

# Raised Bog Monitoring and Assessment Survey 2013



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## **Raised Bog Monitoring and Assessment Survey 2013**

**Fernando Fernandez Valverde, Kieran Connolly, Willie Crowley,  
Joanne Denyer, Katharine Duff & George Smith.**

**Ecology and Environmental Consultants Ireland Ltd**

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## Contents

Contents .....	i
Executive Summary.....	iv
Acknowledgements.....	xii
1 Introduction.....	1
1.1 Scope of the report.....	1
1.2 Project tasks.....	1
1.3 Survey area.....	2
2 Methods.....	5
2.1 Site survey.....	5
2.1.1 Field survey methods.....	5
2.1.2 Project GIS development.....	5
2.1.3 Field system development.....	5
2.1.4 General data recorded.....	6
2.1.5 Recording of quadrats.....	10
2.1.6 Data collection.....	11
2.1.7 Habitat mapping.....	11
2.1.8 Survey training.....	12
2.2 National Resource.....	13
2.2.1 Mapping the national raised bog resource.....	13
2.2.2 National Active and Degraded Raised Bog habitat distribution map.....	14
2.2.3 National habitat distribution and range maps.....	15
2.3 Site reports.....	16
2.4 Conservation status assessment.....	16
2.4.1 Conservation status assessment general methods.....	16
2.4.2 Active Raised Bog conservation status assessment.....	24
2.4.3 Degraded Raised Bog conservation status assessment.....	26
2.4.4 Bog Woodland conservation status assessment.....	29
2.4.5 Depressions on peat substrates of the Rhynchosporion conservation status assessment.....	30
2.4.6 Overall raised bog conservation status assessment.....	31
2.5 NPWS database update.....	32
2.6 Data management system and quality control.....	32
3 Results.....	34
3.1 Data deliverables.....	34
3.2 Project results.....	35
3.2.1 Clarifications.....	35

3.3	Habitat mapping.....	37
3.3.1	National raised bog resource.....	37
3.3.2	National Active Raised Bog habitat distribution and Range maps.....	41
3.3.3	National Degraded Raised Bog habitat distribution and Range maps.....	43
3.4	Conservation status assessment .....	44
3.4.1	Active Raised Bog conservation status assessment.....	44
3.4.2	Degraded Raised Bog conservation status assessment.....	62
3.4.3	Bog Woodland conservation status assessment .....	78
3.4.4	Depressions on peat substrates of the Rhynchosporion conservation status assessment ..	80
3.4.5	Overall raised bog conservation status assessment .....	83
3.5	Impacts and threats assessment.....	85
3.5.1	Peat cutting .....	85
3.5.2	Drainage.....	91
3.5.3	Burning.....	96
3.5.4	Forestry .....	98
3.5.5	Invasive and and problematic native species .....	102
3.5.6	Other impacting activities.....	104
3.6	Management actions.....	104
3.6.1	Restoration works.....	104
3.6.2	National raised bog conservation programme.....	112
4	Discussion.....	113
4.1	Habitat mapping.....	113
4.1.1	Mapping of habitats at site level.....	113
4.1.2	National raised bog resource .....	113
4.1.3	National Active and Degraded Raised Bog habitats distribution and Range maps .....	115
4.2	Conservation status assessment .....	117
4.2.1	Active Raised Bog conservation status assessment.....	118
4.2.2	Degraded Raised Bog conservation status assessment.....	120
4.2.3	Bog Woodland conservation status assessment .....	121
4.2.4	Peat cutting .....	122
4.2.5	Restoration works.....	123
5	References.....	127
	Abbreviations .....	130
	Appendix 1: Plant communities of the high bog.....	131
	Appendix 2: Ecotopes and active peat forming community complexes key.....	135
	Appendix 3: Most common central and sub-central ecotope community complexes .....	141
	Appendix 4: Impacting activities description and ranking .....	152

Appendix 5: Quadrat data .....	153
Appendix 6: Domin scale values .....	159
Appendix 7: Typical species list .....	160
Appendix 8: Active Raised Bog assessment examples.....	161
Appendix 9: National raised bog spatial datasets .....	162
Appendix 10: Active Raised Bog sites assessments versus impacts.....	168
Appendix 11: Degraded Raised Bog sites assessments versus impacts.....	171
Appendix 12: Bord na Móna raised bog sites .....	174
Appendix 13: GIS files submitted.....	175
Appendix 14: Community complexes recorded during 2011/13 survey.....	178

## Executive Summary

The main objective of the study was to undertake a survey of 32 raised bogs and report on the conservation status of the following Habitats Directive Annex I habitats within these bogs: Active raised bogs (ARB) (7110); Bog woodland (91D0); Degraded raised bogs still capable of natural regeneration (DRB) (7120) and Depressions on peat substrates of the Rhynchosporion (7150). The results of the study have been combined with those from Fernandez *et al.* (2012), which included the assessment of the conservation status of similar EU habitats at 12 raised bogs. These combined results were used to update national assessments of the conservation status of ARB and DRB habitats according to EU guidelines (Evans & Arvela, 2011). The information within this report covers the period up to early 2013. Conservation status assessments at the national level for Bog woodland and Depressions on peat substrates of the Rhynchosporion are not provided within this report as this project only covered a small proportion of the national resource of these habitats. The individual site assessments have been incorporated into the national assessments provided in NPWS (2013).

The conservation status assessment method is based on the setting of Favourable Reference Values (FRVs). These reference values have to be at least equal to the value when the Habitats Directive came into force, i.e. in 1994, or greater than this value if the long term viability of the habitat is not assured. DRB (capable of regeneration in 30 years), is an exception to the rule as this habitat should reduce in area if it is successfully restored to ARB. The very fact that DRB exists indicates that there is an obligation, under the Habitats Directive, to restore more active areas than were present when the Directive came into force. Favourable reference values for ARB and DRB set during this study are only approximate until more accurate values can be established based on further topographical and hydrological studies at individual raised bog sites. FRVs are being reviewed by the NPWS national raised bog conservation programme in 2014 based on more recent hydrological assessments (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report, as it was not available when this report was being drafted.

High bog vegetation has been mapped at ecotope level based on the vegetation classification developed by Kelly (1993) and Kelly and Schouten (2002). To identify changes in ecotope area, ecotope extent data has been compared with those of previous surveys. There are certain limitations in the process of comparing data from different surveys, due to differences in surveying, mapping techniques and interpretation between surveys. These discrepancies have been reduced as much as possible by re-interpreting the original data in the light of more standardised definitions of each ecotope and also by taking into account the fact that the more recent surveys have employed more accurate surveying techniques.



The overall extent of the raised bog resource including *intact* high bog and secondary degraded raised bog (intensively drained high bog devoid of vegetation, cutaway bog, cutover and occasionally reclaimed agricultural land with peaty soils) remaining in the country is approximately 207,525ha. Only 49,933ha of *intact* high bog remains in the country out of an original figure of 310,000ha estimated by Hammond (1979). 21,618ha (43.29%) of this *intact* high bog are within designated sites (Special Areas of Conservation (SACs) or Natural Heritage Areas (NHAs)). Detailed habitat data has been collected at least once between 1994 and 2013 for 20,117ha (40.29%) of the national *intact* high bog resource. Only 1,955ha within the 20,117ha corresponds with ARB. However, additional ARB records may be found within un-surveyed high bog sections of the *intact* high bog resource, but any such areas are likely to be very small. The overall extent of secondary degraded raised bog is 157,592ha. Secondary degraded raised bog habitat, which currently is not considered as part of DRB, may in some cases have a higher potential for restoration to ARB than some areas currently classified as DRB. Some DRB areas may have relatively low potential for restoration, particularly those whose hydrology is highly modified by impacting activities (i.e. peat cutting and drainage). These secondary degraded habitat areas may be particularly important in those geographical locations where it is the only raised bog habitat remaining within the original range (e.g. northeast county Mayo, northwest county Kerry).

**Active Raised Bog** national conservation status has been assessed as **Unfavourable Bad-Declining**. Range (13,700km<sup>2</sup>) has been assessed as Unfavourable Bad-Stable, as it is more than 10% below the FRV (26,100km<sup>2</sup>); Area (1,955ha) is 90.95% below FRV (21,618ha). Approximately 13ha (1.61%) have been lost in the 2004/05-2011/13 period within the 44 raised bogs assessed. Area has been given an Unfavourable Bad-Decreasing assessment and an overall 1.5% habitat loss has been estimated at national habitat level in the 2007-2012 reporting period. This decrease is substantially smaller than the 25 to 36.8% reported in the 1994/95-2004/05 period in 2007. The reasons for this change are a combination of the implementation of peat cutting cessation schemes, which resulted in a decline in peat cutting rates and cessation in many sites; the fact that practically no new drains have been inserted on high bog in the new reporting period (2007-2012); and the positive effects of restoration works with some sites showing new active peat forming areas. The effects of extensive drainage works undertaken in the 1980-1990s period would have continued to cause major habitat losses in the 1994/95-2004/05 period. However, this rate of loss would be expected to decrease over time as all the more vulnerable areas were impacted initially and the natural blockage of drains by *Sphagnum* growth would have further reduced the drainage impact and therefore the rate of loss. Structure & Functions (S&Fs) have been assessed as Unfavourable Bad-Stable. The current extent of central ecotope and active flush/soaks (i.e. the more pristine examples of ARB community types), which is 260.17ha, is 36.74% below FRV (957.5ha). However, there has been very little change in the extent of these ecotopes in the reporting period and thus a Stable trend has been given. Despite positive actions being

undertaken, damaging activities continue impacting and threatening raised bog SACs. Furthermore, although Future Prospects (FPs) are obviously more positive within SACs, the FPs for raised bog NHAs and non-designated raised bogs are much more negative. As a result, nationally, FPs have been given an Unfavourable Bad–Declining assessment.

**Degraded Raised Bog** national conservation status has been assessed as **Unfavourable Bad-Declining**. Range has been assessed as Favourable-Stable; Area (47,978ha) is 69.44% above FRV (28,315ha). DRB is a special case since if restored (which is the goal) it becomes ARB and thus the FRV for Area is less than the present day Area. Approximately 45ha of DRB have been lost in the 2004/05-2011/13 period due to peat cutting within the 44 raised bogs assessed. Further habitat losses are expected within NHA raised bogs. The Area has been given an Unfavourable Bad-Decreasing assessment and an overall 1% habitat loss (i.e. high bog losses due to peat cutting) has been estimated in the 2007-2012 reporting period. S&Fs have been assessed as Unfavourable Inadequate-Declining. Despite positive actions being undertaken, damaging activities continue to impact and threaten raised bog SACs. Furthermore, although FPs are more positive within SACs, the FPs for raised bog NHAs and non-designated raised bogs are more negative. As a result FPs at a national level have been given an Unfavourable Bad–Declining assessment.

**Bog Woodland** was only recorded in six of the 44 sites surveyed. The habitat has been given an overall Favourable –Stable assessment at three raised bogs; Unfavourable Inadequate-Declining at two raised bogs and Unfavourable Bad-Declining assessment at one raised bog. Peat cutting, drainage and burning continue to threaten Bog Woodland FPs at those sites given a negative assessment.

**Depressions on peat substrates of the Rhynchosporion** has been given an overall Unfavourable Bad-Declining assessment at 29 bogs, Unfavourable Inadequate-Declining at Carrowbehy/Caher, Unfavourable Bad-Stable at seven bogs and Unfavourable Bad-Improving at seven bogs. Impacting activities such as peat cutting and drainage continue to threaten Rhynchosporion depressions associated habitats (ARB and DRB) at those sites given a negative assessment. Restoration works were undertaken at all those bogs given an Improving trend.

Peat cutting and drainage (both on the high bog and the cutover) associated with peat cutting are the most negatively impacting activities on the raised bogs surveyed.

**High bog drainage** either functional and/or reduced functional (this also includes those blocked but not completely in-filled and thus still discharging some water) was recorded on 42 of the 44 raised bogs surveyed. This activity is considered to have a High Importance/Impact on ARB at 18 raised bogs and thus on these sites would have been responsible, sometimes along with other impacting activities (e.g. peat cutting, adjacent land drainage), for the drying out of the high bog and consequently for ARB losses. High bog drainage has a Medium Importance/Impact at the remaining 24 raised bogs

surveyed. Although habitat losses associated with high bog drains appear not to have taken place in the reporting period on these sites, the activity continues impacting the habitat and it is preventing recovery. **Adjacent land drainage** was reported as having an impact on high bog habitats at 43 of the 44 raised bogs surveyed. This activity was reported as having a High Importance/Impact on ARB at 12 raised bogs and thus on these sites this activity would have been responsible, sometimes along with other activities such as peat cutting and high bog drainage, for the overall drying out of the high bog and ARB losses. This activity was given a Medium Importance/Impact on ARB at 24 raised bogs, although habitat losses appear not to have taken place on these sites in the reporting period due to adjacent land drainage, the activity continues impacting the habitat as it is likely to affect the high bog hydrology/topography in the long term and reduces restoration prospects. A Low Importance/Impact on ARB was given at seven bogs where the activity does not appear to have impacted the habitat in the reporting period.

**Peat cutting** took place at 32 of the 44 raised bogs surveyed in the 2004/05-2012 period. The cutting that continues is of a domestic nature and consists of mechanical peat extraction (i.e. Hopper machinery). Peat cutting has ceased at 14 of these 32 raised bogs during the reporting period meaning that peat cutting has now ceased on 26 of the 44 sites surveyed. A decreasing trend in terms of the intensity of cutting has also been reported at another 14 raised bogs. Cutting re-started at Ferbane and no information is available on the status of cutting for the remaining three bogs. Peat cutting was given a High Importance/Impact on ARB at 11 of the 32 bogs cut as the assessments indicate that the activity is directly connected with habitat loss; Medium at three bogs as it is having some impact on the habitat but no direct habitat losses were recorded and Low at 17 raised bogs as peat cutting at current rates and location does not appear to be having an impact on ARB at the site in the reporting period. There appears to be no impact from peat cutting on ARB at Cloonshanville Bog, as peat cutting was small in extent (<0.03ha in the 2004/05-2010 period) and took place relatively far from ARB. The results only relate to the reporting period (2007-2013) and not to previous or future reporting periods. Peat cutting would have been responsible for decreases/declines in ARB in the past on all of the bogs where currently it is reported as having a Low Importance/Impact or no impact. In addition, a Low Importance/Impact during the current reporting period does not imply a low impact in the next reporting period if the activity was to continue even at current rates. Furthermore, a continuation of peat cutting at these sites would minimise the chances of effective restoration works at the site and therefore the recovery to FRVs, and thus the achievement of Favourable Conservation Status, which is an objective under the Habitats Directive.

**Burning** has been reported at 14 of the 44 raised bogs surveyed. Burning was assessed as having a High Importance/Impact on ARB at one raised bog; Medium at seven<sup>7</sup> raised bogs and Low at four and no impact on ARB at two sites.

**Forestry** (i.e. conifer plantations) on the high bog was reported at six raised bogs of the 44 surveyed. Forestry was assessed as having a High Importance/Impact on ARB at Corliskea, being connected with actual habitat losses; Medium at Ballynafagh and Tawnaghbeg and Low in the remaining bogs. Forestry on land adjacent to the high bog was recorded at 27 of the 44 raised bogs surveyed. This activity was assessed as having a Medium Importance/Impact on ARB at two raised bogs and Low at the remaining 25 sites.

**Invasive species and problematic native species** were recorded at 35 of the 44 raised bogs surveyed. They were only considered to have a High Importance/Impact on ARB at Moanveanlough where *Sarracenia purpurea* was recorded at high densities. A Low Importance/Impact on ARB was given to the remaining sites. *Pinus contorta*, *Rhododendron ponticum*, *Sarracenia purpurea* and *Campylopus introflexus* were reported as the most common invasive species. *Pinus sylvestris* is now reported as a problematic native species rather than alien invasive. The spread of *Pinus* sp. rather than being considered as a problem in its own right is considered to indicate ongoing drying out of the high bog caused by other impacting activities (e.g. drainage, peat cutting and quarrying) creating more negative conditions on the high bog.

**Quarrying** was recorded as having a High Importance/Impact on high bog habitats at All Saint's; Medium Importance/Impact at Knockacoller and its influence is unknown at Killyconny. It was not recorded at any other of the sites surveyed.

**Restoration works** (e.g. blocking of high bog and cutover drains, dam construction) were undertaken at 21 of the 44 raised bogs surveyed. However, only works at seven of the 21 took place within the reporting period (2007-2012). These actions have been ranked as having a High Importance/Impact on ARB at 12 of the 21 raised bogs. A High value indicates that ARB has developed as a result of restoration works (or considerably improved the quality of DRB) within the 2004/05-2011/13 period and major negatively impacting activities have not counteracted this positive trend. A Medium Importance/Impact on ARB was given at eight raised bogs. Although these restoration works encouraged the formation of small areas of new ARB at two of these five raised bogs, negatively impacting activities (e.g. drainage and peat cutting) have counteracted the positive effects of restoration works and overall a net ARB loss took place. A Low Importance/Impact was given to restoration works at Monivea where the area restored seems to be hydrologically disconnected from the high bog. At national level restoration works have taken place or are planned on 46 raised bogs, of which 29 are SACs, 13 are NHAs and four are undesignated.

**In summary**, a decreasing trend in peat cutting, high bog forestry, burning and to a lesser extent drainage on high bog has been noted within SACs. However, adjacent land drainage has been maintained (i.e. former drains widened and deepened) or new drains inserted in some sites. The implementation of the Department of Arts, Heritage and the Gaeltacht's (DAHG's) new peat cutting

cessation scheme has resulted in the apparent cessation of peat cutting in many of these sites and restoration works have also benefited high bog habitats in many of the sites surveyed. The much smaller reduction in ARB losses compared to the previous reporting period confirms the beneficial effects of these schemes. Nevertheless, activities such as peat cutting and drainage continue to impact on the habitat within SACs. Furthermore, the peat cutting cessation scheme does not cover raised bog NHAs (as of April 2013) and peat cutting on these sites appears to have increased in intensity during the reporting period (Ryan, J., pers. comm., 2013). Restoration works have been undertaken or are expected to be undertaken at 29 SACs, however very few NHAs (13) benefit from such works. Thus, a more negative FPs is expected within NHA raised bogs and non-designated raised bogs. Their conservation is essential to prevent habitat losses and preserve the habitat's Range. Raised Bog SACs contain 71.61% of the known ARB national resource (1,400ha out of 1,955ha) and 21.61% of the DRB national resource (10,368ha out of 47,978ha).

The initiation of the national raised bog conservation programme in April 2013 is one of the most positive actions regarding raised bog conservation undertaken recently. This conservation programme includes the establishment of national and site specific conservation objectives, as well as restoration plans. The individual site assessments of the 44 bogs surveyed in 2011-13 have highlighted the potential of cutover areas in some sites to support and develop ARB. This is most critical for small raised bogs, where impacting activities such as peat cutting, drainage and associated subsidence is threatening the continued existence of ARB on the high bog. On such bogs these activities are more likely to have irreversibly modified the high bog (i.e. steep slopes) to such an extent that the only possibility for the long term maintenance/restoration of ARB will be on the cutover. However, this option should also be considered for bigger sites with large cutover areas where the potential increase of ARB would greatly help to achieve national targets for this habitat.

**Recommendations (based on information available up to April 2013):**

- a) A review of the high bog vegetation classification at community complex level is required. This should generate a list and detailed description of vegetation community complexes per ecotope. Although this task was initiated by Fernandez *et al.* (2005), further work is required, particularly on sub-marginal and marginal ecotopes.
- b) An identification, description and classification of the cutover vegetation is required. This should mainly focus on cutover areas where active peat forming vegetation has, or may, develop and thus on areas likely to be considered as potential Active Raised Bog habitat.
- c) An identification of those raised bogs currently not designated where significant areas of ARB are likely to occur is required. Obtaining accurate figures for ARB will require the field surveying of these sites.

- d) Resurvey of sites with significant areas of ARB where only data prior to 2007 is available is recommended. These sites contain 50.13% (980ha) of the 1,955ha of ARB and the previously reported extent may have decreased significantly since the last survey due to ongoing damaging activities (e.g. peat cutting and drainage).
- e) A review of the national unsurveyed *intact* high bog dataset as well as the secondary degraded raised bog dataset is recommended, as their extent and distribution may have been underestimated.
- f) A review of the Area of Bog Woodland on those sites not surveyed in the 2011-2013 period is recommended. This should take into account the minimum tree canopy cover requirement for the habitat (>30%), as well as the level of mapping accuracy and surveying techniques undertaken in this project and Fernandez *et al.* (2012) surveys. A review of the Bog Woodland monitoring sheet is recommended. This should consider the inclusion of *Pinus sylvestris* as a structural data indicator, as well as review the requirements regarding target tree species diameter at breast height (dbh) and presence of old trees and dead wood. The 2011-13 surveys have revealed a very small Area (<1ha) of Bog Woodland at three of the six sites surveyed. The minimum Area needed for a wooded area to be considered Bog Woodland should be revised and defined more precisely.
- g) The complete cessation of peat cutting within SACs and NHAs, further restoration works including the blocking of high bog drains (both reduced functional and functional) and the removal of high bog conifer plantations should be undertaken in order to work towards the objectives of the Habitats Directive.
- h) The implementation of the peat cutting cessation scheme and restoration programmes within NHA raised bogs is recommended to prevent loss of ARB, as well as to maintain the habitat's Range. These sites contain 28.39% of total ARB.
- i) The recent monitoring surveys noted the frequent occurrence of drainage works in areas adjacent to the high bog; their impact should be assessed and recommendations for blocking made where appropriate. Maintenance works (dredging) of rivers and streams near high bog areas were also identified as potentially impacting high bog habitats. An impact assessment of such works should also be undertaken prior to these types of works being carried out.
- j) An assessment of the potential impact of forestry plantations in areas near the high bog should also be undertaken prior to any new plantations being carried out.
- k) Burning on the high bog surface should be controlled.
- l) Quarrying adjacent to the high bog, although not frequently reported, was found to have potentially highly negative impacts on high bog habitats and thus impact assessments should be undertaken prior to any other quarrying activity being initiated near high bog.

- m) Periodic monitoring of raised bogs should continue in order to ascertain changes on high bog vegetation brought about by negatively impacting activities and/or restoration works.
- n) The establishment of a targeted and appropriately designed and implemented restoration programme is recommended to optimise resource use and long-term effectiveness. This programme should include all raised bogs in the country with significant conservation value and restoration potential.
- o) Consideration should be given to the need to restore cutover areas where this will support the conservation of high bog or where high bog conditions are no longer suitable for maintenance or restoration of ARB.
- p) The restoration of ARB within the following areas: Monaghan, southeast Clare, west Mayo, south Tipperary, north Roscommon, Cavan and east Meath, which are part of the Favourable Reference Range and where currently the habitat is absent, is particularly important in order to move towards achieving Favourable Conservation Status.

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# 1 Introduction

## 1.1 Scope of the report

This report presents the field survey methods, conservation status assessment criteria and the results of the 2012-13 Raised Bog Monitoring & Assessment Survey for a total of 32 designated raised bogs carried out by Ecological and Environmental Consultants Ireland Ltd and commissioned by the National Parks and Wildlife Service (NPWS). It also includes the results of the assessments for 12 additional designated raised bogs undertaken by Fernandez *et al.* (2012).

A national assessment of the conservation status of Active and Degraded Raised Bog habitats for the 2007-2013 period following guidelines under Article 17 of the Habitats Directive (92/43/EEC) is derived using all available data.

Information within this report only covers the period prior to early 2013. It is important to note that this report does not include or consider changes that have taken place since 2013, including updates to the definition of Degraded Raised Bog habitat, setting of national and site specific targets for Active Raised Bog and the distribution of Active and Degraded Raised bog habitats in Ireland which are being reviewed as part of national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>).

## 1.2 Project tasks

The main objective of this project was to undertake a survey of 32 raised bogs in Ireland and report on the conservation status of the following four Habitats Directive Annex I habitats within these bogs following modified methods devised by Fernandez *et al.* (2012):

- 7110 Active raised bogs (priority habitat) (ARB)
- 91D0 Bog woodland (priority habitat)
- 7120 Degraded raised bogs still capable of natural regeneration (DRB)
- 7150 Depressions on peat substrates of the Rhynchosporion

The methods assess changes in habitat Area, Structure and Functions (S&Fs) and Future Prospects (FPs). As part of this project, site-specific Future Prospects of Area and S&Fs are assessed at two different levels: Future Status and Future Trend. Modifications of the methods outlined in Fernandez (2012) involve projections of the future status and trend of Area and S&F to determine FPs at each habitat at each site. These updates were applied to the 2012 data and all results were used to derive a national assessment of the conservation status of ARB and DRB habitats adapting the EU guidelines (Evans & Arvela, 2011) (See section 2.4.1.4).

A revised survey approach based on current survey methods was agreed with NPWS prior to the field survey.

### 1.3 Survey area

Table 1.1 below includes a list of sites surveyed as part of the Fernandez *et al.* (2012) (12 raised bogs) and this project (32 raised bogs). A total of 44 raised bogs (7,038ha) have been surveyed between both surveys. See Figure 1.1 for the location of the survey sites (Sheheree Bog (Co. Kerry) is not included in the view).

**Table 1.1** Survey sites

Site Code	Site Name	Designation	High bog area (ha)	County	Survey Year
000006	Killyconny	SAC	83.04	Meath & Cavan	2011
000221	Moorfield Bog/Farm Cottage	NHA	65.12	Galway & Roscommon	2012
000285	Kilsallagh	SAC	182.10	Galway	2012
000296	Lisnageeragh	SAC	269.52	Galway	2012
000297	Addergoole	SAC	156.43	Galway & Mayo	2012
000326	Shankill West	SAC	67.34	Galway	2012
000382	Sheheree	SAC	6.40	Kerry	2012
000391	Ballynafagh	SAC	70.05	Kildare	2011
000497	Flughany	SAC	149.43	Mayo & Sligo	2012
000566	All Saints	SAC	222.95	Offaly	2011
000575	Ferbane	SAC	119.98	Offaly	2012
000580	Mongan	SAC	124.37	Offaly	2011
000581	Moyclare	SAC	74.27	Offaly	2012
000582	Raheenmore	SAC	130.55	Offaly	2011
000585	Sharavogue	SAC	137.02	Offaly	2011
000592	Bellanagare	SAC	878.90	Roscommon	2013
000595	Callow	SAC	351.99	Roscommon	2012
000597	Carrowbehy	SAC	204.55	Roscommon	2012
000600	Cloonchambers	SAC	195.77	Roscommon	2012
000604	Derrinea	SAC	54.83	Roscommon	2012
000614	Cloonshanville	SAC	146.35	Roscommon	2012
000641	Ballyduff	SAC	86.68	Tipperary	2011
000641	Clonfinane	SAC	87.26	Tipperary	2011
000647	Firville	SAC	183.68	Tipperary	2011
000647	Kilcarren	SAC	178.57	Tipperary	2011

Site Code	Site Name	Designation	High bog area (ha)	County	Survey Year
000679	Garriskil	SAC	170.26	Westmeath	2011
001242	Carrownagappul	SAC	323.47	Galway	2012
001818	Ballykenny	SAC	180.81	Longford	2011
001818	Fisherstown	SAC	102.42	Longford &	2012
002110	Cloonfelliv	SAC	55.08	Roscommon	2013
002110	Corliskea	SAC	276.01	Galway & Roscommon	2013
002110	Trien	SAC	124.22	Roscommon	2013
002298	Derrynabrock	SAC	80.49	Mayo & Roscommon	2012
002298	Tawnaghbeg	SAC	71.67	Mayo	2013
002333	Knockacoller	SAC	53.30	Laois	2012
002336	Carn Park	SAC	160.29	Westmeath	2013
002337	Crosswood	SAC	98.12	Westmeath	2012
002346	Brown	SAC	50.88	Longford	2012
002347	Camderry	SAC	195.44	Galway	2012
002349	Corbo	SAC	96.95	Roscommon	2012
002350	Curraghlehanagh	SAC	146.38	Galway	2012
002351	Moanveanlagh	SAC	118.17	Kerry	2012
002352	Monivea	SAC	132.17	Galway	2012
002353	Redwood	SAC	374.73	Tipperary	2012



## 2 Methods

### 2.1 Site survey

#### 2.1.1 *Field survey methods*

Prior to a site visit the NPWS Designated Raised Bog Orthophotos 2010 were examined to identify potential new active peat forming areas. The higher accuracy of the 2010 aerial photographs compared to previous series allowed for the identification of potential active peat forming areas overlooked in the 2004/05 survey. Any newly recorded areas are generally small in area (<1ha). NPWS Regional staff were contacted prior to the site survey and meetings on the sites arranged when possible.

Site notes were recorded throughout the site: community complex types encountered were described, features of interest, impacts and activities and notable species were also recorded (See sections 2.1.4 and 2.1.5 for more information). Detailed notes were recorded in a waterproof notebook and subsequently transferred to each relevant site report. The location of each community complex was fixed on the habitat map using GPS minicomputers (Trimble GeoXT) (See section 2.1.6 for further details on data capture).

Species nomenclature followed the following sources:

- Vascular plants- Stace, C. (2010) *New Flora of the British Isles*. 3rd Edition. Cambridge University Press.
- Bryophytes- Blockeel, T. L. & Long, D. G. (1998) *A check-list and census catalogue of British and Irish bryophytes*. British Bryological Society, Cardiff.
- Lichens- Coppins, B. J. (2002) *Checklist of Lichens of Great Britain and Ireland*. British Lichen Society, London.

#### 2.1.2 *Project GIS development*

Digital spatial data from previous raised bog surveys, which was used for fieldwork and post-survey analysis, was collated. This included the following sources: NPWS Designated Raised Bog Orthophotos 2010, discovery series, 6" maps and Fernandez *et al.* (2005) maps. These data was transferred to the Trimble GeoXT units using GPS Pathfinder Office.

#### 2.1.3 *Field system development*

Field system development included the preparation and testing of ruggedised GPS minicomputers (Trimble GeoXT) prior to the field survey, as well as the customising of data dictionaries using TerraSync software to record data in the field (e.g. community complex type, habitat boundary, impacts, drainage, quadrat, invasive species, rare species).

## 2.1.4 General data recorded

The following are the main features recorded in each raised bog:

### 2.1.4.1 Community complexes

Active and Degraded Raised Bog are divided into **community complexes** which are characterised by **vegetation communities** and these complexes are then amalgamated into **ecotopes** with different physical characteristics using the approach outlined by Kelly and Schouten (2002).

High bog community complexes were described and mapped and detailed notes were taken on each community complex and any flush or soak areas on the high bog. These included: species lists; ground firmness; physical indicators (i.e. burning, bare peat, erosion channels, algae); *Calluna vulgaris* height and cover; macro-topography (i.e. steep slope, slight slope, flat, depression); micro-topography (i.e. hummocks, flats, hollows, pools); pools type (i.e. regular, interconnected, tear) and cover; tussocks type (*Trichophorum germanicum* or *Eriophorum vaginatum*); evidence of degradation or regeneration; cover of *Cladonia* and *Sphagnum* species and *Narthecium ossifragum*; dominant species cover and additional comments. Each community complex was named based on the dominance of one or more than one of the vegetation types listed in Table 2.1 below. A more detailed description of the different plant communities that can be found on high bog was based on Kelly & Schouten (2002) and modified by F. MacGowan and published in Fernandez *et al.* (2005) (See Appendix 1).

Community complex points and ecotope boundary points were used to generate high bog vegetation ecotope maps and subsequently Annex I habitat maps.

**Table 2.1** Characteristic species/features for community complex terminology

Complex number	Vegetation type
1	<i>Calluna vulgaris</i> (face-bank)
2	<i>Trichophorum germanicum</i> dominated
3	<i>Carex panicea</i> dominated
4	<i>Rhynchospora alba</i> dominated
6	<i>Narthecium ossifragum</i> dominated
7	<i>Calluna vulgaris</i> dominated
7a	<i>C. vulgaris</i> & <i>Eriophorum angustifolium</i> complex
9	<i>Eriophorum vaginatum</i> dominated
9a	<i>Eriophorum angustifolium</i> dominated
10	<i>Sphagnum</i> dominated
14	Hummock/hollow frequent pool complex
15	Hummock/hollow scattered pool complex
35	Inter-connected pools with abundant <i>Racomitrium lanuginosum</i> hummocks

#### 2.1.4.2 Ecotopes

Community complexes are grouped into five different ecotopes:

- **Face-bank ecotope**
- **Marginal ecotope**
- **Sub-marginal ecotope**
- **Sub-central ecotope**
- **Central ecotope**

Kelly *et al.* (1995) considered face-bank as part of marginal ecotope and not as an independent ecotope. Face-bank was considered a separate ecotope by Fernandez *et al.* (2005) and Fernandez *et al.* (2012), therefore is also considered as so during the current survey. A description of the most relevant characteristics of each ecotope was based on Kelly & Schouten (2002) and modified by F. MacGowan and published in Fernandez *et al.* (2005) (See Table 2.2 below).

**Table 2.2** Ecotopes characteristics

Ecotope	Characteristics
<b>Face-bank</b>	<p><b>Physical characteristics:</b> Water level low, surface very hard. Degraded micro-topography with low hummocks/flats, hollows &amp; lawns. No pools or wet hollows present.</p> <p><b>Characteristic dominant species:</b> Very tall, vigorous <i>Calluna vulgaris</i>.</p>
<b>Marginal</b>	<p><b>Physical characteristics:</b> Water level low, surface generally hard, soft in spots e.g. <i>Rhynchospora alba</i> hollows. Degraded micro-topography, with very little differentiation between hummocks and hollows, etc. Non-algal pools &amp; tall hummocks absent. Hollows can be frequent &amp; these are dominated by <i>Rhynchospora/Nartheicum/Trichophorum</i> in tussock form/Algal mats. Pools area absent except for tear pools.</p> <p><b>Characteristic species:</b> In lawns <i>Nartheicum</i> is most dominant, <i>Sphagnum papillosum</i> &amp; <i>S. capillifolium</i> are present in small amounts (not in lawns, or in big hummocks, but in small patches). <i>Trichophorum</i> common in tussock form. Kelly <i>et al.</i> (1995) also includes <i>Carex panicea</i> as typical species and more naturally frequent in western sites. In small hummocks <i>Calluna vulgaris</i>, <i>Sphagnum capillifolium</i> and <i>Cladonia portentosa</i> are common.</p> <p><i>Sphagnum</i> species present in order of decreasing occurrence:  <i>S. capillifolium</i> → <i>S. tenellum</i> → <i>S. magellanicum</i> → <i>S. papillosum</i></p>
<b>Sub-marginal</b>	<p><b>Physical characteristics:</b> Surface ranges from hard to soft but not quaking. Wetter vegetation types are absent except for algal mats/<i>Rhynchospora</i> and <i>Nartheicum</i> hollows dominant.</p> <p><b>Characteristic species:</b> In lawns <i>Sphagnum papillosum</i> dominates, although absent from some areas. <i>S. magellanicum</i> &amp; <i>S. capillifolium</i> area present but not <i>S. cuspidatum</i>. <i>Trichophorum</i> is common, but in less tussocky form than in marginal ecotope. <i>Rhynchospora fusca</i> occurs in hollows and pools. In hummocks <i>Calluna vulgaris</i>, <i>Sphagnum capillifolium</i>, <i>Cladonia portentosa</i> are common.</p>

Ecotope	Characteristics
<b>Sub-central</b>	<p><b>Physical characteristics:</b> Surface soft and sometimes quaking, occasionally hard. Micro-topography ranges from <i>Nartheicum</i> hollows to hummocks (moderately developed). Generally, however, sub-central ecotope is lawn dominated with only a few hummocks. The lawns are usually dominated by <i>Sphagnum magellanicum</i>. <i>Sphagnum cuspidatum</i> pools occur occasionally &amp; <i>Rhynchospora</i>/algal hollows area scarce. Wetter vegetation other than pools is common.</p> <p><b>Characteristic species:</b> <i>Sphagnum magellanicum</i> is often common. <i>S. papillosum</i> occurs in small amounts. <i>Trichophorum</i> is scarce. <i>S. austinii</i> present as a relic from when sub-central ecotope was central. According to Kelly <i>et al.</i> (1995) <i>S. magellanicum</i> is often dominant on midland sites although <i>S. papillosum</i> is frequent also.</p>
<b>Central</b>	<p><b>Physical characteristics:</b> Surface very soft and often quaking. Micro-topography usually ranges from pools to tall hummocks (well developed). Pools are frequent to dominant; however, pools do not have to be present for an area to be classed as central. Lawns of <i>Sphagnum cuspidatum</i> are also typical of central ecotope areas. All wet vegetation types are present and frequent.</p> <p><b>Characteristic species:</b> <i>Sphagnum cuspidatum</i> pools are common. <i>Rhynchospora</i>/algal hollows are absent. <i>Cladonia</i> dominated areas are absent.</p> <p>Kelly <i>et al.</i> (1995) differentiate between central ecotope in <b>Midland</b> or <b>Eastern</b> sites and <b>Transitional</b> or <b>Western</b> sites.</p> <p>In the <b>midlands</b> the pools of the central complex are usually colonised by <i>S. cuspidatum</i> with little open water. Other species which tend to occur in the pools are <i>Eriophorum angustifolium</i> and <i>R. alba</i> with <i>Drosera anglica</i> also occurring quite frequently. In between the pools on the midland sites <i>Sphagnum</i> lawns and hummocks are frequent. The lawn species are usually <i>S. magellanicum</i> and <i>S. papillosum</i> while the hummock species are mainly <i>S. magellanicum</i>, <i>S. capillifolium</i>, <i>S. subnitens</i>, <i>S. austinii</i> and <i>S. fuscum</i>. <i>Leucobryum glaucum</i> hummocks can also occur. <i>Nartheicum</i> hollows with <i>S. tenellum</i> are frequent also. <i>Calluna</i> and <i>Erica tetralix</i> occur in abundance, the latter growing well on hummocks. The bog surface is wet and soft and the acrotelm layer is well developed.</p> <p>On the more <b>westerly</b> sites pools tend to be more elongate and interconnecting with each other in places. More open water is seen and although <i>S. cuspidatum</i> is still important, <i>S. denticulatum</i> is more frequent. <i>Campylopus atrovirens</i> occurs around many of the pools edges and islands dominated by <i>Racomitrium</i>, which are quite common. <i>Sphagnum</i> lawns can occur between the pools but in general the inter-pool <i>Sphagnum</i> cover is lower than on the more easterly sites. <i>Nartheicum</i> is frequent and <i>Carex panicea</i> can also reach high abundances. Hummocks of <i>S. austinii</i> and <i>S. fuscum</i> and various other <i>Sphagnum</i> and bryophyte species occur. The bog surface can be wet and soft but in comparison to the midlands central ecotope the acrotelm layer is not as well developed. It is thought that the hydrology of these western</p>



Ecotope	Characteristics
	central pool complexes is somewhat different to the midland sites as excess water may flow through pools rather than through the inter-pool <i>Sphagnum</i> layer.

Central and sub-central ecotopes are classified as ARB. Flushes and soaks that are wet with active *Sphagnum* growth are also classed as ARB. Bog Woodland habitat (91D0) is also considered to occur on active peat forming areas.

Face-bank, marginal and sub-marginal ecotopes are classified as DRB. Dry flushes and coniferous plantations on the high bog are also included within this habitat. This definition is deficient as it does not take into account the actual potential for these ecotopes to be restored to ARB. This issue is being investigated as part of the current national raised bog conservation programme.

Fernandez *et al.* (2005) generated an ecotope vegetation key including the most common active peat forming (i.e. central and sub-central ecotopes) community complexes recorded during their survey (Appendix 2). A description of the most common central and sub-central ecotope community complexes was also provided (Appendix 3). The aim of these documents was to standardise the surveys and make the data collected comparable for future monitoring projects.

#### 2.1.4.3 Activities affecting the high bog

Impacting activities such as peat cutting, high bog and cutaway drainage, burning, forestry on high bog and cutover and invasive species were recorded. These activities were reported based on Ssymank's (2011) list of threats and pressures. Regional NPWS staff were consulted to obtain further information on impacting activities, but also on conservation measures such as restoration works or negotiations with landowners in relation to peat cutting cessation (e.g. turbary rights or land purchases). Additional information related to restoration works was gathered from Bord na Móna, Coillte and NPWS. The NPWS Site Inspection Report database was also consulted during the process; this database holds information on impacting activities that were observed on protected sites. However, the impact data collected during this survey were more detailed than the Site Inspection Report data and therefore these data were not used. Impacts and activities were scored based on scoring method given by Ssymank (2011). Appendix 4 provides a description of drainage data collected in the field and the terminology used in ranking impacting activities.

#### 2.1.4.4 Quadrats

Quadrats recorded in the Fernandez *et al.* (2005) survey were re-surveyed and additional quadrats recorded when considered necessary (e.g. in newly recorded active peat forming areas or when it was deemed that an insufficient number of quadrats were recorded in 2004/05). The size of quadrats was

4m x 4m for Active and Degraded Raised Bog and 10m x 10m for Bog Woodland (See section 2.1.5 for further detail). Quadrat data is provided in each individual Site Report as well as within the NPWS Raised Bog Monitoring Microsoft Access database (See section 2.5).

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#### 2.1.4.5 Photographs

A photographic record of each quadrat was taken. The grid reference of each photograph was fixed with GPS, and the aspect of each measured with a compass.

Additional photographs of impacting activities were also recorded and catalogued (See section 2.6).

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#### 2.1.4.6 Additional data

Additional data recorded in the field included the overall abundance of *Cladonia* (subsp. *Cladina*) species and *Leucobryum glaucum* per site as these species are listed on Annex V of the Habitats Directive.

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#### 2.1.5 Recording of quadrats

Quadrats were recorded mainly within ARB (i.e. central or sub-central ecotopes) and Bog Woodland habitat (91D0), and very occasionally were recorded within DRB. The comparison of 2004/05 quadrats against the most recent 2012/13 quadrats has been used for the S&Fs conservation status assessment of both ARB and DRBs. Change in species cover and other indicators have been taken into consideration to determine whether the S&Fs of a particular section of the high bog are declining or improving (See Appendix 5).

2004/05 quadrats within Active and Degraded Raised Bog were approximately 2x2m whereas 2012/13 quadrats are significantly larger (4x4m). It was decided that due to the heterogeneous nature of a raised bog micro-topography and the fact that the 2004/05 quadrats could only be located with a degree of accuracy of 1-2m on the field a 4x4m quadrat would capture its variability more accurately, as well as making their inter-year comparisons more reliable. Quadrats within Bog Woodland habitat are 10x10m. Bamboo sticks were used to mark the centre of all quadrats recorded during the 2012/13 survey, in order to make their location in future surveys more reliable.

Cover abundance of the vascular and bryophyte indicator species was recorded using the Domin scale (See Appendix 6). For each quadrat a 12-figure grid reference (i.e. 6 Easting and 6 Northing) was obtained using a GPS minicomputer (Trimble GeoXT). All quadrat data were recorded in the field using TerraSync software and have been transferred to the NPWS Raised Bog Monitoring Microsoft Access database. Appendix 5 provides a detailed description of data recorded within an ARB or DRB

quadrat and the definition of each parameter recorded. This Appendix also includes a Bog Woodland quadrat form.

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#### 2.1.6 *Data collection*

A GeoExplorer handheld GPS minicomputer (Trimble GeoXT) was used in the field to record the location of quadrats, ecotope boundaries, photographs, impacting activities (e.g. drainage, peat cutting, invasive plants) and other points of interest. The GPS positions of these features were logged and stored on TerraSync software (Trimble). Additional comments were also stored as text fields in the device.

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#### 2.1.7 *Habitat mapping*

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##### 2.1.7.1 Mapping of habitats at site level

The mapping stage involved digital mapping of habitats according to ecotopes and community complexes based on Kelly (1993) and Kelly and Schouten (2002). GPS minicomputers (Trimble GeoXT) were used in the field for mapping.

A large proportion of the high bog was walked, focusing on active areas, and changes in the vegetation at community complex level were recorded based on the comparison between 2004/05 survey data and current survey data. The 2004/05 vegetation community complex descriptions were examined prior to the field surveys.

In general, the minimum mapping size for ecotopes, and particularly ARB ecotopes, was approximately 4m x 4m. Areas smaller than the minimum mapping unit were not mapped, however, occasionally these were recorded as points, particularly in the case of central and sub-central ecotope vegetation.

A digital copy of the Fernandez *et al.* (2005) 2004/05 ecotope and vegetation community complex maps were used in the field to aid in the mapping of the current vegetation. These maps were imported into the Trimble GeoXT using GPS Pathfinder Office and visualised on the device screen. Hard copies of both ecotope and vegetation community complexes were also brought to the field. Ecotopes were digitised using ArcGIS 9.3 based on the NPWS Designated Raised Bog Orthophotos 2010 and habitat boundary points recorded on the ground. The Irish National Grid (ING) was used as the co-ordinate reference system.

The main steps involved in the survey mapping were:

- Recording community complex records and ecotope boundaries in the field using GPS minicomputers (Trimble GeoXT).

- Recording of previously recorded (i.e. Fernandez *et al.* (2005)) or new quadrats, where required, using TerraSync data dictionary software and GPS minicomputers (Trimble GeoXT).
- Recording of impacting activities (e.g. drainage, peat cutting face-banks, invasive species, drain blocking, etc.).
- In addition, digital photographs were taken of quadrats and impacts and their positions logged in the GPS minicomputers (Trimble GeoXT).
- Post-processing of data to improve the accuracy based on the Active GPS Network from Ordnance Survey Ireland to obtain sub-metre accuracy of data. Data collected on the field was then exported to ArcGIS 9.3 using GPS Pathfinder Office.
- Digitising of ecotopes in ArcGIS 9.3 at a 1:1,500 scale using data collected on the field and NPWS Designated Raised Bog Orthophotos 2010.

Final site maps produced have the following attributes:

- All GIS data were produced in an ESRI compatible format (shapefiles) and are accompanied by appropriate metadata.
- The digitised spatial data have been fully topologically corrected and polygons are fully attributed.
- Where polygon habitat data were created, habitats are in one continuous layer (shapefile), differentiated by habitat attribution.

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### 2.1.8 *Survey training*

Training of all team members was an essential element of the project in order to achieve the maximum consistency with vegetation mapping and the completion of assessments. Field team members were trained on the definition and identification of vegetation community complexes and ecotope based on the vegetation classification developed Kelly (1993) and Kelly and Schouten (2002), and used during the Fernandez *et al.* (2012) survey. Training focused on hydrological concepts, assessment of impacts from activities on the high bog and/or adjacent to the high bog and assessment of changes on raised bog vegetation. Field workers were trained in the use of GPS minicomputers (Trimble GeoXT) for habitat mapping and data recording. Training covered the following topics: data entry, target notes and species recording and photography. Training also covered health and safety specific to surveying raised bog environments. This included the identification of hazards and risks present as well as the steps to be taken to deal with any risk.

## 2.2 National Resource

### 2.2.1 Mapping the national raised bog resource

A review of the national raised bog spatial datasets compiled in 2007, as part of the NPWS conservation status assessment (CSA) project (NPWS, 2007), was undertaken as part of this project.

Datasets have been grouped as follows:

#### 1. Raised Bog for which ecotope data is available

- RBMA13\_ecotope\_map - This dataset contains ecotope data for 43 raised bogs designated as SACs and one raised bog designated as an NHA, all of which were surveyed in the 2011 to 2013 period as part of Fernandez *et al.* (2012) and this project.
- RBMA13\_habitats\_2007\_13\_othersources - This dataset contains ecotope data for two additional sites Clara Bog (SAC 000572) undertaken in 2009 by Fernandez *et al.* (2009a) and Killamuck (Abbeyleix) Bog also undertaken in 2009 by Fernandez *et al.* (2009b).
- RBMA13\_habitats\_prior\_2007 - This dataset contains ecotope data for any other designated raised bog for which the latest ecotope survey was undertaken prior to 2007 (1994-2004/05) and for which no more recent data is available.

#### 2. Raised Bog for which ecotope data is not available

- RBMA13\_unsurveyed\_data\_prior\_2007 - This dataset contains all remaining *intact*<sup>1</sup> raised bog areas not included in the above datasets both designated and undesignated, for which ecotope data is not available. This dataset was compiled in 2007 as part of the NPWS monitoring project (2007) and includes data from the 2000 to 2006 period, and thus the current extent of these sites is likely to be smaller as a result of peat cutting since 2006.

Part of this dataset was updated based on data provided by Bord na Móna from their 2009 habitat surveys. Detailed habitat maps for these sites have been made but are currently unavailable to the NPWS. Only the sites' locations and the ARB extent have been provided to the NPWS by Bord na Móna to date (2013).

#### 3. Secondary degraded raised bog habitat

- RBMA13\_2dary\_DRB\_unsurveyed - This dataset contains intensively drained high bog devoid of vegetation (including the majority of Bord na Móna sites), cutaway bog, cutover and occasionally reclaimed agricultural land with peaty soils. Although this sub-type of DRB does not correspond with the strict definition of DRB in the Habitats Directive Interpretation Manual, the re-establishment of vegetation with peat forming capability, including the

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<sup>1</sup> *Intact* refers to uncut high bog still supporting typical high bog vegetation (Active or Degraded Raised Bog). No completely intact raised bog remains in Ireland and all have been damaged to a certain degree by activities such as turf cutting, drainage, burning and afforestation.

restoration of ARB, in some of these areas may be possible and in fact may even be more feasible than in some areas of currently classified DRB. This dataset was generated in 2007 as part of the CSA (NPWS, 2007). The occurrence of each individual habitat recorded was confirmed on the 2000 OSi aerial photographs. This dataset is incomplete and many more secondary degraded raised bog areas are present in the country (further detail is given in the Discussion section of this report).

A further description of the above datasets is given in Appendix 9.

The above spatial datasets were produced in polygon shapefile format in ArcGIS 9.3 using the Irish National Grid (ING) as the co-ordinate reference system.

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### 2.2.2 National Active and Degraded Raised Bog habitat distribution map

The national ARB and DRB distribution maps created in 2007 by the NPWS (2007) has been reviewed as part of this project to incorporate more recent habitat data generated in the 2007-2013 reporting period.

The above habitat maps consist of the four different datasets mentioned in section 2.2.1 and which are described in further detail in Appendix 9:

- RBMA13\_ecotope\_map,
- RBMA13\_habitats\_2007\_13\_othersources,
- RBMA13\_habitats\_prior\_2007 and
- RBMA13\_unsurveyed\_data\_prior\_2007

Data for the above first three datasets was recorded on the ground and involved vegetation mapping at ecotope level based on Kelly (1993) and Kelly and Schouten (2002). ARB consists of central and sub-central ecotopes, active flushes and Bog Woodland habitat. DRB consists of three ecotopes (sub-marginal, marginal and face bank), as well as inactive flushes and dry woodland on the high bog (the latter does not correspond with the priority habitat Bog Woodland (91D0)). A more detail description of the processes followed to map the ecotopes is given within section 2.1.7.1.

The fourth dataset, which illustrates *intact* high bog, does not include ecotope data as detailed ecotope surveys have not been undertaken so far (2013). Many of the records provided correspond with DRB where the possibilities of finding ARB are low. In those cases (i.e. polygons) where, according to NPWS (2007), the 2000 OSi aerial photograph shows *intact* high bog which may contain ARB the record was classed as "ARB Unknown" under the comment field in the dataset attribute table. Additionally, a total of eight polygons, within this dataset, correspond with ARB records reported by Bord na Móna (Bord na Móna Ecology Team, pers. comm. 2013) as containing ARB (detailed habitat

data is not yet available to NPWS). These polygons have been classed as “ARB present” under the comment field, and included in the national ARB 10km distribution map. These polygons also contain DRB.

Secondary degraded raised bog records from the RBMA13\_2dary\_DRB\_unsurveyed dataset generated by NPWS (2007) have not been reported as part of the DRB national distribution map.

The above spatial datasets were produced in polygon shapefile format in ArcGIS 9.3 using the Irish National Grid (ING) as the co-ordinate reference system.

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### 2.2.3 *National habitat distribution and range maps*

The national ARB and DRB 10km grid habitat distribution maps were produced by intersecting each individual habitat record within the datasets described in the previous sections with the 10km grid. Each 10km grid map shows 10km squares where each habitat is present. The Irish National Grid was used as the co-ordinate reference system (See Figures 3.3 and 3.4).

The habitat's Range is defined as the smallest polygon size containing all grid squares, where each individual habitat was recorded. The current Range map in Irish Grid was generated using 'Species and Habitat types Range Tool' version RangeTool.tbx which is the 'ESRI ArcGIS 10 Toolbox containing the Range tool for version 10.0, version 30/08/2012, downloaded from ([http://bd.eionet.europa.eu/activities/Reporting\\_Tool/Reporting\\_Tool\\_Software](http://bd.eionet.europa.eu/activities/Reporting_Tool/Reporting_Tool_Software)).

The Favourable Reference Range is defined as the Range within which all significant ecological variation of the habitat/species are included for a given biogeographical region and which is sufficiently large enough to allow the long term survival of the habitat/species (Evans & Arvela 2011).

The Favourable Reference Value must be at least the Range (in size and configuration) when the Habitats Directive (92/43/EEC) came into force. In the case of ARB, the Favourable Reference Range is currently considered to be the Range of Degraded Raised Bog still capable of regeneration, as according to the definition of DRB in the Habitats Directive Interpretation Manual (Anon, 2007), the habitat should be capable of regeneration to ARB in 30 years if appropriate measures are put in place (i.e. no major impacting activities are present and any necessary restoration works are implemented). On the other hand Favourable Reference Range for DRB coincides with the current Range, as this corresponds with the Range when the Habitats Directive came into force. Although the objective is to restore DRB to ARB there are likely to be remnants of DRB within its natural Range. DRB Range and Area and ARB FRVs have been reviewed by the NPWS national raised bog conservation programme in 2014 based on more recent hydrological assessments (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.



## 2.3 Site reports

Individual site reports were produced as part of this project. These reports include vegetation descriptions, impacting activities descriptions, conservation status assessments, quadrat data and maps. The maps include ecotope vegetation, community complex maps and impact maps. These are generated based on the spatial data collected during the survey using ArcGIS and 2010 aerial photography.

Site reports also include recommendations on future botanical, hydrological or topographical surveys and restoration works.

## 2.4 Conservation status assessment

One of the main objectives of this project was to assess the conservation status of ARB and DRB at national level following the EU Article 17 guidelines. These assessments are based on the results of site specific conservation status assessments undertaken by Fernandez *et al.* (2012) and this project. Additional information considered relevant to assess these habitats conservation assessments has also been incorporated, particularly related to activities either negative or positive impacting on them. Conservation status assessments at site level were also undertaken for Depressions on peat substrates of the Rhynchosporion (7150) and Bog Woodland (91D0) as part of this project. However, the assessment of their conservation status at national level was not part of the scope of this project as these habitat types are also found in association with other habitats in addition to raised bog habitats.

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### 2.4.1 Conservation status assessment general methods

The conservation status of a habitat is defined as the sum of the influences acting on the habitat that may affect its long-term viability. The EU Habitats Directive (92/43/EEC) requires that habitats listed under Annex I are maintained in 'Favourable Conservation Status' throughout member states. Maintaining or restoring Favourable Conservation Status for Annex I habitats is an objective under Article 2 of the Habitats Directive. Conservation Status is taken as favourable when:

- a) its natural Range and the Area it covers within that Range are stable or increasing,
- b) the specific S&Fs which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future and
- c) the conservation status of its typical species is favourable.

To assess the conservation status of an Annex I habitat at a national level, four parameters are objectively scored: a) **Range**, b) **Area**, c) **S&Fs**, and d) **FPs**. Elements of the guidelines for assessing conservation status at national assessment are scaled down to derive a site-based assessment. Range is not considered at site level.



The method for the assessment of conservation status of an Annex I habitat involves the application of a “traffic-light” system and brings together information on the four parameters for each habitat (three at site level). Each parameter is assessed as having a “Favourable (Fv)” or good/green, “Unfavourable-Inadequate (U1)” or poor/amber, “Unfavourable-Bad (U2)” or bad/red and “unknown” or grey **conservation status** based on Evans & Arvela (2011) (See Table 2.3).

Table 2.3 provides percentage comparative values (current versus FRVs) for each individual parameter, below which the parameter is assessed either as Fv, U1 or U2, as given by Evans & Arvela (2011). These percentage values have been amended and made slightly higher, to take into account an estimated potential 5% discrepancy due to differences in assessment methods (i.e. mapping, habitat interpretation), as described under each specific habitat assessment methods (See Table 2.6).

A **trend attribute** is also given to each parameter (i.e. Range, Area, S&Fs and FPs) conservation status assessment. This indicates whether the status is Increasing/Improving, Stable or Decreasing/Declining. A trend value is also given at overall habitat assessment level. The overall trend value is based on the idea that the most negative trend determines the overall trend. A Stable trend has a nil value, which means the trend for the specific parameter has not changed in the reporting period or is not going to change in the future as regards FPs. Once one of the three parameters is given a Declining/Decreasing trend, the overall trend for the habitat is negative (Declining). On the other hand a combination of neutral and positive (Increasing/Improving) trends results on an overall positive (Improving) trend for the habitat.

Please note that for Range and Area, Evans & Arvela (2011) also recommend to report on a short term trend period extending from 2001-2012. The official national submission for Article 17 as detailed in NPWS (2013) used expert judgement to extend the trends reported in this document to 2001. This use of expert judgement does not materially change the results presented in this report.

The impact of current pressures and future threats including both negative and positive (i.e. conservation measures) are used to determine the FPs of the Range, Area and S&Fs. FPs are then assessed at two levels: Future trend and Future status (See table 2.5).

If any one of the parameters a) Range, b) Area, c) S&Fs, and d) FPs are assessed as “red”, the overall assessment is also “red” (i.e. Unfavourable Bad). All parameters must be green to achieve an overall Favourable assessment. Any other combination results in an Unfavourable Inadequate overall assessment.

The monitoring protocol developed by Fernandez *et al.* (2005) has been refined and updated in conjunction with NPWS staff. Previously, Fernandez *et al.* (2005) assessed the conservation status of raised bog habitats based on the comparison of values (i.e. habitat area and ecotope area) between the 1994 and 2004/05 surveys. However, a new criterion is now used based on the definition of Favourable

Reference Values (FRVs) for both Area and S&Fs. FRVs are values that should be achieved (targets) in order for a habitat to reach a Favourable Conservation Status. These reference values have to be at least equal to the value when the Directive came into force, i.e. in 1994 or greater than this value if the long term viability of the habitat is not assured. The exception to this rule is DRB (capable of regeneration in 30 years) as this habitat should reduce if it is successfully restored to ARB. The very fact that DRB exists indicates that there is an obligation under the Habitats Directive, to restore more active areas than were present when the Directive came into force. Where DRB is designated within an SAC a certain portion of that habitat (though not necessarily all) should be restored within that designated site. Many areas currently called DRB may not be capable of restoration to ARB due to topographical and hydrological changes on the high bog caused by severe damaging activities (e.g. peat cutting and drainage). In some instances cutover, which is currently not defined as DRB, may be more feasible to restore to ARB. The potential for regeneration cannot be properly quantified until comprehensive topographical and hydrological assessments are undertaken. This is currently being carried out as part of the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>).

A more detailed description of the methods used to assess a habitat conservation status is given within this section of the report. Further detail on the methods used to assess the conservation status of each specific habitat is given under sections 2.4.2, 2.4.3, 2.4.4 and 2.4.5.

**Table 2.3** Summary matrix of the parameters and conditions required to assess the conservation status of habitats  
(Evans & Arvela 2011).

Parameter	Conservation status			
	Favourable ('green')	Unfavourable – Inadequate ('amber')	Unfavourable – Bad ('red')	Unknown (insufficient information to make an assessment)
<b>Range</b>	Stable (loss and expansion in balance) or increasing <u>AND</u> not smaller than the 'Favourable Reference Range'	Any other combination	Large decrease: Equivalent to a loss of more than 1% per year within period specified by MS <u>OR</u> More than 10% below 'Favourable Reference Range'	No or insufficient reliable information available
<b>Area covered by habitat type within Range</b>	Stable (loss and expansion in balance) or increasing <u>AND</u> not smaller than the 'Favourable Reference Area' <u>AND</u> without significant changes in distribution pattern within Range (if data available)	Any other combination	Large decrease in surface Area: Equivalent to a loss of more than 1% per year (indicative value MS may deviate from if duly justified) within period specified by MS <u>OR</u> With major losses in distribution pattern within Range <u>OR</u> More than 10% below 'Favourable Reference Area'	No or insufficient reliable information available
<b>Specific structures and functions (including typical species)</b>	Structures and functions (including typical species) in good condition and no significant deteriorations / pressures	Any other combination	More than 25% of the Area is unfavourable as regards its specific structures and functions (including typical species)	No or insufficient reliable information available
<b>Future prospects (as regards Range, Area covered and specific Structures and Functions)</b>	The habitats prospects for its future are excellent / good, no significant impact from threats expected; long-term viability assured	Any other combination	The habitats prospects are bad, severe impact from threats expected; long-term viability not assured.	No or insufficient reliable information available
<b>Overall assessment of CS</b>	All 'green' OR three 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all 'unknown'

#### 2.4.1.1 Range

Range is defined as the area over which a species or habitat is usually found. For the purposes of this exercise, current Range is taken to be the outer limits of the overall area in which a habitat 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 habitat (Evans & Arvela 2011). The calculation of the current Range should be based on the current habitat national distribution map. Range is then depicted as those 10km grid (Irish National Grid) squares intersecting the national habitat distribution map. The Range is then mapped based on the Range mapping rules set by the EU (Evans & Arvela 2011). Current Range value should be compared to the Favourable Reference Range value. Favourable Reference Range is the geographic range within which all significant ecological variations of a habitat are included and which is sufficiently large to allow the long-term persistence of that habitat and must be at least the value given when the Directive came into force. Any change of Range in the reporting period should be assessed and its value compared to the values given in Table 2.3 (Range which is more than 10% below the FRV is considered unfavourable- bad). An assessment of this parameter's trend in the reporting period should be also provided, by comparing Range values given in 2007 (NPWS, 2008) against current values.

#### 2.4.1.2 Area

Area is defined as the area currently occupied by the habitat (Evans & Arvela 2011).

The assessment of the conservation status of Area should be based on any change in Area in the reporting period. The current Area value should be also compared to the FRV, which is defined as the minimum value required for the long-term survival of the habitat and must be at least the value given when the Directive came into force. An assessment of this parameter's trend in the reporting period is provided, by comparing Area values given in 2007 (NPWS, 2008) against current values. As the current Area value is not available for the entire national resource, the Area assessment can only be based on the change in Area within sites assessed by the more recent 2011-13 surveys (i.e. by Fernandez *et al.* (2012) and by this project). See table 2.3 for the rules based approach to assessing Area at national level. See sections 2.4.2 and 2.4.3 for further detail on the methods used to assess this attribute at site level. A summary of each individual ARB and DRB Area assessment at site level is also provided within this report (See Tables 3.5 and 3.11).

#### 2.4.1.3 Structure and functions

The S&Fs assessment is based on the assessment of the condition of the habitat (quality). In the particular case of ARB, the status assessment is based on the percentage value of the most pristine ecotope types (i.e. central and active flush/soaks) within the habitat. The target is that a minimum of 50% of the ARB Area should consist of the most pristine ecotope types. Its change in the reporting period is also assessed to determine this parameter's trend. In the case of DRB, the status assessment is based on the percentage value of the most degraded ecotopes (marginal and face bank) present within the habitat. (See sections 2.4.2 and 2.4.3 for further detail). The target is that a maximum 25% of the DRB Area should consist of these degraded ecotope types. Its change in the reporting period is also assessed to determine this parameter's trend.

The typical species assessment is based on the assessment of S&Fs given above. Thus, in the case of ARB, a positive assessment for S&Fs implies an increase in the extent of the most pristine ecotope types and thus a positive assessment for typical species. On the other hand, an increase in the most degraded ecotopes for DRB and thus a negative assessment implies a negative assessment for the typical species.

As current ecotope values are not available for the entire national resource, the national S&Fs assessment can only be based on those values given for habitats within sites assessed by the more recent 2011-13 surveys (i.e. by Fernandez *et al.* (2012) and by this project). See table 2.3 for the rules based approach to assessing S&Fs at national level. See sections 2.4.2 and 2.4.3 for further detail on the methods used to assess this parameter at site level. A summary of each individual ARB and DRB S&Fs assessment at site level is also provided (See Tables 3.5 and 3.11).

#### 2.4.1.4 Future prospects

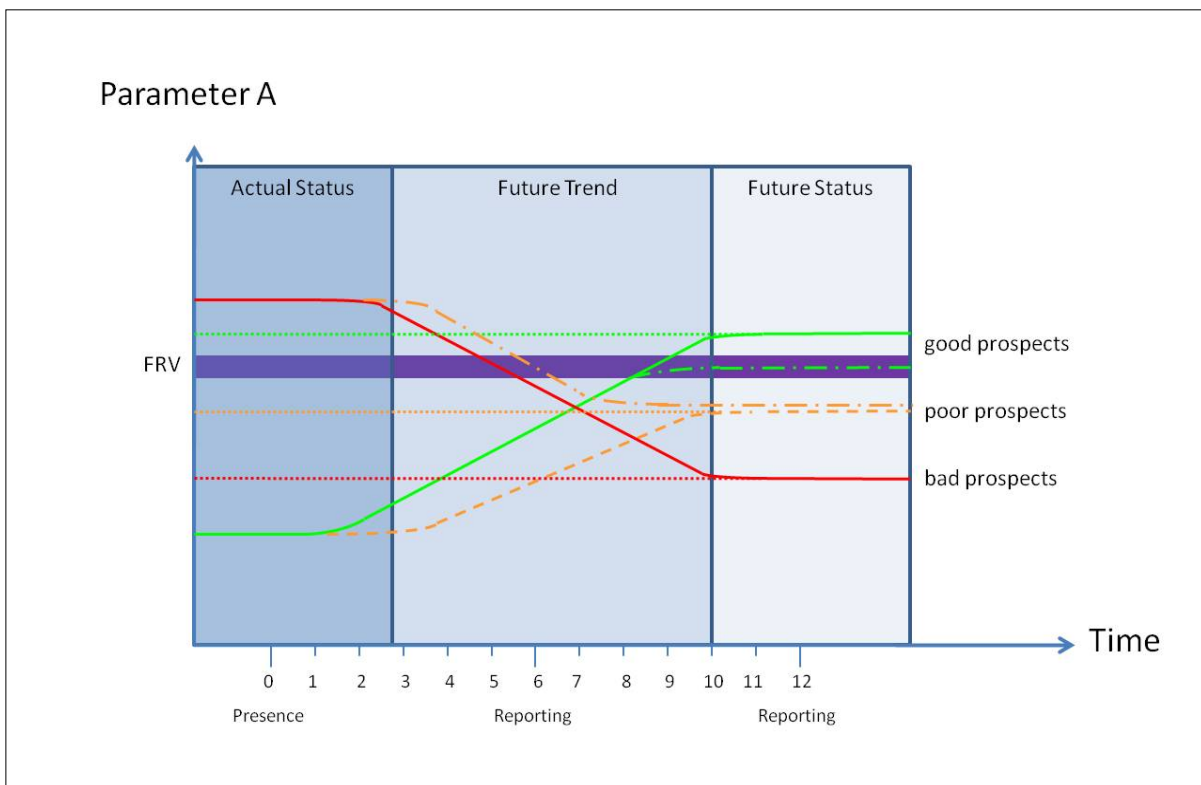
FPs are evaluated on consideration of the expected **Future trend** and **Future status** of Range, Area and Structure & Functions within two reporting periods (i.e. 12 years) (See Figure 2.1 below).

**Future trends** are determined by the influence on the habitat of both **pressures** (i.e. current reporting period impacting activities) and **threats** (i.e. future anticipated impacting activities in the following two reporting periods). Impacting activities could have a negative, positive or neutral effect on the habitat. The assessment of future trends therefore takes into account whether positive and negative influences will be in balance for the respective parameter of the habitat type or whether the one will exceed the other. Future trends are then evaluated as **Increasing/Improving**, **Decreasing/Declining** or **Stable**. The occurrence of negatively impacting activities with High or Medium Importance is likely to indicate a decreasing/declining trend. If there are only impacting activities of Low Importance or none, the future trend is evaluated as stable or even Increasing/Improving.

**Future status** is evaluated by determining whether a parameter will reach its FRV within two reporting periods (i.e. 12 years) taking into account future trend and expert judgement. Future status is then assessed as **Favourable (Good)**, **Unfavourable-Inadequate (Poor)** or **Unfavourable-Bad (Bad)**.

Each parameter (Range, Area and Structure & Functions) is then assessed in respect of its foreseeable future trends and predicted future status (See Table 2.4).

The overall FPs assessment should be based on the most negative scenario. Once a parameter has been identified as having bad prospects, the assessment of FPs is Unfavourable-Bad.



**Figure 2.1** Assessment of the future prospects of a parameter based on its Future Trend and predicted Future Status (Evans & Arvela 2011).

**Table 2.4** Future prospects evaluation matrix (Evans & Arvela 2011).

Actual status of parameter	Future trend	Future status	Prospects (numbers refer to notes below)		
At/above FRV	+ (increasing)	> (above FRV)	Good		
At/above FRV	= (stable)	=/> (on/above FRV)	Good		
At FRV	-(decreasing)	</<< (under FRV)	Poor (1)	Bad (1)	
Above FRV	-(decreasing)	>/=</<< (above/on/under FRV)	Good (2)	Poor (2)	Bad (2)
Below FRV	+ (increasing)	>/=</< (above/on/under FRV)	Good (3)	Poor (3)	Bad (3)
Below FRV	= (stable)	< (under FRV)	Poor (1)		Bad (1)
Below FRV	-(decreasing)	< (under FRV)	Poor (1)		Bad (1)
Unknown	+ (increasing)/-(decreasing)/=(stable)/X (unknown)	X (unknown)	Unknown		
under FRV on/above FRV	X (unknown)	X (unknown)	unknown		

**Notes:**

Good (Favourable), Poor (Unfavourable- Inadequate), Bad (Unfavourable- Bad).

1-Depending whether or not the future status is anticipated to be below the threshold for Unfavourable-Bad in two reporting cycles (12 years) (See Table 2.5).

2-Depending on whether the future status is anticipated to be on/above or under the FRVs or even below the threshold for Unfavourable-Bad in two reporting cycles (12 years)

3-Depending whether the future status will exceed the FRV or the threshold for Unfavourable-Bad in two reporting cycles (12 years).

The assessment of the FPs at national level was based on the FPs assessment results at site level provided by Fernandez *et al.* (2012) and this project. Information from additional sources (e.g. restoration works funded by NPWS, Bord na Móna (<http://www.bordnamona.ie/our-company/biodiversity/local-community-biodiversity-projects/>) and Coillte (<http://www.raisedbogrestoration.ie/>) or from NPWS turf cutting cessation schemes) was also taken into account to assess ARB and DRB FPs at national level. Site FPs were based on the FPs given to Area and Structure & Functions.

#### 2.4.2 Active Raised Bog conservation status assessment

**Range:** this parameter is only assessed at national level (not site level); the assessment is based on the comparison of current Range value against the FRV, as well as on the comparison of current Range against the Range reported in 2007 (NPWS, 2007) in order to assess this parameter's trend (See section 2.2.3 for further detail on how the Range is calculated).

**Area:** this parameter is assessed at both national and site level. The assessment is based on the comparison of current Area of ARB against the FRV for Area.

National Area FRV is based on the overall extent of raised bog resource within designated (SACs and NHAs) sites, including both ARB and DRB.

In this project Area FRV at site level is set as the area of central/sub-central ecotopes and active flush, **plus** the area of **sub-marginal ecotope** (within DRB), present when the Directive came into force in 1994. The definition of DRB implies that it is capable of being restored to ARB. Therefore, it is reasonable to include the higher quality/wetter part of the DRB (i.e. sub-marginal) within the FRV target. As we cannot assume that all areas of DRB can be restored we have taken a more pragmatic approach setting FRVs (by omitting marginal and face-bank ecotopes and inactive flushes from FRV calculations) at site level.

The above national and site level FRVs have recently been reviewed as part of the national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>) and it is clear that not all sub-marginal ecotope will be restorable and thus the above targets will be adjusted.

Area at both national and site level is given a status assessment based on the following thresholds (See Table 2.6):

- A current Area greater, equal or 0-5% below FRV falls into the **Favourable** assessment category.
- A current Area value 5%-15% below FRV falls into the **Unfavourable Inadequate** assessment category.
- A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Area is also given a **trend assessment** based on the change on its value in the reporting period. Thus trend is assessed as **Stable, Increasing** or **Decreasing**.

**Structure & Functions:** this assessment is based on the objective that at least half of the current area of ARB should be made up of central ecotope and active flush/soaks (i.e. more pristine examples of ARB community types). This value is considered to be the S&Fs FRV. This is quite a modest target as a high



bog that has never been impacted by drainage is likely to have been covered by more than 80% of these communities (Ryan, J., pers. comm., 2013).

S&Fs at both national and site level is given a status assessment based on the following thresholds (See Table 2.6):

- A current central ecotope and active flush/soaks area value greater, equal or 0-5% below FRV falls into the **Favourable** assessment category.
- A current central ecotope and active flush/soaks area value 5%-25% below FRV falls into the **Unfavourable Inadequate** assessment category.
- A current central ecotope and active flush/soaks area value more than 25% below FRV falls into the **Unfavourable Bad** assessment category.

A change in typical species distribution and abundance is also described within each site report. This was assessed by analysing quadrat data and also looking at community complexes descriptions. (See Appendix 7 for list of typical species).

S&Fs are also given a **trend assessment** based on the change in the extent of both central ecotope and active flush/soaks in the reporting period. A decrease due to rewetting processes is taken as positive whereas an increase as a result of further drying out is taken as negative. Thus trend is assessed as **Stable, Improving or Declining**.

When neither central ecotope nor active flush/soaks are present or their area was small (<1ha), change in sub-central ecotope extent and quality characteristics is examined to assess S&Fs conservation status and trend.

Every individual sample of ARB (each individual bog usually has a number of separate areas of this habitat) on a high bog has been looked at during the 2011-13 surveys, and any change in its extent analysed and subsequently assessed as stable, expanding, decreasing or newly developed. Detailed information is given within each site report and ecotopes map attribute table. Quadrats reported in 2004/05 and re-surveyed again in 2011-2013 are compared in order to assess any changes in the presence/absence or coverage of indicators and support the assessments at both Area and S&Fs level (See Appendix 5). Any change in community complex descriptions (e.g. improvements within DRB that did not manage to raise it to the status of sub-central ecotope or within ARB that did not manage to raise it to central) is also taken into account in assessing changes within specific habitat areas. These are described within each site conservation status assessment report.

**Table 2.5** ARB assessment method

Area		Structure & Functions	
Current value > = or 0-5% < FRV	F	Current value > = or 0-5% < FRV	F
Current value 5%-15% < FRV	UI	Current value 5%-25% < FRV	UI
Current value 15%-100% < FRV	UB	Current value 25%-100% < FRV	UB

F: Favourable; UI: Unfavourable- Inadequate; UB: Unfavourable- Bad

**Future Prospects:** the FPs assessment is based on the assessment of both **Future trends** and **Future status** of each of the three main parameters: Range, Area and Structure & Functions within two reporting periods (12 years) (See Tables 2.4 and 2.5) (Range is not assessed at site level). Future trends are assessed as Increasing, Decreasing or Stable and the assessment is based on the overall impact of negative (e.g. peat cutting, drainage) and positive activities (e.g. restoration works) at site level, taking into account, both current impacting activities or pressures and anticipated future impacting activities or threats. Future status is assessed as Favourable, Unfavourable Inadequate and Unfavourable Bad based on the Future trend and best expert judgement to assess whether the parameter will reach the different FRVs thresholds (See Table 2.5) within the two following reporting periods (See Figure 2.1). Additional information relating to impacting activities (e.g. raised bog restoration plans and the peat cutting cessation schemes) are also taken into account to assess FPs at national level.

The **overall habitat conservation status assessment** is then based on the “traffic-light” system (See section 2.4.1). If any one of the four parameters a) Range, b) Area c) S&Fs d) FPs are assessed as “red”, the overall assessment is also “red” (i.e. Unfavourable Bad) (Range is not assessed at site level). All parameters must be green to achieve an overall Favourable assessment. Any other combination result in an Unfavourable Inadequate assessment.

Appendix 8 provides a few examples of different assessment scenarios at site level for further detail.

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#### 2.4.3 Degraded Raised Bog conservation status assessment

**Range:** this parameter is only assessed at national level (not site level); the assessment is based on the comparison of current Range value against the FRV, as well as on the comparison of current Range against the Range reported in 2007 (NPWS, 2007) in order to assess this parameter’s trend (See section 2.2.3 for further detail on how the Range is calculated).

**Area:** this parameter is assessed at both national and site level. The assessment is based on the comparison of the current Area of DRB against the FRV for Area.

National Area FRV is based on the difference between the national *intact* high bog resources (ca 50,000ha) and the FRV for ARB Area (See section 2.4.2), which corresponded with the extent of both Active and DRB resources within designated sites.

In this project Area FRV at site level is set as the area of marginal and face bank ecotopes when the Directive came into force in 1994. This FRV is directly related to ARB Area FRV for the site (See section 2.4.2).

As previously mentioned, the definition of DRB implies it is capable of being restored to ARB. Therefore a FRV smaller than current values is desirable in order to achieve Area FRV. Any increase in degraded areas on the high bog can never be seen as a positive development. Even remaining at the status quo is not progress. The FRV for DRB (i.e. marginal and face bank) accepts the fact that it is often not feasible to restore the whole bog and certain high bog areas currently called DRB will remain degraded for a very long time. Some areas such as areas with steep slopes (frequently found at the high bog edge), mounds, small very degraded high bog sections and high bog areas with increased vertical water losses (deep cracks underneath) do not have any longer the suitable topographical and hydrological conditions to support ARB.

The above national and site level FRVs have recently been reviewed as part of the national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>)).

Area at both national and site level is given a status assessment based on the following thresholds:

- A current Area value smaller or 0-5% greater than FRV falls into the **Favourable** assessment category.
- A current Area value 5%-15% above FRV falls into the **Unfavourable Inadequate** assessment category.
- A current Area value more than 15% above FRV falls into the **Unfavourable Bad** assessment category.

Area is also given a **trend assessment** based on the change on its value in the reporting period. Thus trend is assessed as **Stable, Increasing** or **Decreasing**. Any decrease in the habitat area as a result of increase in ARB was taken as positive as regards overall assessment; although a Decreasing trend at Area level is given.

**Structure & Functions:** this assessment is based on the objective that a maximum of 25% of the DRB Area should be made up of marginal and face bank, i.e. the lower quality and drier vegetation communities. This value is set as the S&Fs FRV. DRB is an atypical habitat type as a FRV smaller than current value is desirable in most of the sites due to their current degraded condition.

S&Fs at both national and site level is given a status assessment based on the following thresholds:

- A current marginal and face bank ecotope area value equal or below FRV falls into the **Favourable** assessment category.
- A current marginal and face bank ecotope area value 5%-25% above FRV falls into the **Unfavourable Inadequate** assessment category.
- A current marginal and face bank ecotope value more than 25% above FRV falls into the **Unfavourable Bad** assessment category.

A change in typical species distribution and abundance is also described within each site report. This was assessed by analysing quadrat data and also looking at community complexes descriptions. (See Appendix 7 for list of typical species).

S&Fs are also given a **trend assessment** based on the change of the extent of both marginal and face banks ecotopes. A decrease due to rewetting processes is taken as positive whereas an increase as a result of further drying out is taken as negative. Thus trend is assessed as **Stable, Improving** or **Declining**.

Any change in community complex descriptions (e.g. improvements within the habitats that did not manage to raise it to the status of sub-marginal ecotope) was also taken into account in assessing changes within specific habitat areas. These are described within each site conservation status assessment report.

**Future Prospects:** the FPs assessment is based on the assessment of both **Future trends** and **Future status** of each of the three main parameters: Range, Area and Structure & Functions within two reporting periods (12 years) (See Table 2.4) (Range is not assessed at site level). Future trends are assessed as Increasing, Decreasing or Stable and the assessment is based on the overall impact of negative (e.g. peat cutting, drainage) and positive activities (e.g. restoration works) at site level, taking into account, both current impacting activities or pressures and anticipated future impacting activities or threats. Future status is assessed as Favourable, Unfavourable Inadequate and Unfavourable Bad based on the Future trend and best expert judgement to assess whether the parameter will reach the different FRVs thresholds within the two following reporting periods (See Figure 2.1). Additional information relating to impacting activities (e.g. raised bog restoration plans and the peat cutting cessation schemes) are also taken into account to assess FPs at national level.

The **Overall habitat conservation status assessment** is then based on the “traffic-light” system (See section 2.4.1). If any one of the four parameters a) Range b) Area, c) S&Fs, d) FPs are assessed as “red”, the overall assessment is also “red” (i.e. Unfavourable Bad) (Range is not assessed at site level). All parameters must be green to achieve an overall Favourable assessment. Any other combination result in an Unfavourable Inadequate assessment. The only exception for DRB is when the Area has

decreased as a result of the development of ARB. In such a scenario, the Area is given a Decreasing trend, but the overall habitat conservation status assessment trend is Improving. This is generally coupled by improving trends in other parameters (i.e. S&Fs and FPs).

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#### 2.4.4 Bog Woodland conservation status assessment

The conservation status for this habitat is only assessed at site level. The assessment of the national conservation status is not part of the scope of this project. More detail can be found in NPWS (2013)

**Area:** this assessment is based on the comparison of current Area of Bog Woodland against the FRV for Area, which is equal to the area of the habitat when the Directive came into force in 1994.

Area is given a status assessment based on the following thresholds:

- A current Area value greater or 0-5% below FRV falls into the **Favourable** assessment category.
- A current Area value 5%-15% below FRV falls into the **Unfavourable Inadequate** assessment category.
- A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Area is also given a **trend assessment** based on the change on its value in the reporting period. Thus trend is assessed as **Stable, Increasing or Decreasing**.

**Structure & Functions:** this assessment is based on the assessment of four or a multiple of four monitoring stops (See Appendix 5). However, the small size of Bog Woodland sites on Irish raised bogs limits the number of monitoring stops that can be assessed and generally only one to two monitoring stops per site are recorded. The monitoring stops assessment is based on the achievement of targets within the following parameters (adapted from National Survey of Native Woodlands (Perrin *et al.* 2008 (Vol. 1)) :

- **Positive indicator species**
- **Negative indicator species**
- **Structural data**
- **Target tree species mean diameter breast height (dbh)**
- **Old tree % dead wood**

Any change in **typical species** distribution and abundance within a monitoring stop is also noted (See Appendix 7 for list of typical species).

**Future Prospects:** the FPs assessment is based on the assessment of both **Future trends** and **Future status** of each of the two main parameters: Area and Structure & Functions within two reporting

periods (12 years) (See Tables 2.4 and 2.5). Future trends are assessed as Increasing, Decreasing or Stable and the assessment is based on the overall impact of negative (e.g. peat cutting, drainage) and positive activities (e.g. restoration works), taking into account, both current impacting activities or pressures and anticipated future impacting activities or threats. Future status is assessed as Favourable, Unfavourable Inadequate and Unfavourable Bad based on the Future trend and best expert judgement. If the result of positive measures (e.g. restoration works) are overriding the negative influence of impacting activities, the overall assessment may be Favourable.

The **overall habitat conservation status assessment** is then based on the “traffic-light” system (See section 2.4.1). If any one of the three parameters a) Area, b) S&Fs, c) FPs are assessed as “red”, the overall assessment is also “red” (i.e. Unfavourable Bad). All parameters must be green to achieve an overall Favourable assessment. Any other combination result in an Unfavourable Inadequate assessment.

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#### 2.4.5 *Depressions on peat substrates of the Rhynchosporion conservation status assessment*

The conservation status for this habitat is only assessed at site level. The assessment of the national conservation status is not part of the scope of this project.

*Rhynchospora* spp. depressions are found across the entire bog in both ARB and DRB. The habitat is more frequently found and reaches its finest quality when associated within wet features (*Sphagnum* pools, lawns and hollows) on ARB (e.g. in central ecotope complexes (e.g.4/15) and sub-central (e.g.10/4, 4/35, 4/14, 4/10, 4+P, 4/9a and 6/4+P), where *Rhynchospora* spp. are found with a high coverage (See Appendix 3)). However, it is also found within the sub-marginal ecotope and within tear pools and run off channels in the marginal ecotope but occurs usually at a lower density and is associated with poorer quality raised bog vegetation in these instances (e.g. sub-marginal ecotope complexes (e.g.4/9, 7/6/4 and 3/6/4) and marginal (e.g.7/2)).

There are examples where the abundance of *Rhynchospora alba* may be higher, such as transitional communities towards degraded conditions within ARB. In addition, it is also likely to dominate some community complexes recently affected by burning. However the quality and overall high bog condition declines at these locations as the wet *Sphagnum* dominated pools disappear. Thus, although disturbance could increase the presence of the species, an ongoing drying out of the high bog would lead to the depletion and finally the disappearance of the habitat from the high bog.

**Area:** the physical structure and distribution of the habitat across large sections of the high bog makes the process of calculating its area unfeasible and as a consequence makes the process of calculating specific and realistic FRVs unrealistic. Thus, the assessment of Area is directly based on the assessment of ARB Area. The objective is to increase its Area and improve its quality to values

associated with a favourable conservation status of ARB. Area status is assessed as **Favourable**, **Unfavourable Inadequate** or **Unfavourable Bad**. A favourable assessment of ARB for instance indicates that all sub-marginal ecotope has changed to ARB and thus ARB has reached or exceeded the FRV. As a result Rhynchosporion depressions have also achieved its target Area.

The Area trend assessment is based on the change on the combined extent of ARB and sub-marginal ecotope within DRB in the reporting period. Thus trend is assessed as **Stable**, **Increasing** or **Decreasing**.

**Structure & Functions:** this parameter assessment is directly based on the ARB S&Fs status and trend assessments. The S&Fs are assessed based on the objective that at least half of the current area of ARB should be made up of central ecotope and active flush/soak (i.e. more pristine examples of ARB community types) (See section 2.4.2).

**Future Prospects:** the FPs is based on the assessment of both **Future trends** and **Future status** of each of the two main parameters: Area and Structure & Functions within two reporting periods (12 years) (See Tables 2.4 and 2.5).

The Area FPs status is based on the ARB Area FPs status assessment and the Area FPs trend is based on the trend foreseen for the combined extent of ARB and sub-marginal ecotope in the following two reporting periods.

The S&Fs FPs status and trend are also based on the ARB S&Fs FPs status and trend assessments in the following two reporting periods.

The **overall habitat conservation status assessment** is then based on the “traffic-light” system (See section 2.4.1). If any one of the three parameters a) Area, b) S&Fs, c) FPs are assessed as “red”, the overall assessment is also “red” (i.e. Unfavourable Bad). All parameters must be green to achieve an overall Favourable assessment. Any other combination result in an Unfavourable Inadequate assessment.

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#### 2.4.6 Overall raised bog conservation status assessment

Any, or all, of the four Annex I habitats can be found on a raised bog site, and thus a different conservation assessment could be given to each of these habitats. However, both ARB and Bog Woodland are deemed priority habitats in Annex I of the Habitats Directive, whilst DRB and Depressions on peat substrates of the Rhynchosporion are not. Hence, due to the higher conservation value of the first two habitats, their conservation status has a higher significance when evaluating the assessment of the overall high bog conservation status.

ARB and Bog Woodland are usually interrelated. In fact, Bog Woodland is considered as part of ARB in terms of habitat Area. Thus, generally an Unfavourable conservation status of Bog Woodland

implies an Unfavourable conservation status of ARB. However, in the case of different conservation status assessments for these two habitats, the conservation status of ARB prevails over the conservation status of Bog Woodland in order to assess the overall high bog conservation status.

The only exception to the previous is when ARB is given a Stable assessment trend and DRB an Improving trend as a result of the positive effects of restoration works, indicating that the overall raised bog is improving. Therefore the overall raised bog conservation status assessment is given an Improving trend.

## 2.5 NPWS database update

Survey data was transferred into the NPWS Raised Bog Monitoring MS Access database. Assessment results were also transferred to the database. This database was updated in consultation with NPWS.

The database was also populated with the Fernandez *et al.* (2005) quadrat data, which have been converted to a format comparable to this survey's quadrats.

## 2.6 Data management system and quality control

Project files were organised in a hierarchical way and backups were made on regular basis. Information collected and stored during field work was transferred to the main office on a regular basis.

NPWS Raised Bog Monitoring MS Access database has been used for the purpose of storing data results. Metadata was generated based on NPWS requirements provided in the latest NPWS project data delivery guidelines. Data management also included the generation of Image Catalogue and Resource Catalogue.

Data quality control has been one of the elements of data managements system; this included the following controls:

- Periodic inspection of a subset of data during data collection and transfer to database and GIS systems.
- Field survey rechecks to ensure consistency in vegetation classification.
- Systematic review of datasets, particularly once all habitats datasets have been entered into database and GIS systems to check for topological errors, and ensure thematic and positional accuracy as well and datasets completeness.



Quality control was undertaken by the project manager, who was also assigned the role of GIS specialist.

## 3 Results

### 3.1 Data deliverables

The following is a summary of the data deliverables for this project:

- This final report, both electronic and hard copy in a format suitable for web publication.
- An update of the national conservation assessments for ARB and DRB habitats provided within this report. Additional conservation status assessment Form and Audit Trial documents were also submitted in May 2013 to NPWS.
- 32 site reports were completed (including vegetation (i.e. habitats, ecotopes and community complexes) descriptions; impacting activities descriptions and habitats conservation status assessments; quadrat data; as well as maps based on the spatial data collected during the survey using ArcGIS and 2010 aerial photography). In addition, site reports for 12 additional sites produced by Fernandez *et al.* (2012) were updated based on this project's conservation status assessment methodologies and are also submitted as part of this project's deliverables. Appendix 13 provides a list of GIS shapefiles generated in ArcGIS (.shp, .shx, .sbx, .sbn, .dbf and .lyr) including a description of their parameter tables. Metadata associated with these datasets has also been generated using the NPWS metadata template. Three different types of maps were produced for each site. These maps although mapped at a 1:1,500 scale using the NPWS Designated Raised Bog Orthophotos 2010 feature the 6" 1910 Ordnance Survey as background.
  - Map I: Ecotope and quadrats map: each active peat forming section (i.e. each individual patch of central, sub-central and/or active flush) have been named and a description of these specific areas is given in each site report, quadrats are also depicted on this map.
  - Map II: Community complexes map: each point depicted on the map represents a geographical record for a community complex. The name of the community complex is usually (space allowing) written beside each point.
  - Map III: Impacts map: this map illustrates high bog drainage, burnt areas and high bog cut away in the 2004/05-2010 period.

- The existing NPWS Raised Bog Monitoring MS Access database was updated and populated. The database contains the following data:
  - Survey detail: this contains general site information.
  - Survey quadrats detail: this contains all data recorded on the field related to each quadrat.
  - Survey impacts: this contains information on impacting activities recorded on the site and their impact and influence.
  - Survey ecotope area: this contains information on ecotopes recorded on each site and their area.
  - Survey conservation status assessment: this contains information on the conservation status assessment per habitat and per site.
- A list and digital copy of images compiled during the project in a format suitable for upload to the NPWS Imagebank.

## 3.2 Project results

The following is a summary of the results obtained as part of the 2013 Raised Bog Monitoring Project, which surveyed a selection of raised bogs designated as SAC (31 raised bogs within 28 SACs) and NHA (one raised bog) and additional 12 raised bogs within 10 SACs surveyed in 2011 by Fernandez *et al.* (2012). A total of 139 bogs have been designated in Ireland within 127 sites (74 NHAs and 53 SACs).

The project's field season survey commenced in September 2012 and was completed in February 2013. Appendix 14 provides a list of the most common community complexes found on the high bog grouped according to the ecotope they belong to and listing the number of records of each complex.

National conservation status assessment results are also provided within this section of the report. This took into account this project's individual sites assessment results, Fernandez *et al.* (2012) individual site assessment results and additional data (e.g. Bord na Móna and Coillte data).

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### 3.2.1 Clarifications

The conservation status assessment methodology is based on the comparison of ecotopes data obtained during this and Fernandez *et al.* (2012) surveys with those of previous surveys: Fernandez *et al.* (2005) and Derwin & MacGowan (2000) based on Evans & Arvela (2011) guidelines. In the case of setting FRVs for ARB, original Kelly (1993) and Kelly *et al.* (1995) ecotope data was used, however, this data was amended by Fernandez *et al.* (2005) to make the data more comparable. There are certain limitations in the process of comparing data from different surveys, due to differences in surveying

and mapping techniques (i.e. level of accuracy and mapping detail) between surveys. These discrepancies have been reduced as much as possible by re-interpreting the original data in the light of more standardised definitions of each ecotope (Appendix 3). There have also been changes in mapping methods (i.e. increasing accuracy of new surveying techniques). The discrepancies between surveys and how they have been handled is discussed below.

#### 3.2.1.1 Changes in interpretation of the community complexes

Some community complexes described by Fernandez *et al.* (2005) have been re-allocated to different ecotope types (due to interpretation differences) by this survey and Fernandez *et al.* (2012). For instance, some sections of sub-central ecotope community complex 9/7/10 described in 2005 at Ballykenny Bog and Fisherstown Bog (001818) have been reassessed in 2013 and are now deemed to be sub-marginal rather than sub-central ecotope. In this case there was no real change or sub-central ecotope loss. Any such changes in interpretation are described for each individual site within the site report and the figures against which assessments are made were adjusted accordingly.

#### 3.2.1.2 Higher mapping accuracy and more comprehensive surveying

The use of previous surveys' ecotope data (Fernandez *et al.* (2005), Derwin & MacGowan (2000)) in digital format, which were imported and visualised in the field on the Trimble GeoXT devices, as baseline data for surveying has allowed a more accurate mapping of all ecotopes and particularly ARB. The more recent 2011 to 2013 surveys allocated more time to field survey and focused on improving the boundary of central, sub-central ecotopes and active flushes. Therefore, both an increase in mapping accuracy and more comprehensive surveying has generated improved ecotope maps. These changes have been taken into account to amend original ecotope figures (Fernandez *et al.* (2005), Derwin & MacGowan (2000)) to ensure changes were not over- or underestimated. Each individual site report provides both original and amended figures.

#### 3.2.1.3 New Active Raised Bog areas recorded

The use of the NPWS Designated Raised Bog Orthophotos 2010, which have much higher resolution (0.5m x 0.5m resolution) than the previous OSi 2000 and 2005 aerial photographs used in the 2004/05 surveys allowed for the identification of potential new active peat forming areas prior to the surveying of the site. Many of these potential active peat forming areas have been subsequently confirmed to be either sub-central, central ecotope or active flush. However, the majority of these newly discovered areas are considered to have been already present in 2000 or 2004/05 (See each individual report for further detail). These new areas were described within each individual site report and their extent

added to the original Fernandez *et al.* (2005) and Derwin & MacGowan (2000) figures when considered to be already present at the time.

#### 3.2.1.4 Slight changes of high bog boundary

The high bog boundaries of sites originally mapped by Fernandez *et al.* (2005) and Derwin & MacGowan (2000) have been more accurately mapped as part of this and Fernandez *et al.* (2012) projects. This has resulted in small area changes in the ecotopes at the edge of high bog, particularly in face-bank ecotope. Their amended values have been taken into account and were included in the 2000 and 2004/05 amended ecotope figures given within each site report.

### 3.3 Habitat mapping

#### 3.3.1 National raised bog resource

A series of four shapefile format datasets depicting the distribution of the national resource of raised bog have been updated as part of the project. These datasets contain *intact* high bog data and were divided by those records for which ecotope data is available (i.e. RBMA13\_ecotope\_map, RBMA13\_habitats\_2007\_13\_othersources and RBMA13\_habitats\_prior\_2007) and those high bog records for which ecotope data is not available (i.e. RBMA13\_unsurveyed\_data\_prior\_2007) (See section 2.2).

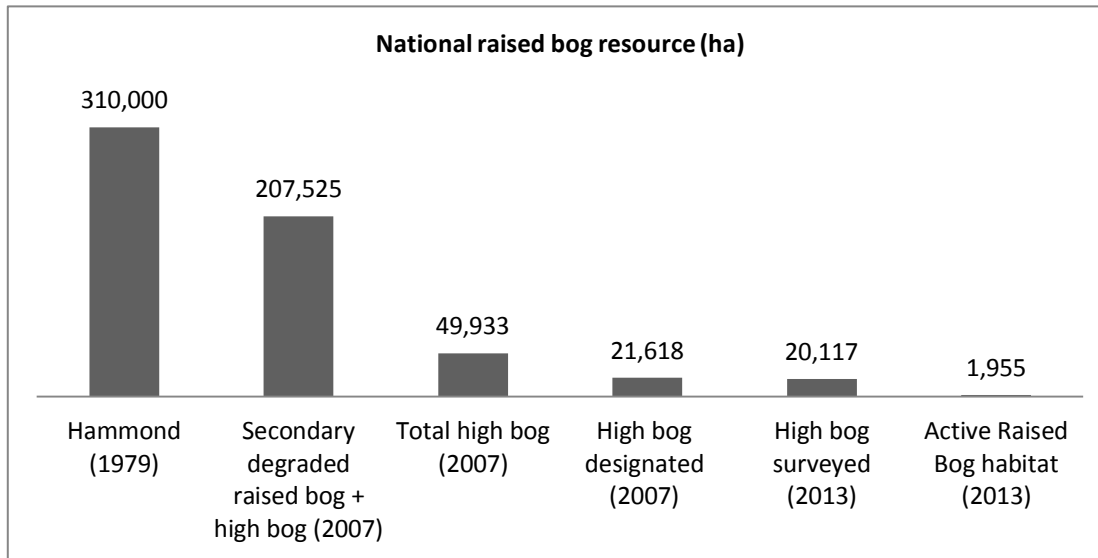
The fourth dataset (RBMA13\_unsurveyed\_data\_prior\_2007) also identifies a total of 8 polygons in which ARB has been reported by Bord na Móna as part of their 2009 habitats surveys (Bord na Móna Ecology Team pers. comm. 2013). Detailed habitat data is not yet available to NPWS (2013). According to Bord na Móna, ARB would have been present within these polygons prior to 2007 as well.

In addition, a fifth dataset named RBMA13\_2dary\_DRB\_unsurveyed which illustrates secondary degraded raised bog habitat has been also updated as part of this project (See section 2.2).

The overall extent of *intact* high bog and secondary degraded raised bog remaining in the country is approximately 207,525ha (See Figure 3.1). Only 49,933 ha of *intact* high bog remain in the country out of an original figure of 310,000ha estimated by Hammond (1979). 21,618ha (43.29%) of this *intact* high bog are within designated sites (SACs or NHAs). There is detailed habitat data collected at least once between 1994 and 2013 for 20,117 ha (40.29%) of the national *intact* high bog resource (this includes 1,749ha of raised bog for which Bord na Móna undertook habitat surveys in 2009, but this data is not yet available to the NPWS). Only 1,955ha within the 49,933ha corresponds with ARB. As already mentioned some additional ARB records may be found within the un-surveyed high bog sections of the 49,933ha *intact* high bog resource reported, but any such areas are likely to be very small. The

previous figures are have been reviewed by the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.

Any discrepancy between the above figures and those given by NPWS (2007) are mostly due to improvements in mapping accuracy. Actual losses in DRB and ARB are described and discussed within sections 3.4.1 and 3.4.2.



**Figure 3.1** National raised bog resource and the amount that has been surveyed by 2013

As table 3.1 below shows 1,955ha (9.72%) out of 20,117ha of *intact* high bog for which detailed ecotope data is available consists of ARB, the remaining consists of DRB. 975ha (49.87%) out of this 1,955ha corresponds with data collected in the 2007-2013 period, the remaining 980ha (50.13%) corresponds with data collected before 2007. The figures given above do not take into account potential ARB losses for those sites surveyed prior 2011. These should be calculated in order to provide a more accurate value for the current extent of ARB. The previous figures are have been reviewed by the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.

**Table 3.1** High bog for which habitat data is available

Data source	Date	ARB		DRB		Total	
		ha	%	Ha	%	Ha	%
RBMA13_habitats_prior_2007	1994-2005	980	50.13	9,755	53.72	10,735	53.37
RBMA13_habitats_2007_13_othersources	2009	113	5.78	442	2.43	555	2.76
Bord na Móna raised bog data <sup>1</sup>	2009	40	2.05	1,749	9.63	1,789	8.89
RBMA13_ecotope_map	2011-2013	822	42.05	6,215	34.22	7,037	34.98
<b>Total</b>		1,955	100	18,162	100	20,117	100

**Note:** The actual extent of raised bog areas not surveyed within the reporting period (2007-2013) would be smaller than given in this report, as peat cutting has continued in these areas since they were mapped.

<sup>1</sup> This corresponds with the 2009 raised bog habitat data for which detailed habitat data is not yet available to NPWS. The 40ha extent is only approximate. This may have increased since restoration works took place in 2011 and 2012. This does not include Killamuck (Abbeyleix) bog, already included in RBMA13\_habitats\_2007\_13\_othersources.

As table 3.2 below illustrates, only 24.06% of the currently know extent of raised bog remaining in the country consists of *intact* high bog. The overall extent of secondary raised bog is 157,592ha. Secondary raised bog is the only raised bog resource type remaining in counties Louth and Limerick. The proportion of high bog remaining versus secondary raised bog varies considerably from one county to another. Thus, for example, only 7.82% of the raised bog resource in county Kildare corresponds with *intact* high bog while 68.93% of the raised bog resource in Meath corresponds with *intact* high bog. According to table 3.2, only *intact* high bog remains in counties Carlow and Cork, this is likely to be the result of intensive land reclamation in the areas surrounding these raised bog remnants. Table 3.2 also shows that detailed habitat data (i.e. ecotope data) is not available for the only few hectares of *intact* raised bog remaining for counties Carlow, Cork and Monaghan. Nevertheless, there are very low chances of finding ARB in these areas, due to their small extent and highly modified/damaged nature.

**Table 3.2** National raised bog resource per county

County	High bog surveyed (ha)	High bog un-surveyed (ha)	Total high bog (ha)	Secondary degraded raised bog (ha)	Total (ha)	% of high bog
Carlow	0	9	9	0	9	100.00
Cavan	75	628	703	3,057	3,760	18.69
Clare	123	441	564	3,450	4,014	14.05
Cork	0	33	33	0	33	100.00
Galway	6,452	7,167	13,619	26,205	39,823	34.20
Kerry	243	652	895	6,388	7,283	12.28
Kildare	474	679	1,153	13,597	14,750	7.82
Laois	291	657	948	3,009	3,957	23.96
Leitrim	517	1,125	1,642	2,081	3,723	44.12
Limerick	0	0	0	337	337	0.00
Longford	796	2,027	2,823	11,963	14,785	19.09
Louth	0	0	0	6	6	0.00
Mayo	475	3,980	4,455	19,738	24,193	18.42
Meath	247	104	351	158	510	68.93
Monaghan	0	172	172	266	438	39.33
Offaly	1,658	2,483	4,141	23,708	27,849	14.87
Roscommon	3,697	8,443	12,140	21,682	33,822	35.89
Sligo	196	844	1,040	5,874	6,914	15.04
Tipperary	1,650	1,147	2,797	6,114	8,911	31.39
Westmeath	1,436	1,013	2,449	9,959	12,407	19.74
<b>Total</b>	<b>18,329</b>	<b>31,604</b>	<b>49,933</b>	<b>157,592</b>	<b>207,525</b>	<b>24.06</b>

Figure 3.2 below shows a snapshot of the raised bog resource remaining in Offaly and surrounding counties. As the figure illustrates mostly secondary degraded raised bog (i.e. light blue) remains in the area compared to *intact* high bog (i.e. dark blue (surveyed high bog) and orange (un-surveyed high bog)).



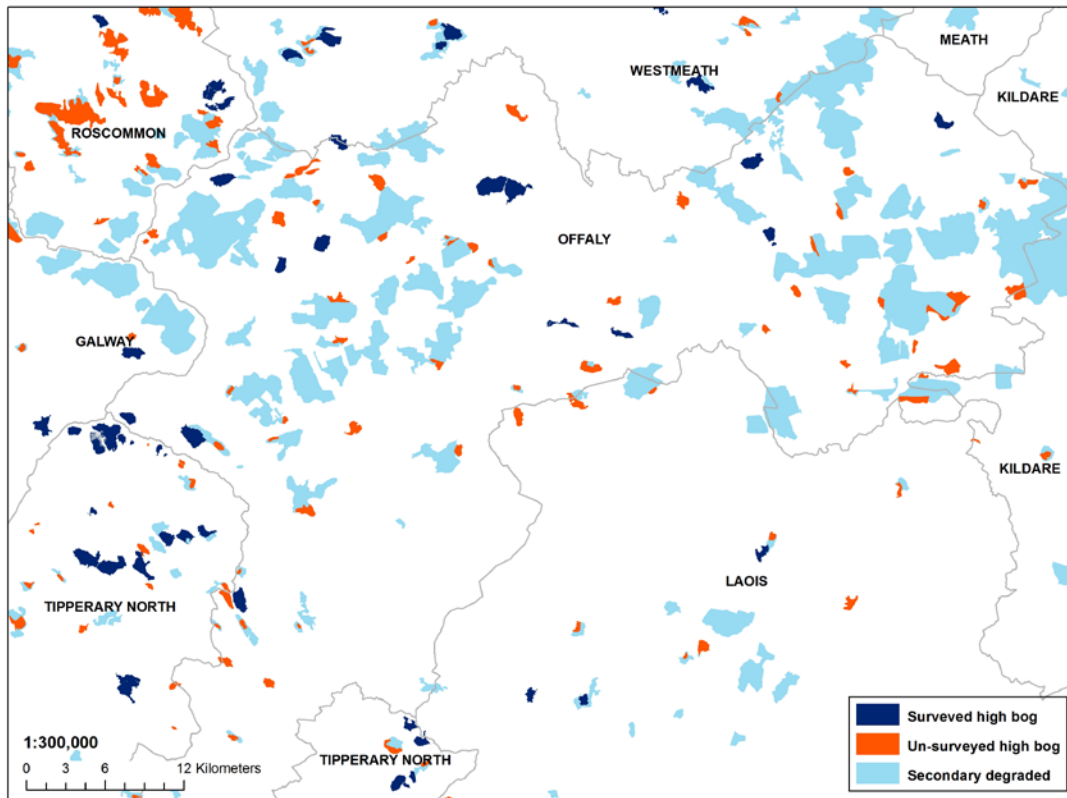


Figure 3.2 Snapshot of remaining intact high bog versus secondary degraded raised bog

### 3.3.2 National Active Raised Bog habitat distribution and Range maps

The ARB distribution map created by NPWS (2007) has been updated as part of this project. This map is a combination of three shapefile format datasets which compile data from vegetation surveys at ecotope level generated in three different time periods, as described in section 2.2.2, as well as habitat records provided by the Bord na Móna 2009 (Bord na Móna Ecology Team, pers. comm. 2013) raised bog habitat surveys (See Appendix 12). According to these datasets 1,955ha of ARB remain in Ireland. 975ha (49.87%) correspond with data collected in the 2007-2013 period and the remaining 980ha (50.13%) collected before 2007 (1994-2005). All habitat records except the Bord na Móna data are limited to designated sites (i.e. SACs or NHAs). The above figures do not take into account potential ARB losses for those sites surveyed prior 2011. These should be calculated in order to provide a more accurate value for the current extent of ARB. This has recently been reviewed as part of the national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.

The 2007 10km distribution and Range maps for ARB have been revised as part of this project. The new distribution map is slightly different to the one reported in 2007. A total of 78 10km grid cells (7,800km<sup>2</sup>) are considered to intersect areas containing ARB (See Figure 3.3). 7,600km<sup>2</sup> were reported

in 2007 by NPWS (2007). Cell N19 within counties Longford and Leitrim was reported as containing ARB, as this cell intersects a Bog Woodland record within Clooncoe Wood and Lough NHA (000424). Bog Woodland (91D0) is also peat forming and thus is reported as part of ARB when is found on a high bog. However, this record is located on fen type vegetation rather than raised bog and thus is now considered not to correspond with ARB within the revised ARB distribution map. Fernandez *et al.* (2009b) reported a new ARB record in the 2007-2013 reporting period within Killamuck (Abbeyleix) bog (Co. Laois). This new record intersects cell S48 and thus is considered an expansion on the habitats national distribution. Although the Fernandez *et al.* (2009b) described the positive benefits (e.g. infilling of drains, increase in *Sphagnum* spp. cover) of restoration works undertaken in 2009 at the site, a small section of ARB was expected to have been there before these works were carried out and thus this new record does not represent an actual increase in the distribution nor Range in the 2007-2012 reporting period. Bord na Móna 2009 raised bog habitat surveys reported habitat records within two additional cells M84 (Co. Roscommon and Galway) and M93 (Co. Roscommon). According to Bord na Móna these records would have been present already in 2006/7. Therefore, this change cannot be taken either as an actual change in the distribution of ARB (See Figure 3.3).

The habitat's Range has also changed and its value differs to the one reported in 2007, which was 13,400km<sup>2</sup> (134 10km cells). The current Range value is 13,700km<sup>2</sup> (137 10km cells). The actual 2007 Range including cells M84, M93 and S48, reported by Bord na Móna (Bord na Móna Ecology Team pers. comm. 2013) and Fernandez *et al.* (2009b) in 2009 as already being present in 2006/7, is 13,700km<sup>2</sup> (137 10km cells). To summarise, there has not been any actual change in habitat Range in the 2007-2012 reporting period<sup>2</sup>.

The current Range of ARB is much smaller than the range of raised bogs in Ireland. The habitat distribution map shows that the Range is separated into two major units. The larger one stretches throughout the midlands and the smaller with an elongated shape in a north-south direction covers areas of counties Clare and Kerry. The DRB Range map also illustrates a gap between these two main areas, which is likely to correspond to areas not suitable for the development of raised bogs. Hammond's (1979) peatland map also indicated that the climatic, geological and altitudinal conditions were more appropriate for the development of blanket bog, both Lowland and Highland in this area. Two isolated records of DRB were reported in counties Carlow and Cork. These are remnants of a previous more extensive habitat distribution along the southern and eastern margins of the country

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<sup>2</sup> These range figures were calculated based on the IT Tool version 10.0 (30/08/2012) generated by ETC/BD. The IT Tool added two new 10 km cells to the range map despite only one 10 km cell corresponding with an actual increase in habitat distribution.

where raised bog development was confined to small basins. These small raised bogs were drained and cutaway down to the mineral layer in the past as described by NPWS (2007).

It should be highlighted that the actual extent, distribution and Range of ARB may be larger than that illustrated by the figures above and shown in Figure 3.3. This is because the actual Area, distribution and Range of ARB is based only on known records of the habitat. It should be acknowledged that the habitat may possibly be present in more un-mapped *intact* high bog areas (i.e. RBMA13\_unsurveyed\_data\_prior\_2007 dataset).

The Favourable Reference Range of ARB was considered by the NPWS (2007) to be the current Range of DRB, the definition of which states that it is still capable of regeneration within a 30 year period if appropriate measures are put in place (i.e. no major impacting activities are present and any necessary restoration works are implemented). This new figure for Range was calculated based on the IT Tool version 10.0 (30/08/2012) generated by European Topic Centre on Biological Diversity. Therefore the change in current Range is only due to there being differing methods used to calculate the Range. The new Favourable Reference Range is 26,100km<sup>2</sup> (261 10km cells). This habitat's current distribution and Range maps will be revised based on data from the more recent national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>)).

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### 3.3.3 National Degraded Raised Bog habitat distribution and Range maps

The DRB distribution map created by NPWS (2007) has been updated as part of this project. This map is a combination of four shapefile format datasets which compile data from vegetation surveys at ecotope level generated in three different time periods as described in the methods section, as well as un-surveyed *intact* raised bog data prior 2007. According to these datasets 47,978ha of DRB remain in Ireland.

The 10km distribution and Range maps for DRB from 2007 were also revised. The 10km distribution map has not changed compared to the one reported in 2007. A total of 201 10km grid cells (20,100km<sup>2</sup>) are considered to intersect areas containing DRB (See Figure 3.4).

The Range differs to the one reported in 2007, which was 24,600km<sup>2</sup> (246 10km cells). The current Range value is 26,100km<sup>2</sup> (261 10km cells) (See Figure 3.4). This new figure for Range was calculated based on the IT Tool version 10.0 (30/08/2012) generated by European Topic Centre on Biological Diversity. Therefore the change in current Range is only due to there being differing methods used to calculate the Range. The Favourable Reference Range value is equal to the current Range (26,100km<sup>2</sup>) as there is no evidence of a decline in Range since the Directive came into force.

The current and Favourable Reference Range of DRB is similar to the Range of the whole raised bog national resource. However, it does not include those areas of secondary degraded raised bog. A total

of 55 10km grid squares are considered to contain exclusively secondary degraded raised bog. Corine (2000) land cover map was the main source of data to depict secondary degraded raised bog. Its occurrence was visually confirmed by overlaying the year 2000 OSi aerial photographs.

It should be highlighted that actual Area, distribution and Range of DRB may be larger than that illustrated by figures above and shown in figure 3.4. Some additional records of *intact* high bog may be also present within the secondary degraded raised bog (i.e. RBMA13\_2dary\_DRB\_unsurveyed) dataset.

This habitat's current distribution and Range maps will be revised based on data from the more recent national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>).

## 3.4 Conservation status assessment

### 3.4.1 Active Raised Bog conservation status assessment

#### 3.4.1.1 Range

The habitat's **current Range** is 13,700km<sup>2</sup> (137 grid cells x 100km<sup>2</sup>) (See section 2.2.3 for further description of method used to calculate habitat Range) (See Figure 3.3 below).

**Favourable Reference Range** is 26,100km<sup>2</sup> (261 grid cells x 100km<sup>2</sup>), which corresponds to the Range of DRB, for which the definition is still capable of regeneration within a 30 years period if appropriate measures are put in place (i.e. no major impacting activities are present and any necessary restoration works are implemented).

The current habitat Range is 47.51% below the Favourable Reference Range. A Range value more than 10% below the FRV is considered to be **Unfavourable Bad** according to the summary matrix given by Evans & Arvela (2011) (See Table 2.3).

The current habitat Range value is similar to the 2007 Range value. The 2007 Range value has been revised as part of this project to take into account several records within cells M84, M93 and S48 where the habitat is considered to have been present in 2006/07 as reported by Fernandez *et al.* (2009b) and Bord na Móna (Bord na Móna Ecology Team pers. comm. 2013), but not originally reported by NPWS (2007) in 2007. This change in Range is the result of improvement in knowledge. Thus, the Range is given a **Stable** trend.

The overall Range national conservation status assessment for ARB is **Unfavourable Bad-Stable**.

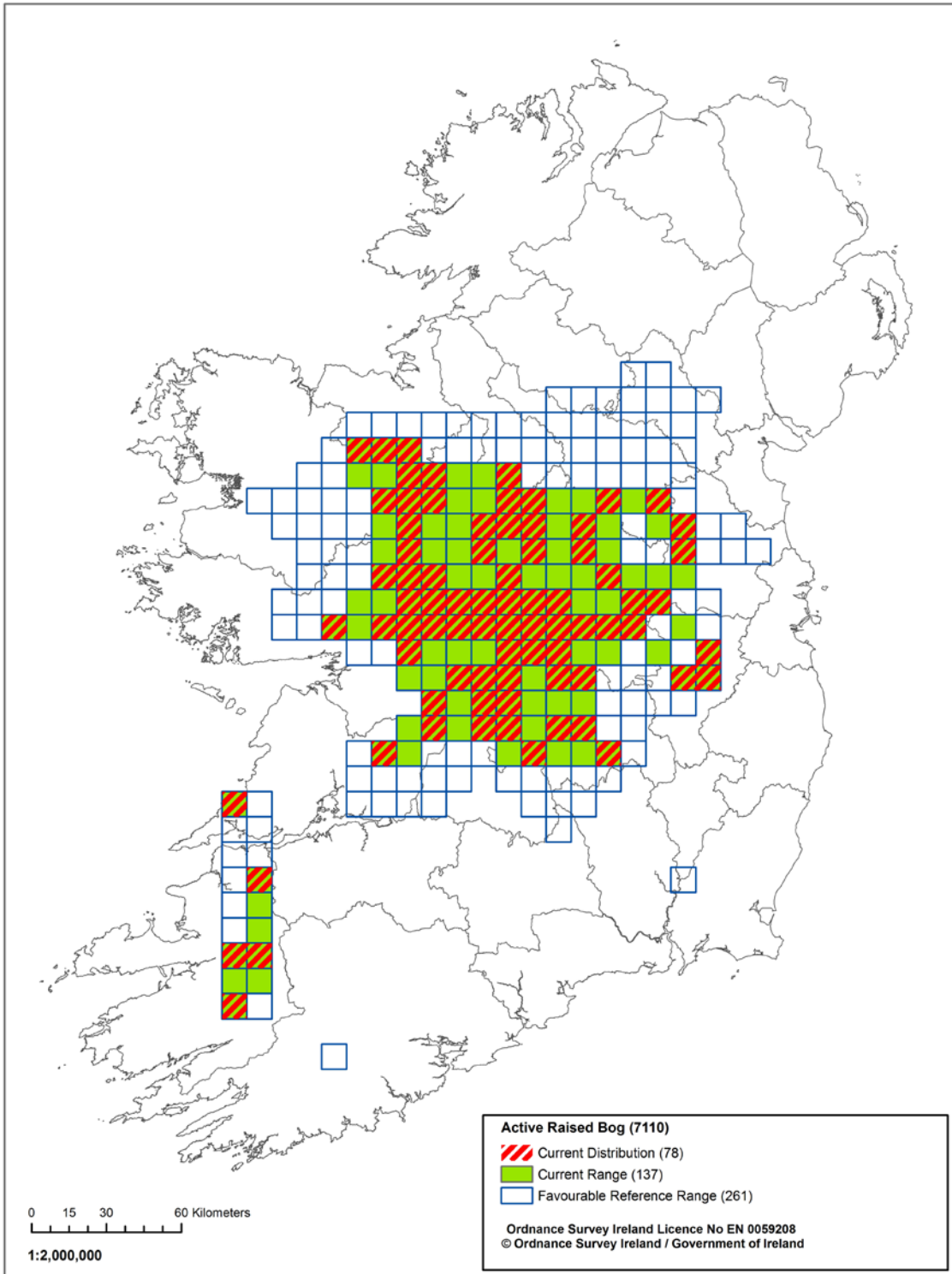


Figure 3.3 Current distribution and Range map of ARB in Ireland

#### 3.4.1.2 Area

The assessment for ARB Area was undertaken for a total 44 raised bogs in the 2011 to 2013 period, as part of Fernandez *et al.* (2012) and this project. All these 44 raised bogs but one, which is designated as an NHA, are within an SAC (38 SACs). No non-designated raised bogs have been surveyed or assessed. The overall high bog extent of these surveyed raised bogs is 7,040ha, which accounts for 32.57% of the total extent of raised bog designated (21,618ha) and 14.10% of the total extent of *intact* high bog remaining in the country (49,933ha). These surveyed raised bogs, which aimed to represent the range of the ecological variation in the habitat, contain a total of 822.49ha of ARB (See Table 3.4). This accounts for 42.07% of the known national resource (1,955ha).

NPWS (2007) set a Favourable Reference Value for the habitat Area in 2007 of 21,520ha (215.2km<sup>2</sup>). Recent data has shown that the actual FRV is **21,618ha (216.8km<sup>2</sup>)**. This change in Area FRV is due to improved knowledge. This value corresponds to the Area of both Active and Degraded Raised bog resources within designated sites. This is based on the official EU definition of DRB, as still capable of regeneration within 30 years period if appropriate measures are put in place (i.e. no major impacting activities are present and any necessary restoration works are implemented). However, the Area required to be restored in order to achieve the FRV will be targeted in areas deemed suitable for restoration throughout the entire range of raised bogs, particularly in adjacent areas to raised bogs within designated sites with ARB present in order to optimise the conservation of their biodiversity values of such sites. This FRV has been recently reviewed and significantly reduced by the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.

The current habitat area (1,955ha) is 90.95% below the FRV (21,618ha). A habitat Area that is more than 15% below the FRV is considered to be **Unfavourable Bad** (See section 2.4.2). This implies that the target for ARB at national level is to restore the remaining 195.47 km<sup>2</sup> of DRB to ARB.

As table 3.6 below illustrates, the habitat Area has decreased by 13.47ha (1.61%) in the 2004/05-2011/13 period in the 44 raised bogs assessed. However, one of the sites (Carn Park (SAC 002336)) was originally surveyed in 2000 and this site has suffered the largest habitat loss in the 2000-2013. Similar overall losses are likely to have taken place in the remaining un-surveyed raised bogs located within SACs (i.e. un-surveyed since before 2004). However, higher losses are expected to have taken place within those sites designated as NHAs where rates of turf cutting are likely to have remained the same or increased (See section 4).

NPWS (2007) reported a total of 1,945ha of ARB in 2007. However, the addition of 40ha recently reported by Bord na Móna (Bord na Móna Ecology Team, pers. comm. 2013) which were already

present in 2006/7, brings the 2007 total figure to 1,985ha. The current Area is 1,955ha, which represents a 30ha loss. Nevertheless as table 3.6 below indicates there is a 29.56ha discrepancy between the original 2004/05 habitat Area figure (865.52ha) and the 2004/05 (amended) figure (835.96ha) for the 44 raised bogs assessed (See section 3.2.1 for further description of amended values), which indicates that the actual overall Area of the habitat in 2004/05 would have been smaller than originally reported and therefore the 30ha decrease in habitat Area in the comparison between the 2007 overall national resource figure and the 2013 figures should be regarded with caution. However, the 13.47ha loss of ARB since 2004/05 from the 44 raised bogs surveyed in 2011-13 can be taken with a high degree of certainty.

The exact habitat losses for the entire habitat national resource in the 2007-2012 period (6 years reporting period) cannot be provided. However, taking into account the actual habitat losses (13.47ha (1.61%)) within the 44 raised bogs assessed, which contain approximately 42.76% of the national resource (1,955ha), and the fact that higher habitat losses are likely to have taken place within NHAs and non-designated bogs, a 1.5% loss of habitat in the reporting period for the entire habitat national resource is considered to be a conservative estimate. Thus, a **Decreasing** trend is given to the Area.

Furthermore, according to the most recent individual site conservation status assessments (See Table 3.3): ARB Area has been assessed as **Unfavourable Bad** at 43 out of 44 raised bogs assessed and **Unfavourable Inadequate** at one raised bog (Carrowbehy), as their current Area is below the FRVs. The Area has been given an **Increasing** trend at 11 raised bogs (restoration works took place at nine of these bogs (Kilsallagh, Lisnageeragh, Mongan, Raheenmore, Ballyduff, Clonfinane, Garriskil, Carrownagappul and Ballykenny); increases associated with natural infilling of drains took place at Ballynafagh and increases caused by subsidence took place at All Saint's, however the increases at All Saint's were also associated with several changes in the distribution of the habitat and losses in Bog Woodland habitat (91D0)); **Stable** at 14 (restoration works took place at four of these bogs (Killyconny, Sharavogue, Firville and Curraghlehane) which in some cases halted further habitat losses. No restoration works and no major activities impacting on ARB were recorded in the other ten sites within this category; nevertheless, activities continue impacting on DRB and thus minimising the potential to recovery to FRVs and the possibility of restoration works on the site. A **Decreasing** trend was given to 19 raised bogs (restoration works took place at eight bogs (Moyclare, Bellanagare, Derrinea, Cloonshanville, Fisherstown, Carn Park, Crosswood, Camderry and Carrowbehy); however, in some cases restoration works only took place recently and only minor localised increases in ARB were noted or only positive results were reported in DRB. Nevertheless, these restoration works have halted further habitat losses; in the other 11 bogs with a decreasing trend, impacting activities outweighed benefits from restoration works or restoration works were of small nature; major impacting activities reported in these 11 bogs (See Appendix 10). These individual bogs assessments



support the above national assessments (UB-Decreasing) since 19 sites reported a decreasing trend while only 11 reported an increasing trend.

Table 3.8 provides a comparison between current high bog area and FRV for habitat Area. The Area FRV ranges from 15.86% of high bog at Camderry to 91.25% of high bog at Raheenmore. The average high bog percentage is 50.27%, which implies that approximately 50% of the high bog should be ARB. These values have been recently reviewed by the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This more recent information has not been incorporated into this report.

To summarise the overall Area national conservation status assessment for ARB is **Unfavourable Bad-Decreasing**.

#### 3.4.1.3 Structure and Functions

Figures estimated by the most recent ARB conservation status assessments (44 raised bogs assessed) as part of Fernandez *et al.* (2012) and this project, show a slight decrease (0.60ha) in the extent of both central and active flush/soak ecotopes in the 2004/05-2011/2013 period. Their extent has decreased from 260.77ha (2004/05 (amended)) to 260.17ha (2011/13). This extent represents 31.70% of the overall extent of ARB surveyed in the 2007-2013 period (822.49ha). Half of the current extent of ARB should be made up of central ecotope and active flush/soak (i.e. more pristine examples of ARB community types) (as described in the section 2.4.2). This represents the **Favourable Reference Value** for ARB S&Fs, thus the **national FRV for S&Fs is 957.5ha**. In the particular case of the 44 raised bogs recently surveyed, the FRV for S&F is 411.25ha, which means that the current value of 260.17ha is 36.74% below FRV. A current value more than 25% below FRV falls in to the **Unfavourable Bad** assessment category (See section 2.4.2).

As mentioned above, there has been a 0.60ha loss of the extent of central and active flush/soak, this accounts for a 0.23% loss in the 2004/05-2011/13 period. Similar losses are likely to have taken place in the remaining un-surveyed raised bogs located within SACs. However, higher losses are expected to have taken place within those sites designated as NHAs (See section 4). Therefore, it seems reasonable to give a conservative estimate of 0.25% loss in the reporting period for the national resource of both central and active flush/soak ecotopes. Taking into account the small magnitude of these losses a **Stable** trend is given to the S&Fs.

Furthermore, according to the most recent individual site conservation status assessments (See Table 3.3); S&Fs have been assessed as **Unfavourable Bad** at 35 out of 44 raised bogs (as the extent of finest/wettest vegetation quality is more than 25% below FRV); **Favourable** at six raised bogs (as the extent of both central and active flush/soak ecotopes within the bog is higher than FRV) and



**Unfavourable Inadequate** at three raised bogs (as the extent of finest/wettest vegetation quality is 5%-25% below FRV). The S&Fs have been given a **Stable** trend at 29 raised bogs (no change on the vegetation quality); **Declining** at eight, which implies that vegetation quality has declined in the reporting period and **Improving** at seven raised bogs, which implies that vegetation quality has improved in the reporting period. These individual bogs assessments support the above national assessments (UB-Stable).

To summarise, the **overall S&Fs national conservation status assessment for ARB** is **Unfavourable Bad-Stable**.

Quadrat analysis has shown slight changes at many of the quadrats analysed. Although some of these changes may be real, many are considered to be the result of discrepancy due to quadrat location. Permanent quadrats have been used in the most recent surveys to avoid similar errors in future monitoring programmes (See section 4 for further detail on quadrat analysis).

No specific **typical species** conservation status assessments have been undertaken either at site or national level. Some of the typical species listed in Appendix 7 have been recorded as good quality habitat indicators within the quadrats (See Appendix 5). A change in the habitat quality (S&Fs) indicates a change in the occurrence of typical species and therefore both are interdependent. As a result, a similar assessment to the S&Fs (UB-Stable) is given to the typical species. A list of typical species for ARB and DRB is given in Appendix 7.

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#### 3.4.1.4 Future Prospects

The most recent Raised Bog Monitoring Surveys (2011-2013) have provided the following habitat FPs results for a total of 44 raised bogs monitored:

**Area FPs** have been given an Unfavourable Bad-Decreasing assessment at 27 raised bogs, Unfavourable Inadequate-Decreasing at one raised bog, Unfavourable Bad-Stable at 10 raised bogs, Unfavourable Bad-Increasing at 5 raised bogs and Unfavourable Inadequate-Increasing at one raised bog. Taking into account these results the overall Area FPs for the 44 raised bogs assessed is Unfavourable Bad-Decreasing.

**S&Fs FPs** have been given an Unfavourable Bad-Declining assessment at 21 raised bogs, Unfavourable Inadequate-Declining at three raised bogs, Favourable-Declining at four raised bogs, Unfavourable Bad-Stable at nine raised bogs, Favourable-Stable at two raised bogs and Unfavourable Bad-Improving at five raised bogs. Taking into account these results the overall S&Fs FPs for the 44 raised bogs assessed is Unfavourable Bad-Declining.

Based on the above assessments the **overall FPs** per site is as follows (See Table 3.5):

**Unfavourable Inadequate–Improving** assessment was given to Mongan Bog and **Unfavourable Bad-Improving** to five raised bogs (Ballyduff, Ballykenny, Clonfinane, Fisherstown and Garriskil) as the habitat Area has increased as a result of restoration works or is expected to increase as the positive influence of restoration works counteracts the negative influence from impacting activities, which are generally Low Importance/Impact in nature (e.g. Fisherstown).

An **Unfavourable Bad-Stable** assessment has been given to 10 bogs, as net change in habitat Area or S&Fs is expected in the following two reporting periods. Restoration works were undertaken at five bogs (Carn Park, Cloonshanville, Killyconny, Raheenmore and Sharavogue) and ARB developed within Carn Park, Cloonshanville and Raheenmore as a result of these works. However, negatively impacting activities remain, which caused habitat losses, and both positive and negative activities are balancing each other out. Improvements in DRB were reported at Killyconny and Sharavogue in this reporting period. Further restoration works are needed to attain a more favourable trend towards FRVs. No Increase/Improvement is expected at the remaining five bogs due to the lack of restoration measures and absence of high negatively impacting activities (Ballynafagh, Brown Bog, Firville (only minor restoration works on the cutover), Sheheree and Tawnaghbeg). Restoration works are needed at these sites to achieve FRVs.

An **Unfavourable Inadequate-Declining** assessment was given to Carrowbehy Bog and **Unfavourable Bad-Declining** to 28 raised bogs. Although restoration works were undertaken at nine of these bogs (Bellanagare, Camderry, Carrowbehy, Carrownagappul, Crosswood, Curraghlahanagh, Kilsallagh, Lisnageeragh and Moyclare) impacting activities continue to threaten the habitat and decreases in extent and/or a decline in quality is expected in the following two reporting periods despite the positive effects of restoration works. Equally, decreases/declines in habitat are expected for those sites without restoration works, including the following eight raised bogs: All Saint's, Cloonchambers, Cloonfelliv, Derrynabrock, Flughany, Moanveanlagh, Monivea and Redwood, despite no habitat losses or declines in quality noted in this reporting period, due to the presence of negatively impacting activities. Further habitats losses or decline in quality are expected in the remaining 11 bogs (Addergoole, Callow, Corbo, Corliskea, Derrinea, Ferbane, Kilcarren, Knockacoller, Moorfield Bog/Farm Cottage, Shankill West and Trien) associated with ongoing highly negatively impacting activities.

An analysis of the current situation as regards the most impacting activities affecting the habitat (See section 3.5), shows the following:

**Peat cutting** - A decreasing trend peat cutting activity has been reported for those bogs that occur within the SAC network. The implementation of the Department of Arts, Heritage and the Gaeltacht new peat cutting cessation scheme has resulted in the apparent cessation of peat cutting in many of these sites (e.g. out of the 44 bogs surveyed 32 were cut at the beginning of the period which was

reduced to 18 by the end of the period) and the reduction of the intensity of the activity in the remaining sites by April 2013 (See Table 3.18). However, the peat cutting cessation scheme does not cover raised bog NHAs and peat cutting on these sites appears to have increased in intensity during the reporting period (Ryan, J., pers. comm., 2013). Fernandez *et al.* (2006) proposed the immediate cessation of peat cutting on SACs and NHAs as the best option to avoid the risk of cutting increasing in the NHAs. No data is available on peat cutting activities in non-designated sites, where some additional areas of ARB have been identified by Bord na Móna surveys on some non-designated sites (Bord na Móna Ecology Team pers. comm. 2013). Peat cutting activity intensity within non-designated sites is likely to have remained stable or increased in the reporting period and will continue in the future.

**Drainage** – Similarly to peat cutting, a very different trend is expected as regards impacts from drainage on raised bog SACs than on NHAs or non-designated bogs. Although the largest proportion of the high bog drains continue impacting the habitat, some have been blocked and thus their impact will be negated once they become non-functional, as part of the infilling process. Very few restoration works have been carried out or are expected to be carried out in the near future within bogs designated as NHAs. Thus, the impact from drainage on these bogs will continue until restoration works on raised bogs are expanded to include NHAs. A similar scenario is expected for those habitat patches within non-designated sites.

**Forestry** - Like peat cutting and drainage a very different trend of the impact from forestry on ARB in the future is expected for NHAs and non-designated sites than SACs. No new forestry plantations have been established on the high bog on raised bog SACs and neither are they expected to be in the future. Conifer plantations remain in some SAC bogs, but clear felling (on the high bog and/or cutover) took place at 10 raised bogs out of 44 surveyed as part of restoration projects: Camderry, Carn Park, Carrowbehy, Cloonshanville, Crosswood, Curraghlahanagh, Killyconny, Kilsallagh, Lisnageeragh and Monivea (See Table 3.26). Their removal will continue to positively impact on the habitat in the future. Very few restoration works have been taken (only Coillte restoration sites) or are expected to be carried out in the near future within bogs designated as NHAs. Thus, the impact from forestry on these bogs will continue until restoration works on raised bogs are expanded to include NHAs. A similar scenario is expected for those habitat patches within non-designated sites.

The impact arising from the above activities will depend on the effectiveness of the following programmes:

**Peat cutting cessation scheme** - As mentioned, the current cessation scheme is reducing the impact from peat cutting on raised bog SACs. However, it may be indirectly increasing the pressure on raised bog NHAs (Ryan, J., pers. comm., 2013) and non-designated sites, not currently covered under this scheme. This is because under the current cessation scheme, a claimant must have been cutting turf on

the land in question during the relevant five year period (2005-10) prior to the required cessation of cutting, which may be encouraging the re-commencement of cutting in NHAs in order to benefit from the compensation scheme.

**Restoration works** - Restoration works have been undertaken or are expected to be undertaken at 47 raised bogs. The positive effects of those works already undertaken will continue in the future. The majority of these restoration works benefit raised bog SACs and very few NHAs (See Table 3.27).

**National raised bog conservation programme** – The initiation of this programme is one of the most positive actions regarding raised bog conservation undertaken in Ireland. This will include the establishment of national and site-specific conservation objectives, as well as restoration plans. However, the positive effects resulting from this programme will not be seen until the actual restoration works are undertaken (See section 3.6.2).

To summarise, the results of the individual site assessments show a negative assessment at all 44 bogs as none is expected to reach FRVs in the following two reporting periods. A **UI-Declining** assessment has been given to one bog and **UB-Declining** to 27 raised bogs. An **UB-Stable** assessment has been given to 10 bogs. A more positive assessment (i.e. Improving trend) has been given to six bogs: **UI-Improving** at one bog and **UB-Improving** to five bogs. The ARB within the sites assessed (822.49ha) account for 42.07% of the ARB national resource (1,955ha). A very similar scenario is expected in the remaining raised bog SACs. The overall habitat Area within SACs is 1,400ha, which accounts for 71.61% of the national habitat resource. Impacts from negatively impacting activities have been successfully reduced within SACs and the benefits from positive management actions (i.e. peat cutting cessation scheme, restoration programmes) have been also particularly positive, as highlighted by the much smaller reduction in habitat losses compared to the previous reporting period. However, a different, more negative, scenario seems to have taken place within NHA raised bogs, as well as in the small proportion of the habitat remaining within non-designated sites, which together hold 28.39% of the national resource. Their conservation is essential to prevent habitat losses and preserve the habitat Range.

Overall, despite positive actions being undertaken, damaging activities continue impacting and threatening on raised bog SACs. Furthermore, although FPs are obviously more positive within SACs, the FPs for raised bog NHAs and non-designated raised bogs are much more negative. Taking into account the 2011-2013 monitoring results and the above activities trends, ARB Area FPs is given an overall Unfavourable Bad-Decreasing assessment and S&Fs Unfavourable Bad-Declining. This is likely to also impact on the Range and thus an overall Unfavourable Bad-Decreasing assessment is given to this parameter. As a result, the overall national FPs in the next two reporting periods (12 years) is **Unfavourable Bad-Declining** (See Table 3.3). A more positive assessment may be given in the future when negatively impacting activities have ceased and further restoration works on the high

bog and cutover areas are implemented within the raised bog SAC and NHA network. It should be highlighted that firstly in many cases negative impacts from impacting activities (e.g. subsidence, drying out processes and habitat losses) will continue for years even when these activities have stopped and secondly that it generally takes a decade for significant areas of ARB to develop on the high bog once restoration works are undertaken.

**Table 3.3** ARB Future Prospects assessment table

Parameter	Future Trend	Future Status	Prospects
Range	Decreasing	Unfavourable Bad	Unfavourable Bad Decreasing
Area	Decreasing	Unfavourable Bad	Unfavourable Bad Decreasing
Structure & function	Declining	Unfavourable Bad	Unfavourable Bad Declining
<b>Future Prospects</b>			<b>Unfavourable Bad Declining</b>

#### 3.4.1.5 Overall conservation status assessment

According to the most recent Raised Bog Monitoring Surveys (2011-2013) results for a total of 44 raised bogs assessed, which contain 42.07% of the national resource, ARB has been given the following assessment (See Table 3.3):

An **Unfavourable Bad** has been given to at all but one of the 44 bogs assessed, as their current Area is more than 25% below FRVs (See Tables 3.5 and 3.7). The Overall assessment trend within these 43 bogs has been assessed as **Improving** at seven raised bogs; **Stable** at six raised bogs and **Declining** at 29 raised bogs (See Appendix 10). Carrowbehy/Caher Bog has been given and **Unfavourable Inadequate-Declining** assessment. As table 3.7 indicates, the current Area value is 76.77% below target (i.e. Area FRV) and the current S&Fs value (i.e. central and active flush/soak area) is 35.35% below target (i.e. S&Fs FRV) for these bogs.

An increase in Area has been reported in all the sites given an **Improving** trend (Ballyduff, Ballykenny, Ballynafagh, Clonfinane, Garriskil, Mongan and Raheenmore). This has been coupled by an improvement in S&Fs in the majority of these sites. Unfavourable Bad-Improving FPs assessment has been given to all except Ballynafagh and Raheenmore. These two bogs were given a Stable trend, as no increase/improvement is expected in the following two reporting periods. Only Ballynafagh within these seven bogs had no restoration works carried out, while only Raheenmore had any impacting activity given a High Importance/Impact negative value. Peat cutting did not occur or has ceased within the 2007-2012 period at all of these bogs. Drainage adjacent to Raheenmore high bog is deemed to have a High Importance/Impact and is hindering the restoration of peat forming communities. Thus Raheenmore was given a UB-Stable assessment for FP. The area of ARB at Ballynafagh has increased slightly due to infilling within the high bog conifer plantation drains, which

controls the drainage from the area of ARB. This process is encouraging the development of new ARB. In addition, it is believed that underlying mineral ridges have prevented drainage effects from peat cutting and drainage elsewhere on the bog from impacting on the central area of ARB. However, no major improvements are expected until restoration works are undertaken at the site and thus Ballynafagh FPs were given a UB-Stable assessment.

A **Stable** trend has been given to Brown Bog, Firville, Killyconny, Sharavogue, Sheheree and Tawnaghbeg. Area, S&Fs and FPs have all been given a Stable trend. Although restoration works were undertaken at three of these sites (Firville, Sharavogue and Killyconny), no improvements in Area or S&Fs have been reported in the current reporting period (2007-2012). A restoration project took place in 1992 and subsequently in 1996/7 at Sharavogue, and positive results were noted within the previous reporting period (1994/95-2004/05). However, no further improvements took place from 2004/05-2011. No major changes have been noted at Firville Bog as only very minor restoration works were undertaken at this site to date. Restoration works in Killyconny were undertaken in 2006-10, and improvements in DRB S&Fs have been noted, but none on ARB yet. Major improvements are expected to take place on cutover areas as high bog has been highly modified (i.e. steep slopes) by peat cutting at this site. None of these sites have any negatively impacting activity given a High Importance/Impact value. No peat cutting took place at any of these bogs during the 2007-2012 reporting period.

20 out of 31 raised bogs given a **Declining** trend have seen a decrease and/or decline in Area and/or S&Fs as a result of highly negatively impacting activities (i.e. peat cutting and drainage). Restoration works, some of them with limited success, were undertaken at 13 of these 29 raised bogs. However, impacting activities continue counteracting any positive results. Although no change in Area and S&Fs have been reported for eight of the 29 raised bogs (Cloonchambers, Cloonfelliv, Curraghleanagh, Derrynabrock, Flughany, Moanveanlagh, Monivea and Redwood), impacting activities (i.e. peat cutting and drainage) seriously compromise the habitat's FPs and thus their potential to achieve Favourable Conservation Status. An increase in Area was noted at Carrownagappul, Lisnageeragh and Kilsallagh as a result of restoration works; S&Fs also improved at Carrownagappul and Lisnageeragh where restoration works were very successful, but S&Fs declined at Kilsallagh. However, impacting activities (i.e. peat cutting and drainage) continue compromising these three sites' path to recovery to Favourable Conservation Status and thus their overall FPs and hence ARB at these sites has been given a Declining trend. A Declining trend has been assigned to All Saints bog mostly related to the Declining FPs trend expected for the habitat due to ongoing impacting activities. Habitat Area has slightly increased overall, but this has been coupled by considerable changes in hydrological conditions within the high bog associated with impacting activities and also by losses in ARB in other sections of the high bog.

A different assessment method was used by this project compared with the one used by Fernandez *et al.* (2005). In this project, FRVs for both Area and S&Fs were established and the potential for the habitat to achieve these targets in the following two reporting periods (i.e. FPs) was assessed (See section 2). None of the raised bogs assessed are above FRVs for Area. If these assessments had been carried out using this methodology in 2004/05, an Unfavourable Bad assessment would also have been given those sites with unfavourable-inadequate (UI) and favourable (F) conservation status assessments. A closer analysis of the conservation status trend indicates whether the habitat at each specific site is on the path to recovery, and thus likely to achieve Favourable Conservation Status, or not. A better understanding of the changes within each raised bog in the reporting period (2007-2013) requires the individual site reports to be read.

To summarise, the overall conservation status assessment of ARB based on each individual raised bog assessment undertaken as part of the most recent Raised Bog Monitoring Surveys (2007-2013) described above is: UB-Declining (30 raised bogs); UI-Declining (one raised bog); UB-Stable (six raised bogs) and UB-Improving (seven raised bogs). The conservation status assessment for each individual parameter at national level is: Range (UB-Stable), Area (UB-Decreasing), S&Fs (UB-Stable) and FPs (UB-Declining) (See Table 3.4). ARB is thus given an overall **Unfavourable Bad-Declining** assessment. In spite of this negative result the assessment undertaken has shown that FPs are more positive for the habitat within SAC designations, which accounts for 71.61% of the national habitat resource, compared to the remaining resource included in NHAs and non-designated sites. The small decrease (13.47ha (1.61%)) in the Area within the sites assessed (43 SACs out of 44 raised bogs surveyed) compared to previous assessment (NPWS, 2008) confirms this more positive trend within SAC raised bogs, which has occurred largely as a result of the implementation of the turf cutting cessation schemes and restoration programmes.

**Table 3.4** Overall ARB conservation status assessment

<b>Range Assessment</b>	<b>Area Assessment</b>	<b>Structure &amp; Functions Assessment</b>	<b>Future Prospects Assessment</b>	<b>Overall Assessment</b>
Unfavourable Bad-Stable	Unfavourable Bad-Decreasing	Unfavourable Bad-Stable	Unfavourable Bad-Declining	Unfavourable Bad-Declining

**Table 3.5** ARB conservation status assessment F: Favourable; UI: Unfavourable Inadequate; UB: Unfavourable Bad

Site Code	Site Name	Area	S&Fs	FPs	Overall
000006	Killyconny	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000221	Moorfield	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000285	Kilsallagh	UB-Increasing	UB-Declining	UB-Declining	UB-Declining
000296	Lisnageeragh	UB-Increasing	UB-Improving	UB-Declining	UB-Declining
000297	Addergoole	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000326	Shankill West	UB-Decreasing	F-Declining	UB-Declining	UB-Declining
000382	Sheheree	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000391	Ballynafagh	UB-Increasing	UB-Stable	UB-Stable	UB-Improving
000497	Flughany	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000566	All Saints	UB-Increasing	F-Improving	UB-Declining	UB-Declining
000575	Ferbane	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000580	Mongan	UB-Increasing	F-Stable	UI-Improving	UB-Improving
000581	Moyclare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000582	Raheenmore	UB-Increasing	UB-Improving	UB-Stable	UB-Improving
000585	Sharavogue	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000592	Bellanagare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000595	Callow	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000597	Carrowbehy	UI-Decreasing	F-Declining	UI-Declining	UI-Declining
000600	Cloonchambers	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000604	Derrinea	UB-Decreasing	UI-Stable	UB-Declining	UB-Declining
000614	Cloonshanville	UB-Decreasing	UB-Stable	UB-Stable	UB-Declining
000641	Ballyduff	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
000641	Clonfinane	UB-Increasing	UB-Stable	UB-Improving	UB-Improving
000647	Kilcarren	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000647	Firville	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000679	Garriskil	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
001242	Carrowmagappul	UB-Increasing	UB-Improving	UB-Declining	UB-Declining
001818	Fisherstown	UB-Decreasing	UB-Declining	UB-Improving	UB-Declining
001818	Ballykenny	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
002110	Trien	UB-Decreasing	F-Stable	UB-Declining	UB-Declining
002110	Corliskea	UB-Decreasing	UI-Declining	UB-Declining	UB-Declining
002110	Cloonfelliv	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002298	Derrynabrock	UB-Stable	UB-Stable	UB-Declining	UB-Declining



Site Code	Site Name	Area	S&Fs	FPs	Overall
02298	Tawnaghbeg	UB-Stable	UB-Stable	UB-Stable	UB-Stable
002333	Knockacoller	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002336	Carn Park	UB-Decreasing	UB-Declining	UB-Stable	UB-Declining
002337	Crosswood	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002346	Brown Bog	UB-Stable	F-Stable	UB-Stable	UB-Stable
002347	Camderry	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
002349	Corbo	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
002350	Curraghlehanagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002351	Moanveanlagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002352	Monivea	UB-Stable	UI-Stable	UB-Declining	UB-Declining
002353	Redwood	UB-Stable	UB-Stable	UB-Declining	UB-Declining

**Table 3.6** ARB Area trend in the 1994/95-2011/13 period

Site Code	Site Name	1994/95 (ha)	2004/05 (ha)	2004/05 (amended) (ha)	2011/13 (ha)	Change 2004/05-2011/13	% change
00000	Killyconny	38.43	4.96	3.91	3.91	0.00	0.00
00022	Moorfield	n/a	8.63	8.85	8.35	-0.50	-5.65
00028	Kilsallagh	19.13	9.01	11.36	11.53	0.17	1.50
00029	Lisnageeragh	13.04	18.26	16.43	29.61	13.18	80.22
00029	Addergoole	65.31	26.59	39.72	39.22	-0.50	-1.26
00032	Shankill West	14.14	15.95	13.75	13.31	-0.44	-3.20
00038	Sheheree	3.70	4.02	4.06	4.06	0.00	0.00
00039	Ballynafagh	21.73	6.43	6.37	6.48	0.11	1.73
00049	Flughany	10.4	8.75	11.4	11.4	0.00	0.00
00056	All Saints	66.61	37.21	38.07	39.78	1.71	4.49
00057	Ferbane	41.73	45.25	36.93	32.63	-4.30	-11.64
00058	Mongan	50.9	53.99	48.21	48.31	0.10	0.21
00058	Moyclare	24.21	21.33	22.41	21.70	-0.71	3.17
00058	Raheenmore	60.49	51.85	51.5	52.31	0.81	1.57
00058	Sharavogue	23.63	25.58	25.78	25.78	0.00	0.00
00059	Bellanagare	91.86	67.02	52.80	49.59	-3.21	-6.08
00059	Callow	11.63	11.85	12.3	11.3	-1.00	8.13
00059	Carrowbehy	67.92	79.37	72.89	69.87	-3.02	-4.14
00060	Cloonchambers	3.48	3.85	7.66	7.66	0.00	0.00
00060	Derrinea	17.29	17.85	17.35	17.05	-0.30	-1.73

Site Code	Site Name	1994/95 (ha)	2004/05 (ha)	2004/05 (amended) (ha)	2011/13 (ha)	Change 2004/05-2011/13	% change
00061	Cloonshanville	28.29	23.04	20.18	20.11	-0.07	-0.35
00064	Ballyduff	18.04	13.05	14.58	15.16	0.58	3.98
00064	Clonfinane	19.41	0.41	2.34	2.59	0.25	10.68
00064	Firville	32.26	17.8	16.75	16.75	0.00	0.00
00064	Kilcarren	27.45	16.96	14.12	11.9	-2.22	-15.72
00067	Garriskil	71.23	40.58	45.12	50.87	5.75	12.74
00124	Carrownagappul	27.97	15.89	18.2	28.07	9.87	54.23
00181	Ballykenny						
00181	Fisherstown	51.39	24.79	7.8	1.39	-6.41	-82.18
00211	Cloonfelliv	n/a	0.60	0.66	0.66	0.00	0.00
00211	Corliskea	61.45	46.41	48.50	44.25	-4.25	-8.76
00211	Trien	17.32	14.17	24.34	24.24	-0.10	-0.41
00229	Derrynabrock	17.93	6.66	6.6	6.6	0.00	0.00
00229	Tawnaghbeg	12.83	10.32	9.87	9.87	0.00	0.00
00233	Knockacoller	17.1	6.07	5.22	4.79	-0.43	-8.24
00233	Carn Park	n/a	32.53	24.39	3.15	-21.24	-87.08
00233	Crosswood	25.74	6.29	5.64	4.64	-1.00	-17.73
00234	Brown Bog	10.87	9.76	10.77	10.77	0.00	0.00
00234	Camderry	8.69	7.41	7.38	6.17	-1.21	-16.40
00234	Corbo	27.59	15.12	15.67	15.52	-0.15	-0.96
00235	Curraghlehanagh	22.43	11.06	9.84	9.84	0.00	0.00
00235	Moanveanlagh	2.75	2.75	4.59	4.59	0.00	0.00
00235	Monivea	4.14	7.41	7.02	7.03	0.01	0.14
00235	Redwood	42.31	6.53	12.11	12.11	0.00	0.00
<b>Total</b>		1,248.19	865.52	835.96	822.49	-13.47	-1.61

**Note:** the overall 1994/95 ARB Area figure cannot be compared to the 2004/05, 2011/13 figures as 1994/95 data does not contain data for two sites (Moorfield Bog/Farm Cottage and Carn Park) which were not surveyed at the time.

**Table 3.7** ARB Favourable Reference Values

Site Code	Site Name	Area Assessment			S&Fs Assessment		
		FRV Target (ha) <sup>1</sup>	2011/13 value (ha) <sup>2</sup>	% below target	FRV 2011/13 Target (ha) <sup>3</sup>	2011/13 value (ha) <sup>4</sup>	% above/below target
000006	Killyconny	45.53	3.91	-91.41	1.96	0.21	-89.29
000221	Moorfield Bog/Farm Cottage	42.75	8.35	-80.47	4.18	1.02	-75.60
000285	Kilsallagh	76.76	11.53	-84.98	5.77	0.66	-88.56
000296	Lisnageeragh	109.93	29.61	-73.06	14.81	2.76	-81.36
000297	Addergoole	99.67	39.22	-60.65	19.00	6.94	-63.47
000326	Shankill West	43.00	13.31	-69.05	6.66	8.15	22.37
000382	Sheheree	5.59	4.06	-27.37	2.01	1.14	-43.28
000391	Ballynafagh	42.16	6.48	-84.63	3.24	1.77	-45.37
000497	Flughany	61.13	11.40	-81.35	5.70	1.67	-70.70
000566	All Saints	142.87	39.78	-72.16	12.72	18.90	48.58
000575	Ferbane	81.73	32.63	-60.08	16.32	1.99	-87.81
000580	Mongan	60.90	48.31	-20.67	24.16	42.71	76.78 <sup>6</sup>
000581	Moyclare	65.45	21.70	-66.84	10.85	4.61	-57.51
000582	Raheenmore	119.12	52.31	-56.09	26.16	1.68	-93.58
000585	Sharavogue	84.24	25.78	-69.40	12.89	0.00	-100.00
000592	Bellanagare	239.77	49.59	-79.32	24.80	11.32	-54.35
000595	Callow	163.46	11.30	-93.09	5.65	0.44	-92.21
000597	Carrowbehy	80.77	69.87	-13.50	34.94	57.72	65.20
000600	Cloonchambers	85.55	7.66	-91.05	3.83	0.38	-90.08
000604	Derrinea	35.58	17.05	-52.08	8.53	7.72	-9.50
000614	Cloonshanville	98.63	20.11	-79.61	8.97	3.61	-59.75
000641	Ballyduff	60.44	15.16	-74.92	7.58	1.29	-82.98
000641	Clonfinane	55.56	2.59	-95.34	1.30	0.68	-47.49 <sup>6</sup>
000647	Firville	136.86	16.75	-87.76	8.38	4.99	-40.45
000647	Kilcarren	130.32	11.90	-90.87	5.95	2.44	-58.99
000679	Garriskil	124.92	50.87	-59.28	25.44	14.65	-42.41
001242	Carrownagappul	143.57	28.07	-80.45	14.02	4.12	-70.61
001818	Ballykenny	130.21	7.57	-94.19	3.79	0.42	-88.90
001818	Fisherstown	76.06	1.39	-98.17	0.70	0.00	-100.00
002110	Cloonfelliv	31.58	0.66	-97.91	0.33	0.14	-57.58

Site Code	Site Name	Area Assessment			S&Fs Assessment		
		FRV Target (ha) <sup>1</sup>	2011/13 value (ha) <sup>2</sup>	% below target	FRV 2011/13 Target (ha) <sup>3</sup>	2011/13 value (ha) <sup>4</sup>	% above/below target
002110	Corliskea	131.92	44.25	-66.46	22.13	19.69	-11.01
002110	Trien	55.84	24.24	-56.59	12.10	15.36	26.94
002298	Derrynabrock	44.98	6.60	-85.33	3.30	1.59	-51.82
002298	Tawnaghbeg	54.81	9.87	-81.99	4.94	2.83	-42.71
002333	Knockacoller	39.30	4.79	-87.81	2.40	1.48	-38.33
002336	Carn Park	69.91	3.15	-95.49	1.58	0.00	-100.00
002337	Crosswood	56.67	4.64	-91.81	2.32	0.14	-93.97
002346	Brown Bog	36.41	10.77	-70.42	5.39	5.38	-0.09
002347	Camderry	31.00	6.17	-80.10	3.09	1.54	-50.16
002349	Corbo	27.59	15.52	-43.75	7.76	3.69	-52.45
002350	Curraghleanagh	43.80	9.84	-77.53	4.92	1.12	-77.24
002351	Moanveanlagh	71.62	4.59	-93.59	2.30	0.17	-92.61
002352	Monivea	109.88	7.03	-93.60	3.52	3.05	-13.35
002353	Redwood	92.49	12.11	-86.91	6.06	0.00	-100.00
	<b>Total</b>	3,540.33	822.49	-76.77	402.43	260.17	-35.35

**Notes:**

<sup>1</sup> 1994 central, sub-central, active flush, Bog Woodland and sub-marginal ecotope area. Carn Park and Moorfield Bog/Farm Cottage were surveyed for the first time at ecotope level in 2000 by Derwin & MacGowan (2000) and 2005 by Fernandez *et al.* (2005) respectively.

<sup>2</sup> 2011/13 central, sub-central ecotope, active flush and Bog Woodland area.

<sup>3</sup> Half of the current central, sub-central ecotope and active flush/soak area. The target is that the area of the highest vegetation quality (i.e. central ecotope and active flush) should be at least this figure.

<sup>4</sup> 2011/13 central ecotope and active flush/soak area.

<sup>5</sup> This figure does not include Bog Woodland, which area is generally included as part of ARB area.

<sup>6</sup> An error in the calculation of the S&F “% above/below target” value was made by Fernandez *et al.* (2012). This has been now rectified and the right value is given in table above.

**Table 3.8** High bog area versus ARB Favourable Reference Value

Site Code	Site Name	High bog area (ha)	2011 ARB FRV (ha)	%
000006	Killyconny	83.04	45.53	54.83
000221	Moorfield Bog/Farm Cottage	65.11	42.75	65.66
000285	Kilsallagh	182.11	76.76	42.15
000296	Lisnageeragh	269.52	109.93	40.79
000297	Addergoole	156.42	99.67	63.72
000326	Shankill West	67.33	43	63.86
000382	Sheheree	6.4	5.59	87.34
000391	Ballynafagh	70.06	42.16	60.18
000497	Flughany	149.42	61.13	40.91
000566	All Saints	222.95	142.87	64.08
000575	Ferbane	119.96	81.73	68.13
000580	Mongan	124.37	60.9	48.97
000581	Moyclare	74.26	64.45	86.79
000582	Raheenmore	130.54	119.12	91.25
000585	Sharavogue	137.01	84.24	61.48
000592	Bellanagare	878.9	239.77	27.28
000595	Callow	351.98	163.46	46.44
000597	Carrowbehy	204.56	80.77	39.48
000600	Cloonchambers	195.77	85.55	43.70
000604	Derrinea	54.84	35.58	64.88
000614	Cloonshanville	146.34	98.63	67.40
000641	Ballyduff	86.68	60.44	69.73
000641	Clonfinane	87.26	55.56	63.67
000647	Firville	183.68	136.86	74.51
000647	Kilcarren	180.84	130.32	72.06
000679	Garriskil	170.26	124.92	73.37
001242	Carrowmagappul	323.48	143.57	44.38
001818	Ballykenny	180.81	130.21	72.01
001818	Fisherstown	102.43	76.06	74.26
002110	Cloonfelliv	55.07	31.58	57.35
002110	Corliskea	276.03	131.92	47.79
002110	Trien	124.22	55.84	44.95
002298	Derrynabrock	80.49	44.98	55.88

Site Code	Site Name	High bog area (ha)	2011 ARB FRV (ha)	%
002298	Tawnaghbeg	71.66	54.81	76.49
002333	Knockacoller	53.3	39.3	73.73
002336	Carn Park	160.29	69.91	43.61
002337	Crosswood	98.11	56.67	57.76
002346	Brown Bog	50.89	36.41	71.55
002347	Camderry	195.44	31	15.86
002349	Corbo	96.95	27.59	28.46
002350	Curraghlahanagh	146.38	43.8	29.92
002351	Moanveanlagh	118.17	71.62	60.61
002352	Monivea	132.17	109.88	83.14
002353	Redwood	374.73	92.49	24.68
	<b>Total</b>	7,040	3,539	50.27

### 3.4.2 Degraded Raised Bog conservation status assessment

#### 3.4.2.1 Range

The **current Range** is 26,100km<sup>2</sup> (261 grid cells x 100km<sup>2</sup>) (See section 2.2.3 for further description of method used to calculate habitat range) (See Figure 3.4).

**Favourable Reference Range** is 26,100km<sup>2</sup> (261 grid cells x 100km<sup>2</sup>), which corresponds with the current Range of DRB, as already described by NPWS (2007).

The current Range is considered to cover all significant ecological variations of the habitat and to be sufficiently large to allow the long term survival of the habitat. As current Range and Favourable Reference Range are considered to be similar, habitat Range has been given a **Favourable** status. There has been no variation in the extent of the Range in the reporting period, thus this parameter has been given a **Stable** trend.

The national Range assessment for DRB is **Favourable–Stable**.

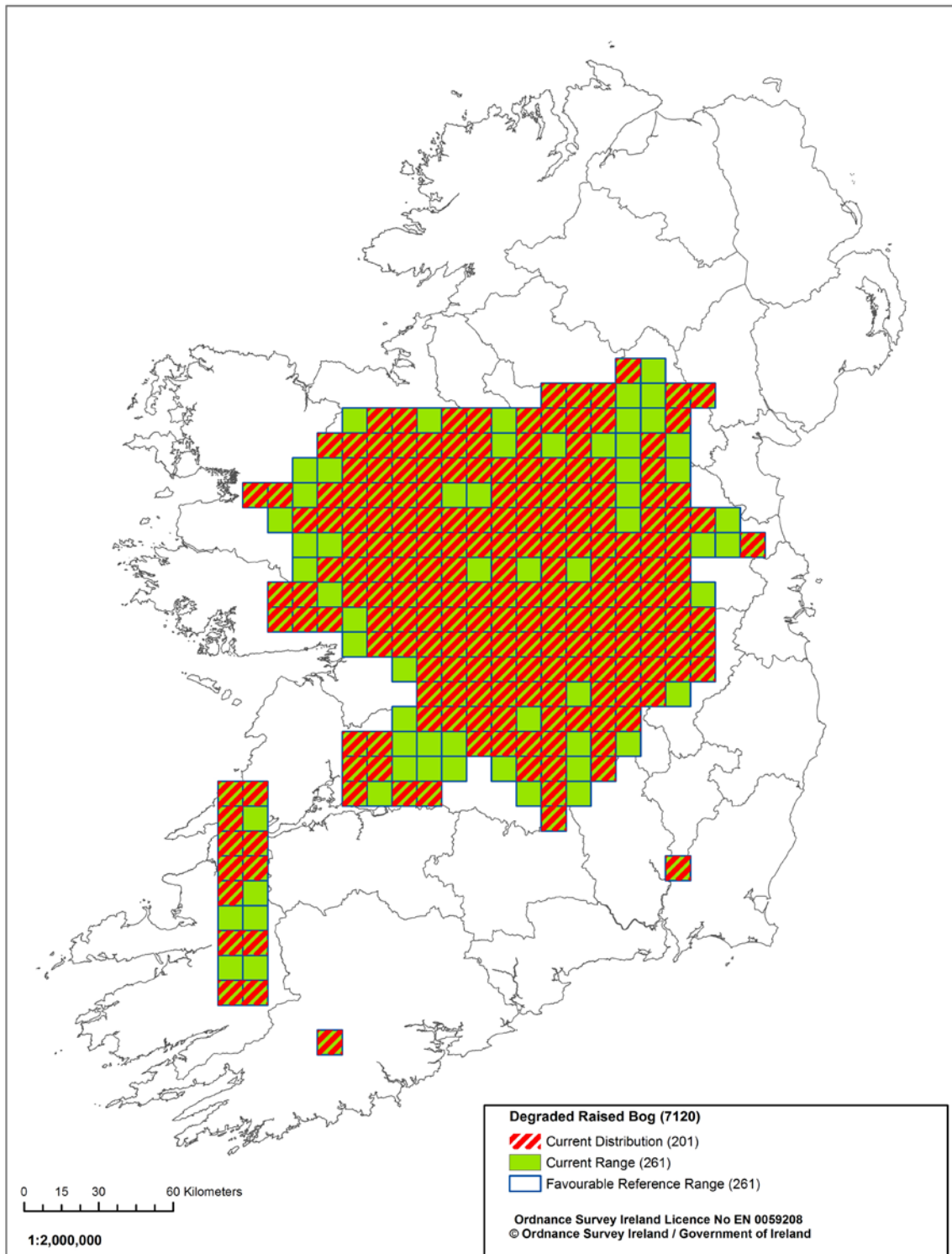


Figure 3.4 Current distribution and Range map of DRB in Ireland

### 3.4.2.2 Area

A DRB Area conservation status assessment has been undertaken for a total of 44 raised bogs in the 2011 to 2013 period, as part of Fernandez *et al.* (2012) and this project. All these 44 raised bogs were within SACs (38 different SACs) except for Moorfield Bog/Farm Cootage, which is designated as a NHA. No non-designated raised bogs have been surveyed or assessed. The overall high bog area of these surveyed raised bogs is 7,040ha, which accounts for 32.57% of the total area of raised bog designated (21,618ha) and 14.10% of the total area of *intact* high bog remaining in the country (49,933ha) (See Figure 3.1). These surveyed raised bogs, which were considered to represent the range of ecological variation in the habitat, contain a total of 6,217.74ha of DRB (See Table 3.12). This accounts for 12.95% of the known habitat national resource (approx. 47,978ha).

NPWS (2007) set a **Favourable Reference Value** for the habitat Area in 2007 of 28,491ha (28.5km<sup>2</sup>). This value was based on the difference between the national *intact* high bog resource (50,011ha) and the FRV for ARB Area (21,520ha), which corresponded with the extent of both Active and DRB resources within designated sites reported by the NPWS at that time. In this project the FRV, based on the most up to date raised bog resource maps is **28,315ha** (49,933ha of intact high bog minus 21,618ha (FRV for ARB) (See Section 2.2.1). This value has been reviewed, and greatly reduced, by the NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>).

According to the official EU definition of DRB; the habitat is still capable of regeneration thus implying that it should be possible to be restored to ARB. DRB is a special case since if restored (which is the goal) it becomes ARB and thus the favourable reference area is less than the present day area. Therefore, both extent values (current Area and FRV Area) cannot be compared on the same basis as for other EU habitats, for which an Area FRV higher than the current Area value is generally the case. The ARB restoration area will be targeted in areas deemed suitable for the restoration throughout the entire range of raised bogs, particularly in adjacent areas to raised bogs within designated sites with ARB present in order to optimise the conservation of their biodiversity values.

The current habitat area (47,978ha) is 69.44% above the FRV (28,315ha). A habitat Area more than 15% above the FRV is given an **Unfavourable Bad** assessment (See section 2.4.3).

As table 3.12 below illustrates the habitat Area has decreased by 31.84ha (0.51%) in the 2004/05-2011/13 period (Carn Park data spans the 2000-2013 period). The actual habitat losses in the 2004/05-2010 period<sup>3</sup> have been approximately 45ha (0.72%), which corresponds with high bog losses due to peat cutting; as figures in table 3.12 also include 13.47ha of habitat increase as a result of ARB lost to

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<sup>3</sup> This reflects the fact that some sites were surveyed in 2004 and others in 2005.



DRB. Similar losses are likely to have taken place in the remaining un-surveyed raised bogs located within SACs. However, much higher losses are expected to have taken place within those NHA Bogs (See section 4) and non-designated bogs. Although the exact habitat losses for the entire habitat national resource in the 2007-2012 period (six year reporting period) cannot be provided, it seems reasonable to give a conservative estimate of 1% loss in the reporting period given that the data above suggests it will be higher than 0.72% for the entire habitat's national resource. Thus, a **Decreasing** trend is given for the Area assessment.

Furthermore, according to the most recent individual site conservation status assessments (See Table 3.11); DRB Area has been assessed as **Unfavourable Bad** at 42 of the 44 raised bogs assessed and **Unfavourable Inadequate** at two raised bogs (Carrowbehy and Camderry) as the current Area extent is above the FRVs. The Area has been given a **Stable** trend at six raised bogs (no peat cutting occurred at these sites in the reporting period (See Appendix 11)); an **Increasing** trend at 13 raised bogs (as a result of drying out processes associated with peat cutting and/or drainage) and **Decreasing** trend at 25 raised bogs (peat cutting caused a decrease in habitat extent at 19 of these bogs; while in the other six bogs (Ballykenny, Ballyduff, Clonfinane, Garriskil, Mongan and Raheenmore) the decrease was as a result of an increase in ARB, and is thus taken as a positive trend (See individual site reports for further detail). These individual bogs assessments support the above national assessments (UB-Decreasing).

To summarise the national Area assessment for DRB is **Unfavourable Bad-Decreasing**.

#### 3.4.2.3 Structure & Functions

Figures provided by the most recent DRB conservation status assessments (44 raised bog assessed) as part of Fernandez *et al.* (2012) and this project, show an overall approximate 100ha decrease in the extent of the most degraded ecotopes within the habitat (i.e. marginal and face bank) in the 2004/05-2011/2013 period. The habitat Area within these 44 bogs (6,217.74ha) accounts for 12.95% of the known habitat national resource (approx. 47,978ha), as previously mentioned.

This change in ecotopes extent is the result of a combination of both positive and negatively impacting activities: peat cutting has resulted in an approximate 45ha high bog (mainly marginal and face bank ecotopes) loss while there has also been actual increases in marginal and face banks as a result of further drying out processes (associated with current and past cutting as well as drainage). On the other hand, restoration works have re-wetted some high bog areas and resulted in marginal ecotope developing into sub-marginal and/or ARB, in the reporting period (2004/05-2011/13).

No FRVs have been established for DRB S&Fs at national level. The objective is to minimise the extent of the most degraded ecotopes (marginal and face bank) through restoration. Site specific FRVs have

been established (See Section 2.4.3) and the objective is that a maximum 25% of the habitat should be made up of the most degraded ecotopes (i.e. marginal and face bank).

According to the most recent individual site conservation status assessments (See Table 3.11):

S&Fs has been assessed as **Favourable-Improving** at three of the 44 raised bogs (Ballykenny, Fisherstown and Sharavogue). The percentage of DRB made up of marginal and face banks ecotope is below the target (25%) and there has been an overall decrease in the extent of marginal and face bank ecotope in the reporting period as a result of restoration works. Peat cutting does not occur at any of these three sites.

A **Favourable-Stable** assessment has been given to five bogs (Kilcarren, Sheheree, Tawnaghbeg, Cloonshanville and Raheenmore). The percentage of DRB made up of marginal and face banks ecotope is below the target (25%) and there has been no change in the overall extent of marginal and face bank ecotope in the reporting period. Restoration works took place at Cloonshanville, where a small amount of high bog was cutaway in the reporting period (0.03ha) and the activity has ceased, and Raheenmore, where no cutting took place in the reporting period. No restoration works have been undertaken at the other three bogs and only a small amount of peat cutting activity was recorded only at Kilcarren (0.10ha cut away in the reporting period). The activity is considered to have ceased at this bog.

A **Favourable-Declining** assessment has been given to three bogs (All Saints, Carn Park and Monivea). The percentage of DRB made up of marginal and face banks ecotope is below the target (25%) and there has been an increase in the overall extent of marginal and face bank ecotope in the reporting period. Some restoration works have been undertaken at Carn Park and Monivea. In the case of the latter, these were undertaken on an area with limited connectivity with the main high bog at the site and thus the positive results from these restoration works have not been able to counteract the negative effects from peat cutting and ongoing drainage. In the case of All Saint's, peat cutting and drainage have caused further drying out and an increase in the extent of face bank ecotope.

An **Unfavourable Inadequate-Improving** assessment has been given at one bog (Clonfinane) and **Unfavourable Bad-Improving** at six bogs (Ballyduff, Camderry, Carrowbehy, Killyconny, Lisnageeragh and Mongan). The percentage of DRB made up of marginal and face banks ecotope is above the target (25%) at all these bogs and there has been an overall decrease in the extent of marginal and face bank ecotope in the reporting period as a result of restoration works. No cutting took place at Killyconny and Carrowbehy bogs in the reporting period. A very small amount of cutting (<0.1ha of high bog cut away) took place at Ballyduff and Mongan bogs where the activity is considered to have ceased. A slightly larger area of high bog was cut away at Camderry (0.79ha) and Lisnageeragh (0.50ha); however, the positive results of restoration works has considerably reduced

the extent of marginal and face banks ecotopes at these two bogs. Peat cutting at Clonfinane consists of an approx. 60ha of commercial exploitation adjacent to western boundary of high bog and outside of the SAC. The extent of marginal ecotope has also been considerably reduced after restoration works were undertaken.

An **Unfavourable Inadequate-Stable** assessment has been given at one bog (Garriskil) and **Unfavourable Bad-Stable** at 18 bogs (See Table 3.11). The percentage of DRB made up of marginal and face banks ecotope is above the target (25%) at all these bogs and there has been no overall change in the extent of marginal and face bank ecotope in the reporting period. Restoration works were undertaken at Garriskil, Bellanagare, Carrownagappul, Kilsallagh and Crosswood. In the case of Garriskil, although no change in the extent of marginal and face bank ecotope has been noted in the reporting period, ongoing expansion of ARB has been recorded. Restoration works at Crosswood are considered to have had limited positive results on the high bog and peat cutting and drainage continue negatively impacting high bog habitats. In the remaining three bogs, the positive results from restoration works have not been able to counteract the negative effects from peat cutting and ongoing drainage. Peat cutting was reported at 11 of the remaining bogs given a Stable trend where restoration works were not undertaken. Peat cutting was generally given a high impact at these bogs as it has reduced the Area of DRB, but has not apparently caused a decline in S&Fs in the reporting period.

An **Unfavourable Inadequate-Declining** assessment has been given at one bog (Addergoole) and **Unfavourable Bad-Declining** at six bogs (Callow, Corbo, Redwood, Shankill West, Curraghlehanagh and Moyclare). The percentage of DRB made up of marginal and face banks ecotope is above the target (25%) at all these bogs and there has been an overall decline in the extent of marginal and face bank ecotope in the reporting period. Although restoration works were undertaken at Curraghlehanagh and Moyclare, the positive results from these restoration works have not been able to counteract the negative effects from peat cutting and ongoing drainage. Peat cutting has been described as having a high impact on the habitat at all these bogs. In addition, drainage on the high bog and adjacent to it was also assessed as having high to medium impact on these bogs.

To summarise, the overall marginal and face banks ecotope extent analysis indicates a decline of an approximate 100ha in their extent within the 44 bogs assessed, which may seem as positive. However, approximately 45 of these 100ha correspond with actual high bog loss, which is taken as highly negative as these losses are irreversible. The remaining 55ha corresponds mainly with marginal ecotope areas developing into sub-marginal ecotope (but in some cases into ARB), associated with re-wetting brought about by restoration works, which indicates an improvement in the habitat S&Fs. However, as described within the habitat mapping methods section, the surveying of marginal/sub-marginal boundaries has not been as comprehensive as boundaries within ARB ecotopes or between

Active and Degraded habitats. Thus, taking these factors into account along with the fact that peat cutting has been given a high Importance/Impact at 26 out of 44 bogs assessed as well as additional high impacts from drainage and fire events, the actual individual site marginal/face bank ecotope extent increase may have been underestimated. In addition, 51 of the 100ha decrease in marginal/face banks ecotopes are restricted to two sites (Camderry (26ha) and Ballykenny (25ha)), where restoration works have considerably improved the S&Fs and thus these improvements in habitat quality are much localised.

A similar change in the extent of marginal/face bank ecotopes is likely to have taken place in the remaining un-surveyed raised bogs located within SACs. However, much greater high bog losses and increases in marginal/face bank ecotopes are expected to have taken place within those sites designated as NHAs and non-designated bogs, since peat cutting rates are generally much higher in such bogs (See section 4). Thus, taking into account the previous data the overall national S&Fs assessment for DRB is **Unfavourable Inadequate-Declining**.

No specific **typical species** conservation status assessment has been undertaken either at site or national level. Some of the typical species listed in Appendix 7 have been recorded as good quality habitat indicators within the quadrats (See Appendix 5). A change in the habitat quality (S&Fs) indicates a variation in the occurrence of typical species and therefore both are interdependent. As a result, a similar assessment to the S&Fs (**UI-Declining**) is given to the typical species. A list of typical species for Active and DRB is given in Appendix 7.

#### 3.4.2.4 Future Prospects assessment

The most recent Raised Bog Monitoring Surveys (2011-2013) have provided the following FPs results for a total of 44 raised bogs monitored (See Table 3.11):

The FPs for Area have been given an Unfavourable Bad-Decreasing assessment at 24 raised bogs, Unfavourable Inadequate-Decreasing at one raised bog, Unfavourable Bad-Stable at 10 raised bogs, Unfavourable Bad-Increasing at eight raised bogs and Unfavourable Inadequate-Increasing at one raised bog. Taking into account these results the overall Area FPs for the 44 raised bogs assessed is Unfavourable Bad-Declining.

**The FPs** for S&Fs have been given an Unfavourable Bad-Declining assessment at 22 raised bogs, Unfavourable Inadequate-Declining at two raised bogs, Favourable-Declining at two raised bogs, Unfavourable Bad-Stable at four raised bogs, Favourable-Stable at five raised bogs and Unfavourable Bad-Improving at four raised bogs, Unfavourable Inadequate-Improving at two bogs and Favourable Improving at three bogs. Taking into account these results the S&Fs FPs for the 44 raised bogs assessed is Unfavourable Bad-Declining.

Based on the above results, the overall **FPs** per site is as follows (See Table 3.11):

An **Unfavourable Bad-Improving** assessment was given to eight raised bogs (Ballyduff, Ballykenny, Clonfinane, Fisherstown, Garriskil, Killyconny, Mongan and Sharavogue). Restoration works were undertaken at all these bogs and as a result S&Fs have improved for all of them. Although the habitat is not expected to reach FRVs in the following two reporting periods (12 years) an Improving trend is foreseen for this period. The Area has decreased as a result of development of new ARB at five of these bogs and remained stable at two raised bogs (Killyconny and Sharavogue). Although the Area of DRB increased at Fisherstown the current absence of major impacting activities and the positive results expected from restoration works indicate an overall Unfavourable Improving FPs for the habitat at this bog.

An **Unfavourable Bad-Stable** assessment was given to eight raised bogs (Carn Park, Ballynafagh, Cloonshanville, Sheheree, Tawnaghbeg, Raheenmore, Brown Bog and Firville). Restoration works took place at Raheenmore but negative impacting activities (adjacent land drainage) seem to continue to impact on high bog habitats negating the positive impacts of the restoration works. Restoration works were also undertaken at Carn Park and Cloonshanville. However, negatively impacting activities continue and thus both negative and positive activities (i.e. restoration works) balance each other. No major impacting activities remain on these eight raised bogs and thus FPs are given a Stable trend. This indicates that the habitat is not expected to reach FRVs in the following two reporting periods (12 years).

An **Unfavourable Inadequate-Declining** assessment was given to one raised bog (Kilcarren) and **Unfavourable Bad-Declining** at 27 bogs. Although some restoration works were undertaken at Monivea, Curraglehanagh, Moyclare, Camderry, Lisnageeragh, Bellanagare, Carrownagappul, Kilsallagh, Crosswood and Carrowbehy, major impacting activities (peat cutting and drainage) continue at these bogs and thus a declining trend is foreseen for the habitat in the following two reporting periods.

An analysis of the current situation as regards the most impacting activities affecting the habitat (See section 3.5), shows the following:

**Peat cutting** - A decreasing trend in peat cutting activity has been reported for those bogs that occur within the SAC network. The implementation of the Department of Arts, Heritage and the Gaeltacht current peat cutting cessation scheme has resulted in the apparent cessation of peat cutting in many of these sites (e.g. out of the 44 bogs surveyed, 32 were cut at the beginning of the reporting period (2007), which was reduced to 18 by the end of the period) and the reduction of the intensity of the activity in the remaining sites by April 2013 (See Table 3.18). However, the peat cutting cessation scheme does not cover raised bog NHAs and peat cutting on these sites appears to have increased in

intensity during the reporting period (Ryan, J., pers. comm., 2013). Fernandez *et al.* (2006) proposed the immediate cessation of peat cutting on SACs and NHAs as the best option to avoid the risk of cutting increasing in the NHAs. No data is available in relation to peat cutting activity in non-designated sites. Peat cutting activity intensity within non-designated sites is likely to have remained stable or increased in the reporting period and may continue in the future.

**Drainage** – Similarly to peat cutting, a very different trend is expected for impacts from drainage on raised bog SACs than on NHAs or non-designated bogs. Although the largest proportion of the high bog drains continue impacting the habitat, some have been blocked and thus their impact will be negated once they become non-functional, as part of the infilling process. Very few restoration works have been carried out or are expected to be carried out in the near future within bogs designated as NHAs. Thus, the impact from drainage on these bogs will continue until restoration works on raised bogs are expanded to include NHAs. A similar scenario is expected for those habitat areas within non-designated sites.

**Forestry** - Like peat cutting and drainage a very different trend of the impact from forestry on DRB in the future is expected for NHAs and non-designated sites than SACs. No new forestry plantations have been established on the high bog in raised bog SACs, nor are they expected to be in the future. Conifer plantations remain in some SAC bogs, but clear felling (on the high bog and/or cutover) took place at 10 raised bogs out of 44 surveyed as part of restoration projects. Their removal will continue to positively impact on the habitat in the future. Very few restoration works have been undertaken (apart from Coillte restoration sites) or are expected to be carried out in the near future within bogs designated as NHAs. Thus, the impact from forestry on these bogs will continue until restoration works on raised bogs are expanded to include NHAs. A similar scenario is expected for those habitat patches within non-designated sites.

The impact arising from the above activities will depend on the effectiveness of the following programmes:

**Peat cutting cessation scheme** - As mentioned above the current cessation scheme is reducing the impact from peat cutting on raised bog SACs. However, on the other hand it may be increasing the pressure on raised bog NHAs (Ryan, J., pers. comm., 2013) and non-designated sites, not currently covered under this scheme. This is because under the current cessation scheme, a claimant must have been cutting turf on the land in question during the relevant five year period (2005-10) prior to the required cessation of cutting, which may be encouraging the re-commencement of cutting in NHAs in order to benefit from the compensations scheme.

**Restoration works** - Restoration works have been undertaken or are expected to be undertaken at 47 raised bogs. The positive effects of those works already undertaken will continue in the future. The majority of these restoration works benefit raised bog SACs and very few NHAs (See Table 3.27).

**National raised bog conservation programme** – The initiation of this programme is one of the most positive actions regarding raised bog conservation undertaken in Ireland. This will include the establishment of national and site specific conservation objectives, as well as restoration plans. However, the positive effects resulting from this programme will not be seen until the actual restoration works are undertaken (See section 3.6.2).

To summarise, the individual assessments results show a negative assessment for 28 raised bogs: **UB-Declining** at 27 raised bogs, **UI-Declining** at one raised bog and **UB-Stable** at eight raised bogs; and a positive assessment (**UB- Improving**) in eight raised bogs. The DRB within the sites assessed (6,217.74ha) accounts for 12.95% of the DRB national resource (47,978ha). A very similar scenario is expected in the remaining raised bog SACs. The overall habitat Area within SACs is 10,368ha, which accounts for 21.61% of the national habitat resource. Impacts from negatively impacting activities have been successfully reduced within SACs and the benefits from positive management actions (i.e. peat cutting cessation scheme, restoration programmes) have been also particularly positive. However, a different scenario seems to have taken place within raised bog NHAs and non-designated sites, which hold 78.39% of the habitats national resource. Their conservation is essential to prevent habitat losses and preserve the habitat Range.

Overall, despite positive actions being undertaken, damaging activities continue impacting and threatening raised bog SACs. Furthermore, although FPs are obviously more positive within SACs, the FPs for raised bog NHAs and non-designated raised bogs are much more negative. Taking into account the 2011-2013 monitoring results and the trends in activities, DRB Area FPs is given an overall Unfavourable Bad-Decreasing assessment and S&Fs Unfavourable Bad-Declining. This is likely to also impact on the Range and thus an overall Favourable Bad-Decreasing assessment is given to this parameter. As a result, the overall national FPs for the next two reporting periods (12 years) is **Unfavourable Bad-Declining** (See Table 3.9). A more positive assessment may be given in the future when negatively impacting activities have ceased and further restoration works on the high bog and cutover areas are implemented within the raised bog SAC and NHA network. It should be highlighted that negative impacts from activities (e.g. subsidence, drying out processes and habitat losses) may continue for years even when these activities have stopped and also, it generally takes at least decade for significant areas of ARB to develop on the high bog once restoration works are undertaken.

**Table 3.9** DRB Future Prospects assessment table

Parameter	Future Trend	Future Status	Prospects
Range	Decreasing	Favourable	Favourable Bad Decreasing
Area	Decreasing	Unfavourable Bad	Unfavourable Bad Decreasing
Structure & function	Declining	Unfavourable Bad	Unfavourable Bad Declining
<b>Future Prospects</b>	<b>Unfavourable Bad Declining</b>		

### 3.4.2.5 Overall conservation status assessment

According to the most recent Raised Bog Monitoring Survey (2011-2013) results for a total of 44 raised bogs assessed (table 3.11), which contain 12.95% of the national resource, DRB has been given the following assessment:

**Unfavourable Bad** at 44 out of 44 raised bogs assessed, as their current Area is more than 15% above FRVs (See section 2 and table 3.11). The Overall assessment trend has been assessed as **Improving** at eight raised bogs; **Stable** at four raised bogs and **Declining** at 32 raised bogs (See Appendix 11). As table 3.13 indicates the current habitat Area value is 77.60% above target (i.e. Area FRV) within the 44 raised bogs assessed.

An **Improving** trend indicates either a decrease in Area as a result of the development of ARB or an improvement of S&Fs (i.e. increase in sub-marginal ecotope). Restoration works were undertaken at all eight raised bogs given an overall improving trend. Only Raheenmore had any negatively impacting activity given a High Importance/Impact. Drainage adjacent to Raheenmore high bog is deemed to have a High Importance/Impact and to hinder the restoration of peat forming communities, thus FPs are only Stable. Peat cutting did not occur or has apparently ceased within the (2007-2012) reporting period at all these bogs.

A **Stable** trend (recorded at four raised bogs) indicates no change in Area or S&Fs, and Stable FPs. No restoration works were undertaken at these bogs and none of the negatively impacting activities reported at these bogs were given a High Importance/Impact.

28 of the 32 raised bogs given an overall habitat **Declining** trend have seen a decrease in the Area as a result of peat cutting (i.e. direct high bog losses). An increasing trend in Area has been given to 13 of these bogs as a result of drying out processes associated with peat cutting and drainage. S&Fs were assessed as Stable at 18 raised bogs, Declining at 10 raised bogs and Improving at four bogs (Camderry, Carrowbehy, Fisherstown and Lisnageeragh). Restoration works were undertaken at these four bogs; FPs were considered Unfavourable Bad-Declining as impacting activities (i.e. peat cutting and drainage) continue to compromise the path to achieving Favourable Conservation Status at



Camderry, Lisnageeragh and Carrowbehy. Fisherstown habitat Area increased during reporting period due to drainage effects and it is taken as negative. Nonetheless, DRB FPs at Fisherstown was given an UB-Improving assessment, as the habitat is expected to improve as a result of restoration works. A Declining FPs trend has been given to 28 of the 32 bogs, as impacting activities are expected to continue impacting on DRB. A Stable FPs trend has been given to three raised bogs (Ballynafagh, Carn Park and Cloonshanville), where although negatively impacting activities impacted on Area and/or S&Fs during the reporting period, these impacting activities are not expected to continue to impact on the habitat in the future (peat cutting has apparently ceased at Ballynafagh and Carn Park and the adjacent land drainage recorded at Cloonshanville is not expected to continue). The residual effects of previous impacting activities (e.g. open face banks, ongoing subsidence, ongoing drying out) at these three raised bogs may still be impacting in the future and this should be monitored. Although restoration works, some of them with limited success were undertaken at 13 of these 32 raised bogs, impacting activities continue counteracting their positive results.

The above results seem more negative than those given in 2005, where some of the raised bogs were given either a Favourable or Unfavourable Inadequate assessment. However, this is because of the differences between the two projects' methodologies, with new criteria now employed for assessing conservation status as described in the Methods section. This is based on the setting of FRVs, and in the particular case of DRB FRVs smaller than current area values are desirable. A closer analysis of the conservation status trend indicates whether the habitat at each specific site is on the path to recovery, and thus to achieving Favourable Conservation Status, or not. A better understanding of the changes within each raised bog in the reporting period (2007-2013) requires reading the individual site reports.

To summarise, the overall conservation status assessment of DRB based on each individual raised bog assessment undertaken as part of the most recent Raised Bog Monitoring Surveys (2007-2013) described above is: UB-Declining (32 raised bogs); UB-Stable (four raised bogs) and UB-Improving (eight raised bogs). The conservation status assessment for each individual parameter at national level is: Range (F-Stable), Area-(UB-Decreasing), S&Fs (UI-Declining) and FPs (UB-Declining) (See Table 3.10). DRB is given an Overall **Unfavourable Bad-Declining** assessment. In spite of this negative result the assessment undertaken has shown that FPs are more positive for the habitat within SAC designations, which accounts for 21.61% of the national habitat resource, compared to the remaining resource included in NHAs and non-designated sites.

**Table 3.10** Overall DRB conservation status assessment

Range Assessment	Area Assessment	Structure & Functions Assessment	Future Prospects Assessment	Overall Assessment
Favourable-Stable	Unfavourable Bad-Decreasing	Unfavourable Inadequate-Declining	Unfavourable Bad-Declining	Unfavourable Bad-Declining

**Table 3.11** DRB conservation status assessment. F: Favourable; UI: Unfavourable Inadequate; UB: Unfavourable Bad

Site Code	Site Name	Area	S&Fs	FPs	Overall
00006	Killyconny	UB-Stable	UB-Improving	UB-Improving	UB-Improving
000221	Moorfield Bog/Farm Cottage	UB-Increasing	UB-Stable	UB-Declining	UB-Declining
000285	Kilsallagh	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000296	Lisnageeragh	UB-Decreasing	UB-Improving	UB-Declining	UB-Declining
000297	Addergoole	UB-Decreasing	UI-Declining	UB-Declining	UB-Declining
000326	Shankill West	UB-Increasing	UB-Declining	UB-Declining	UB-Declining
000382	Sheheree	UB-Stable	F-Stable	UB-Stable	UB-Stable
000391	Ballynafagh	UB-Decreasing	UB-Stable	UB-Stable	UB-Declining
000497	Flughany	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000566	All Saints	UB-Decreasing	F-Declining	UB-Declining	UB-Declining
000575	Ferbane	UB-Increasing	UB-Stable	UB-Declining	UB-Declining
000580	Mongan	UB-Decreasing	UB-Improving	UB-Improving	UB-Improving
000581	Moyclare	UB-Increasing	UB-Declining	UB-Declining	UB-Declining
000582	Raheenmore	UB-Decreasing	F-Stable	UB-Stable	UB-Improving
000585	Sharavogue	UB-Stable	F-Improving	UB-Improving	UB-Improving
000592	Bellanagare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000595	Callow	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
000597	Carrowbehy	UI-Increasing	UB-Improving	UB-Declining	UB-Declining
000600	Cloonchambers	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000604	Derrinea	UB-Increasing	UB-Stable	UB-Declining	UB-Declining
000614	Cloonshanville	UB-Increasing	F-Stable	UB-Stable	UB-Declining
000641	Ballyduff	UB-Decreasing	UB-Improving	UB-Improving	UB-Improving
000641	Clonfinane	UB-Decreasing	UI-Improving	UB-Improving	UB-Improving
000647	Firville	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000647	Kilcarren	UB-Increasing	F-Stable	UI-Declining	UB-Declining
000679	Garriskil	UB-Decreasing	UI-Stable	UB-Improving	UB-Improving

Site Code	Site Name	Area	S&Fs	FPs	Overall
001242	Carrownagappul	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
001818	Ballykenny	UB-Decreasing	F-Improving	UB-Improving	UB-Improving
001818	Fisherstown	UB-Increasing	F-Improving	UB-Improving	UB-Declining
002110	Cloonfelliv	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002110	Corliskea	UB-Increasing	UB-Stable	UB-Declining	UB-Declining
002110	Trien	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002298	Derrynabrock	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002298	Tawnaghbeg	UB-Stable	F-Stable	UB-Stable	UB-Stable
002333	Knockacoller	UB-Increasing	UB-Stable	UB-Declining	UB-Declining
002336	Carn Park	UB-Increasing	F-Declining	UB-Stable	UB-Declining
002337	Crosswood	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002346	Brown Bog	UB-Stable	UB-Stable	UB-Stable	UB-Stable
002347	Camderry	UI-Increasing	UB-Improving	UB-Declining	UB-Declining
002349	Corbo	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
002350	Curraghlahanagh	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
002351	Moanveanlagh	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
002352	Monivea	UB-Decreasing	F-Declining	UB-Declining	UB-Declining
002353	Redwood	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining

**Table 3.12** DRB Area trend in the 1994/95-2011/13 period

Site Code	Site Name	1994/95 (ha)	2004/05 (ha)	2004/05 (amended) (ha)	2011/13 (ha)	Change 2004/05-2011/13(ha)	% change
000006	Killyconny	46.80	78.08	79.13	79.13	0.00	0.00
000221	Moorfield Bog/Farm Cottage	n/a	54.98	56.61	56.76	0.15	0.26
000285	Kilsallagh	167.30	175.49	172.38	170.58	-1.80	-1.04
000296	Lisnageeragh	257.55	252.17	253.60	239.91	-13.69	-5.40
000297	Addergoole	94.40	131.23	118.60	117.20	-1.40	-1.18
000326	Shankill West	51.79	51.05	53.69	54.02	0.33	0.61
000382	Sheheree	2.85	2.52	2.34	2.34	0.00	0.00
000391	Ballynafagh	42.76	64.40	64.60	63.58	-1.02	-1.58
000497	Flughany	128.37	129.94	138.24	138.02	-0.22	-0.16
000566	All Saints	159.90	186.17	185.30	183.17	-2.13	-1.15
000575	Ferbane	78.83	74.72	83.03	87.33	4.30	5.18
000580	Mongan	74.10	70.37	76.16	76.06	-0.10	-0.13
000581	Moyclare	51.83	54.44	52.49	52.56	0.07	0.13

Site Code	Site Name	1994/95 (ha)	2004/05 (ha)	2004/05 (amended) (ha)	2011/13 (ha)	Change 2004/05-2011/13(ha)	% change
000582	Raheenmore	71.73	78.68	79.04	78.23	-0.81	-1.02
000585	Sharavogue	114.25	111.43	111.23	111.23	0.00	0.00
000592	Bellanagare	762.11	785.79	831.87	829.31	-2.56	-0.31
000595	Callow	348.47	345.91	342.99	340.68	-2.31	0.67
000597	Carrowbehy	137.39	123.42	131.67	134.69	3.02	2.29
000600	Cloonchambers	189.97	188.33	189.97	188.11	-1.86	-0.98
000604	Derrinea	38.68	38.13	37.49	37.79	0.30	0.80
000614	Cloonshanville	118.78	123.65	126.19	126.23	0.04	0.03
000641	Ballyduff	72.67	73.67	72.13	71.52	-0.61	-0.85
000641	Clonfinane	66.62	86.83	84.92	84.67	-0.25	-0.29
000647	Firville	152.53	165.87	166.93	166.93	0.00	0.00
000647	Kilcarren	152.41	161.70	166.82	168.94	2.12	1.27
000679	Garriskil	99.96	129.68	125.14	119.39	-5.75	-4.59
001242	Carrowmagappul	299.26	306.60	308.38	295.41	-12.97	-4.21
001818	Ballykenny	127.72	168.65	178.30	173.24	-5.06	-2.84
001818	Fisherstown	50.61	77.64	94.63	101.04	6.41	6.77
002110	Cloonfelliv	n/a	54.01	54.55	54.41	-0.14	-0.26
002110	Corliskea	213.52	224.35	229.78	231.78	2.00	0.87
002110	Trien	104.93	108.08	100.02	99.98	-0.04	-0.04
002298	Derrynabrock	54.59	65.80	74.69	73.89	-0.80	-1.07
002298	Tawnaghbeg	59.21	61.39	61.79	61.79	0.00	0.00
002333	Knockacoller	36.90	47.03	48.30	48.51	0.21	0.43
002336	Carn Park	n/a	120.09	137.09	157.14	20.05	14.63
002337	Crosswood	77.68	95.09	95.60	93.47	-2.13	-2.23
002346	Brown Bog	40.01	41.11	40.12	40.12	0.00	0.00
002347	Camderry	184.72	184.53	188.85	189.27	0.42	0.22
002349	Corbo	76.93	86.41	84.62	81.43	-3.19	-3.77
002350	Curraglehanagh	126.77	136.47	138.48	136.54	-1.94	-1.40
002351	Moanveanlagh	117.38	116.77	114.33	113.58	-0.75	-0.66
002352	Monivea	141.01	130.28	129.36	125.14	-4.22	-3.26
002353	Redwood	376.08	420.53	368.13	362.62	-5.51	-1.50
	<b>Total</b>	5,569.37	6,183.48	6,249.58	6,217.74	-31.84	-0.51

**Note:** the individual site and the total 1994/95 DRB Area figures cannot be compared to those for 2004/05 or 2011/13 figures as the 1994/95 data does not include data for certain areas of high bog that are now mapped as part of a site (i.e. isolated small polygons adjacent to the main area of high bog on a site have been included in the

2004/05 and 2011/13 figures, but were not included in the 1994/95 figures; further detail is provided within each site report). In addition, 1994/95 data does not include data for three sites (Cloonfelliv Bog, Moorfield Bog/Farm Cottage Bog and Carn Park Bog) as these were not surveyed at that time.

**Table 3.13** DRB Favourable Reference Values

Site Code	Site Name	Area Assessment			S&Fs Assessment		
		FRV Target (ha) <sup>1</sup>	2011/13 value (ha) <sup>2</sup>	% above <sup>3</sup> target	FRV 2011/13 Target (ha) <sup>4</sup>	2011/13 M+FB value (ha) <sup>5</sup>	% change
00006	Killyconny	37.51	79.13	110.96	19.78	38.57	94.97
000221	Moorfield Bog/Farm Cottage	22.36	56.76	153.85	14.19	22.76	60.39
000285	Kilsallagh	105.35	170.58	61.92	42.65	83.16	95.01
000296	Lisnageeragh	159.59	239.91	50.33	59.98	75.17	25.33
000297	Addergoole	56.75	117.20	106.52	29.30	32.98	12.56
000326	Shankill West	24.33	54.02	122.03	13.51	25.18	86.45
000382	Sheheree	0.81	2.34	188.89	0.59	0.00	-100.00
000391	Ballynafagh	27.90	63.58	127.89	15.90	27.96	75.90
000497	Flughany	88.29	138.02	56.33	34.51	72.70	110.69
000566	All Saints	80.08	183.17	128.73	45.79	40.62	-11.30
000575	Ferbane	38.23	87.33	128.43	21.83	31.51	44.34
000580	Mongan	63.47	76.06	19.84	19.02	51.42	170.42
000581	Moyclare	9.81	52.56	435.78	13.14	19.68	49.77
000582	Raheenmore	11.42	78.23	585.03	19.56	15.24	-22.08
000585	Sharavogue	52.77	111.23	110.78	27.81	27.82	0.04
000592	Bellanagare	639.13	829.31	29.76	207.33	378.09	82.36
000595	Callow	188.52	340.68	80.71	85.17	150.30	76.47
000597	Carrowbehy	123.79	134.69	8.81	33.67	89.74	166.51
000600	Cloonchambers	110.22	188.11	70.67	47.03	60.96	29.63
000604	Derrinea	19.26	37.79	96.21	9.45	22.33	136.30
000614	Cloonshanville	47.71	126.23	164.58	31.56	20.00	-36.63
000641	Ballyduff	26.23	71.51	172.63	17.88	26.45	47.93
000641	Clonfinane	31.70	84.67	167.10	21.17	24.82	17.26
000647	Firville	46.82	166.93	256.54	41.73	62.38	49.48
000647	Kilcarren	50.52	168.94	234.40	42.24	44.07	4.34
000679	Garriskil	45.34	119.39	163.32	29.85	37.10	24.30
001242	Carrownagappul	179.91	295.41	64.20	73.85	147.38	99.56
001818	Ballykenny	50.60	173.24	242.37	43.31	16.18	-62.64
001818	Fisherstown	26.37	101.04	283.16	25.26	17.03	-32.58
002110	Cloonfelliv	23.49	54.41	131.63	13.60	20.53	50.93
002110	Corliskea	144.11	231.67	60.76	57.92	105.61	82.35
002100	Trien	68.38	99.98	46.21	25.00	55.87	123.52

Site Code	Site Name	Area Assessment			S&Fs Assessment		
		FRV Target (ha) <sup>1</sup>	2011/13 value (ha) <sup>2</sup>	% above <sup>3</sup> target	FRV 2011/13 Target (ha) <sup>4</sup>	2011/13 M+FB value (ha) <sup>5</sup>	% change
002298	Derrynabrock	35.51	73.89	108.08	18.47	26.73	44.70
002298	Tawnaghbeg	16.85	61.79	266.71	15.45	7.60	-50.81
002333	Knockacoller	14.00	48.51	246.50	12.13	16.03	32.18
002336	Carn Park	90.38	157.14	73.87	39.29	34.95	-11.03
002337	Crosswood	41.44	93.47	125.56	23.37	49.00	109.69
002346	Brown Bog	14.48	40.12	177.07	10.03	24.15	140.78
002347	Camderry	164.44	189.27	15.10	47.32	65.90	39.27
002349	Corbo	69.36	81.43	17.40	20.36	46.01	126.01
002350	Curraghleanagh	102.58	136.54	33.11	34.14	44.07	29.11
002351	Moanveanlagh	46.55	113.58	144.00	28.40	35.81	26.11
002352	Monivea	22.29	125.14	461.42	31.29	21.02	-32.81
002353	Redwood	282.24	362.62	28.48	90.66	237.34	161.81
<b>Total</b>		3,500.89	6,217.62	77.60	1,554.42	2,452.22	Na

**Notes:**

<sup>1</sup> 2011/13 high bog area minus 7110 area FRV.

<sup>2</sup> 2011/13 DRB area.

<sup>3</sup> An error in the calculation of the Area “% above target” values was made by Fernandez *et al.* (2012). This has been now rectified and the right value is given in table above.

<sup>4</sup> 25% of the current Degraded Raised Bog habitat area. The target is that the extent of marginal and face bank ecotopes should not be larger than 25% of the current Degraded Raised Bog habitat area.

<sup>5</sup> 2011/13 Marginal and face bank ecotope area.

### 3.4.3 Bog Woodland conservation status assessment

As table 3.14 below indicates, Bog Woodland has been surveyed and its conservation status assessed at a total of six raised bogs as part of Fernandez *et al.* (2012) and this project in the 2011-2013 period. Bog Woodland was previously reported to occur at Clonfinane (Fernandez *et al.* 2005). However, the 2011 survey reported that the woodland in the high bog at Clonfinane was wrongly classified as Bog Woodland habitat in previous surveys and thus this priority habitat is not present at the site.

Area has been given a **Favourable-Stable** assessment at five of these six raised bogs and **Unfavourable Bad-Stable** at one site (All Saint’s) (See Table 3.14). Current Area at All Saint’s is 17.96% below the FRV due to habitat loss (0.76ha) following a severe fire event in 2002/3 (See Table 3.15). However, no change in Area has taken place in the new reporting period (2005 – 2011) and the trend is therefore Stable. Area has decreased as a result of a more comprehensive surveying and

mapping as well as a more precise definition of the canopy cover needed to be considered woodland (> 30%) as part of the 2011-13 surveys at the following sites: Cloonshanville, Trien and Sheheree. However, this is not considered to be an actual change in Area and those areas deemed not to correspond with woodland have been allocated to ARB vegetation (mainly active flush vegetation).

Although S&Fs have been assessed as **Favourable-Stable** in the reporting period at all sites surveyed, some of the attributes assessed (e.g. *Betula pubescens* dbh distribution, presence of large diameter deadwood and senescent trees, *Sphagnum* cover and regeneration) have failed (i.e. attribute did not reach the target) at four of the sites (Addergoole, Corliskea, Sheheree and Trien). Best expert judgement was considered in these cases as the woodland was considered to be wet, healthy, featuring a good species composition and structure, and of overall very high quality during the field survey. As a result a negative S&F assessment was considered not actually indicate the status of this parameter. The small size of the woodland in three cases (e.g. Corliskea, Sheheree and Trien) only allowed the recording of one monitoring stop and also reduces the chances for the habitat to pass all targets.

FPs have been assessed as **Favourable-Stable** at three of six raised bogs (Addergoole, Sheheree and Cloonshanville) as impacting activities recorded at these sites do not pose a major threat to the habitat in the near future. However, an **Unfavourable Inadequate-Declining** assessment has been given at Corliskea and Trien and **Unfavourable Bad-Declining** at All Saint's. Peat cutting, drainage and burning continue threatening Bog Woodland associated habitats (i.e. ARB and DRB) at these sites and thus the FPs of Bog Woodland. In the particular case of All Saint's, quarrying also threatens both Bog Woodland and associated habitats. Bog Woodland appears to be getting drier at this site as per evidence reported during this project's survey.

Bog Woodland has been given an overall **Favourable-Stable** assessment at Addergoole, Cloonshanville and Sheheree. An **Unfavourable Inadequate-Declining** was given to the habitat at Corliskea and Trien, as a result of Unfavourable FPs. An **Unfavourable Bad-Declining** assessment was given at All Saint's due to the Unfavourable assessment at Area and FPs level. An Unfavourable Bad assessment should also have been given to this habitat at All Saint's in the 2005 report (Fernandez *et. al.* (2005) as the decrease in Area took place in the 1994/95-2004/05 period.

**Table 3.14** Bog Woodland habitat conservation status assessment. F: Favourable; UI: Unfavourable Inadequate; UB: Unfavourable Bad

Site Code	Site Name	Conservation status			
		Area	S&Fs	FPs	Overall
000297	Addergoole	F-Stable	F-Stable	F-Stable	F-Stable
000382	Sheheree	F-Stable	F-Stable	F-Stable	F-Stable
000566	All Saints	UB-Stable	F-Stable	UB-Declining	UB-Declining
000614	Cloonshanville	F-Stable	F-Stable	F-Stable	F-Stable
002110	Corliskea	F-Stable	F-Stable	UI-Declining	UI-Declining
002110	Trien	F-Stable	F-Stable	UI-Declining	UI-Declining

**Table 3.15** Bog Woodland habitat FRVs

Site Code	Site Name	Area Assessment			S&Fs Assessment		
		FRV Target (ha)	2011/13 value (ha)	% below target	FRV 2011/13 Target (ha)	2011/13 value (ha)	% change
000297	Addergoole	1.22	1.22	0.00	Na	Na	Na
000382	Sheheree	0.04	0.04	0.00	Na	Na	Na
000566	All Saints	17.48	14.34	-17.96	Na	Na	Na
000614	Cloonshanville	2.17	2.17	0.00	Na	Na	Na
002110	Corliskea	0.25	0.25	0.00	Na	Na	Na
002110	Trien	0.04	0.04	0.00	Na	Na	Na

**Note:**

Na: not applicable; no area target established for S&Fs, but specific indicators targets have been established for the habitat (See Appendix 5)

3.4.4 *Depressions on peat substrates of the Rhynchosporion conservation status assessment*

Rhynchosporion depressions Area has been assessed as **Unfavourable Bad-Increasing** at 10 bogs; **Unfavourable Bad-Stable** at 26 bogs and **Unfavourable Bad-Decreasing** at seven bogs. An **Unfavourable Inadequate-Increasing** assessment has been given to Carrowbehy/Caher Bog (See Table 3.16). An Unfavourable assessment indicates an Area value below FRV. An Increasing trend indicates an increase in the combined extent of ARB and sub-marginal ecotope within DRB at the site. A Stable trend indicates no change in their combined extent, whereas a Decreasing indicates a reduction in their combined extent in the reporting period.



Rhynchosporion depressions S&Fs have been assessed as **Favourable-Stable** at four bogs (All Saints, Brown Bog, Mongan and Trien); **Favourable-Declining** at two bogs (Carrowbehy/Caher and Shankill West); **Unfavourable Inadequate-Stable** at two bogs (Derrinea and Monivea); **Unfavourable Inadequate-Declining** at Corliskea; **Unfavourable Bad-Improving** at five bogs (Ballykenny, Ballyduff, Carrownagappul, Garriskil and Lisnageeragh); **Unfavourable Bad-Stable** at 25 bogs and **Unfavourable Bad-Declining** at five bogs (Corbo, Kilsallagh, Camderry, Fisherstown and Carn Park) (See Table 3.16). A Favourable assessment indicates a S&Fs value equal or greater than the FRV (the target being that at least half of the current area of ARB should be made up of central ecotope and active flush/soak (i.e. more pristine examples of ARB community types)) whereas Unfavourable assessment indicates a S&Fs value below FRV. An Improving trend indicates an increase in the combined extent of central ecotope and active flush/soak in the reporting period while Stable no change and Declining trends indicate a reduction in their extent.

Rhynchosporion depressions FPs have been given an **Unfavourable Inadequate-Improving** at Mongan; **Unfavourable Inadequate-Declining** at Carrowbehy/Caher; **Unfavourable Bad-Improving** at 7 bogs; **Unfavourable Bad-Stable** at eight bogs and **Unfavourable Bad-Declining** at 27 bogs (See Table 3.16).

Rhynchosporion depressions has been assessed as having an overall **Unfavourable Bad-Declining** assessment at 29 bogs, **Unfavourable Inadequate-Declining** at Carrowbehy/Caher, **Unfavourable Bad-Stable** at seven bogs and **Unfavourable Bad-Improving** at seven bogs (See Table 3.16). Restoration works were undertaken at all those bogs given an Improving trend.

**Table 3.16** Rhynchosporion depressions conservation status assessment F: Favourable; UI: Unfavourable Inadequate; UB: Unfavourable Bad

Site Code	Site Name	Conservation status <sup>1</sup>			
		Area	S&Fs	FPs	Overall
000006	Killyconny	UB-Increasing	UB-Stable	UB-Improving	UB-Improving
000221	Moorfield Bog/Farm Cottage	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000285	Kilsallagh	UB-Stable	UB-Declining	UB-Declining	UB-Declining
000296	Lisnageeragh	UB-Increasing	UB-Improving	UB-Declining	UB-Declining
000297	Addergoole	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000326	Shankill West	UB-Decreasing	F-Declining	UB-Declining	UB-Declining
000382	Sheheree	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000391	Ballynafagh	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000497	Flughany	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000566	All Saints	UB-Stable	F-Stable	UB-Declining	UB-Declining

Site Code	Site Name	Conservation status <sup>1</sup>			
		Area	S&Fs	FPs	Overall
000575	Ferbane	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000580	Mongan	UB-Increasing	F-Stable	UI-Improving	UB-Improving
000581	Moyclare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000582	Raheenmore	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000585	Sharavogue	UB-Increasing	UB-Stable	UB-Improving	UB-Improving
000592	Bellanagare	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000595	Callow	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000597	Carrowbehy	UI-Increasing	F-Declining	UI-Declining	UI-Declining
000600	Cloonchambers	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000604	Derrinea	UB-Stable	UI-Stable	UB-Declining	UB-Declining
000614	Cloonshanville	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000641	Ballyduff	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
000641	Clonfinane	UB-Increasing	UB-Stable	UB-Improving	UB-Improving
000647	Firville	UB-Stable	UB-Stable	UB-Stable	UB-Stable
000647	Kilcarren	UB-Stable	UB-Stable	UB-Declining	UB-Declining
000679	Garriskil	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
001242	Carrowmagappul	UB-Stable	UB-Improving	UB-Declining	UB-Declining
001818	Ballykenny	UB-Increasing	UB-Improving	UB-Improving	UB-Improving
001818	Fisherstown	UB-Increasing	UB-Declining	UB-Improving	UB-Declining
002110	Cloonfolliv	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002110	Corliskea	UB-Decreasing	UI-Declining	UB-Declining	UB-Declining
002110	Trien	UB-Stable	F-Stable	UB-Declining	UB-Declining
002298	Derrynabrock	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002298	Tawnaghbeg	UB-Stable	UB-Stable	UB-Stable	UB-Stable
002333	Knockacoller	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002336	Carn Park	UB-Stable	UB-Declining	UB-Stable	UB-Declining
002337	Crosswood	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002346	Brown Bog	UB-Stable	F-Stable	UB-Stable	UB-Stable
002347	Camderry	UB-Increasing	UB-Declining	UB-Declining	UB-Declining
002349	Corbo	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
002350	Curraglehanagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002351	Moanveanlagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining
002352	Monivea	UB-Decreasing	UI-Stable	UB-Declining	UB-Declining
002353	Redwood	UB-Stable	UB-Stable	UB-Declining	UB-Declining

**Note:**

<sup>1</sup> The assessment methodology has been revised as part of this project. As a result, Fernandez *et al.* (2012) conservation status has been reassessed.

3.4.5 Overall raised bog conservation status assessment

According to table 3.17 below nine raised bogs have been given an **Unfavourable Bad-Improving** overall assessment; four **Unfavourable Bad-Stable** and 31 **Unfavourable Bad-Declining**.

The assessment given to ARB has been the overriding attribute used to assess the overall assessment of a raised bog at all the sites but Killyconny and Sharavogue. Raised bog has been given an overall Improving trend despite a Stable trend assessment for ARB. DRB was given an Improving trend at these two bogs as a result of the positive effects of restoration works. This assessment is considered to indicate that the overall raised bog condition is improving.

Ballynafagh Bog was given an overall Improving trend despite a negative trend given to DRB. ARB was given an Improving trend for this site and peat cutting, which was the most impacting activity, is considered to have apparently ceased at this site and thus improving the habitats future prospects.

In the case of Addergoole and Cloonshanville the overall raised bog was given a negative assessment (UI-Declining) despite a more positive result (F-Stable) to the other priority habitat at the sites (Bog Woodland). The assessment of ARB is considered to override the one given to Bog Woodland as ARB would cover a larger extent on the site.

**Table 3.17** Overall raised bog conservation status. F: Favourable; UI: Unfavourable Inadequate; UB: Unfavourable Bad

Site Code	Site Name	Conservation status				Overall
		7110	7120	7150	91D0	
000006	Killyconny	UB-Stable	UB-Improving	UB-Improving	n/a	UB-Improving
000221	Moorfield Bog/Farm Cottage	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining
000285	Kilsallagh	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining
000296	Lisnageeragh	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining
000297	Addergoole	UB-Declining	UB-Declining	UB-Declining	F-Stable	UB-Declining
000326	Shankill West	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining
000382	Sheheree	UB-Stable	UB-Stable	UB-Stable	F-Stable	UB-Stable
000391	Ballynafagh	UB-Improving	UB-Declining	UB-Stable	n/a	UB-Improving
000497	Flughany	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining
000566	All Saints	UB-Declining	UB-Declining	UB-Declining	UB-	UB-Declining
000575	Ferbane	UB-Declining	UB-Declining	UB-Declining	n/a	UB-Declining

Conservation status

Site Code	Site Name	7110	7120	7150	91D0	Overall
000580	Mongan	UB-Improving	UB-Improving	UB-Improving	na	UB-Improving
000581	Moyclare	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000582	Raheenmore	UB-Improving	UB-Improving	UB-Stable	na	UB-Improving
000585	Sharavogue	UB-Stable	UB-Improving	UB-Improving	na	UB-Improving
000592	Bellanagare	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000595	Callow	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000597	Carrowbehy	UI-Declining	UB-Declining	UI-Declining	na	UB-Declining
000600	Cloonchambers	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000604	Derrinea	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000614	Cloonshanville	UB-Declining	UB-Declining	UB-Stable	F-Stable	UB-Declining
000641	Ballyduff	UB-Improving	UB-Improving	UB-Improving	na	UB-Improving
000641	Clonfinane	UB-Improving	UB-Improving	UB-Improving	na	UB-Improving
000647	Kilcarren	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
000647	Firville	UB-Stable	UB-Stable	UB-Stable	na	UB-Stable
000679	Garriskil	UB-Improving	UB-Improving	UB-Improving	na	UB-Improving
001242	Carrownagappul	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
001818	Fisherstown	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
001818	Ballykenny	UB-Improving	UB-Improving	UB-Improving	na	UB-Improving
002110	Cloonfelliv	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002110	Corliskea	UB-Declining	UB-Declining	UB-Declining	UI-	UB-Declining
002110	Trien	UB-Declining	UB-Declining	UB-Declining	UI-	UB-Declining
002298	Derrynabrock	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002298	Tawnaghbeg	UB-Stable	UB-Stable	UB-Stable	na	UB-Stable
002333	Knockacoller	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002336	Carn Park	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002337	Crosswood	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002346	Brown Bog	UB-Stable	UB-Stable	UB-Stable	na	UB-Stable
002347	Camderry	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002349	Corbo	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002350	Curraghleanagh	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002351	Moanveanlagh	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002352	Monivea	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining
002353	Redwood	UB-Declining	UB-Declining	UB-Declining	na	UB-Declining

## 3.5 Impacts and threats assessment

The following section of the report summarises the most important impacting activities affecting raised bogs in Ireland (April 2013). A summary of data from the most recent raised bog monitoring surveys: Fernandez *et al.* (2012) and this project is also provided. This data includes activities both on the high bog and adjacent land impacting and threatening habitats on the high bog for a total of 44 raised bogs.

### 3.5.1 Peat cutting

#### 3.5.1.1 Peat cutting prior 2007

According to NPWS (2007), domestic turf cutting, which in the past mainly consisted of hand cutting, became mechanised in the 1980s stimulated by the introduction of the Turf Development Act in 1981. As recognised by Feehan & O'Donovan (1996) the mechanisation of peat extraction by private producers allowed the exploitation of small bogs by small commercial companies and co-operatives. They also noted that this was accompanied by intensive drainage of the high bog, which was practically non-existent on smaller bogs up to 1981. Therefore, as a result, medium and small sized bogs became increasingly severely impacted by mechanised turf cutting in the following three decades. Indeed the IPCC *Bogs and Fens of Ireland Conservation Plan 2005* (Foss *et al.* 2001) postulated that the widespread use of machinery in the late 1990s/early 2000s greatly accelerated the process of decline in the peatland resource, particularly Lowland Raised Bogs. They consider that more peat is being harvested over a wider area of bog and on a semi-commercial basis since the decline of hand cutting. This has in many cases altered the scale of cutting from the traditional domestic small scale level to a much more intensive semi-industrial scale extraction.

As reported by NPWS (2007), following the publication of the list of SAC raised bog sites in 1997, there was prolonged and strenuous objection from turf cutters. The objectors were especially concerned about loss of property rights, loss of future fuel supplies and loss of a way of life in the summer months. The Minister for Arts, Heritage, Gaeltacht and the Islands at the time, Síle de Valera T.D., addressed the objections of bog owners by allowing them cut turf for domestic use for 10 years, up to and including 2008, at which stage all cutting should cease. When the NHAs were designated in 2004, a similar 10-year derogation was put in place, allowing cutting on them until 2014. The first "Turf cutting cessation scheme" within SACs was initiated in April 1999, to provide an incentive for domestic cutters to cease cutting permanently.

A new agreement between the Government and the Farming Organisation on review of the implementation of the EU Habitats Regulations (1997) was reached in 2004. This agreement was

complemented by the second "Turf cutting cessation scheme". Under this agreement, save in exceptional circumstances, people were allowed to continue domestic cutting on their plots for up to 10 years following their nomination for designation. In addition, after the 10 year period the Department would review whether or not there are particular circumstances in which domestic turf cutting can continue on raised bogs without impacting on the achievement of their conservation objectives. In 2005, 117 raised bogs out of 139 bogs within the 128 designated sites (75 NHAs and 53 SACs), were still being cut for turf (Fernandez *et al.*, 2006).

Fernandez *et al.* (2006) examined the impact of turf cutting on designated bogs with the main objectives being to assess the impacts of turf cutting and to develop appropriate responses to such impacts. They noted that 2,660 turf cutting plots were cut in 2003 on 93 bogs (44 NHAs and 49 SACs) identified as having priority habitats (i.e. 7110 and/or 91D0). Fernandez *et al.* (2006) also estimated that 20,000 turbarry rights exist on all designated sites (139 bogs designated) but that only a small proportion of those were actively cut at the time.

The report offered a variety of options for the cessation of turf cutting on designated bogs, ranging from immediate and complete cessation (recommended) to phased cessation based on: potential impact of cutting and related activities on sensitive areas (in particular those with or near ARB and/or Bog Woodland) or the designation status of the bog. However, the NPWS believed that the cessation of cutting only in parts of bogs while allowing cutting to continue in other parts of the same bog was not feasible or manageable and that the cessation of cutting in 2008 in SACs as proposed by Minister de Valera in 1999 was the best option. Restoration works were also required on many bogs, as recommended by Fernandez *et al.* (2006).

Although peat cutting recorded by Fernandez *et al.* (2006) was mainly for domestic purposes, peat cutting for semi-commercial purposes also occurred at a number of designated sites. Mechanical peat extraction, generally by hopper machinery, for fuel purposes was the most common technique on the sites surveyed. This method of peat cutting involves the insertion of drains on the cutover of various width and depth generally perpendicular to the face-bank. Occasionally, high bog drains are also inserted close to the face-bank.

Fernandez *et al.* (2006) noted that the common trend was a reduction in the length of margin actively cut and a decline in number of cutters actively cutting in the 1994/95-2004/05 reporting period. However, this trend was coupled by intensification in the amount of peat extracted as result of the mechanisation of cutting. This resulted in an increase in the negative effects associated with this peat cutting. Fernandez *et al.* (2005) estimated that the overall loss of high bog to peat cutting in the ten year reporting period (1994/95-2004/05) was 1% within 48 raised bogs for which their conservation status was assessed.

To summarise, NPWS have operated two turf cutting cessation schemes since 1999 to buy out turbary rights in NHAs and SACs (NPWS, 2008). Fernandez *et al.* (2006) considered that the schemes were relatively successful in dealing with obvious commercial activity (i.e. moss peat developments), but were less successful in dealing with small scale, semi-commercial to commercial fuel peat operations and had almost negligible impact on domestic cutting. They did not appear to have significantly reduced the numbers of cutters or the negative effects of cutting on raised bog priority habitats.

#### 3.5.1.2 Peat cutting Post-2007

The Department of Arts, Heritage and the Gaeltacht has put in place a new compensation scheme for those affected by the cessation of turf cutting on SAC raised bogs. This cessation of turf cutting compensation scheme comprises a payment of €1,500 per year, for 15 years or, where feasible, relocation of turf cutters to non-designated bogs where they can continue to cut turf. Those wishing to relocate can avail of the financial payment or the delivery of 15 tonnes of cut turf per annum while relocation sites are identified and prepared. The costs of acquiring and preparing relocation sites is met by the State. An additional once-off payment of €500 for qualifying turf cutters is provided where legal agreements are signed with the Minister for Arts, Heritage and the Gaeltacht

The qualifying criteria for the cessation of turf cutting compensation scheme are that:

- The claimant must have a legal interest in one of the 53 raised bog special areas of conservation – i.e. ownership or turbary right;
- The claimant must have been the owner or entitled to exercise turbary rights on the land in question on 25 May 2010;
- The turbary on the site must not be exhausted;
- The claimant must have been cutting turf on the land in question during the relevant five year period (2005-2010); and
- No turf cutting or associated activity is on-going on the property.

According to the statistics provided by the Department (<http://www.npws.ie/peatlandsturf-cutting/turfcutting/compensationschemestatics/>) (April 2013) a total of 2,668 applications from cutters within the 53 SACs were received with 1,888 applying for payment and 780 for relocation.

According to data recorded by both Raised Bog Monitoring surveys (Fernandez *et al.* (2012) and this project), peat cutting was reported at 31 of the 44 raised bogs surveyed in the 2004/05-2010 period (based on the comparison of 2004/05 OSi and 2010 NPWS aerial photographs (See Table 3.18)). In addition, cutting was reported from Ferbane in the 2011/12 period, despite not taking place between 2004/05-2010. There is a possibility that limited turf cutting occurred in the following two years (2011/12) in some of the remaining 12 raised bogs (Ballykenny, Brown Bog, Carrowbehy, Derrinea,

Firville, Fisherstown, Garriskil, Killyconny, Raheenmore, Sharavogue, Sheheree and Tawnaghbeg), where cutting for the 2004/05-2010 period did not take place. Cutting of a commercial nature occurred adjacent to Clonfinane bog, but not on the designated high bog. As table 3.14 indicates, peat cutting did not occur, and has apparently ceased, at 14 out of those 32 bogs where peat cutting occurred in the reporting period (2007-2012) (All Saint's, Ballyduff, Ballynafagh, Carn Park, Carrownagappul, Cloonshanville, Ferbane, Flughany, Kilcarren, Knockacoller, Mongan, Moyclare, Redwood and Shankill West); a decreasing trend in terms of the intensity of cutting has been reported at another 14 raised bogs (Addergoole, Callow, Camderry, Cloonchambers, Cloonfelliv, Corbo, Corliskea, Crosswood, Curraghlehanagh, Kilsallagh, Lisnageeragh, Moanveanlagh, Monivea and Trien) and no information is available for the remaining three bogs (Bellanagare, Derrynabrock and Moorfield Bog/Farm Cottage) (based on data provided by NPWS (Ryan, J., pers. comm., 2013)).

Peat cutting, within those 32 raised bogs where the activity was reported, consisted of the direct removal of peat from the high bog. This peat cutting was of a domestic nature and consisted of mechanical peat extraction (i.e. hopper machinery). Through this technique the high bog margin is directly cutaway using the hydraulic bucket of a Hopper machine. Once extracted, peat is extruded from the hopper directly onto the spread grounds, generally on the cutover adjacent to the face-bank to dry out, but occasionally (and more frequently on western sites), when the adjacent cutover areas are either too small or too wet, the peat is spread on the high bog (particularly when lateral peat cutting, where the machinery works from the high bog, is carried out). Peat cutting also involves the insertion of drains of various width and depth perpendicular to the face-bank on the cutover to ensure dry spread grounds. Occasionally, high bog drains are also inserted close to the face-bank.

As described in the DRB Area conservation status assessment section of the report, it has been estimated that there has been a minimum 1% of high bog loss from all raised bogs (both designated and undesignated) in the reporting period (2007-2012) due to peat cutting.

A closer look at data provided by the most recent Raised Bog Monitoring Surveys indicates that peat cutting had a High Importance/Impact on ARB at 11 of the 32 bogs cut (as the assessments indicate that the activity is directly connected with habitat losses) within the reporting period; Medium at three bogs (as, according to the assessments, peat cutting is having some impact on the habitat but no direct habitat losses were recorded in the reporting period); Low at 17 raised bogs (as peat cutting at current rates and location does not appear to be having an impact on ARB at the site in the reporting period); no impact from peat cutting on ARB in the reporting period was reported at Cloonshanville, as peat cutting was small in extent (<0.03ha in the 2004/05-2010 period) and took place relatively far from ARB (See Table 3.18).

A similar Importance/Impact from peat cutting, to those given to ARB were assigned to Rhynchosporion depressions habitat (7150), as both habitats are so interlinked.



Peat cutting was assessed as having High Importance/Impact on Bog Woodland (91D0) at All Saint's, Medium at Corliskea and Low at Trien and no impact on the habitat in the remaining sites with Bog Woodland (Addergoole, Cloonshanville and Sheheree).

Peat cutting was reported as having High Importance/Impact on DRB at 26 of the 32 raised bogs cut (as it directly reduced the Area of the habitat in the reporting period); Medium at three raised bogs (as generally only small (<0.10ha) extent of high bog was lost in the 2004/05-2010 period, but some declines in habitat quality were also noted in the reporting period) and Low at three raised bogs (as only small (<0.10ha) extent of high bog was lost in the 2004/05-2010 period and the activity does not appear to have impacted on the quality in the reporting period) (See Table 3.18).

Although cutting does not directly threaten the high bog habitats at those sites where it apparently ceased, secondary impacts (i.e. on-going subsidence and drainage related to open face-banks) continue posing a threat to ARB in many of them. Furthermore, in some of the sites, these secondary impacts are diminishing the potential for expansion of the habitat despite restoration works.

#### **Peat cutting trend**

The above data indicates a decreasing trend of peat cutting activity within those raised bogs for which a recent survey has been undertaken. A similar trend is likely to have occurred at the remaining SAC raised bogs, based on the data relating to the implementation of the peat cutting cessation scheme made available (April 2013) by the Department of Arts, Heritage and the Gaeltacht. A very different trend is taking place within sites designated as NHAs (Ryan, J., pers. comm., 2013), where peat cutting rates seem to have increased. A similar scenario to NHA bogs is likely to be taken place within non-designated sites, at least those near SACs where relocation programmes are being implemented.

**Table 3.18** Surveyed sites peat cutting summary (to April 2013)

Site Code	Site Name	Approx. high bog area cut away (2004/05-2010) (ha)	Location	Approx. number plots cut (2004/05-2010)	2011/2012 activity trend	Impact on Annex I habitat			
						7110	7120	7150	91D0
000221	Moorfield Bog/Farm Cottage	0.35	Inside High Bog	7	Not available	L	H	L	na
000285	Kilsallagh	1.63	Inside High Bog	39	Decreasing	L	H	L	na
000296	Lisnageeragh	0.5	Inside High Bog	13	Decreasing	L	H	L	na
000297	Addergoole	1.9	Inside High Bog	28	Decreasing	H	H	H	na
000326	Shankill West	0.11	Inside High Bog	1	None current	H	H	H	na
000391	Ballynafagh <sup>1</sup>	0.77	Inside High Bog	27	None current	L	H	L	na
000497	Flughany	0.22	Inside High Bog	4	None current	L	H	L	na
000566	All Saints	0.42	Inside High Bog	11	None current	H	H	H	H
000575	Ferbane	n/av	Inside High Bog	0 (1 plot reported in 2010/2011)	None current	L	M	L	na
000580	Mongan	<0.10	Outside High Bog	1	None current	L	L	L	na
000581	Moyclare	0.64	Inside High Bog	25	None current	H	H	H	na
000592	Bellanagare	5.77	Inside High Bog	102	Not available	H	H	H	na
000595	Callow	3.31	Inside High Bog	50	Decreasing	H	H	H	na
000600	Cloonchambers	1.86	Inside High Bog	37	Decreasing	L	H	L	na
000614	Cloonshanville <sup>2</sup>	0.03	Inside High Bog	1	None current	n	L	L	na
000641	Ballyduff	0.03	Inside High Bog	2	None current	L	L	L	na
000641	Clonfinane	60	Inside High Bog	60ha commercial exploitation of high bog adjacent to but outside of the SAC	No change	M	M	M	na
000647	Kilcarren	0.1	Inside High Bog	2	None current	M	M	M	na
001242	Carrownagappul	3.1	Inside High Bog	48	None current	L	H	L	na
002110	Cloonfelliv	0.14	Inside High Bog	4	Overall decreasing within SAC 2110	L	H	L	na
002110	Corliskea	2.25	Inside High Bog	43		H	H	H	M
002110	Trien	0.12	Inside High Bog	5		L	H	L	L
002298	Derrynabrock	0.08	Inside High Bog	2	Not available	L	H	L	na
002333	Knockacoller	0.22	Inside High Bog	9	None current	H	H	H	na
002336	Carn Park	1.19	Inside High Bog	31	None current	H	H	H	na

Site Code	Site Name	Approx. high bog area cut away (2004/05-2010) (ha)	Location	Approx. number plots cut (2004/05-2010)	2011/2012 activity trend	Impact on Annex I habitat			
						7110	7120	7150	91D0
002337	Crosswood	3.13	Inside High Bog	44	Decreasing	H	H	H	na
002347	Camderry	0.79	Inside High Bog	17	Decreasing	M	H	M	na
002349	Corbo	3.34	Inside High Bog	48	Decreasing	H	H	H	na
002350	Curraglehanagh	1.94	Inside High Bog	39	Decreasing	L	H	L	na
002351	Moanveanlugh	0.75	Inside High Bog	24	Decreasing	L	H	L	na
002352	Monivea	4.2	Inside High Bog	97	Decreasing	L	H	L	na
002353	Redwood	5.5	Inside High Bog	42	None current	L	H	L	na

**Notes:**

The number of plots where cutting has occurred is only approximate and based on the comparison between 2004/05 and 2010 aerial photography. The activity trend is based on recent data (April 2013) provided by NPWS; the cessation of peat cutting activity on some of the sites requires confirmation. The table above does not include data for the remaining sites surveyed in the 2011-13 period where cutting did not take place in the 2004/5-13 period. Cutting has continued in some of the sites included in the above list in 2013/14 (Ryan, J., pers. comm., 2014).

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; n/av: not available; na: not applicable

<sup>1</sup> Peat cutting at Ballynafagh was given a H Importance/Impact on 7110 and 7150 habitats in 2011 by Fernandez *et al.* (2012). This has been revised during this project as peat cutting appears not to have caused any decrease or decline in the Area or S&F in the reporting period

<sup>2</sup> Peat cutting at Cloonshanville was considered not to have any impact on ARB in the reporting period.

Peat cutting was reported as Peat extraction (C01.03)

### 3.5.2 Drainage

According to Fernandez *et al.* (2005) drainage works are undertaken to dry out the high bog surface and is generally used to facilitate the cutting of turf. It is found either on the high bog and/or the adjacent cutover area.

Fernandez *et al.* (2005) recorded drainage on the high bog on 46 of the 48 raised bogs surveyed. The activity was considered to have high negative influence on high bog habitats at 21 raised bogs and in several cases was considered to be the main reason for the decline in ARB Area. Cutover drainage was deemed to have a high negative influence on the high bog at 29 out of 48 raised bogs. Most of these bogs also had extensive peat cutting, which generally correlates with cutover drainage maintenance. According to observations made by this survey, high bog drainage is rarely maintained and in-filling processes are frequent in many sites. However, natural blocking of drains is a very slow process and

active blocking of drains is required to counteract the negative effects of this activity. Indeed, the blocking of drains was considered essential for the recovery of the habitat.

Larger scale drainage directed at improving agricultural land and providing for improved bog drainage was also considered a serious threat to the hydrological status of the high bog and therefore ARB.

A more recent view from the latest raised bog monitoring surveys (2011-21013) shows (See Table 3.19) that:

- The overall length of **high bog drains** is 531km within the 42 raised bogs (of the 44 surveyed), where drainage on the high bog was reported. Approx. 461km continues to impact high bog habitats: 207km remain not blocked: functional; 95km not blocked: reduced-functional; 158km blocked: reduced-functional and 1km blocked: functional. The remaining 70km high bog drains are classed as not functional.
- **High bog drains** were reported as having a High Importance/Impact on ARB at 18 raised bogs and thus this activity would have been responsible, along with others (e.g. peat cutting, adjacent land drainage) in some sites, for the drying out of the high bog and consequently for ARB losses (See Table 3.19). This activity was given a Medium Importance/Impact on ARB at the remaining 24 raised bogs (although habitat losses associated with high bog drains appear not to have taken place in the reporting period on these sites, the activity continues impacting the habitat and it is preventing recovery). High bog drains were assessed as having High Importance/Impact on DRB at 14 bogs and Medium at 28 bogs. The activity was assessed as having a High Importance/Impact on Rhynchosporion depressions at 13 bogs and Medium at 29. High bog drains were given a High Importance/Impact on Bog Woodland at All Saint's and Medium at Corliskea, Cloonshanville and Trien.
- **Adjacent land drainage** was reported as having an impact on high bog habitats at 43 of the 44 raised bogs surveyed (See Table 3.19). The actual length of drainage adjacent to the high bog is unknown. Drainage maintenance has been frequently reported at many sites (See individual site reports for further detail). Adjacent land drainage was reported as having a High Importance/Impact on ARB at 12 raised bogs and thus this activity would have been responsible, along with others (e.g. peat cutting, high bog drainage) in some sites, for the overall drying out of the high bog and ARB losses. This activity was given a Medium Importance/Impact on ARB at the remaining 24 raised bogs (although habitat losses appear not taken place in the reporting period associated with adjacent land drainage, the activity continues to impact on the habitat as it is likely to affect the high bog hydrology/topography in the long term and reduces its restoration prospects). A Low Importance/Impact on ARB was given at seven bogs (the activity does not appear to have impacted the habitat in the reporting

period). Adjacent land drainage was assessed as having High Importance/Impact on DRB at 10 bogs, Medium at 26 bogs and Low at seven bogs. The activity was assessed as having a High Importance/Impact on Rhynchosporion depressions at 10 bogs Medium at 26 bogs and Low at seven bogs. Adjacent land drainage was given a High Importance/Impact on Bog Woodland at All Saint's and Cloonshanville, Medium at Trien and Low at Corliskea.

### **Drainage trend**

According to drainage data gathered as part of the two most recent Raised Bog Monitoring Surveys:

- Very few new high bog drains have been inserted on the surveyed sites (only 79m at Callow Bog).
- Approximately 15km of high bog drains have been blocked in the 2007-2013 reporting period. This took place at Carn Park, Camderry, Fisherstown, Cloonshanville, Killyconny and Kilsallagh. This actual figure is higher as the drains within felled plantations have also been blocked, but have not been mapped (and thus not been measured) in detail or not mapped at all as these are not discernible on the 2010 aerial photographs (e.g. Lisnageeragh and Curraghleanagh).

To summarise, a very large proportion (461km out of 531km) of the high bog drains within the 44 bogs surveyed continue drying out the high bog and thus impacting on high bog habitats. Very little change in their status has taken place in the reporting period (with only approximately 15km of drains blocked). Natural infilling of drains although recorded in some sites (e.g. Ballynafagh where natural infilling has encouraged the formation of new active peat forming vegetation), is not counteracting the negative impacts from high bog drains. Therefore, high bog drainage is given a very slight decreasing trend for the sites surveyed. A similar trend is likely to have occurred at the remaining raised bog within SACs. The trend within NHA sites and non-designated bogs is unknown.

A very different trend seems to have occurred for drainage adjacent to the high bog (cutover drainage and agricultural land drainage). The latest Raised Bog Monitoring Surveys have noted adjacent land drainage maintenance for many sites. Although no actual statistical data is available, adjacent land drainage maintenance is a matter of concern, due to its impact on high bog habitats.

**Table 3.19** Surveyed sites drainage summary

Site Code	Site Name	Length (km)	Location	Impact on Annex I habitats			
				7110	7120	7150	91D0
000006	Killyconny	n/av	Outside High Bog	M	M	M	na
000006	Killyconny	4.103	Inside High Bog	M	M	M	na
000221	Moorfield Bog/Farm Cottage	n/av	Outside High Bog	H	H	H	na
000221	Moorfield Bog/Farm Cottage	2.833	Inside High Bog	H	H	H	na
000285	Kilsallagh	n/av	Outside High Bog	M	M	M	na
000285	Kilsallagh	13.254	Inside High Bog	H	H	H	na
000296	Lisnageeragh	n/av	Outside High Bog	L	L	L	na
000296	Lisnageeragh	10.804	Inside High Bog	M	M	M	na
000297	Addergoole	n/av	Outside High Bog	H	M	M	na
000297	Addergoole	5.434	Inside High Bog	H	M	M	na
000326	Shankill West	n/av	Outside High Bog	M	M	M	na
000326	Shankill West	4.95	Inside High Bog	H	H	H	na
000391	Ballynafagh	n/av	Outside High Bog	M	M	M	na
000391	Ballynafagh <sup>1</sup>	4.192	Inside High Bog	M	M	M	na
000497	Flughany	n/av	Outside High Bog	L	L	L	na
000497	Flughany	12.457	Inside High Bog	M	M	M	na
000566	All Saints	n/av	Outside High Bog	H	H	H	H
000566	All Saints	27.393	Inside High Bog	H	H	H	H
000575	Ferbane	n/av	Outside High Bog	H	H	H	na
000575	Ferbane	10.889	Inside High Bog	H	H	H	na
000580	Mongan	n/av	Outside High Bog	M	M	M	na
000580	Mongan	9.305	Inside High Bog	M	M	M	na
000581	Moyclare	n/av	Outside High Bog	M	M	M	na
000581	Moyclare	3.8	Inside High Bog	H	H	H	na
000582	Raheenmore	n/av	Outside High Bog	H	H	H	na
000582	Raheenmore	9.4	Inside High Bog	M	M	M	na
000585	Sharavogue	n/av	Outside High Bog	L	L	L	na
000585	Sharavogue	21.912	Inside High Bog	M	M	M	na
000592	Bellanagare	n/av	Outside High Bog	M	M	M	na
000592	Bellanagare	59.541	Inside High Bog	H	H	H	na
000595	Callow	n/av	Outside High Bog	H	H	H	na
000595	Callow	28.332	Inside High Bog	H	H	H	na
000597	Carrowbehy	n/av	Outside High Bog	H	M	M	na

Site Code	Site Name	Length (km)	Location	Impact on Annex I habitats			
				7110	7120	7150	91D0
000597	Carrowbehy	7.37	Inside High Bog	H	M	M	na
000600	Cloonchambers	n/av	Outside High Bog	M	M	M	na
000600	Cloonchambers	3.835	Inside High Bog	M	M	M	na
000604	Derrinea	n/av	Outside High Bog	M	M	M	na
000604	Derrinea	1.488	Inside High Bog	H	H	H	na
000614	Cloonshanville	n/av	Outside High Bog	H	H	H	H
000614	Cloonshanville	6.511	Inside High Bog	H	M	M	M
000641	Ballyduff	n/av	Outside High Bog	M	M	M	na
000641	Ballyduff	11.825	Inside High Bog	M	M	M	na
000641	Clonfinane	n/av	Outside High Bog	L	L	L	na
000641	Clonfinane	13.587	Inside High Bog	M	M	M	na
000647	Firville	n/av	Outside High Bog	M	M	M	na
000647	Firville	1.909	Inside High Bog	M	M	M	na
000647	Kilcarren	n/av	Outside High Bog	M	M	M	na
000647	Kilcarren	6.559	Inside High Bog	H	H	H	na
000679	Garriskil	n/av	Outside High Bog	M	M	M	na
000679	Garriskil	12.158	Inside High Bog	M	M	M	na
001242	Carrownagappul	n/av	Outside High Bog	M	M	M	na
001242	Carrownagappul	16.005	Inside High Bog	M	M	M	na
001818	Ballykenny	n/av	Outside High Bog	M	M	M	na
001818	Ballykenny	25.929	Inside High Bog	M	M	M	na
001818	Fisherstown	n/av	Outside High Bog	L	L	L	na
001818	Fisherstown	10.164	Inside High Bog	H	H	H	na
002110	Cloonfelloiv	n/av	Outside High Bog	M	M	M	na
002110	Cloonfelloiv	0.968	Inside High Bog	M	M	M	na
002110	Corliskea	n/av	Outside High Bog	L	L	L	L
002110	Corliskea	8.997	Inside High Bog	H	H	M	M
002110	Trien	n/av	Outside High Bog	M	M	M	M
002110	Trien	11.03	Inside High Bog	H	M	M	M
002298	Derrynabrock	n/av	Outside High Bog	M	M	M	na
002298	Derrynabrock	4.028	Inside High Bog	M	M	M	na
002298	Tawnaghbeg	n/av	Outside High Bog	M	M	M	na
002298	Tawnaghbeg	3.673	Inside High Bog	M	M	M	na
002333	Knockacoller	n/av	Outside High Bog	H	H	H	na

Site Code	Site Name	Length (km)	Location	Impact on Annex I habitats			
				7110	7120	7150	91D0
002333	Knockacoller	1.47	Inside High Bog	M	M	M	na
002336	Carn Park	n/av	Outside High Bog	M	M	M	na
002336	Carn Park	5.384	Inside High Bog	M	M	M	na
002337	Crosswood	n/av	Outside High Bog	H	H	H	na
002337	Crosswood	8.01	Inside High Bog	H	H	H	na
002346	Brown Bog	n/av	Outside High Bog	L	L	L	na
002347	Camderry	n/av	Outside High Bog	M	M	M	na
002347	Camderry	5.48	Inside High Bog	H	H	H	na
002349	Corbo	n/av	Outside High Bog	H	H	H	na
002349	Corbo	0.839	Inside High Bog	M	M	M	na
002350	Curraghleanagh	n/av	Outside High Bog	M	M	M	na
002350	Curraghleanagh	10.502	Inside High Bog	M	M	M	na
002351	Moanveanlagh	n/av	Outside High Bog	M	M	M	na
002351	Moanveanlagh	1.15	Inside High Bog	M	M	M	na
002352	Monivea	n/av	Outside High Bog	H	H	H	na
002352	Monivea	4.358	Inside High Bog	M	M	M	na
002353	Redwood	n/av	Outside High Bog	M	M	M	na
002353	Redwood	41.93	Inside High Bog	M	M	M	na

**Notes:**

Length provided corresponds with the length of functional and reduced-functional drains (including blocked drains if applicable)

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; n/av: not available; na: not applicable

<sup>1</sup> High bog drainage at Ballynafagh was given a H Importance/Impact on 7110 and 7150 habitats in 2011 by Fernandez *et al.* (2012). This has been revised during this project as drainage appears not to have caused any decrease or decline in the Area or S&F in the reporting period.

Drainage was reported as Drainage (J02.07)

### 3.5.3 Burning

Burning was reported by Fernandez *et al.* (2005) as frequently occurring on raised bogs and affected a total of 24 of the 48 raised bogs surveyed in the reporting period (1994/95-2004/05).

More recent data from this project's surveys (2011-2013) shows that burning took place at 14 of the 44 raised bogs surveyed. Burning was assessed as having a High Importance/Impact on ARB at Fisherstown; Medium at seven raised bogs and Low at four bogs (See table 3.20) and no impact on ARB at two sites where it took place. Burning had a High Importance/Impact on DRB at Fisherstown



and Carrownagappul; Medium at 6 raised bogs and Low at another six bogs. This activity was ranked at having a High Importance/Impact on Rhynchosporion depressions at Fisherstown; Medium at seven raised bogs and Low at six additional bogs. Burning affected Bog Woodland (91D0) at Corliskea and was given a Medium Importance/Impact (See Table 3.20). A High Importance/Impact indicates that habitat losses have taken place as a result of this activity.

Damage from burning on the high bog vegetation depends on the intensity and frequency of burning; and in some severe cases decreases the *Sphagnum* cover and thus the capacity to generate new peat.

The previous data is based on the 2011-2013 surveys during which the entire high bog surfaces were walked. The 2010 NPWS aerial photographs were used for the mapping burnt areas. Those fire events post 2010 were mapped based on field data. Fire events reported correspond with either recent events (<2 years) or older (2-5 years) severe fire events where the evidence from burning are still obvious on the ground. Additional fire events (e.g. light burning, small events) may have been overlooked and thus the above figures should be taken as a minimum value. The reported fire events damaged a total of 735ha out of 2,524ha of high bog, which accounts for 29% of the total extent of the 14 bogs where fire events were reported.

Burning may be in some cases associated with peat cutting, since high rates of cutting (i.e. high number of turf banks being cut away, high rate of high bog losses) were reported at six of the 14 raised bogs where fire events were reported (Callow, Carrownagappul, Corliskea, Crosswood, Monivea and Redwood). Fire events were also reported at bogs with low rates of cutting (Ballynafagh, Clonfinane, Flughany, Mongan and Shankill West), and bogs where peat cutting no longer takes place (Fisherstown and Firville) indicating that in these cases burning activity and peat cutting are not connected.

### **Burning trend**

A comparison between burning records reported by Fernandez *et al.* (2005) (24 raised bogs burnt out of 48) and the most recent data (14 raised bogs burnt out of 44) indicates a reduction in the frequency of burning. A similar trend is likely to have taken place in the remaining raised bog SACs. No information is available on the impact/frequency of burning on NHA designated raised bog or non-designated bogs.

**Table 3.20** Surveyed sites fire events summary

Site Code	Site Name	Area burnt (ha)	% high bog burnt	Impact on Annex I habitat			
				7110	7120	7150	91D0
000326	Shankill West	47.17	70.06	M	M	M	na
000391	Ballynafagh	48.37	69.04	M	M	M	na
000497	Flughany	132.5	88.68	M	M	M	na
000580	Mongan	50	40.20	L	L	L	na
000595	Callow	8.63	2.45	na	L	L	na
000641	Clonfinane	59.47	68.15	M	M	M	na
000647	Firville	14	7.62	L	L	L	na
000647	Kilcarren	22	12.17	L	L	L	na
001242	Carrownagappul	185	57.19	M	H	M	na
001818	Fisherstown	26.55	25.42	H	H	H	na
002110	Corliskea	70.6	25.58	M	M	M	M
002337	Crosswood	6	6.12	na	L	L	na
002352	Monivea	6	4.54	L	L	L	na
002353	Redwood	33.74	9.00	M	M	M	na

**Notes:**

The fire events reported above are those that were very obvious (i.e. vegetation moderately to severely damaged and large high bog extent damaged) on the ground as noted during the 2011-2013 fieldwork, which occasionally were already visible on the 2010 aerial photographs. Further fire events may have taken place in the 2007-2012 reporting period for the above sites and in some other sites. Minor fire events have not been recorded nor have fire events that pre-date 2005.

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; n/av: not available; na: not applicable

Burning was reported as Fire (J01)

### 3.5.4 Forestry

According to Fernandez *et al.* (2005), forestry, which mainly consists of coniferous plantations, is found either on the high bog or on the cutover area adjacent to the high bogs. Surface drainage is always associated with forestry plantations and has similar negative effects to that carried out to facilitate peat cutting. However, other impacts such as shading of vegetation and compression of the peat caused by heavy machinery are also related to afforestation.

Fernandez *et al.* (2005) reported that 4.36% (2,179ha) of the high bog surface of *intact* raised bogs in Ireland was afforested. A total of 8,040ha of secondary degraded raised bog have been planted with conifers. This corresponds to areas of very degraded raised bog (i.e. intensively drained, devoid of vegetation, cutover and cutaway) and subsequently planted. However, the actual extent of coniferous

plantation on cutover raised bog is likely to be higher, as the secondary degraded raised bog dataset was not accurately mapped as mentioned in the Discussion section. This data was obtained by intersecting Forest Inventory and Planning System (FIPS) 1998 maps with raised bog maps produced as part of Fernandez *et al.* (2005). Coniferous plantations encompass three class categories within FIPS maps (i.e. Conifers forestry, Cleared and Planting Grant applications). The year 2000 aerial photography was used to confirm the presence of coniferous plantations within these categories. Egan (1999) mentioned that in 1987, Coillte initiated a major afforestation programme on cutaway bog and up to 1998 over 4,000ha were planted.

**Table 3.21** Coniferous plantations on raised bog in Ireland (Fernandez *et al.* 2005)

	Extent (ha)	Coniferous plantations (ha)	% of planted high bog
Surveyed high bog (Active and DRB)	18,423	682	3.70
Un-mapped high bog (Presence of ARB unknown)	31,588	1,497	4.74
Subtotal	50,011	2,179	4.36
Secondary degraded raised bog	157,787	8,040	5.1
<b>Total</b>	<b>207,909</b>	<b>10,219</b>	<b>4.92</b>

**Note:**

Above figures were given by Fernandez *et al.* (2005), more recent data not available.

A review of the most recent Raised bog Monitoring surveys data shows that:

Forestry on the high bog was recorded at six raised bogs of the 44 surveyed (Ballynafagh, Bellanagare, Callow, Corliskea, Fisherstown and Tawnaghbeg). A total of 35.25ha of forestry on the high bog was mapped. Forestry was assessed as having a High Importance/Impact on ARB at Corliskea, being connected with actual habitat losses; Medium at Ballynafagh and Tawnaghbeg and Low in the remaining bogs. The activity was given a Medium Importance/Impact on DRB and Rhynchosporion depressions at Ballynafagh, Corliskea and Tawnaghbeg and Low in the remaining bogs. No impact on Bog Woodland (91D0) from this activity was reported (See Table 3.22).

Forestry on land adjacent to high bog was recorded at 27 of the 44 raised bogs surveyed. This activity was assessed as having a Medium Importance/Impact on ARB at Carrowbehy and Derrynabrock and Low at the remaining sites. Forestry on adjacent land was given a Medium Importance/Impact on DRB and Rhynchosporion depressions at Derrynabrock and Low in the remaining sites. No impact on Bog Woodland (91D0) from this activity was recorded (See Table 3.22). The approx extent of forestry on adjacent land having some sort of impact on high bog habitats is over 400ha (See Table 3.22).

## Forestry trend

The most recent Raised Bog Monitoring Surveys data shows that no new high bog plantations have been undertaken on the 44 sites surveyed. Indeed only one plantation (at Carrowbehy) seems to have been carried out adjacent to the high bog within the SAC boundary. However, more plantations may have also taken place on cutover outside SAC boundaries in the (2007-2012) reporting period.

Forestry on the high bog has been removed within the 2007-2012 period at six raised bogs (Kilsallagh, Lisnageeragh, Cloonshanville, Carn Park, Camderry and Curraghlehanagh). A total of 103ha were removed with an additional 3.14ha removed prior to 2005 at Carrowbehy.

Additionally, 115ha of conifer plantation adjacent to the high bog have been clear-felled at Curraghlehanagh, Crosswood, Killyconny, Lisnageeragh and Monivea (See Table 3.26).

The above figures given in table 3.21 by Fernandez *et al.* (2005) have changed in the new reporting period (2007-2012) as a result of the removal of high bog forestry. However more recent data on a national scale is not available.

According to NPWS (2007), grant aid for private forestry, which is administered by the Forest Service of the Department of Agriculture, Food and the Marine, was effectively controlled on designated peatlands. All grant-aided development in Ireland must conform to the Forest Service Forest biodiversity guidelines, which set out measures to protect existing habitats and wildlife and to maximise the biodiversity of forests.

Coillte Teoranta, one of the major owners of peatland in the country, has ceased planting conifers on intact peatlands in its ownership, on both economic and environmental grounds. It has also made strong commitments to the implementation of the Helsinki Process on Sustainable Forest Management and as part of their Nature Conservation Programme, Coillte has undertaken LIFE Raised Bog Restoration Projects (<http://www.raisedbogrestoration.ie/>) that have resulted in the felling of coniferous plantations and drain blocking on some raised bogs where it had plantations on or adjacent to the high bog in SACs and NHAs (e.g. Carn Park, Cloonshanville, Kilsallagh, Lisnageeragh) (See Table 3.26).

To summarise, the impact and threat to raised bog habitats from afforestation appear to be declining particularly on raised bogs designated as SACs. The current trend for NHA raised bogs and non-designated sites is unknown.

**Table 3.22** Surveyed sites forestry plantations summary

Site Code	Site Name	Area planted (ha)	Location	Impact on Annex I habitat			
				7110	7120	7150	91D0
000221	Moorfield Bog/Farm Cottage	8.15	Outside High Bog	L	L	L	na
000285	Kilsallagh	14.69	Outside High Bog	L	L	L	na
000296	Lisnageeragh	14.5	Outside High Bog	L	L	L	na
000326	Shankill West	6.2	Outside High Bog	L	L	L	na
000391	Ballynafagh <sup>1</sup>	10.84	Inside High Bog	M	M	M	na
000497	Flughany	0.04	Outside High Bog	L	L	L	na
000581	Moyclare	4.4	Outside High Bog	L	L	L	na
000585	Sharavogue	n/av	Outside High Bog	L	L	L	na
000592	Bellanagare	9.5	Inside High Bog	L	L	L	na
000592	Bellanagare	132	Outside High Bog	L	L	L	na
000595	Callow	6.55	Inside High Bog	L	L	L	na
000595	Callow	11.62	Outside High Bog	L	L	L	na
000597	Carrowbehy	6.4	Outside High Bog	M	L	L	na
000600	Cloonchambers	19	Outside High Bog	na	L	na	na
000604	Derrinea	n/av	Outside High Bog	L	L	L	na
000641	Ballyduff	n/av	Outside High Bog	L	L	L	na
000647	Firville	Unknown	Outside High Bog	L	L	L	na
000647	Kilcarren	Unknown	Outside High Bog	L	L	L	na
001242	Carrownagappul	59	Outside High Bog	L	L	L	na
001818	Fisherstown	1	Inside High Bog	L	L	L	na
001818	Fisherstown	13	Outside High Bog	L	L	L	na
002110	Corliskea	4.19	Inside High Bog	H	M	M	na
002110	Corliskea	7.5	Outside High Bog	L	L	L	na
002110	Trien	4	Outside High Bog	L	L	L	na
002298	Derrynabrock	3.84	Outside High Bog	M	M	M	na
002298	Tawnaghbeg	3.17	Inside High Bog	M	M	M	na
002298	Tawnaghbeg	32.8	Outside High Bog	L	L	L	na
002333	Knockacoller	15	Outside High Bog	L	L	L	na
002336	Carn Park	16	Outside High Bog	L	L	L	na
002346	Brown Bog	5	Outside High Bog	L	L	L	na
002350	Curraghlehanagh	13.5	Outside High Bog	L	L	L	na
002351	Moanveanlagh	5.8	Outside High Bog	L	L	L	na
002352	Monivea	11.4	Outside High Bog	L	L	L	na

**Notes:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; n/av: not available; na: not applicable

<sup>1</sup> High bog forestry at Ballynafagh was given a H Importance/Impact on raised bog habitats in 2011 by Fernandez *et al.* (2012). This has been revised during this project as although this activity and associated drainage continue drying out the high bog appears not to have caused any decrease or decline in the Area or S&F in the reporting period

Forestry was reported as Artificial planting on open ground (non-native trees) (B01.02)

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### 3.5.5 *Invasive and and problematic native species*

Fernandez *et al.* (2005) reported invasive species at 35 of the 48 raised bogs surveyed (See Tables 3.19 and 3.20). However, these were not considered a major threat to raised bog habitats in general but were described as being more impacting on specific sites. The most common invasive species were *Pinus contorta*, *Rhododendron ponticum* and *Sarracenia purpurea*. *Pinus sylvestris* was also described as an invasive species when it was found encroaching on the high bog, however now is deemed a problematic native species. Its origin was mostly adjacent coniferous plantations and the spread of pines was described as likely to indicate drying out of the high bog.

The more recent Raised Bog Monitoring Surveys (2007-2013) show that invasive species and problematic native species were recorded at 35 of the 44 raised bogs surveyed (See Table 3.23 and 3.24). They were only considered to have a High Importance/Impact on ARB at Moanveanlagh where *Sarracenia purpurea* dominates many areas and competes with native flora. A Low Importance/Impact on ARB was given to the remaining sites. Invasive species were given a High Importance/Impact on DRB at Moanveanlagh and Carn Park as a result of spreading of *Pinus contorta* in this site, and Low at the remaining bogs. Similarly to ARB, invasive species were only assessed as having a High Importance/Impact on Rhynchosporion depressions at Moanveanlagh. Only Sheheree was reported as invasive species (*Rhododendron ponticum*) having an impact (Low) on Bog Woodland (91D0).

*Pinus contorta*, *Rhododendron ponticum*, *Sarracenia purpurea* and *Campylopus introflexus* were reported as the most common invasive species.

The spread of *Pinus sylvestris* on the high bog rather than a being considered as a problem in its own right is considered to indicate ongoing drying out of the high bog caused by other impacting activities (e.g. drainage, peat cutting quarrying) creating more negative conditions on the high bog (e.g. All Saint's).

### **Invasive species and problematic native species trend**

Although comprehensive monitoring of invasive and problematic native species was not part of the more recent Raised Bog Monitoring Surveys, the results do not indicate any change in their extent or impact on high bog habitats on the raised bogs surveyed, except in specific cases (e.g. Moanveanlagh

where *Sarracenia purpurea* seems to have continued spreading). A similar scenario is likely to be found on the remaining raised bog SACs, as well as NHAs and non-designated sites. Thus, invasive species and problematic native species are given a Stable trend for the entire raised bog national resource.

**Table 3.23** Surveyed sites invasive species summary

Site Code	Site Name	Area affected (ha)	Impact on Annex I habitats			
			7110	7120	7150	91D0
000006	Killyconny	<0.1	L	L	L	na
000221	Moorfield Bog/Farm Cottage	<0.1	L	L	L	na
000285	Kilsallagh	<0.1	L	L	L	na
000296	Lisnageeragh	<0.1	L	L	L	na
000297	Addergoole	<0.1	na	L	na	na
000382	Sheheree	<1	L	L	L	L
000391	Ballynafagh	<0.05	L	L	L	na
000575	Ferbane	<0.1	na	L	L	na
000585	Sharavogue	<0.1	L	L	L	na
000592	Bellanagare	<0.1	L	L	L	na
000595	Callow	<0.1	L	L	L	na
000597	Carrowbehy	<0.1	L	L	L	na
000600	Cloonchambers	<0.1	L	L	L	na
000614	Cloonshanville	17.98	L	L	L	na
000641	Ballyduff	<0.1	L	L	L	na
000679	Garriskil	<0.5	L	L	L	na
001818	Ballykenny	<0.5	L	L	L	na
001818	Fisherstown	<0.1	L	L	L	na
002110	Cloonfelliv	<0.1	na	L	na	na
002110	Trien	<0.1	L	L	L	na
002336	Carn Park	<0.1	L	na	L	na
002336	Carn Park	54.86	na	H	na	na
002337	Crosswood	<0.5	L	M	L	na
002347	Camderry	<0.1	L	L	L	na
002350	Curraghleanagh	<0.1	L	L	L	na
002351	Moanveanlugh	<0.1	H	H	H	na
002352	Monivea	<0.1	L	L	L	na
002353	Redwood	<0.1	L	L	L	na

**Note:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; na: not applicable

**Table 3.24** Surveyed sites problematic native species summary

Site Code	Site Name	Area affected (ha)	Impact on Annex I habitats			
			7110	7120	7150	91D0
000575	Ferbane	<0.5	L	M	M	na
000581	Moyclare	4	M	M	M	na
000582	Raheenmore	<0.1	L	L	L	na
000641	Clonfinane	<0.1	L	L	L	na
000647	Firville	<0.05	L	L	L	na
000647	Kilcarren	<0.05	L	L	L	na
002337	Crosswood	<0.5	L	M	L	na
002346	Brown Bog	n/av	L	L	L	na

**Note:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; na: not applicable

### 3.5.6 *Other impacting activities*

Other impacting activities recorded at the sites and having some negative influence on high bog habitats included the following:

- Quarrying: recorded at All Saints, where it was deemed to have a High Importance/Impact on high bog habitats; Knockacoller where the activity was deemed to have Medium Importance/Impact and Killyconny where its influence on high bog habitats is unknown.
- Grazing: recorded at Curraghlahanagh, Moyclare and Garriskil, and deemed to have Low Importance/Impact.
- Motorised vehicles: recorded at Addergoole, Ballynafagh, Kilcarren and Tawnaghbeg and deemed to have Low Importance/Impact.

## 3.6 Management actions

### 3.6.1 *Restoration works*

According to the most recent Raised Bog Monitoring Surveys (2011-2013) data, restoration works have been undertaken at a total of 21 raised bogs of the 44 surveyed. Only works at Camderry (2005-07); Cloonshanville (2005-07); Crosswood (2005-07); Curraghlahanagh (2005-07); Killyconny (2006-09); Kilsallagh (2005 onwards); Lisnageeragh (2005-07) took place within the new reporting period (2007-2012). Restoration works were undertaken by the NPWS, Coillte or Bord na Móna. The positive effects from pre-2007 restoration works are still obvious in the majority of sites restored. Restoration works



mainly consisted of drain blocking and/or conifer plantation removal both on the high bog and cutover areas.

These actions have been ranked as having a High Importance/Impact on ARB within the 2004/05-2011/13 reporting period at 12 of the 21 raised bogs (See Table 3.26). A High value indicates that ARB has developed as a result of restoration works and major negatively impacting activities have not counteracted this positive trend. A Medium Importance/Impact on ARB was given at Bellanagare, Camderry, Carrowbehy, Crosswood, Curraghlehanagh, Killyconny, Moyclare and Sharavogue. Considerable improvements in DRB have been noted at Camderry, Killyconny and Sharavogue; this would have also indirectly halted further ARB losses within these sites. Although these restoration works encouraged the formation of small areas of new ARB at Bellanagare and Carrowbehy, negatively impacting activities (e.g. drainage and peat cutting) have counteracted the positive effects of restoration works and overall a net ARB loss took place. In the particular case of restoration works undertaken at Crosswood, which consisted of the removal of 39.1ha of cutover conifer plantations, the project had limited success. Restrictions were placed on drain blocking due to the concerns of adjacent turbary plot holders. Curraghlehanagh restoration works mostly consisted of the removal of conifers and blocking of drains on a 40ha cutover conifer area and a 1ha high bog area. This project did not result in the formation of new ARB, but has locally enhanced DRB quality. Restoration works at Moyclare consisted of high bog drain blocking. However, further ARB losses took place at this site, mostly related to ongoing damaged caused by drainage and peat cutting. A Low Importance/Impact was given to restoration works at Monivea where the area restored seems to be hydrological disconnected from the high bog. Restoration works were also undertaken at Firville, however, these were of a minor nature (only a few cutover drains blocked) and thus they are considered not to have any impact on high bog habitats.

Restoration works were assessed as having a High Importance/Impact on DRB and Rhynchosporion depressions at 17 bogs; Medium at five bogs (Carrowbehy, Crosswood, Curraghlehanagh, Lisnageeragh and Moyclare) and Low at Monivea. Increases in ARB extent in the 2004-2013 period were noted at 12 of the bogs surveyed (See Table 3.25). The increase in habitat extent was of significant extent in the following bogs: Lisnageeragh, Carrownagappul, Garriskil and Ballykenny.

Table 3.27 provides an overview of restoration works undertaken or planned in the Republic of Ireland raised bogs (as of April 2013). Restoration works have taken place or are planned on 46 bogs, of which 29 are SACs, 13 are NHAs and four are undesignated. The total area over which restoration works have been carried out or are planned to be carried out is 2,439ha, which accounts for is 30.17% of the total area of raised bog in these sites. DAHG has committed to undertake restoration works on designated raised bogs (SACs and NHAs) as part of the current National Raised Bog SAC

Management Plan in order to improve Conservation Status of ARB (See Section 3.6.2) (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>).

**Table 3.25** Surveyed sites where a significant increase in ARB due to restoration works occurred in the 2004-2013 period

Site Name	Increase in ARB Area (ha)
Lisnageeragh	13.18
Carrownagappul	9.87
Garriskil	5.5
Ballykenny	5.06
Carn Park	1.1
Raheenmore	0.81
Cloonshanville	0.67
Ballyduff	0.58
Fisherstown	0.5
Kilsallagh	0.45
Clonfinane	0.25
Mongan	0.1

**Table 3.26** Surveyed sites where restoration works were carried out

Site Code	Site Name	Activity code <sup>1</sup>	Area (ha)	Length (km) drain blocked	Comment	Impact on Annex I habitat				Date of works	Results assessment
						7110	7120	7150	91D0		
000006	Killyconny	4.2		0.32	HB drains blocked	M	H	H	Na	2006-2009	DRB quality enhancement
		4.2	6		Cutover drains blocked	M	H	H	Na		
		B02.02	9		Cutover conifers removed	M	M	M	Na		
000285	Kilsallagh	B02.02	9.43		HB conifers removed	H	H	H	Na	2005 onwards	DRB quality enhancement & ARB development
		4.2		0.91	HB drains blocked	H	H	H	Na		
000296	Lisnageeragh	B02.02	6.76		HB conifers removed	M	M	M	Na	2005-2007	DRB quality enhancement & ARB development
		4.2		4.53	HB drains blocked	H	H	H	Na		
		B02.02	18.7		Cutover conifers removed	M	M	M	Na		
000580	Mongan	4.2		8.89	HB drains blocked	H	H	H	Na	1983/4 & 1997	DRB quality enhancement & ARB development
000581	Moyclare	4.2		2.78	HB drains blocked	M	M	M	Na	1995-2005	No obvious improvements (damaging activities continue); restoration likely to have halted greater ARB losses
000582	Raheenmore	4.2		9.49	HB drains blocked	H	H	H	na	1994/1999	DRB quality enhancement & ARB development
		4.2		Na	3 peat dams	H	H	H	na		
000585	Sharavogue	4.2		21.91	HB drains blocked	M	H	H	na	1992 & 1996/97	DRB quality enhancement
		4.2		Unkn own	Cutover drains blocked	M	H	H	na		
000592	Bellanagare	4.2		34.14	HB drains blocked	M	H	H	na	1994-1999	DRB quality enhancement & ARB development

Site Code	Site Name	Activity code <sup>1</sup>	Area (ha)	Length (km) drain blocked	Comment	Impact on Annex I habitat				Date of works	Results assessment
						7110	7120	7150	91D0		
000597	Carrowbehy	B02.02	3.14		HB conifers removed	M	M	M	na	Prior 2005	DRB quality enhancement & ARB development
		4.2		4.49	HB drains blocked	M	M	M	na		
000614	Cloonshanville	B02.02	17.98		HB conifers removed	H	H	H	H	2005-2007	DRB quality enhancement & ARB development
		4.2		0.17	HB drains blocked	H	H	H	H		
000641	Ballyduff	4.2		9.30	HB drains blocked	H	H	H	na	2003	DRB quality enhancement & ARB development
000641	Clonfinane	4.2		13.69	HB drains blocked	H	H	H	na	1997-1998	DRB quality enhancement & ARB development
000679	Garriskil	4.2		11.95	HB drains blocked	H	H	H	na	1998	DRB quality enhancement & ARB development
001242	Carrownagappul	4.2		4.56	HB drains blocked	H	H	H	na	2003	DRB quality enhancement & ARB development
001818	Ballykenny	4.2		25.93	HB drains blocked	H	H	H	na	2003	DRB quality enhancement & ARB development
		4.2		Unkn own	Cutover drains blocked	H	H	H	na		
001818	Fisherstown	4.2		9.42	Cutover drains blocked	H	H	H	na	2006	DRB quality enhancement & ARB development
002336	Carn Park	B02.02	54.86		HB conifers removed	H	H	H	na	2005-2006	DRB quality enhancement & ARB development
		4.2		3.78	HB drains blocked	H	H	H	na		
002337	Crosswood	B02.02	39.1		Cutover conifers removed	M	M	M	na	2005-2007	No obvious improvements (damaging activities continue); restoration

Site Code	Site Name	Activity code <sup>1</sup>	Area (ha)	Length (km) drain blocked	Comment	Impact on Annex I habitat				Date of works	Results assessment
						7110	7120	7150	91D0		
		4.2		n/av	Cutover drains blocked	M	M	M	na		likely to have halted greater ARB losses
002347	Camderry	B02.02	13.44		HB conifers removed	M	H	H	na	2005-2007	DRB quality enhancement
		4.2		0.64	HB drains blocked	M	H	H	na		
002350	Curraghleanagh	4.2		n/av	HB drains blocked	M	M	M	na	2005-2007	DRB quality enhancement
		4.2		n/av	Cutover drains blocked	M	M	M	na		
		B02.02	1		HB conifers removed	M	M	M	na		
		B02.02	39.7		Cutover conifers removed	M	M	M	na		
002352	Monivea	B02.02	9.3		Cutover conifers removed	L	L	L	na	2006	Restoration area appears to be a separate hydrological unit to the high bog; no obvious improvements reported
		4.2		n/av	Cutover drains blocked	L	L	L	na		

**Notes:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; n/av: not available; na: not applicable

<sup>1</sup> 4.2: Restoring/Improving the hydrological regime; B02.02: Forestry clearance

**Table 3.27** Raised Bogs restoration in Ireland (up to early 2013)

Site Code	Site Name	Designation	County	Restoration	Restoration Area including planned restoration (ha) <sup>1</sup>	High bog area 1994/2000 (ha)
000006	Killyconny	SAC	Meath/Cavan	Undertaken	45	83.26
000229	Ballygar Bog	NHA	Galway	Planned	29	106.3
000281	Keeloges Bog	NHA	Galway	Planned	4	222
000285	Kilsallagh	SAC	Galway	Undertaken	29.7	186.43
000296	Lisnageeragh	SAC	Galway	Undertaken	51.4	263.83
000301	Lough Lurgen Bog/Glenamaddy Turlough	SAC	Galway	Undertaken	14.3	603.93
000440	Clooncraff and Cloonlarge/Lough Ree	SAC	Roscommon	Undertaken and Planned	61	524.34
000572	Clara	SAC	Offaly	Undertaken	239	446.32
000580	Mongan	SAC	Offaly	Undertaken	24.4	124.6
000581	Moyclare	SAC	Offaly	Undertaken	27.3	76.04
000582	Raheenmore	SAC	Offaly	Undertaken	36.6	132.23
000585	Sharavogue	SAC	Offaly	Undertaken	49.2	137.88
000592	Bellanagare	SAC	Roscommon	Undertaken	141.8	853.97
000597	Carrowbehy	SAC	Roscommon	Undertaken	9.1	203.44
000614	Cloonshanville	SAC	Roscommon	Undertaken	34.2	147.07
000640	Arragh More Bog	NHA	Tipperary	Planned	101	179.5
000641	Clonfinane	SAC	Tipperary	Undertaken	51.1	86.05
000641	Ballyduff	SAC	Tipperary	Undertaken	14.7	90.72
000674	Ballynagrenia and Ballinderry	NHA	Westmeath	Undertaken	52	174.1
000679	Garriskil	SAC	Westmeath	Undertaken	28.3	170.17
000684	Lough Derravaragh	NHA	Westmeath	Planned	26	49
000694	Wooddown Bog	NHA	Leitrim/ Longford	Planned	51	115.4
000890	Cangort Bog	NHA	Offaly/ Tipperary	Planned	13	54
000937	Scohaboy Bog	NHA	Tipperary	Undertaken	121.4	214.2
000985	Lough Kinale and Derragh Lough	NHA	Cavan	Planned	37	7.4

Site Code	Site Name	Designation	County	Restoration	Restoration Area including planned restoration (ha) <sup>1</sup>	High bog area 1994/2000 (ha)
001227	Aughrim Bog	NHA	Galway	Planned	45	158.9
001242	Carrownagappul	SAC	Galway	Undertaken	57.5	328.15
001254	Derrinlough Bog	NHA	Galway	Planned	57	131.3
001388	Carbury Bog (Ardkill)	NHA	Kildare	Undertaken	41.8	80.9
001580	Girley Bog	NHA	Meath	Undertaken +	41	68.4
001818	Ballykenny	SAC	Longford	Undertaken	137.4	187.88
001818	Fisherstown	SAC	Longford	Undertaken and planned	35.3	102.63
002332	Coolrain Bog	SAC	Laois	Undertaken	56.5	54.71
002336	Carn Park bog	SAC	Westmeath	Undertaken	132.2	156.17
002337	Crosswood	SAC	Westmeath	Undertaken	42.7	103.42
002338	Drumalough East	SAC	Roscommon	Undertaken	43.2	82.23
002340	Moneybeg and Clareisland Bogs	SAC	Meath/Westmeath	Planned	16	142.08
002341	Ardagullion bog	SAC	Longford	Undertaken	25	57.64
002342	Mount Hevey	SAC	Meath/Westmeath	Undertaken	58.2	221.29
002347	Camderry	SAC	Galway	Undertaken	13.8	193.41
002350	Curraghlahanagh	SAC	Galway	Undertaken +	51.7	149.2
002352	Monivea	SAC	Galway	Planned	9	145.15
Not-designated	Killamuck (Abbeyleix) Bog	Not applicable	Laois	Undertaken	109	109
Not-designated	Lodge Bog	Not applicable	Kildare	Undertaken	35	35
Not-designated	Derrydoo-Woodlough	Not applicable	Galway	Undertaken	80	200
Not-designated	Cuckoo Hill Bog	Not applicable	Roscommon	Undertaken	60	124
<b>Total</b>					2,439	8,084

**Notes:**

<sup>1</sup> Restoration Area including planned restoration (ha) includes restoration works on the cutover areas in some sites. All sites where restoration works are planned will be completed by 2015.

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### 3.6.2 *National raised bog conservation programme*

The Department of Arts, Heritage and the Gaeltacht initiated a new national raised bog conservation programme in April 2013:

(<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). This includes the following:

- Development of national conservation objectives for the Active and Degraded raised bog habitats and site-specific conservation objectives for the raised bog SACs and selected compensatory sites.
- Development, along with the Peatlands Council, of a National Raised Bog SAC Management Plan.
- Development, along with the Peatlands Council, of an approach to the management of Raised Bog Natural Heritage Areas consistent with national conservation objectives.
- Preparation of draft hydrological / restoration plans for the SACs and compensatory sites to ensure that the national and site specific objectives are technically feasible and sustainable.
- Identification of priorities for undertaking works and further investigations to facilitate the implementation of the subsequent restoration programme.
- Production of guidance documents for all main technical elements of the restoration works.
- Identification and assessment of possible compensatory habitat for areas lost since SACs were nominated for designation.



## 4 Discussion

### 4.1 Habitat mapping

#### 4.1.1 *Mapping of habitats at site level*

Appendix 14 includes a list of all the community complexes recorded during the 2011 to 2013 surveys, the majority of which are described in Appendix 3. As this appendix illustrates, a total of seven central ecotope community complexes have been recorded. A total of 57 sub-central ecotope community complexes have been recorded. Five of the sub-central community complexes (9/7/6+P, 9/7/6+TP, 9/7/4+P, 6+P and 6/9+P) have the same names as sub-marginal community complexes. Although similar species characterise (i.e. dominate) the community complexes with the same name, the *Sphagnum* cover is lower in the sub-marginal ecotope complexes.

The face bank ecotope only consists of three different community complexes, as shown in Appendix 14.

Appendix 14 shows a high number of sub-marginal (141) and marginal (88) ecotopes community complexes recorded. The new surveys have consistently used complex names identified in the original surveys (Fernandez *et al.* (2005) and Derwin & MacGowan (2000)) on each site. However, the number of complexes recorded per site has been reduced by amalgamating complexes with similar characteristics during the more recent surveys (2011-2013). Despite the attempt to reduce the number of community complexes reported, the final total number of sub-marginal and marginal community complexes is rather high. This highlights the need for a comprehensive analysis of the different sub-marginal and marginal vegetation types in order to generate a more manageable list of community complexes within these ecotopes.

#### 4.1.2 *National raised bog resource*

Only 24.06% (49,933ha) of the currently known extent of raised bog (207,525ha) remaining in the country consists of *intact* high bog (See Figure 3.1). The overall extent of secondary degraded raised bog is 157,592ha. Secondary degraded raised bog is the only raised bog resource type remaining in counties Louth and Limerick. Detailed habitat data (i.e. ecotope level) is not available for the few hectares of intact raised bog remaining for counties Carlow, Cork and Monaghan. Nevertheless, there is a very low chance of finding ARB in these areas, due to their small extent and highly modified/impacted nature. Hammond (1979) estimated that there were approximately 310,000ha of raised bog in the country at that time. This is 49.38% larger than currently reported. Visual validation of the 2000 OSi aerial photographs shows areas of secondary degraded raised bog (e.g. cutover areas)

that should be included in this dataset and also high bog areas currently included in this dataset that should be included in some of the other datasets (e.g. RBMA13\_unsurveyed\_data\_prior\_2007). Therefore both total raised bog resource extent (207,525ha) and the *intact* high bog extent (49,933ha) are likely to be underestimated.

Traditional cutting of bogs by turbary over the last 400 years has had a serious impact on raised bogs and 68% of their extent has been cut away by this process (Hammond 1979, Ryan & Cross, 1984, Cross 1990). The mechanisation of peat cutting combined with a grant aid scheme under the Turf Development Act (1981) enabled many small scale extraction programmes to get underway and has resulted in further losses of the raised bog resource. The most serious impact of mechanisation has been on midland raised bogs, accounting for a loss of 22% of the resource in less than 50 years (Cross, 1990). Only 8% of the original peatland area remaining in 1984 was considered suitable for conservation (Ryan & Cross, 1984). Further losses have occurred in the last two decades but despite this, the Republic of Ireland still has the most extensive area of conservation worthy sites remaining in Western Europe.

Two datasets depicting peatland coverage, in addition to the ones used in this report to map the raised bog national resource, are currently available. These are the most recent Corine 2006 Land Cover (CLC) Map produced by the EPA and the revised Peat Soils Map generated by Connolly and Holden (2009). The first consists of two separate spatial datasets: a) the National vector dataset of CLC changes larger than 5 ha between 2000 and 2006 (CHA06) in Irish National Grid coordinates and b) National vector dataset of CLC data for 2006 (CLC2006) in Irish National Grid (25 ha minimum mapping unit). Connolly and Holden (2009) Peat Soils Map consists of a shapefile that illustrates the spatial extent of peat soils in the Republic of Ireland, as derived from the following sources: The Peatland Map of Ireland (Hammond 1979); The Indicative Soil Map of Ireland (Fealy & Green, 2009) and The CORINE 2000 land cover map. Visual validation of the Peat Soils Map against the 2000 OS aerial photographs indicates that some of the areas identified as raised bog soils on the map no longer correspond with raised bog habitat, or secondary degraded raised bog. On the other hand, some areas (e.g. north Leitrim and north Sligo) listed in the Peat Soils Map as raised bog soils are not included in the currently reported national raised bog datasets updated in this report (e.g. RBMA13\_unsurveyed\_data\_prior\_2007). Some of the areas mapped as raised bog soils may correspond with lowland blanket bog instead of raised bogs. Thus, the review of this dataset to identify additional raised bog resource records is highly recommended.

The un-surveyed *intact* high bog dataset (i.e. RBMA13\_unsurveyed\_data\_prior\_2007) encompasses 31,604ha and includes intact high bog areas that are both designated (3,289ha or 10.41%) and un-designated (28,315ha or 89.59%). Some of these areas may still contain ARB, as highlighted by the Bord na Móna 2009 surveys. Thus, the occurrence of ARB within some areas, particularly those greater

than 60ha, is possible. Some of these sites particularly those containing ARB could be considered as compensatory habitat for those ARB and DRB areas lost since the Habitats Directive came into force in Ireland in 1994.

Secondary degraded raised bog habitat, which currently does not correspond with the strict definition of DRB, may in some cases have a higher potential for restoration to ARB than areas currently classified as DRB. These habitat areas may be particularly important in those geographical locations where secondary degraded raised bog is the only raised bog habitat type remaining (northeast county Mayo, northwest county Kerry). On the other hand, there are areas currently classed as DRB that are so highly modified (e.g. on steep slopes; small high bog sections remaining; high bog areas with increased vertical water losses (deep cracks underneath)) by impacting activities (i.e. peat cutting and drainage) that they no longer have suitable conditions for the development of ARB.

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#### 4.1.3 *National Active and Degraded Raised Bog habitats distribution and Range maps*

The actual Area, distribution and Range of ARB are likely to be slightly different than reported. The habitat may be present in un-mapped *intact* high bog areas (i.e. 29,816ha (59.71%) out of 49,933ha), as identified recently by the Bord na Móna (2009) surveys (See Figure 3.1). However, the possibility of occurrence within many of these areas is small as many of them are likely to be highly degraded. On the other hand, 50.13% (980ha) of the 1,955ha of ARB calculated corresponds with data collected before 2007. The actual Area of ARB within these sites is likely to be smaller now due to habitat losses caused by ongoing impacting activities. However, it needs also be realised that the 2011 to 2013 surveys frequently found new small areas of ARB as a result of a more comprehensive surveying compared with previous surveys. More accurate mapping of ecotope boundaries has also resulted in the amendment of ARB areas in many sites. Both higher mapping accuracy and more comprehensive surveying may also result in changes in the habitat extent of sites surveyed before 2007.

The number of 10km cells containing ARB has not changed in the 2007-2012 period. Cell N19 within counties Longford and Leitrim, which was reported as containing ARB, is now considered not to contain ARB. This is the result of habitats re-interpretation rather than an actual loss. Bord na Móna (2009) data intersects two new cells (M84 and M93). ARB would have been already present within them in 2006/07, according to Bord na Móna (Bord na Móna Ecology Team, pers. comm. 2013). Fernandez *et al.* (2009b) reported a new ARB record in the 2007-2013 reporting period at Killamuck (Abbeyleix) bog. This new record intersects cell S48 in county Laois, but the habitat is also considered to be already present in 2006/07. Therefore, although NPWS (2007) reported originally 76 10km cells in 2007, the actual habitat Range at that time is now considered to be 78 cells; this change is due to improvement in knowledge.

As already mentioned, the actual Area, distribution and Range of DRB may be larger than that illustrated by figures given within this report. Some additional records of *intact* high bog may be also present within the secondary degraded raised bog (i.e. RBMA13\_2dary\_DRB\_unsurveyed) dataset. The secondary degraded raised bog dataset was mostly generated from the degraded raised bog category in 2000 Corine land cover map (EPA, 2000). Corine classifies coniferous plantations on peat soils as a conifer habitat and not as Degraded Raised Bog. Other exceptions may also be found (i.e. small sections of very Degraded Raised Bog classed as another habitat type). In addition, large areas of land surrounding current raised bog have also been reclaimed for agriculture, but most of these will have significant areas of peat soils.

#### 4.1.3.1 Recommendations

The high number of sub-marginal and marginal ecotopes community complexes reported during the 2011 to 2013 surveys highlights the need for a comprehensive analysis of the different sub-marginal and marginal vegetation types in order to generate a simplified and thus manageable list of community complexes within these ecotopes. The more recent surveys reported a series of sub-central ecotope community complexes (complex 10, 7/10, 7/10+My, 7/10+My+Mol, 7/10+Mol+My+Ulex, 3/9+P and 6/3+P) not previously listed or described by Fernandez *et al.* in 2005 (See Appendices 2 and 3). The Fernandez *et al.* (2005) key (Appendix 2) and description of the most common central and sub-central ecotope community complexes (Appendix 3) was an attempt to list and describe raised bog vegetation based on the their vegetation surveys, expert knowledge and following the Kelly (1993) and Kelly and Schouten (2002) vegetation classification. However, no statistical analysis was undertaken. This key was used in the 2011/13 surveys and surveyors felt that the minimum *Sphagnum* cover should in general be increased in the Key and ARB ecotopes descriptions.

To summarise, taking into account the shortcomings of the key (Appendix 2) and vegetation descriptions (Appendix 3), a more statistically based analysis and classification of raised bog vegetation is recommended in order to generate a more manageable list of community complexes per ecotope. This should also cover cutover areas as well as high bog vegetation, particularly under those circumstances where restoration works were undertaken and where active peat forming vegetation may have developed.

The improvement and refinement of the secondary degraded raised bog dataset is recommended. This should include a review of additional secondary degraded raised bog areas currently not included in this dataset and a re-digitising of the dataset to improve its accuracy as well as reclassifying some of the *intact* high bog areas currently found within this dataset to the un-surveyed high bog dataset (e.g. RBMA13\_unsurveyed\_data\_prior\_2007). This process should also include the review of the two datasets more recently available (Corine, 2006 and Peat Soil Map (Connolly and Holden, 2009)) as

these will provide new raised bog resource records. Some of these may correspond with actual *intact* high bog, which would require the review of current distribution and Range maps for DRB and in some cases ARB.

The classification of those un-surveyed *intact* high bog areas (i.e. RBMA13\_unsurveyed\_data\_prior\_2007) based on their potential to support ARB is recommended. Botanical surveys are required to determine whether active peat forming communities are present within those areas of un-surveyed high bog (i.e. 29,816ha (59.71%) out of 49,933ha) (See Figure 3.1) with higher potential to support the habitat. Some of these areas could be considered as compensatory habitat for those ARB and DRB areas lost since the Habitats Directive came into force in Ireland in 1994.

Resurvey of sites with significant areas of ARB where only data prior to 2007 is available is recommended. These sites contain 50.13% (980ha) of 1,955ha of ARB and the previously reported extent may have decreased significantly since the last survey due to ongoing damaging activities (e.g. peat cutting and drainage).

## 4.2 Conservation status assessment

A new criterion to assess the conservation status of raised bog habitats has been developed and implemented. This is based on the definition of Favourable Reference Values for both Area and S&Fs at site level. FRVs are values that should be achieved (targets) in order for a habitat to reach a Favourable Conservation Status. The Future Prospects for each of these two parameters to achieve the targets in two reporting periods (12 years) is also assessed. The Future Prospects are assessed for the Range (only at national level), Area and S&Fs at two levels (Status and Trend) based on the overall impact of negative (e.g. peat cutting, drainage) and positive activities (e.g. restoration works) on the habitat. Achieving Favourable Conservation Status for Annex I habitats is an objective under Article 2 of the Habitats Directive. These reference values have to be at least equal to the value when the Directive came into force, i.e. in 1994 or greater than this value if the long term viability of the habitat is not assured. The exception to this rule is DRB (capable of regeneration in 30 years) as this habitat Area should reduce if it is successfully restored to ARB. Current national ARB Area FRV is based on the extent of raised bog resource (ARB and DRB) within designated sites, while the site level Area FRV is based on the extent of central/sub-central ecotopes and active flush, plus the area of sub-marginal ecotope when the Directive came into force in 1994. In the cases of DRB, Area FRV is estimated to be equal to the area of marginal and face bank ecotopes when the Directive came into force. These values are only approximate until further topographical and hydrological surveys allow the establishment of more feasible FRVs. A more accurate estimation of FRVs will help to determine which high bog areas

and bogs are most suitable for restoration to ARB and which ones are not due to their highly modified nature (steep slopes, mounds, vertical water losses due to internal peat cracks).

The ongoing NPWS national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>) is reviewing the national and site level conservation objectives. This work includes development of techniques to allow the establishment of more accurate FRVs.

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#### 4.2.1 *Active Raised Bog conservation status assessment*

**Range** has been assessed as **Unfavourable Bad-Stable** as the current Range value is more than 10% below the FRV, and no change in the Range value has been recorded in the reporting period.

**Area** has been assessed as **Unfavourable Bad-Decreasing** at national level, as current Area value is more than 15% below the FRV and its extent has decreased in the reporting period. However, only a slight decrease (approx. 1.5%) has been reported in the 2007-2012 period. This decrease is substantially smaller than the 36.8% reported in 2007. Fernandez *et al.* (2005) mentioned that the 36.8% figure could have been slightly overestimated due to differences (e.g. vegetation interpretation and mapping techniques) between the 2005 survey and the original surveys undertaken by Kelly *et al.* (1995). However they considered that the real decrease in habitat Area between 1995 and 2005 was unlikely to be lower than 25%.

Although habitat (ecotope) data used in the 2007 assessment, which compared 1990s and 2004/05 data, and this project's assessments are based on similar methodologies (ecotope mapping), the comparison of the more recent survey data (2004/05 and 2011/2013) is more reliable, as both employed high accuracy mapping equipment (GPS minicomputers). The use of this equipment has allowed much more accurate mapping than mapping methods used in 1994/95 (See section 4.1) when such equipment was not available. Slight discrepancies in ecotope interpretation between the 1990s and 2004/05 surveys were also mentioned in 2007 assessments. However, the 2007 assessments tried to minimise discrepancies caused by differences on surveying techniques, and thus making data comparison more reliable, by allowing a 5% mapping error, as well as re-interpreting some 1990s vegetation types. For instance, some 1994/95 sub-central ecotope areas were re-assigned to sub-marginal ecotope and thus the original ARB ecotope extent reduced accordingly. Thus, although the 2007 assessment may have slightly overestimated habitat losses in the 1994/95-2004/05 period, as already mentioned by Fernandez *et al.* (2005), considerable habitat losses took place in the reporting period. In addition, the 2007 assessments identified a direct relationship between habitat losses and major impacting activities at the sites monitored.

The 1.5% decrease in ARB area in the 2007-12 period compared to the 25 to 36.8% decrease figure reported in 2007 shows a more positive scenario (albeit still negative). The reasons for this reduction in rate of losses are a combination of a number of factors. These include the implementation of peat cutting cessation schemes which resulted in a decline in peat cutting rates and cessation in many sites; the fact that few new drains have been inserted on high bog in the new reporting period (2007-2012) and the positive effects of restoration works, with many sites showing new active peat forming areas. The effects of extensive drainage works undertaken in the 1980-1990s period would have continued to cause major habitat losses in the 1994/95-2004/05 period. However, this rate of loss would be expected to decrease over time as the more vulnerable areas were impacted initially and the natural blockage of drains by *Sphagnum* growth would have further reduced the drainage impact and therefore the rate of loss.

S&Fs have been assessed as **Unfavourable Bad-Stable**. Although a slight decrease in habitat quality has been noted within the 44 raised bogs monitored, the habitat quality is considered not to have changed overall at these raised bogs in the reporting period. These results have been extrapolated to national level. The S&Fs assessment is based on the current extent of the highest quality vegetation types within the habitat (central and active flush/soaks) versus FRVs and its change in a reporting period. This is a simplified method to assess the habitat condition (quality) and other attributes such as site hydrological regime, water quality, microtopography, range of zones, good quality indicator species, negative indicators, typical species, *Sphagnum* spp. cover, indicators of local distinctiveness could be used in order to assess the S&Fs as listed in the habitat National Raised Bog SAC Management Plan (NPWS, in prep). Nevertheless, a high percentage of high quality vegetation (central and active flush) within a site suggests that the targets of these additional attributes are being met.

The 2011-13 Monitoring programmes have detected slight changes within the quadrats resurveyed. This may indicate changes of vegetation towards either more degraded (i.e. drier) or better (i.e. wetter) conditions, but it should be realised that some of these changes may have also occurred as a result of natural transitional processes (e.g. *Sphagnum* hummocks may grow and replace lawns, certain *Sphagnum* species may replace others as the microtopography changes). Therefore, changes cannot be analysed out of context (i.e. natural change and change due to impacting activities need to be considered together). However, many of the changes noted are the result of discrepancies in the quadrat location (up to 2m) between both year surveys despite the use of highly accurate surveying equipment (GPS minicomputers (Trimble GeoXT)). The use of permanent quadrats in the 2011/13 surveys is expected to minimise the discrepancy due to quadrat location in the next reporting period.

The overall conservation status assessment at site level shows the direct correlation between restoration works and improvements in the habitat conservation status as well as lack of major

negatively impacting activities. On the other hand, where restoration works were undertaken on some sites with a negative conservation status (i.e. negative trend), major negatively impacting activities continue to hinder the habitats recovery despite the positive effects of restoration works. Restoration works were not undertaken in many other sites and impacting activities (i.e. peat cutting and drainage) continue to threaten the habitat. Thus, an **Unfavourable Bad-Declining Future Prospects** assessment has been given to the habitat in the majority of sites monitored and at national level.

The national assessments are based on the results of individual assessments undertaken for 44 raised bogs, mostly designated as SAC (43 out of 44). As mentioned within the Impacts and Threats section of the report, the current peat cutting cessation scheme and restoration works are focused on SAC raised bogs, which account for 71.61% of the known national resource. This leaves the remaining 28.39% of the resource in a much more negative situation (i.e. negatively impacting activities continue to seriously threaten the habitat). Peat cutting rates have increased within NHAs (Ryan, J., pers. comm., 2013) and drainage continues to damage the habitat as very few restoration works have been undertaken within NHAs. Thus, the conservation status of the habitats within NHAs and non-designated sites is likely to be much more negative than the ones for SAC raised bogs. Their conservation is essential to prevent habitat losses and preserve the habitat's Range.

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#### 4.2.2 *Degraded Raised Bog conservation status assessment*

**Range** has been assessed as **Favourable-Stable**. As current Range value corresponds with FRV and there has been no change in the extent of the Range in the reporting period.

**Area** has been assessed as **Unfavourable Bad-Decreasing** at national level, as current habitat Area is more than 15% above the FRV and a Decreasing trend has been noted in the reporting period. Habitat losses are the result of a combination of both negatively impacting activities (e.g. peat cutting) and positive impacting activities (i.e. restoration work). The latter re-wetted high bog areas and as a result marginal ecotope turned into sub-marginal and/or ARB. However, a large proportion of the losses are due to the direct and irreversible loss of high bog caused by peat cutting. Peat cutting causes an expansion of marginal and face bank ecotopes and thus also a decline in quality (S&F).

The FRVs of the ARB and DRB conservation status assessments are linked. However, it is not considered that these values should be zero for DRB national level. Ireland is obliged to ensure that Favourable Conservation Status is achieved for both Active and DRB, which may not necessarily require the restoration of the total national area of DRB. Ireland was obliged to designate areas of DRB that were capable of regeneration to ARB. The aim is to restore a certain amount of DRB to ARB throughout its Range and this will result in a reduction of the Area of DRB, but not necessarily a change in the current Range of DRB.



S&Fs have been assessed as **Unfavourable Inadequate-Declining**. This decline is directly related to declines in quality caused by peat cutting. The S&Fs conservation status assessment is based on the change in the extent of the poorest quality vegetation types within the habitat (marginal and face bank) in a reporting period. This is a simplified method to assess the habitat condition (quality) and other attributes such as site hydrological regime, water quality, microtopography, range of zones, good quality indicator species, negative indicators, typical species, *Sphagnum* spp. cover, indicators of local distinctiveness could be used in order to assess the S&Fs as listed in the National Raised Bog SAC Management Plan (NPWS, in prep.). Nevertheless, an increase in the extent of marginal and face bank ecotopes within a site indicates a bad condition of the above attributes.

The overall conservation status assessment at site level shows the direct connection between restoration works and improvements in the habitat's conservation status as well as lack of major negatively impacting activities. On the other hand although restoration works were undertaken on some sites with negative conservation status (i.e. negative trend), major negatively impacting activities continue to hinder the habitats recovery despite the positive effects of restoration works at these sites. Restoration works were not undertaken in many other sites and impacting activities (i.e. peat cutting and drainage) continue to threaten the habitat. Peat cutting continues to directly cause irreversible losses of high bog and thus habitat losses. Thus, an **Unfavourable Bad-Declining Future Prospects** assessment has been given to the majority of the sites monitored and at national level.

The national assessments are based on the results of individual assessments undertaken for 44 raised bogs, mostly designated as SAC (43 out of 44). As mentioned within the Impacts and Threats section of the report, the current peat cutting cessation scheme and restoration works are focused on SAC raised bogs, which account for 21.61% of the known national resource. Leaving the remaining 78.39% resource under a much more negative situation (i.e. negatively impacting activities continue seriously threatening the habitat). Peat cutting rates have increased within NHAs (Ryan, J., pers. comm., 2013) and drainage continues to damage the habitat as very few restoration works were carried out within NHAs. Thus, the habitat conservation status of those habitat samples within NHAs and non-designated sites is likely to be much more negative than the ones for SAC raised bogs. Their conservation is essential to prevent habitat losses and preserve the habitat Range.

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#### 4.2.3 *Bog Woodland conservation status assessment*

The new surveys have shown a reduction in the Area of Bog Woodland habitat at three of six sites surveyed (Cloonshanville, Trien and Sheheree). However, this is the result of a more comprehensive surveying and accurate mapping, as well as a more precise definition of the canopy cover required for a wooded area to be considered woodland (> 30%) within the 2011-13 surveys. This change implies

that the habitat Area should be revised for any other Bog Woodland site on those raised bogs not surveyed in the 2011-2013 period.

*Pinus sylvestris* is no longer reported as a non-native species but is generally considered to be a problematic native species on the high bog. An increase in its cover is likely to indicate further drying out within the high bog. This highlights the need to incorporate the species into the Bog Woodland assessment sheet as part of the structural data indicators in order to monitor any change in its cover. A <10% cover per monitoring stop should be considered (Cross J., pers. comm., 2013).

The survey results shows that the extent of Bog Woodland is very small (<1ha) at three of the six sites surveyed: Corliskea, Trien and Sheheree. The minimum extent needed for a wooded area to be considered woodland should be revised and defined more precisely.

The 2011-13 surveys have shown a general lack of large dbh (>20cm) *Betula pubescens* trees in many of the sites surveyed (Addergoole, Corliskea, Trien), as well as an absence of old trees & dead material at Addergoole, Corliskea, Trien and Sheheree. Thus, rather than being a negative indication of the status of this woodland type, these may be common characteristics of Bog Woodland on raised bogs, likely to be particularly influenced by the small size of these woodlands, which allow little variation within them.

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#### 4.2.4 Peat cutting

Peat cutting has been assessed as having a High Importance/Impact on ARB at 11 of the 32 bogs reported as being cut (as the assessment indicates the activity is directly connected with habitat losses) within the reporting period; Medium at three bogs (as the assessments indicate that peat cutting is having some impact on the habitat but no direct habitat losses were recorded in the reporting period); Low at 17 raised bogs (as peat cutting at current rates and location does not appear to be having an impact on ARB at the site in the reporting period) and no impact on ARB at one raised bog (Cloonshanville) in the reporting period. Peat cutting was reported as having High Importance/Impact on DRB at 26 of the 32 raised bogs (as it directly reduced the extent of the habitat in the reporting period); Medium at three raised bogs (as generally only small (<0.10ha) extent of high bog was lost in the 2004/05-2010 period, but some declines in habitat quality noted in the reporting period) and Low at three raised bogs (as only small (<0.10ha) extent of high bog was lost in the 2004/05-2010 period and the activity does not appear to have impacted on habitat quality also in the reporting period).

As stated above, the previous results only relate to the current reporting period (2007-2013) and not to previous or future reporting periods if the activity continues. Peat cutting and associated drainage would have been responsible for decreases/declines in ARB in all of the bogs where currently it is reported as having a Low Importance/Impact. In addition, a Low Importance/Impact during the

current reporting period does not imply a low impact in the next reporting period if the activity was to continue even at current rates. Furthermore, a continuation of peat cutting at these sites would minimise the chances of effective restoration works at the site, through the reduction of suitable areas for restoration, and therefore the recovery to FRVs, and thus the achievement of Favourable Conservation Status.

Although cutting does not directly threaten the high bog habitats at those sites (14 of the 44 sites surveyed, See Table 3.18) where it has not been reported in the reporting period or has apparently ceased, secondary impacts (i.e. on-going subsidence and drainage related to open face-banks) continue posing a threat to ARB in some of them. Furthermore, in some of the sites, these secondary impacts are diminishing the potential for expansion of the habitat despite the positive results of restoration works.

Data provided in the Results section indicates a decreasing trend in peat cutting activity within those raised bogs located within SACs as result of the implementation of the peat cutting cessation scheme currently made available by the Department of Arts, Heritage and the Gaeltacht. A very different trend is taking place within sites designated as NHAs (Ryan, J., pers. comm., 2013), where peat cutting rates seems to have increased. A similar scenario is likely to be taken place within non-designated sites, at least those near SACs where relocation programmes are being implemented. Raised Bog SACs contain 71.61% of the known ARB national resource (1,400ha out of 1,955ha) and 21.61% of the DRB national resource (10,368ha out of 47,978ha).

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#### 4.2.5 *Restoration works*

The results to date support the importance of restoration work in slowing down and reversing the loss of ARB. Further high bog and cutover restoration works (e.g. removal of conifers, blocking of drains) and a more appropriate management of adjacent land drainage is required in many sites. This is especially true for those sites where a negative assessment and trend has been given, but also the case in other sites in order to achieve Favourable Reference Values and thus Favourable Conservation Status.

Restoration works did not have the expected results in a small number of sites, particularly in those where negatively impacting activities (i.e. drainage and peat cutting) have counteracted the positive results from the restoration works (e.g. Crosswood, Moyclare), and in others the restoration works took place in cutover areas apparently not hydrologically connected to the high bog (e.g. Monivea). The potential for restoration on the high bog is small in some sites as it has been highly modified and the cutover areas may have the highest potential to restore peat forming habitats in a very long term, such as the case of Killyconny Bog.

It should be highlighted, that a restored area will only return to active bog where suitable physical conditions existed prior to drainage and/or can be created. Although positive results have been reported in most of the sites surveyed, it is however expected that some other sites will show continued deterioration due to the long term impacts of previous damage. However without the restoration works the deterioration of these sites would have been significantly greater.

In addition to NPWS, an increasing number of organisations have become actively involved in undertaking or planning restoration works in recent years. The main organisations carrying out this work on at a large scale have been Bord na Móna and Coillte. At a site level works have been also undertaken by the Irish Peatland Conservation Council (IPCC) and Abbeyleix Bog Project. This change is a very positive development with multiple benefits for raised bog conservation.

The individual site assessments have highlighted the potential of cutover areas in some sites to support and develop ARB in a very long term. This is most critical for small raised bogs, where impacting activities such as peat cutting, drainage and associated subsidence is threatening the continued existence of ARB on the high bog. On such bogs these activities are more likely to have irreversibly modified the high bog (i.e. steep slopes) to such an extent that the only possibility for the long term maintenance/restoration of ARB will be on the cutover. However, this option should also be considered for bigger sites with large cutover areas where the potential increase of ARB would greatly help to achieve national targets for this habitat. Further work is required to understand the nature of regenerating cutover and when to classify them as ARB. Some of these cutover areas may develop into wet heath, woodland, poor fen, etc., rather than ARB once restoration works are undertaken. Thus, the potential to restore ARB on cutover areas should be investigated in all sites. The issues of how to assess the potential of cutover for ARB development and the monitoring of actual results will require considerable further work.

#### 4.2.5.1 Recommendations

Despite the positive results of the peat cutting cessation scheme and restoration programmes (e.g. reduction in habitat losses and stable S&F) within SAC raised bogs, impacting activities continue within SACs: peat cutting continues in some SACs as the main damaging activity impacting on raised bog habitats. With the reduction in peat cutting, drainage associated with peat cutting, agriculture and forestry, is now the most negatively impacting activity in some of the bogs surveyed. Forestry on the high bog and adjacent land continue to cause impacts and burning, although decreased in frequency, also continues to take place. The complete cessation of peat cutting within SACs, further restoration works including the blocking of high bog and cutover drains in some cases (both reduced functional and functional) and the removal of high bog conifer plantations, and cutover in some cases, should be undertaken to work towards the objectives of the Habitats Directive.

The implementation of the peat cutting cessation scheme and restoration programmes within NHA raised bogs is recommended in order to prevent loss of ARB, as well as to maintain the habitat's Range. These sites are estimated to contain 28.39% of total ARB.

The surveying of those sites designated as NHA and remaining SACs surveyed prior 2007 is recommended in order to ascertain changes in habitat quality and the impact from negatively impacting activities.

The recent monitoring surveys noted the frequent occurrence of drainage works in areas adjacent to the high bog; their impact should be assessed and recommendations for blocking made where appropriate. Maintenance works (dredging) of rivers and streams near high bog areas were also identified as potentially impacting high bog habitats. An impact assessment of such works should also be undertaken prior to these types of works being carried out.

An assessment of the potential impact of forestry plantations in areas near the high bog should be also undertaken prior to any new plantations is carried out. Burning on the high bog surface should be controlled. Quarrying adjacent to the high bog, although not frequently reported, was found to have potentially highly negative impacts on high bog habitats and thus impact assessments should be undertaken prior to any other quarrying activity being initiated near a high bog.

Further botanical monitoring surveys at ecotope level are recommended to ascertain changes on high bog vegetation brought by negatively impacting activities and/or restoration works.

A review of the Area of Bog Woodland on those sites not surveyed in the 2011-2013 period is recommended. This should take into account the minimum tree canopy cover requirement for the habitat (>30%), level of mapping accuracy and surveying undertaken in this project and Fernandez *et al.* (2012) surveys. A review of the Bog Woodland monitoring sheet is recommended. This should consider the inclusion of *Pinus sylvestris* as a structural data indicator, as well as review the requirements regarding target tree species dbh and presence of old trees and dead wood. The 2011-13 surveys have shown that there is a very small Area (<1ha) of Bog Woodland at three of the six sites surveyed. Hence, the minimum Area needed for a wooded area to be considered woodland should be revised and defined more precisely.

The establishment of a targeted and appropriately designed and implemented restoration programme is recommended to optimise resource use and long-term effectiveness. This programme should include all raised bogs in the country with significant conservation value and restoration potential. The establishment of such a restoration programme is expected to be one of the outputs of the ongoing national raised bog conservation programme (<http://www.npws.ie/peatlandsturf-cutting/nationalraisedbogsacmanagementplan/>). The establishment of more accurate FRVs is expected to be one of the main outputs of this programme.

Consideration should be given to the need to restore cutover areas where this will support the conservation of the high bog or where the high bog conditions are no longer suitable for maintenance or restoration of ARB.

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## Abbreviations

ARB	Active Raised Bog habitat (7110)
DRB	Degraded Raised Bog habitat (7120)
dbh	diameter at breast height
F	Favourable
FPs	Future Prospects
FRV	Favourable Reference Value
NHA	Natural Heritage Area
SAC	Special Area of Conservation
S&Fs	Structure and Functions
UB	Unfavourable Bad
UI	Unfavourable Inadequate

## Appendix 1: Plant communities of the high bog

Plant communities of the high bog based on Kelly & Schouten (2002) and modified by F. MacGowan and published in Fernandez *et al.* (2005).

Vegetation types listed in order of decreasing wetness: 2A, 3Ba, 1, 3a, 3Bb, 3c, 3Bb, 3D, 3E, 4A, 4B, 4C, 4D, 4E, 4F, 4G.

<b>POOLS</b>			
Depressions on the bog surface where the water table drops below surface level for only very short periods of time. They are characterised by the presence of aquatic plant species such as <i>Sphagnum cuspidatum</i> and <i>Cladopodiella fluitans</i> (looks like black strings). <i>Eriophorum angustifolium</i> & <i>Rhynchospora alba</i> .			
Type	Local name	Physical characteristics	Diagnostic species assemblage
2	Community of <i>Sphagnum cuspidatum</i> & <i>Eriophorum angustifolium</i>	Permanent pools & wet hollows on the high bog. Occurs only where water table remains above ground level all year.	<i>Sphagnum cuspidatum</i> , <i>Eriophorum angustifolium</i> and <i>Rhynchospora alba</i> .
2A	Typical variant	Permanent pools & wet hollows on the high bog. Occurs only where water table remains above ground level all year.	
2B	Variant with <i>Rhynchospora fusca</i> This variant is a rarity.	Species-poor shallow pools & hollows at marginal areas. Presence of algal mat indicates a fluctuation water table.	Differential species: <i>Rhynchospora fusca</i>
2C	Variant with <i>Molinia caerulea</i> This variant is a rarity.	Pools & hollows on cutaway or marginal areas. Slightly nutrient-enriched due to ground-water influence or water movement. Presence indicates very wet conditions.	Differential species: <i>Molinia caerulea</i> , <i>Juncus bulbosus</i> & <i>Sphagnum recurvum</i>
	Algal pools	Pools occurring more often in marginal and sub-marginal areas with algae dominating the vegetation indicating fluctuation in water levels.	Algae

**HOLLOWS**

Shallow depressions on the bog surface where surface water collects, or where the water table reaches ground level or lies just above ground level, depending on seasonal conditions. Marginal hollows tend to be elongated as they are focus points for surface water run-off. They are often dominated by *Narthecium ossifragum*. On the high bog they take many forms but are often eye-shaped.

Type	Local name	Physical characteristics	Diagnostic species assemblage
1	Community of <i>Rhynchospora alba</i> & <b>Algal mats</b>	Confined to hollows & erosion channels on the bog margins. Surface run-off is high during periods of high rainfall. Narrow, linear features with the long axis corresponding to the direction of flow. Moss cover low (<20%), algal cover high (52%).	<i>Rhynchospora alba</i> , <b>Algal mat</b> and <i>Narthecium ossifragum</i>
3a	Typical variant: Community of <i>Narthecium ossifragum</i> , <i>Sphagnum papillosum</i> & <i>S. magellanicum</i>	Damp, elongated hollows holding water during periods of high rainfall. Herb cover 25%: dwarf shrub cover 28%: moss cover >60% suggesting that hollows remain damp for a long period of time.	<i>Narthecium ossifragum</i> , <i>Rhynchospora alba</i> , <i>Sphagnum papillosum</i> , <i>S. magellanicum</i> and <i>S. tenellum</i>

**LAWNS**

These are shallow hollows or flat areas where one species dominates to form a lawn. This is frequently a *Sphagnum* species, such as *Sphagnum magellanicum*, which can completely fill a hollow to form a small lawn.

Type	Local name	Physical characteristics	Diagnostic species assemblage
3B	Sociation of <i>Sphagnum magellanicum</i>	Confined to pools or very wet hollows which are completely in-filled & remain wet throughout the year.	Dominant species: <i>Sphagnum magellanicum</i>
3Ba	Sub-variant with <i>Sphagnum cuspidatum</i>	Wettest lawn in central ecotope	Differential species: <i>Sphagnum cuspidatum</i> , <i>Cladopodiella fluitans</i> , <i>Menyanthes trifoliata</i> and <i>Drosera anglica</i>
3Bb	Sub-variant with <i>Sphagnum capillifolium</i>	Dry lawn grading into low hummock (Drier than other lawn types).	<i>Sphagnum capillifolium</i> , <i>Eriophorum vaginatum</i> & <i>Calluna vulgaris</i>
3Bc	Sub-variant with <i>Molinia caerulea</i>	Only occurs in flushes or soaks.	Differential species: <i>Molinia caerulea</i> and <i>Potentilla erecta</i>
3C	Sociation of <i>Sphagnum papillosum</i>	Hollows to low hummocks – Central ecotope.	Dominant species: <i>Sphagnum papillosum</i> in large amounts.

<b>FLATS</b>			
<p>These are more or less flat areas which are intermediate between hollow &amp; hummock communities. They tend to be drier than the above situations.</p>			
Type	Local name	Physical characteristics	Diagnostic species assemblage
4	Community of <i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> & <i>Cladonia portentosa</i>		<i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> , <i>Cladonia portentosa</i> , <i>Dicranum scoparium</i> & <i>Hypnum jutlandicum</i>
4A	Typical variant: Community of <i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> & <i>Cladonia portentosa</i>	Found in either Flats or Hummocks – no specific dominant species.	<i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> , <i>Cladonia portentosa</i> , <i>Dicranum scoparium</i> & <i>Hypnum jutlandicum</i>
4D	Sociation of <i>Cladonia portentosa</i>	Found in all ecotopes, although more widespread in drier ecotopes. Lichen cover high (86%), moss cover only intermediate (45%).	Dominant species: <i>Cladonia portentosa</i>

<b>HUMMOCKS</b>			
<p>These are mounds on the bog surface which can range from a few cm to more than a meter in height. They are usually composed mainly of <i>Sphagnum</i> species such as <i>Sphagnum magellanicum</i>, <i>S. capillifolium</i>, <i>S. austinii</i> &amp; <i>S. fuscum</i> but other bryophytes species such as <i>Hypnum jutlandicum</i> &amp; <i>Leucobryum glaucum</i> are also important, especially as the hummock grows taller and becomes drier. <i>Calluna vulgaris</i> is another important element, as it flourishes where the water table is not at surface level.</p>			
Type	Local name	Physical characteristics	Diagnostic species assemblage
4A	Typical variant: Community of <i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> & <i>Cladonia portentosa</i>	Hummocks where no specific moss species dominates.	<i>Calluna vulgaris</i> , <i>Sphagnum capillifolium</i> , <i>Cladonia portentosa</i> , <i>Dicranum scoparium</i> & <i>Hypnum jutlandicum</i>
4C	Sociation of <i>Leucobryum glaucum</i>	Dwarf shrub cover on these hummocks is relatively high indicating comparatively dry conditions.	Dominant species: <i>Leucobryum glaucum</i>
4D	Sociation of <i>Cladonia portentosa</i>	Moss cover only intermediate.	Dominant species: <i>Cladonia portentosa</i>
4E	Sociation of <i>Sphagnum capillifolium</i>	Relatively low hummocks (<30cm tall) & dwarf shrub cover is high usually around 55%.	Dominant species: <i>Sphagnum capillifolium</i>
4F	Sociation of <i>Sphagnum austinii</i>	Tall hummocks (50-100cm) & shrub cover high (55%).	Dominant species: <i>Sphagnum austinii</i>

FACE BANK		
Type	Local name	Diagnostic species assemblage
4G	Sociation of <i>Calluna vulgaris</i> & <i>Hypnum jutlandicum</i>	<i>Calluna vulgaris</i> & <i>Hypnum jutlandicum</i> dominated.

DISTURBED AREAS			
Areas where draining and/or burning has detrimentally affected the vegetation. Bare peat is characteristic.			
Type	Local name	Physical characteristics	Diagnostic species assemblage
3D	Variant with <i>Campylopus paradoxus</i> & Algal mats	Originally lawns damaged by draining and or burning.	Differential species: <i>Campylopus paradoxus</i> , <i>C. introflexus</i> & <b>Algal mats</b>
3E	Variant with <i>Trichophorum germanicum</i>	Originally lawns now damaged.	Differential species: <i>Trichophorum germanicum</i>
4B	Variant with <i>Campylopus introflexus</i>	Burnt and/or drained former Flats or Hummock area.	Differential species: <i>Campylopus introflexus</i> , <i>C. paradoxus</i> , <i>Cladonia furcata</i> , and <i>Cladonia uncialis</i> subsp. <i>biuncialis</i> .
4E	Sociation of <i>Sphagnum capillifolium</i>		Dominant species: <i>Sphagnum capillifolium</i>
4G	Sociation of <i>Calluna vulgaris</i> & <i>Hypnum jutlandicum</i>		Dominant species: <i>Calluna vulgaris</i> & <i>Hypnum jutlandicum</i>

## Appendix 2: Ecotopes and active peat forming community complexes key

The following is a rough guide (produced by Fernandez *et al.* (2005)) to key out ecotopes and the most common Active Raised Bog community complexes on Irish raised bogs. It is not an attempt to summarise all the community complexes present on Irish raised bogs and should thus be considered as a basis for future surveys that will need to be amended/updated. This key was formulated once the 2004/05 surveys were finished and some of the community complexes described within the site reports do not fall into the categories developed in the key. However, in hindsight, considering their descriptions, some of them could be renamed and would then correspond to the community complexes under this key. The key is intended to enable a determination to marginal and sub-marginal ecotope level within DRB.

The description of each community complex is applicable to a 5m-radius circle around the position of the surveyor. These community complexes are pooled into ecotope types. The following attributes are considered to define a community complex: vegetation composition and cover: *Sphagnum* cover, robustness of *Calluna vulgaris*, presence of *Cladonia* species; ground firmness (firm, soft, very soft, quaking); acrotelm depth and micro-topography (e.g. flats, lawns, hollows, pools, hummocks). The communities are given numeric names according to the dominant or characteristic species. A more comprehensive description of the community complexes is given in Appendix 3. The presence of pools has also been considered to name some of the community complexes. This raised bog vegetation classification is based on Kelly *et al.* (1995) survey and terminology.

1	Western indicators <i>Racomitrium lanuginosum</i> , <i>Campylopus atrovirens</i> and large pools with frequent open water all <b>present</b>	3
2	Western indicators <i>Racomitrium lanuginosum</i> , <i>Campylopus atrovirens</i> and large pools with frequent open water <b>absent</b>	7
3	- Pools > 20% cover	4
	- Pools 10-20% cover	5
	- Pools < 10% cover	<b>Marginal Ecotope</b>
4	- <i>Sphagnum</i> cover > 30%	<b>Central Ecotope- Complex 35</b>
	- <i>Sphagnum</i> cover (10-30%)	6
	- <i>Sphagnum</i> cover <10%	<b>Sub-marginal Ecotope</b>
	- <i>Sphagnum</i> absent	<b>Marginal Ecotope</b>

<b>6</b>	<b>Sub-central Ecotope</b>	
	- <i>Narthecium ossifragum</i> > 25%	<i>Complex 6/35</i>
	- <i>Carex panicea</i> >20%	<i>Complex 3/35</i>
	- <i>Rhynchospora alba</i> >20%	<i>Complex 4/35</i>
	- <i>Eriophorum</i> sp. >20%	<i>Complex 9/35</i>
	- None of the above	<i>Complex 35 –</i>
<b>5</b>		
	- <i>Sphagnum</i> cover 20-30% and <i>Narthecium ossifragum</i> >20%	<b>Sub-central Ecotope Complex 6 + P</b>
	- <i>Sphagnum</i> cover <20%	<b>Sub-marginal Ecotope</b>
<b>7</b>		
	- <i>Sphagnum</i> cover <10%	<b>8</b>
	- <i>Sphagnum</i> cover (10-30%)	<b>9</b>
	- <i>Sphagnum</i> cover (30-40%)	<b>10</b>
	- <i>Sphagnum</i> cover >40%	<b>11</b>
<b>8</b>		
	- Tall robust <i>Calluna vulgaris</i> (>0.4m / >50% cover) and firm ground, at the edges of the high bog	<b>Face-Bank Ecotope</b>
	- <i>Calluna vulgaris</i> not so tall and robust (ca 0.3m) or if so not occurring at >50% cover	<b>Marginal Ecotope</b>
<b>9</b>		
	- Pools cover < 15%	<b>Sub-marginal Ecotope</b>
	- Pools cover > 15% and <i>Sphagnum</i> cover 10-20%	<b>Sub-marginal Ecotope</b>
	- Pools cover > 15% and <i>Sphagnum</i> cover 20-30% (40-50% in the pools). At least one western indicator species present. Healthy <i>Sphagnum</i> hummocks ( <i>S. papillosum</i> , occasionally <i>S. austinii</i> and <i>S. fuscum</i> )	<b>Sub-central Ecotope-Complex 6+Pools</b> (or <b>6/4 + P</b> when <i>Rhynchospora alba</i> >15%)
	- Pools cover > 15% and <i>Sphagnum</i> cover 20-30% (40-50% in the pools). No western indicator species present.	<b>Sub-marginal Ecotope</b>
<b>10</b>		
	- Pools cover <15% or absent	<b>12</b>
	- Pools cover >15%	<b>13</b>



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<b>12</b>	<ul style="list-style-type: none"> <li>- <i>Narthecium ossifragum</i> &lt;30%, ground soft to very soft, hummocks-hollows and sometimes pools. (<i>Sphagnum</i> cover close to 40%).</li> <li>- <i>N. ossifragum</i> &lt;30%, ground soft to very soft, hummocks-hollows and sometimes pools. (<i>Sphagnum</i> cover close to 30%)</li> <li>- <i>N. ossifragum</i> &gt;30%, ground firm to soft, hummocks-hollows, and pools &lt;5%. (<i>Sphagnum</i> cover close to 30%)</li> <li>- <i>N. ossifragum</i> &gt;30%, at least one western indicator present and pool cover 10-15%</li> </ul>	<p><b>14</b></p> <p><b>Sub-marginal Ecotope (e. g Complex 9/7)</b></p> <p><b>Sub-marginal Ecotope (e. g Complex 9/7/6)</b></p> <p><b>Sub-central Ecotope-Complex 6 + P</b></p>
<hr/>		
<b>14</b>	<ul style="list-style-type: none"> <li>- <i>Eriophorum angustifolium</i> &gt; 15% and ground very soft</li> <li>- <i>E. vaginatum</i> &gt; 15%</li> <li>- <i>Rhynchospora alba</i> &gt; 15%</li> <li>- <i>Carex panicea</i> &gt;15%</li> <li>- None of the above. <i>Narthecium ossifragum</i> 15-30%</li> </ul> <p>(These are considered transitional sub-marginal–sub-central community complexes where <i>Sphagnum</i> cover averages at 40%. Similar features but higher <i>Sphagnum</i> cover section 22)</p>	<p><b>Sub-central Ecotope-Complex 9a/10</b></p> <p><b>16</b></p> <p><b>Sub-central Ecotope-Complex 4/10</b></p> <p><b>Sub-central Ecotope-Complex 3/10</b></p> <p><b>Sub-central Ecotope-Complex 6/10</b></p>
<b>16</b>	<ul style="list-style-type: none"> <li>- <i>Calluna vulgaris</i> &lt;20%</li> <li>- <i>C. vulgaris</i> &gt;20%</li> </ul>	<p><b>Sub-central Ecotope-Complex 9/10</b></p> <p><b>17</b></p>
<hr/>		
<b>17</b>	<ul style="list-style-type: none"> <li>- <i>Narthecium ossifragum</i> (&lt;10%)</li> <li>- <i>Narthecium ossifragum</i> (&gt;10%)</li> </ul> <p>(These are considered transitional sub-marginal –sub-central community complexes where <i>Sphagnum</i> cover averages at 40%. <i>Sphagnum capillifolium</i> is the dominant <i>Sphagnum</i>)</p>	<p><b>Sub-central Ecotope-Complex 9/7/10</b></p> <p><b>Sub-marginal Ecotope (e.g. Complex 9/7)</b></p>

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<b>13</b>		
	- <i>Eriophorum</i> species >20%	18
	- <i>Eriophorum</i> sp. & <i>Calluna vulgaris</i> co-dominate each at >10-15% cover	19
	- <i>Rhynchospora alba</i> >15%	20
	- <i>Carex panicea</i> > 15%	21
	- <i>Narthecium ossifragum</i> >30% (ground firm to soft)	<b>Sub-marginal Ecotope</b>
	- None of the above. Well-developed micro-topography present and the <i>Sphagnum</i> cover is close to 40%	<b>Sub-central Ecotope-Complex 15-</b>
	(These are considered transitional sub-marginal –sub-central community complexes where <i>Sphagnum</i> cover around 40%. Similar features but higher <i>Sphagnum</i> cover section 27)	
<b>18</b>		
	- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope- Complex 9 + Pools (or 9a + P when <i>E. angustifolium</i> is dominant)</b>
	- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope- Complex 6/9 + Pools</b>
<b>19</b>		
	- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope-Complex 9/7 + Pools</b>
	- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope-Complex 9/7/6 + Pools</b>
<b>20</b>		
	- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope-Complex 4 + Pools</b>
	- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope-Complex 6/4 + Pools</b>
<b>21</b>		
	- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope-Complex 3 + Pools</b>
	- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope-Complex 6/3 + Pools</b>
<b>11</b>		
	- Pools cover <10% or absent	22
	- Pools cover (10-20%)	23
	- Pools cover >20%	24

22	- <i>Sphagnum</i> cover (40-50%). Similar to section 14 but higher <i>Sphagnum</i> cover	14
	- <i>Sphagnum</i> cover >50%,	25
	- <i>Sphagnum</i> cover >50%. Micro-topography better developed than above with hummocks and more distinctive pools	<b>Central Ecotope-Complex 10/15</b>
25	- <i>Eriophorum</i> sp.> 20% and ground very soft in-filled hollows-lawns 10-20%- <i>S. cuspidatum</i> ) (Transitional community complex to central ecotope.)	26
	- <i>Eriophorum</i> sp, (>20%). Little or no (<10%) in-filled hollows-lawns of <i>S. cuspidatum</i> and <i>S. capillifolium</i> at >30% cover	<b>Sub-central Ecotope- Complex 9/7/10</b>
	- <i>Eriophorum</i> sp, (>20%). Little or no (<10%) in-filled hollows-lawns of <i>S. cuspidatum</i> , <i>S. papillosum</i> dominant and <i>C. panicea</i> >15%	<b>Sub-central Ecotope- Complex 10/9/3</b>
	- <i>Rhynchospora alba</i> > 15%	<b>Sub-central Ecotope- Complex 10/4</b>
	- <i>Carex panicea</i> >15%	<b>Sub-central Ecotope- Complex 10/3</b>
	- None of the above. <i>Narthecium ossifragum</i> 15-30%	<b>Sub-central Ecotope- Complex 10/6</b>
26	- <i>Eriophorum angustifolium</i> dominant	<b>Sub-central Ecotope- Complex 10/9a</b>
	- <i>E. vaginatum</i> dominant	<b>Sub-central Ecotope- Complex 10/9</b>
23	- <i>Sphagnum</i> cover (40-60%)	27
	- <i>Sphagnum</i> cover >60%	<b>Central Ecotope- Complex 15 or 4/15 when <i>Rhynchospora alba</i> &gt;15%</b>
27	- <i>Eriophorum</i> species >20%	28
	- <i>Rhynchospora alba</i> >15%	29
	- <i>Carex panicea</i> >15%	<b>Sub-central Ecotope- Complex 6/3 + Pools</b>
	- None of the above. <i>Narthecium ossifragum</i> 15-30%	<b>Sub-central Ecotope- Complex 6 + Pools</b>
28	- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope- Complex 9 + Pools</b>
	- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope- Complex 6/9 + Pools</b>

<b>29</b>	
- <i>Narthecium ossifragum</i> (<10% cover)	<b>Sub-central Ecotope- Complex 4 + Pools</b>
- <i>N. ossifragum</i> (10-30% cover)	<b>Sub-central Ecotope- Complex 6/4 +Pools</b>
<b>24</b>	
- <i>Sphagnum</i> cover (40-60%)	<b>30</b>
- <i>Sphagnum</i> cover >60%	<b>Central Ecotope- Complex 14</b>
<b>30</b>	
- <i>Narthecium ossifragum</i> (>20% cover)	<b>Sub-central Ecotope- Complex 6/14</b>
- <i>Rhynchospora alba</i> (>20% cover)	<b>Sub-central Ecotope- Complex 4/14</b>
- None of the above	<b>Sub-central Ecotope- Complex 14-</b>

## Appendix 3: Most common central and sub-central ecotope community complexes

### CENTRAL ECOTOPE COMPLEXES

#### Complex 14

**Micro-topography:** Hummocks, hollows and pools (>20% cover) and sometimes lawns.

**Sphagnum cover:** > 60%

**Firmness:** Very soft to quaking

**Characteristic species:** *Sphagnum cuspidatum* (>20% cover)

Apart from some soak areas, this central ecotope complex indicates the wettest conditions on the high bog. Quaking mats of *Sphagnum* characterise this complex with *S. cuspidatum*-filled pools covering >20% of the complexes surface area. The pools support *Eriophorum angustifolium*, *Drosera anglica* and *Menyanthes trifoliata* with *Rhynchospora alba* around the pool edges and in patches within the pools. Algae is absent from the pools. The inter-pool areas usually support frequent hummocks of *Sphagnum capillifolium* as well as hummocks of *S. fuscum* and *S. austinii*. *S. papillosum* and *S. magellanicum* are also frequent usually occurring in lawns and replacing *S. cuspidatum* as the dominant *Sphagnum* towards the edges of the complex. *Calluna vulgaris* (5-10%) and *Eriophorum vaginatum* (5-10%) are found at low cover values on the hummocks with *Narthecium ossifragum* and *Erica tetralix* also present, but at a lower cover value (ca. 5%). The overall *Sphagnum* cover is 60-100%.

In some areas drier versions of this complex are found with characteristics intermediate between central and sub-central ecotope. Pool cover in these areas is still at least 20% cover, but algal pools are more common. Furthermore, although *Sphagnum cuspidatum* dominates, *S. magellanicum* is more frequent than above. The overall *Sphagnum* cover is also lower, tending to average at 40-60% cover. In some of these areas *Narthecium ossifragum* dominates the inter-pool vegetation at close to 20% cover (Sub-central complex 6/14) and in other areas *Rhynchospora alba* becomes more common and the complex is termed 4/14. If neither of these species occur at >20% cover the complex is simply termed 14-.

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Complex 15

**Micro-topography:** Hummocks, hollows and pools (10-20% cover) and sometimes lawns.

**Sphagnum cover:** >60%

**Firmness:** Very soft and sometimes quaking

**Characteristic species:** *Sphagnum cuspidatum* (>10% cover)

This is a wet central ecotope complex that is characterised by scattered *Sphagnum cuspidatum*-filled pools usually covering 10-20% of the complexes surface area. The complex is often found in a depression and the bog surface is very soft and sometimes quaking. The pools support *Eriophorum angustifolium*, *Drosera anglica* and *Menyanthes trifoliata* with *Rhynchospora alba* around the pool edges and in patches within the pools. There are also very occasional patches of algae and/or open water in the pools. The inter-pool areas usually support frequent hummocks of *Sphagnum capillifolium* (10%) as well as hummocks of *S. fuscum* and *S. austinii*. *S. papillosum* and *S. magellanicum* are also frequent (20-40% cover) and usually dominate around the pool edges, and also occur in lawns as well as low hummocks. *Calluna vulgaris* (5-10%) and *Eriophorum vaginatum* (5-10%) are found at low cover values on the hummocks with *Narthecium ossifragum* and *Erica tetralix* also present, but at a lower cover value (ca. 5%). The overall *Sphagnum* cover averages at 60-80%. When the presence of *Rhynchospora alba* is greater than 15% the complex is termed 4/15.

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Complex 10/15

**Micro-topography:** Hummocks, hollows and lawns with pools (<10% cover)

**Sphagnum cover:** >50%

**Firmness:** Very soft and sometimes quaking

**Characteristic species:** *Sphagnum magellanicum* and *S. cuspidatum* co-dominate the lawns/pools

This is a central ecotope complex and the bog surface is usually very soft underfoot and is occasionally quaking. The micro-topography is characterised by hummocks, lawns and pools. However, the pools are more like *Sphagnum* filled hollows/lawns than pools with *S. cuspidatum* and *S. magellanicum* usually dominating in them. *S. magellanicum* is usually a larger component of this complex than it is in Complex 14 or 15. *Rhynchospora alba* is also more frequent than in Complex 14 or 15 occurring at 10-20% cover across the *Sphagnum* lawns. *Sphagnum papillosum* also occurs in lawns and low hummocks particularly at pool margins (where the pools are more distinct). *Eriophorum vaginatum* often grows abundantly across the *Sphagnum* lawns and where it reaches cover values of >20% the complex is termed 10/9/15. *Calluna vulgaris* (10%) grows on hummocks, which are usually composed of *S. papillosum* and *S. capillifolium* with occasional *S. austinii*. The overall *Sphagnum* cover averages at >50%.

*Narthecium ossifragum* is usually present at a low cover value (ca.5%), but can increase towards the margins of the complex.

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Complex 35

**Micro-topography:** Pools (>20%), flats and hummocks

**Sphagnum cover:** >30%

**Firmness:** Soft to very soft and sometimes quaking

**Characteristic species:** *Racomitrium lanuginosum* and *Campylopus atrovirens*

This is the wet central ecotope complex of western raised bogs. Pools are frequent, covering >20% of the complexes surface area, but tend to differ from the pools of the midland raised bogs in a number of ways. Firstly, they tend to be deeper and more elongate and inter-connecting. Secondly, open water is much more visible and predominates in many pools. Thirdly, although *S. cuspidatum* is still present, *S. denticulatum* is much more frequent than in the midland bogs and is sometimes the most common of the aquatic *Sphagna*. Where the pools are shallower there is a higher cover of *Sphagnum cuspidatum* and pools sometimes contain scattered *Rhynchospora alba*, *Eriophorum angustifolium*, *Drosera anglica* and *Menyanthes trifoliata* and some algal patches are present, but not dominant. *Campylopus atrovirens* is usually present at the pool margins along with *Sphagnum papillosum*. Island hummocks of *Racomitrium lanuginosum* are also common. The inter-pool vegetation has a much poorer *Sphagnum* cover than in the midland raised bogs with *Narthecium ossifragum* flats usually dominating. Hummocks are present, however, with *S. austinii*, *S. fuscum* and *S. capillifolium* occurring. The overall *Sphagnum* cover is much lower than in the midland raised bogs averaging at approximately >30% with *S. papillosum* usually the most abundant *Sphagna*. *Carex panicea* is also much more common on this central complex (10%) than in the midland central complexes where it is usually absent or present in very low amounts (<5%). *Eriophorum vaginatum* and *Calluna vulgaris* are usually present on hummocks. Where *Narthecium ossifragum* flats reach cover values of >25%, the *Sphagnum* cover is usually slightly lower (10-30%) and the complex is termed sub-central 6/35.

## SUB-CENTRAL ECOTOPE COMPLEXES

### Complex 15-

**Micro-topography:** Hummocks and hollows and pools (>15% cover)

**Sphagnum cover:** >50% (This has been increased from 30/40% to greater than 50% based on most recent 2011/13 survey results)

**Firmness:** Soft to very soft but rarely quaking

**Characteristic species:** *Sphagnum cuspidatum* (>5%)

This is a sub-central complex in which there is a moderate to well developed micro-topography with hummocks and hollows and pools. The surface is soft to very soft underfoot, but rarely quaking and the pools, which cover 10-20% of the surface area, are showing signs of desiccation. This is evidenced by a reduced cover of *S. cuspidatum* and increased algal cover in most pools. *Sphagnum magellanicum* is colonising the edges and covers some of the former pool areas. *Sphagnum papillosum* and sometimes *S. pulchrum* are present at the pool edges and *Rhynchospora alba* and *Narthecium ossifragum* are frequent and appear to be invading the former pool areas. *Eriophorum angustifolium* (10%), *Menyanthes trifoliata* and *Drosera anglica* are all present in the more permanent pools. The overall *Sphagnum* cover is approximately 30-40% and is composed mostly of hummocks. Occasionally, these hummocks can be large (>0.5m) and are usually composed of *S. capillifolium* and *S. austinii*. *Calluna vulgaris* (10-20%) and *Eriophorum vaginatum* (10%) dominate the vegetation on hummocks and *Narthecium ossifragum* is present in flats (10%) along with *Carex panicea* (ca. 5%).

### Complex 10/9

**Micro-topography:** In-filled hollows/lawns and hummocks with pools <10% or absent

**Sphagnum cover:** >50%

**Firmness:** Soft to very soft and sometimes quaking

**Characteristic species:** *Eriophorum* sp. (>20%) and *Sphagnum cuspidatum* (10-20%)

This is a wet sub-central complex, which shares many characteristics of a central complex ecotope. The surface, in general, is soft to very soft underfoot with occasional quaking areas. There is a very good *Sphagnum* cover (60-70%) and the vegetation is dominated by lawns of *S. papillosum*, *S. magellanicum* and *S. cuspidatum* along with frequent tufts of *Eriophorum vaginatum* (>20%) and *E. angustifolium*. However, the Micro-topography is poorly developed with lawns dominating and only occasional low hummocks and very occasional small pools. The hummocks are usually of *S. capillifolium* and *S. papillosum* (which grades into lawns) and occasionally of *S. fuscum* and *S. austinii*. *Calluna vulgaris*



(10%) is frequent on hummocks and *Rhynchospora alba* (10%) is scattered across the *Sphagnum* lawns, which are composed mostly of *S. cuspidatum* and *S. magellanicum*. A variant of this complex occurs where *Eriophorum angustifolium* is more dominant and this is termed **10/9a**. The dominant *Sphagna* in 10/9a is usually *S. magellanicum*.

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Complex 10/4

**Micro-topography:** Hummocks and hollows with pools <10% or absent

**Sphagnum cover:** >50% (This has been increased from 40/60% to greater than 50% based on most recent 2011/13 survey results)

**Firmness:** Very soft

**Characteristic species:** *Rhynchospora alba* (>15%)

This is a sub-central complex, in which the surface is usually very soft underfoot. Low hummocks and hollows are present and sometimes there are occasional pools (<20% cover) that appear to be suffering from desiccation. *Sphagnum* (50-60%) dominates the vegetation occurring in low hummocks, lawns, in-filled hollows and dried-out pools along with *Rhynchospora alba* (>15%), which is found growing in dried-out pools, hollows and lawns. The hollows and pools appear to have a lowered water table and thus algae is often frequent and the dominant *Sphagna* are *Sphagnum papillosum* and *S. magellanicum* with only small patches of *S. cuspidatum* occurring (ca. 10%). *Eriophorum angustifolium*, *Drosera anglica* and *Menyanthes trifoliata* are found occasionally. Hummocks of *S. capillifolium* are frequent and hummocks of *S. austinii*, *S. subnitens* and *S. fuscum* are also usually present. *Calluna vulgaris* (10-20%) dominates in hummocks with *Eriophorum vaginatum* (5-20%) frequent in places. *Narthecium ossifragum* is present at low cover values in hollows (<10%). In areas where the cover of *Sphagnum* decreases to ca. 40-50% the complex is termed **4/10**. Where pools occur at a cover of 10-20%, but the description of the complex is similar to above, the complex is termed **4 + P**.

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Complex 10/6

**Micro-topography:** Hummocks and hollows with pools <10% or absent

**Sphagnum cover:** 40-60%

**Firmness:** Very soft

**Characteristic species:** *Narthecium ossifragum* (15-30%)

This is a sub-central complex in which there is a poorly developed micro-topography. The bog surface is very soft underfoot and the *Sphagnum* cover is usually 40-60% dominated by lawns/low hummocks of *S. papillosum* and *S. magellanicum* with *S. cuspidatum* found in in-filled hollows in the wettest parts of

the complex. However, these areas generally display signs of desiccation (algae) though *Menyanthes trifoliata*, *Drosera anglica* and *Eriophorum angustifolium* are usually present. *Narthecium ossifragum* lawns and hollows are dominant averaging at 15-30% cover along with small scattered amounts of *Rhynchospora alba*. Hummocks of *Sphagnum capillifolium* and *S. austinii* are usually present at low cover values, as is *Eriophorum vaginatum* (10%). In areas where the cover of *Sphagnum* decreases to ca. 40-50% the complex is termed **6/10**. Where pools occur at a cover of 10-20%, but the description of the complex is similar to above, the complex is termed **6 + P**.

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*Complex 9/10*

**Micro-topography:** Hummocks and hollows with pools <10% or absent

***Sphagnum* cover:** >40% (This has been increased from 40/50% to greater than 40% based on most recent 2011/13 survey results)

**Firmness:** Soft to very soft but not quaking

**Characteristic species:** *Eriophorum vaginatum* (>15%)

This is a sub-central complex in which the surface is soft to very soft underfoot, but not quaking. Low hummocks and hollows characterise the micro-topography and sometimes there are very occasional pools (<10% cover). The *Sphagnum* cover is 40-60% composed mostly of lawns/low hummocks of *S. papillosum*. *S. magellanicum* and *S. cuspidatum* are present in small patches in the wettest areas, but *S. cuspidatum* usually doesn't reach cover values of 10%. *S. capillifolium*, *S. austinii* and *S. fuscum* are also usually present. *Eriophorum vaginatum* is the dominant higher plant (>15%) with *Calluna vulgaris* (10%) on hummocks. *Eriophorum angustifolium* and *Rhynchospora alba* occur in the wetter areas of the complex at approximately 5-10% cover. *Narthecium ossifragum* is present in hollows but at very low cover values (5%), increasing to 10-20% in areas where the complex becomes more degraded. In some areas where there are no pools, *Calluna vulgaris* increases to greater than 20% and the complex is termed **9/7/10**. A variant of this complex occurs where *Eriophorum angustifolium* is more dominant and the surface is very soft underfoot. This is termed **9a/10**. Where pools occur at a cover of 10-20%, but the description of the complex is similar to above, the complex is termed **9 + P** or **9a + P**.

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Complex 6/9 + Pools (6/9 + P)

**Micro-topography:** Hummocks and hollows with pools 10-20%

**Sphagnum cover:** 30-50%

**Firmness:** Soft

**Characteristic species:** *Narthecium ossifragum* (10-30%) and *Eriophorum* sp. (>20%)

This is a sub-central complex in which the bog surface is soft underfoot and low hummocks, hollows and pools characterise the micro-topography. Pools cover 10-20% of the surface area and many have an algal covering with a patchy cover of *Sphagnum cuspidatum* (30-50% of each pool) though most have a high cover of *S. papillosum* and/or *S. magellanicum* around their margins. *Drosera anglica*, *Rhynchospora alba* and *Eriophorum angustifolium* are also present in the pools. The overall *Sphagnum* cover is 30-40% composed mostly of hummocks of *S. papillosum*, *S. capillifolium* and *S. austinii*. *Narthecium ossifragum* (20%) and *Eriophorum vaginatum* (15-20%) dominate the inter-pool vegetation along with *Calluna vulgaris* (10%). Complex 6 + P is similar, but has a lower cover of *Eriophorum vaginatum* and usually a lower *Sphagnum* cover and is thus considered to be more degraded.

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Complex 6 + Pools (6 + P)

**Micro-topography:** Hummocks, hollows and flats with pools 10-20%

**Sphagnum cover:** 30-50%

**Firmness:** Soft

**Characteristic species:** *Narthecium ossifragum* (10-30%)

This sub-central complex is similar to the sub-central complex 6/4 + P, but is not restricted to western raised bogs and the cover of *Rhynchospora alba* is usually not so high (<10%). Hummocks, hollows, flats and pools characterise the micro-topography and the surface is soft underfoot. Pools cover 10-20% of the surface area and contain algae with a patchy cover (ca. 30-50% of each pool) of *Sphagnum cuspidatum* along with *Rhynchospora alba*, *Drosera anglica* and *Eriophorum angustifolium*. Hummocks of *S. capillifolium* are frequent and there are usually occasional hummocks of *S. austinii* and *S. fuscum*. The inter-pool vegetation is dominated by flats of *Narthecium ossifragum* (>25%) with *Calluna vulgaris* found growing on hummocks usually at 10-20% cover. This is considered a poor quality sub-central ecotope complex with many attributes of a sub-marginal ecotope complex.

The overall *Sphagnum* cover is 30-40% and may be even lower on western sites. Furthermore, in western sites *S. denticulatum* becomes more prominent and the overall *Sphagnum* cover in the pools is usually lower (ca. 20-30% of each pool) with *S. papillosum* and *Campylopus atrovirens* found at the pool

edges. On the western sites *Carex panicea* is usually frequent and where it reaches cover values of >15% the complex is termed **6/3+ P**.

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Complex 6/35

**Micro-topography:** Flats, pools (>20% cover) and hummocks

**Sphagnum cover:** >25% (This has been increased from 10/30% to greater than 25% based on most recent 2011/13 survey results)

**Firmness:** Soft

**Characteristic species:** *Racomitrium lanuginosum*, *Campylopus atrovirens* and *Narthecium ossifragum* (>25%)

This is a sub-central complex that is found on western raised bogs. The bog surface is usually soft though it can be very soft occasionally. It is similar to the central complex 35, but *Narthecium ossifragum* flats are more common with *N. ossifragum* covering >25% of the surface area. Pools cover >20% of the surface area and have a very patchy cover of *Sphagnum* (ca. 20% of each pool). The pools are mostly filled with open water though *Eriophorum angustifolium*, *Drosera anglica* and *Menyanthes trifoliata* area usually present as well as algae. *Sphagnum papillosum* is usually abundant at the pool margins with the western indicator *Campylopus atrovirens* also present. Island hummocks of *Racomitrium lanuginosum* are also usually occasional. *Narthecium ossifragum* (25%) dominates the inter-pool areas along with *Rhynchospora alba* (10-20%), which occurs mostly at the pool margins. The overall *Sphagnum* cover within this complex is 10-30% with *S. papillosum*, the most abundant of the *Sphagna*. Hummocks of *S. capillifolium* are frequent in the inter-pool areas and there is usually occasional *S. austinii* and *S. fuscum*. There are usually patches of *Carex panicea* in the inter-pool areas and there are no dominant higher plants other than *Narthecium ossifragum*. Where the cover of *Carex panicea* increases to >20% the complex is termed **3/35**. Where the cover of *Rhynchospora alba* increases to >20% the complex is termed **4/35**. Where the cover of *Eriophorum vaginatum* increases to >20% the complex is termed **9/35**. If there are no species occurring at >20% cover, but the characteristics described above apply the complex is termed **35-**.

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Complex 6/4 + Pools (6/4 + P)

**Micro-topography:** Flats, pools (>10% cover) and hummocks

**Sphagnum cover:** 30-40%

**Firmness:** Soft to very soft and rarely quaking

**Characteristic species:** *Narthecium ossifragum* (15-30%) and *Rhynchospora alba* (>15%)

This sub-central complex is usually found on western raised bog sites. The bog surface is very soft underfoot and there may be some quaking areas close to the pools. The pool cover is variable, ranging from between 10-30% cover. *Sphagnum cuspidatum* is found in scattered patches of the pools (averaging at ca. 30-50% of each pool) with *S. papillosum* at the pool margins along with *Campylopus atrovirens*. Large patches of open water are also present with *Sphagnum denticulatum*, *Drosera anglica* and algae usually present. The overall *Sphagnum* cover is also variable, but averages at 30-40% with hummocks of *Sphagnum capillifolium*, *S. papillosum* and occasionally *S. fuscum* found in the inter-pool areas. *Narthecium ossifragum* dominates flats occurring at 15-30% cover with *Rhynchospora alba* also characterising the complex, being found at 15-20% cover in depressions, lawns and at the edges of pools. *Carex panicea* is also usually present at 5-10% cover as well as *Eriophorum* sp. (10%).

On midland sites there is usually a higher *Sphagnum* cover (40-50%) with *S. cuspidatum* averaging at >50% cover of each pool and *Campylopus atrovirens* is absent.

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Complex 3/10

**Micro-topography:** Hummocks, flats and hollows with pools <15% or absent

***Sphagnum* cover:** 30-50%

**Firmness:** Soft to very soft

**Characteristic species:** *Carex panicea* (>15%)

This is a sub-central complex that tends to occur on sites that have some western indicators present such as *Pleurozia purpurea*. *Carex panicea* reaches high cover values (>20%) within the complex due to the western influence, reaching cover values of 40% in the more western sites. The bog surface is soft underfoot and very soft in places. The *Sphagnum* cover is 30-50%, tending to be higher on the less western sites. This is dominated by hummocks of *Sphagnum capillifolium* and *S. papillosum* with occasional hummocks of *S. fuscum*. There are usually also small patches of *S. cuspidatum* in in-filled hollows. Where the *Sphagnum* cover is >50%, the complex is termed **10/3**. Another variant corresponds to **complex 10/9/3** where hollows/lawns and pools are < 10% or absent, *Sphagnum magellanicum* is very rarely found and *S. papillosum* is the most common *Sphagna* forming hummocks and lawns. Characteristic species include *Eriophorum vaginatum* and *E. angustifolium* (>20%-combined), *Carex panicea* cover >10%. Where pools occur at a cover of 10-20%, but the description of the complex is similar to above, the complex is termed **3 + P**.

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Complex 9/7 + Pools (9/7 + P)

**Micro-topography:** Hummocks and hollows with pools (>10% cover)

**Sphagnum cover:** >25% (This has been increased from 30/40% to greater than 25% based on most recent 2011/13 survey results)

**Firmness:** Soft to very soft and occasionally quaking

**Characteristic species:** *Eriophorum* sp. and *Calluna vulgaris* co-dominate each at >10-15%

This is a sub-central complex in which the bog surface is generally soft with occasional quaking areas. The pools within this complex are small in size and the pool cover averages at >10%. These pools usually have a good cover (>75% of each pool) of *Sphagnum cuspidatum* with *Eriophorum angustifolium*, *Rhynchospora alba* and *Drosera anglica* also present. In some areas the pools are not distinctive and appear more like *Sphagnum* filled lawns with *Narthecium ossifragum* often found scattered throughout the *Sphagnum* pool/lawn patches. *S. papillosum* and *S. magellanicum* are frequent at the pool margins and/or in lawns and on some sites *S. pulchrum* is found. *Calluna vulgaris* (20-30%) and *Eriophorum vaginatum* (10-15%) dominate the inter-pool areas and there are occasional large wide hummocks of *Sphagnum capillifolium* and *S. austinii* with lower hummocks of *S. capillifolium* frequent as well as occasional *S. fuscum*. The general *Sphagnum* cover varies between 30-40%. Where *Narthecium ossifragum* increases to >10% cover the complex is termed **9/7/6 + Pools**.

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Complex 9/7/10

**Micro-topography:** Hummocks and hollows with pools absent

**Sphagnum cover:** 40-60%

**Firmness:** Soft to very soft

**Characteristic species:** *Calluna vulgaris* (20%) and *Eriophorum vaginatum* (>15%) and *Sphagnum capillifolium* is the dominant *Sphagnum*.

This is a transitional sub-central/sub-marginal complex that has characteristics of each ecotope. The complex usually grades into the sub-marginal complex 9/7 and the differences between the two complexes are very subtle. The surface is usually soft underfoot and hummocks and hollows characterise the Micro-topography with no pools present. Generally, however, the *Sphagnum* layer in the sub-central complex is thicker and has a slightly higher cover (averaging 50-60%). *S. capillifolium* is by far the dominant *Sphagnum* within this complex reaching cover values of up to 50% with *S. tenellum* also frequent and only small amounts of *S. papillosum* and *S. magellanicum* recorded along with very occasional hummocks of *S. austinii*. *Eriophorum vaginatum* (20-25%) is also more abundant in the sub-

central complex and characterises the vegetation along with *Calluna vulgaris* (20%) and a general lack of any cover (<5%) of *Narthecium ossifragum*.

## SUB-MARGINAL ECOTOPE COMPLEXES

### Complex 9/7

**Micro-topography:** Hummocks and hollows with pools absent

***Sphagnum* cover:** 30-40%

**Firmness:** Soft

**Characteristic species:** *Calluna vulgaris* (20%) and *Eriophorum vaginatum* (10-20%)

This is a sub-marginal complex that has many characteristics of and usually grades into the sub-central complex 9/7/10. The differences between the two complexes are subtle and are not easy to detect in the field. However, in general the *Sphagnum* layer in the sub-marginal complex is thinner and reaches a slightly lower abundance cover averaging at 30-40%, but ranging from 20-50%. Although *Eriophorum vaginatum* (10-20%) characterises the vegetation along with *Calluna vulgaris* (20-30%), it is not as abundant as it is in the sub-central complex. Furthermore, there is an increase in cover of *Narthecium ossifragum* (5-10%) in the sub-marginal complex. Where the complex is degraded slightly further, the *Sphagnum* cover is lower (ca. 30%) and there is an increase in cover of *Narthecium ossifragum* (>10%) and the complex is termed 9/7/6.

## Appendix 4: Impacting activities description and ranking

### Drainage description and classification

Drains were classified and described as follows on the field:

#### Not blocked

- **Functional:** running water on the day of the visit, or no running water on the day of the visit but no vegetation in the drain, or vegetation in the drain (i.e. *Sphagnum* species) less than 2/3 of the drain height.
- **Non-functional:** drain completely covered in vegetation and it appears water does not run through the drain any longer.
- **Reduced functional:** more than 2/3 of the drain height covered by vegetation (i.e. *Sphagnum* species).

#### Blocked

- **Functional:** dams are not working and water running through the drain.
- **Non-functional:** drain completely covered in vegetation and it appears water does not run through the drain any longer.
- **Reduced functional:** drain contains open water or more than 2/3 of the drain height covered by vegetation (i.e. *Sphagnum* species).

### Impacting activities ranking

Impacting activities were ranked according to their **importance** as follows (based on Evans & Arvela, 2011):

Code	Meaning	Comment
H	High importance/impact	Important direct or immediate influence and/or acting over large areas.
M	Medium importance/impact	Medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally.
L	Low importance/impact	Low direct or immediate influence, indirect influence and/or acting over small part of the area/ acting only regionally.

Activities are categorised according to their **influence**: (-1): negative / (0): neutral / (+1): positive



## Appendix 5: Quadrat data

### Active (7110) and Degraded Raised Bog (7120) quadrat data

**Ecotope type:** Central / Sub-central / Sub-marginal / Marginal

**Complex Name**

**Quadrat Name**

**Firmness**

- Firm: ground does not sink under the weight of your body.
- Soft: ground sinks approximately 1 to 3cm but little amount of water is released by the peat or *Sphagnum*.
- Very soft: ground sinks more than 3cm and a considerable amount of water is released by the peat or *Sphagnum*.
- Quaking: ground bounces or shakes when the surveyor jumps.

**Note:** An increase in firmness indicates drier conditions.

**Burnt**

- No: evidence of recent burning absent.
- Light: *Sphagnum/Leucobryum* hummocks have been slightly damaged. Higher plants assemblage largely unaffected by the burn. Little or no patches of bare peat present, *Calluna vulgaris* although damaged still growing from old shoots and *Cladonia portentosa* absent.
- Severe: *Sphagnum/Leucobryum* hummocks have been badly damaged but some regeneration may have started. Higher plants assemblage dominated by pioneer species such as *Narthecium ossifragum* and *Carex panicea*. Some patches of bare peat present, *Calluna vulgaris* only growing from new shoots and *Cladonia portentosa* absent.

**Algae in hollows %**

**Algae in pools %**

**Bare peat %**

**Note:** An increase in any of the three indicators (algae in hollows, algae in pools, bare peat) indicates more degraded conditions.

**High hummocks %:** mounds on the bog surface taller than 25cm above ground level usually composed of *Sphagnum* species but other bryophyte species such as *Hypnum jutlandicum* and

*Leucobryum glaucum* are also important, *Calluna vulgaris* is another important element as it is frequently found on the hummocks

\*High hummocks with tall *Calluna vulgaris*: high hummock with tall *Calluna vulgaris* (>40cm).

**Low hummocks %:** mounds on the bog surface lower than 25cm above ground level usually composed of *Sphagnum* species, *Calluna vulgaris* is another important element as it is frequently found on the hummocks.

**Note:** hummocks % cover will always be = or > than *Sphagnum hummocks* cover (mentioned below), never smaller, as some of the hummocks may be dominated by *Calluna vulgaris* for instance and not *Sphagnum* species.

**Hollows %:** shallow depressions (less than 5cm deep) on the bog surface

**Lawns %:** shallow hollows or flat areas where one species dominates in an area of at least 0.5m diameter; this is frequently a *Sphagnum* species such as *S. magellanicum*, *S. papillosum*.

\***Flats:** these are more or less flat areas but intermediate between hummock and hollow communities that tend to be drier than these situations. *Narthecium ossifragum* and/or *Carex panicea* generally dominates flats.

**Pools %:** depression on the bog surface where the water table remains above the surface level all year around or below only for a short period of time. They are characterised by the presence of aquatic species such as *Sphagnum cuspidatum*, but they could be also open water.

**Note:** all the above quadrat micro-topographical features should add up to 100% cover (e.g. hummocks+hollows+ pools, etc.).

**Note:** A decrease in pools cover indicates drier conditions, but it could be also a natural process where pools are replaced by hummocks or lawns.

**Pool type:**

- Absent
- Regular: pools that have a more or less rounded shape and are isolated
- Interconnecting: pools are continuous (i.e. running into each other)
- Tear: pools with an elongated shape not interconnected

***S. austinii* hummock type:** *Sphagnum austinii*

- Absent
- Active: hummocks variable in size with apparent evidence of spreading
- Relic: usually large hummocks with no obvious sign of spreading

***S. austinii* hum %**

***S. austinii* height (cm)**

***S. fuscum* hummock type:** *Sphagnum fuscum*

- Absent
- Active: hummocks variable in size with apparent evidence of spreading
- Relic: usually large hummocks with no obvious sign of spreading

***S. fuscum* hum %**

***S. fuscum* height (cm)**

**Note:** Both *S. austinii* and *S. fuscum* are considered good quality indicators. A decline in their cover indicates more degraded conditions.

***Leucobryum glaucum*:** present or absent

***Trichophorum* type:** *Trichophorum germanicum*

- Absent
- Flats: plant grows in a loose form
- Tussocks: plant grows in a tuft form

***Trichophorum* %**

**Note:** An increase in *Trichophorum germanicum* is likely to indicate more degraded conditions.

***S. cuspidatum* %:** *Sphagnum cuspidatum*

***S. denticulatum* %:** *Sphagnum denticulatum*

**Note:** A decrease in *Sphagnum cuspidatum* or *S. denticulatum* is likely to indicate drier conditions. However, it could be also part of a natural transition process if other negative indicators absent.

***S. magellanicum* %:** *Sphagnum magellanicum*

***S. papillosum* %:** *Sphagnum papillosum*

***S. capillifolium* subsp. *rubellum* %:** *Sphagnum capillifolium* subsp. *rubellum*

***S. tenellum* %:** *Sphagnum tenellum*

***S. subnitens* %:** *Sphagnum subnitens*

**Note:** An increase in more typically hummock or lawn species (*Sphagnum magellanicum*, *S. papillosum*, *S. capillifolium*, *S. tenellum* or *S. subnitens*) at the expense of more typically pool species (*S. cuspidatum*

and *S. denticulatum*) is likely to indicate drier conditions. However, it could be also part of a natural transition process if other negative indicators absent.

**R. fusca %:** *Rhynchospora fusca*

**R. alba %:** *Rhynchospora alba*

**Note:** An increase in *Rhynchospora alba* and/or *R. fusca* is likely to indicate more drier or degraded conditions. However, it could be also part of a natural transition process if other negative indicators absent.

**N. ossifragum %:** *Narthecium ossifragum*

**Note:** An increase in *Narthecium ossifragum* is likely to indicate more drier or degraded conditions.

**Sphag pools %**

**Dominant pool Sphag:** *Sphagnum cuspidatum*, *S. pulchrum*, *S. denticulatum*

**Sphag lawns %**

**Sphag humm %**

**Sphag holl %**

**Total Sphag %**

**Hummock indicators:** *Sphagnum austinii*, *S. fuscum*

**Cladonia portent %:** *Cladonia portentosa*

**Other Cladonia sp**

**Note:** The absence of *Cladonia portentosa* in a quadrat were it was previously recorded indicates the occurrence of a fire event.

**C. panicea %:** *Carex panicea*

**Calluna cover %:** this includes both *Calluna vulgaris* and *Eric tetralix* cover

**Calluna height (cm):** *Calluna vulgaris* height

**Note:** An increase in *Calluna vulgaris* and/or *Eric tetralix* cover is likely to indicate more drier or degraded conditions. However, it could be also part of a natural transition process if other negative indicators are absent.

**Other Notable Species**

**Other comment**

Bog Woodland (91D0) assessment sheet

(from Cross & Lynn, 2013)

Site name	Recorders	Photo no.s
Stop Number	Date	Grid ref
<b>Positive indicator species</b>	✓	<b>Negative indicator species</b>
<p><b>Trees and woody species</b></p> <p><i>Betula pubescens</i>  <i>Salix aurita</i>  <i>Salix atrocinerea</i></p> <p><b>Dwarf shrubs, herbs &amp; ferns</b></p> <p><i>Dryopteris dilatata</i>  <i>D. carthusiana.</i>  <i>Carex rostrata</i>  <i>Juncus effusus</i>  <i>Molinia caerulea</i>  <i>Vaccinium oxycoccos</i>  <i>Empetrum nigrum</i>  <i>Vaccinium myrtillus</i>  <i>Epilobium palustre</i>  <i>Calluna vulgaris</i>  <i>Potentilla erecta</i></p> <p><b>Mosses</b></p> <p><i>Polytrichum commune</i>  <i>Sphagnum fimbriatum</i>  <i>Sphagnum fallax</i>  <i>Sphagnum palustre</i>  <i>Hylocomium splendens</i>  <i>Aulacomnium palustre</i></p>		<p><i>Pteridium aquilinum</i>  <i>Rubus</i> agg.  <i>Rhododendron ponticum</i>                      Non-native conifer species                      List:</p> <p>Others                      List:</p>
Pass = <i>Betula pubescens</i> , <i>Sphagnum</i> species plus ≥5 of the other species		Pass = Negative indicator species <10%
<b>Structural data</b>	<b>Result</b>	<b>Stop level</b>
Median canopy height >4m Total canopy cover >30% of plot <i>Betula pubescens</i> >50% of canopy Dwarf shrub layer cover <50% <i>Calluna</i> cover <40% % <i>Sphagnum</i> cover (pass = ≥25%) % Bryophyte cover (pass = ≥50%)	<b>Result=</b>	≥7 passes = pass <7 passes = fail

Target tree species dbh	✓	Old trees & dead wood (any species)	Result
<i>Betula pubescens</i> 5-10cm 10-20cm >20cm		No. of old/senescing trees or dead stems >10cm No. of standing dead trees >10cm  No. of fallen dead trees/branches >10cm	
Pass = Over all stops each size class represented		Pass = 1+ old/senescing trees (or dead stems) in >25% of stops and 4+ standing dead or fallen dead in total number of stops	
<i>Betula pubescens</i> regeneration			
Pass = ≥1 sapling >1m in all stops			

*Assessment method*

Of the nine criteria assessed at the individual-plot level, seven had to reach their target to achieve a pass. Of the three criteria assessed at the multi-plot level, two had to reach their target to achieve a pass. For the overall site level assessment, a green (favourable) assessment result could be achieved only if all plots passed at the individual-plot and multi-plot levels. Thus, in the case of a site with 4 plots, one failure out of the five assessed (four plots plus the multi-plot) was allowed for a site to receive an amber (unfavourable – inadequate) assessment. More than one failure resulted in a red (unfavourable – bad) assessment (See Table below). However, the sites surveyed as part of this project and Fernandez *et al.* (2012) were so small that only one or two plots could in many cases be recorded and here a more subjective approach had to be used to assess S&Fs.

Assessment	Stop level	4-stop level
Green	4 stops pass	3 passes
Amber	4 stops pass	2 passes
Amber	3 stops pass	3 passes
Red	3-4 stops pass	1 pass
Red	<3 stops pass	Any result

## Appendix 6: Domin scale values

Cover/abundance is a measure of the vertical projection on to the ground of the extent of the living parts of a species (Dahl and Hadac, 1941).

Cover	Domin
91–100%	10
76–90%	9
51–75%	8
34–50%	7
26–33%	6
11–25%	5
4–10%	4
<4% (many individuals)	3
<4% (several individuals)	2
<4% (few individuals)	1

## Appendix 7: Typical species list

### Active and Degraded Raised Bog typical species (derived from NPWS (2007))

**Vascular plants:** *Andromeda polifolia*, *Drosera anglica*, *D. intermedia*, *D. rotundifolia*, *Eriophorum angustifolium*, *E. vaginatum*, *Menyanthes trifoliata*, *Narthecium ossifragum*, *Racomitrium lanuginosum*, *Rhynchospora alba*, *Utricularia minor*, *Vaccinium oxycoccos*.

**Mosses, liverworts and lichens:** *Aulacomnium palustre*, *Campylopus atrovirens*, *Cladonia* spp (*C. ciliata* and *C. portentosa*), *Leucobryum glaucum*, *Pleurozia purpurea*, *Sphagnum denticulatum*, *S. capillifolium*, *S. cuspidatum*, *S. fuscum*, *S. austinii*, *S. magellanicum*, *S. papillosum*, *S. pulchrum*, *S. subnitens*.

### Bog Woodland habitat typical species (derived from NPWS (2007))

**Vascular plants:** *Agrostis canina*, *Betula pubescens*, *Calluna vulgaris*, *Carex canescens*, *C. echinata*, *C. nigra*, *C. rostrata*, *Dryopteris dilatata*, *Empetrum nigrum*, *Eriophorum vaginatum*, *Holcus lanatus*, *Juncus effusus*, *Molinia caerulea*, *Pinus sylvestris*, *Pteridium aquilinum*, *Salix aurita*, *Vaccinium myrtillus*, *V. oxycoccos*.

**Mosses, liverworts and lichens:** *Aulacomnium palustre*, *Polytrichum commune*, *Sphagnum capillifolium*, *S. fimbriatum*, *S. palustre*, *S. fallax*, *S. squarrosum* and *S. teres*, *Cladonia portentosa*.

### Rhynchosporion depressions typical species (derived from NPWS (2007))

**Vascular plants:** *Rhynchospora alba*, *R. fusca*, *Drosera intermedia*, *D. rotundifolia*, *Drosera anglica*, *Eriophorum angustifolium*, *Narthecium ossifragum*.

**Mosses, liverworts and lichens:** *Sphagnum cuspidatum*, *S. denticulatum*, *S. magellanicum*, *S. papillosum*, *S. pulchrum* (local), *Lycopodium inundatum* (very rare).



## Appendix 8: Active Raised Bog assessment examples

		Area			S&Fs			FPs	Overall
Raheenmore	Assessment	Current (52.31ha) < FRV (119.12ha) <b>(56.09% below FRV)</b>	<b>UB</b>	<b>UB- Increasing</b>	Current (1.68ha) < FRV (26.16ha) <b>(93.58% below FRV)</b>	<b>UB</b>	<b>UB- Improving</b>	<b>UB-Stable</b>	<b>UB- Improving</b>
	Trend	<b>Increasing</b>			<b>Improving</b>				
Carrowbehy/Caher	Assessment	Current (69.87ha) < FRV (80.77ha) <b>(13.50% below FRV)</b>	<b>UI</b>	<b>UI- Decreasing</b>	Current (57.72ha) > FRV (34.94ha) <b>(65.20% above FRV)</b>	<b>F</b>	<b>F- Declining</b>	<b>UI- Declining</b>	<b>UI- Declining</b>
	Trend	<b>Decreasing</b>			<b>Declining</b>				
Mongan	Assessment	Current (48.31ha) < FRV (60.90ha) <b>(20.67% below FRV)</b>	<b>UB</b>	<b>UB- Increasing</b>	Current (42.71ha) > FRV (24.16ha) <b>(76.78% above FRV)</b>	<b>F</b>	<b>F- Stable</b>	<b>UI- Improving</b>	<b>UB- Improving</b>
	Trend	<b>Increasing</b>			<b>Stable</b>				
Kilcarren	Assessment	Current (11.9ha) < FRV (130.32ha) <b>(90.87% below FRV)</b>	<b>UB</b>	<b>UB- Decreasing</b>	Current (2.44ha) < FRV (5.95ha) <b>(58.99% below FRV)</b>	<b>UB</b>	<b>UB- Stable</b>	<b>UB- Declining</b>	<b>UB- Declining</b>
	Trend	<b>Decreasing</b>			<b>Stable</b>				

## Appendix 9: National raised bog spatial datasets

The following shapefiles originally compiled as part of NPWS (2007) have been reviewed and updated with more recent data available for the current reporting period (2007 – 2013). These datasets represent the national raised bog resource (See NPWS (2007) for further detail on these datasets).

### 1. Raised Bog for which ecotope data is available

The following three datasets contain raised bog habitat data mapped at ecotope level according to Kelly (1993). ARB consists of two ecotopes (central and sub-central) and active peat forming flushes. Bog Woodland habitat (91D0), on raised bog, is also deemed part of ARB as it also actively forms peat. DRB consists of marginal, sub-marginal, facebank ecotopes and inactive flushes. All the records but one (i.e. Killamuck (Abbeyleix) bog within RBMA13\_habitats\_2007\_13\_othersources) provided by these sources are limited to designated sites (i.e. NHAs or SACs). A very small amount of ARB is considered to potentially be outside designated sites.

- **RBMA13\_ecotope\_map**-This dataset contains ecotope data for 43 raised bogs designated as SAC and one raised bog designated as NHA surveyed in the 2011 to 2013 period as part of Fernandez *et al.* (2011) and this project's surveys. These dataset is further described within the methods section.
- **RBMA13\_habitats\_2007\_13\_othersources**-This dataset contains ecotope data for two additional sites Clara bog (SAC 000572) undertaken in 2009 by Fernandez *et al.* (2009a) and Killamuck (Abbeyleix) bog also undertaken in 2009 by Fernandez *et al.* (2009b). Further information about methods and mapping can be found within both reports.
- **RBMA13\_habitats\_prior\_2007**-This dataset contains ecotope data for any other designated raised bog for which the latest ecotope survey was undertaken prior to 2007. Data within this dataset was generated by Kelly *et al.* (1995), Derwin & MacGowan (2000) and Fernandez *et al.* (2006) for the 1994 to 2004 period and Fernandez *et al.* (2005) for the 2004-2005 period.

### 2. Raised Bog for which ecotope data is not available

- **RBMA13\_unsurveyed\_data\_prior\_2007** – This ecotope contains all remaining *intact* raised bog areas not included in the above datasets both designated or not designated for which ecotope data is not available. This dataset was compiled in 2007 as part of NPWS (2007). This dataset includes data from the 2000 to 2006 period, and thus its current extent would be smaller as a result of peat cutting since 2006. The occurrence of ARB within the reported records is unknown but is likely to be extremely limited.

Data was compiled from the following sources:

- EPA Corine Land cover map (2000)
- Conaghan, J., (2000)
- NPWS Enquiries database (2006)
- NPWS Management Plans Support Unit (MPSU) maps (2006)
- NPWS Habitat Assignment Project (2006)
- Teagasc Hammond Peatlands soils map (1979) digitised
- Ordnance Survey of Ireland 2000 aerial photographs

This dataset specifies within the attribute table (“Comment” field), whether the record is likely to correspond with DRB, whether ARB is absent or the presence of ARB is Unknown (i.e. ARB unknown). In this particular case, there is some potential for occurrence of ARB. Occasionally, the occurrence of raised bog was reported by the mentioned sources and it was found to correspond with blanket bog – heath or fen instead raised bog. These records were therefore ruled out from the dataset.

The majority of the raised bog areas included in this dataset were reported by Corine 2000 (level 4). The original Corine 2000 raised bog polygons were occasionally modified as part of NPWS (2007) to fit the high bog shape shown on the 2000 OSi aerial photographs. The remaining raised bog, which corresponds to secondary degraded raised bog, was included in the secondary degraded dataset (i.e. RBMA13\_2dary\_DRB\_unsurveyed). In those cases where other sources mentioned above indicated the occurrence of raised bog, the high bog boundary was digitised taking into also using the 2000 OSi aerial photographs. The origin of each raised bog record was reported under “Source” field within Attribute table. A more detailed description of the processes followed to extract raised bog data from CLC 2000 map and Hammond (1979) map is given below in this appendix. This also includes a description of these two sources shortcomings given by NPWS (2007).

### 3. Secondary degraded raised bog habitat

- **RBMA13\_2dary\_DRB\_unsurveyed**-This dataset contains intensively drained high bog devoid of vegetation (including the majority of Bord na Móna sites), cutaway bog, cutover and occasionally reclaimed agricultural land with peaty soils. Although this sub-type of DRB does not correspond with the strict definition of the Habitats Directive Interpretation Manual, the re-establishment of vegetation with peat forming capability, including the restoration of ARB, in some of these areas may be possible and in fact may even be more feasible than in some areas of currently classified DRB. This dataset was generated in 2007 as part of NPWS (2007).

Data was compiled from the following sources:

- EPA Corine Land cover map (2000)

- Conaghan, J., (2000)
- NPWS Enquiries database (2006)
- Teagasc Hammond Peatlands soils map (1979) digitised
- Ordnance Survey of Ireland 200 aerial photographs

Corine 2000 exploited raised bog areas (level 5) were selected for this category. However visual validation was carried out as it was noted that Corine 2000 classified certain areas as intact when they are exploited and vice versa. Some areas reported by Corine as exploited correspond with improved agricultural land with peaty soils. Some of these areas were ruled out from this dataset as they no longer correspond to raised bog. Those areas reported by Conaghan (2000) were digitised using the 2000 OSi aerial photograph. Hammond (1979) highlighted certain areas within the Man modified category that were also included in this dataset. The location of these areas reported by Hammond (1979) may have been slightly off the actual location. In this particular case the raised bog boundary was re-digitised using 2000 OSi aerial photograph.

#### **EPA Corine Land cover map (2000)**

Corine Land Cover (CLC) is a map of the European environmental landscape based on interpretation of satellite images. It provides comparable digital maps of land cover for each country for much of Europe. The CLC 2000 project in Ireland forms part of the update of land cover maps for the whole of Europe, which is being co-ordinated by the EEA (European Environmental Agency) with the co-operation of national competent authorities in contributing states. The Environmental Protection Agency (EPA) is the national competent authority for CLC 2000 data in Ireland. The CLC 2000 database was created by first assessing and correcting the existing CLC 1990 land cover database and images for geometric and thematic content, followed by mapping land cover changes using 2000 satellite imagery and ancillary data. The CORINE project provides a coarse quantification of land cover in Ireland.

CLC is based on a simple 3-level hierarchy classification system consisting of 44 land cover classes. The land cover inventory was conducted at a scale of 1:100,000 and the minimum area digitised in the updated version, CORINE 2000 is 25 ha. Additional work was undertaken for some habitat on the hierarchical levels 4 and 5 of raised bog and up to level 6 of blanket bog (<http://www.epa.ie/OurEnvironment/Land/CorineLandCover>).

Raised bog land cover was divided into two subtypes:

- Exploited raised bog (Code 41211) mainly corresponds to cutaway, cutover, reclaimed agricultural land with peat soils (e.g. surrounding either cutaway, cutover or intact raised bog). These areas are mostly deemed secondary degraded raised bog. Bord na Móna extensive cutover

bogs areas have been classified as secondary degraded category. These areas of secondary degraded of geographical importance (i.e. isolated sections of raised bog in counties outside the main concentration of raised bog) were remapped (re-digitised) as part of NPWS (2007) with the aid of the 2000 OSi aerial photography. These areas occasionally included small areas of reclaimed agricultural land where all the peat may have been removed. These areas would therefore not be considered raised bog and therefore excluded from the final dataset.

- Intact raised bog (Code 41212) corresponds to either DRB or ARB. Occasionally large drained areas of high bog where the raised bog vegetation remains were included in this type. These areas correspond with DRB. However those areas where the top vegetation layer has been removed and mapped as 41212 by CLC, were allocated to secondary degraded raised bog along with Exploited raised bog (41211) by NPWS (2007). These areas generally grade into cutover and reclaimed land with peaty soils.

NPWS (2007) identified the following shortcomings in CLC map:

- Although CLC maps was identified as the most comprehensive source of information to generate raised bogs distribution and range maps, several deficiencies on habitat boundaries and clarification were noted. NPWS (2007) tried to minimise them by processing CLC data (i.e. reclassifying or adjusting high bog boundaries). 2000 OSi aerial photograph were used for this purpose.
- According to NPWS (2007) CLC 2000 map occasionally classed small sections of intact raised bog as other habitat type (e.g. land occupied by agriculture with areas of natural vegetation). These areas were re-classed as DRB by NPWS (2007).
- Raised bogs afforested with conifers were frequently reported as conifers and not as raised bogs. These areas were mapped by NPWS (2007) and classed as DRB. However, NPWS (2007) highlighted that this step was not done systematically and some high bog afforested areas are still not included in the final dataset (i.e. RBMA13\_2dary\_DRB\_unsurveyed).
- Those raised bog areas mapped by CLC as Exploited raised bog (41211) where the high bog vegetation is *intact* were promoted to Intact raised bog (41212). The presence of ARB is unknown here.

To summarise, CLC raised bog records were included in the RBMA13\_unsurveyed\_data\_prior\_2007 dataset when they were considered to correspond with *intact* high bog or in RBMA13\_2dary\_DRB\_unsurveyed when they correspond with secondary degraded raised bog. In addition, each record was classed as DRB where the possibilities of finding ARB are minute or those where the presence of ARB is unknown. Those CLC raised bog areas already mapped more accurately by additional sources were not included in the final datasets to avoid duplicates.

## **Teagasc Hammond Peatlands soils map of Ireland (1979) digitised**

According to NPWS (2007), Hammond's Peatland soils map of Ireland (1979) was described as the most comprehensive over-view of the distribution of peatlands in Ireland at the end of the 1970s.

Hammond's map was produced based on data from several sources, principally the detailed soil map data from the National Soil Survey carried out by An Foras Talúntais since 1968, these maps covered 10 counties fully and two counties partially. Aerial photographs from 1973/74 together with site visits covered the rest of the country. No aerial cover existed however for county Donegal and parts of counties Sligo, Cork, Waterford and Louth. Hammond acknowledged that these counties were not covered by the same detailed reconnaissance field sheets as the other counties and were mapped principally on the basis of the far cruder 1920 peat map for Ireland. However, these deficiencies seemed to apply more to blanket bog than raised bog and Hammond's map was regarded as the only peatland map which has been methodically produced and which specifically targeted peatlands.

Raised bogs, were divided into seven subtypes:

1-Raised Bog –Machine Peat

2-Raised Bog – Milled Peat

3-Raised Bog – Moss Peat

4-Raised Bog – Man Modified

5-Raised Bog – True Midland Type

6-Raised Bog – Transitional Type

7-Raised Bog – Potential Industrial Areas

Although Hammond's map categorised mires (i.e. blanket bog, raised bog and fen) according to the level of disturbance (i.e. man modified, milled peat, moss peat), the current status of those sites considered unmodified is likely to have changed since 1979. Hammond's maps were therefore considered not reliable for identifying the current site status due to the impact of the Turf Development Act (1981-1995) supported projects and private afforestation grant aids. However, Hammond's map was considered to be the most accurate national map available for indicating the location of raised bog peat soils.

The Soils Division of Teagasc digitised the original Hammond's Peatland Map of Ireland (1979). This dataset was used to complete the raised bog distribution datasets (i.e. RBMA13\_2dary\_DRB\_unsurveyed and RBMA13\_unsurveyed\_data\_prior\_2007) generated by NPWS (2007). This process allowed further validation for those records already identified by other sources and more importantly identified raised bog areas in grid squares where raised bog were not reported

by other sources. Only three records of *intact* raised bog, which are given in RBMA13\_unsurveyed\_data\_prior\_2007, not recorded by any of the other sources were given by Hammond's (1979) map. However Hammond's map extremely useful for mapping some areas of secondary degraded raised bog, which are given in RBMA13\_2dary\_DRB\_unsurveyed, not reported by additional sources (e.g. Corine 2000).

NPWS (2007) also mentioned that some raised bog areas reported by Hammond in 1979 were not visible on the 2000 OSi aerial photographs. This was likely to be due to either the complete transformation of the landscape through land reclamation or in some cases to errors in Hammond's maps. These areas were not included in the datasets but it is probable that at least some of these areas still contain raised bog peat soils.

## Appendix 10: Active Raised Bog sites assessments versus impacts

Site code	Site Name	Area	S&Fs	FPs	Overall	Restoration works done	Peat cutting	HB cut away (2004/05-2010)	Approx number plots cut (2004/05-2010)	HB drainage	HB drainage (Km)	Outside HB drainage	Outside HB drainage (Km)	Forestry on HB	Forestry on HB (ha)	Forestry adjacent to HB	Forestry adjacent to HB (ha)	Fire	Fire (ha)	Invasive	Invasive (ha)	Quarrying	Quarrying (ha)
000006	Killyconny	UB-Stable	UB-Stable	UB-Stable	UB-Stable	Yes	na	Na	na	M	4.103	M	n/av	na	na	na	na	na	na	L	<0.1	n/av	n/av
000221	Moorfield	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	L	0.35	7	H	2.833	H	n/av	na	na	L	8.15	na	na	L	<0.1	na	na
000285	Kilsallagh	UB-Increasing	UB-Declining	UB-Declining	UB-Declining	Yes	L	1.63	39	H	13.254	M	n/av	na	na	L	14.69	na	na	L	<0.1	na	na
000296	Lisnageeragh	UB-Increasing	UB-Improving	UB-Declining	UB-Declining	Yes	L	0.5	13	M	10.804	L	n/av	na	na	L	14.5	na	na	L	<0.1	na	na
000297	Addergoole	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	H	1.9	28	H	5.434	H	n/av	na	na	na	na	na	na	na	na	na	na
000326	Shankill West	UB-Decreasing	F-Declining	UB-Declining	UB-Declining	No	H	0.11	1	H	4.95	M	n/av	na	na	L	6.2	M	47.17	na	na	na	na
000382	Sheheree	UB-Stable	UB-Stable	UB-Stable	UB-Stable	No	na	Na	na	na	na	na	na	na	na	na	na	na	na	L	<1	na	na
000391	Ballynafagh	UB-Increasing	UB-Stable	UB-Stable	UB-Improving	No	L	0.77	25	M	4.192	M	n/av	M	10.84	na	na	M	48.37	L	<0.05	na	na
000497	Flughany	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	0.22	4	M	12.457	L	n/av	na	na	L	0.04	M	132.5	na	na	na	na
000566	All Saints	UB-Increasing	F-Improving	UB-Declining	UB-Declining	No	H	0.42	11	H	27.393	H	n/av	na	na	na	na	na	na	na	na	H	16
000575	Ferbane	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	L	n/av	1	H	10.889	H	n/av	na	na	na	na	na	na	na	na	na	na
000580	Mongan	UB-Increasing	F-Stable	UI-Improving	UB-Improving	Yes	L	0.1	1 (near to HB)	M	9.305	M	n/av	na	na	na	na	L	50	na	na	na	na
000581	Moyclare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	Yes	H	0.64	25	H	3.8	M	n/av	na	na	L	4.4	na	na	na	na	na	na
000582	Raheenmore	UB-Increasing	UB-Improving	UB-Stable	UB-Improving	Yes	na	Na	na	M	9.4	H	n/av	na	na	na	na	na	na	na	na	na	na
000585	Sharavogue	UB-Stable	UB-Stable	UB-Stable	UB-Stable	Yes	na	Na	na	M	21.912	L	n/av	na	na	L	Unkno wn	na	na	L	<0.1	na	na
000592	Bellanagare	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	Yes	H	5.77	102	H	59.541	M	n/av	L	9.5	L	132	na	na	L	<0.1	na	na



Site code	Site Name	Area	S&Fs	FPs	Overall	Restoration works done	Peat cutting	HB cut away (2004/05-2010)	Approx number plots cut (2004/05-2010)	HB drainage	HB drainage (Km)	Outside HB drainage	Outside HB drainage (Km)	Forestry on HB	Forestry on HB (ha)	Forestry adjacent to HB	Forestry adjacent to HB (ha)	Fire	Fire (ha)	Invasive	Invasive (ha)	Quarrying	Quarrying (ha)	
000595	Callow	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	H	3.31	50	H	28.332	H	n/av	L	6.55	L	11.62	na	na	L	<0.1	na	Na	
000597	Carrowbehy	UI-Decreasing	F-Declining	UI-Declining	UI-Declining	Yes	na	Na	na	H	7.37	H	n/av	na	na	M	6.4	na	na	L	<0.1	na	na	
000600	Cloonchambers	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	1.86	37	M	3.835	M	n/av	na	na	na	na	na	na	L	<0.1	na	na	
000604	Derrinea	UB-Decreasing	UI-Stable	UB-Declining	UB-Declining	No	na	Na	na	H	1.488	M	n/av	na	na	L	n/av	na	na	na	na	na	na	na
000614	Cloonshanvillie	UB-Decreasing	UB-Stable	UB-Stable	UB-Declining	Yes	na	Na	na	H	6.511	H	n/av	na	na	na	na	na	na	L	17.98	na	na	
000641	Ballyduff	UB-Increasing	UB-Improving	UB-Improving	UB-Improving	Yes	L	0.03	2	M	11.825	M	n/av	na	na	L	n/av	na	na	L	<0.1	na	na	
000641	Clonfinane	UB-Increasing	UB-Stable	UB-Improving	UB-Improving	Yes	M	60	1 <sup>1</sup>	M	13.587	M	n/av	na	na	na	na	M	59.47	na	na	na	a	
000647	Firville	UB-Stable	UB-Stable	UB-Stable	UB-Stable	No	na	Na	na	M	1.909	M	n/av	na	na	L	n/av	L	14	na	na	na	na	na
000647	Kilcarren	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	M	0.1	2	H	6.559	M	n/av	na	na	L	n/av	L	22	na	na	na	na	na
000679	Garriskil	UB-Increasing	UB-Improving	UB-Improving	UB-Improving	Yes	na	Na	na	M	12.158	M	n/av	na	na	na	na	na	na	L	<0.5	na	na	na
001242	Carrownagapul	UB-Increasing	UB-Improving	UB-Declining	UB-Declining	Yes	L	3.1	48	M	16.005	M	n/av	na	na	L	59	M	185	na	na	na	na	na
001818	Ballykenny	UB-Increasing	UB-Improving	UB-Improving	UB-Improving	Yes	na	Na	na	M	25.929	M	n/av	na	na	na	na	na	na	L	<0.5	na	na	na
001818	Fisherstown	UB-Decreasing	UB-Declining	UB-Improving	UB-Declining	Yes	na	Na	na	H	10.164	L	n/av	L	1	L	13	H	26.55	L	<0.1	na	na	na
002110	Cloonfelliv	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	0.14	4	M	0.968	M	n/av	na	na	na	na	na	na	na	na	na	na	na
002110	Corliskea	UB-Decreasing	UI-Declining	UB-Declining	UB-Declining	No	H	2.25	43	H	8.997	L	n/av	H	4.19	L	7.5	M	70.6	na	na	na	na	na
002110	Trien	UB-Decreasing	F-Stable	UB-Declining	UB-Declining	No	L	0.12	5	H	11.03	M	n/av	na	na	L	4	na	na	L	<0.1	na	na	na
002298	Derrynabrock	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	0.08	2	M	4.028	M	n/av	na	na	M	3.84	na	na	na	na	na	na	na
002298	Tawnaghbeg	UB-Stable	UB-Stable	UB-Stable	UB-Stable	No	na	Na	na	M	3.673	M	n/av	M	3.17	L	32.8	na	na	na	na	na	na	na
002333	Knockacoller	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	H	0.22	9	M	1.47	H	n/av	na	na	L	15	na	na	na	na	M	18	
002336	Carn Park	UB-Decreasing	UB-Declining	UB-Stable	UB-Declining	Yes	H	1.19	31	M	5.384	M	n/av	na	na	L	16	na	na	L	<0.1	na	na	na

Site code	Site Name	Area	S&Fs	FPs	Overall	Restoration works done	Peat cutting	HB cut away (2004/05-2010)	Approx number plots cut (2004/05-2010)	HB drainage	HB drainage (Km)	Outside HB drainage	Outside HB drainage (Km)	Forestry on HB	Forestry on HB (ha)	Forestry adjacent to HB	Forestry adjacent to HB (ha)	Fire	Fire (ha)	Invasive	Invasive (ha)	Quarrying	Quarrying (ha)
002337	Crosswood	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	Yes <sup>2</sup>	H	3.13	44	H	8.01	H	n/av	na	na	na	na	na	na	L	<0.5	na	na
002346	Brown Bog	UB-Stable	F-Stable	UB-Stable	UB-Stable	No	na	Na	na	na	na	L	n/av	na	na	L	5	na	na	na	na	na	na
002347	Camderry	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining	Yes	M	0.79	17	H	5.48	M	n/av	na	na	na	na	na	na	L	<0.1	na	Na
002349	Corbo	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining	No	H	3.34	48	M	0.839	H	n/av	na	na	na	na	na	na	na	na	na	na
002350	Curraghlehanagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining	Yes	L	1.94	39	M	10.502	M	n/av	na	na	L	13.5	na	na	L	<0.1	na	na
002351	Moanveanlagh	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	0.75	24	M	1.15	M	n/av	na	na	L	5.8	na	na	H	<0.1	na	na
002352	Monivea	UB-Stable	UI-Stable	UB-Declining	UB-Declining	Yes <sup>2</sup>	L	4.2	97	M	4.358	H	n/av	na	na	L	11.4	L	6	L	<0.1	na	na
002353	Redwood	UB-Stable	UB-Stable	UB-Declining	UB-Declining	No	L	5.5	42	M	41.93	M	n/av	na	na	na	na	M	33.74	L	<0.1	na	na

**Notes:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; na: not applicable; n/av: not available

<sup>1</sup>commercial exploitation adjacent to HB

<sup>2</sup> not on high bog

## Appendix 11: Degraded Raised Bog sites assessments versus impacts

Site code	Site Name	Area	S&Fs	FPs	Overall	Restoration works done	Peat cutting	HB cut away (2004/05-2010)	Approx number plots cut (2004/05-2010)	HB drainage	HB drainage (km)	Outside HB drainage	Outside HB drainage (Km)	Forestry on HB	Forestry on HB (ha)	Forestry adjacent to HB	Forestry adjacent to HB (ha)	Fire	Fire (ha)	Invasive	Invasive (ha)	Quarrying	Quarrying (ha)
000006	Killyconny	UB-Stable	UB-Improving	UB-Improving	UB-Improving	Yes	na	Na	na	M	4.103	M	n/av	na	na	na	na	na	na	L	<0.1	n/av	n/av
000221	Moorfield	UB-Increasing	UB-Stable	UB-Declining	UB-Declining	No	H	0.35	7	H	2.833	H	n/av	na	na	L	8.15	na	na	L	<0.1	na	na
000285	Kilsallagh	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	Yes	H	1.63	39	H	13.254	M	n/av	na	na	L	14.69	na	na	L	<0.1	na	na
000296	Lisnageeragh	UB-Decreasing	UB-Improving	UB-Declining	UB-Declining	Yes	H	0.5	13	M	10.804	L	n/av	na	na	L	14.5	na	na	L	<0.1	na	na
000297	Addergoole	UB-Decreasing	UI-Declining	UB-Declining	UB-Declining	No	H	1.9	28	M	5.434	M	n/av	na	na	na	na	na	na	L	<0.1	na	na
000326	Shankill West	UB-Increasing	UB-Declining	UB-Declining	UB-Declining	No	H	0.11	1	H	4.95	M	n/av	na	na	L	6.2	M	47.17	na	na	na	na
000382	Sheheree	UB-Stable	F-Stable	UB-Stable	UB-Stable	No	na	Na	na	na	na	na	na	na	na	na	na	na	na	L	<1	na	na
000391	Ballynafagh	UB-Decreasing	UB-Stable	UB-Stable	UB-Declining	No	H	0.77	25	M	4.192	M	n/av	M	10.84	na	na	M	48.37	L	<0.05	na	na
000497	Flughany	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	H	0.22	4	M	12.457	L	n/av	na	na	L	0.04	M	132.5	na	na	na	na
000566	All Saints	UB-Decreasing	F-Declining	UB-Declining	UB-Declining	No	H	0.42	11	H	27.393	H	n/av	na	na	na	na	na	na	na	na	H	16
000575	Ferbane	UB-Increasing	UB-Stable	UB-Declining	UB-Declining	No	M	n/av	1	H	10.889	H	n/av	na	na	na	na	na	na	L	<0.1	na	na
000580	Mongan	UB-Decreasing	UB-Improving	UB-Improving	UB-Improving	Yes	L	<0.10	1 (near to HB)	M	9.305	M	n/av	na	na	na	na	L	50	na	na	na	na
000581	Moyclare	UB-Increasing	UB-Declining	UB-Declining	UB-Declining	Yes	H	0.64	25	H	3.8	M	n/av	na	na	L	4.4	na	na	na	na	na	na

000582	Raheenmore	UB- Decreasing	F-Stable	UB-Stable	UB- Improving	Yes	na	Na	na	M	9.4	H	n/av	na	na	na	na	na	na	na	na	na	na
000585	Sharavogue	UB-Stable	F- Improving	UB- Improving	UB- Improving	Yes	na	Na	na	M	21.912	L	n/av	na	na	L	n/av	na	na	L	<0.1	na	na
000592	Bellanagare	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	Yes	H	5.77	102	H	59.541	M	n/av	L	9.5	L	132	na	na	L	<0.1	na	na
000595	Callow	UB- Decreasing	UB- Declining	UB- Declining	UB- Declining	No	H	3.31	50	H	28.332	H	n/av	L	6.55	L	11.62	L	8.63	L	<0.1	na	na
000597	Carrowbehy	UI- Increasing	UB- Improving	UB- Declining	UB- Declining	Yes	na	Na	na	M	7.37	M	n/av	na	na	L	6.4	na	na	L	<0.1	na	na
000600	Cloonchambers	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	No	H	1.86	37	M	3.835	M	n/av	na	na	L	19	na	na	L	<0.1	na	na
000604	Derrinea	UB- Increasing	UB-Stable	UB- Declining	UB- Declining	No	na	Na	na	H	1.488	M	n/av	na	na	L	n/av	na	na	na	na	na	na
000614	Cloonshanville	UB- Increasing	F-Stable	UB-Stable	UB- Declining	Yes	L	0.03	1	M	6.511	H	n/av	na	na	na	na	na	na	L	17.98	na	na
000641	Ballyduff	UB- Decreasing	UB- Improving	UB- Improving	UB- Improving	Yes	L	0.03	2	M	11.825	M	n/av	na	na	L	n/av	na	na	L	<0.1	na	na
000641	Clonfinane	UB- Decreasing	UI- Improving	UB- Improving	UB- Improving	Yes	M	60	1 <sup>1</sup>	M	13.587	M	n/av	na	na	na	na	M	59.47	na	na	na	na
000647	Firville	UB-Stable	UB-Stable	UB-Stable	UB-Stable	No	na	Na	na	M	1.909	M	n/av	na	na	L	n/av	L	14	na	na	na	na
000647	Kilcarren	UB- Increasing	F-Stable	UB- Declining	UB- Declining	No	M	0.1	2	H	6.559	M	n/av	na	na	L	n/av	L	22	na	na	na	na
000679	Garriskil	UB- Decreasing	UI-Stable	UB- Improving	UB- Improving	Yes	na	Na	na	M	12.158	M	n/av	na	na	na	na	na	na	L	<0.5	na	na
001242	Carrowmagapul	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	Yes	H	3.1	48	M	16.005	M	n/av	na	na	L	59	H	185	na	na	na	na
001818	Ballykenny	UB- Decreasing	F- Improving	UB- Improving	UB- Improving	Yes	na	Na	na	M	25.929	M	n/av	na	na	na	na	na	na	L	<0.5	na	na
001818	Fisherstown	UB- Increasing	F- Improving	UB- Improving	UB- Declining	Yes	na	Na	na	H	10.164	L	n/av	L	1	L	13	H	26.55	L	<0.1	na	na
002110	Cloonfellov	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	No	H	0.14	4	M	0.968	M	n/av	na	na	na	na	na	na	L	<0.1	na	na
002110	Corliskea	UB- Increasing	UB-Stable	UB- Declining	UB- Declining	No	H	2.25	43	H	8.997	L	n/av	M	4.19	L	7.5	M	70.6	na	na	na	na
002110	Trien	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	No	H	0.12	5	M	11.03	M	n/av	na	na	L	4	na	na	L	<0.1	na	na
002298	Derrynabrock	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	No	H	0.08	2	M	4.028	M	n/av	na	na	M	3.84	na	na	na	na	na	na
002298	Tawnaghbeg	UB-Stable	F-Stable	UB-Stable	UB-Stable	No	na	Na	na	M	3.673	M	n/av	M	3.17	L	32.8	na	na	na	na	na	na
002333	Knockacoller	UB- Increasing	UB-Stable	UB- Declining	UB- Declining	No	H	0.22	9	M	1.47	H	n/av	na	na	L	15	na	na	na	na	M	18
002336	Carn Park	UB- Increasing	F-Declining	UB-Stable	UB- Declining	Yes	H	1.19	31	M	5.384	M	n/av	na	na	L	16	na	na	H	54.86	na	na
002337	Crosswood	UB- Decreasing	UB-Stable	UB- Declining	UB- Declining	Yes <sup>2</sup>	H	3.13	44	H	8.01	H	n/av	na	na	na	na	L	6	M	<0.5	na	na
002346	Brown Bog	UB-Stable	UB-Stable	UB-Stable	UB-Stable	No	na	Na	na	n a	na	L	n/av	na	na	L	5	na	na	na	na	na	na

002347	Camderry	UI-Increasing	UB-Improving	UB-Declining	UB-Declining	Yes	H	0.79	17	H	5.48	M	n/av	na	na	na	na	na	na	L	<0.1	na	na
002349	Corbo	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining	No	H	3.34	48	M	0.839	H	n/av	na	na	na	na	na	na	na	na	na	na
002350	Curraghlehanagh	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining	Yes	H	1.94	39	M	10.502	M	n/av	na	na	L	13.5	na	na	L	<0.1	na	na
002351	Moanveanlagh	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining	No	H	0.75	24	M	1.15	M	n/av	na	na	L	5.8	na	na	H	<0.1	na	na
002352	Monivea	UB-Decreasing	F-Declining	UB-Declining	UB-Declining	Yes <sup>2</sup>	H	4.2	97	M	4.358	H	n/av	na	na	L	11.4	L	6	L	<0.1	na	na
002353	Redwood	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining	No	H	5.5	42	M	41.93	M	n/av	na	na	na	na	M	33.74	L	<0.1	na	na

**Notes:**

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact; na: not applicable; n/av: not available

<sup>1</sup>commercial exploitation adjacent to HB

<sup>2</sup> not on high bog

## Appendix 12: Bord na Móna raised bog sites

The following is the list of Bord na Móna raised bog sites and the Area of ARB within them.

Complex name	Site name	County	Approx. BnM area (ha)	Comment	Easting	Northing	ARB Area (ha) <sup>1</sup>
Clonboley 2	Clare Island	Roscommon	200	Zoned for restoration	198,000	236,900	4
	Ballydangan South	""	230	Currently managed for Red Grouse; (Ballydangan Red Grouse Project-leased to Moore Gun Club) zoned for restoration	191900	235500	20-30
Clonboley 1	Ballydangan North	""	190	Zoned for restoration	190400	236000	1
	Cranberry	""	110	Part designated NHA; Zoned for restoration	191000	234000	2-5
Kileglan	Cuckoo Hill	""	124	BnM Restoration completed 2011	187400	239600	<1
	Porteen (sub-site)	""	40	Zoned for restoration	186300	240600	0
	Nacreeva (sub-site)	""	90	""	185352	240260	5
	Cregganycarna (sub-site)	""	30	""	185800	239300	0
	Goats Lough South (sub-site)	""	70	""	184500	240000	0
	Goats Lough North (sub-site)	""	200	""	183600	241000	2
	Camlough (sub-site)	""	20	""	187640	239050	0
Cuil na Mona	Abbeyleix Bog	Laois	200	BnM Restoration completed 2009. Leased to Abbeyleix Bog management Committee	24300	182600	1
Derrydoo/ Woodlough	Moyarwood (sub-site)	Galway	190	BnM Restoration started 2012	164900	233300	<1
	Lenareagh (sub-site)	""	125	BnM Restoration started 2012	162400	232600	<1
	Paul's Lough (sub-site)	""	130	BnM Restoration started 2012	161270	231400	<1

**Note:**

<sup>1</sup> Approx ARB Area based on 2009 survey work. These areas were already present in 2006/7.

## Appendix 13: GIS files submitted

The following is a list of GIS (.shp) files generated and submitted as part of this project:

### Raw spatial data recorded on the field:

The following are the original spatial data files recorded in the field, and after post-processing in the office to obtain sub-meter accuracy as part of this project and Fernandez *et al.* (2012).

- RBMA13\_commu\_complex\_dots: This file provides point records for all vegetation community complexes classed according to the ecotope type they belong to. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Ecot\_type]: ecotope type; [Name]: vegetation community complex name; [Comment]: additional info specific for that point record; [County]; [Date1]: date data recorded.
- RBMA13\_ecotope\_boundary\_dots: This file provides point records for ecotope boundaries. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Boudnary\_T]: this field describes ecotope boundary type (e.g. C (central) / SC (sub-central), F (flush) / SM (sub-marginal)); [Other\_bound]: other boundary not included in precious field; [County]; [Comment]: additional info specific for that point record; [Date1]: date data recorded.
- RBMA13\_flush\_dots: This file provides point records for flushes and whether they are active peat forming or not. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Name]: flush name; [Active]: is the flush active peat forming or not; [County]; [Comment]: additional info specific for that point record; [Date1]: date data recorded.
- RBMA13\_quadrat\_data\_dots: This file provides point records for quadrats recorded. The attribute table fields correspond with heading described under Appendix 5.
- RBMA13\_additional\_data\_dots: This file provides point records for any additional data considered relevant to the survey site. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [County]; [Comment]: additional info specific for that point record.
- RBMA13\_drainage\_dots: This file provides point records for drainage data. Drainage is classified according to terminology provided in Appendix 4. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Not\_Blocke]: not blocked drain functionality (i.e. functional, no functional or reduced functional); [Blocked]: blocked drain functionality; [Width]: drain width in m; [Depth]: drain depth in m; [County]; [Comment]: additional info specific for that point record.
- RBMA13\_photo\_records\_dots: This file provides point records for photographic data. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Photo\_ID]; [Aspect]: photographic aspect; [Type]: detail or overview; [County]; [Comment]: additional info specific for that dot record (e.g. quadrat name); [Date1]: date data recorded.

- RBMA13\_invasive\_species\_dots: This file provides point records for invasive species data. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Species]: species Latin name; [Comment]: additional info specific for that point record (e.g. quadrat name); [County]; [Other]: additional info.

## Digitised spatial data:

The following are the spatial data files digitised in the office based on post-processed spatial data recorded in the field as part of this project and Fernandez *et al.* (2012) and NPWS Designated Raised Bog Orthophotos 2010.

- RBMA13\_ecotope\_map: This file provides polygon data illustrating habitats depicted based on the ecotope vegetation classification. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Designatio]: designation type (e.g. SAC, NHA); [Ecotope]: ecotope type; [Area]: ecotope area in m<sup>2</sup>; [County]; [Survey\_Nam]: survey name; [Survey\_Date]; [Authors]: map authors; [Survey\_Met]: survey method (e.g. ground survey); [Name]: specific active peat forming sections name given; [Comment]: additional info relating to each active peat forming section, whether it is newly developed, has expanded or decreased.
- RBMA13\_drainage\_map: This file provides line data illustrating high bog drains depicted based on the drainage data recorded on the field and NPWS Designated Raised Bog Orthophotos 2010. Drainage is classified according to terminology provided in Appendix 4. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [2004\_5\_cat]: drain type in 2004-2005; [Drain\_No]: drain number or name; [Drain\_leng]: drain length in m; [2011\_3cat]: drain type in 2011-2013; [Change]: change in the 2004/05-2011/13 period in the drain status; [County]; [Comment]: additional info relating to each specific drain.
- RBMA13\_additional\_data\_map: This file provides additional line data such as dams. Attribute table includes the following field: [Site\_Name]; [Site\_Code]; [County]; [Name]: dam name.
- RBMA13\_burnt\_areas\_map: This file provides polygon data illustrating areas recently burnt. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Area]: burnt area in m<sup>2</sup>; [Survey\_Dat]: survey date; [County]; [Comment]: period burn took place.
- RBMA13\_high\_bog\_cutaway\_2004\_5\_10\_map: This file provides polygon data illustrating high bog area cutaway by peat cutting in the 2004/05-2010 period. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [County]; [Area]: area cutaway in m<sup>2</sup>.

In addition the following national raised bog resource spatial datasets compiled in 2007 as part of the NPWS monitoring project (2007) has been reviewed as part of this project (See Appendix 9):

- RBMA13\_habitats\_2007\_13\_othersources: This file provides polygon data illustrating habitats depicted based on the ecotope vegetation classification. Attribute table includes the following



fields: [Site\_Name]; [Site\_Code]; [Designatio]: designation type (e.g. SAC, NHA); [Ecotope]: ecotope type; [Area]: ecotope area in m<sup>2</sup>; [County]; [Survey\_Nam]: survey name; [Survey\_Date]; [Authors]: map authors; [Survey\_Met]: survey method (e.g. ground survey); [Name]: specific active peat forming sections name given.

- RBMA13\_habitats\_prior\_2007: This file provides polygon data illustrating habitats depicted based on the ecotope vegetation classification. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Designatio]: designation type (e.g. SAC, NHA); [Ecotope]: ecotope type; [Area]: ecotope area in m<sup>2</sup>; [County]; [Survey\_Nam]: survey name; [Survey\_Date]; [Authors]: map authors; [Survey\_Met]: survey method (e.g. ground survey).
- RBMA13\_unsurveyed\_data\_prior\_2007: This file provides polygon data for *intact* raised bog areas both designated and un-designated for which ecotope data is not available. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Designatio]: designation type (e.g. SAC, NHA); [County]; [Source]: data source; [Authors]: source authors; [Survey\_Met]: survey method (e.g. desktop, ground survey); [Survey\_Date]; [Other\_Sour]: additional data source; [Comment]: additional info related to the occurrence of Active Raised bog or Degraded Raised Bog habitat within the polygon; [Area]: ecotope area in m<sup>2</sup>.
- RBMA13\_2dary\_DRB\_unsurveyed: This file provides polygon data for intensively drained high bog devoid of vegetation (including the majority of Bord na Móna sites), cutaway bog, cutover and occasionally reclaimed agricultural land with peaty soils. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Designatio]: designation type (e.g. SAC, NHA); [County]; [Source]: data source; [Authors]: source authors; [Survey\_Met]: survey method (e.g. desktop, ground survey); [Survey\_Date]; [Other\_Sour]: additional data source; [Comment]: additional info related to the digitising of the record; [Area]: ecotope area in m<sup>2</sup>.

## Appendix 14: Community complexes recorded during 2011/13 survey

Ecotope	Community complex	Variant	N° of records <sup>1</sup>
<b>Central</b>			
	35		522
		35+My	1
	15		244
		15+My	2
	10/15		176
		10/15 (B)	1
	14		84
<b>Sub-central</b>			
	9/7/10		808
		9/7/10(B)	1
		9a/7/10	8
		9/7/10+My	11
		9/7/10+Mo	1
		9/7/10+My+Mol	4
	9/10		738
		9/10(B)	33
		9a/10	92
		9/10+P	1
		9+P	28
		9a+P	15
		9/10+My	5
		9a/10+My	1
	6/35 (W)		667
		3/35 (W)	28
		4/35 (W)	20
		9/35 (W)	19
		35-(W)	2
	9/7+P		421
		9/7+P+My	4
		9/7/6+P*	210
		9/7/6+TP*	1
		9/7/4+P*	8
	10/4		292
		10/4+My	11
		4/10	248

Ecotope	Community complex	Variant	N° of records <sup>1</sup>
		4+P	243
		4+P+My	2
	6/9+P		238
		6/9a+P*	3
		6/9+P+My	1
	6+P*		158
		6+P(B)	91
	6/4+P (W)		235
	3/10 (W)		201
		3+P (W)	65
		3/9a+P	22
	10/9		109
		10/9+My	1
		10/9a	33
		10/9a+My	3
	15-		102
		4/15	26
		6/15	21
	10/6		87
		10/6(B)	2
		10/6+My	6
		10/6+My(B)	1
		6/10	49
	10		22
	7/10		21
		7/10+My	2
		7/10+Mol+My+Ulex	12
		7/10+My+Mol	4
	3/9+P		9
	6/3+P (W)		3

<sup>1</sup> This field indicates the number of points taken on the field correlating to each community complex recorded. The number of points recorded bears no reflection on the area that the community complex covers.

\*Same name has been given to a sub-marginal ecotope community complex. Although similar species characterise (i.e. dominate) these community complexes, the *Sphagnum* cover is lower in the sub-marginal ecotope complexes.

Ecotope	Community complex	Nº of records	Community complex	Nº of records	Community complex	Nº of records
Sub-						
	9/7/6	4982	9/7+Ph	20	7+Mol+Ulex	4
	9/7	2117	9/7/2+P	20	7+My+Mol	4
	9/7/3	1776	9/7/3+TP	19	6/3/2+TP	4
	6/3	579	9/6/3	19	4/6	4
	6/3+P	570	7/6(B)	17	4/6(B)	4
	6/3/9	470	6/4/2	17	9a/7/6+My(B)	3
	9/7/6+P	362	9/7/3+AP	16	9a/7(B)	3
	9/7/6(B)	318	6/3+AP	16	9/7/3+Pines	3
	7/6	311	6/3/9(B)	16	9a/7/2	3
	9/7/6+My	304	3/6/9	16	9/7/2+Ph	3
	9/7/3+P	298	6+AP	16	9/7/2+TP	3
	3/6/4	205	7/6/3	15	6/9a	3
	9/7/2	188	6/3+My(B)	14	6/9+TP+My	3
	6+P	185	6/9	14	9/6/2	3
	4/9	181	6/3/2	13	6/3/2+P(B)	3
	6/3+TP	177	9/7/6/2	12	9/2+TP	3
	6/9+P	175	7/9+P	11	9a/7/6+My	2
	9/7/4	170	7/6+My	11	9a/7/6+Ph(B)	2
	9a/7/3	139	9/3/2	11	9/7/6/2+My	2
	9/7+Cl	138	6/3/4	10	9/7/6/3	2
	9a/7/6	114	9/7/6+AP	9	9a/7/6+P	2
	9a/7	88	6/7/9	9	9/7/6+TP(B)	2
	7/6/4	87	7/9+Cl	9	9/7/3+Ra	2
	6/3(B)	86	9/7/4+P	9	3/6/4+Mo	2
	9/7+My	76	6/2+Cl	9	3/6/4+TP	2
	9/7(B)	69	9a/7/3(B)	8	9/7/2+Cl	2
	6/4+P	60	6/3/9a+P	8	9a/7/2+P	2
	9/6/3+P	55	6/9(B)	8	6/9+TP	2
	6/3/9a	54	6/3+P(B)	7	4	2
	6/3+TP(B)	48	6/3/2+P	7	4/6+P	2
	9/7/6+TP	41	9/7/6+Mo	6	9/7/6+Pines	1
	4/9/2	36	9/7+TP	6	9/7/6/4+My	1
	6/9+P(B)	36	9/7/3+Mo	6	9/7+Pines	1

7/9	35	6/3/9a+TP	6	9a/7/3+Cl	1
9/7/3+My	32	9/7/4+My	6	9/7/3+My(B)	1
6/3/9+P	32	9/7+Mo	5	9/7/3+P+Cl	1
9a/6/3	31	9/7+My+Ph	5	6/3+TP+My(B)	1
9/7/6+My(B)	27	9a/7/3+P	5	6/3/9+My	1
9/7/6+P(B)	27	7/6/3+Pines	5	6/3/9+TP	1
4/9a+P	26	7/6/4+TP	5	4/9+My	1
9/7/3(B)	24	9/7/2+AP	5	4/9a+P+My	1
6/3+My	24	7+Mol+My+Ulex	5	9/6+P	1
7	22	6/4/9a	5	6/9/2	1
9/7/6+Ph	21	9a/7+Cl	4	9/6	1
9/7/3+Cl	21	9/7+My(B)	4	9/3	1
4/7	21	9/7/2+My	4		
9a/7/6(B)	20	4/9a	4		
9/7/6/4	20	6/9/3	4		
<b>Marginal</b>					
3/6	1705	7+Cl	12	7/9a	4
3/6/2	467	4/2+EC	11	2/4	3
6/7	397	3/2+Cl	10	3/7/6+TP	3
7/2	352	6/2	10	6/4(B)	3
6/7/3	320	3/6+AP	9	7/9/6	3
3/6(B)	252	6/7+My	9	3/6+Ph	2
3/6/7	182	6/7+TP	9	3/6/7+Mo	2
3/2	170	3/6/7+Cl	9	3/2+TP	2
3/6+My	104	3/9a	9	3/6/4+P	2
3/7/6	93	7+BP	9	3/9a+TP	2
2/6	75	3/6+TP(B)	8	3+BP	2
7/9(B)	47	6/7+Pines	8	6/7/3+P	2
3/2+ER	46	2	8	6/7/3+Ph	2
2/7	45	2/3/9	8	9+BP(B)	2
3/6+P	42	6/4	8	9a/3(B)	2
3/6/4	41	3/6/2+Ra	7	3/6(B)+Mo	1
6/7/2	34	3/6/9a	7	3/6+Mo	1
3/6+TP	31	6/7(B)	6	3/6/2+Cl	1
4/6/2	30	7/2+ER	6	3/6/2+Mo	1
3/6+ER	27	7/2+Mo	6	7/2+AP	1

3/6/2(B)	26	7/2+My	6	3/6/7+Pines	1
7/2(B)	26	9/2	6	3/2+Mo	1
9+BP	24	3/9	5	3/4/2	1
3/6+My(B)	21	9a/3	5	2/6+My	1
6/2+P	21	3/6+Pines	4	2/7+Pines	1
3/7	19	3/6/2+AP	4	7/9+My+Mo	1
3/6+Cl	18	3/6/2+ER	4	7+My	1
3/2+My	16	3/6/2+TP	4	7+Ph	1
7/9+Cl	15	4/2	4		
6/7/3+My	13	7/9+My	4		
<b>Face bank</b>					
1	177	1(B)	4	1+My	1