Date of estimation	May 2007
2.4.3 Method used	1 = based on expert opinion
2.4.4 Quality of data	1 = poor
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	110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings) 803 – Infilling of ditches, dykes, pools etc. 811 – management of aquatic and bank vegetation for drainage purposes
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	67,500 km^2
2.5.3 Date of estimation	May 2007
2.5.4 Quality of data	1 = poor
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	n/a
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	67,500 km^2
2.7.2 Favourable reference population	27 50km grid cells
2.7.3 Suitable Habitat for the species	67,500 km^2
2.7.4 Other relevant information -	see background doc.
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)



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

1:1,800,000

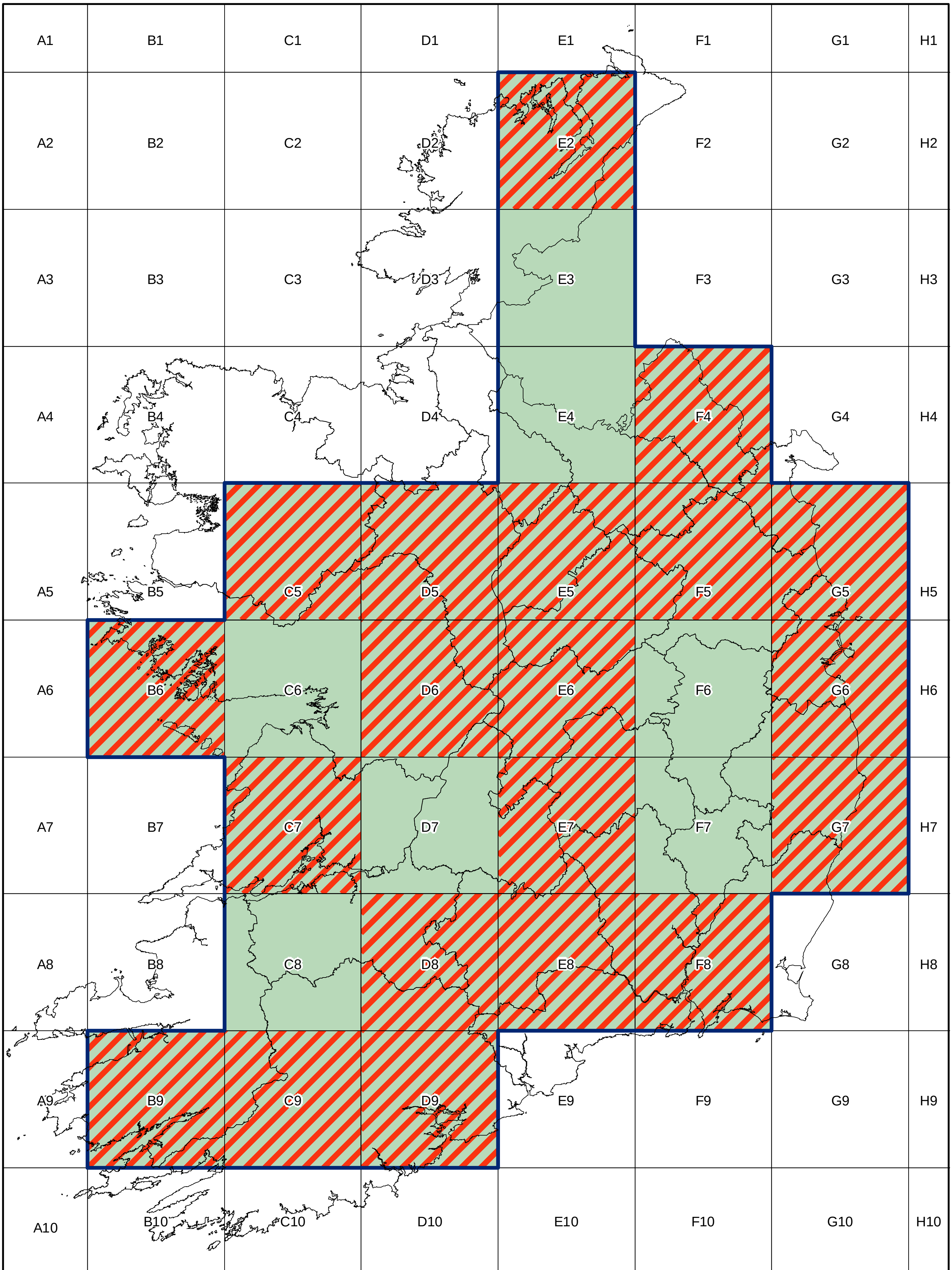
0 12.5 25 50 Kilometers

Myotis brandtii

1320

Current Distribution (20 cells)
Current Range (27 cells)
Favourable Reference Range (27 cells)
D10 50km grid cells

Date: October 2007



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1:1,800,000

0 12.5 25 50 Kilometers

Myotis mystacinus

1330

Current Distribution (20 cells)
Current Range (27 cells)
Favourable Reference Range (27 cells)
D10 50km grid cells

Date: October 2007

1322 Natterer's bat (Myotis nattereri)

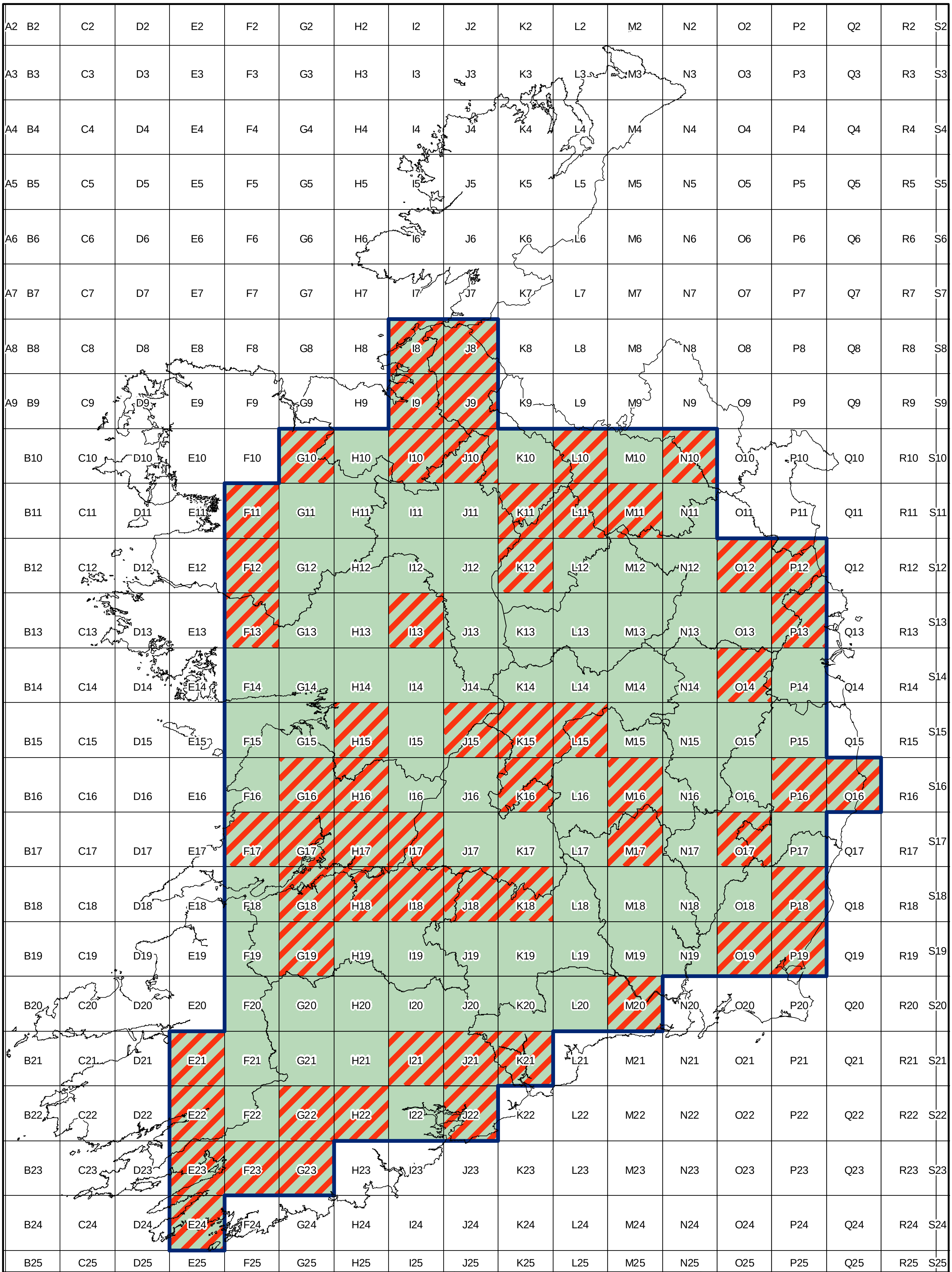
1. National Level	
Species code	1322
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Shiel C.B. (1999) *Bridge usage by bats in County Leitrim and County Sligo*. A report prepared for the Heritage Council. ▪ Shiel C.B., McAney, C.M. & Fairley, J.S. (1991) Analysis of the diet of Natterer's bat *Myotis nattereri* and the common long-eared *bat Plecotus auritus* in the west of Ireland. *J. Zool*. 223: 299-305. ▪ Smiddy, P. (1991) Bats and bridges. *Irish Naturalists' Journal* 23: 425-426.
2.3 Range	
2.3.1 Surface area	54,000 km^2
2.3.2 Date	April 2007
2.3.3 Quality of data	1 = poor (no specific survey)
2.3.4 Trend	0 = 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	In the absence of more detailed data, 20 km squares are taken as a proxy of population. The species is considered to be present in 135 20km grid cells.

2.4.2 Date of estimation	12 October 2006
2.4.3 Method used	1 = based on expert opinion
2.4.4 Quality of data	1 = poor
2.4.5 Trend	not known, but thought 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	110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 400 – Urbanised areas 507 – bridge, viaduct (specifically insensitive bridge repair works, as this species roosts in cracks & crevices under bridges) 701 – water pollution 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings) 803 – infilling of ditches, dykes, ponds, pools, marshes 811 – management of aquatic and bank vegetation for drainage purposes
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	54,000 km^2
2.5.3 Date of estimation	12 October 2006
2.5.4 Quality of data	1 = poor. One of our least known bat species.
2.5.5 Trend	0 = stable
2.5.6 Trend-Period	N/A
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	54,000 km^2
2.7.2 Favourable reference population	135 20km grid cells
2.7.3 Suitable Habitat for the species	54,000 km^2
2.7.4 Other relevant information -	see background doc.
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 CS1	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

Myotis nattereri

1322

Current Distribution (59 cells)
Current Range (135 cells)
Favourable Reference Range (135 cells)
W48 20km grid cells

Date: October 2007

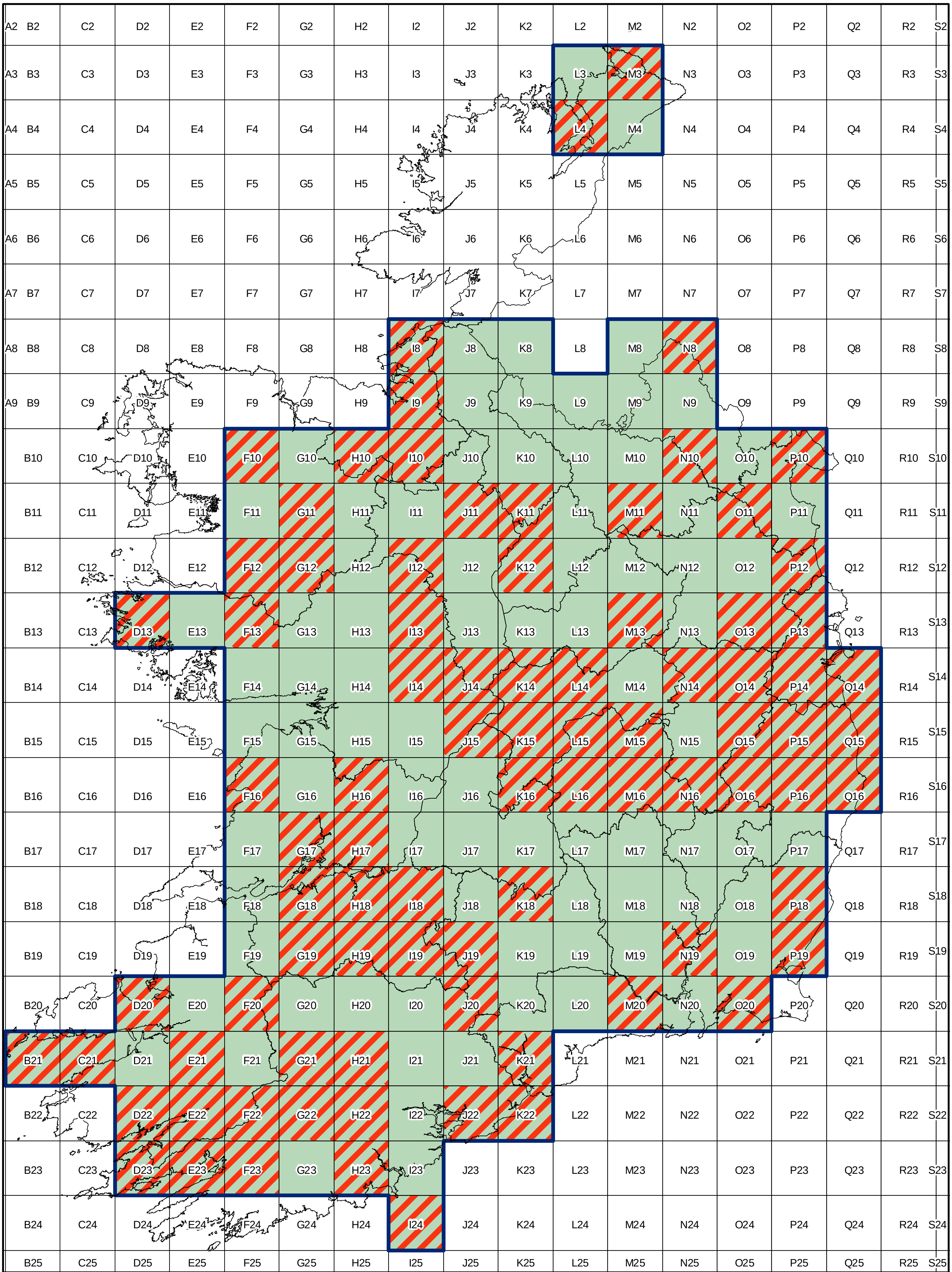
1326 Brown long-eared bat (*Plecotus auritus*)

1. National Level	
Species code	1326
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Bat Conservatin Group Dublin (1999) Bats in houses. A report to the Heritage Council. ▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Shiel C.B., McAney, C.M. & Fairley, J.S. (1991) Analysis of the diet of Natterer's bat *Myotis nattereri* and the common long-eared *bat Plecotus auritus* in the west of Ireland. *J. Zool*. 223: 299-305.
2.3 Range	
2.3.1 Surface area	66,800 km^2
2.3.2 Date	June 2007. Extrapolated from records held on BCI database and O'Sullivan (1994).
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	0 = stable
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	In the absence of more detailed data, 20km squares are taken as a proxy of population. The species is considered to be present in 167 20km grid cells.
2.4.2 Date of estimation	June 2007
2.4.3 Method used	1 = based on expert opinion

2.4.4 Quality of data	2 = moderate
2.4.5 Trend	not known, but thought 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	110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 401 – Continuous urbanisation 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings and light pollution)
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	66,800 km^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	N/A
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	66,800 km^2
2.7.2 Favourable reference population	167 20km grid cells.
2.7.3 Suitable Habitat for the species	67,200 km^2
2.7.4 Other relevant information -	see background doc.
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	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

Plecotus auritus

1326

- Current Distribution (86 cells)
- Current Range (167 cells)
- Favourable Reference Range (167 cells)
- W48 20km grid cells

Date: October 2007

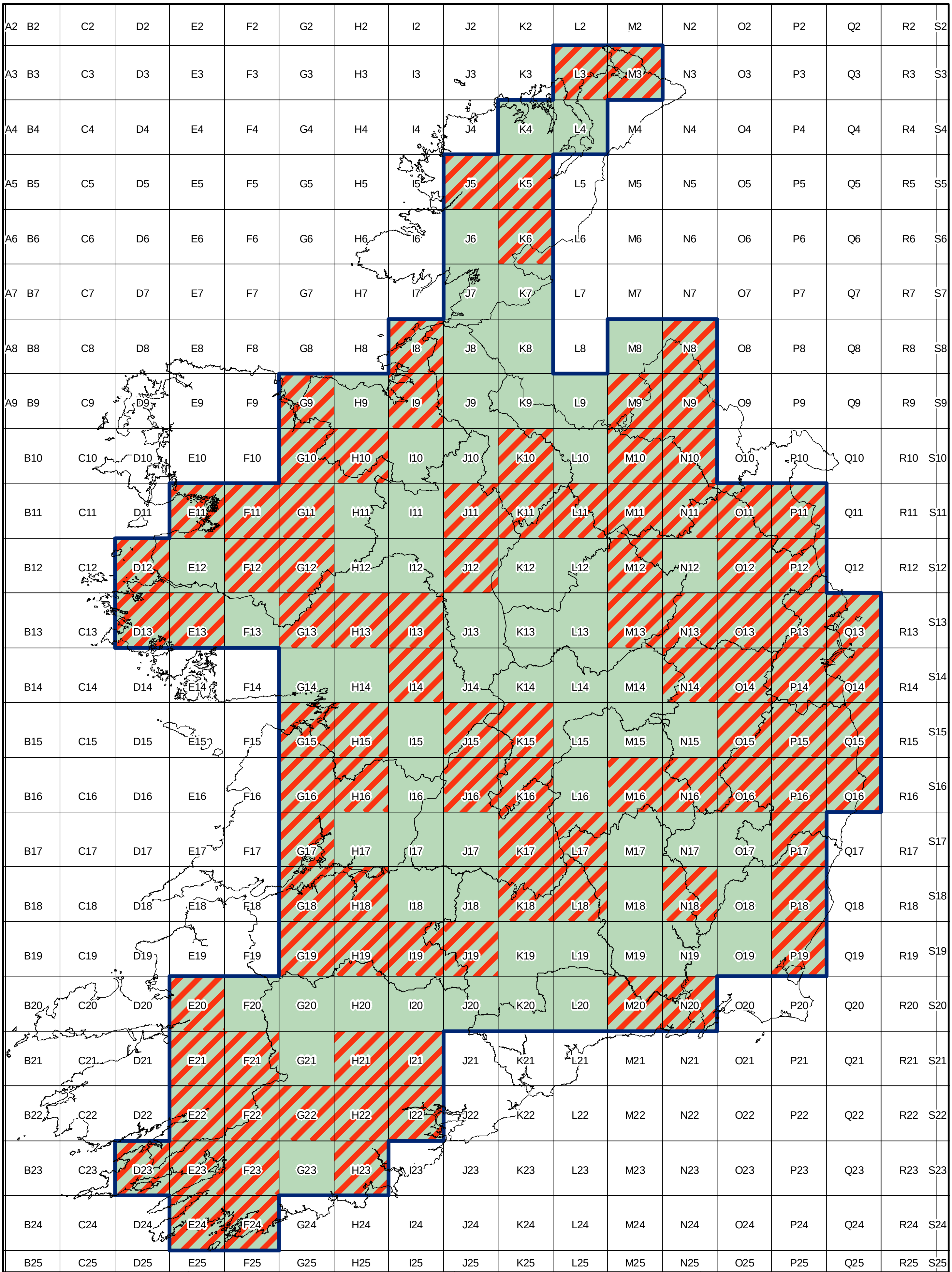
1331 Leisler's bat (*Nyctalus leisleri*)

1. National Level	
Species code	1331
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Roche, N., Catto, C., Langton, S., Aughney, T. & Russ, J. (2005) Development of a Car-Based Bat Monitoring Protocol for the Republic of Ireland. *Irish Wildlife Manuals*, No. 19. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
2.3 Range	
2.3.1 Surface area	64000km^2
2.3.2 Date	Extrapolated from records collated between 2000-2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys)
2.3.4 Trend	0 = stable
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	In absence of more detailed data 20 km squares are taken as a proxy for population. All 20km within the range are thought to be positive for the species - 160 20km grid cells.
2.4.2 Date of estimation	June 2007
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	Probable net increase Car transect survey data suggests the species may be increasing, but this is based on only 4 years of data – not sufficient to calculate robust trends.
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	110 – use of pesticides 141 – Abandonment of pastoral systems 151 – Removal of hedges & copses 152 – Removal of scrub 164 – Forestry clearance 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings)
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	64000km^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	N/A
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	64,000 km^2
2.7.2 Favourable reference population	160 20km grid cells
2.7.3 Suitable Habitat for the species	64,400 km^2
2.7.4 Other relevant information -	see background doc.
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 CS1	Favourable (FV)



AN ROINN COMHSHAOIL, OIDHREACHTA AGUS RIALTAIS ÁITIÚIL
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1:1,800,000

0 12.5 25 50 Kilometers

Nyctalus leisleri

1331

Current Distribution (97 cells)
Current Range (160 cells)
Favourable Reference Range (160 cells)
D10 50km grid cells

Date: October 2007

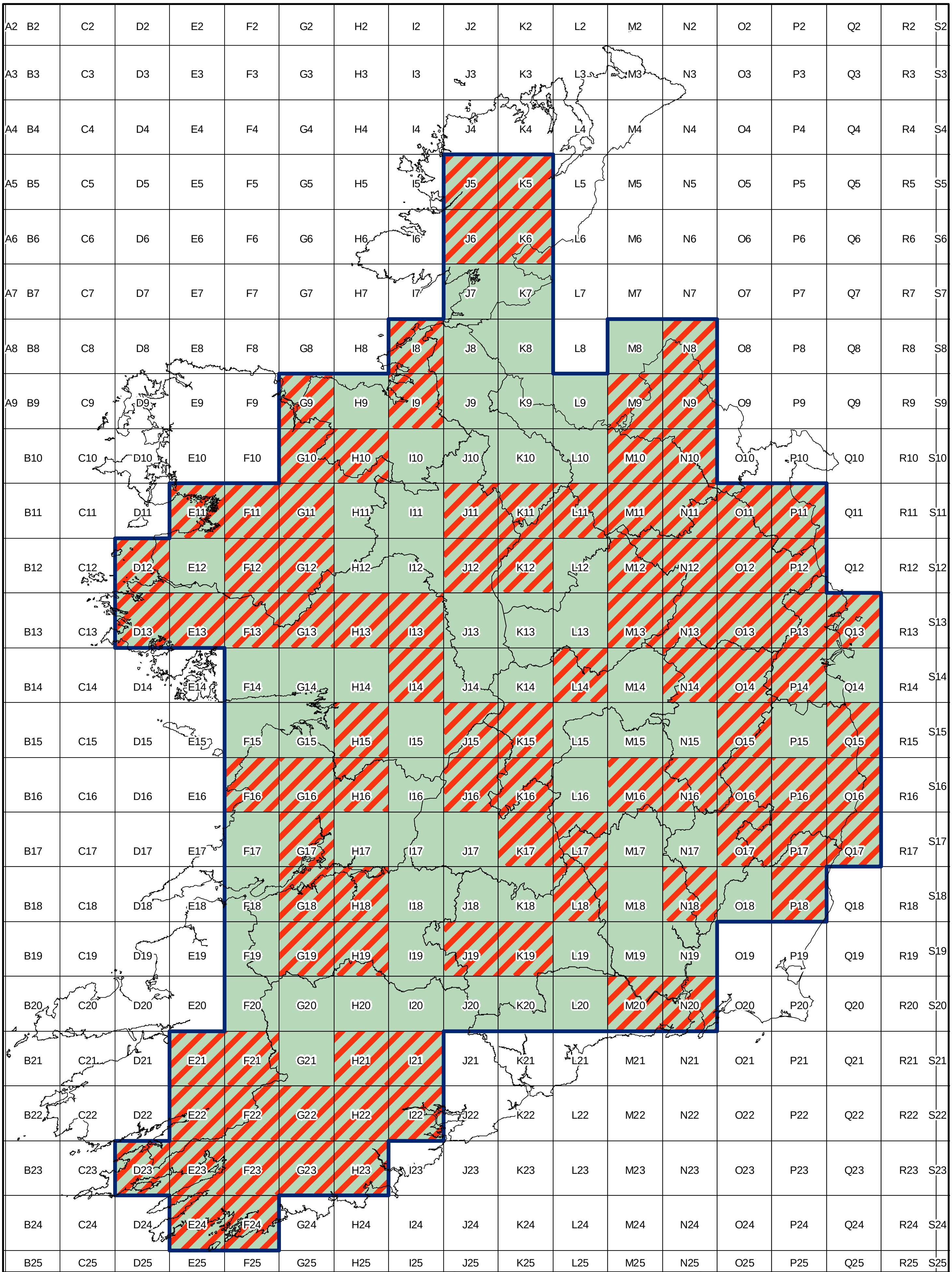
5009 Soprano pipistrelle (*Pipistrellus pygmaeus*)

1. National Level	
Species code	5009
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
1.1 Range	Whole country

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. *Irish Wildlife Manuals* No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ McAney, K. (2006) A conservation plan for Irish vesper bats. *Irish Wildlife Manuals* No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ O'Sullivan, P. (1994) *Bats in Ireland*. Special Zoological Supplement to the Irish Naturalists' Journal. ▪ Roche, N., Catto, C., Langton, S., Aughney, T. & Russ, J. (2005) Development of a Car-Based Bat Monitoring Protocol for the Republic of Ireland. *Irish Wildlife Manuals*, No. 19. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
2.3 Range	
2.3.1 Surface area	64000 km^2
2.3.2 Date	Extrapolated from records collated between 2000-2007
2.3.3 Quality of data	2 = moderate (extrapolated from surveys)
2.3.4 Trend	0 = stable
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	In the absence of more detailed data, 20 km squares are taken as a proxy of population. The species is considered to be present in 160 20km grid cells.
2.4.2 Date of estimation	June 2007
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	Stable, possibly increasing, but only 4 years of car survey data – not sufficient to estimate trends
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	This species is less adaptable than the common pipistrelle. Its tendency to form large roosts (>2000 animals) in domestic houses can lead to conflict with house owners. 110 – use of pesticides 151 – Removal of hedges & copses 152 – Removal of scrub 790 – other pollution or human impacts / activities (i.e. roost disturbance in domestic dwellings)
2.4.11 Threats	As 2.4.10
2.5 Habitat for the species	
2.5.2 Area estimation	64000 km^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	N/A
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	64000 km^2
2.7.2 Favourable reference population	160 20km grid cells
2.7.3 Suitable Habitat for the species	64000 km^2
2.7.4 Other relevant information -	see background doc.
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 CS1	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

Pipistrellus pygmaeus

5009

- Current Distribution (97 cells)
- Current Range (160 cells)
- Favourable Reference Range (160 cells)
- W48 20km grid cells

Date: October 2007

Background to the conservation assessment for the Mountain Hare *Lepus timidus (hibernicus)*

1. Introduction

In Ireland, *Lepus timidus* occurs as a distinct, endemic sub-species, *Lepus timidus hibernicus*, the Irish hare. *Lepus timidus* is widely distributed across northern Europe and Asia, ranging from Ireland in the west to Japan in the east.

Recent work indicates that the Irish hare's unique morphology and ecology is the result of genetic adaptation due to the isolation from other *Lepus timidus* populations for at least 35,000 - 57,000 years (Hughes *et al*., 2006). One of the notable differences between the Irish hare and *Lepus timidus* in other regions is that the former does not undergo complete winter whitening.

The Irish hare is the only native lagomorph species in Ireland and while a number of introductions of the brown hare (*Lepus europaeus*) are known from the nineteenth century, this latter species is only currently known from isolated populations in the northern half of Ireland (Fairley, 2001; Sheppard, 2004; Neil Reid, pers. comm). There is no evidence thus far that there is introgression of brown hare DNA into that of the Irish hare (Hughes *et al.*, 2006). Rabbits (*Oryctolagus cuniculus*) are believed to have been introduced to Ireland by the Normans some 800 years ago.

2. Range

A distribution map of Irish hare was published in 1979 (Ní Lamhna, 1979). This showed the species to be widespread throughout Ireland, with records from all counties and some offshore islands. A badger (*Meles meles*) survey carried out between 1989 and 1993 recorded the presence of hares in 503 of the 729 1 km squares surveyed (Smal, 1995). National surveys conducted in 2006 and 2007 also indicate a widespread distribution (N. Reid *et al*., in prep.). The present range [74, 900km^2] is calculated on the basis of the combined data from the badger survey, the recent national surveys and the biology.ie website.

2.1 Trends

As its range implies, the Irish hare is found in many different habitats including farmland and upland habitats such as bog and heath (see 4. Habitat section below for further details). Some of these have contracted, or have been modified, particularly by changes in farming practices, increased urbanisation and industrial development.

Research carried out between 1994 and 1997 that examined the distribution of the Irish hare in Northern Ireland suggested that while it was widely distributed, there was evidence of a reduction in range (Dingerkus & Montgomery, 2002). However, as discussed in the Population section below, due to large multi-annual fluctuations in population size, it is difficult to detect trends. Nonetheless, overall comparisons between the data published by Ní Lamhna and the most recent surveys (2006/07), suggest that while there may be changes at local level, the national range of the hare has remained stable.

2.2 Favourable reference range

The current range, covering almost the entire country, is sufficiently large to allow long term survival of the species. Thus, the favourable reference range is equal to the current range - 74, 900km^2.

3. Population

Population densities for Irish hare are known to be highly variable, both within and between populations. In addition, populations can rapidly increase and decrease in a short space of time.

A review of historical and contemporary hare distribution and abundance records in Northern Ireland suggested a decline in hare numbers (Dingerkus & Montgomery, 2002). Surveys carried out in Northern Ireland in 2004, 2005 and 2006 estimated the population to be 5.1, 3.1 and 2.6 hares / km^2 respectively (Tosh *et al.*, 2006; Hall-Aspland *et al.*, 2006).

The first national hare survey was carried out in Ireland in 2006 and repeated in 2007. (Reid *et al.* in prep.). The estimate produced from the 2007 data – 535,600 – is significantly higher than the 2006 estimate – 232,500 (see Table 1).

Table 1. *Density and abundance estimates for 2006 & 2007 stratified by region. (area of Republic of Ireland = 69,915km^2). From Reid et al. (in prep)*

Region	**2006**		**2007**	
	Mean density (hares/km^2)	**Mean individual abundance**	**Mean density** (hares/km^2)	**Mean individual abundance**
West and north-west	2.62 (1.30-4.67)	59,200 (29,400-105,400)	7.63 (4.58-15.19)	172300 (103,500-342,900)
East	4.20 (2.32-8.20)	96,700 (53,300-188,700)	9.13 (4.66-17.56)	210,100 (107,400-404,100)
South-west	3.16 (1.35-6.78)	76,700 (32,800-16,4500)	6.31 (3.08-11.81)	153200 (74,900-286,800)
Republic of Ireland	**3.33** (1.97-6.21)**	**232,500 (137,800-433,800)**	**7.66** (4.83-14.29)**	**535,600 (338,100-998,400)**

***Overall density significantly different between 2006 and 2007*

Smaller scale studies have revealed that hare populations can vary significantly over time. For example, on a farmland (improved grassland, arable and tillage) site in Co. Wexford, densities ranged between 11.1 and 50.5 hares / km^2 over a 10 year period (1995 to 2005) (R. Jeffrey, unpublished data).

3.1 Trends

As discussed above, and seen from the 2006 / 2007 survey data, Irish hare populations are capable of large and rapid fluctuations. The reasons for such multi-annual fluctuations are poorly understood, but it is important that natural, self-correcting trends can be distinguished from those that require conservation action (Reynolds *et al.,* 2006). More data is required before any underlying trends can be reliably determined.

3.2 Threats/pressures

Local factors likely to negatively influence hare numbers include loss of refuge areas for daytime shelter, such as hedgerows and rushy areas; changes in farming practices, such as the conversion of semi-natural grassland to ryegrass (*Lolium* spp.) dominated pasture or marginal land to forestry; increased urbanisation; hunting. During the coursing season (September to February), 6-7,000 hares are taken from the wild (under license), and run at coursing meetings. They are then returned to their place of capture. Re-release data suggests approximately 90% of hares are returned to the wild after coursing. However, further research is required to establish the reproductive viability of these hares post-coursing and the impact on local population demographics of hare removal and return.

There is a well established population of brown hare (*Lepus europaeus*) in Northern Ireland, but this species was not confirmed from the Republic during the recent survey work. While there is no evidence to suggest that there has been any introgression of brown hare DNA into that of the Irish hare (Hughes *et al.*, 2006), this is considered to be a potential threat.

The following pressures are thought to be important:

101 – modification of cultivation practices
103 – agricultural improvement
243 – trapping, poisoning, poaching
401 – continuous urbanisation
502 – routes / autoroutes

The following threats are also recognised:

101 – modification of cultivation practices
103 – agricultural improvement
141 – abandonment of pastoral systems
243 – trapping, poisoning, poaching
401 – continuous urbanisation
502 – routes / autoroutes
964 – genetic pollution

4. Habitat

The Irish hare occupies the typical *Lepus timidus* habitats such as upland heath and bog, but is also found in agricultural pastoral and arable landscapes and other lowland habitats such as coastal sand dune systems. Highly modified grasslands such as those found on golf courses, airports and even around industrial complexes are also utilised by hares in Ireland. A feature likely to be important in all these habitats is the availability of undisturbed lying-up areas, as well as suitable feeding grounds. Given the broad range of habitats used, the area of habitat is taken, at the 10km level, to equal the extent of occurrence - 74, 900km^2.

Diet in all these habitats tends to be dominated by grass species, but can also include herbs and shrubby species, where they are available..

Fairley (2001) suggests that hares are probably more common on agricultural land that on un-farmed uplands, but only where agricultural management is favourable for their survival. The recent national hare survey (Reid *et al*., in prep) produced density estimates stratified by habitat which show that hares are more abundant in lowland farmland habitat, while upland areas support lower densities of this species (see Table 2).

Table 2. *Density and abundance estimates for 2007 stratified by habitat within the Republic of Ireland. (Area of bog, moor heath & marsh = 12,166km^2, Mixed farmland = 10,876km^2, Pastoral farmland = 37,334km^2 and Other habitats = 9,539km^2). From Reid* et al. *(in prep)*

Habitats	**2007**	
	Mean density (hares/km^2)	**Mean individual abundance**
Bog, moor, heath & marsh	2.89 (1.27-6.53)	35,200 (15400-79500)
Mixed farmland	7.96 (2.96-17.49)	86,600 (32100-190300)
Pastoral farmland	9.18 (5.96-17.11)	342,700 (222,000-641,100)
Other	3.58 (0.00-8.14)	34,100 (0-77,800)
Republic of Ireland (all habitats)	**7.19 (5.46-11.07)**	**498,600 (326,400-966,000)**

4.1 Trends

Irish hares are adapted to live in most terrestrial habitats throughout Ireland and thus could be considered to be fairly immune to habitat change. However, while there is limited information available, changes to habitats where hare densities are highest (i.e. agricultural land), could have large impacts. Habitat management changes include the switch from spring to winter cereals; from hay to silage making; and from low to high livestock densities. Change in land cover between 1990 and 2000 was examined by the CORINE land cover project. In this period, the largest change occurred in the arable land class (including land used for silage production), which increased by 31 %. The largest change in absolute areas of land cover was a reduction in land used as pasture and mixed farmland (www.epa.ie). While these changes may not lead to a reduction in actual extent of habitat available to the hare, they can lead to reduced habitat quality.

Hares do occur in woodland, but this habitat is considered marginal for them. Consequently, the current rate of afforestation (which was running at an average of 12,300ha per year between 1980 and 2005 [Forest Service figures]) and the current afforestation target of c. 20,000ha per year to bring the national forest cover up to 17% by 2030, is a potential cause for concern.

Increased urbanisation, particularly suburban expansion, has reduced the extent of suitable habitats for hare. Furthermore, habitat fragmentation is occurring as a result of the intensive, ongoing road development programme.

Overall, these changes will have reduced the extent and quality of habitat for hares in Ireland, although this is not apparent at the 10km level. Further research is required to determine what impact these changes are having on the hare population.

5. Future prospects

An all Ireland Species Action Plan for the Irish hare was published in November 2005 (Anon, 2005). This identifies actions to be delivered in areas such as policy and legislation, site safeguard and management and research and monitoring. Implementation of the actions identified in ongoing.

The Rural Environment Protection Scheme (REPS) has almost 60,000 participants in Ireland. This scheme requires among other things, the retention of hedgerows as well as areas of un-cultivated land. Such areas are likely to be important for hares. However, continuing intensification of farming, with the use of larger and faster machinery is likely to negatively impact on hare populations as might the increased afforestation.

The hare remains widespread in Ireland and recent survey estimates suggest that the population is healthy. The hare is expected to survive and prosper in Ireland - good prospects.

6. Conclusions

6.1 Range

The current range of the Irish hare is the same as the favourable reference range, with no evidence of recent change. As the range is stable and not smaller than the favourable reference range, it can be considered to be Favourable.

6.2 Population

Hare density varies considerably between years e.g. from 3.33/km^2 in 2006 to 7.66/km^2 in 2007. The factors causing these changes are poorly understood, but may be largely governed by natural processes, which in turn may impact both directly and indirectly on hare numbers. E.g. wet springs can cause increased leveret mortality, but rainfall patterns will also influence agricultural operations which in turn will impact on hare survival. Because of the extent of inter-annual variation, it is not possible to identify a specific favourable reference value for population. Although the hare appears able to respond well to favourable conditions and has shown an ability to produce rapid population growth under such circumstances, more data on population cycles and trends is required for this species. This parameter is considered "unknown" at this stage.

6.3 Habitat

The Irish hare occurs in many habitats throughout Ireland. Data shows that these habitats support hares at different densities. However, changes to habitats and their management where hare densities have the potential to be at their highest (i.e. agricultural land), could have large impacts on populations.

Although there is still sufficient habitat available for the hare, some reduction in the extent and quality of hare habitats has occurred over recent decades. Consequently, this parameter is taken as Unfavourable – inadequate.

6.4 Future prospects

Despite the negative assessment of habitat, the future prospects of the hare in Ireland are considered to be favourable.

6.5 Overall assessment

Unfavourable – inadequate.

7. References

Anon. (2005) *All Ireland Species Action Plans. Irish Lady's-tresses (*Spiranthes romanzoffiana), *Pollan (*Coregonus autumnalis*), Hare (*Lepus timidus hibernicus*), Corncrake (*Crex crex*).* National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin and Environment and Heritage Service, Department of the Environment, Belfast.

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Reynolds, J. C., O'Mahony, D. and Aebischer, N. J. (2006) Implications of "cyclical" population dynamics for the conservation of Irish hares (*Lepus timidus hibernicus*). *Journal of Zoology,* **270**: 408-413.

Sheppard, R. (2004) Brown hares *Lepus europaeus* Pallas in NW Ireland. *Irish Naturalists Journal,* **27 (12)**: 484-485.

Smal, C. (1995) *The badger and habitat survey of Ireland*. The Stationery Office, Dublin.

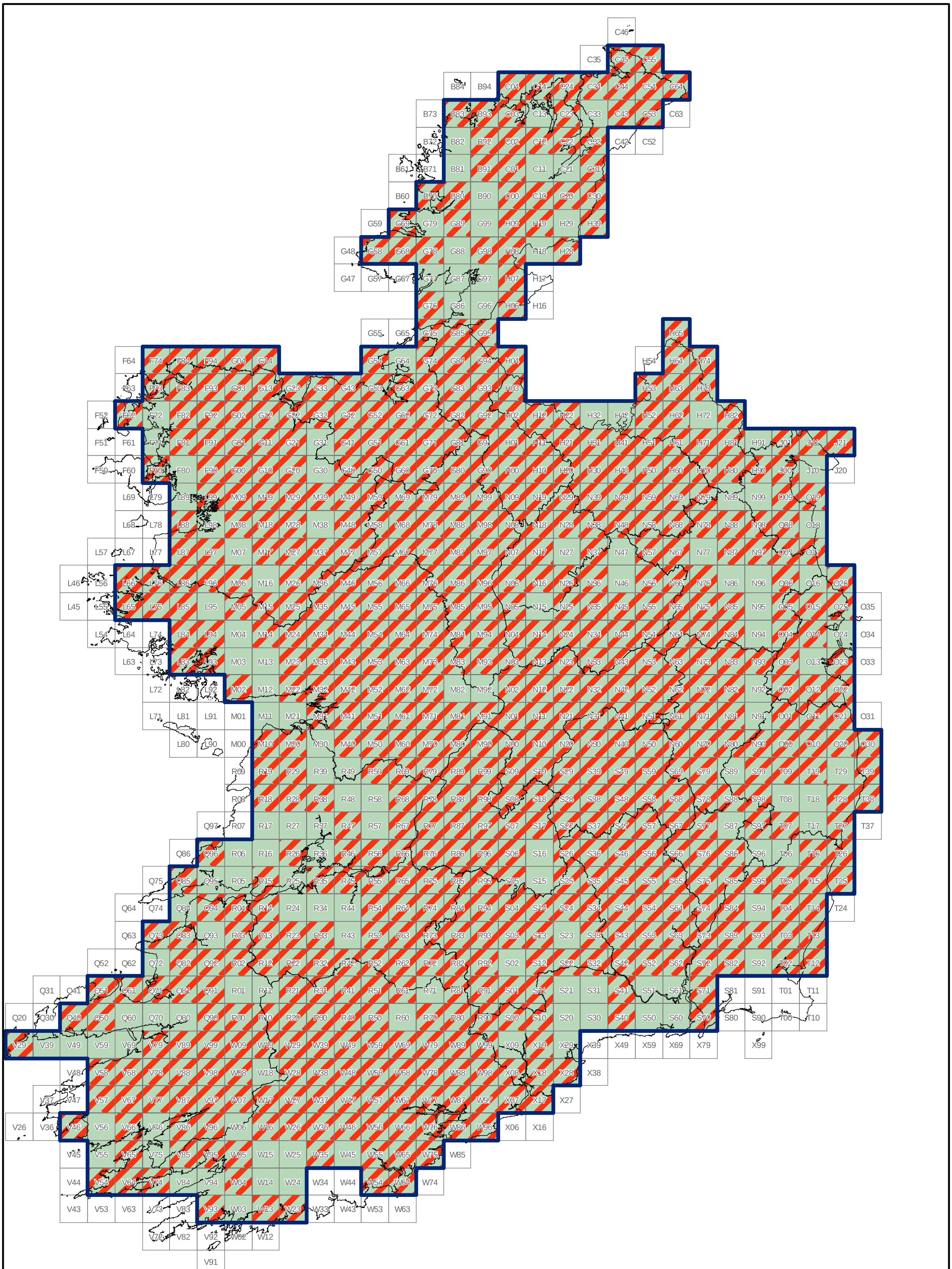
1334 Mountain hare (*Lepus timidus*)

1. National Level	
Species code	1334
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	▪ Dingerkus, S. K. and Montgomery, W. I. (2002) A review of the status and decline in abundance of the Irish hare (*Lepus timidus hibernicus*) in Northern Ireland. *Mammal Review,* 32 (1): 1-11. ▪ Fairley, J. (2001) *A basket of weasels.* Privately published, Belfast. ▪ Hall-Aspland, S., Sweeney, O., Tosh, D., Preston, J., Montgomery, I. and McDonald, R. (2006) *Northern Ireland Irish hare survey 2006*. A report prepared by Quercus for the Environment and Heritage Service, Belfast. ▪ Hughes, M., Montgomery, I. and Prodöhl, P. (2006) *Population genetic structure and systematics of the Irish hare.* A report prepared by Quercus for the Environment and Heritage Service, Belfast. ▪ Ní Lamhna, E. (1979) (ed.) *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland* (2nd edition). An Foras Forbartha, Dublin. ▪ Reid, N., Dingerkus, K., Tosh, T., Paxton, C.G.M., Marques, T.A., Borchers, D.L., Montgomery, W.I., Marnell, F., Jeffrey, R., Lynn, D., Kingston, N. & McDonald, R.A. (in prep) Hare Survey of Ireland 2006/07. *Irish Wildlife Manuals*, No. xx. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland. ▪ Reynolds, J. C., O'Mahony, D. and Aebischer, N. J. (2006) Implications of "cyclical" population dynamics for the conservation of Irish hares (*Lepus timidus hibernicus*). *Journal of Zoology,* 270: 408-413. ▪ Smal, C. (1995) *The badger and habitat survey of Ireland*. The Stationery Office, Dublin.
2.3 Range	
2.3.1 Surface area	74,900km^2
2.3.2 Date	1989-2007
2.3.3 Quality of data	2 = moderate – extrapolated from surveys
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	Pre-1980 (Ni Lamhna) v post 2000
2.3.7 Reasons for reported trend	N/A
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	535,600 [338,100 - 998,400]
2.4.2 Date of estimation	2007
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, but significant inter-annual variation.
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	101 – modification of cultivation practices 103 – agricultural improvement 161 – general forestry management 243 – trapping, poisoning, poaching 401 – continuous urbanisation 502 – routes / autoroutes
2.4.11 Threats	101 – modification of cultivation practices 103 – agricultural improvement 141 – abandonment of pastoral systems 161 – general forestry management 243 – trapping, poisoning, poaching 401 – continuous urbanisation 502 – routes / autoroutes 964 – genetic pollution
2.5 Habitat for the species	
2.5.2 Area estimation	74,900km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Net loss, but extent unknown
2.5.6 Trend-Period	1994-2007
2.5.7 Reasons for reported trend	3 – direct human influence
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	74,900km^2
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	74,900km^2
2.7.4 Other relevant information	
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Unknown (XX)
Habitat for the species	Inadequate (U1)
Future prospects	Favourable (FV)
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

Lepus timidus

1334

- Current Distribution (619 cells)
- Current Range (749 cells)
- Favourable Reference Range (749 cells)
- W48 10km grid cells

Date: October 2007

Background to the conservation assessment for the otter *Lutra lutra*

1. Introduction

The Eurasian otter is widespread throughout all Irish fresh-water and most coastal habitats (Chapman & Chapman, 1981; Lunnon & Reynolds, 1991; Bailey & Rochford, 2006). Dramatic declines occurred in many European otter populations during the latter half of the 20th Century (Macdonald & Mason, 1994) and otters remain threatened, declining, rare, or extinct in many European states. However, in a third of European countries, environmental improvements and focussed conservation efforts have helped to re-establish widespread healthy populations (Conroy & Chanin, 2001).

The otter is an opportunistic predator that exploits prey in proportion to its availability in the environment (Ottino & Giller, 2004). In Ireland, as throughout Europe, diet is predominantly of aquatic origin. In freshwater areas, spraints commonly contain stickleback, salmonids, frogs, and eels (Bailey & Rochford, 2006), while crayfish can be a dominant prey species locally (MacFadden & Fairley, 1983). Terrestrial prey is taken infrequently, with birds occurring in just 3% of spraints, and mammals occurring even more rarely (Bailey & Rochford, 2006). Otter diet has not been studied on a national basis for coastal areas, but a survey on Inis Mór found that rockling and wrasse dominated the diet, while eel, sea scorpion, blenny and molluscs were also important (Kingston *et al*., 1999).

In the Irish Red Data book the otter is listed as internationally important (Whilde, 1993). The Eurasian otter is classified as 'near threatened' by the IUCN (2006) and is listed as a strictly protected species under Appendix II of the Bern convention (Council of Europe, 1979). Because it is listed in Appendix 1 of CITES (1979), trade in otter is only permitted in exceptional circumstances.

The otter has been protected in Ireland since 1976 (Wildlife Act 1976), although licenses to hunt otters were issued under this Act until the 1990s. The Wildlife Amendment Act (2000) removed the hunting clause entirely and it is now illegal to hunt, disturb, or intentionally kill otters.

2. Range

Three national surveys of otters have been conducted in Ireland. The first national otter survey found signs of otters throughout the country, at 88% of 2,042 sites (Chapman & Chapman, 1982). A smaller follow-up survey of 246 sites carried out a decade later found that otters were still countrywide although a highly significant 13% decrease in otter presence was recorded (Lunnon & Reynolds, 1991). The most recent otter survey, carried out 14 years later, searched 525 sites and found that otter presence had declined by a further 5% to just over 70%, but that the species was still present throughout the country (Bailey & Rochford, 2006). The current range has been calculated as 66,500 km² from 2004-2007 distribution records held by NPWS. The majority of these records come from the NPWS survey of 2004/05; additional records come from Lughaidh O'Neill (TCD) and NPWS staff. Expert opinion has been used to fill in some blank squares in the midlands as these areas were not covered in the 2004/05 survey, but otters are known to occur there.

2.1 Trends in range and favourable reference range

Despite the decline in status from 88% in 1980/81 to 70% at present, the otter remains widespread throughout the country with no apparent reduction in range. The current range is therefore take to be the favourable reference range - 66,500 km² .

3. Habitat

Habitat is discussed here before population, as the habitat data was used to calculate population. Habitat was estimated on the basis of four classes of water bodies: rivers, streams, lakes and coast (high water mark).

<u>Rivers</u> are measured as the length of the midline. However, because otters have been observed not to forage beyond 80m from the coast, rivers greater than 80m wide are considered as comprising two separate strips of otter habitat and both banks are measured rather than one. The average width of rivers (as presented in the vector OSI data) was calculated by combining the ground-truth data gathered by Chapman & Chapman (1982) and Bailey & Rochford (2006). In addition to the width of the rivers, a 10m riparian buffer (both banks) was considered to comprise part of the otter habitat.

Manipulation of the data set: Manually eliminated one bank where watercourse width was less than 80m.

<u>Streams</u> are measured as the length of the midline. The average width of streams (as presented in the vector OSI data) was calculated by combining the ground-truth data gathered by Chapman & Chapman (1982) and Bailey & Rochford (2006). In addition to the width of the streams, a 10m riparian buffer (both banks) was considered to comprise part of the otter habitat.

Manipulation of the data set: none

<u>Lakes</u> and <u>coast</u> are measured as the length of a single shore where less than 80m wide, and both shores where greater than 80m wide. Any shore within 80m of another shore gives access to the same foraging habitat and should not therefore be counted twice. The width of lake and coast habitat was estimated to be an 80m strip of water from the length of shore calculated above. In addition to this 80m strip of water for lakes and coast, a 10m terrestrial buffer was considered to comprise part of the otter habitat.

Manipulation of the data set: Lakes layer buffered on inside by 40m, (by buffering both sides by 40m then intersecting with original lakes layer). Lakes length is = perimeter / 2

HWM layer buffered by 40m. HWM length = number of sections *((total perimeter/2)-buffer width)

Results

The ground-truth data gathered by Chapman & Chapman (1982) and Bailey & Rochford (2006) divided river width into the following classes; <2m, 2-5m, 5-10m, 10-20m, >20m. Using the following mid range values; 1m, 4m, 8m, 15.5m, 30m[1], the average width of river features comes out as 12.9m (n = 893), and the average width of stream features comes out as 4.2m (n = 955). The total habitat may thereby be calculated by simple multiplication of the lengths of various habitats available (table 1).

Table 1 – the total length and area of otter habitat present in the Republic of Ireland.

	Total rivers	Total Streams	Total Coast	Total Lake
Width of water body (m)	12.9	4.2	80.0	80.0
Width of habitat (m)	32.9	24.2	90.0	90.0
Length of habitat (km)	13326.1	64458.1	8107.6	4298.9
Habitat areas (Sq. km)	439.0	1560	729.7	386.9
Total habitat size (Sq. km)	**3115.4**			

Table 2 – the total length and area of otter habitat protected within candidate SACs selected for otter in the Republic of Ireland.

	Total rivers	Total Streams	Total Coast	Total Lake
Length of habitat (km)	3344.0	5025.0	4493.0	837.0
Width of water body (m)	12.9	4.2	80.0	80.0
Width of habitat (m)	32.9	24.2	90.0	90.0
Habitat areas (Sq. km)	110.151	121.605	404	75.33
Total habitat size (Sq. km)	**711.086**			

3.1 Habitat trends and favourable reference value

While there has been some localised reduction in otter habitat quality, due mainly to water pollution and clearance of riparian vegetation, this has been balanced to some extent by the reduced occurence of severe water pollution episodes (e.g. those causing fish kills) and the abandonment of pastoral systems which has led to increased scrubby vegetation and reduced disturbance of river corridors. The area of suitable habitat available at present (3115 km^2) is considered favourable for the long term viability of the otter in Ireland.

4. Population

The otter population in Ireland is estimated to be in the region of 6,416 female animals (not including juveniles), with an upper confidence level of 9,724 and a lower confidence level of 4,537. Females are used here because of their tendency to maintain stable home ranges.

[1] a conservative estimate based on the midpoint of the next logical division 20-40m.

These population estimates were calcluated (by Lughaidh O'Neill, TCD) from average females home ranges derived from the following:

- Observations of seven adult females in mesotrophic Irish rivers (>4mg orthophosphate per l), showed females occupying exclusive home-ranges averaging 7.5 ± 1.5 km that were inversely related to river width ($R^2_{adj} = 0.68$, $F_6 = 13.5$, $P = 0.014$). The relationship was approximated by the equation [*(home range length) = 40.42/(river-width) + 5.284*] (L. Ó Néill unpublished data).
- Observations of ten female otters on oligotrophic rivers (<2mg orthophosphate per l) in Scotland showed no relationship between home-ranges and river width, with home-ranges averaging 18.7±3.5km (Kruuk, 2006).
- Observations of 10 coastal otters on Shetland found that adult females occupied group ranges at densities of 2.6±0.9 km/individual (Kruuk and Moorhouse, 1991).

To account for the lack of data for watercourses with orthophosphate levels between 2 and 4mg per l, L. O'Neill calculated the fitted line as the average intercept and slopes for more and less productive rivers. Note that the oligotrophic group showed no relationship with river width so they had a slope of 0 and an intercept of 18.6. The confidence intervals for spatial requirements of otters in this intermediate class of river were taken to be the most extreme limits for the other two groups.

Based on interpolation of the EPA point data for orthophosphate levels, each section of river within the contours of a particular orthophosphate level was assigned that orthophosphate value. The length of each water course type (oligotrophic river, meso-oligotrophic river, mesotrophic river, oligotrophic stream etc.) within each river basin district was converted into a number of otters by dividing it by the spatial requirements of female otters in that habitat. For otters in rivers the appropriate spatial requirements was for watercourses 12.9m wide, for streams 4.2m wide, for lakes 80m wide (see Habitat above).

4.1 Population trends

Between the first national survey in 1980/81 and the most recent survey in 2004/05, a net population loss of 23.7% (- 0.98% p.a.) has been estimated, with the majority of this decline occuring in the first ten years.

It is assumed that the decline in status between the first survey (Chapman & Chapman, 1982) and more recent surveys is a result of population decline. To calculate the decline in the otters population since the original otter survey, the proportional change in status[2] within each river basin district was recorded for the 1991 survey (Lunnon & Reynolds, 1991) and the 2006 survey (Bailey & Rochford, 2006). Then the otter population calculated above was multiplied by the change in status. Upper CI for status was multiplied by upper CI for population estimators etc.

[2] It is unlikely that any survey will ever find 100% regardless of the status of otters. Hence, it makes more sense to look at trends using 1982 as the reference. A drop from 88% in the reference survey (1982) to 70% in the latest survey therefore equates to a 20.5% decline (rather than 18%).

The change in status within each river basin district and nationally is presented in Fig 1.

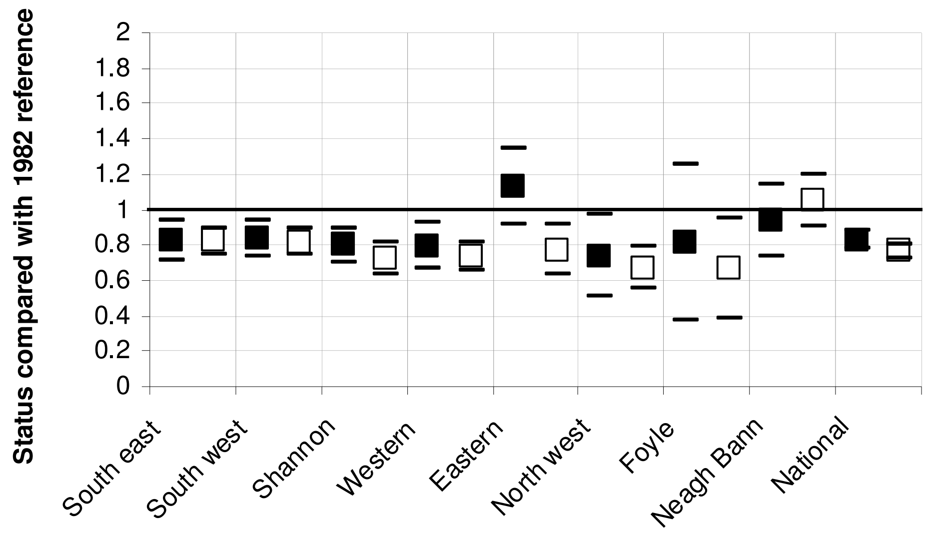


Fig. 1 – Status of the otter within each river basin district and nationally as recorded in 1992 (Lunnon – filled symbols) and 2006 (Bailey – open symbols) by comparison with the 1982 result (Chapman – '1' line).

Note that the Bailey & Rochford (2006) survey shows a 20% decline even for the upper confidence limit for the national situation. For the observed population result this decline is as high as 23.6%. The Shannon, Western, and North Western river basin districts show the greatest declines (according to the upper confidence intervals). How these declines in status are likely to effect population sizes is shown in Fig. 2 and Table 3.

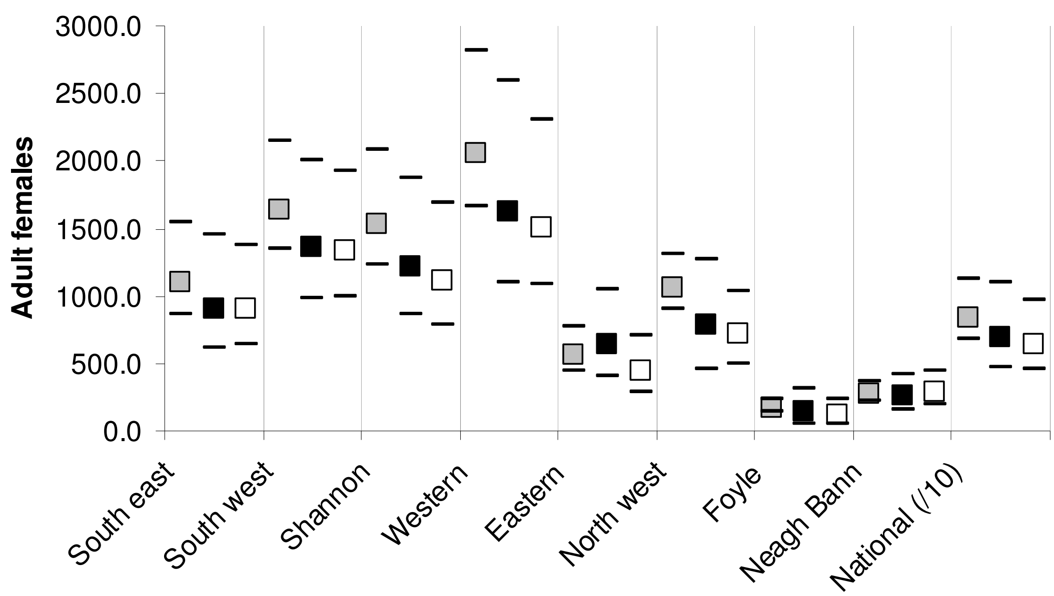


Fig. 2 – Changes in the estimated otter population taking into account changes in status as recorded by the national otter surveys. Chapman & Chapman (1982) – Grey; Lunnon & Reynolds (1992) – Black; Bailey & Rochford (2006) – White.

Table 3 – Population estimates of adult females based on the status recorded in 1982, 1992 and 2006.

	CHAPMAN			LUNNON			BAILEY		
	estimate	LCL	UCL	estimate	LCL	UCL	Estimate	LCL	UCL
South east	1096.5	860.4	1547.4	909.4	616.8	1457.3	899.3	643.3	1381.2
South west	1637.4	1347.7	2143.1	1365.6	987.7	2004.1	1340.9	998.8	1921.9
Shannon	1534.1	1230.3	2087.8	1224.1	859.7	1872.9	1108.1	779.5	1693.2
Western	2051.2	1657.5	2818.1	1628.9	1105.9	2595.5	1507.1	1081.7	2302.0
Eastern	568.7	445.7	776.3	641.6	406.9	1042.9	439.9	283.0	708.2
North west	1063.9	908.0	1309.0	785.8	461.7	1268.2	714.1	498.7	1038.3
Foyle	181.4	144.2	254.5	147.8	54.1	319.3	120.9	56.0	240.6
Neagh Bann	272.6	216.7	367.7	257.0	160.3	421.6	285.5	195.4	438.9
National	**8405.8**	6810.5	11304.0	**6960.2**	4653.1	10981.8	**6416.1**	4536.5	9724.3

5.1 *Favourable reference population*

The current population estimate (6416) is 7.8% below the 1991 population estimate and 23.6 % below the 1982 figure. However, despite these decreases it would appear that the otter population in Ireland remains healthy; population modelling for the south-eastern river basin district has shown that even the present otter population in that area is sufficent to maintain the otter within that district for up to 100 years, assuming that there is no futher decline in status (O'Neill, unpublished data). Similar modelling has yet to be done, however, for the other river basin districts.

The Habitats Directive requires that the favourable reference population be no lower than the population in 1994. However, given the significant decrease in status before 1994 and the extensieve network of SACs now designated for the otter, it has been decided that a more optimistic target is justified and can be achieved. Consequently, the target for the otter population is to return all SACs to the status that was recorded within the Chapman & Chapman (1982) survey, while simultaneously ensuring that no further loss of status occurs outside SACs.

Table 4 – Population estimates of adult females within otter SACs based on the status recorded in 1982, 1992, and 2006.

	CHAPMAN			LUNNON			BAILEY		
	estimate	LCL	UCL	estimate	LCL	UCL	estimate	LCL	UCL
South east	244.1	192.9	299.2	202.4	138.3	281.7	200.2	144.3	267.0
South west	398.9	328.2	511.4	332.7	240.5	478.2	326.6	243.2	458.6
Shannon	370.8	300.5	484.2	295.8	210.0	434.3	267.8	190.4	392.6
Western	583.1	479.1	764.2	463.1	319.7	703.9	428.5	312.7	624.3
Eastern	45.4	36.4	56.6	51.2	33.3	76.1	35.1	23.1	51.7
North west	734.5	608.0	936.5	542.5	309.2	907.3	493.0	334.0	742.8
Foyle	12.2	7.8	31.6	9.9	2.9	39.7	8.1	3.0	29.9
Neagh Bann	0.0	0.0	7.4	0.0	0.0	8.5	0.0	0.0	8.8
National	**2389**	1952.9	3091.1	**1897.6**	1253.9	2929.7	**1759.3**	1250.7	2575.7

Table 5 – Target future population of female otters based on all SACs returning to the status observed in the reference survey (1982) while the rest of the habitat remains at the current status.

	estimate	LCL	UCL
Current population	6416.1	4536.5	9724.3
Predicted increase if SACs return to 1982 status	629.7	702.2	515.4
Target population	7046	5239	10240

The favourable reference population is therefore set at 7046 female otters, a 10.2% increase on the present level.

6. Threat and pressures

Otters are subject to pressures in both the terrestrial and the aquatic (freshwater and marine) environments. Impacts that reduce the availability or quality of, or cause disturbance to, these habitats are likely to affect otters. These factors may act directly (e.g. through road kills or the removal of holt sites) or indirectly (e.g. by reducing prey availability).

The following impacts are considered relevant:

110 Use of pesticides
120 Fertilisation
151 removal of hedges and copses
152 removal of scrub
168 felling of native or mixed woodland
210 Professional fishing (including loster pots and fyke nets)
230 Hunting
243 trapping, poisoning, poaching
300 Sand and gravel extraction
312 mechanical removal of peat
400 Urbanised areas, human habitation
401 continuous urbanisation
410 Industrial or commercial areas
420 Discharges
421 disposal of household waste
422 disposal of industrial waste
423 disposal of inert materials
424 other discharges
502 routes, autoroutes
507 bridge, viaduct
701 water pollution
709 other forms or mixed forms of pollution
803 infilling of ditches, dykes, ponds, pools, marshes or pits

810 Drainage
811 management of aquatic and bank vegetation for drainage purposes
820 Removal of sediments (mud ...)
830 Canalisation
852 modifying structures of inland water course

Overall, these can all be classed as both past pressures and future threats. While some of these impacts are declining, with future prospects in some cases looking bright (pollution etc.) they are still likely to continue to pose localised or occasional threats. New autoroutes and bridges are probably not a significant threat (because of modern mitigation requirements), however existing roads will continue to threaten otter populations (or at least cause deaths) (L.Ó Neill pers. comm.).

It can be difficult to identify the cause of death of an otter, although the number of otters reported dead from "unknown" causes is surprisingly low (Reuther, 2002). Explaining the absence of otters from certain sites can also pose difficulties. A number of reviews of otter mortality have been carried out in Ireland: O'Sullivan & Fitzgerald (1995) reported, for a period between 1982 and 1992, a total of 628 otters found dead in Ireland. The vast majority of recorded otter deaths were caused by road traffic accidents with a further 14% killed by fishing gear. Poole *et al.* (2007) examined otter mortality in fyke nets specifically, but also concluded that roadkill was probably the most signficant cause of direct mortality in this country. There is likely to be some bias in both of these datasets, however, as road kills are relatively visible whereas it is likely that fishermen fail to report all otters found dead in fishing gear (Reuther, 2002). Nonetheless, a roadkill website was established in January 2007 to track the geographical and seasonal mortality of otters on Irish roads (see: www.biology.ie). O'Sullivan (1996) quoted eight major and 16 specific threats to otters from data collated for 29 European countries (Table 6).

Table 6. The major and specific threats (percentage of times listed) to otters in 29 European countries/regions, ranging from Ireland to Siberia (from O'Sullivan (1996)).

Major threats	%	Specific threats/areas of conflict	%
Habitat destruction	28	River/wetland drainage	17
Water pollution	25	Sand/gravel abstraction	3
Mortalities/illegal killings	19	Water abstraction	1
Recreation/disturbances	13	Urbanisation	5
Hydroelectric schemes	5	Organic pollution	14
Aquaculture/fisheries	5	Industrial pollution	14
Oil spillages	1	Acidification/forestry	3
American mink	1	Poisonous marine algae	1
		Aquaculture/fisheries	8
		Fyke nets/fish traps	7
		Mammal traps	5
		Hunting/killing	8
		Road traffic	9
		Angling	2
		Boating	1
		Tourism	2

(Data source: modified from Foster-Turley *et al.* (1990). The criteria used to classify threats are not necessarily mutually exclusive.)

Licenses to hunt otters were issued under the 1976 Wildlife Act until the early 1990s. No further license were issued after then and the Wildlife Amendment Act (2000) removed the otter hunting clause entirely. However, there are some concerns that where mink hunting (which is not regulated) takes place along water courses this may be indirectly or directly threatening otter populations (L. Ó Neill, pers. comm.). Also while trapping (for fur) is certainly a past threat, 'vermin control' continues and some accidental or even deliberate bi-catch of otter is possible.

7. Future Prospects

Although otter range has remained stable in Ireland, the results of the national surveys suggest that otter densities have declined since 1980. Most of this decline seems to have taken place in the 1980s, when levels of severe water pollution were at their worst, with a significantly lower rate of decline in the 15 year period between 1990 and 2005. Despite these declines, population modelling for the south-eastern river basin district has shown that even the present otter population in that area is sufficent to maintain the otter within that district for up to 100 years, assuming that there is no futher decline in status (O'Neill, unpublished data).

A number of significant steps have been take in recent years to secure the long term future of the otter in Ireland: 44 SACs have been designated for the otter. Most of these are large sites incorporating extensive river/lake or coastal systems. The National Roads Authority have prepared strict guidance for the protection of otters during the planning and construction of national roads. NPWS has drafted a Species Action Plan for the otter which will be published later this year following a period of public consultation. Furthermore, under the Water Framework Directive, water quality is expected to improve.

In England, Scotland and Wales, the otter is showing strong recovery from previous low levels. Although the Irish population (North and South) has bucked this trend, population densities here remain among the highest in Europe. It is also clear from the experience in Britain that when water quality and terrestrial habitat needs are met, this species is capable of strong and sustained population expansion.

8. Complementary information

8.1 Favourable reference range

Despite the decline in status from 1980/81 to the present, the otter remains widespread throughout the country with no apparent reduction in range. The current range is therefore taken to be the favourable reference range - 66,500 km^2.

8.2 Favourable reference population

The target for the otter population is to return all SACs to the status that was recorded within the Chapman & Chapman (1982) survey, without any further loss of status outside SACs. The favourable reference population is therefore calculated 7046 female otters, a 10.2% increase on the present level.

8.3 Suitable habitat

The area of suitable habitat available at present (3115 km^2) is considered favourable for the long term viability of the otter in Ireland.

9. Conclusions

8.1 Range

As range is stable and not smaller than the favourable reference range, this parameter is considered to be Favourable.

8.2 Population

The population has declined 23.6% in the last 24 years and is 10.2% below the favourable reference population. This parameter is considered to be Unfavourable - Inadequate.

8.3 Habitat

The area of suitable habitat available at present (3115 km^2) is considered sufficient in extent and quality for the long term viability of the otter in Ireland. This parameter is considered Favourable.

8.4 Future prospects

Otters are expected to persist and thrive in Ireland for the long term. Otter status is expected to improve again in the coming decades, returning to previously high levels within the extensive SAC network designated for the species. This parameter is considered Favourable.

8.5 Overall assessment

Amber : Unfavourable - Inadequate

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1355 Otter (*Lutra lutra*)

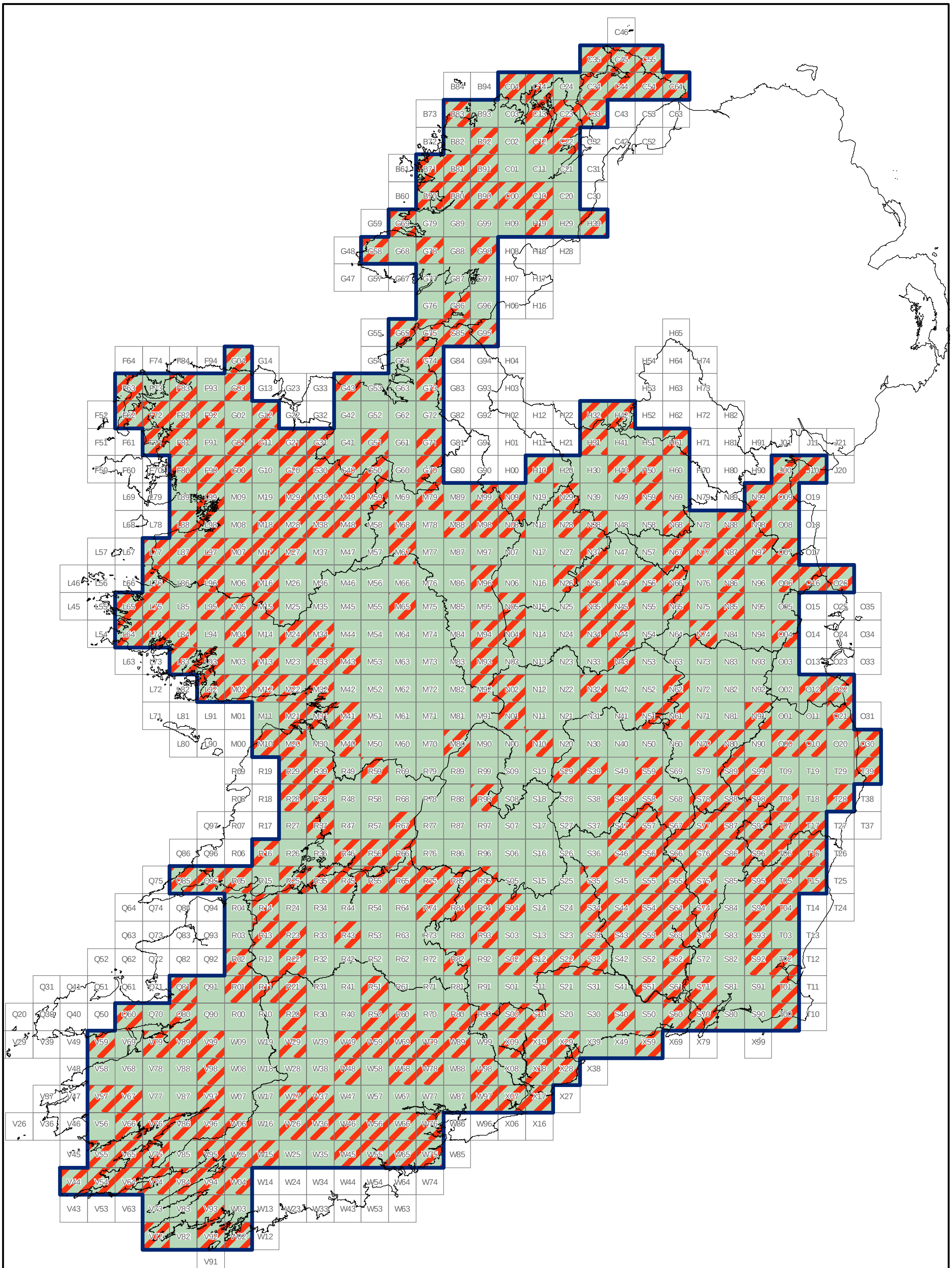
1. National Level	
Species code	1355
Member State	IE
Biogeographic regions concerned within the MS	Atlantic (ATL)

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	Atlantic (ATL)
2.2 Published sources	▪ Bailey, M. & Rochford, J. (2006) Otter survey of Ireland 2004/2005. *Irish Wildlife Manuals* No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government. ▪ Chapman, P.J. & Chapman, L.L. (1982) *Otter survey of Ireland*. The Vincent Wildlife Trust, London. ▪ Kruuk, H. (2006) *Otters – ecology, behaviour, and conservation*. Oxford University Press, Oxford. ▪ Kruuk, H. & Moorhouse, A. (1991) The spatial organization of otters (*Lutra lutra*) in Shetland. *Journal of Zoology*, London 224: 41-57. ▪ Lunnon, R. & Reynolds, J. (1991) *Report on the national otter survey of Ireland 1990-91.* Unpublished report to the Wildlife Branch, OPW, Dubiln.
2.3 Range	
2.3.1 Surface area	66,500 km²
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	1982 to 2007
2.3.7 Reasons for reported trend	N/a
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	6,416 adult females (lower confidence limit: 4,536; upper confidence limit: 9,724)
2.4.2 Date of estimation	June 2007
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	- 0.98% p.a. = net loss by 23.7% 1982 estimate: 8,405 (6810 – 11,304)
2.4.7 Trend-Period	1982-2006
2.4.8 Reasons for reported trend	Assumed main reasons for change of populations where known 3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence
2.4.9 Justification of % thresholds for trends	

2.4.10 Main pressures	110 Use of pesticides 120 Fertilisation 151 removal of hedges and copses 152 removal of scrub 168 felling of native or mixed woodland 210 Professional fishing 230 Hunting 243 trapping, poisoning, poaching 300 Sand and gravel extraction 302 removal of beach materials 310 Peat Extraction 312 mechanical removal of peat 400 Urbanised areas, human habitation 401 continuous urbanisation 410 Industrial or commercial areas 420 Discharges 421 disposal of household waste 422 disposal of industrial waste 423 disposal of inert materials 424 other discharges 502 routes, autoroutes 507 bridge, viaduct 700 Pollution 701 water pollution 709 other forms or mixed forms of pollution 803 infilling of ditches, dykes, ponds, pools, marshes or pits 810 Drainage 811 management of aquatic and bank vegetation for drainage purposes 820 Removal of sediments (mud ...) 830 Canalisation 852 modifying structures of inland water course
2.4.11 Threats	110 Use of pesticides 120 Fertilisation 151 removal of hedges and copses 152 removal of scrub 168 felling of native or mixed woodland 210 Professional fishing 230 Hunting 243 trapping, poisoning, poaching 300 Sand and gravel extraction 302 removal of beach materials 310 Peat Extraction 312 mechanical removal of peat 400 Urbanised areas, human habitation 401 continuous urbanisation 410 Industrial or commercial areas 420 Discharges 421 disposal of household waste 422 disposal of industrial waste 423 disposal of inert materials 424 other discharges 502 routes, autoroutes 507 bridge, viaduct 700 Pollution 701 water pollution 709 other forms or mixed forms of pollution 803 infilling of ditches, dykes, ponds, pools, marshes or pits 810 Drainage 811 management of aquatic and bank vegetation for drainage purposes 820 Removal of sediments (mud ...) 830 Canalisation 852 modifying structures of inland water course
2.5 Habitat for the species	

2.5.2 Area estimation	3115.4 km²
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	1982 - 2006
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	66,500 km²
2.7.2 Favourable reference population	7046
2.7.3 Suitable Habitat for the species	3115.4 km²
2.7.4 Other relevant information	The majority of the distribution records come from the NPWS survey of 2004/05; additional records come from Lughaidh O'Neill (TCD) and NPWS staff. Expert opinion has been used to fill in some blank squares in the midlands as these areas were not covered in the 2004/05 survey, but otters are known to occur there
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Inadequate (U1)
Habitat for the species	Favourable (FV)
Future prospects	Favourable (FV)
Overall assessment of CS	Inadequate (U1)



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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Lutra lutra

1355

Current Distribution (358 cells)
Current Range (665 cells)
Favourable Reference Range (665 cells)
W48 10km grid cells

Date: December 2007

Background to the conservation assessment for the pine marten, *Martes martes*

1. Introduction

The pine marten (*Martes martes*) is a medium sized arboreal carnivore, typically inhabiting forested ecosystems or landscapes within which woodland or scrub habitats constitute a substantial proportion. The pine marten is a protected species under Appendix III of the 1979 Bern Convention on the Conservation of European Wildlife and Natural Habitats. It is also included in Annex V of the European Community's Habitats Directive of 1992. In the Republic of Ireland it is protected under the Wildlife Acts (1976 & 2000) and according to the Irish Red Data Book, the pine marten population in Ireland is internationally important (Whilde 1993).

Until recently, there has only been one systematic attempt to investigate the distribution and status of the species in Ireland. This was undertaken by O`Sullivan (1983) who sampled 428 10km National Grid plots between 1978 and 1980. Only 79 (just under 23%) of these grids were positive for pine marten presence, which supports the statement of Fairley (2001) that the species is the rarest of all Irish mammals. O`Sullivan (1983) emphasised 3 important points concerning the distribution of pine martens in the Republic of Ireland:

i) Their range and distribution had undergone a major reduction.
ii) Pine martens were absent from regions where historical records indicated they were formerly present.
iii) The population was concentrated in woodland areas in the mid western region of the country and this constituted a stronghold for the species.

2. Range

2.1 Historical: 1870 – 1975

The pine marten is widespread in forests throughout Europe. It was formerly widespread in Ireland but suffered serious decline in the 17th century with the deforestation of the country. Pine martens further suffered in the 19th century due to persecution by gamekeepers and trappers; the former considered it vermin and the latter sought their pelts (Hayden & Harrington, 2000). Fairley (2001) attempted to collate data on the range and distribution of pine martens in Ireland prior to the study of O'Sullivan (1983) for the period 1870-1975 by means of a literature search. He found that during the period, records of pine martens were found in 30 counties, the exception being Cavan & Carlow. He broke down the records into 3 distinct periods: (i) 1870-1905, (ii) 1906-1940, and (iii) 1941-1975. His results are summarised in Table 1. Fairley's records combined with O'Sullivan's suggest that from mid 20th century a dramatic decline occurred in the distribution of the species.

Table 1. Number of counties in Ireland with historical records of pine marten (from Fairley 2001).

Period	Number of Counties with Pine martens
1870 – 1905	26
1906 – 1940	23
1941 - 1975	19

2.2 *Recent: 1976 - 2007*

O'Mahony *et al*. (2007) recognise 3 principal factors for the increased distribution of pine martens in Ireland in recent years. Firstly, since the 1980s there has been a large increase in the area covered by forestry (see 4. Habitat below for further details). Second, is the legal protection afforded the species in 1976 under the Wildlife Act. Prior to statutory protection, general predator control programs that utilised poisoned baits and snares, and direct persecution of pine martens for their pelts and due to their perceived pest status, contributed to their decline in distribution (O'Sullivan, 1983). The third factor that has influenced the current distribution range is deliberate release into regions where they were historically present but were thought to have been locally extirpated. In particular the population in the south-west, centred on Killarney and Glengarriff, can be largely explained by deliberate releases. Other undocumented translocations of individual animals may also have occured on a local basis.

The National Pine Marten Survey of Ireland 2005/06 (NPMS) (O'Mahony *et al*. 2007) surveyed a random selection of 183 x 10km National Grid squares previously surveyed by O'Sullivan (1983). Of these 52 (28%) were positive and 131 (72%) were negative in the original survey by O'Sullivan. The results of the NPMS indicate that out of the 183 10km National Grids surveyed, 117 (64%) are currently positive for pine marten and 66 (36%) are negative (see Fig 1 below).

Large areas of the country were not surveyed by O'Sullivan (1983) and consequently were not covered by O'Mahony *et al.* (2007). In April 2007, in an attempt to fill some of these distributional gaps, NPWS regional staff were asked to contribute recent additional sightings of pine martens. Recent records were also added from an on-line roadkill website sponsored by NPWS [www.biology.ie]. In total 215 x 10km grid squares now have recent records of pine martens.

Two outlier populations are apparent – one in the south-west, the other in the south. A small scale re-introduction project was carried out in the south-west in the 1990s, with animals released in Killarney National Park and, more recently, in Glengarriff Nature Reserve. However, there is evidence that populations may have persisted naturally in both of these areas from earlier in the century – O'Sullivan (1983) has positive sites from both Kerry and Waterford.

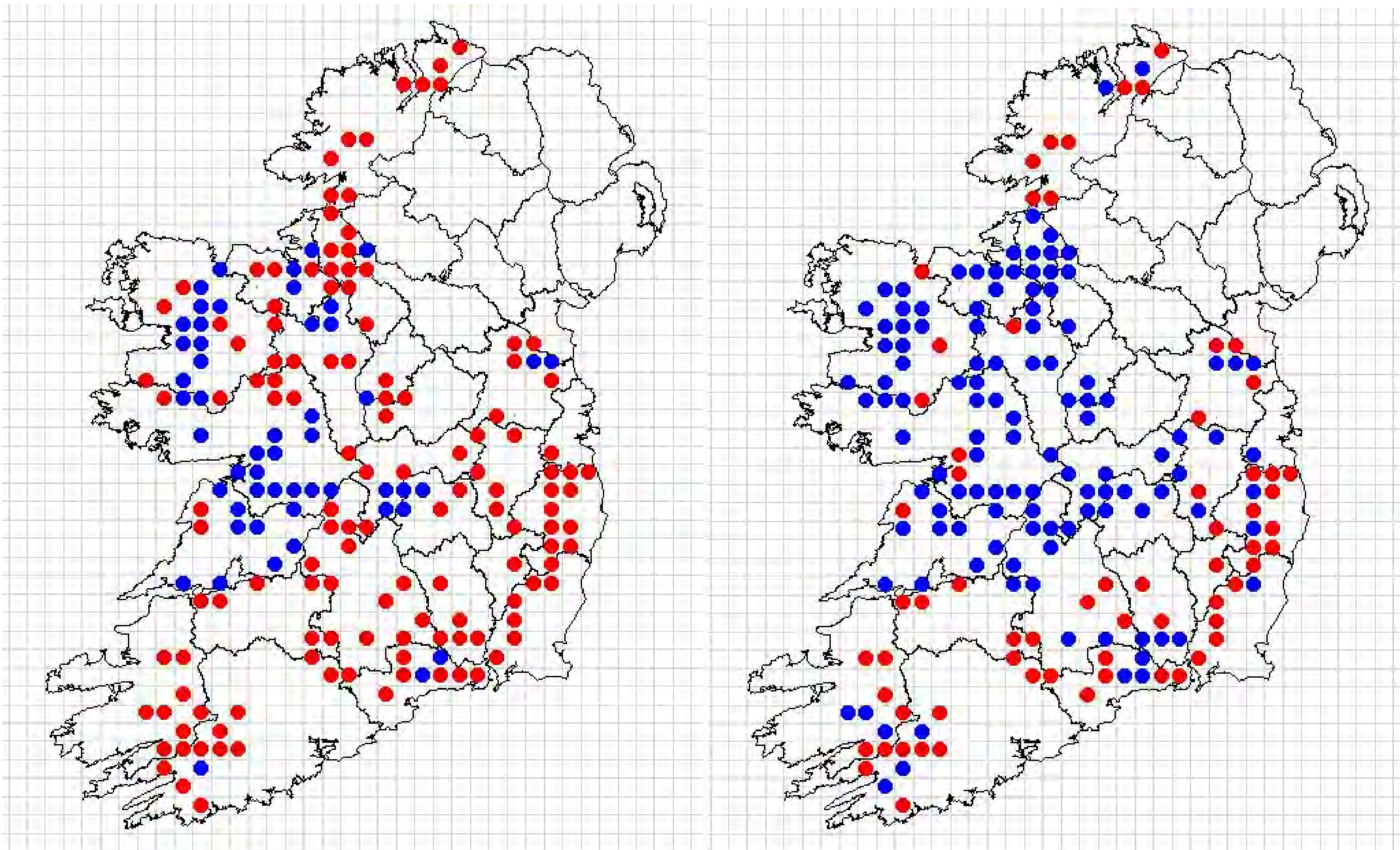
Arising from this distribution data, the range of the pine marten (extent of occurrence) has been calculated as 382 x 10km grid squares - 38,200 km^2.

2.3 Trend

The results of the NPMS show an increase in the number of positive grids from 28% in 1980 to 64% in 2006, an average annual increase of c1.37%.

2.4 Summary

The range of the pine marten is clearly increasing, with consolidation in the west and considerable expansion across the east of the country. The two outlier populations also appear to be expanding. However, there are still some regions where suitable habitat exists and pine martens do not occur. It would appear that the species is in a phase of re-colonisation.



a (1978 – 80)

b (2005-06)

Figure 1. Distribution of pine marten in the Republic of Ireland in (a) 1978-80, and from a re-survey in (b) 2005-06. Data is shown indicating 10km^2 national grid squares where pine marten were present (●) or absent (●). Data from 1978-80 is from O' Sullivan (1983); 2006 data from O'Mahony (2007). Total sample size of 10km^2 national grid squares available for comparison $n = 183$. Changes are statistically significant (McNemar Test; $\chi^2 = 34.3$, df =1, $P<0.001$; corrected for continuity). Source: O'Mahony (2007).

3. Population Abundance

There is currently no data available on the population abundance of pine martens in Ireland. However, a study carried out by Aine Lynch (2006) in part of Killarney National Park did produce rough estimates of pine marten densities for woodlands in that area.

Lynch (2006) used 5 x 2.5km transects in different woods and set out 10 live traps per transect. In total, 21 animals were caught from which she inferred a density of between 0.5 to 2.0 pine martens per km^2. Caution is required when extrapolating such results to other sites or habitats.

Pine marten densitied in other countries are more in line with the lower end of Lynch's scale. Zalewski & Jedrzejewski (2006) estimated the density of pine martens in Bialowieza Forest, Poland, using radio-tracking and live trapping. That study found an estimated density of 0.36 to 0.75 per km^2. The habitat examined in that study was 100% primeval forest and abundances were shown to be positively correlated with the abundance of forest rodents from the previous year. Zalewski & Jedrzejewski (2006) also reviewed pine marten studies from several other countries and found that estimated density ranged from <0.01 to 0.865 individuals per km^2. Density was also shown to vary according to year, activity and season.

Similarly, home range can be highly variable with records from $2km^2$ in Germany to $23.6km^2$ in Scotland (O'Mahony, 2007).

We can get a rough indication of the pine marten population by multiplying the area of suitable habitat within the present range (5,811 km^2 - see below) by the upper and lower density estimates derived from the Lynch study (i.e. 0.5 and 2.0). This gives us a population range of 2,905 – 11,622. Given that newly colonised areas are likely to support lower densities than areas where the animal is well established, the lower end of the range may be nearer the mark.

However, all such figures come with a health warning and before more meaningful numbers can be estimated further research in a number of areas is required, in particular:

i) habitat selection studies including how the species may use open habitat
ii) home range studies
iii) investigations on population demography, productivity, survival etc
iv) examination of mortality through predation, hunting and persecution

Data on roadkill is now being collated on a national level (www.biology.ie). Initial indications are that only small numbers (10s) of pine martens are killed by traffic per annum.

Until more meaningful numbers can be estimated the number of occupied 10km squares can be used as a proxy for population. Latest records (2005-2007) suggest that 215 such squares are occupied. Given recent expansions, this figure is also taken as the favourable reference population.

3.1 Trend

Pine marten population has been increasing in recent decades as evidenced by the range expansion (see above). During this expansion phase, however, it is likely that newly colonised areas support significantly lower densities than areas where the species is long established, so a simple correlation between range expansion and population increase is not valid. In summary, there is an increasing trend but not enough data to determine the rate of population increase.

4. Habitat

The core habitats of the pine marten in Ireland consists of woodland, forest, scrub and transitional vegetation. Table 2 provides an estimate of the extent of these habitats in Ireland in 2005. The habitat available to the pine marten has increased year on year in recent decades. In fact it has almost doubled in less than 30 years. The mean rate of afforestation between 1980 and 2005 was 12,300ha per year. Current government policy includes an afforestation rate of c. 20,000ha per year to bring the national forest cover up to 17% by 2030. This is to be achieved through private operators, and farm forestry is the biggest provider. State afforestation is now almost non-existent. An issue which remains to be clarified is whether or not farm scale, patchy forest networks will be of use to pine martens and help to maintain local breeding populations.

In 2005, however, only 10,000ha of afforestation was achieved, and farm land availability for conversion to forestry is now restricted due to high prices of land and other factors. Considerable state afforestation is required if the 17% target is to be attained; this target is currently under review.

Habitat / Type	**Area (ha)**	**Area (km2)**	**Source**
Coniferous Dominated	549,063	5,490.63	Forest Service
Broadleaved dominated	90,850	908.50	Forest Service
Mixed Forest	28,350	283.50	Forest Service
Other Wooded land	41,000	410.00	Forest Service
Private Woodland (estates etc)	100,000	1,000.00	Forest Service
Scrub / Transitional Vegetation	200,000	2,000.00	(O'Mahony '07)
Total	1,009,263	10,902.63	

Table 2. The extent of the main pine marten habitats in Ireland in 2005.

The pine marten now occurs over approximately 53.3% of the country (38,200km^2 out of 71,728km^2). If we consider that the habitats detailed above occur on a simple porportional basis both inside and outside the pine marten range then we can calculate the area of suitable habitat available to the pine marten within its range thus: 53.3% of 10,902km^2 = 5,811 km^2.

5. Pressures / Threats

- It is unknown how current forest management practices may impact on the species.
- Future afforestation policy is under review and currently requires substantial private planting on farmland. New woodlands are likely to be relatively small and fragmented and it is unsure how pine martens may utilise such habitats.
- In other countries it is suspected that predation by foxes, and to a lesser extent raptors, may influence local populations of pine marten.
- Habitat loss and fragmentation is occurring in some areas, especially of hazel type scrub in the west (Declan O'Mahony pers.comm.).

- It is likely that low level, local persecution is currently occurring particularly in the west (traditional and related to perceived livestock depredations) and also in areas where pine martens may impact on gamebird populations such as pheasants.
- As a result of increasing range of the species there is likely to be increased potential for human-pine marten conflict, especially where game is being reared.
- Pine martens are killed on roads, but the impact of roadkill remains to be quantified.

6. Future prospects

1. Pine marten range is expanding in Ireland, likely to be mediated by:
   - Increased afforestation and habitat connectivity
   - Legal protection leading to reduced direct persecution (i.e. hunting / control) and a decrease in indirect persecution (i.e. the use of poisoned baits)
   - Natural population expansion from historically low level
   - Deliberate releases/translocation

2. The population appears is in a phase of growth and has not reached full carrying capacity in the general environment. O'Mahony (2007) suggests that the population is low, certainly in the more recently colonised areas. It is hypothesised that the 'source and sink' paradigm is very relevant to pine martens in Ireland as the species inhabits a highly fragmented environment and dispersal ability, in open habitats especially, is unknown. It is suggested that larger contiguous forest blocks in core pine marten areas are 'source' populations where population growth or stability occurs, and areas outside of these are 'sink' where mortality exceeds local production and immigration from source habitats is required to maintain numbers.

3. Potential pine marten habitat (i.e. woodland) has roughly doubled since the 1980s and the NPMS indicates that pine martens are found in a variety of habitats, including exclusively coniferous forests that were often isolated (O'Mahony, 2007). Afforestation continues, but it remains to be seen whether the current ambitious planting targets will be met. Further work is also required to determine whether changing patterns of planting, with fewer substantial new forests and more low acreage plots, will be as suitable for pine martens.

There is evidence that the population of this species can be significantly affected by human control and habitat alteration. As pine marten range increases the species will come into more conflict with landowners through suspected livestock depredations and game killing which is likely to result in local population control, even though that is currently illegal.

Overall the future prospects for this species are considered to be good.

7. Complementary information

7.1 Favourable reference range

Range has increased since the 1980s by over 100%. Favourable reference range is taken to be the present range – 38,200km^2.

7.2 Favourable reference population

Population is probably on the increase, given the range expansion. Although there is insufficient data available to produce reliable population estimates, the work by Lynch (2006) suggests that normal densities are likely to vary between 0.5 and 2.0 animals per km^2. This would translate into a national estimate of 2,905 – 11,622 animals. Given that recently colonised areas can be expected to have lower densities and that some peripheral records are likely to be of vagrant or one off animals, then a national figure at the lower end of the scale can be expected.

Further work is required to allow a meaningful figure to be developed, based on the carrying capacity of various habitat types in Ireland. In the meantime the number of occupied 10km squares can be used as a proxy for population. Latest records (2005-2007) suggest that 215 such squares are occupied. Given recent expansions, this figure is also taken as the favourable reference population.

7.3 Suitable habitat for the species

Woodland as a primary habitat for pine martens has increased substantially over the last 20 years with government policy to further increase it to 17% of the land area by 2030. The present area of habitat [5,811 km^2] is also taken as the favourable reference area.

7.4 Future Prospects

Given the increasing trends in range, habitat and population, and the likelihood of further increases as more suitable habitat becomes available, and notwithstanding the potential risks from increased persecution, the prospects for the pine marten in Ireland are considered to be good.

8. General Evaluation Matrix for Conservation Status for Pine Martens in Ireland

Range	Favourable (FV)
Population	Favourable (FV)
Habitat	Favourable (FV)
Future Prospects	Favourable (FV)
Overall CS Assessment	Favourable (FV)

References

Fairley, J. (2001) *A basket of weasels*. Privately published. Belfast, Northern Ireland.

Lynch, A.B., Brown, M.J.F. & Rochford, J.M. (2006) Fur snagging as a method of evaluating the presence and abundance of a small carnivore, the pine marten (Martes martes). *J. Zoology* **270**: 330-339.

O'Mahony, D., O'Reilly, C. & Turner, P. (2007) *National pine marten survey of Ireland: an assessment of the current distribution of pine marten in the Republic of Ireland.* Unpublished report to the Forest Service and National Parks & Wildlife Service.

O'Sullivan, P. (1983) Distribution of the pine marten in the Republic of Ireland. *Mammal Review* **13**: 39-44

Zalewski, A. & Jedrzejewski, W. (2006) Spatial organisation and dynamics of the pine marten Martes martes population in Bialowieza Forest (E. Poland) compared with other European woodlands. *Ecography* **29**: 31-43.

Whilde, A. (1993) *Irish red data book 2: vertebrates*. HMSO, Belfast.

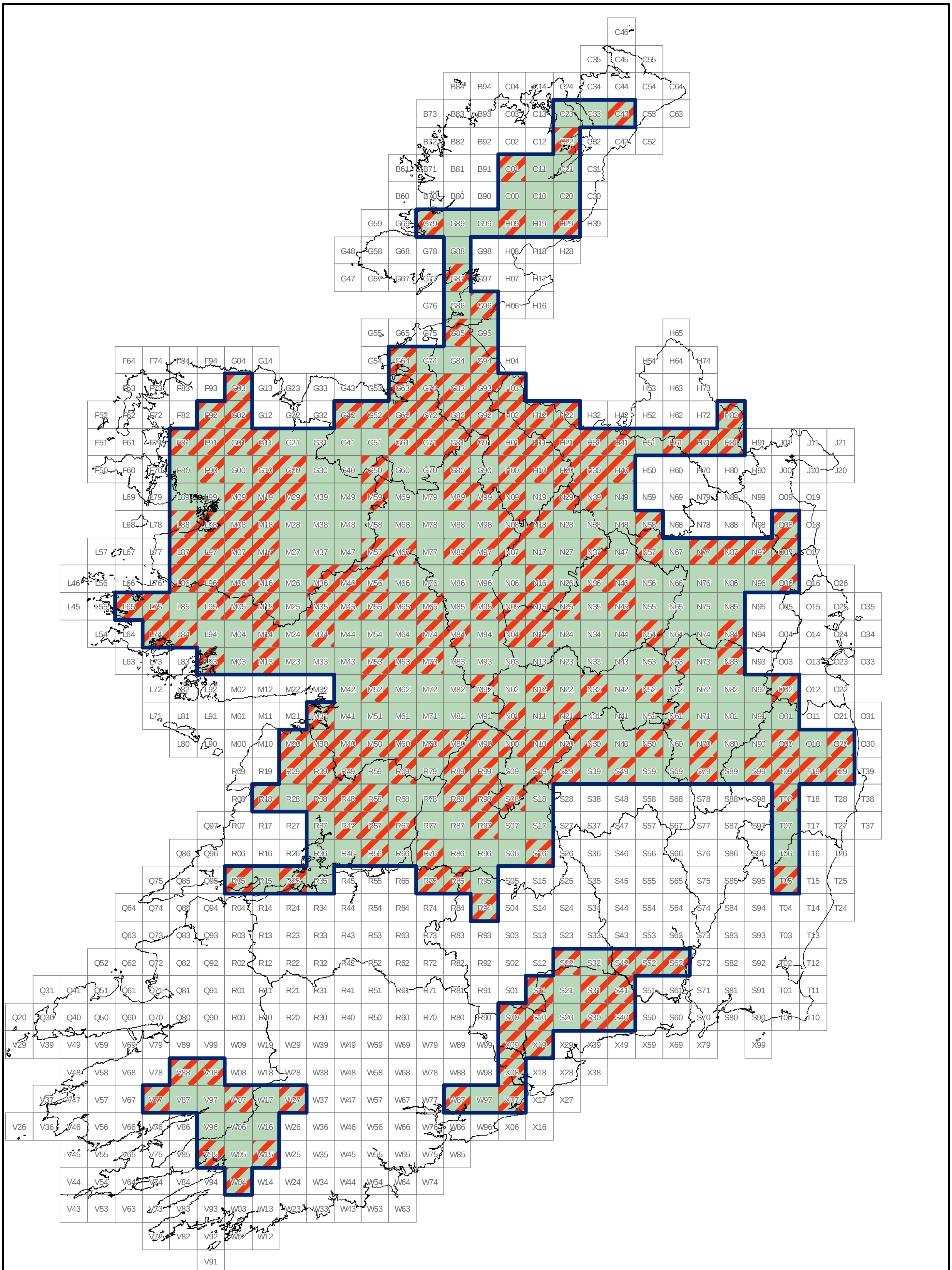
1357 Pine marten (*Martes martes*)

1. National Level	
Species code	1357
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	▪ Fairley, J. (2001) *A basket of weasels*. Privately published. Belfast, Northern Ireland. ▪ Hayden, T. & Harrington, R. (2000) *Exploring Irish Mammals*. Town House, Dublin. ▪ Lynch, A.B., Brown, M.J.F. & Rochford, J.M. (2006) Fur snagging as a method of evaluating the presence and abundance of a small carnivore, the pine marten (Martes martes). *J. Zoology* 270: 330-339. ▪ O'Mahony, D., O'Reilly, C. & Turner, P. (2007) *National pine marten survey of Ireland: an assessment of the current distribution of pine marten in the Republic of Ireland.* Unpublished report to the Forest Service and National Parks & Wildlife Service. ▪ O'Sullivan, P. (1983) Distribution of the pine marten in the Republic of Ireland. *Mammal Review* 13: 39-44
2.3 Range	
2.3.1 Surface area	38,200 km^2
2.3.2 Date	June 2007
2.3.3 Quality of data	3 = good
2.3.4 Trend	Increased from 28% of surveyed sites in 1980 to 64% of the same sites in 2006. Equivalent of 1.37 % increase p.a.
2.3.6 Trend-Period	1980 - 2006
2.3.7 Reasons for reported trend	Assumed main reasons for change of range where known 3 = direct human influence (legal protection) 4 = indirect anthropo(zoo)genic influence - afforestation 5 = natural processes
2.4 Population	
1.2 Distribution map	
2.4.1 Population size estimation	Presence in 10km squares is used as a proxy for population, 215 10km squares occupied (based on data from 2005-2007).
2.4.2 Date of estimation	May 2007
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	125% increase in occupied squares from 52 10km squares (1980) to 117 10km squares (2006) over 26 years. Net increase of 1.37% p.a.
2.4.7 Trend-Period	1980-2006
2.4.8 Reasons for reported trend	3 = direct human influence (legal protection) 4 = indirect anthropo(zoo)genic influence - afforestation 5 = natural processes
2.4.9 Justification of % thresholds for trends	
2.4.10 Main pressures	151 – removal of hedges and copses 152 – removal of scrub 160 – general forestry management 243 – trapping, poisoning, poaching 502 – routes, autoroutes

2.4.11 Threats	151 – removal of hedges and copses 152 – removal of scrub 160 – general forestry management 243 – trapping, poisoning, poaching 502 – routes, autoroutes
2.5 Habitat for the species	
2.5.2 Area estimation	5,811 km^2
2.5.3 Date of estimation	June 2007
2.5.4 Quality of data	2 = moderate
2.5.5 Trend	Net increase in national forest cover at rate of 12,300ha p.a.
2.5.6 Trend-Period	1980-2005
2.5.7 Reasons for reported trend	3 = direct human influence (afforestation) 5 = natural processes (scrub encroachment)
2.6 Future prospects	1 = good prospects

2.7 Complementary information	
2.7.1 Favourable reference range	38,200 km^2
2.7.2 Favourable reference population	215 10km squares
2.7.3 Suitable Habitat for the species	5,811 km^2
2.7.4 Other relevant information	
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	Favourable (FV)



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DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT

1:1,800,000

0 12.5 25 50 Kilometers

Martes martes

1357

- Current Distribution (215 cells)
- Current Range (382 cells)
- Favourable Reference Range (382 cells)
- W48 10km grid cells

Date: October 2007

Conservation Assessment of the Grey Seal (*Halichoerus grypus* Fabricius) in the Republic of Ireland

May, 2007

1.0 Ecology of the Grey Seal in the Republic of Ireland

The grey seal (*Halichoerus grypus* Fabricius 1791) is widely distributed around the Irish coast, being part of a larger population inhabiting the northeast Atlantic. Recorded as early as 1837 (O'Gorman, 1963), the species was once hunted by coastal communities and accounts of hunting are available in local literature from the west of Ireland (e.g. Ó Criomhthain, 1973; Ó Súilleabháin, 1995). Bounties were paid for grey seals killed as a fishery protection measure until 1976, when the species became protected under the Irish Wildlife Act.

Grey seals are gregarious, forming aggregations at terrestrial "colonies" where they come ashore ('haul out') to breed, rest, socialise and moult. Local populations in Ireland, as in western Europe, follow an annual cycle with an autumn/winter breeding season, a winter/spring moult and summer foraging period at sea (Bonner, 1981; Kiely, 1998). Breeding in Ireland takes place on offshore islands and isolated mainland sites, predominantly between the months of September and November (Lockley, 1966; Ó Cadhla *et al*., 2007a). The number of grey seals present at Irish colonies has been shown to vary with season, the annual peaks occurring during breeding and moult periods (Kiely, 1998; Kiely *et al*., 2000). While seasonal patterns in site use can be consistent between years, terrestrial habitats used during the moult and summer in Ireland may not always be used for breeding (Kiely, 1998; Kiely *et al*., 2000).

Research has shown that adult grey seals of both sexes may demonstrate a high degree of interannual fidelity to breeding sites (Pomeroy *et al.*, 1994; Twiss *et al*., 1994), supporting the concept of distinct breeding stocks within the broader European region (Bonner, 1981). Studies at a number of colonies in the Republic have described individual seals' fidelity to haul-out sites and movement between them (Kiely, 1998; Kiely *et al*., 2000). Although there is evidence that breeding stocks may be genetically distinct (Allen *et al*., 1995), they do not appear to be spatially isolated year-round (McConnell *et al*., 1992; Hammond *et al.*, 1993). Individual grey seals of all ages can range widely and remain at sea for extended periods when foraging, using haul-out sites up to several hundred miles from breeding areas (e.g. Stobo *et al*., 1990; McConnell *et al*., 1992; Thompson *et al*., 1996; Kiely *et al*., 2000). Nothing is currently known of Irish grey seal movements or habitat use within their aquatic range, however.

Dietary studies from seals accidentally captured in fishing nets (i.e. by-catch) and from faeces collected at haul-out sites (BIM, 1997; Berrow *et al*., 1998; Kiely *et al*., 2000; Philpott, 2001; BIM, 2001; Rogan *et al*., 2001) indicate a wide range of prey preferences with a strong emphasis on demersal (i.e. seafloor) fish species (e.g. whiting *Merlangius merlangus*, *Trisopterus* species, flatfish), sandeels (*Ammodytidae*) and cephalopods. Species of commercial value such as cod (*Gadus morua*), monkfish (*Lophius piscatorius, L. budegassa*), herring (*Clupea harengus*) and Atlantic salmon (*Salmo salar*) are also eaten by grey seals and this interaction with coastal or marine fisheries causes ongoing controversy in the Republic. Grey seals are sensitive to human disturbance and seek out more remote environments for the purposes of rest and reproduction. Despite protection measures in the Republic a number of illegal culling actions have taken place since the enactment of the 1976 Wildlife Act (*see* Summers, 1983; Kiely & Myers, 1998; Ó Cadhla *et al*., 2007a). These incidents appear to be isolated events but changes in site use (Kiely & Myers, 1998) and pup production (Summers, 1983; Ó Cadhla *et al*., 2007a) are thought to have directly resulted from such actions.

Epizootics in western Europe in 1998 and 2002 caused by the Phocine Distemper Virus (PDV) were thought to impact on grey seal populations in the northeast Atlantic. However, in the Republic of Ireland the absence of reliable national population estimates for both seal species prior to 2003 precluded any scientific assessment of impact due to disease and the overall conservation status of the Irish grey seal population remained unknown. This large-scale shortfall in data for the grey seal was addressed by the development and completion of a comprehensive national grey seal population assessment in 2005 (Ó Cadhla *et al*., 2007a).

2.0 Extent and Terrestrial Distribution

The extent to which the grey seal occupies its potential range in the Republic of Ireland is poorly determined at present (*see* 3.0). Significant efforts have recently been made, however, to systematically determine the species' terrestrial distribution along the Republic's coastline, particularly since 1994 (Appendix I). While much of the attention has been focused on breeding population distribution, due to the ability to estimate population size from pup count data (*see* 5.1), efforts have also been made to assess grey seal terrestrial distribution and abundance on a national scale during the summer (Cronin *et al*., 2004) and moult seasons (Ó Cadhla *et al*., 2007b).

In order to establish and verify all known grey seal breeding sites in the Republic of Ireland a comprehensive review of grey seal distribution data for the Republic of Ireland was carried out between February and May 2005 (Ó Cadhla *et al*., 2007a). This covered all published and unpublished information available from surveys conducted up to 2005 (Appendix I) and dating back to R.M. Lockley's original study in 1964-65 (Lockley, 1966). The review process incorporated field reports and notes written by individual National Parks & Wildlife Service (NPWS) staff over the 1978-2004 period, included material compiled and presented in Lyons (2004), and also information gathered via a questionnaire-survey circulated to all NPWS field staff in early 2005. Further efforts were made to verify records and gather additional information through liaison with members of the wider scientific community, the Irish fishing industry, the Commissioners of Irish Lights, island inhabitants, naturalists and other members of the public.

The review process and recent comprehensive, nationwide surveys indicate that grey seals may be found extensively along virtually the entire coastline of the Republic of Ireland (as recorded by Lockley, 1966) with areas of haul-out concentration along the southwest, west and northwest coasts and more patchy haul-out distribution along the eastern and southern coasts (Appendix II). The most prominent gaps in distribution occur along the eastern (i.e. Irish Sea) coast, most likely due to reduced availability of uninhabited/undisturbed coastal habitat (*see* 4.0). Given questions over the reliability in the present context of information dating as far back as the 1960's and 1970's, and scientifically robust, comprehensive data gathered since 1994, it was decided that the extent of grey seal terrestrial distribution (2007) should reflect the more recent data, thereby establishing a firmer baseline for future assessments of this kind.

The current known distribution of grey seal haul-out sites in the Republic of Ireland was mapped using ArcView GIS 3.2 (Appendix II). Data shown consist of the combined distribution of breeding and summer haul-out sites recorded during national population assessments by Cronin *et al*. (2004) and Ó Cadhla *et al*. (2007a). The majority of haul-out sites described in this plot were supported by information from previous studies (Appendix I), although pre-1994 data were less specific on exact location in many cases. It is thus assumed that the plot shown represents the best current knowledge of the grey seal's terrestrial distribution in the Republic of Ireland. The description will be further improved by a recent nationwide haul-out assessment during the 2007 moult season (Ó Cadhla *et al*., 2007b), the data analysis for which is currently in progress.

In assessing the distribution and Conservation Status of grey seals at terrestrial haul-out sites, however, it should be noted that significant seasonal changes are known to occur throughout the annual cycle (Kiely, 1998; Kiely *et al*., 2000). An example of such seasonal changes is shown on a local scale in Table 1 below. Thus reliance on breeding season research (e.g. Ó

Cadhla *et al*., 2007a) alone as a means of population monitoring will fall short of detecting changes in extent or natural range during other key phases of the grey seal's annual cycle.

TABLE 1

Seasonal changes in grey seal count data from s selection of terrestrial haul-out sites among islands of the Inishkea Group, February 1995 to December 1996. Substrate type codes at each site are as follows: BB-boulder beach; GB-grass bank; IR-intertidal reef; MB-mixed beach; RI-inlet with rocky ledges; RL-rocky ledges; SB-sandy beach.

			1995-1996	Mean total count per season (1995-1996)			
Island	Substrate	Aspect	*Mean ± S.E.*	*Moult*“	*Summer*	*Breeding*	*Moult*✿
Inishkeeragh	RL	NE	2.0 ± 1.0	•	•		
	BB	SE	51.8 ± 17.5	⬤	•	•	⬤
Carricknaronty	IR	-	14.2 ± 3.5		●	●	•
Carricknaronty Rocks	RL	SW	10.3 ± 7.0	●			•
	RL	W	47.2 ± 8.6	⬤	●	⬤	●
	RL	W	19.9 ± 8.6	●	•	⬤	●
Carrickmoylenacurhoga	RI	S	8.9 ± 2.0	●	•	●	•
	RL	SE	24.2 ± 5.4	●	●	•	●
	RI	SE	14.6 ± 3.9	•	●	●	•
	RL	SE	10.8 ± 3.1	•	●	●	•
Carrigee	RL	S	13.8 ± 2.6	●	●	●	•
	RL	E	11.6 ± 2.3	●	●	•	•
Carrickawilt	IR	-	26.4 ± 11.5		●		
	GB	-	8.0			•	
	RL	N	67.1 ± 18.8	⬤		●	⬤
	BB	E	74.5 ± 25.1	⬤		●	⬤
	RI	SE	8.3 ± 2.0	●	•	•	•
Inishkea North	RI	W	15.4 ± 4.3	●	●	●	•
	RI	E	6.4 ± 2.1	•	•	•	●
	MB, GB	S/SE	62.5 ± 22.5	•		•	⬤
	BB	S/SE	101.0 ± 8.1	⬤			⬤
	BB	S	9.6 ± 6.8	●	•	•	
	SB	N/NW	517.5 ± 151.0	⚫	•	•	•
Inishkea South	IR	NE	2.6 ± 1.2	•	•	•	
	RL	E	6.6 ± 1.8		•	•	
	IR, BB	E	7.1 ± 1.3		•	•	•
Duvillaun More	RL	NE	5.7 ± 1.4		•	•	
	G	N	5.0			•	
	MB, RL	E	5.4 ± 1.0		•	•	
	G	SE	4.3 ± 0.3			•	

(Mean total grey seal count: •=1-11; ●=11-50; ⬤=51-150; ⚫=150+ , blank = zero)

3.0 Range

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*' (EC, 2006).

In the context of their semi-terrestrial ecology as marine mammals, grey seals may be interpreted to occupy two discrete biogeographic regions within their range: Atlantic (ATL) and Marine Atlantic (MATL). However, very little is known of grey seal distribution in the Republic of Ireland beyond the species' documented haul-out sites (Appendix II) and information on grey seal movements and habitat use in Irish waters is currently restricted to qualitative data, (a) from sporadic sightings made by land-based/boat-based observers, and (b) from general capture locations of seals accidentally by-caught in commercial fishing operations (Berrow *et al*., 1998; Kiely, 1998; BIM, 1997; BIM, 2001).

Based on extensive telemetry data gathered in the UK via satellite relay data loggers, grey seals movements are generally believed to occur on two geographic scales (Hammond, 2003): (i) long and distant travel (up to 2,100 km from the haul-out site; (ii) local, restricted travel to discrete foraging areas (generally within 60km of the haul-out site) (e.g. McConnell *et al*., 1992; Hammond *et al*., 1993; Thompson *et al*., 1996). A number of satellite-tagged grey seals have been observed to enter Irish waters and to haul-out at Irish sites during such movements (Sea Mammal Research Unit, University of St. Andrews, *pers. comm.*).

Since the coastal and marine range of grey seals in the Republic of Ireland can only currently be described as *Unknown* beyond the species' terrestrial distribution and the Habitats Directive applies within member states' entire exclusive economic zone (EEZ), it is thus considered pragmatic to presently include all waters of the Irish EEZ as potentially part of the species' range. A graphical representation of the species' Potential Range was thus drawn up to include all Irish waters (Appendix III), using ArcView 3.2. The area of the polygon containing the potential range of the grey seal in the Republic of Ireland is thus estimated as 410,310 km^2.

4.0 Habitat

While the terrestrial distribution of grey seals in the Republic of Ireland has received a measure of research attention in recent years (*see* 2.0), the coastal and offshore habitats utilised by and available to the species are not well understood and there is no current understanding of grey seal habitat use, requirements or preferences outside of the terrestrial/coastal interface. Recent research efforts (Kiely, 1998; Kiely & Myers, 1998; Kiely *et al*., 2000; Lidgard *et al*., 2001; Ó Cadhla & Strong, 2003; Ó Cadhla *et al*., 2005; Ó Cadhla *et al*., 2006) have, however, sought to describe the various terrestrial habitat types occupied by grey seals during breeding and other shore-based phases of the annual cycle (e.g. Table 1). These habitats all fall under Coastland and Marine Littoral categories described in Fossitt (2000), ranging from grass banks atop islands of various size to estuarine sandbanks, intertidal rock ledges and boulder beaches (e.g. Table 1).

Ongoing research and new telemetry studies of grey seals in the Republic of Ireland would certainly provide further data to indicate specific habitat preferences on land and at sea. Yet the Conservation Status of terrestrial habitats for the grey seal, at least, would appear to be Favourable. This assessment is based on current knowledge of basic habitat availability adjacent to breeding sites (Kiely & Myers, 1998; Ó Cadhla & Strong, 2003; Ó Cadhla *et al*., 2005; Ó Cadhla *et al*., 2006) and indications that the population size is considered stable or perhaps increasing at a number of nationally-important colonies studied since 1994 (see 5.2).

5.0 Population Status

5.1 Population estimation

Prior to 2005, research to estimate grey seal population size in the Republic of Ireland focused on important local/regional colonies (Appendix I), largely using proven ground-based methods, whether for (a) breeding population assessment (e.g. Summers, 1980; Summers, 1983; Kiely & Myers, 1998), (b) mark-recapture estimation via photo-identification (e.g. Kiely, 1998; Kiely *et al*., 2000) or (c) haul-out size estimation (Kiely, 1998; Kiely *et al*., 2000).

Since 1994, 'through-counting' (Boyd & Campbell, 1971) has been the preferred method of estimating local breeding population sizes in the Republic of Ireland (e.g. Kiely & Myers, 1998; Lidgard *et al*., 2001). It involves visits to breeding sites at intervals of 10-15 days, temporarily marking individual pups with a dye solution and classifying each living pup encountered by its developmental stage (*after* Radford *et al*., 1978; Kovacs & Lavigne, 1986). Dead pups are also recorded, marked and removed from the shoreline where they might be washed into the sea or covered by beach material. By this sampling method, pup production is assessed cumulatively over the breeding season. To derive an all-age population estimate, the total observed pup production is then subject to a multiplication factor based on grey seal life history parameters measured in the UK (Harwood & Prime, 1978).

Such studies delivered a combined Irish & Celtic Sea population in 1997-1998 of 5,198-6,976 (mark-recapture estimate: 5,613; Kiely *et al*., 2000) and a rough minimum population estimate of 4,000+ grey seals in the Republic of Ireland as a whole, collated from the results of local ground-surveys (Ó Cadhla & Mackey, 2002). More recent research efforts, however, explored and adopted the use of aerial survey techniques to estimate population size on local, regional and national levels (Cronin *et al*., 2004; Cronin & Ó Cadhla, 2004; Strong & O'Donnell, *unpubl.;* Ó Cadhla *et al*., 2006; Ó Cadhla *et al*., 2007a).

In 2005, the continued absence of comprehensive data on a national scale was addressed by means of combined aerial and ground-surveys (Ó Cadhla *et al*., 2007a) The methods used in collecting pup production data were (i) digital aerial photography; (ii) through-counting; (iii) ground-counting; (iv) ground-truthing of aerial survey data, and (v) aerial- and ground-based reconnaissance. Pup production modelling carried out in collaboration with the Sea Mammal Research Unit, University of St. Andrews delivered national and regional pup production estimates and total population estimate in the Republic of Ireland of **5,509-7083 grey seals** of all ages (Ó Cadhla *et al*., 2007a).

The 2005 national grey seal survey represents the first effective population assessment for the Republic of Ireland as a whole and its results can thus be considered an appropriate reference baseline for the species (Ó Cadhla *et al*., 2007a). The national breeding population survey was followed by a national moult population survey in the spring of 2007 (Ó Cadhla *et al*., 2007b), the data analysis for which is currently under way.

5.2 Population trends

Given the absence of a comprehensive national grey seal population assessment prior to 2005 and long time-intervals between monitoring visits to selected colonies (*see* Appendix I), there is little historic information available on which to reliably determine current national population trends. However, surveys since 1995 using consistent methodology at several nationally-important colonies do provide an indication of possible trends at a local, if not regional, level (Appendix IV). Best studied among these colonies are the islands of the Inishkea Group, County Mayo and Blasket Islands, County Kerry, both of which are designated as Special Areas of Conservation (Appendix V), lying along the western seaboard which remains the stronghold of grey seal breeding around the island of Ireland (Ó Cadhla *et al*., 2007a).

Research carried out at the Inishkea Group indicates that pup production at several key breeding islands in the archipelago has been increasing since through-counting surveys began there in 1994 (Ó Cadhla & Strong, 2003). This pattern at the country's largest breeding colony (Fig. 1) appears to have continued to 2005 at least with pup production at individual islands (and hence population size) continuing to increase and a number of islands delivering population estimates 2-5x their 1995 estimate (Appendix IV). Care must be taken in reading too much into these data, however, in the absence of annual monitoring which would better address inter-annual variation in pup production and population size whether at local, regional or national levels.

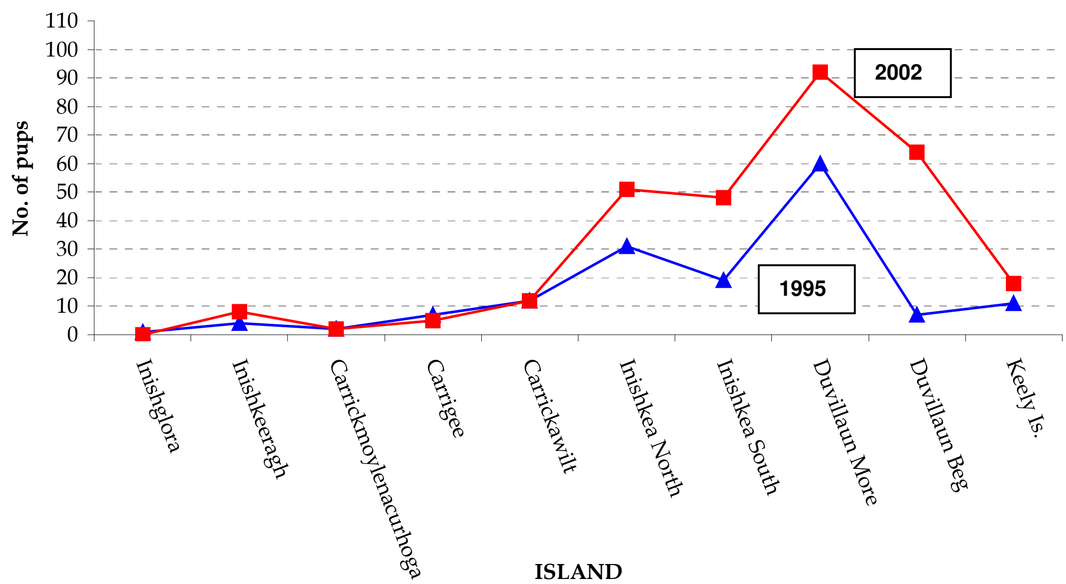


Fig. 1. Grey seal pup production recorded among all islands in the Inishkea Group among which grey seal breeding was assessed in 1995 and 2002. (*after* Ó Cadhla & Strong, 2002).

Research at the Blasket Islands (prior to 2004) and islands of the east and southeast coasts (i.e. Lambay I & Ireland's Eye, Saltee Islands, respectively) also indicate that pup production may have increased since the 1996-98 period. However, following an illegal culling incident at Beginish (Blasket Islands) in 2004, it appears that pup production on this island particularly, and among the Blasket Islands as a whole, may have been directly affected by the killing of up to 50+ newborn pups and a number of adults, delivering to lower estimates of pup production for 2005 (Ó Cadhla *et al*., 2007a).

Additional assessment of grey seal population trends in the Republic of Ireland are not possible at present, given the absence of a national monitoring strategy. Nor are trends in haul-out abundance outside the breeding season possible to determine, since most studies to date have concentrated on surveys during the breeding season (Appendix I). However population assessment methods have been tried and tested and research experience and skills now exist in the Republic of Ireland by which both issues may be addressed in a more coherent, co-ordinated fashion, permitting better evaluation of the population's Conservation Status into the future.

6.0 Conservation Status

6.1 Range Conservation Status

The Favourable Reference Range (FRR) for the grey seal in the Republic of Ireland is not known due to the absence of information on grey seal distribution in Irish coastal and offshore waters. However, since the range of coastal haul-out sites used by the species appears to be stable and historical distribution data are supported by current information, a Favourable conservation status is indicated.

- **Species Range Area:** Potentially 410,310 km^2, the area of the Rep. of Ireland's EEZ.
- **Favourable Reference Range:** Undetermined

6.2 Habitat Conservation Status

A detailed understanding of grey seal habitat availability and preferences in the Republic of Ireland does not currently exist, whether in the aquatic or terrestrial environments. However, based on coastland and littoral habitat availability adjacent to existing breeding and haul-out sites and the relatively small, stable population size currently using these sites throughout the Republic of Ireland, the Habitat Conservation Status for the grey seal may be inferred as Favourable.

6.2 Population Conservation Status

The Favourable Reference Population 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 considered that the population estimate derived in 2005 by means of a comprehensive national survey (5,509-7083 grey seals of all ages - Ó Cadhla *et al*., 2007a) represents the Favourable Reference Population for the Republic of Ireland.

- **Species Population:** Defined via nationally-acquired pup production data during the 2005 breeding season.
- **Favourable Reference Population:** Derived by Ó Cadhla *et al*. (2007a), based on data collected over the 2005 breeding season, the estimated population size in the Republic of Ireland and Favourable Reference Population is 5,509-7083 grey seals.

Following the General Evaluation Matrix for assessing the Conservation Status of Annex II Species (EC, 2006); because the Estimated Present Population appears to be stable or increasing, the Conservation Status of the grey seal in the Republic of Ireland is Favourable.

7.0 Impacts and Threats

7.1 Positive impacts

7.1.1 Conservation designations

In the late 1990s the National Parks and Wildlife Service (NPWS) proposed all of the major known breeding sites of the two species as Special Areas of Conservation (SACs). There are currently ten SACs in Ireland with the grey seal listed as a qualifying interest (D. Lyons, NPWS, *pers. comm.*) (Appendix V). In the light of recent comprehensive population research (Ó Cadhla *et al*., 2007a), the vast majority of these designations are wholly appropriate and newly-described seasonal haul-outs/colonies of regional importance could also be considered into the future. In this regard, the islands of Inishtrahull (Co. Donegal), St. Patrick'sIsland (Co. Dublin) and sandbanks of Wexford Harbour/Raven Point (Co. Wexford) contain important haul-out aggregations of grey seals in all seasons of the annual cycle.

7.1.2 Ongoing monitoring

Ongoing monitoring of grey seal populations over the last decade by members of University College Cork and NPWS staff has provided some very useful information (Appendix IV) and directly contributed to the successful completion of Ireland's first national grey seal population assessment in 2005 (Ó Cadhla *et al*., 2007a, 2007b). While such co-ordinated efforts have been consistent in their methodology, most have been sporadic and inconsistent in timing, however, making it difficult to robustly examine regional population trends.

The value of ongoing local monitoring initiatives cannot be underestimated. The 2005 national grey seal population assessment highlighted the significance of individual breeding colonies and regions within a national context. A smaller-scale national monitoring programme for grey seals, reviewed at annual intervals would determine the most appropriate time for a repeat national assessment and provide consistent scientific data on regional population trends. Ideally surveys should be carried out at 'index' sites throughout the annual cycle, providing important data on the influence of covariates on seal haul-out behaviour at these sites and potentially providing seasonal population estimates, such as those provided by photo-identification studies (e.g. Kiely *et al.,* 2000). While contributing to the understanding of population trends and improving the accuracy of population estimates, such research will be essential if the importance of specific sites and/or regions are to have a sound scientific basis, upon which effective identification, management and monitoring of Special Areas of Conservation (SAC) can proceed.

7.1.3 Research programmes

Dedicated research has been conducted on grey seals in the Republic of Ireland since 1994 by staff from University College Cork, NPWS and occasionally other groups (Appendix I). These efforts have provided vital information on aspects of the species' ecology, such as seasonal changes in haul-out abundance, haul-out behaviour, terrestrial habitat use and foraging ecology (e.g. Kiely, 1998; Kiely *et al*., 2000; BIM, 2001). However, large information gaps remain with respect to both the terrestrial and aquatic ecology of the species. Information on the offshore distribution and habitat use of grey seals in Irish waters is also urgently required. Experience now being gained by University College Cork's research team in techniques for harbour seal capture and tracking indicate that grey seals could now be successfully tagged and tracked in the Republic of Ireland's waters for the first time. Such a research undertaking would be an ambitious step forward, representing a further positive stage towards the guidance, delivery and implementation of an effective conservation strategy for the species.

7.1.4 Research collaboration

Research initiatives since 1994 have strengthened links and experience-exchange between scientists from UCC, NPWS staff and world leading experts in grey seal research from the Sea Mammal Research Unit, University of St. Andrews, Scotland, the National Marine Mammal Laboratory (NOAA, USA) and other international bodies. NPWS staff have actively participated in national and local population surveys and have provided valuable assistance to UCC researchers in the field, building capacity, skills and data-sharing between the NPWS and the research community. As a result there now exists a national and regional expertise in addressing research and conservation agendas, a feature which will assist in future monitoring and research programmes.

7.1.5 Changes in fishing practices

Grey seals have been documented as accidentally-captured and drowned in several static-net commercial fisheries in the Republic of Ireland (*see* 7.2.1). However the geographic scale and temporal span of many static-net fisheries in the Republic of Ireland have declined in the last decade (An Bord Iascaigh Mhara, *unpubl.*), and consequently the potential for incidental by-catch of grey seals may have reduced significantly. Since November 2006, at-sea drift net fishing for salmon has been banned in Irish waters. Although never quantified, the drift net fishery was responsible for incidental catches of both grey seals and harbour seals. The recent ban of the fishery therefore also has positive implications for both species.

7.2 Negative impacts and threats

7.2.1 Fisheries interactions

A number of dedicated studies into Irish seal-fishery interactions have been conducted in the last decade (e.g. BIM, 1997; Berrow *et al*., 1998; Kiely *et al*., 2000; BIM, 2001; Rogan *et al*., 2001). These studies, which require great sensitivity and co-operation from the fishing industry, have been carried out on relatively local scales to date, dealing with seasonal fisheries for demersal and pelagic fish species (e.g. tangle-net fishing for monkfish – Kiely *et al*., 2000, spring cod fishery – BIM, 1997, 2001). However, most studies have reported potentially significant mortality rates (on average, up to ca. 50 grey seals per season) due to entanglement in fishing gear and the data indicate two important features: (1) not all by-caught seals are reported or landed for analysis; (2) data are skewed towards juvenile grey seals.

No cohesive by-catch monitoring programme for seals has ever existed in Irish waters and accurate figures for grey seal by-catch cannot be delivered at this time, either on temporal or spatial scales. It is thus considered that (a) studies carried out to date represent a fraction of the existing problem, and (b) a programme monitoring grey seal by-catch in static-net fisheries would be advisable in order to further assess the status of this interaction which may be impacting negatively on the grey seal population in the Republic of Ireland.

In contrast, the impact (both real and perceived) of grey seals on Irish fisheries has led to calls for population control by the fishing industry and the demands of seal conservation and marine resource management occasionally come into conflict. The most damaging examples of such conflict for the grey seal population have historically taken the form of illegal culls at grey seal breeding colonies, the most recent of which occurred at the Blasket Islands in 2004 (Ó Cadhla *et al*., 2007a) and previous examples of which also occurred in 1992 and 1978-1981 (Kiely & Myers, 1998).

Fishermen and other commercial operators may obtain a Section 42 licence from the NPWS to shoot grey seals acting as pests in fishery operations. However the number of seals approved for removal in such situations is generally low (1-2 seals per annum) and anecdotal evidence gathered by UCC suggests that removal by shooting may not be operating as an effective solution in many cases. A new initiative is currently under way to assess other potential means of managing the problem and alleviating damage to ecologically sensitive fish stocks (e.g. native salmonids) while maintaining seal populations at favourable conservation levels.

In spite of a general reduction in several traditional static-net fisheries in Irish waters, the problem of seal predation on and damage to commercially exploited fish species continues to be demonstrated, particularly in select estuarine and aquaculture situations along the western seaboard (Rogan & Ó Cadhla, 2003; Ó Cadhla, O., CMRC, *pers. comm*). While several studies in the last decade (BIM, 1997, 2001; Kiely *et al*., 2000; Rogan *et al*., 2001) have concentrated research on evaluating the degree of operational interaction between grey seals and fisheries, the scale of interaction by grey seals on commercial fishing and aquaculture is unclear and economic loss due to damage is not currently quantifiable. This matter also requires addressing if any scientific and socio-economic basis for management is envisaged.

In the current absence of any reliable information on grey seal foraging ecology, the issue of competition between grey seals and commercial fishermen for the same resources has been largely ignored. Environmental considerations are now integrated into the Common Fisheries Policy (CFP) by a way of an 'ecosystem approach' to the marine environment, taking into account the interaction among food webs of ecosystems. Given adequate data on fish stocks, the fisheries, grey seal population size and the species' foraging ecology, it should be possible to estimate the impact of grey seals on commercial fishing operations. Considering the need for spatially-explicit management of fish stocks, spatially-explicit population foraging distribution data of a top marine predator would be invaluable to resource managers and policy makers.

University College Cork's research team has recently begun to address this ecological issue via a study of the foraging distribution of harbour seals off southwest Ireland. The determination of spatial overlap between seal foraging, fish abundance and human activity would help to inform local and national management policy. Such information could assist government agencies in assessing predation pressures by grey seals on vulnerable or economically important fish stocks and in delineating marine Special Areas of Conservation for grey seals. It is envisaged that future studies of grey seal foraging ecology will play crucial role in the management and conservation of the species in the Republic of Ireland.

7.2.2 Disease

It is known that grey seals in western Europe were affected by outbreaks of Phocine Distemper Virus (PDV) in 1988-89 and 2002. Yet no grey seal mortalities were observed in the Republic of Ireland and no increase in grey seal strandings was reported to the relevant authorities or scientific community. The absence of consistent monitoring of regional grey seal haul-out groups, however, ruled out the possibility of investigating the impact of disease in terms of haul-out abundance or health status. Previously the occurrence of an unexplained die-off of ca. 12 juvenile grey seals on Tory Island in early 1997 remained unexplained and improperly managed. No co-ordinated seal stranding programme currently exists, although a rehabilitation & release programme, predominantly dealing with pups < 1 year old, is carried out by the Irish Seal Sanctuary in Co. Dublin. A more cohesive collaborative monitoring framework for grey seal health status would allow better examination and management of disease outbreaks and their impacts in the Republic of Ireland in future.

7.2.3 Ecotourism

A growing marine eco-tourism industry around the Irish coast may be potentially be a cause for concern with respect to negative impacts, particularly where vessels and/or terrestrial guides are operating in the immediate vicinity of significant grey seal breeding colonies (e.g. Lambay Island; Blasket Islands; Saltee Islands). It is suggested that a generalised 'code of conduct' be established to advise boat operators and marine tour operators of appropriate boating and behaviour in order to minimise disturbance to grey seals whether in or outside Special Areas of Conservation.

8.0 Future Prospects

8.1 Future Prospects for the species' Conservation Status

While significant information is required with respect to the species' range and habitat in the Republic of Ireland, population trends of the grey seal in Ireland are stable or increasing (*see* 5.2) in colonies studied since 1994. The population is thus determined to currently have a Favourable Conservation Status. Furthermore, terrestrial Habitat Conservation Status appears to be Favourable.

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

Monitoring (long-term systematic observation) is nevertheless necessary in the Republic of Ireland to consistently determine the conservation status and population trends of the grey seal. It is recommended that a national grey seal population assessment be conducted annually in order to deliver robust estimates of national population size and distribution. It is also recommended that future population estimation surveys be conducted in the Republic of Ireland on a seasonal basis in order to effectively address issues of habitat management and species conservation throughout the annual cycle.

Range of the Grey Seal:	**Unknown**
Habitat for the Grey Seal:	**Unknown, Favourable (terrestrial)**
Population of the Grey Seal:	**Favourable**
Future Prospects for the Grey Seal:	**Favourable**
Overall Assessment:	**Favourable Conservation Status**

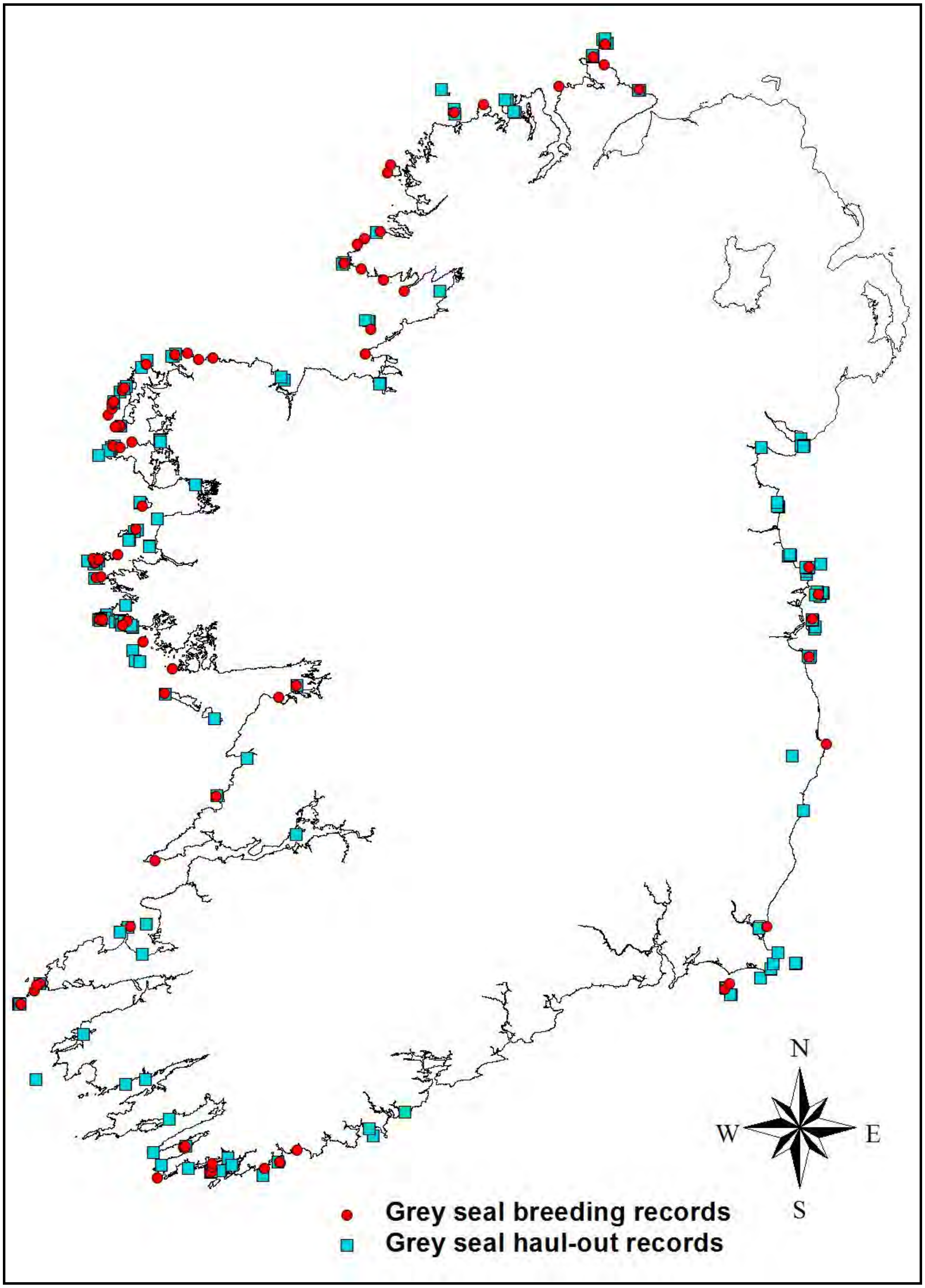
Appendix I

Surveys for the Grey Seal in the Republic of Ireland

YEAR(S)	REFERENCES	SEASONS	LOCATIONS	SURVEY TYPE
1964-65	Lockley, 1966	Breeding	National survey	Minimum pup count Reconnaissance
1978-2003	Warner, *unpublished* Warner, 1979 Summers, 1980 Summers, 1983 Lyons, 2004	All	Selected colonies	Minimum pup count Reconnaissance Haul-out count Pup tagging
1989	McMahon, 1989	Breeding	Blasket Islands	Pup count Pup tagging
1994	BIM, 1997	Breeding	Inishkea Group	Pup through-count
1994	Kiely, 1998	Breeding	Inishkea Group	Reconnaissance
1995-97	Kiely, 1998 Kiely & Myers, 1998	All	Inishkea Group Blasket Islands Saltee Islands	Pup through-count Haul-out abundance Photo-ID Mark-recapture
1997-99	Kiely *et al*., 2000 Lidgard *et al*., 2001	All	Saltee Islands Irish Sea Eastern Celtic Sea	Pup through-count Haul-out abundance Photo-ID Mark-recapture
1997-99	BIM, 2001	Breeding	Inishkea Group Southwest Mayo Northwest Galway Donegal coast	Pup through-count Pup tagging Reconnaissance
2002	Ó Cadhla & Strong, 2003	Breeding	Inishkea Group	Pup through-count
2003	Cronin *et al*., 2004	Summer	National	Haul-out count
2003	Cronin & Ó Cadhla 2004	Breeding	Blasket Islands	Aerial population assessment
2003	Cronin & Ó Cadhla 2004	Breeding	Inishkea Group Donegal coast	Single aerial count Reconnaissance
2003	Strong & O'Donnell, *unpublished*	Breeding	North Galway	Single aerial count Reconnaissance
2004	Ó Cadhla *et al*., 2005	Breeding	Slyne Head islands Hen Island	Pup through-count
2004	Ó Cadhla *et al*., 2006	Breeding Moult	Southwest Mayo Northwest Galway	Single ground-count Reconnaissance Aerial scoping survey
2005	Ó Cadhla *et al*., 2007a	Breeding	National survey	Aerial population assessment Pup through-count
2007	Ó Cadhla *et al*., 2007b	Moult	National survey	Aerial haul-out assessment

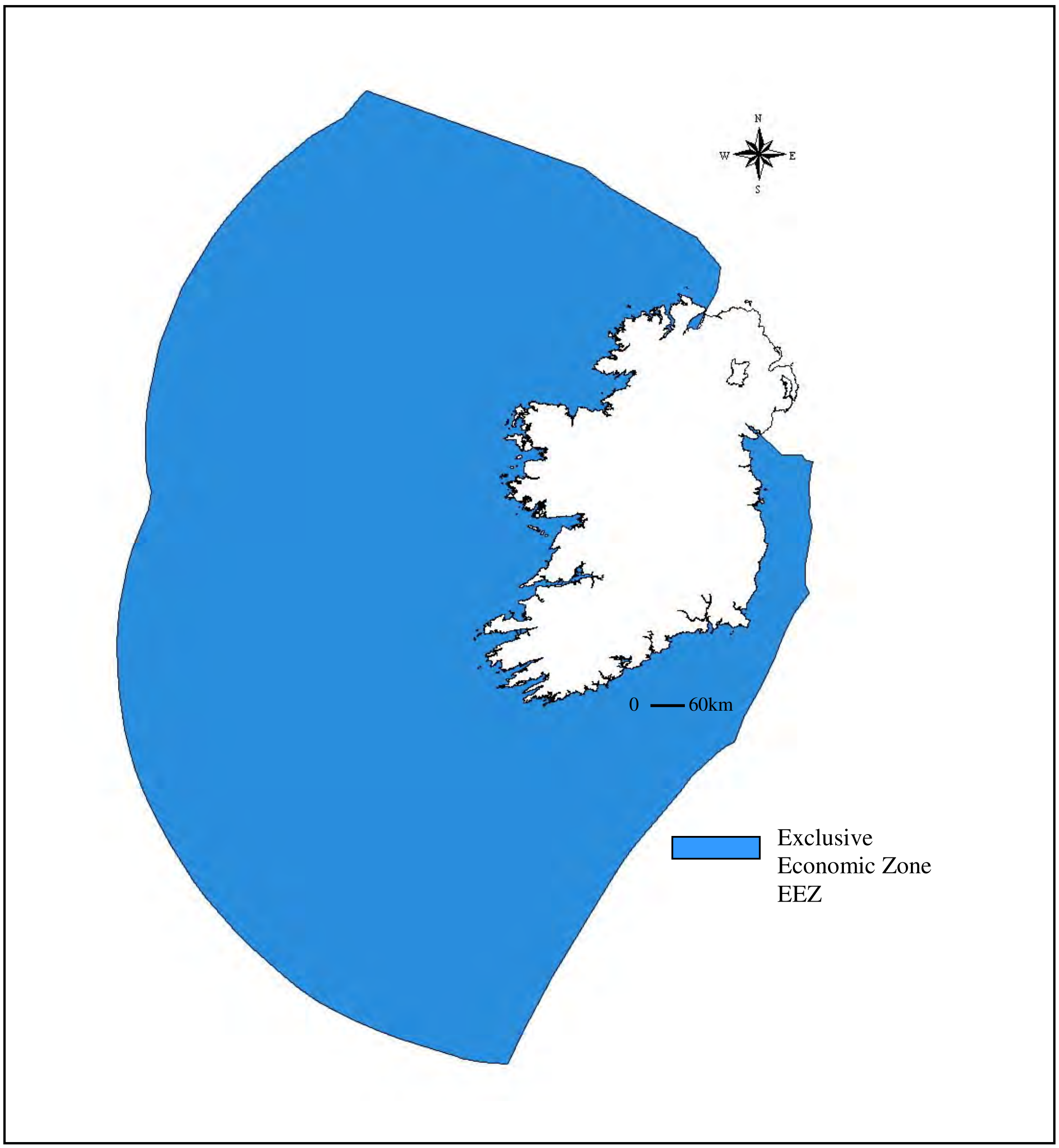
Appendix II

Terrestrial Distribution of Grey Seals in the Republic of Ireland (2007)



Appendix III

Potential range of the Grey Seal in the Republic of Ireland (2007)



Appendix IV

Population trends over time at key breeding colonies

Comparative estimates of all-age population size (N_E) and pup production data (P) for a selection of key breeding sites in the Republic of Ireland. Estimates and coefficients of variation (CV) generated via production model plots are shown in addition to minimum productions recorded by through-counting where this method was used. [*adapted from* Ó Cadhla *et al*., 2007a; n/d = not determinable]

Breeding colony	Site name	Year	N_E	Pup production Model estimate P_i	 CV	Pup production Through-count P_T
Inishkea Group, Co. Mayo	Keely I.	1995	28-36	8	0.20	11
		2002	63-81	18	0.14	18
		2005	151-194	43	0.10	
	Duvillaun Beg	1995	25-32	n/d	n/d	7
		2002	207-266	59	0.04	64
		2005	242-311	69	0.05	
	Duvillaun More	1995	182-234	52	0.07	60
		2002	263-338	75	0.04	92
		2005	256-329	73	0.05	
	Inishkea South	1995	56-72	16	0.18	19
		2002	151-194	43	0.10	48
		2005	333-428	95	0.08	
	Inishkea North	1995	88-113	25	0.22	31
		2002	175-225	50	0.07	51
		2005	277-356	79	0.08	
	Carrickawilt to Inishglora	1995	70-90	20	0.26	26
		2002	95-122	n/d	n/d	27
		2005	95-122	27	0.14	
Blasket Islands, Co. Kerry	*all*	1996	473-608	135	0.23	155
		2003	665-855	190	0.05	
		2005	648-833	185	0.06	
	Beginish	1996	375-482	107	0.16	117
		2003	543-696	155	0.07	
		2005	469-603	134	0.06	
Saltee Islands, Co. Wexford	*all*	1998	301-387	86	0.17	128
		2005	571-734	163	0.07	178
Lambay Island & Ireland's Eye, Co. Dublin	*all*	1998	168-216	48	0.22	49
		2005	203-261	58	0.09	
Slyne Head islands, Co. Galway	*all*	2004	238-306	68	0.25	63
		2005	238-306	68	0.12	

Appendix V

Special Areas of Conservation (SACs) designated for Grey Seals in the Rep. of Ireland

Site Code	Name of site	County
000204	LAMBAY ISLAND	DUBLIN
000707	SALTEE ISLANDS	WEXFORD
000101	ROARINGWATER BAY AND ISLANDS	CORK
002172	BLASKET ISLANDS	KERRY
000328	SLYNE HEAD ISLANDS	GALWAY
000278	INISHBOFIN AND INISHSHARK	GALWAY
000495	DUVILLAUN ISLANDS	MAYO
000507	INISHKEA ISLANDS	MAYO
000190	SLIEVE TOOEY/ TORMORE ISLAND/ LOUGHROS BEG BAY	DONEGAL
000147	HORN HEAD AND RINCLEVAN	DONEGAL

Appendix VI

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1364 Grey Seal (*Halichoerus grypus*)

National Level	
Species code	1364
Member State	IE
Biogeographic regions concerned within the MS	ATL, MATL
Range	Unknown (Potentially 410,310 km^2, i.e. area of the Rep. of Irelands' EEZ)

Biogeographic level	
Biogeographic region	ATL, MATL
Published sources	▪ Ó Cadhla, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Hiby, A.R. & Lyons, D. (2007 *in prep.*). Grey seal breeding population assessment in the Republic of Ireland: 2005. *Irish Wildlife Manuals (intended)*. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O'Keeffe, C. (2004). Harbour seal population assessment in the Republic of Ireland: August 2003. *Irish Wildlife Manuals* No. 11. Dept. of the Environment, Heritage and Local Government, 7 Ely Place, Dublin. Ireland. 34 pp. ▪ Lyons, D.O. (2004). Summary of National Parks & Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003. *Irish Wildlife Manuals* No. 13. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government. 7 Ely Place, Dublin. Ireland. ▪ Ó Cadhla, O. & Mackey, M. (2002). *Out of sight, out of mind? Marine mammals and seabirds on Ireland's Atlantic Margin*. *In* F. Convery & J. Feehan (eds.) Achievement and Challenge - RIO +10 and Ireland. Environmental Institute, University College, Dublin. p. 423-426. ▪ Kiely, O., Lidgard, D.C., McKibben, M., Baines, M.E. & Connolly, N. (2000). *Grey Seals: Status & Monitoring in the Irish & Celtic Seas*. Maritime Ireland/Wales INTERREG report No. 3. Marine Institute, 80 Harcourt St., Dublin. 76 pp. ▪ Also, see Appendix VI of Conservation Assessment report.
Range	
Surface area	Unknown (Potentially 410, 310 km^2)
Date	05/2007
Quality of data	1 - poor
Trend	Unknown
Trend-Period	Not applicable
Reasons for reported trend	0
Population	
Distribution map	See Figure 2
Population size estimation	5,509-7083
Date of estimation	September-December 2005
Method used	3 = from complete inventory
Quality of data	3 = good
Trend	Stable or Increasing (% unknown)
Trend-Period	1978-2005
Reasons for reported trend	1, 4, 5
Justification of % thresholds for trends	Unknown
Main pressures	200, 211, 212, 213, 230, 300, 320, 530, 600, 621, 690, 700, 710, 750, 860, 944, 962, 963
Threats	200, 211, 212, 213, 230, 530, 621, 690, 700, 944, 962, 963

Habitat for the species	
Area estimation	Unknown (Potentially 410, 310 km²)
Date of estimation	05/2007
Quality of data	1 - poor
Trend	Unknown
Trend-Period	Not applicable
Reasons for reported trend	Not applicable
Future prospects	1 = good prospects

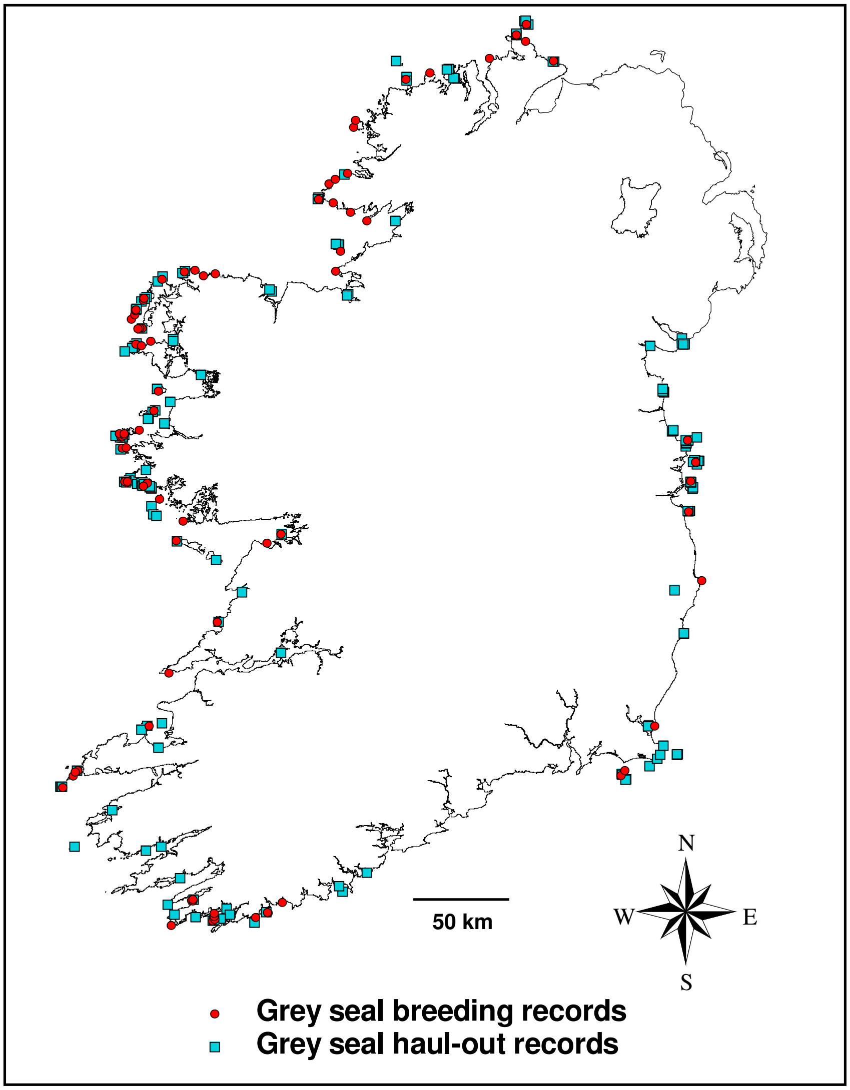
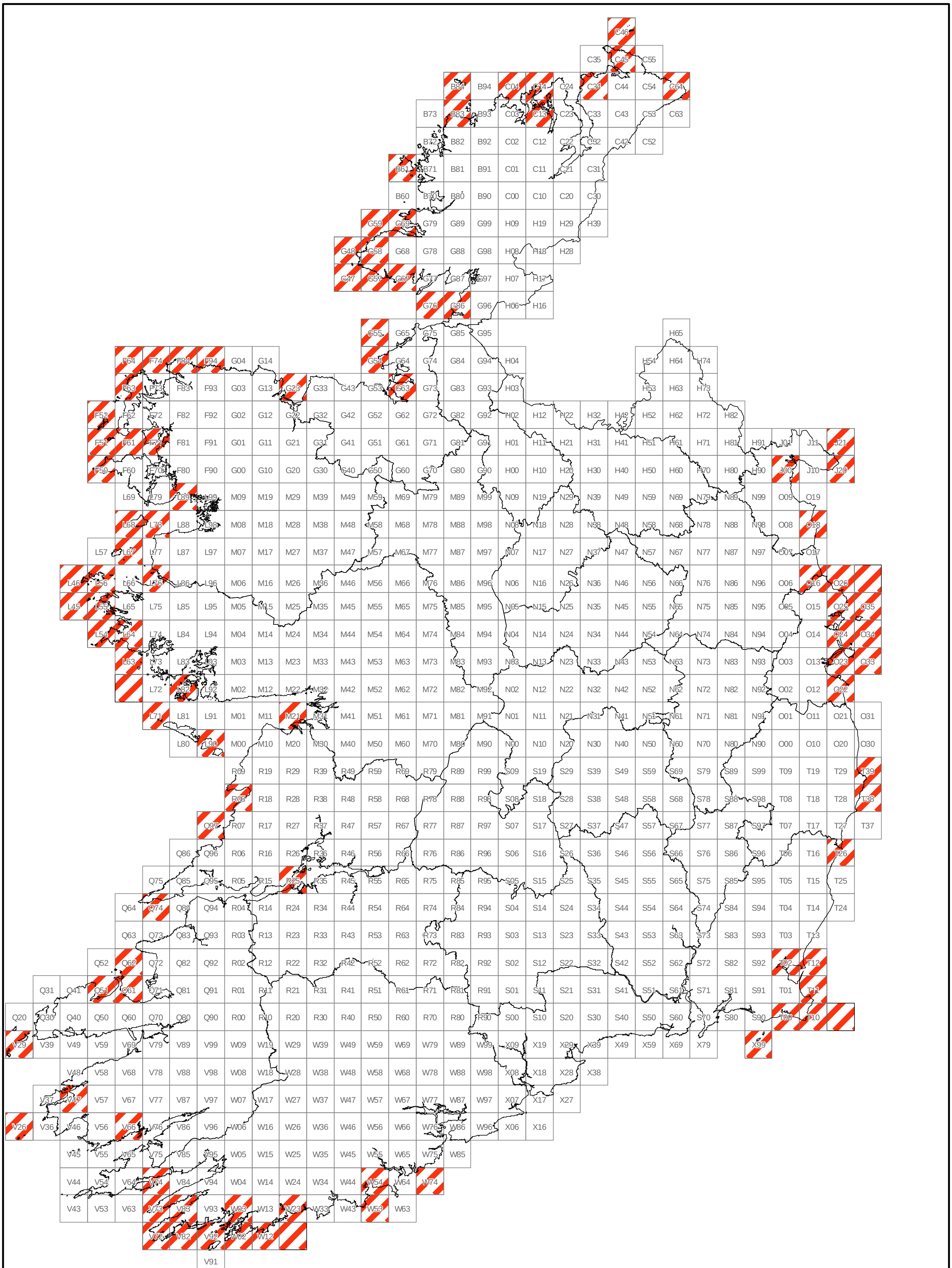


Fig. 2. Distribution of known grey seal terrestrial haul-out sites in the Rep. of Ireland (2005).

Complementary information	
Favourable reference range	Unknown
Favourable reference population	5,509-7,083 (based on breeding data from 2005)
Suitable Habitat for the species	Favourable (Availability of terrestrial habitat for use is thought not to be limiting. There is no estimate for areas away from the coast)

Other relevant information	Positive Impacts: Changes in fishing intensity and practices, leading to reduced antagonism from industry towards the species; Conservation measures presently in place in the country, e.g. 10 SACS, active local monitoring, greater emphasis towards public environmental responsibility and conservation; Environmental education and seal eco-tourism; Dedicated research programmes in place investigating aspects of the species ecology; Collaboration with international experts in seal research and population monitoring; National capacity-building and skill-strengthening in monitoring techniques and application. Negative Impacts: Continued by-catch; Occasional illegal culling; Competition for prey resources with fisheries; Excessive disturbance at key breeding and moulting haul-out sites; Competition for prey resources with fisheries; Excessive disturbance at key breeding and haul-out sites; Tourism-oriented developments on offshore islands. Additional Information: Habitat for the species is assessed as favourable. This is based on the terrestrial haul-out habitat, however there is no estimate for the area of suitable habitat beyond the coastal areas.
Conclusions* *(assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Favourable (FV)
Habitat for the species	Favourable (FV) with respect to terrestrial haul-out habitat
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

Halichoerus grypus

1364

Current Distribution (99 cells)

W48 10km grid cells

Date: October 2007

Conservation Assessment of the Harbour Seal (*Phoca vitulina vitulina* L.) in the Republic of Ireland

May, 2007

1.0 Ecology of the Harbour Seal in the Republic of Ireland

The harbour seal (*Phoca vitulina* L.) is the most widely-distributed pinniped species, inhabiting cold-temperate and temperate waters in the northern hemisphere on both sides of the north Atlantic and north Pacific oceans (Bigg, 1981). Harbour seals, are semi-aquatic mammals (Pitcher & McAllister, 1981) that spend time ashore at terrestrial sites on which they haul-out to rest, breed, moult, engage in social activity and escape predation (Thompson, 1989; Boily, 1995). Five separate subspecies are generally recognised and *Phoca vitulina vitulina* is the subspecies found in Europe (Bonner, 1990). Studies on the genetic population structure of the harbour seal have identified 17 distinct populations of harbour seals across its geographical range in the north Atlantic (NAMMCO, 2006). Based on information from neutral markers, mitochondrial DNA and a suite of nuclear micro-satellite markers, harbour seals in Northern Ireland and Scotland are considered to be part of the same population (Andersen *et al*., 2006). It is likely that harbour seals using terrestrial haul-out sites and the waters surrounding the Republic of Ireland are of the same genetic stock or population, however in the absence of information on the genetic structure of harbour seals in the Republic of Ireland this has not been confirmed. Whilst acknowledging that a distinct 'population' of harbour seals in the Republic of Ireland is unlikely, in this instance the term will represent harbour seals using terrestrial haul-out sites and the waters surrounding the Republic of Ireland.

The breeding season of the harbour seal varies widely across its geographical range, occurring in February in California with a gradual shift in the timing in northern latitudes. In the British Isles most pups are born in late June and early July (Bonner, 1990) and are able to swim soon after birth (Bonner, 1972) possibly an adaptation to living in close proximity to terrestrial predators, including man (Bonner, 1990). Pups spend a short amount of time ashore in the first few weeks of life relative to other phocid species and lactation lasts approximately 4 to 6 weeks (Allen, 1988; Bowen, 1991).

Phocid seals undergo an annual moult. Seals haul out more frequently and for longer periods during the moult, possibly due to higher energetic demands associated with follicular regeneration (Watts, 1996). The period of moult in seals may last six weeks to several months (Ashwell-Erickson *et al*., 1986) and the onset of moult in the harbour seal generally occurs after the pupping and mating periods (Ling, 1972); in Ireland the moult occurs between the period of August to October.

Patterns of movement in phocids generally are species specific and likely to be influenced by sex, size and condition (Thompson *et al*., 1998). Harbour seals are generally considered to be a relatively sedentary coastal species undertaking limited seasonal movements (Brown & Mate, 1983; Thompson, 1993; Thompson *et al*., 1994, 1996; Bjørge *et al*., 1995; Lowry *et al*., 2001). Harbour seals demonstrate philopatry or site fidelity in parts of their range (Yochem *et al*., 1987; Thompson, 1989; Corpe, 1996; Härkönen & Harding, 2001), whilst using a range of haul-out sites throughout the annual cycle (Brown & Mate, 1983; Thompson, 1989; Thompson *et al.,* 1996). Sex and age related differences in site fidelity in harbour seals have been described (Härkönen & Harding, 2001).

Harbour seal haul-out behaviour is known to be influenced by environmental and climatic variables, particularly the tidal cycle, time of day, wind speed, wind direction and degree of precipitation (Pauli & Terhure, 1987; Yochem *et al*., 1987; Thompson *et al.*, 1994; Grellier *et al.,* 1996; Withrow & Loughlin, 1996; Small *et al*., 2003). Harbour seal use of terrestrial haul-out sites in southwest Ireland has been investigated since 2003 by conducting year-round counts at haul-out sites and using photo-identification techniques and telemetry to provide information on site fidelity and haul-out behaviour. Statistical modeling of telemetry and count data has provided a means of determining the effect of variables such as time of day, weather and tide on the seals' haul-out behaviour as well as a means of correcting counts conducted under sub-optimal conditions (Cronin, 2007). The models suggest that the abundance of harbour seals at haul-out sites in the area is highest near midday during August and late afternoon/early evening in September. The outcome of this study is useful for predicting the optimal timing of future harbour seal surveys, at least in the study area.

The research on harbour seal habitat use in southwest Ireland has also provided some limited information on the seals use of their aquatic environment. The behaviour of tagged seals in the study varied over the year, animals spent a higher proportion of time ashore post moult in October, decreasing over the winter months to a minimum in February when most time was spent at sea, increasing until April and remaining relatively constant through the proceeding months until July (Cronin *et al*., 2007). Winter activity patterns of radio tagged seals around Orkney in Scotland suggest that they spend less time in inshore waters at this time of year and longer periods at sea may represent the more successful foraging strategy (Thompson *et al*., 1989). Studies of the seasonal variation in body condition of harbour seals have shown that they are at their fattest during winter (Drescher, 1979; Pitcher, 1986). The seasonal change in haul-out behaviour has been shown in other studies also; data from harbour seals tagged with satellite relay data loggers in St. Andrews Bay suggests that the proportion of time tagged seals spent near the haul-out increased steadily from winter through to summer and the probability of being hauled out is much lower in winter months (Sharples, 2005). Harbour seal pups tagged with satellite linked time depth recorders in Alaska rapidly increased the proportion of time spent at sea, from deployment in August, remaining constant through until February to April when a slight decrease was seen (Rehberg & Small, 2001).

Research effort on seal diet in Ireland to date has focused largely on the diet of the grey seal (*Halichoerus grypus*) (Anon, 1997, 2001; Kiely *et al*., 2000; Rogan *et al*., 2001; Arnett & Whelan, 2002). Research on harbour seal diet has been limited to studies conducted in Co. Down, Northern Ireland in the late 1990's (Wilson *et al.,* 2002), in Galway Bay in western Ireland since 2000 (Gilleran, *in prep*) and in Bantry Bay and the Kenmare River in southwest Ireland since 2006. Dietary analysis involved scat & stomach content analysis and additionally, in the case of the latter study, fatty acid signature analysis. There is no published information on the diet of harbour seals in the Republic of Ireland to date.

The fine-scale information on the at-sea behaviour of harbour seals currently tagged in southwest Ireland will provide a means of identifying foraging areas offshore. Modeling the telemetry and population data using recent techniques (Matthiopoulos *et al.,* 2004) will contribute to spatially explicit population foraging distribution information. A simultaneous study on the diet of harbour seals in the study area of southwest Ireland will provide auxiliary information.

2.0 Extent and Seasonal Distribution

Data from the 2003 national harbour seal survey represents the most recent distribution of harbour seal haul-out sites in the Republic of Ireland; this was mapped using ArcView GIS 3.2 (Appendix I) (Cronin *et al*., 2004). The distribution of the majority of haul-out sites described is supported by information from surveys prior to the national census and from local and regional surveys from 2003 to date (Appendix II). It is thus assumed that the plot shown represents the best current knowledge of the harbour seal's terrestrial distribution in the Republic of Ireland.

Harbour seal haul-out distribution during the 2003 moult season in the Republic of Ireland was predominantly along the western seaboard of Ireland. However, there were noticeable gaps in harbour seal distribution along the coasts of Clare, the Shannon Estuary, north Kerry and much of southern counties Cork and Waterford, Wexford and Wicklow (Cronin *et al*., 2007), as was also the case in 1978 (Summers *et al.,* 1980). Haul-out sites for harbour seals in

Ireland have tended historically to be found among sheltered inshore bays and islands, coves and estuaries (Lockley, 1966; Summers *et al.*, 1980). In this respect the indented coastline of western Ireland provides more favoured haul-out habitat for the species than the south and east coasts. Noticeable gaps in harbour seal distribution along the coasts of Clare, the Shannon Estuary, north Kerry and much of southern counties including Cork, Waterford, Wexford and Wicklow may be explained by the more homogenous nature the shoreline in these areas compared to the indented west coast, providing less preferred haul-out habitat as well as less shelter (Cronin, 2007). Harbour seals generally select sites protected from wind exposure (Bjørge *et al.*, 2002). Higher potential for disturbance may also be a reason for the low numbers of harbour seals on the south and east coast. The coastline along the south and east of Ireland is relatively developed (DoELG, 2001) with potentially higher levels of anthropogenic disturbance to seals compared to the remainder of the country and studies have shown that harbour seals select haul-out sites that are low in disturbance (Schneider & Payne, 1983; Thompson, 1989). Further investigations using Geographical Information Systems (GIS) to map the distribution of haul-out sites in relation to variables such as substrate type, bathymetry, biological wave exposure, proximity to anthropogenic disturbance and prey availability would help determine the relationship between harbour seal abundance and distribution at haul-out sites on the Irish coast and the variables associated with the sites.

The information on harbour seal distribution resulting from the 2003 national census, depicted in Appendix I, represents the distribution of the species during the annual moult only however. In assessing the distribution and conservation status of harbour seals at terrestrial haul-out sites, it should be noted that significant seasonal changes in haul-out site use are known to occur throughout the annual cycle (Cronin, 2007). An example of such seasonal changes is shown in Appendix III. Thus reliance on moult season assessments alone as a means of population monitoring will fall short of detecting changes in extent or natural range during other important phases of the harbour seal's annual cycle.

3.0 Range

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'* (EC, 2006).

Harbour seal home ranges are generally believed to be relatively small with most foraging trips within 40km of haul-out sites (Thompson *et al.*, 1996; Lowry *et al.,* 2001). Up until recently there was no information available on harbour or grey seal use of the waters surrounding Ireland. Researchers at University College Cork (UCC), Ireland in collaboration with the Sea Mammal Research Unit, St. Andrews University, Scotland are currently investigating harbour seals use of waters in southwest Ireland. The project runs from 2006 until 2008 and involves the deployment of novel tags combining GPS and GSM technologies to provide information on the fine scale movement and behaviour of the species in Irish waters. Preliminary results from this research so far suggest limited movements of harbour seals in southwest Ireland; the maximum distance travelled by a tagged seal from the coast was approximately 40km (Cronin, *in prep*). However, the sample size of tagged seals to date is small (12) and all efforts have been focused in the southwest only, therefore caution must be exercised when making inferences about offshore movement and behaviour at the population level. Harbour seals have been shown to range up to 200km and 850 km from tagging sites in the UK and US respectively (Rehberg & Small, 2001; Sharples *et al*., 2005). Considering such information and the fact that the Habitats Directive applies within member states' exclusive economic zone (EEZ), it is considered pragmatic to include all waters in the Irish EEZ as potentially part of the species range. The area encompassed by the potential range of the harbour seal in Ireland is estimated therefore as 410,310 km^2. The potential range of the harbour seal in the Republic of Ireland was mapped using ArcView GIS 3.2 (Appendix IV).

4.0 Habitat

Haul-out habitat varies across the harbour seals' geographical range and includes tidal sand and mud bars, sand and gravel beaches, inter-tidal rocks and reefs and ice floes and glacial drift (Stewart, 1984). In Ireland harbour seals use inter-tidal rocky shores, sand and mud bars within sheltered bays, coves and estuaries (Lockley, 1966; Summers *et al*., 1980, Cronin *et al*., 2007).

Recent research efforts have determined the full range of terrestrial sites used by harbour seals throughout the annual cycle in southwest Ireland and investigated seasonal patterns of seal abundance, which varied between sites (Cronin, 2007). Factors considered to play an important role in the year-round selection of haul-out sites are substrate type, distance from human disturbance, shelter from prevailing winds and immediate access to deep water (Bigg, 1981; Scheffer & Slipp, 1944; Bjørge *et al.*, 2002; Montgomery, 2005). Haul-out site selection by seals across the year may be determined by the physical characteristics of a site fulfilling particular physiological or behavioural requirements. The use of haul-out sites exclusively for pupping have been observed (Vaughan, 1971; Jeffries, 1986). Selected pupping sites generally have immediate access to deep water and are away from human disturbance and other con-specifics, as females drive other seals away from their pups (Thompson 1987, 1989, Montgomery, 2005).

Almost all efforts to date in Ireland have focused on harbour seal terrestrial distribution and habitat use. Recent research however, is providing information on harbour seals use of their aquatic habitat (Cronin, 2007; Cronin *et al.,* 2007). Preliminary results suggest that harbour seals in southwest Ireland use coastal waters within relatively close proximity (<40km) to their terrestrial haul-out sites (Cronin, *in prep*).

While ongoing research will provide further data to indicate specific terrestrial and aquatic habitat preferences, the Conservation Status of habitats for the harbour seal would appear to be Favourable. This assessment is based on current knowledge of habitat availability adjacent to breeding and moulting sites (Cronin, 2007; Cronin *et al*., 2004, 2007) and indications that the population size may be increasing, at least at nationally-important sites in the southwest of the country (Heardman *et al.,* 2006).

5.0 Population Status

5.1 Population estimation

Considerable efforts have been made in establishing the most appropriate time to obtain reliable harbour seal population estimates throughout their range (Thompson *et al*., 1989, 1997; Huber, 1995; Adkinson *et al.,* 2003; Jeffries *et al*., 2003; Hayward *et al*., 2005). Population estimates are obtained primarily by counting seals ashore at haul-out sites and surveys tend to focus on the breeding season and the moult season, when significant proportions of the population gather ashore (Jemison & Kelly, 2001; Boveng *et al*., 2003; Reijnders *et al*., 2003). Due to the physiological constraints on seals undergoing the moult they spend more time ashore during this period and haul-out frequency is likely to remain constant between years (Thompson *et al.,* 1989; Thompson & Harwood, 1990) thereby allowing a degree of comparability between moult population estimates.

While breeding season counts provide reliable estimates of abundance as well as valuable pup production data, Härkönen *et al.* (1999) concluded that in non-stable age-structured populations the influence of the differential haul-out behaviour on estimating abundance is likely to be greater during the breeding period than during the moult period. Reijnders *et al.* (2003) recommended future use of moult count data to obtain a reliable and consistent index of population abundance of harbour seals in the Wadden Sea, while Thompson *et al.* (1997) suggest that counts made during the August moult provided more reliable population estimates for harbour seals hauling out on rocky shores in the UK. Large-scale surveys of harbour seal populations occurring in rocky-shore habitats in the northeast Atlantic and northeast Pacific are generally conducted during the annual moult (Reijnders *et al.,* 1997; Huber *et al.,* 2001; Small *et al*., 2001, Duck *et al*., 2005).

Harbour seal haul-out behaviour is known to be influenced by environmental and climatic variables, particularly the tidal cycle, time of day, wind speed, wind direction and degree of precipitation (Pauli & Terhure, 1987; Yochem *et al*., 1987; Thompson *et al.*, 1994; Grellier *et al.,* 1996; Withrow & Loughlin, 1996; Small *et al*., 2003). In general, the number of harbour seals ashore at a site appears to reach a maximum within two hours of low tides occurring in the afternoon (Thompson *et al*., 1997), though this can vary with location, haul-out habitat type and site availability during the tidal cycle (Stewart, 1984; Yochem *et al*., 1987; Thompson *et al*., 1989; Thompson & Miller, 1990). While it is not possible to control for all of these variables simultaneously they are taken into consideration when planning the daily timing of population surveys.

The population of harbour seals in Ireland was first enumerated by Lockley (1966), who based his minimum estimate of 1,000 on data collected incidentally, during surveys of grey seals *(Halichoerus grypus),* in the autumns of 1964-65. More detailed census work was carried out in Northern Ireland by Venables and Venables (1960), Nairn (1979) and, more recently, by Wilson and Corpe (1996). The first harbour seal census of the island of Ireland was undertaken in July 1978 (Summers *et al*., 1980). Based on a combination of boat and aerial surveys, this gave a minimum estimate of 1,248 but population size was considered to be 1,500 to 2,000 individuals. Additional information in the Republic of Ireland was collected by Warner (1983, 1984) and haul-out counts were conducted by the National Parks & Wildlife Service (NPWS) of the Department of Environment, Heritage and Local Government at some well-known sites in the intervening years. However, these counts have varied in location, consistency, timing and methodology and could not provide complete national or island-wide perspectives on population size and distribution.

Recent population monitoring in Northern Ireland has indicated a consistent decline in the breeding population along the County Down coastline (Wilson & Montgomery-Watson, 2002; Wilson *et al*., 2002). Furthermore, research by the Environment & Heritage Service Northern Ireland estimated a minimum population of 1,248 harbour seals in 2002 (Duck, 2006). While this survey set an effective baseline for the region, with little known about the population inhabiting the rest of the island these important findings have been difficult to place into a wider context.

A significant effort was made in 2003 to address the shortfall in population data by means of a co-ordinated national census programme that could act as a definitive population assessment and as a tool for ongoing monitoring. The census was funded by the NPWS. The primary objectives of this programme were to obtain an up-to-date harbour seal population estimate for the Republic of Ireland and for individual haul-out sites and to contribute important information to the understanding of current harbour seal distribution throughout Ireland.

Consideration of background data on harbour seal distribution for the Republic of Ireland (Lockley, 1966; Summers *et al*., 1980; Warner, 1983, 1984) and the predominance of rocky shore haul-out habitat, suggested that the harbour seal moult represented the best single period from which to derive estimates of population size across the range of known haul-out sites.

A well-established, cost-effective technique for counting harbour seals from the air was utilised. This helicopter-based thermal imaging technique developed by the Sea Mammal Research Unit, (SMRU), University of St. Andrews, Scotland (Hiby *et al.,* 1993, 1996), has been used for monitoring harbour seal populations in the UK since 1988 and it was adopted for the harbour seal survey of Northern Ireland in 2002 (Duck*,* 2006). In order to validate count data acquired by aerial means and investigate errors in ground-counting harbour seals among a range of monitoring sites, twelve harbour seal haul-out sites along the Irish coast was chosen for 'ground-truthing', i.e. to be surveyed by shore-based observers prior to and simultaneously with the aerial survey. Collated and revised aerial- and ground-count figures yielded a 2003 minimum population estimate in the Republic of Ireland of 2,905 harbour seals, with 31.7%, 31.6%, 33.6% and 3.1%, of the national minimum population estimate occurring in the northwest, west, southwest and southeast/east of the country respectively (Cronin *et al.*, 2004, 2007).

The estimate of 2,905 animals in the Republic of Ireland, when combined with a near identical survey of Northern Ireland in 2002 (Duck, 2006), gives an All-Ireland minimum population of 4,153 harbour seals.

Studies show that annual counts conducted during both the breeding season and the moult provide accurate estimates of abundance in estuarine habitat. In contrast, counts conducted during the moult provide more reliable abundance estimates in rocky-shore habitats (Thompson *et al*., 1997). Breeding season counts in estuarine habitats provide the opportunity for simultaneous collection of information on pup production. Additionally they provide the opportunity for the integration of information on the haul-out behaviour of tagged seals, prior to moult associated tag loss, to improve population estimates. The 2003 survey demonstrated that some estuarine areas and inter-tidal sandbanks might form very significant haul-out sites, particularly in Counties Donegal, Sligo, Wexford and inner Galway Bay. Potential differences in haul-out behaviour across different habitat types warrant an investigation into the suitability of population estimation surveys during the breeding season at some localities in Ireland.

5.2 Population trends

Although the minimum population estimate obtained in 2003 is more than three times the 1978 estimate (1,248) (Summers *et al*., 1980), the figures are not directly comparable due to different timing and survey techniques. The 1978 survey was carried out during the breeding season and did not cover the entire coastline of Ireland. The 2003 estimate should instead be considered as a more reliable baseline figure against which future estimates can be compared to assess population trends.

Counts of harbour seals at haul-out sites in southwest Ireland have been conducted by NPWS rangers during April to October from 1985 to 1999 and during August and September from 2000 to present and have shown an 8% and 13% annual increase in the Kenmare River and Bantry Bay respectively (Heardman *et al.,* 2006) (Figure 1). This may reflect a national trend but in the absence of an historic national population estimate directly comparable to the 2003 estimate it is not possible to ascertain this. Heardman *et al*. (2006) suggest the evident increase in harbour seal numbers in southwest Ireland may be attributed to lack of persecution following the 1976 Wildlife Act which affords protection to the species in Ireland. Prior to such, a bounty system operated in an attempt to reduce the impact of seal predation on fish stocks (Hayden & Harrington, 2000).

The increasing trend in harbour seal numbers in the southwest of Ireland could be a result of possible shifts or changes in the distribution of the harbour seal in Ireland. In 1978-84, the harbour seal population in the Republic of Ireland was found to be concentrated in the west and northwest of the country (Summers *et al.,* 1980; Warner, 1983, 1984) while Co. Down held almost half of the all-Ireland population at this time (Nairn, 1979). The southwest was not identified as important an area for harbour seal haul-outs in the 1978 breeding season (Summers *et al*., 1980) as it was during the 2003 moult (5.2% and 33.5% of the national population estimates respectively). The species is generally considered to be site-specific (Pitcher & McAllister, 1981; Brown & Mate, 1983) nevertheless seasonal variations in site-use have been described (Thompson, 1989; Thompson & Harwood, 1990; Matthews & Kelly, 1996; Thompson *et al.,* 1997) and therefore caution must be exercised in comparing these data.

Bantry Bay

Kenmare River

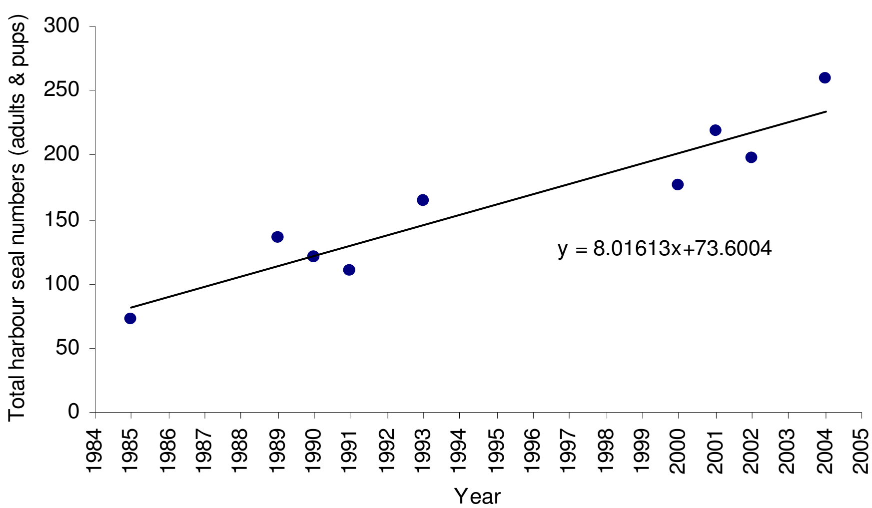


Figure 1. Harbour seal counts in Bantry Bay, Co. Cork and the Kenmare River, Co. Kerry between 1994 and 2005, showing a 13% and 8% increase per annum respectively (*after* Heardman *et al.,* 2006)

6.0 Conservation Status

6.1 Range Conservation Status

The Favourable Reference Range (FRR) for the harbour seal in the Republic of Ireland is not known due to the scarcity of information on harbour seal distribution in Irish coastal and offshore waters. However, since the range of coastal haul-out sites used by the species appears to be stable and historical distribution data are supported by current information, a Favourable conservation status is indicated.

- **Species Range Area:** potentially 410,310 km^2, the area of Irelands' EEZ
- **Favourable Reference Range:** Unknown

6.2 Habitat Conservation Status

A detailed understanding of harbour seal habitat availability and preferences in the Republic of Ireland does not currently exist, whether in the aquatic or terrestrial environments. However, based on coastland littoral habitat availability adjacent to existing breeding and moulting haul-out sites and the relatively small, stable population size currently using these sites throughout the Republic of Ireland, the Habitat Conservation Status for the harbour seal may be inferred as Favourable.

6.2 Population Conservation Status

The Favourable Reference Population 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 considered that the minimum population estimate of 2,905 derived in 2003 by means of a comprehensive national survey (Cronin *et al*., 2004, 2007) represents the Favourable Reference Population for the Republic of Ireland.

- **Species Population:** Defined via nationally-acquired haul-out count data during the 2003 moult season.
- **Favourable Reference Population:** Derived by Cronin *et al*., 2007, based on data collected during the 2003 moult season, the estimated minimum population size in the Republic of Ireland and Favourable Reference Population is 2,905 harbour seals.

Following the General Evaluation Matrix for assessing the Conservation Status of Annex II Species (EC, 2006); because the Estimated Present Population appears to be stable or increasing, at least in certain parts of the species national range, the Conservation Status of the harbour seal in the Republic of Ireland is Favourable.

7.0 Impacts and Threats

7.1 Positive impacts

7.1.1 Conservation designations

In the late 1990s the National Parks and Wildlife Service (NPWS) proposed all of the known breeding sites of the two species as Special Areas of Conservation (SACs). There are currently seven SACs in Ireland with the harbour seal listed as a qualifying interest (D. Lyons, NPWS, *pers. comm.*) (Appendix V).

7.1.2 Ongoing monitoring

Ongoing monitoring of harbour seals at specific haul-out sites by NPWS staff over the past three decades has provided useful information (Appendix II). Most of these efforts have been sporadic and inconsistent in timing and survey methodology, making it difficult to robustly examine regional population trends. However monitoring of harbour seal abundance at haul-out sites in southwest Ireland has been carried out in a more rigorous fashion by NPWS since the mid 1980s, providing valuable information on local population trends (Heardman *et al.,* 2006). The value of ongoing local monitoring initiatives cannot be underestimated. The 2003 survey highlighted the significance of individual haul-out sites and regions within a national context. A smaller-scale national monitoring programme for harbour seals, reviewed at annual intervals would determine the most appropriate time for a repeat national census and provide data on regional population trends. Ideally surveys would be carried out at 'index' sites throughout the annual cycle, providing important data on the influence of covariates on seal haul-out behaviour at these sites and potentially providing information on pup production and breeding season population estimates. As well as contributing to the understanding of trends in national population estimates and improving the accuracy of these estimates, such research efforts will be essential if the importance of specific sites and/or regions are to have a sound scientific basis and are necessary for the effective identification, management and monitoring of Special Areas of Conservation (SAC).

7.1.3 Research programmes

Dedicated research on the harbour seal in southwest Ireland has been conducted since 2003 by researchers from University College Cork (UCC), providing vital information on aspects of the species ecology such as seasonal changes in abundance, haul-out behaviour, habitat use and foraging ecology (Cronin, 2007; Cronin *et al.,* 2007). A collaborative study, funded by the Marine Institute under the NDP, is currently addressing the foraging ecology of the species and using novel telemetry technology to provide information, heretofore unavailable, on the offshore distribution and behaviour of harbour seals in Irish waters. The study is also providing valuable information on the diet of the harbour seal in Ireland.

7.1.4 Collaboration

The recent research initiatives have strengthened links between scientists from UCC and world leading experts in pinniped research and population monitoring techniques from the Sea Mammal Research Unit, St. Andrews University Scotland and the National Marine Mammal Laboratory in NOAA, US. NPWS staff have actively participated in national and local population surveys and have provided valuable assistance to UCC researchers in the field during tag deployments on harbour seals, further strengthening links between the NPWS and the research community and building national skills and capacity.

7.1.5 Drift net ban

Since November 2006, at-sea drift net fishing for salmon has been banned in Irish waters. Although never quantified, the drift net fishery was responsible for incidental catches of both harbour seals and grey seals. The recent ban of the fishery has positive implications for both species.

7.2 Negative impacts and threats

In some areas across the species' geographical range the numbers of harbour seals are increasing (Small *et al*., 2003; Thompson *et al.,* 2005; Waring *et al*., 2006; Heardman *et al*., 2006; Jemison *et al.,* 2006). However declines in abundance have also been observed in many areas and have been attributed to recruitment failure, competition for resources, disturbance and disease (Frost *et al*., 1999; Thompson *et al*., 2001; Matthews & Pendleton, 2006; Lonergan *et al*., 2007). A scientific committee working group on harbour seals was recently established by the North Atlantic Marine Mammal Commission (NAMMCO) to assess the status of harbour seals across the North Atlantic and to evaluate threats to the species (NAMMCO, 2007).

7.2.1 Disease

Epidemics of phocine distemper virus (PDV) affected European harbour seal populations in 1998 and 2002 and harbour seal abundance has fluctuated in the northeast Atlantic due to outbreaks of this disease (Dietz *et al.,* 1989; Harding *et al.,* 2002). Predicting the potential long-term effects of disease such as PDV on harbour seal populations requires information on pre-epidemic population trajectories (Harding *et al*., 2002; Lonergan & Harwood, 2003). It is known that harbour seals in Ireland were affected by outbreaks of Phocine Distemper Virus (PDV) in 1988-89 and 2002 (CWSS, 1991; Barrett *et al*., 2003). Yet, in spite of apparent local increases in seal deaths and changes in haul-out counts at a few sites in western Ireland (Gilleran, J., NUIG, *pers. comm.*) and confirmed pathology from an animal found on the Aran Islands (Kennedy, S., DARDNI, *pers. comm.*), in the absence of consistent monitoring of regional haul-out groups in the Republic and a reliable up-to-date population estimate, it was not clear if the disease caused a significant decline in population size in the Republic or indeed around the island of Ireland as a whole.

7.2.2 Fisheries interactions

Harbour seals are harvested and/or taken incidentally by fisheries (Bjørge *et al*., 2002) and they have significant direct and indirect interactions with fisheries in many areas (Olesiuk *et al*., 1995; Trites *et al*., 1996; Middlemass *et al*., 2006).

A number of dedicated marine mammal and fishery interaction observer programmes have operated in the waters around Ireland, mostly operating offshore and off the south coast. Of these, a small number of harbour seals (3) have been reported to have been entangled in gill (tangle) nets (BIM, unpublished data, Rogan, E. UCC, *pers comm.*). Strandings programmes have primarily focused on recovering small cetaceans for post-mortem examination. Only a small number of harbour seals (<5) have been examined, and in one of these, cause of death was reported to be from entanglement in fishing gear (Rogan, E. UCC, *pers comm.).*

The perceived impact of seals on Irish fisheries has led to calls for population control and the demands of seal conservation and marine resource management have come into conflict. In the absence of reliable information on seal foraging ecology, the issue has remained largely ignored by Government. Environmental considerations are now integrated into the Common Fisheries Policy (CFP) by a way of an 'ecosystem approach' to the marine environment, taking into account the interaction among food webs of ecosystems. Given adequate data on fish stocks, the fisheries, seal population sizes and their foraging ecology it should be possible to estimate the impact of seals on commercial fisheries. Considering the need for spatially explicit management of fish stocks, spatially explicit population foraging distribution data of a top marine predator would be invaluable to resource managers and policy makers. We have begun to address this in the recently undertaken study of the offshore foraging distribution of harbour seals tagged in southwest Ireland. Further information on both the terrestrial and offshore distribution of harbour seals in Ireland will help overcome limitations associated with small sample size and sample biases (age, sex and location) and population estimate uncertainty, augmenting the estimation of a spatially explicit Irish harbour seal population foraging distribution. The determination of spatial overlap between seal foraging, fish abundance and human activity would help to inform local and national management policy. Such information could assist government agencies in assessing predation pressures by seals on vulnerable or economically important fish stocks and in delineating marine Special Areas of Conservation for seals.

The physical and operational interactions between seals and the fishing industry is also a problem in Ireland. In spite of a general reduction in several traditional static-net fisheries in Irish waters the problem of seal predation on and damage to commercially exploited fish species continues to be demonstrated, particularly in select estuarine and aquaculture situations along the western seaboard (Rogan & Ó Cadhla, 2003; Ó Cadhla, O., CMRC, *pers. comm*). Whilst several studies in the last decade (Anon, 1997, 2001; Kiely *et al*., 2000; Rogan *et al*., 2001; Arnett & Whelan, 2002) have concentrated research efforts on evaluating the degree of operational interaction between grey seals and fisheries, the scale of interaction by harbour seals on commercial fishing and aquaculture is unclear and economic loss due to damage is not currently quantified. Fishermen and other commercial operators may obtain a Section 42 licence from the NPWS to shoot harbour and grey seals acting as pests in such operations. However the number of seals approved for removal in such situations is generally low (1-2 seals per annum) and anecdotal evidence gathered by UCC suggests that removal by shooting may not be operating as an effective solution in such cases (Ó Cadhla, O. CMRC, *pers. comm*.). A new initiative is currently under way to assess other potential means of managing the problem and alleviating damage to ecologically sensitive fish stocks (e.g. native salmonids) while maintaining seal populations at favourable conservation levels.

7.2.3 Ecotourism

Over one-third of the national population of harbour seals use haul-out sites in southwest Ireland (Cronin *et al*., 2007). A growing seal-watching eco-tourism industry in the area is a cause for concern, particularly as it is primarily operating in the immediate vicinity of significant breeding and moulting sites in inner Bantry Bay and the Kenmare River. Moreover the periods of highest boating activity coincide with periods of breeding and moulting, when the seals are most vulnerable. Despite the fact that Glengarriff harbour in inner Bantry Bay is an SAC, with the harbour seal specifically listed as a qualifying interest, there is no legislative framework or guidelines in place to protect the seals from disturbance. It is suggested that a ‘code of conduct’ be put in place to advise boat operators and seal-viewing tour operators of appropriate boating and behaviour within the harbour in order to minimise disturbance to the seals. Despite the fact that the Kenmare River SAC does not yet have the harbour seal listed as a qualifying interest, it is suggested that a precautionary approach be taken and such a code of conduct be put in place within the Kenmare River also, considering the potential conflict between seal conservation and ecotourism in the inner bay. A code of conduct has been successfully implemented in the Shannon Estuary on the west coast of Ireland to minimise disturbance to a resident bottlenose dolphin (*Tursiops truncatus*) population from a growing dolphin-watching ecotourism based in the area (DCMNR, 2005). Ideally sustainable ecotourism should advocate a non-consumptive use of wildlife and natural resources, financially contribute to an area and directly benefit the conservation of a site and the economic well-being of the local residents (Ziffer, 1989).

8.0 Future Prospects

8.1 Future Prospects for the species’ Conservation Status

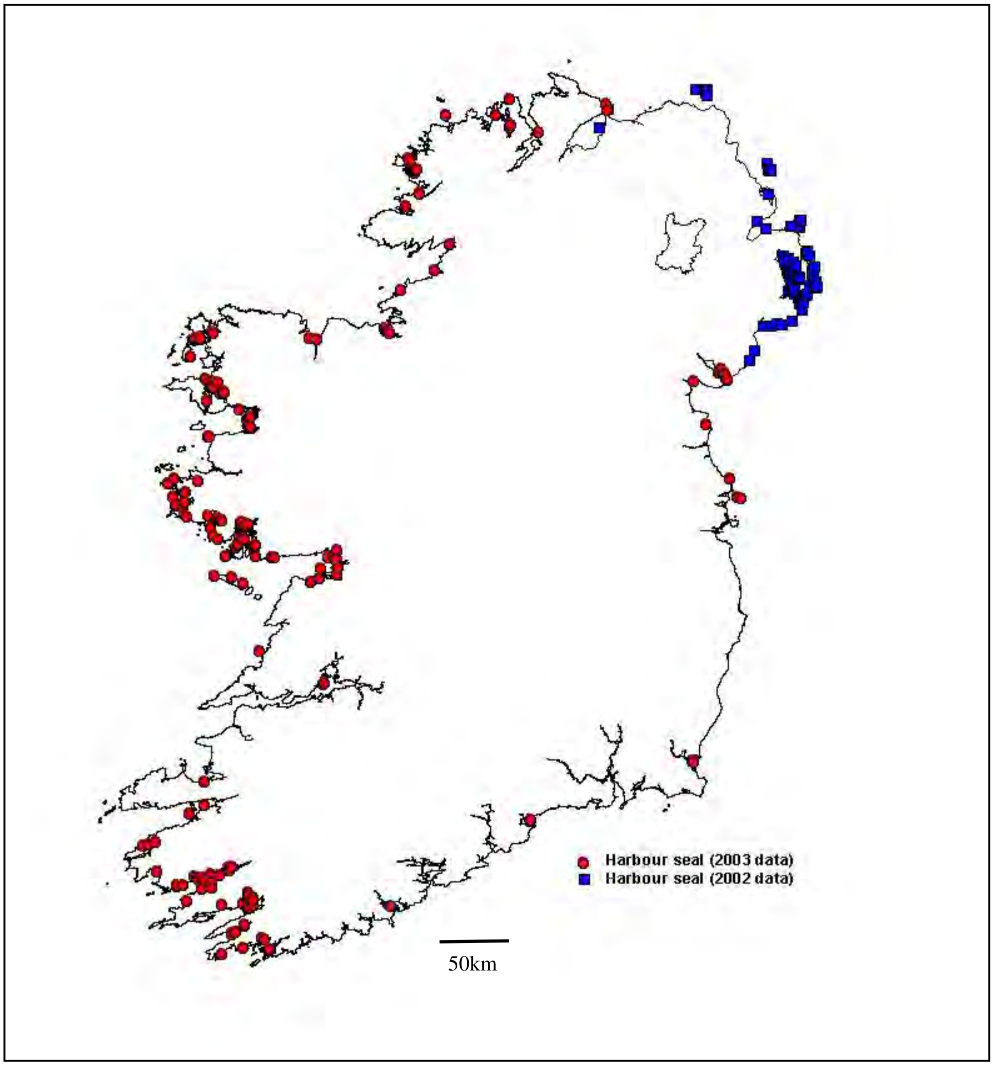
Monitoring (long-term systematic observation) is necessary to determine conservation status and trends. It is recommended that a national harbour seals census be conducted at annual intervals in Ireland as Teilmann (2007) suggests that annual population surveys as opposed to multiple surveys every other year would maximise the power to detect trends in the population. A robust estimate of population trend can be calculated in as few as five years (Adkinson *et al.,* 2003). It is also recommended that future population estimation surveys of this kind be conducted over the entire island of Ireland. 'Monitoring must therefore lead to a clear picture of the actual conservation status and its trends on various levels and indicate the effectiveness of the directive in terms of approaching and reaching this objective' (EC, 2005).

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

Range of the Harbour Seal:	**Favourable**
Habitat for the Harbour Seal:	**Favourable**
Population of the Harbour Seal:	**Favourable**
Future Prospects for the Harbour Seal:	**Favourable**
Overall Assessment:	**Favourable Conservation Status**

Appendix I

Distribution of harbour seal haul-out sites in Ireland (2003) (*after* Cronin *et al.,* 2004)



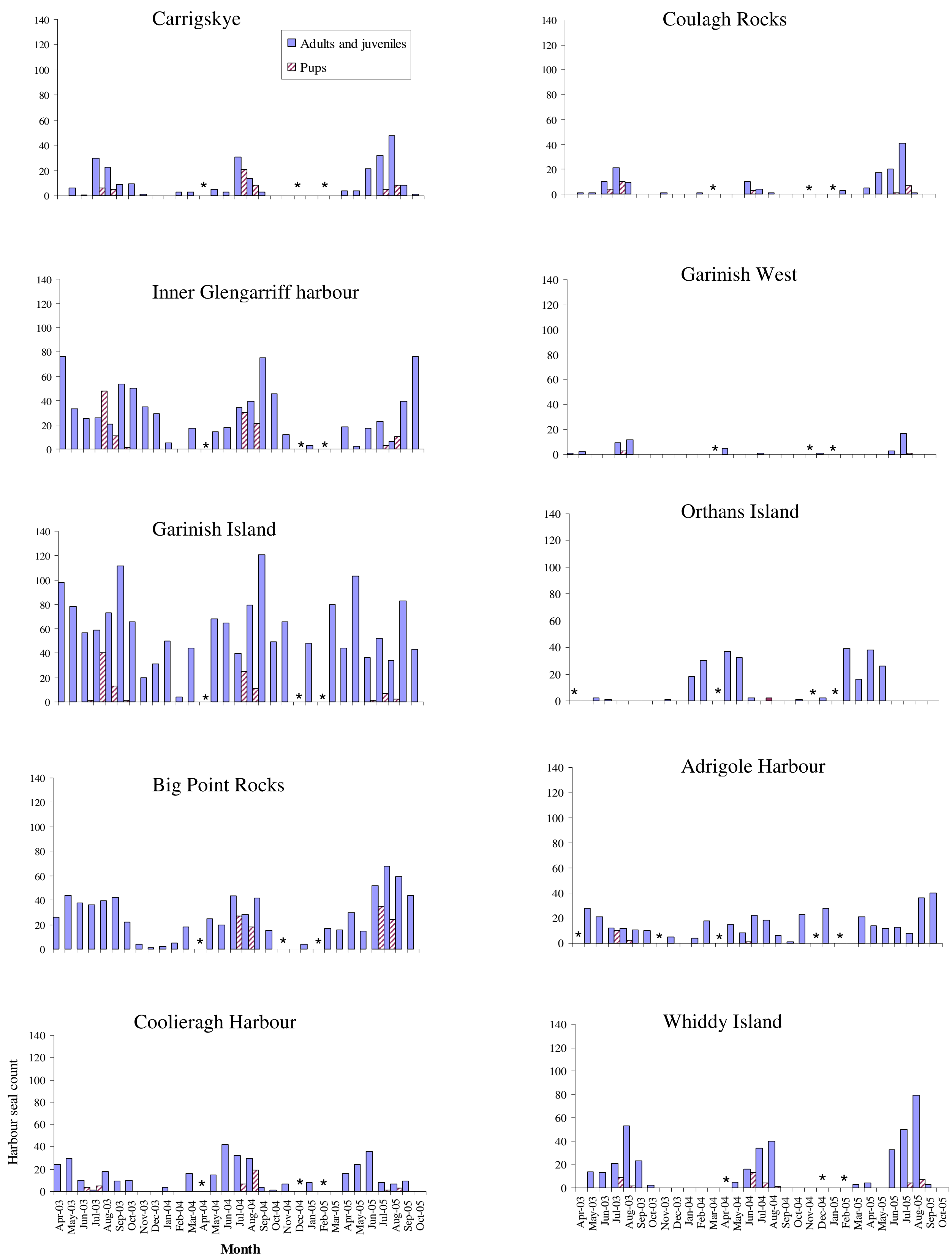
Appendix II

Surveys of the Harbour Seal in the Republic of Ireland

YEAR(S)	REFERENCES	SEASONS	LOCATIONS	SURVEY TYPE
1964-65	Lockley, 1966	Moult	National	Minimum count Reconnaissance
1978-2003	Warner, *unpublished* Gilleran, *unpublished* Nairn, 1977 Nairn, 1979 Summers *et al*., 1980 Warner, 1983, 1984 Harrington, 1990 Smiddy, 1998 Lyons, 2004	Breeding Moult	Selected haul-out sites in counties Donegal, Sligo, Mayo, Clare, Galway, Kerry, Cork, Waterford, Down.	Haul-out count Minimum pup count Reconnaissance
1964-2004	Heardman *et al*., 2003	Breeding Moult	Bantry Bay, Co. Cork Inner Kenmare River, Co. Kerry	Haul-out count Minimum pup count
2003	Cronin *et al*., 2004 Cronin *et al*., 2007	Moult	National	Minimum population estimate (aerial, thermal imagery)
2003-2007	Cronin, 2006 Cronin, 2007 Cronin *et al*., 2007	All	Bantry Bay, Co. Cork Inner Kenmare River, Co. Kerry	Reconnaissance Haul-out count Minimum pup count Photo-ID Telemetry

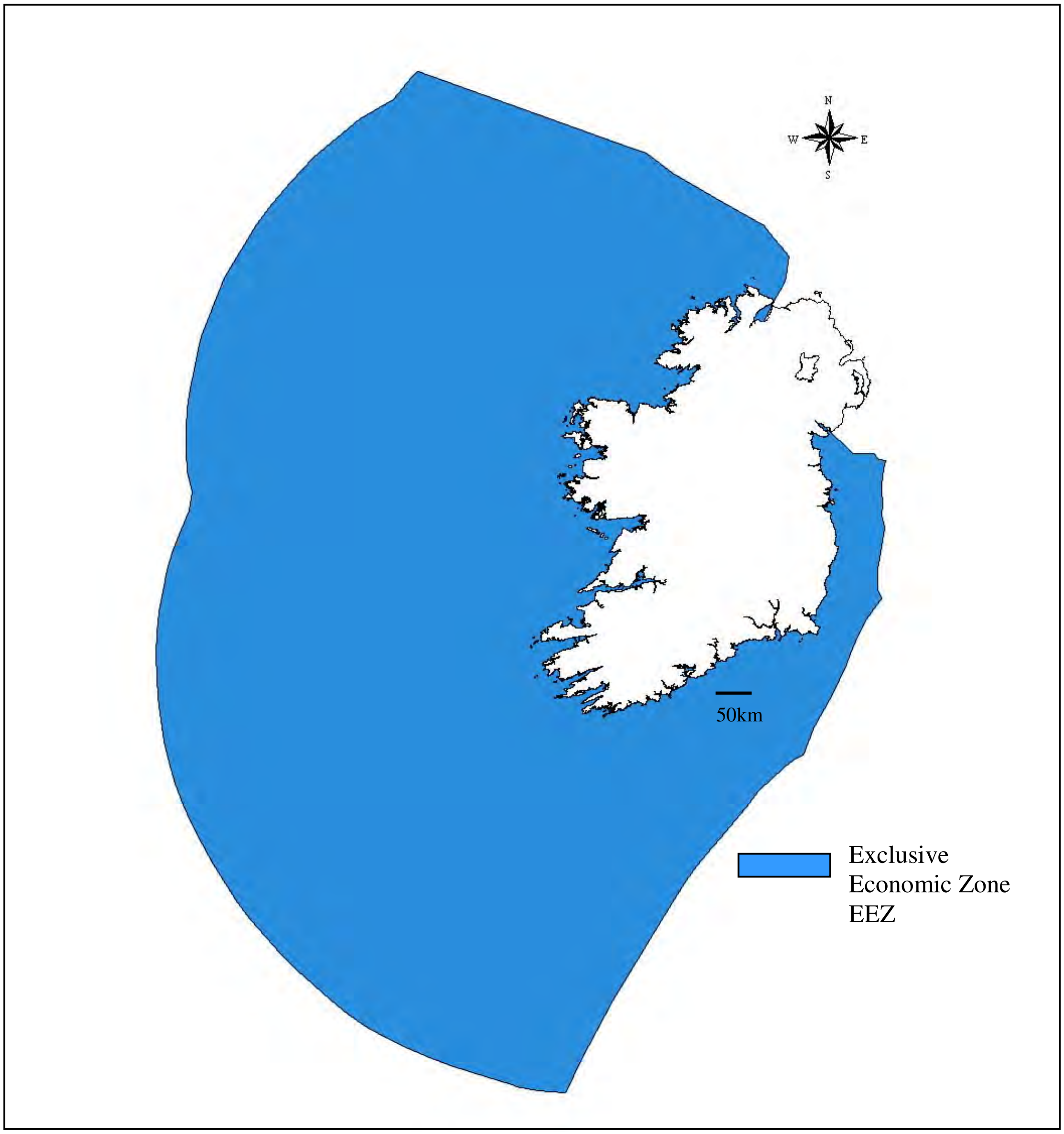
Appendix III

Variation in site use throughout the annual cycle - Maximum harbour seal counts at haul-out sites in Bantry Bay, Co. Cork April 2003 to October 2005 (*= no count)
(*after* Cronin, 2007)



Appendix IV

Potential Range of the Harbour seal in Ireland (2007)



Appendix V

Special Areas of Conservation (SACs) designated for Harbour Seals in the Republic of Ireland

Site Code	Name of site	County
000090	Glengarriff Harbour and woodland	Cork
000133	West of Ardara/Maas Road	Donegal
000268	Galway Bay Complex	Galway
000622	Ballysadare Bay	Sligo
000627	Cummeen Strand/Drumcliff Bay	Sligo
001482	Clew Bay Complex	Mayo

Appendix VI

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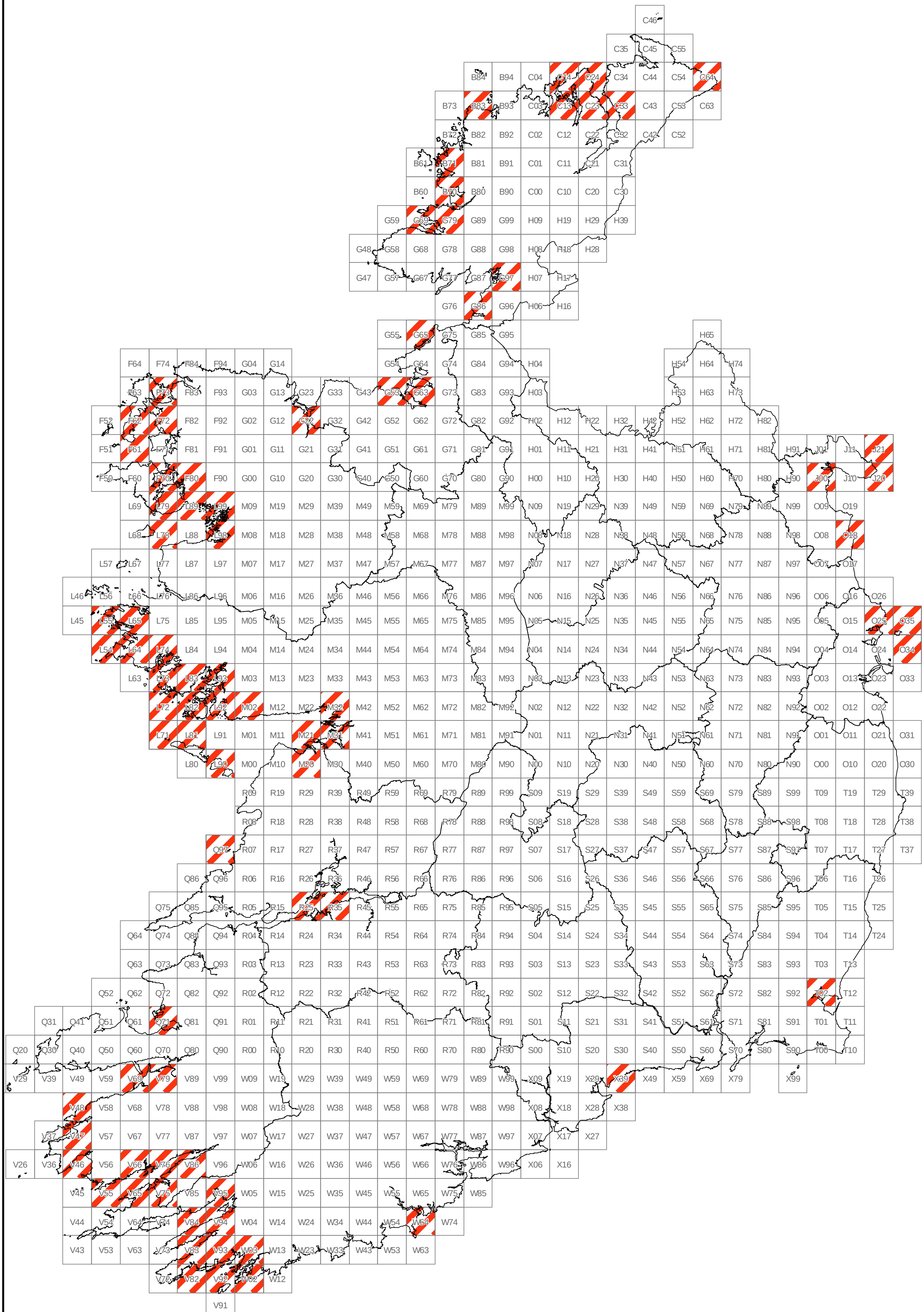
1365 Harbour Seal (*Phoca vitulina vitulina*)

National Level	
Species code	1365
Member State	IE
Biogeographic regions concerned within the MS	ATL, MATL
Range	Unknown (Potentially 410,310 km - area of Irelands' EEZ)

Biogeographic level	
Biogeographic region	ATL, MATL
Published sources	▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O' Keeffe, C. (2007). An assessment of population size and distribution of harbour seals in the Republic of Ireland during the moult season in August 2003. *Journal of Zoology (in press)* ▪ Cronin, M.A. (2006). The status of the harbour seal (*Phoca vitulina vitulina*) in the Republic of Ireland. NAMMCO Scientific Publications SC/14/HS/13. 14 pp. ▪ Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O'Keeffe, C. (2004). Harbour seal population assessment in the Republic of Ireland: August 2003. *Irish Wildlife Manuals* No. 11. Dept. of the Environment, Heritage and Local Government, 7 Ely Place, Dublin. Ireland. 34 pp. ▪ Lyons, D.O. (2004). Summary of National Parks & Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003. *Irish Wildlife Manuals* No. 13. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government. 7 Ely Place, Dublin. Ireland. ▪ Also, see Appendix VI of Conservation Assessment report.
Range	
Surface area	Unknown (Potentially 410,310 km²)
Date	05/2007
Quality of data	2 = moderate
Trend	Unknown
Trend-Period	Not applicable
Reasons for reported trend	0
Population	
Distribution map	See Figure 2
Population size estimation	2,905
Date of estimation	August 2003
Method used	3 = from complete inventory
Quality of data	3 = good
Trend	Unknown
Trend-Period	Not applicable
Reasons for reported trend	Not applicable
Justification of % thresholds for trends	Trend unknown but unlikely to be negative
Main pressures	200, 211, 212, 230, 530, 621, 690, 710, 963
Threats	200, 211, 212, 230, 530, 621, 690, 710, 963
Habitat for the species	
Area estimation	Unknown (potentially 410,310 km^2)
Date of estimation	05/2007
Quality of data	1 = poor
Trend	Unknown
Trend-Period	Not applicable
Reasons for reported trend	Not applicable
Future prospects	1 = good prospects

Complementary information	
Favourable reference range	Unknown
Favourable reference population	2,905 (minimum population estimate derived during the 2003 national harbour seal census)
Suitable Habitat for the species	Favourable Availability of terrestrial habitat for use is considered not to be limiting. There is no estimate for areas away from the coast.
Other relevant information	Positive Impacts: Changes in fishing intensity and practices, leading to reduced antagonism from industry towards the species; Conservation measures presently in place in the country e.g. 6 SACS, active local monitoring, greater emphasis towards public environmental responsibility and conservation; Environmental education and seal eco-tourism; Dedicated research programmes in place investigating aspects of the species ecology; Collaboration with international experts in seal research and population monitoring; National capacity-building and skill-strengthening in monitoring techniques and application. Negative Impacts: Continued by-catch; Occasional illegal culling; Competition for prey resources with fisheries; Disturbance at key breeding and moulting haul-out sites; No Other comments: Habitat for the species is assessed as favourable. This is based on the terrestrial haul-out habitat, however there is no estimate for the area of suitable habitat beyond the coastal areas.
Conclusions (assessment of conservation status at end of reporting period)	
Range	Unknown (XX)
Population	Favourable (FV)
Habitat for the species	Favourable (FV) with respect to terrestrial haul-out habitat (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

Phoca vitulina

1365

Current Distribution (81 cells)

W48 10km grid cells

Date: October 2007

1376 & 1377 Maerls (*Lithothamnion corralloides*) & (*Phymatolithon calcareum*)

1. National Level	
Species code	1376 Maerl - *Lithothamnion corralloides* 1377 Maerl - *Phymatolithon calcareum*
Member State	IE
Biogeographic regions concerned within the MS	(MATL)
1.1 Range	Range within the country concerned

2. Biogeographic level (complete for each biogeographic region concerned)	
2.1 Biogeographic region	(MATL)
2.2 Published sources	▪ Blunden G, Binns WW, Perks F. 1975. Commercial collection and utilisation of maërl. *Econ Bot*, **29**: 140-145. ▪ Blunden, G., Farnham, W. F., Jephson, N., Barwell, C. J., Fenn, R.H., & Plunkett, B. A. (1981). The composition of maerl beds of economic interest in Northern Brittany, Cornwall and Ireland. Proc. Int. Seaweed Symp., 10: 651-656. ▪ Blunden G, Campbell SA, Smith JR, Guiry MD, Hession CC, Griffin RL. 1997. Chemical and physical characterization of calcified red algal deposits known as maërl. *J. appl. Phycol.*, **9**: 11-17. ▪ Bosence DWJ. 1979. Live and dead faunas from coralline algal gravels, Co. Galway. *Palaentology*, **22**: 449-478, pls 51-52. ▪ Briand X. 1991. Seaweed harvesting in Europe. In *Seaweed Resources in Europe: Uses and Potential*. (Guiry, M. D. Blunden, G., editors), 259-308. John Wiley & Sons, Chichester. ▪ De Grave S, 1999. The influence of sedimentary hetrogeneity wuthin maerl beds and differences in infaunal crustacean communities. *Estuarine, Coastal and Shelf Sciences* **29**. 153 – 163. ▪ De Grave S, Whitaker A. 1999. A census of maerl beds in Irish waters. *Aquatic Conserv: Mar. Freshw. Ecosyst.*, **9**: 303-311. ▪ De Grave S, Whitaker A. 1999. Benthic community readjustment following dredging of a muddy maerl matrix. Marine Pollution Bulletin **38.** 102 – 108. ▪ De Grave S, Fazakerley H, Kelly L, Guiry MD, Ryan M, Walshe J. 2000. A study of selected maërl beds in Irish waters and their potential for sustainable extraction. *Mar. Resour. Ser., Irel.*, **10**: 1-44. ▪ Gallagher M. 2000. Preliminary sublittoral survey of maërl beds in Strangford Lough. B.Sc. Grall, J. & Hall-Spencer, J.M. (2003) Problems facing maerl conservation in Brittany. Aquatic Conservation, Marine and Freshwater Ecosystems 13, 55-64 ▪ Hall-Spencer, J. M. (1995a). The effects of scallop dredigng on maerl beds in the Firth of Clyde. Porcupine Newsletter 6 (1): 16-27. ▪ Hall-Spencer, J. M. (1995c). Evaluation of the direct impact of scallop dredging on the substratum and on the benthos. Final report to the EC. Ref. no. PEM/93/08. ▪ Hall-Spencer, J. M. (1998). Conservation issues relating to maerl beds as habitats for molluscs. J. Conchology Special Publication, 2: 271-286. ▪ Hall-Spencer J. 1998. Conservation issues relating to maerl beds as habitats for molluscs. *Journal of Conchology, Special Publication*, **2**: 271-286.

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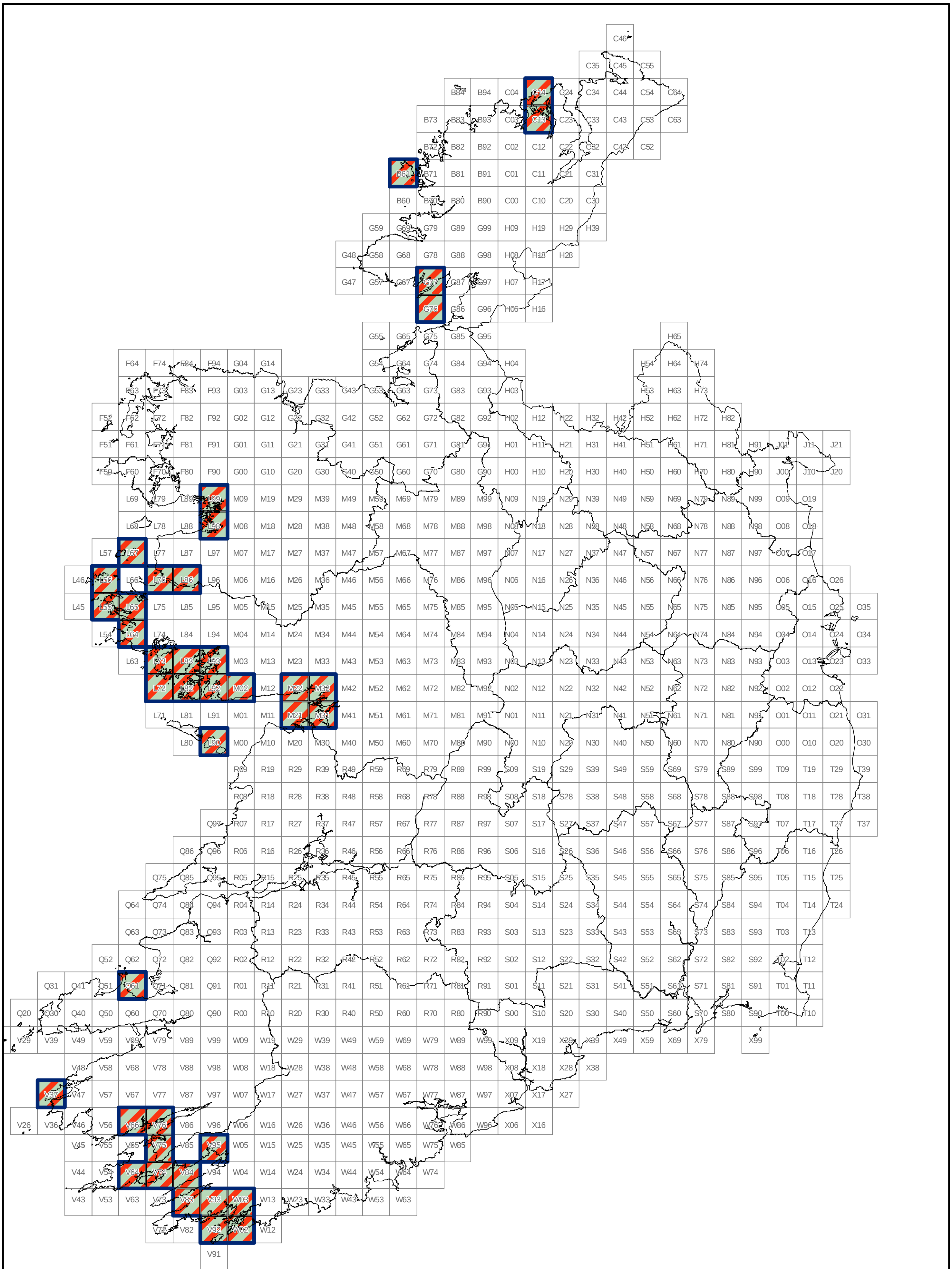
2.3 Range	
2.3.1 Surface area	40 X 100 km²
2.3.2 Date	1852-2006
2.3.3 Quality of data	2 = moderate
2.3.4 Trend	0 = stable
2.3.6 Trend-Period	1994-2006
2.3.7 Reasons for reported trend	NA
2.4 Population	
2.4.1 Population size estimation	Unknown
2.4.2 Date of estimation	2007
2.4.3 Method used	N/A
2.4.4 Quality of data	1 = poor
2.4.5 Trend	Unknown
2.4.7 Trend-Period	1994-2006
2.4.8 Reasons for reported trend	0 = unknown
2.4.9 Justification of % thresholds for trends	N/A
2.4.10 Main pressures	200 Aquaculture 210 Professional fishing 301 Sand and gravel extraction 503 Removal of flora 701 Water pollution 954 invasion of a non-native species (as a result of human activities).

2.4.11 Threats	200 Aquaculture 210 Professional fishing 301 Sand and gravel extraction 503 Removal of flora 701 Water pollution 954 invasion of a non-native species (as a result of human activities).
2.5 Habitat for the species	
2.5.2 Area estimation	Unknown
2.5.3 Date of estimation	2007
2.5.4 Quality of data	1 = poor
2.5.5 Trend	Unknown
2.5.6 Trend-Period	1994-2006
2.5.7 Reasons for reported trend	N/A
2.6 Future prospects	Moderate

2.7 Complementary information	
2.7.1 Favourable reference range	40 X 100 km²
2.7.2 Favourable reference population	Unknown
2.7.3 Suitable Habitat for the species	Unknown
2.7.4 Other relevant information	The distribution of *Lithothamnium corallioides* and *Phymatolithon calcareum* have not been mapped in detail. Thee two species form a thin veneer on the surface up to about 20cm in depth. Beneath the veneer is a deposit of dead maerl gravel with varying degrees of mud. The biodiversity of the maerl bed will vary according to the three dimensional structure of the living veneer and the composition of the deposit below it. Dead maerl gravel may also be found away from living beds. It is not known whether these beds are formed by movement of the gravel by wave action, or whether they supported live maerl in the past. Beds of maerl gravel are as ecologically important as those with live material present. Maerl is extremely slow growing i.e. 1-2 mm per year and so maerl gravel must be considered to be a geological feature that is non-renewable. It is not known whether the population of live maerl if removed will recover. As improved knowledge on the distribution and extent becomes available the known range of the species may increase. To date only one small area is licensed for extraction. Fishing impacts are likely to continue to have some effect on maerl beds. The two species can be difficult to tell apart as colour is not very reliable and during survey work that are generally not distinguished. Please note that the same form & maps have been completed for both species.
2.8 Conclusions (assessment of conservation status at end of reporting period)	
Range	Favourable (FV)
Population	Unknown (XX)
Habitat for the species	Unknown (XX)
Future prospects	Unfavourable Inadequate (U1)
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

Lithothamnium coralloides/ Phymatolithon calcareum

1376 / 1377

Current Distribution (40 cells)
Current Range (40 cells)
Favourable Reference Range (40 cells)
W48 10km grid cells

Date: August 2007

Conservation Assessment of slender green feather-moss (*Hamatocaulis vernicosus* (Mitt.) Hedenäs) in Ireland

May, 2007

1.0 Ecology of *Hamatocaulis vernicosus* in Ireland

Hamatocaulis vernicosus (slender green feather-moss) is a straggling moss of mesotrophic fens and was first recorded in Ireland in 1872 at Lough Bray by D. Moore (Moore 1872), although the first record for the Republic supported by a specimen is 1946 at Portnashangan, Co. Westmeath, by K.C. Harris. It is scattered in Ireland with records from the counties of Waterford, Galway, Wexford, Meath, Westmeath, Wicklow, Donegal and Mayo, and an old record (1901) from Lisburn in Co. Down in the north (Blockeel & Long 1998). Wetlands in Cos. Mayo and Galway form the main stronghold for this species, with only scattered records elsewhere. There are several places in the east of the country with only old records, and it has probably disappeared from most of these.

H. vernicosus is characteristic of mires which are mineral-rich but not strongly calcareous. At one extreme, it has been collected from a *Ranunculus omiophyllus-Montia fontana* flush, indicating a relatively poor substrate. At the other, its habitat overlaps with that of the basiphile *D. cossonii*. Although the two species are not often found growing together, very occasionally they occur intermixed or in close proximity. *H. vernicosus* is also known as an associate of *Saxifraga hirculus*. However, its associates are often unremarkable (e.g. *Calliergonella cuspidata*, *Philonotis fontana*) and consequently it may be under-recorded. It appears to be sensitive to eutrophication, and the sorts of mesotrophic fens where it grows can often become dominated by *C. cuspidata* at the expense of rarer species such as *H. vernicosus*, in conditions of increasing eutrophication, whereas both more acidic and more basic flushes seem to be somewhat more resilient.

2.0 Mapping assessment data

2.1 Distribution

Information on threatened bryophytes in Ireland, including *H. vernicosus*, is being compiled by the National Parks and Wildlife Service as part of a project towards a bryophyte Red Data Book for Ireland, which has been running since 1999 and is due for completion in 2009. This has entailed collation of existing data and new fieldwork, and is resulting in a database of threatened bryophytes, from which distribution maps are produced. Most historical sites for *H. vernicosus* have been visited, and all will have been visited within the next two years. In addition some new sites have been discovered. Many old specimens of *H. vernicosus* have been redetermined as other species (Blockeel 1997) - it had been regarded as somewhat critical species in the past - and records unsupported by specimens have been largely ignored.

2.2 Range

Range can be a difficult concept for bryophytes, which tend to occur in often very scattered or disjunct populations, the plants occupying small 'micro-habitats' within larger, more generally recognised habitats.

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 range outline following IUCN guidelines is 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). Thus, this pragmatic solution was adopted, and the range of *H. vernicosus* follows the EC and IUCN definitions. A polygon can be drawn around the sites where *H.*

vernicosus is currently known to occur (Appendix 1). There may well be as-yet undiscovered populations of *H. vernicosus* that occur outside the ‘range’ as defined above.

2.3 Habitat

A list of typical habitats for *H. vernicosus* (see 5.0. below) was derived from a number of information sources:

- NPWS bryophyte database where colonies of *H. vernicosus* are recorded
- Published literature (Appendix I)
- Unpublished field notes held by NPWS
- *H. vernicosus* Special Areas of Conservation

Habitat types possibly capable of supporting niches for *H. vernicosus* listed in the EU Habitats Directive are as follows:

EU code	Current name as adopted in Directive 97/62/EC	CORINE code and/or previous name, as given in Directive 92/43/EEC (where different)	Lay title or English name
7110	Active raised bogs	51.1	Active raised bogs
7120	Degraded raised bogs still capable of natural regeneration	51.2 Degraded raised bogs (still capable of natural regeneration)	Degraded raised bog
7130	Blanket bogs	52.1 and 52.2 Blanket bog (active only)	Blanket bog
7140	Transition mires and quaking bogs	54.5	Very wet mires often identified by an unstable 'quaking' surface
7150	Depressions on peat substrates of the Rhynchosporion	54.6 Depressions on peat substrates (Rhynchosporion)	Depressions on peat substrates
7210	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae	53.3 Calcareous fens with *Cladium mariscus* and *Carex davalliana*	Calcium-rich fen dominated by great fen sedge (saw sedge)
7220	Petrifying springs with tufa formation (Cratoneurion)	54.12	Hard-water springs depositing lime
7230	Alkaline fens	54.2	Base-rich fens

However, mapping these is unlikely to be useful as a ‘predictor’ for *H. vernicosus* because it occurs in ‘micro-habitats’ within larger habitats. A more pragmatic and accurate approach to mapping the extent of suitable habitat was therefore adopted. This entailed mapping the extent of flushes and mires from aerial photographs for the range of polygons in which *H. vernicosus* is known to occur.

3.0 Range

H. vernicosus is a particularly difficult plant for which to determine range. It grows in at least two different habitats: upland transitional flushes and wet lowland sedge meadows. For the purposes of the conservation assessment a pragmatic definition of the range has been adopted, i.e. the smallest polygon encompassing the 10km squares in which *H. vernicosus* is known to occur. The ‘core range’ is in the uplands of Co. Mayo and Co. Galway, with outliers in Cos. Donegal, Westmeath and Waterford.

3.1 Range Conservation Status

The Favourable Reference Range (FRR) for *H. vernicosus* in Ireland is taken to be its current range (i.e. a polygon containing all the 10 km^2 squares from which *H. vernicosus* has been recorded recently). This is though to encompass the ecological range of variation for the species in Ireland.

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 as either the area of the grid cells occupied by the habitat which is 800 km^2 (8 grid cells x 100 km^2) or the area of the polygon which contains all of the grid cells, which is also 800 km^2
- **Favourable Reference Range:** 800 km^2 (8 grid cells x 100 km^2).

4.0 Population

4.1 Population estimation

Recent survey work by NPWS has included some observations on the abundance of *H. vernicosus* at its known sites, but population estimates are no more than very rough approximations. There are a number of problems in estimating bryophyte populations, notably the difficulty in deciding what constitutes ‘an individual’. On the one hand, ‘an individual’ could be defined as a single shoot, while on the other it might refer to a large genetically homogenous colony comprising thousands or even millions of individual shoots. In practice a pragmatic solution is required, which usually means a very rough estimation of the number of shoots or, more usually, an estimation of the area of ground covered by the plant at each site. (ref. Hallingbäck *et al.* 1996). In the case of *H. vernicosus*, estimates are very approximate, but it seems that there must be millions of individual shoots covering several hectares of ground in total, with the largest population probably being at Scragh Bog.

Table 1. Location and population estimates for *Hamatocaulis vernicosus* in Ireland.

Site	County	Grid reference	First seen	Last seen	Population size
Meentygrannagh Bog	Donegal	C02_06_	Lockhart 1999	Lockhart 2004	'A number of colonies'
Glenamoy Bog Complex (Rathavisteen)	Mayo	F982371	Lockhart 1999	Lockhart 1999	Small patch *ca.* 10 x 1 m
Carrowmore Lake Complex (Largan More)	Mayo	F902240	Lockhart 1999	Lockhart 1999	Abundant over *ca.* 10 x 5 m
Owenduff/Nephin Complex (Uggool)	Mayo	F927187	Lockhart 1999	Lockhart 1999	Small patch < 20 x 20 cm
Lough Carra/Mask Complex (Lough Mask)	Galway	M062628	Jury, Rumsey & Webb 1983	Lockhart 2000	Pure over *ca.* 10 x 20 m, extensive in patches over 1 ha
Lough Corrib (NW of Gortachalla Lough)	Galway	M225375	Holyoak 2004	Lockhart 2004	'Strong population', dominant over several tens of m²
Scragh Bog (Portnashangan)	Westmeath	N423589	Harris 1946	Lockhart 2004	Very extensive, covering several hectares
Comeragh Mountains (below Sgilloge Loughs)	Waterford	S286123	Appleyard 1966	Lockhart 1998	In a flush extending for several hundred metres
Comeragh Mountains (River Nire)	Waterford	S279116	Ratcliffe 1963	Lockhart 1998	Very abundant and dominant over *ca.* 1 ha
TOTAL					**Unknown but probably < 10 ha**

4.2 Population trends

Because of the lack of historical population estimates, it is impossible to assess population trends in individual colonies of *H. vernicosus* at this stage. It can however be inferred that the total population of this plant in Ireland has declined in historic times due to the loss of suitable habitat with the decline of intact peatlands.

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). Several of the populations are considered large, covering hectares, and these are thought to be robust and stable. The smaller populations, in the uplands, are in remote locations and are not considered threatened. At present there are at least nine populations in Ireland:

- Meentygrannagh Bog, Co. Donegal (site code 000173): a number of colonies
- Glenamoy Bog Complex, Co. Mayo (site code 000500): small patch *ca.* 10 x 1 m at Rathavisteen
- Carrowmore Lake Complex, Co. Mayo (site code 000476): abundant over a small area (*ca.* 10 x 5 m) at Largan More
- Owenduff/Nephin Complex, Co. Mayo (site code 000534): small patch at Uggool, < 20 x 20 cm
- Lough Carra/Mask Complex, Co. Galway (site code 001774): more or less pure over ca. 10 x 20 m, and extensive in patches over a wider area of ca. 1 ha at Lough Mask
- Lough Corrib, Co. Galway (site code 000297): dominant over several tens of square metres, north-west of Gortachalla Lough

- Scragh Bog, Co. Westmeath (site code 000692): very extensive over several hectares
- Comeragh Mountains, Co. Waterford (site code 0001952): two sub-populations:
  - very abundant over *ca.* 1 ha on Nire River
  - extending for several hundred metres in a flush below Sgilloge Loughs

There are also the following confirmed records:

- Holdenstown Bog, Co. Wicklow (site code 001757): recorded in a small bog east of Yellowford Crossroads in 1975, and specimen confirmed, but not refound since. No population details.
- Drumone-Lough Bane, Co. Meath (not SAC): recorded in 1978 in 'cut-over bog'. According to Mhic Daeid (1995), "it was discovered that it was not located at Lough Bane, but at a site about 6 km to the north, near the village of Dromone. The site consisted of a small area of fen carr. It has since been destroyed by drainage and afforestation". No population details.
- Pallis Bridge, Co. Wexford (not SAC): recorded in 'marshy ground' in 1969. Revisited in 2000, when "only a very small amount of suitable ground" was seen, and *H. vernicosus* could not be refound. No population details.
- Owenduff/Nephin Complex (Lough Nambrackkeagh), Co. Mayo: small population recorded in 1987 but habitat since lost to coniferous afforestation.

In addition there are two unconfirmed records:

- Maam Cross, Bunscannive, Co. Galway: recorded in 1987, and apparently a specimen exists, but has not been determined critically. The site was re-visited recently, but the bogs in the area have deteriorated due to overstocking and suitable habitat no longer remains. No population details.
- Lough Bray, Co. Wicklow: recorded in 1872. No specimen, and no population details, but it might be correct. The site will be visited in 2007 as part of the NPWS programme of rare bryophyte surveys.

All other records are erroneous.

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, the Conservation Status of *H. vernicosus* in Ireland is Favourable.

- **Species population:** 9 populations.
- **Favourable Reference Population:** 9 populations..

5.0 Habitat

See 2.3. above for a detailed list of sources of Habitat information and habitats mapped.

There is a correlation between the presence of *H. vernicosus* in an area and availability of suitable habitat – it is strictly confined to mesotrophic fen,, a transitional habitat between acid bog and base-rich fen. This appears to occur in at least two forms in Ireland: upland transitional flushes and wet lowland sedge meadows.

5.1 Habitat Conservation Status

Because the specific habitat niches occupied by *H. vernicosus* are 'micro-habitats', and have not been mapped, it is not possible to accurately determine their extent, or the extent to which they have declined. Undoubtedly with the historical decline in area of intact peatlands there would have been a decline in suitable habitat for *H. vernicosus*. Nevertheless, the currently estimated suitable habitat (257 ha.) is greater than the estimated population area (ca. 10 ha.). Furthermore, the sites supporting *H. vernicosus*, several of which are large, are considered to be in good condition and are not considered to be under threat.

Therefore it can be inferred that the Conservation Status of Habitat is Favourable.

6.0 Future Prospects

6.1 Negative impacts and threats

With the recent decline in commercial afforestation on peatlands, the remote populations of *H. vernicosus* in the uplands are not thought to be currently threatened, except perhaps by wind farm developments. The large populations in the lowlands (at Lough Corrib, Lough Mask and Scragh Bog) are potentially at risk from agricultural activities, particularly eutrophication. However, all are within SACs and Scragh Bog is also a Nature Reserve. The main pressures and threats (with activity codes in parentheses) can be summarised as follows:

- Pollution (120, 701)

  The main form of pollution affecting *H. vernicosus* is eutrophication from agricultural activities. The increased nutrient input resulting from high levels of nitrogen in the environment favours a few vigourous species at the expense of more ecologically demanding species. In the case of vascular plants, typical species favoured are nettles *Urtica dioica* and hogweed *Heracleum sphondylium*, which can smother less competitive but less nutrient-demanding species. In the case of bryophytes, *Calliergonella cuspidata* is the most common beneficiary of increased nutrient input in wet grassland and fens, particularly in conditions that are neither strongly acidic nor strongly basic (Hedenäs 2003). Prime sources of eutrophication are agricultural run-off from adjacent fields, and over-stocking.

- Land use (141, 149, 161, 810)

  A number of land use changes threaten and have threatened *H. vernicosus* habitats. Of these, the most important is drainage, which destroys the wetland as a precursor to conversion to agricultural use or forestry. The site at Lough Nambrackkeagh in the Owenduff/Nephin Complex has certainly been destroyed by drainage and afforestation.

  Land management also comes under this broad heading. A regime of light seasonal grazing is appropriate for most wetland sites managed for nature conservation. If grazing is increased, this can result in changes in the vegetation structure, physical damage such as poaching, and eutrophication. If grazing is removed altogether, this may lead to a succession that results in the development of scrub and woodland and the ultimate loss of *H. vernicosus*.

  Numerous other land use changes, any of which could threaten specific sites, include urbanisation, development of wind farms and dumping. *H. vernicosus* sites may be at particular risk from wind farm developments, as they tend to occur on hillsides with little other obvious economic potential.

- Climatic change

There is now little doubt that the climate is undergoing dramatic changes, and that this is at least partly due to human activities. The effects of this on individual species are unpredictable, but it is likely that the ranges of many species will shift, and possibly contract.

6.2 Positive Impacts

A number of these threats are being addressed through national legislation. Some of the rarest plants in Ireland, including *H. vernicosus*, 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 *H. vernicosus* 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 *H. vernicosus*. Ireland to date has 8 SACs in which *H. vernicosus* is one of the key features (Appendix III). On present knowledge, it appears that the entire known national population of *H. vernicosus* is protected within Special Areas of Conservation in Ireland. However, it is perfectly possible that further populations may be discovered.

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

A number of other initiatives are underway in Ireland that should have a positive impact on *H. vernicosus*. The EU LIFE initiative is funding a number of peatlands re-building projects. Scragh Bog is a nature reserve. The Irish Peatland Conservation Council has published a Conservation Plan 2005 (www.ipcc.ie) designed to promote the conservation of Ireland's remaining peat bogs. It has also produced *The Irish Bogs and Fens Conservation Strategy* (Irish Peatland Conservation Council 2001). One of the initiatives mentioned in this document is the Global Action Plan for Peatlands (GAPP), which has been developed by a wide partnership of organisations under the auspices of the Ramsar Convention on Wetlands.

An ongoing monitoring programme of rare and threatened bryophytes, including *H. vernicosus*, has been established by the NPWS.

6.3. Future Prospects Conservation Status

Although the range of *H. vernicosus* has declined historically, the current range is the same as the FRR. Therefore it has a Favourable Conservation Status.

The population of *H. vernicosus* in Ireland has almost certainly declined in historic times due largely to the loss of suitable habitat through the decline of intact peatlands (see 4.2, above). However, it is still substantial, and the Estimated Present Population is the same as the Favourable Reference Population (see 4.3, above). Population therefore has a Favourable Conservation Status.

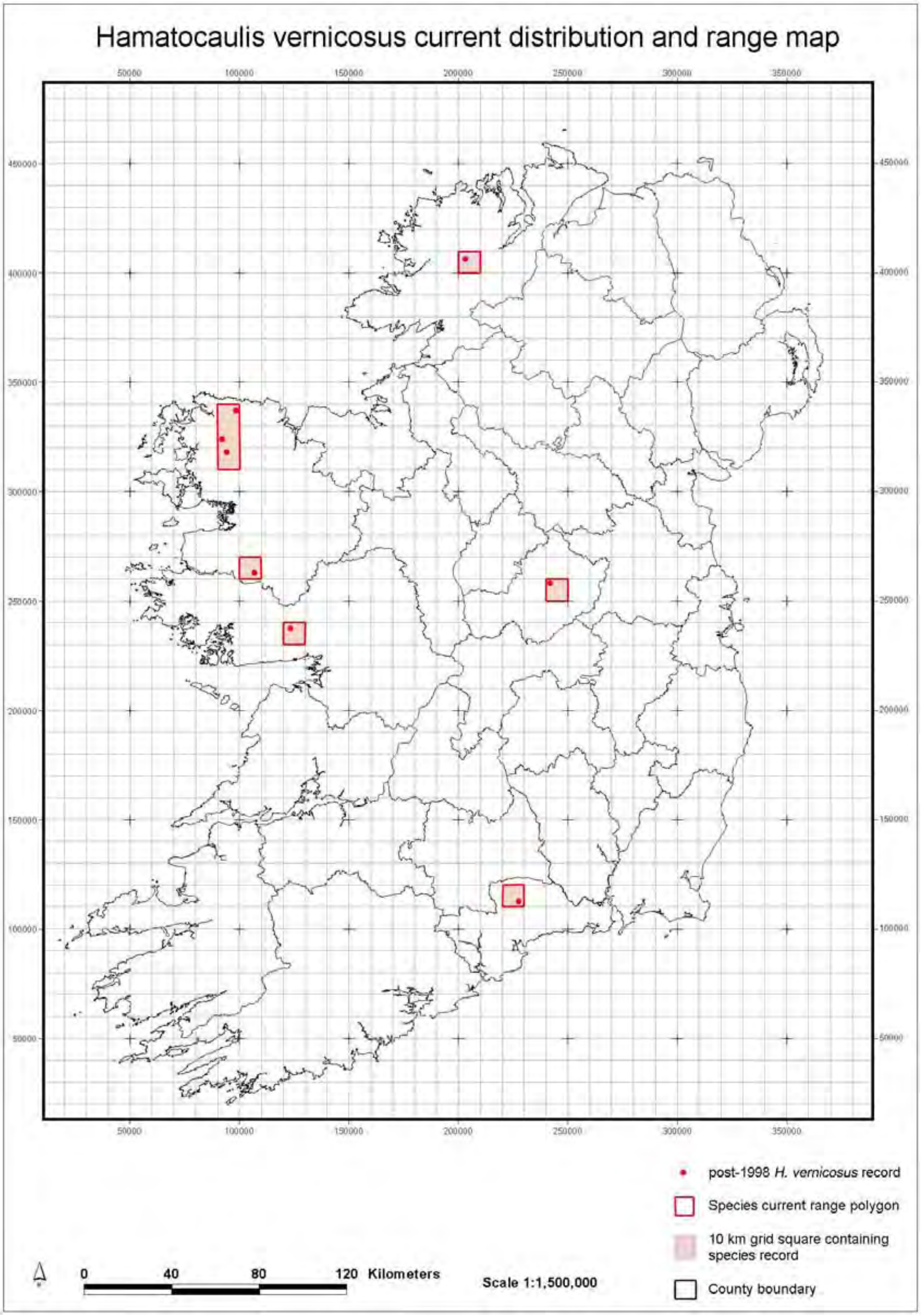
The estimated area of suitable habitat for *H. vernicosus* in Ireland is greater than the estimated population area. (ca. 10 ha.). The habitats that support populations are considered to be in good condition and several hold extensive populations. Habitat therefore has a Favourable Conservation Status.

Considering the measures in place that will assist its protection, it is expected that *H. vernicosus* will survive in Ireland. The overall Conservation Status for the Future Prospects of *H. vernicosus* is therefore Favourable.

Range of *Hamatocaulis vernicosus*:	**Favourable**
Population of *Hamatocaulis vernicosus*:	**Favourable**

Appendix I

Range and distribution of *Hamatocaulis vernicosus* in Ireland (2007)



Appendix II

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Appendix III

Surveys of *Hamatocaulis vernicosus* in Ireland

Holyoak, D.T. 2002. *Survey of Rare and Threatened Bryophytes in North Donegal.* Unpublished report to National Parks and Wildlife Service, Dublin.

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Holyoak, D.T. 2004. *Survey of Rare and Threatened Bryophytes in County Galway.* Unpublished report to National Parks and Wildlife Service, Dublin.

Appendix IV

Special Areas of Conservation (SACs) designated for *Hamatocaulis vernicosus* in Ireland

Site Code	Site Name	County
000173	Meentygrannagh Bog	Donegal
000500	Glenamoy Bog Complex	Mayo
000476	Carrowmore Lake Complex	Mayo
000534	Owenduff/Nephin Complex	Mayo
001774	Lough Carra/Mask Complex	Galway
000297	Lough Corrib	Galway
000692	Scragh Bog	Westmeath
001952	Comeragh Mountains	Waterford

1393 *Drepanocladus vernicosus* (*Hamatocaulis vernicosus*)

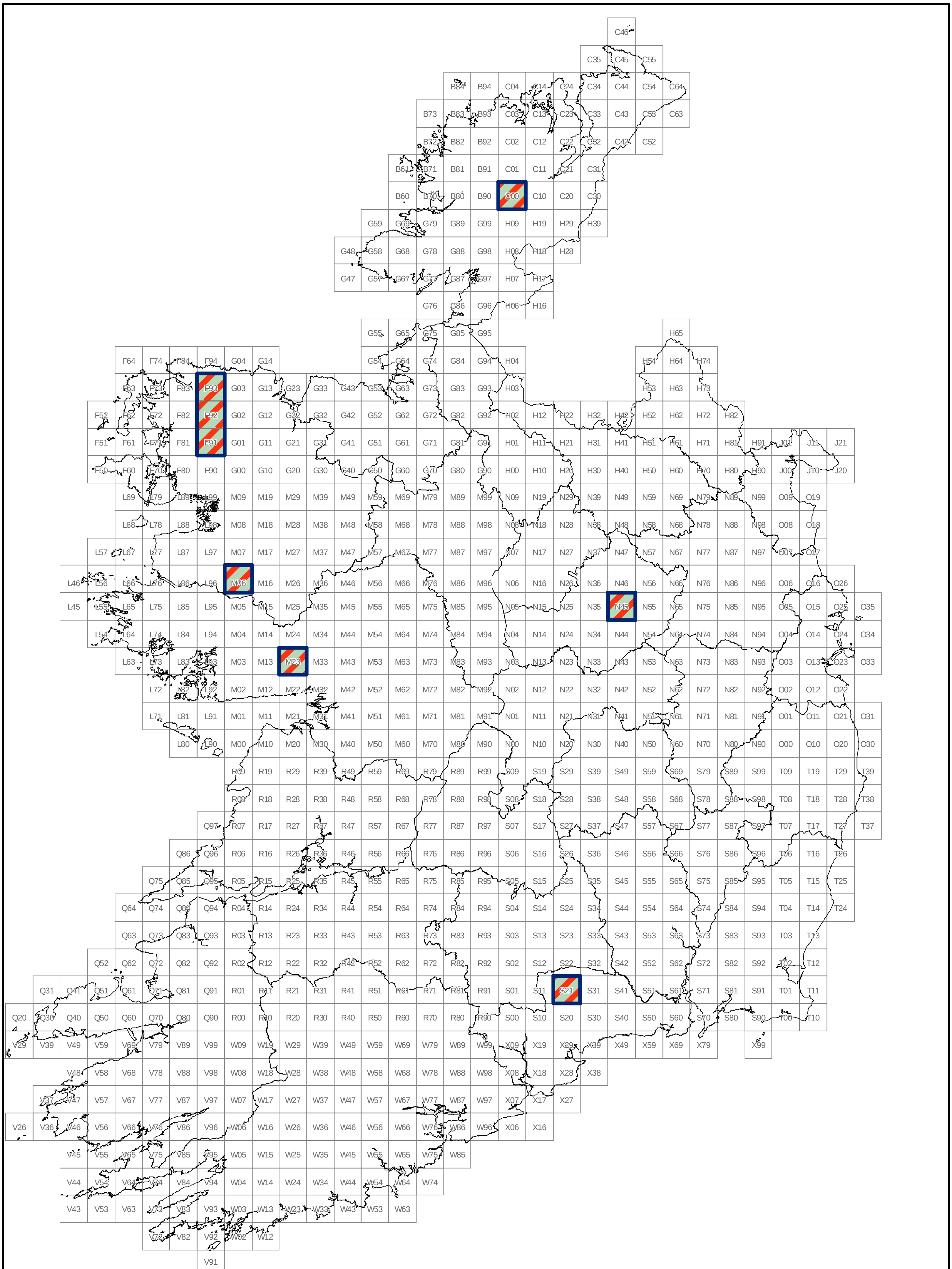
National Level	
Species code	1393
Member State	Ireland IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	800 km^2 (8 grid cells x 100 km)

Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Blockeel, T.L. (1997). *A revision of British (and Irish) specimens of* Drepanocladus vernicosus. Unpublished report to JNCC. ▪ Blockeel, T.L. (2000). The identification of *Drepanocladus revolvens* and *D. cossonii*, and their distribution in Britain and Ireland. *Bulletin of the British Bryological Society* 75: 32-40. ▪ Blockeel, T.L. & Long, D.G. (1998). *A check-list and census catalogue of British and Irish bryophytes.* British Bryological Society, Cardiff. ▪ Church, J.M., Hodgetts, N.G., Preston, C.D. & Stewart, N.F. (2001). *British Red Data Books. Mosses and liverworts.* Peterborough, Joint Nature Conservation Committee. ▪ Curtis, T. & Harrington, T. (1976). The Baltinglass meeting. *Irish Biogeographical Society Bulletin* 1: 37-41. ▪ European Committee for the Conservation of Bryophytes (ed.) (1995). *Red Data Book of European bryophytes*. Trondheim, European Committee for the Conservation of Bryophytes. ▪ Hedenäs, L. (1989). The genera *Scorpidium* and *Hamatocaulis*, gen. nov., in northern Europe. *Lindbergia* 15: 8-36. ▪ Hedenäs, L. (2003). The European species of the *Calliergon-Scorpidium-Drepanocladus* complex, including some related or similar species. *Meylania* 28: 1-116. ▪ Hill, M.O. & Preston, C.D. (1998). The geographical relationships of British and Irish bryophytes. *Journal of Bryology* 20: 127-226. ▪ Hill, M.O., Preston, C.D. & Smith, A.J.E. (eds.) (1994). *Atlas of the bryophytes of Britain and Ireland. Volume 3 Mosses (Diplolepideae).* Colchester, Harley Books. ▪ Hodgetts, N.G. (2002). *Survey of Rare and Threatened Bryophytes in County Roscommon.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Hodgetts, N.G. (2003). *Survey of Rare and Threatened Bryophytes in North Sligo.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Hodgetts, N.G. (2004). *Survey of Rare and Threatened Bryophytes in County Clare.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Hodgetts, N.G. (2006). *Survey of Rare and Threatened Bryophytes in Mid/East Cork and Dingle Peninsula.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (2001). *Survey of Rare and Threatened Bryophytes in Counties Leitrim and Cavan.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (2002). *Survey of Rare and Threatened Bryophytes in North Donegal.* Unpublished report to National Parks and Wildlife Service, Dublin.

Published sources	▪ Holyoak, D.T. (2003). *Survey of Rare and Threatened Bryophytes in County Mayo.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (2004). *Survey of Rare and Threatened Bryophytes in County Galway.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Megaw, W.R. (1933). Irish moss records. *Irish Naturalists' Journal* 4: 246. ▪ Mhic Daeid, G.C. (1995). *Information on populations of EU Annex II plant species.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Moore, D. (1872). Proceedings of the Royal Irish Academy, Series 2 Science, Vol 1, 329-474.
	▪ Wijk, R. van der, Margadant, W.D. & Florschütz, P.A. (1962). Index Muscorum, Vol. II (D-Hypno). *Regnum Vegetabile* 26: 1-535. ▪ Wyse Jackson, M.B., Lockhart, N.D. & Madden, B. (1995). *Literature review of wetland vegetation studies and rare plant records in the Gort-Ardrahan Catchment, Cos. Clare and Galway.* Report by Biosphere Environmental Services, Greystones.
Range	
Surface area	800 square kilometres
Date	May 2007
Quality of data	2 = moderate
Trend	0 = stable
Trend-Period	1998-2007
Reasons for reported trend	1 = improved knowledge/more accurate data
Population	
Distribution map	
Population size estimation	9 populations
Date of estimation	2007
Method used	3 = from complete inventory
Quality of data	2 = moderate
Trend	0 = stable
Trend-Period	1998-2007
Reasons for reported trend	1 = improved knowledge/more accurate data
Justification of % thresholds for trends	Three populations could not be refound during 1998-2007, while four others were discovered. There is insufficient information to estimate percentage decline/increase but overall the population is probably more or less stable.
Main pressures	120 Fertilisation 161 Forestry planting 810 Drainage 701 Water pollution
Threats	120 Fertilisation 141 Abandonment of pastoral systems 149 Undergrazing 161 Forestry planting 701 Water pollution 810 Drainage
Habitat for the species	
Area estimation	Area of suitable habitat estimated to be 257 ha.
Date of estimation	May 2007
Quality of data	2 = moderate
Trend	Stable
Trend-Period	1998-2007
Reasons for reported trend	1 = improved knowledge/more accurate data
Future prospects	1 = good prospects

Complementary information	
Favourable reference range	800 square kilometres
Favourable reference population	9 populations
Suitable Habitat for the species	257 ha.
Other relevant information	Positive Impacts: *H. vernicosus* is protected under the Flora Protection Order (1999). Significant conservation measures in place in the country presently e.g. all populations are within SACs. The EU LIFE initiative is funding a number of peatlands re-building projects. Scragh Bog is a nature reserve. The Irish Peatland Conservation Council has published a Conservation Plan 2005 designed to promote the conservation of Ireland's remaining peat bogs. It has also produced *The Irish Bogs and Fens Conservation Strategy* (Irish Peatland Conservation Council 2001). One of the initiatives mentioned in this document is the Global Action Plan for Peatlands (GAPP), which has been developed by a wide partnership of organisations under the auspices of the Ramsar Convention on Wetlands.Negative Impacts: drainage and eutrophication, due to agricultural use of fertilisers and manure spreading, are probably the main two threats.

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

Drepanocladus vernicosus

1393

Current Distribution (8 cells)
Current Range (8 cells)
Favourable Reference Range (8 cells)
W48 10km grid cells

Date: October 2007

Conservation Assessment of petalwort (*Petalophyllum ralfsii* (Wils.) Nees & Gottsche) in Ireland

May, 2007

1.0 Ecology of *Petalophyllum ralfsii* in Ireland

Petalophyllum ralfsii (petalwort) is a small thalloid liverwort of open calcareous sandy ground in dune slacks and machair and was first recorded in Ireland in 1861 near Malahide by B. Carrington. It is scattered in Ireland with records from the counties of Kerry, Clare, Galway, Dublin, Mayo, Sligo and Donegal (Blockeel & Long 1998). Dune systems in Cos. Donegal, Mayo and Galway form the main stronghold for this species, with other significant, but much smaller, populations in Cos. Kerry, Clare, Sligo and Dublin.

Petalophyllum ralfsii is usually found on damp, calcareous sand in dune slacks and machair, where it is wet or even subject to inundation in the winter. In dune slacks it often occurs in a zone around the margins of seasonally flooded basins or depressions. In machair it is usually found around the sides of eroding sand hills on open, flushed sandy plains. *P. ralfsii* often seems to favour the sides of paths or wheel ruts where the soil receives some disturbance, leading to gaps in the vegetation. It does not grow in slacks that are water-filled for long periods or heavily shaded. It has also been recorded in an old gravel pit. It usually disappears from view when the substrate dries out in the summer, surviving as tubers. It can vary in apparent abundance from year to year, depending on weather conditions. Sporophytes are produced mainly between March and May.

This Mediterranean-Atlantic species is widely but sparsely distributed in southern and western Europe and has also been recorded in North America. It may be declining in parts of its range because of the extreme vulnerability of the habitat and it can be assumed that the British and Irish populations are of international importance – at least two Irish populations comprise millions of thalli (Holyoak, pers. comm.).

2.0 Mapping assessment data

2.1 Distribution

Information on threatened bryophytes in Ireland, including *P. ralfsii*, is being compiled by the National Parks and Wildlife Service as part of a project towards a bryophyte Red Data Book for Ireland, which has been running since 1999 and is due for completion in 2009. This has entailed collation of existing data and new fieldwork, and is resulting in a database of threatened bryophytes, from which distribution maps are produced. All historical sites for *P. ralfsii* have been visited, and in addition several new sites have been discovered.

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 for bryophytes, which tend to occur in often very scattered or disjunct populations, the plants occupying small 'micro-habitats' within larger, more generally recognised habitats. However, it is relatively easy to determine the range of *P. ralfsii*, because it's habitat is well-circumscribed and its extent well-known. The sort of damp calcareous sandy ground where this species grows is highly characteristic of the 'major habitats' machair and dune slack.

The Irish 10km^2 grid was overlaid with the squares that contain machair and dune slack. 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). The true potential range of *P. ralfsii* is considerably less than the 74 grid squares identified as containing 'suitable habitat', since not all dune slacks are suitable for the species. It is considered that the current range of *P. ralfsii* more or less reflects its potential range. This leads to a fragmented range for *P. ralfsii* that nonetheless encompasses a large part of the west coast of Ireland plus a smaller area on the east coast.

2.3 Habitat

A list of typical habitats for *P. ralfsii* (see 5.0. below) was derived from a number of information sources:

- NPWS bryophyte database where colonies of *P. ralfsii* are recorded
- Published literature (Appendix I)
- Unpublished field notes held by NPWS
- *P. ralfsii* Special Areas of Conservation

As *P. ralfsii* is so habitat-specific, this was a simple task. The habitats mapped for the range of *P. ralfsii* in Ireland are:

EU Habitats Directive Annex 1 habitats:

- Machair (Code 21A0)
- Humid Dune Slacks (Code 2190)

These habitats have been identified and mapped by NPWS.

3.0 Range

The range of *P. ralfsii* in Ireland is centred on the western coastline, occurring in fragmented blocks from Donegal in the north-west down the west coast to Kerry. In addition, the range includes a smaller area of dunes on the east coast.

3.1 Range Conservation Status

The Favourable Reference Range (FRR) for *P. ralfsii* in Ireland is taken to be its present range (i.e. a polygon drawn around all the 10 km^2 squares from which *P. ralfsii* has been recorded recently). This is thought to encompass the ecological range of variation for the species in Ireland.

Furthermore, dune systems and machair in Ireland have been extensively surveyed in recent years, and most significant populations of *P. ralfsii* are likely to have been found. As a consequence of recent survey, the current known range of *P. ralfsii* is greater than it has been at any time in the past, simply because many sites for the species were not previously known about. The range of *P. ralfsii* may actually have declined, but there is no evidence for this, again because of the paucity of previous survey work.

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 as either the area of the grid cells occupied by the habitat which is 3000 km^2 (30 grid cells x 100 km^2) or the area of the polygon which contains all of the grid cells, which is also 3000 km^2
- **Favourable Reference Range:** 3000 km^2 (30 grid cells x 100 km^2).

4.0 Population

4.1 Population estimation

Recent survey work by NPWS has included some observations on the abundance of *P. ralfsii* at its known sites. In the case of small populations, population estimates are counts of individual thalli. In the case of large populations, population estimates are arrived at by extrapolating upwards from smaller samples, and are therefore no more than approximations. There are a number of problems in estimating bryophyte populations, notably the difficulty in deciding what constitutes 'an individual'. In the case of *P. ralfsii*, a single rosette is taken to be an individual, although this takes no account of the fact that rosettes might be connected by underground structures, or that some populations might consist of clonal swarms. (Hallingbäck *et al.* 1996).

Table 1. Location and population estimates for *Petalophyllum ralfsii* in Ireland.

Site	County	Grid reference	First seen	Last seen	Population size (no. of thalli)
Tranarossan and Melmore (Rosses Strand)	Donegal	C119428	Holyoak 2002	Lockhart 2006	15 (2002); 2 (2006)
Sheephaven (Rosepenna)	Donegal	C121372	Holyoak 1999	Holyoak 1999	26 (1999)
Horn Head & Rinclevan (Tramore)	Donegal	B982360	Holyoak 2002	Holyoak 2002	3 (2002)
Gweedore Bay & Islands (Damph Beg; Bunlack machair)	Donegal	B802295	Holyoak 1999	Holyoak 2002	24 (1999); 7 (2002); 0 (2006)
Gweedore Bay & Islands (Derrybeg)	Donegal	B799262	Holyoak 2002	Lockhart 2006	3 (2002); 12 (2006)
Gweedore Bay & Islands (Keadew Point)	Donegal	B733182	Crundwell 1962	Lockhart 2006	20 (1998); 16 (2002); 3 (2006)
West of Ardara/Maas Road (Dooey Point)	Donegal	B757021	Holyoak 1999	Holyoak 2002	4 (1999); 3 (2002)
West of Ardara/Maas Road (Sheskinmore)	Donegal	G690953	Lockhart 1998	Lockhart 2006	50 (1998); 1 (2006)
Bunduff Lough & Machair/Trawalua/ Mullaghmore	Sligo	G707563	Lockhart & Wyse Jackson 1998	Hodgetts 2003	22 (1998); 76 (1999); 2 (2003)
Glenamoy Bog Complex (Garter Hill)	Mayo	F807407	Lockhart 1998	Lockhart 2006	> 1000 (1998); 1,600,000 (1999); > 10 (2006)
Mullet/Blacksod Bay Complex (Doolough)	Mayo	F736223	Lockhart 1998	Lockhart 2006	20 (1998); 77 (1999); 3 (2006)
Mullet/Blacksod Bay Complex (Dooyork)	Mayo	F737202	Lockhart 1998	Lockhart 1998	6 (1998); 0 (1999)
Inishkea Islands	Mayo	F567233	Lockhart 1998	Lockhart 1998	7 (1998)
Doogort Machair/Lough Doo	Mayo	F702095	Lett 1903	Lockhart 1998	4 (1998); 0 (2003);

					0 (2006)
Keel Machair/Menaun Cliffs	Mayo	F646046	Warburg 1962	Lockhart 2006	'hundreds' (1998); 430 (1999); 'hundreds' (2003); > 50 (2006)
Mweelrea/Sheeffry/ Erriff Complex (Dooaghtry)	Mayo	L753686	Perry 1968	Lockhart 2006	> 50 (1997); 150,000 (1999); 'hundreds' (2003); > 23 (2006)
Omey Island Machair	Galway	L558560	Lockhart 1998	Lockhart 2006	304 (1998); 6 (2006)
Slyne Head Peninsula (Mannin More)	Galway	L607460	Holyoak 2004	Lockhart 2006	> 13 (2004); ca. 80,000 (2006)
Slyne Head Peninsula (Truska Machair)	Galway	L587462	Lockhart 1998	Lockhart 2006	2,400,000 (1998); 5,500,000 (1999); 'thousands' (2004); > 150,000 (2006)
Slyne Head Peninsula (Doon Hill, Aillebrack)	Galway	L58_42_	Long 1988	Lockhart (2006)	30 (1997); > 300 (1998); 14 (1999); 18 (2004); 2 (2006)
Murvey Machair	Galway	L662389	Lockhart 1998	Lockhart 2006	30 (1998); 38 (1999); 101 (2004); 7 (2006)
Black Head-Poulsallagh Complex (Fanore)	Clare	M138086	Long 1994	Lockhart 2006	12 (1998); 10 (2006)
Tralee Bay & Magherees peninsula, West to Cloghane (SW Lough Naparka)	Kerry	Q616168	Lockhart 1998	Lockhart 1998	5 (1998); 0 (2003); 0 (2006)
Tralee Bay & Magharees peninsula, West to Cloghane (Magherabeg)	Kerry	Q612158	Lockhart 1998	Hodgetts 2003	16 (1998); 36 (2003); 0 (2006)
Tralee Bay & Magheress peninsula, West to Cloghane (Kilshannig)	Kerry	Q620172	Hodgetts 2003	Hodgetts 2003	3 (2003)
Castlemaine Harbour (Inch Dunes)	Kerry	V6__9__	Lockhart 1983	Lockhart 1983	'common' (1983)
Castlemaine Harbour (Rossbehy)	Kerry	V648916	Holyoak 2006	Holyoak 2006	20 (2006)
Ballinskelligs Bay & Inny Estuary (Inny Ferry)	Kerry	V474682	Scully 1890	Lockhart 1998	*ca.* 50 (1998)
North Dublin Bay (North Bull)	Dublin	O247378	Pitkin & Synnott 1975	Lockhart & Holyoak 2004	> 100 (1999); 5 (2004)
TOTAL					**7,331,682 (max)** **150,252 (min)**

4.2 Population trends

Because of the lack of historical population estimates, and the considerable annual and seasonal (apparent) fluctuations in populations, it is almost impossible to assess population trends in individual colonies of *P. ralfsii* at this stage. The fact that there is a huge discrepancy between the estimated minimum and maximum totals is not surprising, considering the wild fluctuations that this species apparently undergoes, at least in terms of visible thalli.

It appears that the species is declining at several sites, but it is difficult to draw firm conclusions from these figures. Differences between counts may be largely attributable to the amount of search effort involved and the prevailing weather conditions around the time of search (N. Lockhart, pers. comm.). *P. ralfsii* is apparently much less frequent when the ground is dry, and more frequent when it is damp. This may reflect temporary conditions, or a general reduction in the water table, or it may be an indication of the deleterious effects of climate change. On the other hand, in Cornwall *P. ralfsii* has apparently *increased* in recent years (D. Holyoak, pers. comm.), and this may be as a result of climate change *favouring* the species.

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 29 populations in Ireland:

- Tranarossan and Melmore, Co. Donegal (site code 000194), up to 15 plants at Rosses Strand
- Sheephaven, Co. Donegal (site code 001190), up to 26 plants at Rosepenna
- Horn Head & Rinclevan, Co. Donegal (site code 000147), very small population of 3 plants
- Gweedore Bay & Islands, Co. Donegal (site code 001141): three small sub-populations:
  - up to 24 plants at Damph Beg/Bunlack machair
  - up to 12 plants at Derrybeg
  - up to 20 plants at Keadew Point
- West of Ardara/Maas Road, Co. Donegal (site code 000197): two sub-populations:
  - very small population at Dooey Point with only 3 or 4 plants
  - up to 50 plants at Sheskinmore, but only one recorded in 2006
- Bunduff Lough & Machair/Trawalua/Mullaghmore, Co. Sligo (site code 000625), up to 76 plants
- Glenamoy Bog Complex, Co. Mayo (site code 000500), at least 1,600,000 plants at Garter Hill
- Mullet/Blacksod Bay Complex, Co. Mayo (site code 000470), two sub-populations:
  - up to 77 plants at Doolough
  - 6 plants at Dooyork
- Inishkea Islands, Co. Mayo (site code 000507), small population of 7 plants
- Doogort Machair/Lough Doo, Co. Mayo (site code 001497), small population with a maximum of 4 plants seen
- Keel Machair/Menaun Cliffs, Co. Mayo (site code 001513), from 50 to > 430 plants
- Mweelrea/Sheeffry/Erriff Complex, Co. Mayo (site code 001932), large population with between several hundred and 150,000 plants at Dooaghtry
- Omey Island Machair, Co. Galway (site code 001309), 304 counted in 1998, but down to 6 in 2006
- Slyne Head Peninsula, Co. Galway (site code 002074): three sub-populations:

  - a few plants seen at Mannin More in 2004, but an estimated 80,000 in 2006
  - huge population at Truska machair, with at least 150,000 plants in 2006, and an estimated 5,500,000 in 1999 – probably the largest population in Ireland and perhaps in the world
  - > 300 plants at Doon Hill, Aillebrack in 1998, but down to 2 in 2006
- Murvey Machair, Co. Galway (site code 002129), observed population fluctuated between 7 and 101 plants between 1999 and 2006
- Black Head-Poulsallagh Complex, Co. Clare (site code 000020), 10-12 plants at Fanore
- Tralee Bay & Magharees peninsula, West to Cloghane, Co. Kerry (site code 002070), three sub-populations:
  - 5 plants SW of Lough Naparka
  - 36 plants at Magherabeg in 2003
  - 3 plants at Kilshannig
- Castlemaine Harbour, Co. Kerry (site code 000343): two sub-populations:
  - ‘common at southern tip’ of the Inch peninsula in 1983
  - *ca.* 20 plants at Rossbehy
- Ballinskelligs Bay & Inny Estuary, Co. Kerry (site code 000335), *ca.* 50 plants
- North Dublin Bay, Co. Dublin (site code 000206), > 100 plants at North Bull in 1999, but down to 5 in 2004

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, the Conservation Status of *P. ralfsii* in Ireland is Favourable.

- **Species population:** 29 populations.
- **Favourable Reference Population:** 29 populations.

5.0 Habitat

See 2.3. above for a detailed list of sources of Habitat information and habitats mapped.

There is abundant evidence for the correlation between the presence of *P. ralfsii* in an area and availability of suitable habitat – it is strictly confined to open, base-rich damp dune slacks and machair.

5.1 Habitat Conservation Status

The habitat occupied by *P. ralfsii* has been mapped and visited by NPWS staff and other workers frequently in recent years. Observations suggest that the dune slack and machair habitat is still extensive and in good condition for *P. ralfsii*. Therefore it can be inferred that the Conservation Status of Habitat is Favourable.

However, it should be noted that numbers of plants appear to have declined recently. This is thought to be mainly a reflection of the amount of search effort involved and prevailing weather conditions around the time of search. It is too early to ascertain whether a decrease in numbers is a temporary fluctuation or symptomatic of a long-term decline, but the situation needs to be monitored. Certainly coastal habitats such as dune slack and machair often come under pressure (see 6.1, below), and vigilance is needed.

6.0 Future Prospects

6.1 Negative impacts and threats

Because of the fragility of its habitat and its specialised ecology, *P. ralfsii* is potentially threatened by a large number of factors, including holiday developments, recreational activities, under-grazing, over-grazing, erosion and desiccation due to water abstraction. Having said that, many sites are good quality intact dune systems and are recorded as having no perceived current threats. The main pressures and threats (with activity codes in parentheses) can be summarised as follows:

- Grazing imbalance (120, 148, 149, 171, 900)
  It is important to achieve the right balance of grazing in order to conserve *P. ralfsii*. A reduction in grazing by livestock and rabbits may threaten the plant at some sites, as it needs a short, open sward in order to compete. Any spread of coarser vegetation, because of a reduction in grazing, could constitute a threat to its survival. On the other hand, too high a level of grazing may have a deleterious impact on *P. ralfsii* through physical damage, soil erosion and an excessive input of nutrients.

- Physical disturbance (501)
  Although it is likely that a small amount of disturbance, in the form of soil compaction, may be favourable to this plant, more extreme forms of disturbance, which break the bryophyte crust on the surface, are likely to be detrimental. Thus, a certain level of off-roading by vehicles may actually be beneficial, through providing wheel-ruts as habitat, but too much may destroy the integrity of the surface and threaten the plant. Some of the smaller populations are particularly at risk from disturbance events.

- Pollution (120, 701)
  Pollution of the groundwater, chiefly through eutrophication from agricultural activities such as slurry-spreading and application of fertilisers, is a threat to *P. ralfsii*. This appears to have eliminated it from Akeragh, Banna & Barrow Harbour, for example. Eutrophication may occur directly from over-stocking on the site, or it may be due to run-off from adjacent agricultural land.

- Desiccation (810, 920)
  General desiccation, as a consequence of climate change, drainage schemes or a lowering of the water table, is a very serious threat to *P. ralfsii*. This plant requires at least seasonal wetness, and if the number of days per year when the turf is wet reduces, then it is very noticeable that *P. ralfsii* is much reduced. Whether it disappears completely or retreats to its underground storage-organ is not known. Clearly *P. ralfsii* is well adapted to survive periods of desiccation as a dormant underground structure, but it is not yet known how much desiccation can be withstood before it disappears completely.

- Land use (141, 150, 600, 620)
  Large-scale changes in land use constitute perhaps the most significant threats to *P. ralfsii*. Dune systems are under constant pressure from proposed developments such as golf courses, caravan parks, hotel building and other leisure developments, all of which are capable of obliterating suitable habitat for this plant. It is likely that the Malahide locality has been destroyed in this way.

6.2 Positive Impacts

A number of these threats are being addressed through national legislation. Some of the rarest plants in Ireland, including *P. ralfsii*, 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 *P. ralfsii* 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 *P. ralfsii*. Ireland to date has 20 SACs in which *P. ralfsii* is one of the key features (Appendix V). On present knowledge, it appears that the entire national population of *P. ralfsii* is protected within Special Areas of Conservation in Ireland.

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

An ongoing monitoring programme of rare and threatened bryophytes, including *P. ralfsii*, has been established by the NPWS.

6.3. Future Prospects Conservation Status

The range of *P. ralfsii* is not considered to have declined historically, or at least there is no evidence of a decline. It still occurs at the great majority of the sites from which it has been recorded. It has a Favourable Conservation Status.

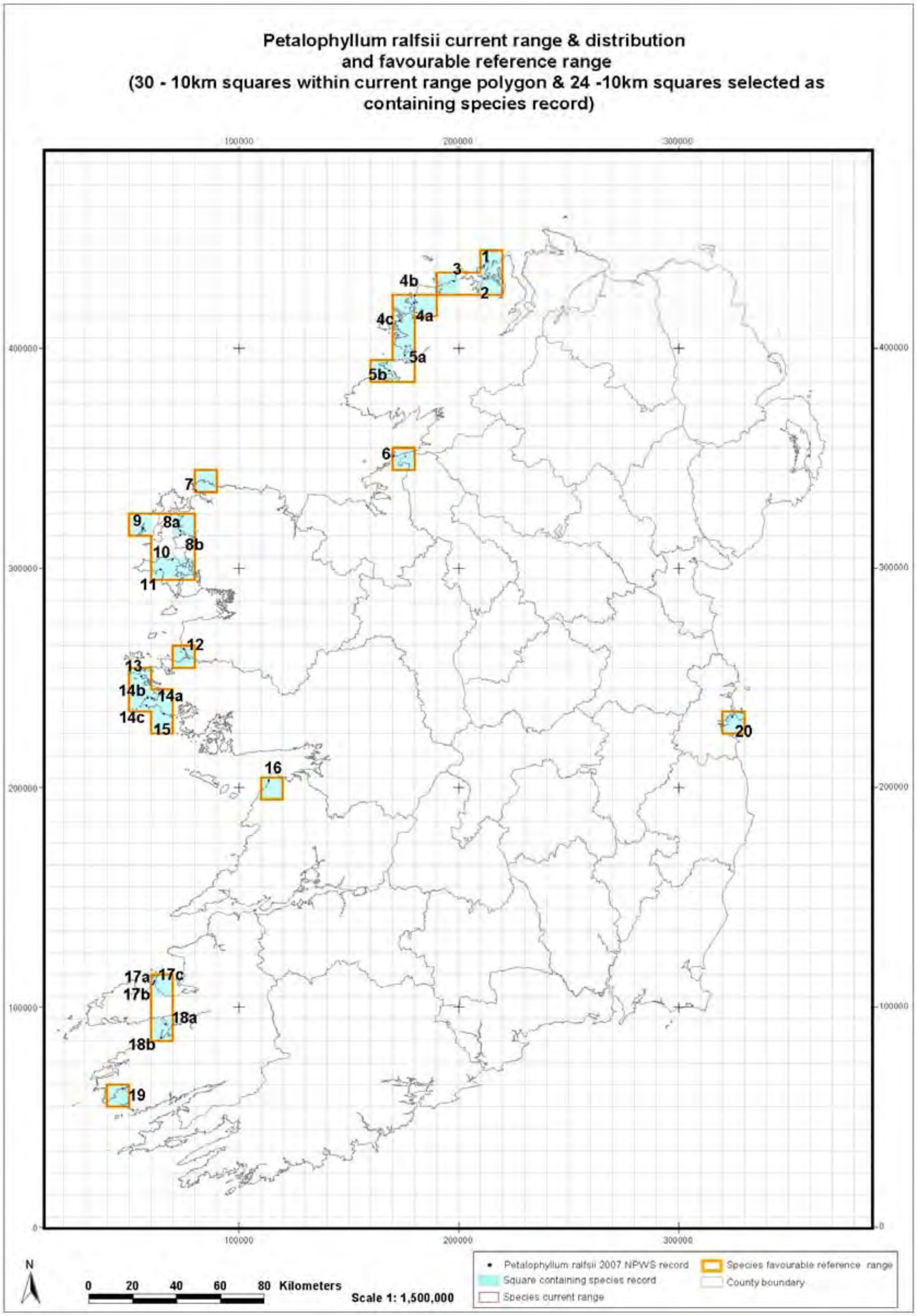
The population of *P. ralfsii* in Ireland is substantial, and appears to be fairly stable. However, long-term trends are at present difficult to distinguish from short-term fluctuations, and it may be that this species has declined, although there is no evidence for this, due to the paucity of fieldwork in the past. Population therefore has a Favourable Conservation Status.

The habitat of *P. ralfsii* – dune slacks and machair – is still extensive and largely in good condition for *P. ralfsii*, and most identified suitable areas still support *P. ralfsii*. Habitat has a Favourable Conservation Status.

Considering the impacts, pressures and threats to *P. ralfsii* 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 *P. ralfsii* is Favourable.

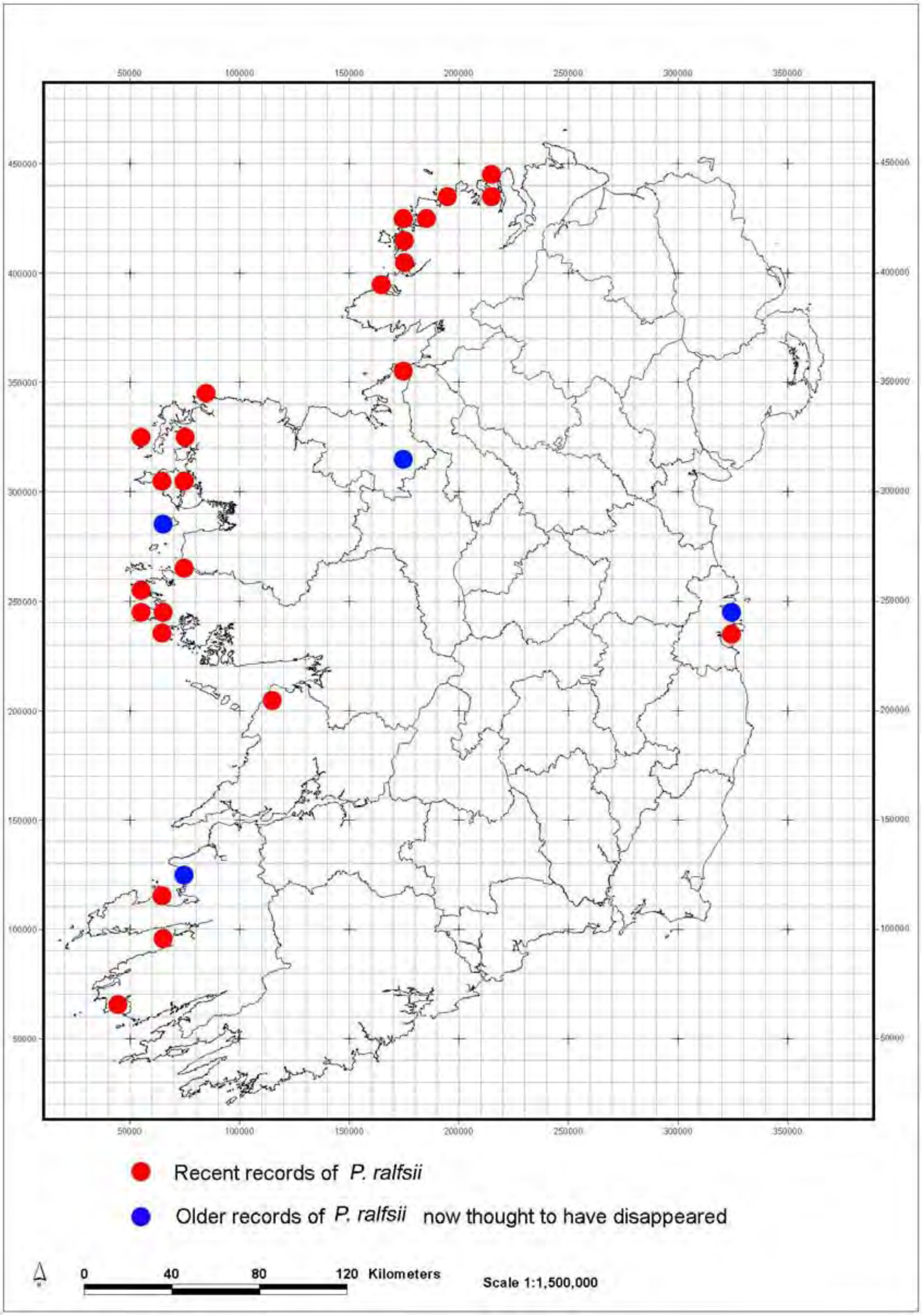
Range of *Petalophyllum ralfsii*:	**Favourable**
Population of *Petalophyllum ralfsii*:	**Favourable**
Habitat for *Petalophyllum ralfsii*:	**Favourable**
Future Prospects for *Petalophyllum ralfsii*:	**Favourable**
Overall Assessment:	**Favourable Conservation**

Appendix I
Range of *Petalophyllum ralfsii* in Ireland (2007)



Appendix II

Distribution of *Petalophyllum ralfsii* in Ireland (2007)



Appendix III

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

Hallingbäck, T., Hodgetts, N.G. & Urmi, E. 1996. How to use the new IUCN Red List categories on bryophytes. Guidelines proposed by the IUCN SSC Bryophyte Specialist Group. *Anales del Instituto de Biologia, Serie Botanica* 67(1): 147-157

Appendix IV

Surveys of *Petalophyllum ralfsii* in Ireland

Hodgetts, N.G. 2003. *Survey of Rare and Threatened Bryophytes in North Sligo.* Unpublished report to National Parks and Wildlife Service, Dublin.

Hodgetts, N.G. 2006. *Survey of Rare and Threatened Bryophytes in Mid/East Cork and Dingle Peninsula.* Unpublished report to National Parks and Wildlife Service, Dublin.

Holyoak, D.T. 1999. Report on surveys of *Petalophyllum ralfsii* in Co. Mayo and Co. Galway, Western Ireland, 16-22 April 1999. Unpublished report for NPWS.

Holyoak, D.T. 2002. *Survey of Rare and Threatened Bryophytes in North Donegal.* Unpublished report to National Parks and Wildlife Service, Dublin.

Holyoak, D.T. 2003. *Survey of Rare and Threatened Bryophytes in County Mayo.* Unpublished report to National Parks and Wildlife Service,
Dublin.

Holyoak, D.T. 2004. *Survey of Rare and Threatened Bryophytes in County Galway.* Unpublished report to National Parks and Wildlife Service, Dublin.

Appendix V

Special Areas of Conservation (SACs) designated for *Petalophyllum ralfsii* in Ireland

Site Code	Site Name	County
000194	Tranarossan and Melmore	Donegal
001190	Sheephaven	Donegal
000147	Horn Head & Rinclevan	Donegal
001141	Gweedore Bay & Islands	Donegal
000197	West of Ardara/Maas Road	Donegal
000625	Bunduff Lough & Machair/Trawalua/Mullaghmore	Sligo
000500	Glenamoy Bog Complex	Mayo
000470	Mullet/Blacksod Bay Complex	Mayo
000507	Inishkea Islands	Mayo
001497	Doogort Machair/Lough Doo	Mayo
001513	Keel Machair/Menaun Cliffs	Mayo
001932	Mweelrea/Sheeffry/Erriff Complex	Mayo
001309	Omey Island Machair	Galway
002074	Slyne Head Peninsula	Galway
002129	Murvey Machair	Galway
000020	Black Head-Poulsallagh Complex	Clare
002070	Tralee Bay & Magharees peninsula, West to Cloghane	Kerry
000343	Castlemaine Harbour	Kerry
000335	Ballinskelligs Bay & Inny Estuary	Kerry
000206	North Dublin Bay	Dublin

1395 *Petalophyllum ralfsii*

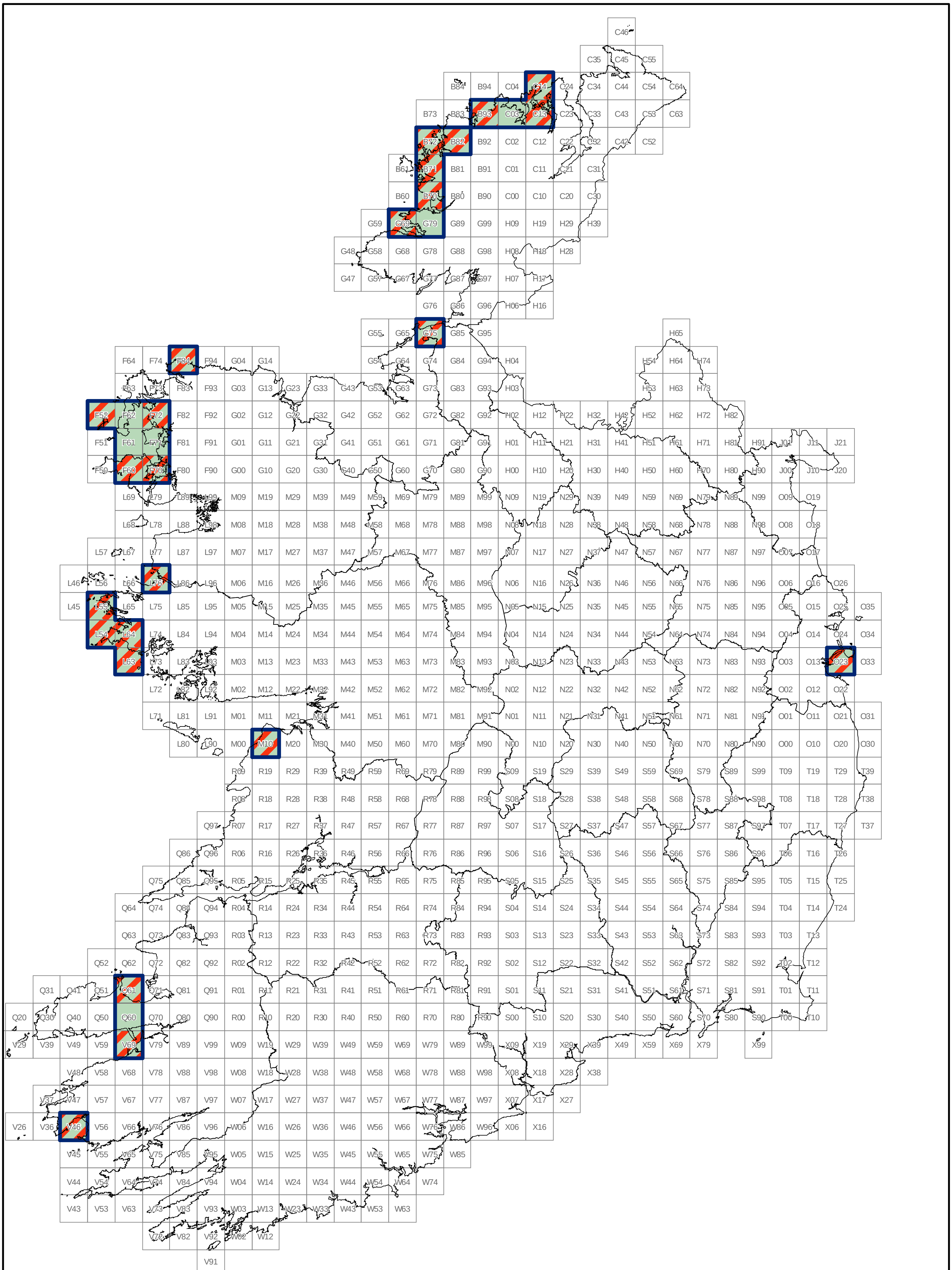
National Level	
Species code	1395
Member State	Ireland IE
Biogeographic regions concerned within the MS	Atlantic (ATL)
Range	3,000 km^2 (30 grid cells x 100 km)

Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Atlantic (ATL)
Published sources	▪ Blockeel, T.L. & Long, D.G. (1998). *A check-list and census catalogue of British and Irish bryophytes.* British Bryological Society, Cardiff. ▪ Church, J.M., Hodgetts, N.G., Preston, C.D. & Stewart, N.F. (2001). *British Red Data Books. Mosses and liverworts.* Peterborough, Joint Nature Conservation Committee. ▪ Crandall-Stotler, B.J., Stotler, R.E. & Ford, C.H. (2002). Contributions toward a Monograph of *Petalophyllum* (Marchantiophyta). *Novon* 12 (3): 334-337. ▪ European Committee for the Conservation of Bryophytes (ed.) (1995). *Red Data Book of European bryophytes*. Trondheim, European Committee for the Conservation of Bryophytes. ▪ Hill, M.O. & Preston, C.D. (1998). The geographical relationships of British and Irish bryophytes. *Journal of Bryology* 20: 127-226. ▪ Hill, M.O., Preston, C.D. & Smith, A.J.E. (eds.) (1991). *Atlas of the bryophytes of Britain and Ireland. Volume 1 Liverworts (Hepaticae and Anthocerotae).* Colchester, Harley Books. ▪ Hodgetts, N.G. (2003). *Survey of Rare and Threatened Bryophytes in North Sligo.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Hodgetts, N.G. (2006). *Survey of Rare and Threatened Bryophytes in Mid/East Cork and Dingle Peninsula.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (1999). Report on surveys of *Petalophyllum ralfsii* in Co. Mayo and Co. Galway, Western Ireland, 16-22 April 1999. Unpublished report for NPWS. ▪ Holyoak, D.T. (2002). *Survey of Rare and Threatened Bryophytes in North Donegal.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (2003). *Survey of Rare and Threatened Bryophytes in County Mayo.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Holyoak, D.T. (2004). *Survey of Rare and Threatened Bryophytes in County Galway.* Unpublished report to National Parks and Wildlife Service, Dublin. ▪ Macvicar, S.M. (1926). *The Student's Handbook of British Hepatics.* V.V. Sumfield, Eastbourne. ▪ Söderström, L., Urmi, E. & Váňa, J. (2002). Distribution of Hepaticae and Anthocerotae in Europe and Macaronesia. *Lindbergia* 27: 2-47. ▪ Stotler, R.E., Ford, C.H. & Crandall-Stotler, B.J. (2002). Typifications in the genus Petalophyllum (Marchantiophyta). *Bryologist* 105 (3): 400-406.
Range	
Surface area	3,000 square kilometers
Date	May 2007
Quality of data	3 = good
Trend	+ increase from 1,100 to 3,000 square kilometres

Trend-Period	1998-2007
Reasons for reported trend	1 = improved knowledge/more accurate data
Population	
Population size estimation	29 populations
Date of estimation	2007
Method used	3 = from complete inventory
Quality of data	3 = good
Trend	0 = stable
Trend-Period	1998-2006
Reasons for reported trend	1 = improved knowledge/more accurate data
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	120 Fertilisation 148 Overgrazing general 149 Undergrazing 150 Restructuring agricultural land holding 171 Stock feeding 501 Paths, tracks, cycling tracks 600 Sport and leisure structures 620 Outdoor sports and leisure activities 810 Drainage 701 Water pollution 900 Erosion
Threats	120 Fertilisation 141 Abandonment of pastoral systems 148 Overgrazing, general 149 Undergrazing 150 Restructuring agricultural land holding 171 Stock feeding 600 Sport and leisure structures 620 Outdoor sports and leisure activities 810 Drainage 900 Erosion 920 Drying out
Habitat for the species	
Area estimation	Area of dune systems with *P. ralfsii* is 2,235 ha.
Date of estimation	May 2007
Quality of data	3 = good
Trend	Stable
Trend-Period	1998-2007
Reasons for reported trend	1 = improved knowledge/more accurate data
Future prospects	1 = good prospects

Complementary information	
Favourable reference range	3,000 square kilometres
Favourable reference population	29 populations
Suitable Habitat for the species	2,235 ha.
Other relevant information	Positive Impacts: *P. ralfsii* is protected under the Flora Protection Order (1999). Negative Impacts: Because of the fragility of its habitat and its specialised ecology, *P. ralfsii* is potentially threatened by a large number of factors, including holiday developments, recreational activities, overgrazing, undergrazing, erosion and desiccation due to water abstraction.

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

Petalophyllum ralfsii

1395

- Current Distribution (24 cells)
- Current Range (30 cells)
- Favourable Reference Range (30 cells)
- W48 10km grid cells

Date: October 2007