

# Raised Bog Monitoring Project 2011

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## **Raised Bog Monitoring Project 2011**

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## Executive Summary

The main objective of the study was to undertake a survey of 12 raised bogs in 10 SACs and report on the conservation status of the following Habitats Directive Annex I habitats within these bogs: Active raised bogs (7110); Bog woodland (91D0); Degraded raised bogs still capable of natural regeneration (7120) and Depressions on peat substrates of the *Rhynchosporion* (7150).

A new conservation status assessment method has been developed for these sites based on the setting of favourable reference values. The reference values are based on the habitat and ecotope area in 1994, when the Directive came into force in Ireland. Degraded Raised Bog (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 Active Raised Bog. Reference values are only approximate until more accurate values can be established based on further topographical and hydrological studies at individual raised bog sites.

Active Raised Bog conservation status has been assessed as Unfavourable Bad at all bogs surveyed. Since the original surveys in 1992/94 the area of Active Raised Bog has decreased from 486ha to 281ha (42%) in 2011. However since 2004/05, the overall habitat trend has been assessed as Improving at seven bogs; Stable at three bogs and Declining at two bogs. The area of the habitats has increased by approximately 12ha (4.5%) in the 2004/05 – 2011 reporting period. This increase is associated with re-wetting processes associated with restoration works.

Degraded Raised Bog has been given an Unfavourable Bad assessment at all bogs surveyed. The overall habitat trend has been assessed as Improving at eight bogs; Stable at one bog and Declining at three bogs. Approx. 1ha of high bog has been lost due to peat cutting at Ballynafagh, All Saints, Ballyduff and Kilcarren since 2004/05.

Depressions on peat substrates of the *Rhynchosporion* have been given a Favourable conservation status assessment at 10 bogs and Unfavourable Inadequate at two bogs. The trend varied from Improving at nine bogs to Stable at one bog and Declining at two bogs. Bog Woodland habitat has been given an Unfavourable Bad - Declining assessment at the only site where it is present (All Saints). Since the original 1994 survey the area of Bog Woodland has decreased from 17.48ha to 14.34ha (18%) in 2011.

The most negatively impacting activities on the bogs surveyed are drainage both on the high bog and the cutover, and peat cutting. Peat cutting which was formerly widespread is now only ongoing at All Saints, and it was phased out at four other bogs during the reporting period. Both drainage and peat cutting are considered the main reasons for an Unfavourable Bad – Declining assessment for Active Raised Bog at All Saints and Kilcarren. Other impacting activities such as burning, forestry, invasive species and quarrying were reported. Restoration works were undertaken at nine out of the 12 raised bog surveyed (but only at Killyconny bog in the new reporting period i.e. since 2004/05). Evidence of

both Active and Degraded Raised Bog improvement was noted in those areas of the high bog where restoration took place.

Several recommendations are made:

- a) further monitoring of additional raised bogs should be undertaken in order to produce a more representative view of the conservation status of Annex I EU habitats at national level,
- b) further topographical and hydrological studies at site level are needed to set site specific favourable reference values,
- c) a national restoration program for designated raised bogs should be developed and
- d) further studies on regenerating cutovers should be undertaken in order to provide a more accurate picture of their potential to support the target Active Raised Bog reference values (particularly for small sites).



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## Introduction

### Scope of the report

This report presents the field survey methods, conservation status assessment criteria and the results of the 2011 Raised Bog Monitoring Project carried out by Ecologic Environmental & Ecological Consultants Ltd and commissioned by the National Parks and Wildlife Service (NPWS).

### Project tasks

The main objective of the study was to undertake a survey of a selection of 12 raised bogs, within 10 designated sites in Ireland and report on the conservation status of the following four Habitats Directive Annex I habitats within these bogs:

- 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

Changes in habitat Area, Structure and Functions (S&F) or intensity of impacting activities (i.e. pressures and threats) from previous surveys have been assessed. The new survey results can be used to update national assessments of the conservation status of each habitat type.

### Survey area

The 12 raised bogs surveyed are listed in table 1. See Figure 1.1 for the location of the survey sites.

Table 1.1 Survey sites

Site Code	Site Name	Survey ID	High bog area (ha)	County
			2011	
000006	Killyconny	70	83.04	Meath - Cavan
000391	Ballynafagh	72	70.06	Kildare
000566	All Saints	73	222.95	Offaly
000580	Mongan	74	124.37	Offaly
000582	Raheenmore	71	130.54	Offaly
000585	Sharavogue	75	137.01	Offaly
000641	Ballyduff	76	86.68	Tipperary
000641	Clonfinane	77	87.26	Tipperary
000647	Kilcarren	79	179.26	Tipperary
000647	Firville	78	183.68	Tipperary
000679	Garriskill	80	170.26	Westmeath
001818	Ballykenny	81	180.81	Longford
<i>Total</i>			<i>1,656</i>	

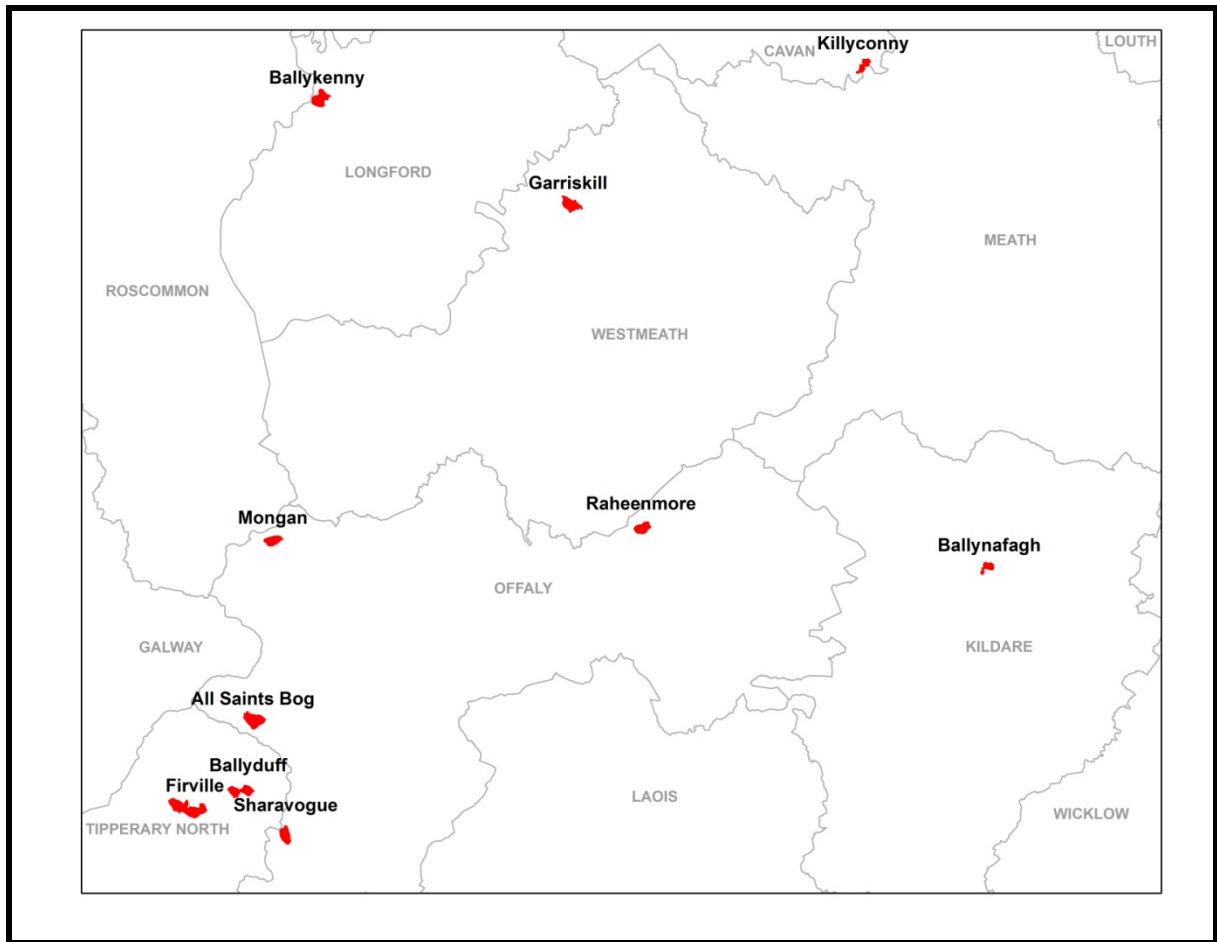


Figure 1.1 Location of surveyed sites (Ordnance Survey Ireland Licence No EN 0059208 © Ordnance Survey Ireland / Government of Ireland)



## Methods

### 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 most recent 2010 aerial photographs allowed the identification of new active peat forming areas overlooked in the 2004/05 survey. These 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.

Site notes were recorded throughout the site: community complex types encountered were described, features of interest, impacts and activities, fauna and notable species were also recorded (see General data recorded and Recording of quadrats sections for more information). Detailed notes were recorded in a waterproof notebook. The location of each community complex was fixed on the habitat map using the GeoXT Trimble handheld GPS minicomputer, (see Data collection section 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.

### General data recorded

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

#### Community complexes

Active and Degraded Raised Bog are divided into a series of **community complexes** which are characterised by a series of **vegetation communities** and these complexes are then amalgamated into a series of **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 cespitosum* 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 different plant communities that can be found on a high bog was developed by MacGowan (pers. comm., 2003) based on Kelly & Schouten (2002) (Appendix 1).

Community complexes points and ecotope boundary points were used to generate high bog vegetation ecotopes maps and subsequently annexed habitats maps.

Table 2.1 Characterising species for community complex terminology

Complex number	Vegetation type
1	<i>Calluna vulgaris</i> (face-bank)
2	<i>Trichophorum cespitosum</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

## 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 therefore is also considered as so during the current survey. A description of the most relevant characteristics of each ecotope (table 2.2 below) was produced by MacGowan (pers. comm., 2003) based on Schaff & Streefkerk (2002) and included in Fernandez *et al.* (2005).

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.</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/Narthecium/Trichophorum</i> in tussock form/Algal mats. Pools absent except for tear pools.</p> <p><b>Characteristic species:</b> In lawns <i>Narthecium</i> is most dominant, <i>Sphagnum papillosum</i> &amp; <i>S. capillifolium</i> present in small amounts (not lawns, not big hummocks, but 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>, <i>Cladonia portentosa</i> common and burnt/draind types.</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>Narthecium</i> hollows dominant.</p> <p><b>Characteristic species:</b> In lawns <i>Sphagnum papillosum</i> dominant, although absent from some areas. <i>S. magellanicum</i> &amp; <i>S. capillifolium</i> present but not <i>S. cuspidatum</i>. <i>Trichophorum</i> 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> common and burnt/draind types.</p>
<b>Sub-central</b>	<p><b>Physical characteristics:</b> Surface soft and sometimes quaking, occasionally hard. Micro-topography ranges from <i>Narthecium</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 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> 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>

Ecotope	Characteristics
	<p>Kelly <i>et al.</i> (1995) differentiate between central ecotope in <b>midlands</b> sites and <b>western</b> sites. 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>Narthecium</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> 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>Narthecium</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 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.</p>

Central and sub-central ecotopes are allocated to ARB (7110). 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 allocated to DRB (7120). Dry flushes and coniferous plantations are also included within this habitat.

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). In addition 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.

#### 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. Impacting activities were reported based on Article 17 of the Habitats Directive 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. turbarry rights or land purchases). 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.

Impacts and activities were scored based on scoring method given by Ssymank (2011). Appendix 4 provides a description of drainage data collected on the field and terminology used in ranking impacting activities.

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## Quadrats

Quadrats recorded in the Fernández *et al.* (2005) survey were re-surveyed and additional quadrats recorded when considered necessary (e.g. new active peat forming areas recorded in 2011 or when it was deemed that an insufficient number of quadrats were recorded in 2004/05). The size of quadrats was 4m x 4m (see Recording of quadrats section for further detail).

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## Photographs

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

Additional photographs of impacting activities were also recorded.

## Recording of quadrats

Quadrats were recorded mainly within Active Raised Bog (7110) (i.e. central or sub-central ecotopes) and Bog Woodland habitat (91D0), and very occasionally were recorded within DRB (7120). The comparison of 2004/05 quadrats against the most recent 2011 quadrats has been used for the assessment S&F of both ARB and DRB conservation status. Variation in species cover, and other indicators have been taken into consideration to determine whether the S&F of a particular section of the high bog are declining or improving (see Appendix 6).

2004/05 quadrats within Active and Degraded Raised Bog were approximately 2x2m whereas 2011 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 instead of 4x4m. Bamboo sticks were used to mark all quadrats recorded (i.e. middle section of quadrat) during the 2011 survey, in order to make their location in future surveys more reliable.

Cover in vertical projection for all vascular and bryophyte species was recorded using the Domin scale (see Appendix 5). For each relevé a 12-figure grid reference (i.e. 6 Easting and 6 Northing) was obtained using a DGPS unit. 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 6



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.

## Habitat mapping

The mapping stage involved digital mapping of habitats according to ecotopes and community complexes based on Kelly (1993) and Kelly and Schouten (2002). A DGPS/GIS handset (Trimble XT) was used in the field for mapping.

Almost the entire surface of the high bog was walked through and changes in the vegetation at community complex level were assessed 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 survey.

The minimum mapping size for ecotopes was approximately 4m x 4m. Generally, 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 Fernández *et al.* (2005) 2004/05 ecotope and vegetation community complex maps were used in the field to aid in the mapping of current vegetation. These maps were imported into the Trimble GeoXT 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 within the sites using DGPS/GIS handsets (Trimble XT).
- Recording of previously recorded (i.e. Fernández *et al.* 2005) or new quadrats, where required, using TerraSync data dictionary software.
- Recording of impacting activities (e.g. drainage, peat cutting face-banks, invasive species, drain blocking, etc.).
- Digital photographs were taken of quadrats and impacts and their positions logged in the DGPS/GIS handsets.
- Mapping was done at a 1:1500 scale using the NPWS Designated Raised Bog Orthophotos 2010 as background.

Final site maps were produced in ESRI ArcGIS and 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. There are no open polygons, dangling arcs or digitising artefacts. There are no ‘multipolygon’ features’. Polygons are fully attributed.
- Habitat polygons are in one continuous layer (shapefile), differentiated by habitat attribution.

## 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. Post-processing of data was carried out to improve accuracy based on the Active GPS Network from Ordnance Survey Ireland to obtain sub-metre accuracy of data.

## Site reports

Individual site reports are presented in Volume 2. These reports include vegetation descriptions, impacting activities descriptions and habitats conservation status assessments results, quadrat data, as well as maps based on the spatial data collected during the survey using ArcGIS and aerial photography.

## Conservation status assessment

### *Conservation status assessment at national level*

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; a habitat’s 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&F which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future
- c) the conservation status of its typical species is favourable

To assess conservation status of Annex I habitats, 4 parameters are objectively scored: **i) Range, ii) Area, iii) Structure and Functions, and iv) Future Prospects** (Evans & Arrela, 2011).

The method for the assessment of conservation status involves the application of a “traffic-light” system and brings together information on the four parameters for each habitat. Each parameter is

assessed as being “Favourable FV” or good/green, “Unfavourable Inadequate (UI)” or poor/amber, “Unfavourable Bad (UB)” or bad/red and “unknown” or grey.

Favourable Reference Values (FRVs) are set as targets against which current and future values can be judged. 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) (7120) as this habitat should reduce if it is successfully restored to ARB (7110). Where 7120 is designated within an SAC a certain portion of that habitat should be restored within that designated site, although not necessarily all the DRB, as in some instances cutover bog may be more feasible to restore.

FRVs are set for Range and Area. 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 survival of that habitat. Favourable Reference Area is the minimum value required for the long-term viability of the habitat.

The assessment of S&F includes an assessment of the condition and the typical species that characterise the habitat. Targets should be set for favourable condition and measured using a suitable suite of indicators.

The impact of pressures and conservation measures are used to determine the Future Prospects of the habitat.

If any one of the four parameters i) Range, ii) Area, iii) Structure & Functions, and iv) Future Prospects 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.

Additional qualifiers are given to each assessment (i.e. Range, Area, S&F and Future Prospects) of conservation status. These indicate the **attribute trend** and thus whether the status is Increasing/Improving, Stable or Decreasing/Declining.

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#### *Conservation status assessment at raised bog level*

The assessment of the conservation status of Annex I raised bog habitats at each raised bog is based on the conservation status of each one of the following attributes:

- **Area**
- **Structure & Functions (i.e. quality)** - including conservation status of its typical species.
- **Future Prospects** - based on current and future impacts and threats, as well positive actions (e.g. restoration works) (Ellmauer, 2010).

The monitoring protocol developed by Fernández *et al.* (2005) has been refined and updated. NPWS staff were consulted during the process. The results of these individual assessments can be used as part of the national assessments.

A new criterion has been developed to assess conservation status of raised bog habitats within this project based on the definition of FRVs for both habitat Area and S&F. FRVs are values that should be achieved in order for a habitat to reach a Favourable conservation status. The previous criterion (Fernández *et al.*, 2005) was based on the comparison of values (i.e. habitat area and ecotope area) between the 1994 and 2004/05 surveys.

ARB (7110) and DRB (capable of regeneration in 30 years) (7120) assessments are inextricably linked. The very fact that habitat 7120 exists indicates that we are obliged under the Habitats Directive, to restore more active areas than were present when the Directive came into force.

Many areas of DRB may not be capable of regeneration due to changes on the high bog (topographical structure (i.e. steep slopes) and hydrology) caused by severe damaging activities (e.g. peat cutting, drainage); however the potential for regeneration cannot be properly quantified until comprehensive topographical and hydrological surveys are undertaken.

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#### Active Raised Bog conservation status assessment

**Area:** this assessment is based on the comparison of current area of ARB against the FRV area. Until comprehensive topographical and hydrological studies are undertaken at each individual site the FRV is set at the area of central/sub-central ecotopes and active flush, **plus** the area of **sub-marginal ecotope** (DRB), present when the Directive came into force in 1994. As previously mentioned, 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).

- A current habitat area greater, equal or 0 - 5% below FRV falls into the **Favourable** assessment category (see table 2.3).
- A current habitat area value 5% - 15% below FRV falls into the **Unfavourable Inadequate** assessment category.
- A current habitat area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Area is also given a **trend assessment** based on the variation 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 (i.e. more pristine examples of ARB community types). This value is considered to be the S&F FRV. This is quite a conservative 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.

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

Any variation in **typical species** distribution and abundance is also noted (e.g. by analysing quadrat data and also looking at community complexes descriptions) (see Appendix 7 for list of typical species).

Structure & Functions are also given a **trend assessment** based on the variation of the extent of both central ecotope and active flush in the reporting period. Thus trend is assessed as **Stable, Improving** or **Declining**.

When neither central ecotope nor active flush are present or their area is small, variation in sub-central ecotope extent and quality characteristics is examined to assess S&F conservation status (i.e. an increase or decrease 0-5% in sub-central ecotope area is taken stable: Favourable assessment; a decline as Unfavourable assessment: 5-25% Unfavourable Inadequate and >25% Unfavourable Bad).

Every individual sample of ARB (each individual bog usually has a number of separate areas of this habitat) on a high bog is examined, and any variation in its extent analysed and subsequently assessed as stable, expanding, decreasing or newly developed. Detailed information is given within each site report. Quadrats reported in 2004/05 and re-surveyed again in 2011 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&F level (see Appendix 6). Any variation in community complex is also taken into account to evaluate changes within specific habitat areas, the overall habitat Area and its S&F.

Table 2.3 Active Raised Bog 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:** this attribute is subjectively assessed and is based on the overall impact of negative and positive activities. The intensity and influence of the activities and any change in the reporting period are evaluated. A trend value is also given (e.g. Stable, Improving, Declining) based on the likely future effects of these impacting activities on the habitat. A Favourable - Stable assessment means that no major threatening activities have occurred, habitat Area or S&F have not changed in the reporting period and restoration works have taken place; A Favourable – Improving assessment means that habitat Area or S&F have Increased/Improved in the reporting period and are expected to do in the future, mostly due to restoration works and lack of major impacting activities; An Unfavourable Inadequate - Stable assessment means that no further Decrease/Decline in habitat Area or S&F are expected or an Increase/Improvement due to the lack of restoration measures. An Unfavourable Bad-Declining assessment means that a further Decrease/Decline of habitat Area or S&F is expected due to the presence of impacting activities. If the result of positive measures (e.g. restoration works) are overriding the negative influence of impacting activities, the overall assessment may be favourable.

**Overall assessment:** this assessment is based on the “traffic-light” system previously mentioned. If any one of the three parameters i) Area, ii), S&F iii), Future Prospects 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 assessment.

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

#### Degraded Raised Bog conservation status assessment

**Area:** this assessment is based on the comparison of current area of DRB against the FRV area. Until comprehensive topographical and hydrological studies are undertaken at each individual site the FRV is estimated to be equal to the area of marginal and face bank ecotopes and inactive flush when the Directive came into force in 1994. 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 ARB 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, face bank and inactive flush) accepts the fact that it is often not feasible to restore the whole bog and

certain areas (e.g. the edges, steep slopes and mounds) with unsuitable topographical and hydrological conditions will remain too dry to support ARB.

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

Area is also given a **trend assessment** based on the variation 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 is taken as positive as regards overall assessment; although a Decreasing trend at Area level is given.

**Structure & Functions:** the assessment is based on the variation in marginal, face bank ecotopes<sup>1</sup> and inactive flush in the reporting period.

- A variation in the marginal and face banks ecotopes area between 0 – 5% in the reporting period falls into the **Favourable - Stable** trend assessment category.
- A decrease in marginal and face banks ecotopes area in the reporting period as a result of development of either sub-marginal or ARB falls into the **Favourable- Improving** trend assessment category.
- An increase in marginal and face banks ecotopes area between 5% - 25% in the reporting period associated with drying out processes falls into the **Unfavourable Inadequate - Declining** trend assessment category.
- An increase in marginal and face banks ecotopes area greater than 25% in the reporting period associated with drying out processes falls into the **Unfavourable Bad - Declining** trend assessment category.
- A decrease in marginal and face banks ecotopes area in the reporting period due to peat cutting greater than 0.10ha falls into the **Unfavourable Bad - Declining** trend assessment category. (A decrease smaller than 0.10ha would fall into the Favourable - Stable trend assessment category if none of the above cases occurred.)

Any variations in community complex (e.g. improvements within the habitats that do not manage to raise it to the status of sub-marginal ecotope) are also taken into account to evaluate changes within specific habitat areas, the overall habitat Area and its S&F.

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<sup>1</sup> Note: where cutting has recently occurred it is expected that the area of face bank ecotope will continue to expand for at least a decade following cessation of cutting due to drying out of the face bank area.

Any variation in **typical species** distribution and abundance was also noted (e.g. by analysing quadrats data and also looking at community complex descriptions) (see Appendix 7 for list of typical species).

**Future Prospects:** this attribute is subjectively assessed and is based on the overall impact of negative and positive activities. The intensity and influence of the activities and any change in the reporting period are evaluated. A trend value is also given (e.g. Stable, Improving, Declining) based on the likely future effects of these impacting activities on the habitat. A Favourable - Stable assessment means that no major threatening activities have occurred, habitat Area or S&F have not changed in the reporting period and restoration works have taken place; A Favourable – Improving assessment means that habitat Area or S&F have Increased/Improved in the reporting period and are expected to do in the future, mostly due to restoration works and lack of major impacting activities; An Unfavourable Inadequate - Stable assessment means that no further Decrease/Decline in habitat Area or S&F are expected or an Increase/Improvement due to the lack of restoration measures. An Unfavourable Bad-Declining assessment means that a further Decrease/Decline of habitat Area or S&F is expected due to the presence of impacting activities. If the result of positive measures (e.g. restoration works) are overriding the negative influence of impacting activities, the overall assessment may be Favourable.

**Overall assessment:** this assessment is based on the “traffic-light” system previously mentioned. If any one of the three parameters i) Area, ii), S&F iii), Future Prospects 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 assessment. The only exception for this habitat would be when the Area has decreased as a result of the development of ARB. In such a scenario, the Area would be given a Decreasing trend, but the overall assessment would be assessed as Improving when other attributes (i.e. S&F and Future Prospects) are also assessed as Improving.

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### Bog Woodland

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

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



Area is also given a trend assessment based on the variation 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 6). The monitoring stops assessment is based on the achievement of targets within the following parameters (derived 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 variation in **typical species** distribution and abundance was also noted (see Appendix 7 for list of typical species).

**Future Prospects:** this attribute is subjectively assessed and is based on the overall impact of negative and positive activities. The intensity and influence of the activities and any change in the reporting period are evaluated. Future Prospects are assessed as Favourable, Unfavourable Inadequate or Unfavourable Bad. A trend value is also given (e.g. Stable, Improving, Declining) based on the likely future effects of these impacting activities on the habitat. If the result of positive measures (e.g. restoration works) are overriding the negative influence of impacting activities, the overall assessment may be Favourable.

**Overall assessment:** this assessment is based on the “traffic-light” system previously mentioned. If any one of the three parameters i) Area, ii), S&F iii), Future Prospects 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 assessment.

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#### Depressions on peat substrates of the *Rhynchosporion*

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

According to Fernandez *et al.* (2005) the abundance of *Rhynchospora alba* may increase in transitional communities towards degraded conditions within ARB. In addition it is likely to dominate some community complexes recently affected by burning. However the habitat's 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.

Therefore, considering the above, the habitat's conservation status assessment is based on the variation on ARB and sub-marginal ecotope within DRB (e.g. an increase in their overall area and particularly ARB would give a Favourable assessment, whereas a decline in their overall area would give an Unfavourable assessment).

**Area and Structure & Functions:** 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 to establish realistic FRVs. Thus the assessment of the Area and S&F conservation status is based on the variation in associated vegetation area: ARB and sub-marginal ecotope combined.

- An increase in the combined area of ARB and sub-marginal ecotope greater than 5% in the reporting falls into the **Favourable – Increasing** trend assessment category.
- A variation in the combined area of ARB and sub-marginal ecotope between 0 – 5% in the reporting falls into the **Favourable - Stable** trend assessment category.
- A decrease in the combined area of ARB and sub-marginal ecotope area between 5% - 15% in the reporting period falls into the **Unfavourable Inadequate - Declining** trend assessment category.
- A decrease in the combined area of ARB and sub-marginal ecotope area greater than 15% in the reporting period falls into the **Unfavourable Bad - Declining** trend assessment category.

Any variation in community complexes dominated by *Rhynchospora alba* or *Rhynchospora fusca* in the reporting period is also taken into account in evaluating changes within the overall habitat Area and its S&F.

Any variation in **typical species** distribution and abundance was also noted (see Appendix 7 for list of typical species).

**Future Prospects:** this attribute is subjectively assessed and is based on the overall impact of negative and positive activities. The intensity and influence of the activities and any change in the reporting period are evaluated. A trend value is also given (e.g. Stable, Improving, Declining) based on the likely future effects of these impacting activities on the habitat. A Favourable - Stable assessment means that no major threatening activities have occurred, habitat Area or S&F have not changed (i.e. no variation in ARB and/or sub-marginal ecotope within DRB) in the reporting period; A Favourable –

Improving assessment means that habitat Area or S&F have Increased/Improved (i.e. increase in ARB and/or sub-marginal ecotope within DRB (never at the expense of ARB)) in the reporting period and are expected to do in the future, mostly due to restoration works and lack of major impacting activities; An Unfavourable Inadequate - Declining assessment means that some decline or negative changes in associated habitats (i.e. ARB and/or sub-marginal ecotope within DRB) took place in the reporting period; An Unfavourable Bad-Declining assessment means that a major decline or negative changes in associated habitats (i.e. ARB and/or sub-marginal ecotope within DRB) took place in the reporting period. If the result of positive measures (e.g. restoration works) are overriding the negative influence of impacting activities, the overall assessment may be Favourable.

**Overall assessment:** this assessment is based on the “traffic-light” system previously mentioned. If any one of the three parameters i) Area, ii), S&F iii), Future Prospects 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 assessment.

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#### Overall raised bog conservation status

Any, or all, of the four Annexed habitats can be found on a raised bog site, and thus a different conservation assessment could have been given to each Annexed habitat. However, both ARB and Bog Woodland are deemed priority habitat in Annex I of the Habitats Directive, whilst DRB and Depressions on peat substrates of the Rhynchosporion (EU 7150) are not. Hence due to the higher conservation value of the first two habitats, the conservation status of these two habitats has a higher significance value on 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

## Results

### Data deliverables

The following is a summary of the data deliverables:

- 12 completed **site reports were completed** (including vegetation (i.e. habitats, ecotopes and community complexes) descriptions, impacting activities descriptions and habitats conservation status assessments results, quadrats data, as well as maps based on the spatial data collected during the survey using ArcGIS and aerial photography). Appendix 9 provides a list of GIS shapefiles generated in ArcGIS (.shp, .shx, .sbx, .sbn, .dbf and .lyr) including a description of their attribute tables. Three different types of maps were produced. These maps although mapped at a 1:1500 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 active flush) have been named and a description of these specific areas is given in each site report, quadrats are also depicted in 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 written beside each point.
  - Map III: Impacts map: this map illustrates drainage, burnt areas and high bog cutaway in the 2004/05-2010 period.
- The existing NPWS Raised Bog Monitoring MS Access database 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.

## Project results

The following is a summary of the results obtained as part of the 2011 Raised Bog Monitoring Project, which surveyed a small proportion of raised bogs designated as SAC (12 raised bogs within 10 SACs surveyed out of 139 bogs designated within 127 sites (74 NHAs and 53 SACs). NHAs or non-designated sites were not proposed for surveying. Only sites located in the east of the River Shannon were surveyed during this project.

The 2011 field season survey commenced in August and was completed in October. A total of 12 raised bogs within 10 designated sites were surveyed (see figure 1.1 for their location). The area of the high bog at the sites surveyed ranged from 71ha at Ballynafagh to 228ha at All Saints (see table 1.1). A total of 62 quadrats were recorded.

Appendix 10 provides a list of the most common community complexes found on the high bog grouped according to the ecotope they belong to and listing number of records.

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### Clarifications

The conservation status assessment methodology is based on the comparison of ecotope data obtained during this survey compared with those of Fernandez *et al.* (2005) and, for FRVs, with amended survey data from Kelly (1993) and Kelly *et al.* (1995). There are certain limitations in this process due to differences in surveying and mapping techniques between different surveys. The discrepancies have been reduced as much as possible by re-interpreting the original data in the light of more standardise definitions of ecotope (Appendix 3). There have also been changes due to the increasing accuracy of surveying techniques. The discrepancies between surveys and how they have been handled is discussed below:

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#### Changes in interpretation of the community complexes

Some community complexes described by Fernandez *et al.* (2005) have been re-allocated to a different vegetation type within this survey. For instance, some sections of sub-central ecotope community complex 9/7/10 at Ballykenny bog (001818) have been reassessed 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 reports and the figures against which assessments are made are adjusted accordingly.

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#### Higher mapping accuracy and a more comprehensive survey in 2011

The use of the 2004/05 (Fernández *et al.* 2005) ecotope maps in digital format, which were imported and visualised in the field on the GeoXT Trimble devices, as baseline data for surveying has allowed a

more accurate mapping of ARB ecotopes. The 2011 survey 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 an improved ecotope map. These changes have been taken into account to amend Fernandez *et al.* (2005) ecotope figures to ensure changes were not overestimated. Each individual site report features both original and amended Fernandez *et al.* (2005) figures.

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#### New Active Raised Bog areas discovered in 2011

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

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#### Slight changes of high bog boundary

Fernandez *et al.* (2005) high bog boundary has been more accurately mapped as part of the 2011 project. 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 are included in the 2004/05 amended ecotope figures given within each site report.

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#### *Conservation status assessment*

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#### Active Raised Bog

##### OVERALL CONSERVATION STATUS ASSESSMENT:

ARB conservation status has been assessed as **Unfavourable Bad** at all raised bogs surveyed, as their current area is below FRV (see tables 3.1 for assessment results and 3.2 for FRV values versus current area values). Nonetheless, the overall habitat trend has been assessed as **Improving** at 7 raised bogs; **Stable** at 3 raised bogs and **Declining** at 2 raised bogs. As table 3.2 indicates the current habitat area value is 75.27% below target (i.e. Area FRV) and current S&F value (i.e. central and active flush area) is 25.74% below target (i.e. S&F FRV).

All sites, apart from Ballynafagh, assessed as having an Improving trend have had restoration works carried out. The area of ARB at Ballynafagh has increased slightly due to infilling within the high bog conifer plantation drains, which controls drainage from the area of ARB. This process is encouraging the development of new habitat. 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.

A **Stable trend** has been given to Sharavogue and Firville. A restoration project took place in 1992 and subsequently in 1996/7 at Sharavogue; positive results were noted within the previous reporting period (1994/95-2004/05). However, no further improvements took place in the new reporting period 2004/05-2011. No major changes have been noted at Firville bog either, where no significant restoration works have been undertaken to date.

A **Decreasing trend** has been noted at Kilcarren and All Saints. Habitat area had continued decreasing at Kilcarren as previously reported by Fernandez *et al.* (2005), as negative impacting activities continue damaging the habitat. All Saints has also been given a Declining trend mostly related to the Unfavourable Bad Future Prospects expected for the habitat. Habitat area has slightly increased overall, but this has been accompanied 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.

As table 3.3 illustrates a Favourable conservation status was given to Mongan and Sharavogue in 2005. This was based on a different conservation status assessment methodology. If these assessments had been carried out using the 2011 methodology, an Unfavourable Bad assessment would also be given for these two sites as their ARB area was also below the FRV in 2005.

#### AREA ASSESSMENT

ARB Area has been assessed as **Unfavourable Bad** at all raised bogs surveyed, as their current area is below the FRV. The ARB Area has been given a similar trend to that described above for the overall habitat: **7 raised bog Increasing trend; 3 Stable and 2 Decreasing trend.**

The area of habitat has slightly increased by approximately 12ha in the reporting period (2004/05-2011) as a result of expansion and development of active peat forming areas after restoration works.

In addition, to the above assessments table 3.4 provides a comparison between current high bog area and FRV for habitat Area. The habitat's Area FRV ranges from 52.99% of high bog at Mongan to 91.25% of high bog at Raheenmore. These values may be revised following topographical and hydrological examination.

#### STRUCTURE & FUNCTIONS ASSESSMENT

ARB S&F have been assessed as **Favourable** at **2 raised bogs** and **Unfavourable Bad** at the **remaining 10 bogs**. All Saints and Mongan have been given a **Favourable** assessment due to the large proportion of finest/wettest quality vegetation (central ecotope and/or active flush) present on the high bog. The

remaining bogs have been given an **Unfavourable Bad** assessment as the area of the finest vegetation quality is below the FRV (50% of ARB should consists of finest/wettest vegetation quality) (see table 3.2 for further detail on FRV values versus current values). Four out of these 10 bogs with Unfavourable Bad assessment have been given an **Improving trend**, which implies that vegetation quality has increased in the reporting period. Restoration works were undertaken on all four bogs. No variation in habitat quality (i.e. S&F) has been noted at the remaining 6 bogs.

Quadrat analysis has shown that slight changes occurred at many of the quadrats in the reporting period. Although some of these changes indicate changes of vegetation towards either more degraded (i.e. drier) or better (i.e. wetter) conditions, 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 *Sphagnum* grows). Therefore changes should not be analysed out of context (i.e. looking at several changes indicating a trend within the quadrat and taking into account activities affecting the habitat (e.g. cutting or drainage would lead to drier conditions and restoration to wetter conditions)). On the other hand some of the changes noted are also the result of discrepancy on the quadrat location (up to 2m) between both year surveys despite the use of highly accurate surveying equipment (Trimble GeoXT). The use of permanent quadrats in the 2011 survey will minimize the discrepancy due to quadrat location in the next reporting period.

#### FUTURE PROSPECTS ASSESSMENT

ARB Future Prospects have been assessed as **Favourable** at 7 raised bogs; **Unfavourable Inadequate** at 3 and **Unfavourable Bad** at 2 bogs. All Saints and Kilcarren have been given an **Unfavourable Bad** assessment as negatively impacting activities continue to threaten the habitat as the decline in its area indicates. An **Unfavourable Inadequate**, but **Stable** assessment has been given to Ballynafagh, Raheenmore and Firville. Although no major changes have taken place at these sites, negatively impacting activities continue threatening the habitat and hinder the recovery to FRVs. The remaining 7 raised bog have been given a **Favourable** assessment, with either a **Stable** or **Improving** trend depending on whether none or further increases in the area or improvement in the habitat's S&F are expected in the future based on current activities at the sites.



Table 3.1 Active Raised Bog conservation status assessment

Code	Site Name	Habitat area (ha)		Conservation status			
		2004/05 (amended)	2011	Area	S&F	Future Prospects	Overall
000006	Killyconny	3.91	3.91	UB-Stable	UB-Stable	F-Stable	UB-Stable
000391	Ballynafagh	6.23	6.48	UB-Increasing	UB-Stable	UI-Stable	UB-Improving
000566	All Saints	38.07	39.78	UB-Increasing	F-Increasing	UB-Declining	UB-Declining
000580	Mongan	48.21	48.31	UB-Increasing	F-Stable	F-Improving	UB-Improving
000582	Raheenmore	51.50	52.31	UB-Increasing	UB-Improving	UI- Stable	UB-Improving
000585	Sharavogue	25.78	25.78	UB-Stable	UB-Stable	F-Stable	UB-Stable
000641	Ballyduff	14.48	15.16	UB-Increasing	UB-Improving	F-Improving	UB-Improving
000641	Clonfinane	2.34	2.59	UB-Increasing	UB-Stable	F-Improving	UB-Improving
000647	Kilcarren	14.18	11.9	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000647	Firville	16.75	16.75	UB-Stable	UB-Stable	UI- Stable	UB-Stable
000679	Garriskill	45.12	50.87	UB-Increasing	UB-Improving	F-Improving	UB-Improving
001818	Ballykenny	2.52	7.57	UB-Increasing	UB-Improving	F-Improving	UB-Improving
<b>Total</b>		269.09	281.41				

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

Table 3.2 Active Raised Bog favourable reference values

Code	Site Name	Area Assessment			Structure & Functions Assessment		
		FRV Target (ha) <sup>1</sup>	2011 value (ha) <sup>2</sup>	% below target	FRV 2011 Target (ha) <sup>3</sup>	2011 value (ha) <sup>4</sup>	% above/below target
000006	Killyconny	45.53	3.91	91.41	1.96	0.21	(-) 89.29
000391	Ballynafagh	42.16	6.48	84.63	3.24	1.77	(-) 45.37
000566	All Saints	142.87	39.78	72.16	12.72 <sup>5</sup>	18.9	(+) 48.58
000580	Mongan	60.9	48.31	20.67	24.16	42.71	(+) 176.78
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	n/a
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	(-) 52.31
000647	Kilcarren	130.32	11.9	90.87	5.95	2.44	(-) 58.99
000647	Firville	136.86	16.75	87.76	8.38	4.99	(-) 40.45
000679	Garriskill	124.92	50.87	59.28	25.44	14.65	(-) 42.41
001818	Ballykenny	130.21	7.57	94.19	3.79	0.42	(-) 88.90
<b>Total</b>		1,138.13	281.41	75.27	120.85	89.74	(-) 25.74

<sup>1</sup> 1994 central, sub-central, active flush, bog woodland and sub-marginal ecotope area.

<sup>2</sup> 2011 central, sub-central ecotope, active flush and bog woodland area.

<sup>3</sup> Half of the current central, sub-central ecotope and active flush 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 central ecotope and active flush area.

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

Table 3.3 Active Raised Bog 2005 versus 2011 assessments

Code	Site Name	2005 Assessment				2011 Assessment			
		Area	S&F	Future Prospects	Overall	Area	S&F	Future Prospects	Overall
000006	Killyconny	UB	UB	UB	UB	UB-Stable	UB-Stable	F-Stable	UB-Stable
000391	Ballynafagh	UB	UB	UB	UB	UB-Increasing	UB-Stable	UI-Stable	UB-Improving
000566	All Saints	UB	B	B	UB	UB-Increasing	F-Increasing	UB-Declining	UB-Declining
000580	Mongan	F	F	F	F	UB-Increasing	F-Stable	F-Improving	UB-Improving
000582	Raheenmore	UI	UB	UB	UB	UB-Increasing	UB-Improving	UI-Stable	UB-Improving
000585	Sharavogue	F	F	F	F	UB-Stable	UB-Stable	F-Stable	UB-Stable
000641	Ballyduff	UB	UB	UI	UB	UB-Increasing	UB-Improving	F-Improving	UB-Improving
000641	Clonfinane	UB	UB	UB	UB	UB-Increasing	UB-Stable	F-Improving	UB-Improving
000647	Kilcarren	UB	UI	UI	UB	UB-Decreasing	UB-Stable	UB-Declining	UB-Declining
000647	Firville	UB	UB	UI	UB	UB-Stable	UB-Stable	UI-Stable	UB-Stable
000679	Garriskill	UB	UI	UI	UB	UB-Increasing	UB-Improving	F-Improving	UB-Improving
001818	Ballykenny	UB	UB	UI	UB	UB-Increasing	UB-Stable	F-Improving	UB-Improving

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

Table 3.4 High bog area versus Active Raised Bog favourable reference value

Code	Site Name	High bog area (ha)	2011 ARB FRV	%
000006	Killyconny	83.04	45.53	54.83
000391	Ballynafagh	70.06	42.16	60.18
000566	All Saints	222.95	142.87	64.08
000580	Mongan	124.37	65.9	52.99
000582	Raheenmore	130.54	119.12	91.25
000585	Sharavogue	137.01	84.24	61.48
000641	Ballyduff	86.68	60.44	69.73
000641	Clonfinane	87.26	55.56	63.67
000647	Kilcarren	180.84	130.32	72.06
000647	Firville	183.68	136.86	74.51
000679	Garriskill	170.26	124.92	73.37
001818	Ballykenny	180.81	130.21	72.01

## Degraded Raised Bog

### OVERALL CONSERVATION STATUS ASSESSMENT

DRB has been assessed as having an **Unfavourable Bad** conservation assessment at **all raised bogs surveyed**, as their current area is above the FRV. Nonetheless, the **overall habitat trend** has been assessed as **Improving** at **8 raised bogs**; **Stable** at **1 raised bog** and **Declining** at **3 raised bogs** (see tables 3.5 for assessment results and 3.6 for FRV versus current area values).

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, there are differences between the two projects methodologies with new criteria employed for assessing conservation status in 2011, 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.

An **Improving trend** indicates either a decrease in area as a result of the development of ARB or an improvement of S&F (i.e. increase in sub-marginal ecotope) as given at Killyconny, Mongan, Raheenmore, Sharavogue, Ballyduff, Clonfinane, Garriskill and Ballykenny.

A **Stable trend** indicates no variation in Area or S&F, and Stable Future Prospects. This trend has been given to Firville.

A **Declining trend** indicates a decrease in Area or decline of S&F as a result of impacting activities (e.g. drainage, peat cutting). Area has decreased due to peat cutting at Ballynafagh and All Saints (where it's S&F have also declined) and although it has increased at Kilcarren it has been at the expense of ARB and thus its Future Prospects are deemed Unfavourable Inadequate – Declining as a result of negatively impacting activities, which continue drying out the high bog and thus threatening the habitat.

### AREA ASSESSMENT

DRB Area has been assessed as **Unfavourable Bad** at all raised bogs surveyed, as their current area is above the FRV (see Methods section). Area has been given a similar trend to that described above for the overall habitat as follows: **1 raised bog Increasing trend** (i.e. increase in its area, which indicates drier conditions and thus negative trend) at Kilcarren; **3 Stable** at Killyconny, Sharavogue and Firville (i.e. no variation in area) and **8 Decreasing trend**. Only the decrease at Ballynafagh and All Saints is related to actual losses in high bog due to peat cutting. Decreases in area for the remaining 6 bogs are due to the expansion or development of ARB, which should be taken as a positive trend (see table 3.6 for comparison between current area versus FRV).

The area of DRB has decreased by approximately 13ha in the reporting period (2004/05- 2011) (see table 3.5). Approximately 1ha has been lost due to peat cutting at All Saints, Ballynafagh, Ballyduff and Kilcarren. The losses within the Ballyduff and Kilcarren bogs have been less than 0.10ha in area. The other 12ha has been lost due to the expansion of ARB.

STRUCTURE & FUNCTIONS ASSESSMENT

DRB S&F have been assessed as **Favourable** at **11 raised bogs** and **Unfavourable Bad** at **1 bog** (All Saints). All Saints has been given an **Unfavourable - Declining** trend as a result of expansion of face bank ecotope associated with drying out processes. Those bogs with a Favourable assessment have been given either **Stable trend** (i.e. no variation in S&F; 4 bogs) or **Improving trend** (i.e. improvement in S&F; 7 bogs) associated with re-wetting processes after restoration works (see table 3.6 for variation on drier ecotopes (i.e. marginal and face bank ecotopes)).

FUTURE PROSPECTS ASSESSMENT

DRB Future Prospects have been assessed as **Favourable** at **8 raised bogs**; **Unfavourable Inadequate** at **3 bogs** and **Unfavourable Bad** at **1 bog**. All Saints has been given an **Unfavourable Bad - Declining** assessment as negatively impacting activities continue to threaten the habitat as the decline in its area and S&F indicates. An **Unfavourable Inadequate – Stable** assessment has been given to Firville and Ballynafagh as no further improvement in S&F are expected unless restoration works take place. Kilcarren has been given an **Unfavourable Inadequate – Declining** assessment as impacting activities continue threatening the habitat and hinder recovery to ARB.

Table 3.5 Degraded Raised Bog conservation status assessment

Code	Site Name	Habitat area (ha)		Conservation status			
		2004/05 (amended)	2011	Area	S&F	Future Prospects	Overall
000006	Killyconny	79.13	79.13	UB-Stable	F-Improving	F-Improving	UB-Improving
000391	Ballynafagh	64.6	63.58	UB-Decreasing	F-Stable	UI-Stable	UB-Declining
000566	All Saints	185.3	183.17	UB-Decreasing	UB-Declining	UB-Declining	UB-Declining
000580	Mongan	76.16	76.06	UB-Decreasing	F-Improving	F-Improving	UB-Improving
000582	Raheenmore	79.04	78.23	UB-Decreasing	F-Stable	F-Stable	UB-Improving
000585	Sharavogue	111.23	111.23	UB-Stable	F-Improving	F-Improving	UB-Improving
000641	Ballyduff	72.13	71.52	UB-Decreasing	F-Improving	F-Improving	UB-Improving
000641	Clonfinane	84.42	84.67	UB-Decreasing	F-Improving	F-Improving	UB-Improving
000647	Kilcarren	166.76	168.94	UB-Increasing	F-Stable	UI-Declining	UB-Declining
000647	Firville	166.93	166.93	UB-Stable	F-Stable	UI-Stable	UB-Stable
000679	Garriskill	125.14	119.39	UB-Decreasing	F-Improving	F-Improving	UB-Improving
001818	Ballykenny	178.3	173.24	UB-Decreasing	F-Improving	F-Improving	UB-Improving
<b>Total</b>		1389.14	1376.09				

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

Table 3.6 Degraded Raised Bog favourable reference values

Code	Site Name	Area Assessment			Structure & Functions Assessment		
		FRV Target (ha) <sup>1</sup>	2011 value (ha) <sup>2</sup>	% above target	2004/05 M +FB value (ha) <sup>3</sup>	2011 M +FB value (ha) <sup>4</sup>	% variation
000006	Killyconny	37.51	79.13	210.96	43.57	38.57	11.48
000391	Ballynafagh	27.90	63.58	227.89	28.87	27.96	3.15
000566	All Saints	80.08	183.17	228.73	40.74	40.62	0.29
000580	Mongan	58.47	76.06	130.08	55.52	51.42	7.38
000582	Raheenmore	11.42	78.23	685.03	15.24	15.24	0.00
000585	Sharavogue	52.77	111.23	210.78	29.82	27.82	6.71
000641	Ballyduff	26.23	71.51	272.63	33.06	26.45	19.99
000641	Clonfinane	31.7	84.67	267.10	31.07	24.82	20.12
000647	Kilcarren	50.52	168.94	334.40	44.17	44.07	0.23
000647	Firville	46.82	166.93	356.54	62.38	62.38	0.00
000679	Garriskill	45.34	119.39	263.32	37.1	37.1	0.00
001818	Ballykenny	50.60	173.24	342.37	41.62	16.18	61.12

<sup>1</sup> 1992 high bog area minus 7110 area FRV.

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

<sup>3</sup> 2004/05 Marginal and face bank ecotope area.

<sup>4</sup> 2011 Marginal and face bank ecotope area.

## Bog Woodland

Bog Woodland was previously reported to occur at Clonfinane (Fernández *et al.*, 2005). The 2011 survey shows that this priority habitat is not present at the site and the woodland in the high bog at Clonfinane was wrongly classified as Bog Woodland habitat in previous surveys. Therefore, only All Saints is the only site surveyed in 2011 considered to harbour Bog Woodland habitat (91D0).

Area has been given an **Unfavourable Bad - Stable** assessment as the current area is 17.96% below the FRV due to habitat loss (0.76ha) following a severe fire event in 2002/3. However no variation in area has taken place in the new reporting period (2005 – 2011) and the trend is therefore Stable.

S&F have been assessed as **Favourable-Stable** in the reporting period as all monitoring stops passed. However, additional monitoring stops should have been included in the northwest section of the woodland that appears to be drying out.

Impacting activities such as peat cutting, drainage and quarrying threaten associated habitats (i.e. ARB and DRB). Evidence of changes within Bog Woodland indicates that it may be getting drier and thus future prospects are deemed **Unfavourable Inadequate- Declining**.

Bog Woodland has been given an overall **Unfavourable Bad – Declining** assessment at All Saints due to a negative assessment of Area and Future Prospects (see table 3.7 and 3.8).

An Unfavourable Bad assessment should also have been given in the 2005 report (Fernandez *et. al.* (2005) considering that the loss of area took place in the 1994/5-2004/05 period.

Table 3.7 Bog Woodland habitat conservation status assessment

Code	Site Name	Bog Woodland area (ha)		Conservation status			
		2004/05 (amended)	2011	Area	S&F	Future Prospects	Overall
000566	All Saints	14.34	14.34	UB-Stable	F-Stable	UI-Declining	UB-Declining

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

Table 3.8 Bog Woodland habitat favourable reference values

Code	Site Name	Area Assessment			Structure & Functions Assessment		
		FRV Target (ha)	2011 value (ha)	% below target	FRV 2011 Target (ha)	2011 value (ha)	% variation
000566	All Saints	17.48	14.34	17.96	na	na	na

na: not applicable; no area target established for S&F, but specific indicators targets have been established for the habitat (see Appendix 6)

## Depressions on peat substrates of the Rhynchosporion

### OVERALL CONSERVATION STATUS ASSESSMENT

Rhynchosporion depressions has been assessed as having a **Favourable** conservation assessment at **10 raised bogs** and **Unfavourable Inadequate** at **2 bogs**. An **Improving trend** has been given at **9 out of 10 raised bogs** with a Favourable assessment, as all three parameters (i.e. Area, S&F and Future Prospects) are given a positive assessment. The **remaining one bog** with Favourable assessment (Firville) is given a **Stable trend** as no changes have taken place in associated habitats (ARB and DRB). An **Unfavourable Inadequate – Declining** assessment has been given to Kilcarren and All Saints as a result of decreases and a decline in associated habitats Area and S&F or Unfavourable prospects for their future.

### AREA ASSESSMENT

Rhynchosporion depressions Area has been assessed as **Favourable** at **11 raised bogs**. Two (All Saints and Firville) have been given a **Stable trend** and the remaining **9** an **Improving trend** for similar reasons to those described above for the overall assessment. Similarly, an **Unfavourable Inadequate** assessment has been given to Kilcarren (decreasing trend due to a decrease in associated area).

STRUCTURE & FUNCTIONS ASSESSMENT

Rhynchosporion depressions S&F have been assessed as **Favourable** at **11 raised bogs** and **Unfavourable Inadequate - Declining** at **1 bog** (Kilcarren). Those bogs with a Favourable assessment have been given either **stable trend** (i.e. no variation in S&F; **2 bogs**) or **Improving trend** (i.e. improvement in S&F; **9 bogs**) (see table 3.9).

FUTURE PROSPECTS ASSESSMENT

Rhynchosporion depressions Future Prospects have been given a **Favourable assessment** at **10 raised bogs**; 3 were given a **Stable trend** (i.e. no major variation expected in near future) and 7 an **Improving trend** (i.e. increases in Area or improvement in S&F expected). Both All Saints and Kilcarren were given an **Unfavourable Inadequate - Declining** assessment.

Table 3.9 Rhynchosporion depressions conservation status assessment

Code	Site Name	Conservation status			
		Area	S&F	Future Prospects	Overall
000006	Killyconny	F-Increasing	F-Improving	F-Improving	F-Improving
000391	Ballynafagh	F-Increasing	F-Improving	F-Stable	F-Improving
000566	All Saints	F-Stable	F-Stable	UI-Declining	UI-Declining
000580	Mongan	F-Increasing	F-Improving	F-Improving	F-Improving
000582	Raheenmore	F-Increasing	F-Improving	F-Stable	F-Improving
000585	Sharavogue	F-Increasing	F-Improving	F-Improving	F-Improving
000641	Ballyduff	F-Increasing	F-Improving	F-Improving	F-Improving
000641	Clonfinane	F-Increasing	F-Improving	F-Improving	F-Improving
000647	Kilcarren	UI-Decreasing	UI-Declining	UI-Declining	UI-Declining
000647	Firville	F-Stable	F-Stable	F-Stable	F-Stable
000679	Garriskill	F-Increasing	F-Improving	F-Improving	F-Improving
001818	Ballykenny	F-Increasing	F-Improving	F-Improving	F-Improving

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

Overall raised bogs conservation status

According to table 3.10 below **7 raised bogs** have been given an **Unfavourable Bad-Improving** overall assessment; **3 Unfavourable Bad-Stable** and **2 Unfavourable Bad-Declining**. The overall assessment given to both priority habitats present on a high bog (i.e. ARB and Bog Woodland) has been the overriding attribute employed to assess the overall assessment of a raised bog (see above assessments for further detail).

Table 3.10 Overall raised bog conservation status

Code	Site Name	Conservation status				Overall raised bog
		7110	7120	7150	91D0	
000006	Killyconny	UB-Stable	UB-Improving	F-Improving	n/a	UB-Stable
000391	Ballynafagh	UB-Improving	UB-Declining	F-Improving	n/a	UB-Improving
000566	All Saints	UB-Declining	UB-Declining	UI-Declining	UI-Declining	UB-Declining
000580	Mongan	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving
000582	Raheenmore	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving
000585	Sharavogue	UB- Stable	UB-Improving	F-Improving	n/a	UB- Stable
000641	Ballyduff	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving
000641	Clonfinane	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving
000647	Kilcarren	UB-Declining	UB-Declining	UI-Declining	n/a	UB-Declining
000647	Firville	UB-Stable	UB-Stable	F-Stable	n/a	UB-Stable
000679	Garriskill	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving
001818	Ballykenny	UB-Improving	UB-Improving	F-Improving	n/a	UB-Improving

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

### *Impacts and threats assessment*

The 2011 survey also reported impacts both on the high bog or adjacent land impacting and threatening EU habitats on the high bog. The following are the survey findings:

#### Peat cutting

Peat cutting, which consists of the direct removal of peat from the high bog, has occurred during the reporting period (2004/05-2011) at 5 raised bogs surveyed (see table 3.11). Commercial peat cutting is ongoing adjacent to the designated site at Clonfinane. The impact arising from this activity on high bog habitats at these sites is deemed to have a Medium Importance. Cutting also occurred at Mongan but on adjacent cutover. Approximately 1ha of high bog has been lost due to peat cutting in the reporting period at the sites surveyed. The highest losses took place at Ballynafagh and All Saints where the activity is deemed to have a High Importance/Impact on high bog habitats.

Any peat cutting that took place on these sites between 2004/05-11 is of a domestic nature and consists 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 adjacent to the face-bank to dry out. This method of 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.



High bog cutting was already stopped prior to the new reporting period (2004/05-2011) at Mongan, Raheenmore, Sharavogue, Clonfinane, Firville, Garriskill and Ballykenny. Cutting was ceased in during the reporting period at Killyconny, Ballynafagh, Ballyduff and Kilcarren; and thus of the 12 sites surveyed only continues at All Saints.

Although cutting does not directly threaten the high bog habitats at those sites where it was phased out, 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.

Table 3.11 Peat cutting summary

Code	Site Name	Peat cutting				Comment
		Importance	Influence	High bog cutaway (2004/05-2011)	Location	
000391	Ballynafagh	H	-1	0.77ha	Inside HB	
000566	All Saints	H	-1	0.42ha	Inside HB	
000580	Mongan	L	-1	<0.10ha	Outside HB	Cutting on cutover
000641	Ballyduff	L	-1	0.03ha	Inside HB	
000641	Clonfinane	M	-1	0.00ha	Inside HB	60ha commercial exploitation of high bog adjacent to but outside of the SAC
000647	Kilcarren	M	-1	0.10ha	Inside HB	

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact

HB: High Bog

### Drainage

All 12 raised bogs surveyed feature some high bog drains functional or reduced functional high bog drains. This reduced functional drains also includes drains blocked but not completely in-filled and thus still providing for relatively rapid drainage of the high bog (see table 3.12). High bog drains have been deemed to have a High Importance/Impact at 3 raised bogs: Ballynafagh, All Saints and Kilcarren.

Cutover drainage (i.e. outside the high bog and functional and/or reduced functional) was also recorded at all 12 raised bogs. This drainage type is generally associated with former or current peat cutting, but also agriculture land management or rivers and streams management. This activity is considered to have a High Importance/Impact at 2 raised bogs: All Saints and Raheenmore.

Both high bog and cutover drainage have been given a Medium Importance/Impact at many of the other raised bogs surveyed (see table 3.12 for further detail).

Table 3.12 Drainage summary

Code	Site Name	Drainage			
		Importance	Influence	Length (km) <sup>1</sup>	Location
000006	Killyconny	M	-1	4.103	Inside High Bog
000006	Killyconny	M	-1	n/av	Outside High Bog
000391	Ballynafagh	H	-1	4.192	Inside High Bog
000391	Ballynafagh	M	-1	n/av	Outside High Bog
000566	All Saints	H	-1	27.393	Inside High Bog
000566	All Saints	H	-1	n/av	Outside High Bog
000580	Mongan	M	-1	9.305	Inside High Bog
000580	Mongan	M	-1	n/av	Outside High Bog
000582	Raheenmore	M	-1	9.40	Inside High Bog
000582	Raheenmore	H	-1	n/av	Outside High Bog
000585	Sharavogue	M	-1	21.912	Inside High Bog
000585	Sharavogue	L	-1	n/av	Outside High Bog
000641	Ballyduff	M	-1	11.825	Inside High Bog
000641	Ballyduff	M	-1	n/av	Outside High Bog
000641	Clonfinane	M	-1	13.587	Inside High Bog
000641	Clonfinane	M	-1	n/av	Outside High Bog
000647	Firville	M	-1	1.909	Inside High Bog
000647	Firville	M	-1	n/av	Outside High Bog
000647	Kilcarren	H	-1	6.559	Inside High Bog
000647	Kilcarren	M	-1	n/av	Outside High Bog
000679	Garriskil	M	-1	12.158	Inside High Bog
000679	Garriskil	M	-1	n/av	Outside High Bog
001818	Ballykenny	M	-1	25.929	Inside High Bog
001818	Ballykenny	M	-1	n/av	Outside High Bog

<sup>1</sup> This figure only includes functional and reduce-functional drains.

H: High importance/impact; M: Medium importance/impact; L: Low importance/impact

## Burning

Burning is still common on many raised bogs and this activity is mainly associated with peat cutting.

This activity has been recorded in the reporting period at the following sites and its importance and influence has been ranked as follows:

- Ballynafagh bog (SAC 000391): Medium Importance/Impact / 48.37ha burnt (69% high bog).
- Mongan bog (SAC 000580): Low Importance/Impact / 50ha burnt (40% high bog).
- Clonfinane bog (SAC 000641): Medium Importance/Impact / 59.47ha burnt (68% high bog).
- Firville bog (SAC 000647): Low Importance/Impact / 14ha burnt (7.6% high bog).
- Kilcarren bog (SAC 000647): Low Importance/Impact / 19ha burnt (12.32% high bog).

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## Forestry

Forestry can occur either on the high bog or on the cutover area adjacent to the high bog. Forestry on the raised bogs surveyed, only consists of coniferous plantation. Drainage associated with forestry planting is the main impact associated with forestry and thus has a similar effect to that of drainage.

Forestry has been reported on the high bog at Ballynafagh (000391), and it covers 10.84ha. This activity is deemed to have High Importance/Impact on high bog habitats.

Coniferous plantations are also found adjacent to the high bog at the following bogs:

- Sharavogue (000585): Low Importance/Impact on high bog habitats.
- Ballyduff (000641): Low Importance/Impact on high bog habitats.
- Firville (000647): Low Importance/Impact on high bog habitats.
- Kilcarren (000647): Low Importance/Impact on high bog habitats.

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## Invasive species

Invasive species have been recorded at 10 raised bogs: Raheenmore, Killyconny, Ballynafagh, Sharavogue, Ballyduff, Clonfinane, Firville, Kilcarren, Garriskill and Ballykenny. Invasive species were deemed to have a Low Importance/Impact at all these raised bogs and their area is always smaller than 0.1ha.

Conifers and particularly *Pinus sylvestris* were the most commonly reported invasive species at the sites surveyed. However, *Rhododendron ponticum* was also reported at Ballynafagh, Garriskill and Ballykenny.

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## Other impacting activities

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

- Quarrying: recorded at All Saints, where it was deemed to have a High Importance/Impact on high bog habitats; Killyconny where its influence on high bog habitats is unknown.
- Grazing: recorded at Garriskill and deemed to have Low Importance/Impact.
- Motorised vehicles: recorded at Ballynafagh and Kilcarren high bog and deemed to have Low Importance/Impact.

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## Management actions

## Restoration works

Restoration works have been carried out at 8 out of the 12 raised bog surveyed (see table 3.13) by NPWS. However, only the restoration works at Killyconny were carried out in this reporting period (2004/05-2011). Restoration works at all other sites were carried out previous to this. Restoration work ranged from the blocking of high bog and/or cutover drains to the construction of dams.

Evidence of improvement in both ARB and DRB was noted in those areas of the high bog where restoration took place. In the case of Killyconny only improvements on DRB quality (i.e. expansion of sub-marginal ecotope) have been noted. This site is at an early stage in the restoration process as drains were only blocked recently. Coillte Teoranta recently undertook a restoration program as part of their LIFE project at Killyconny. This mainly included the removal of conifer plantation on cutover and its effects were not assessed as part of this survey.

Table 3.13 Sites where restoration works were carried out

Code	Site Name	Restoration works	Date	Results assessment
000006	Killyconny	Blocking of HB and cutover drains; removal of cutover conifer plantation	2006-2009	DRB quality enhancement
000580	Mongan	Blocking of HB drains	1983/4 & 1997	DRB quality enhancement & ARB development
000582	Raheenmore	Blocking of HB drains and dams construction on the cutover	1994/1999	""
000585	Sharavogue	Blocking of HB drains, restoration of lagg zone	1992 & 1996/97	""
000641	Ballyduff	Blocking of HB drains	2003	""
000641	Clonfinane	Blocking of HB drains	1997-98	""
000679	Garriskil	Blocking of HB drains	1998	DRB quality enhancement & ARB development
001818	Ballykenny	Blocking of HB drains and cutover drains	2003	DRB quality enhancement & ARB development

## Further management actions

The NPWS has engaged in negotiations with land owners in relation to the purchase of land and turbary rights at many of the sites surveyed. This has allowed for the cessation of peat cutting in all sites except for All Saints where negotiations continue. Thus this activity continues at All Saints damaging high bog habitats and threatening their survival.

## Conclusions

A number of conclusions can be made regarding the findings of this project:

**ARB** has been given an **Unfavourable Bad conservation status** at **all raised bogs surveyed**, as their current area is below the FRV. Nonetheless, the **overall trend** has been assessed as **Improving** at **7 raised bogs**; **Stable** at **3 raised bogs** (Killyconny, Sharavogue and Firville) and **Declining** at **2 raised bogs** (All Saints and Kilcarren). The latter two bogs have been given a Declining trend due to the impact from negative activities such as peat cutting and drainage. ARB area has increased by approximately 12ha in the 2004/05 – 2011 reporting period. This increase is associated with re-wetting processes associated with restoration works undertaken prior to the reporting period.

**ARB favourable reference values** are only approximate until more accurate values can be established once further topographical and hydrological studies allow a better understanding of the potential capacity of a damaged high bog to support ARB. The above values may not be achievable solely on the high bog especially in the case of small high bog sites where impacting activities such as drainage and peat cutting have modified irreversibly the high bog topography and hydrology (e.g. steep slopes) so that it is not technically feasible to restore ARB. In these cases the restoration of adjacent cutover areas may be the most feasible way to reach the reference values.

The 2011 survey is characterised by a higher mapping accuracy and more comprehensive surveying which resulted in an improved vegetation (i.e. ecotope) map. These changes have been taken into account to amend Fernandez *et al.* (2005) ecotope figures in order not to overestimate changes by comparing original values against new values.

**DRB** has been given an **Unfavourable Bad conservation status** at **all raised bogs surveyed**, as their current area is above the FRV. DRB is a particular habitat for which an FRV area below current values is required. Nonetheless, the **overall habitat trend** has been assessed as **Improving** at **8 raised bogs**; **Stable** at **1 raised bog** (Firville) and **Declining** at **3 raised bogs** (Ballynafagh, All Saints and Kilcarren). The latter three bogs have been given a Declining trend due to the impact from negative activities such as peat cutting and drainage. The area of DRB has decreased by approximately 13ha in the reporting period (2004/05 - 2011). Approximately 1ha has been lost in total, due to peat cutting at All Saints, Ballynafagh, Ballyduff and Kilcarren.

**Bog Woodland** was only recorded at All Saints. The habitat has been given an **Unfavourable Bad – Declining** assessment at this site. Bog Woodland has been given a Declining trend due to the impact from negative activities such as peat cutting and drainage. Bog Woodland was previously reported at Clonfinane. However, the woodland type present at the site is not considered to correspond with the EU Annex I habitat (91D0).

**Depressions on peat substrates of the Rhynchosporion** have been given a **Favourable conservation status** assessment at **10 raised bogs** and **Unfavourable Inadequate - Declining** at **2 bogs** (All Saints and Kilcarren). The latter two bogs have been given a Declining trend due to the impact from negative activities such as peat cutting and drainage. An **Improving trend** has been given at **9 out of 10 raised bogs** with a Favourable assessment. The **remaining one bog** (Firville) with **Favourable** assessment has been given a **Stable** trend.

The conservation status of priority habitats (i.e. ARB and Bog Woodland) is considered the overriding attribute to assess the conservation status of each raised bog. Therefore, **7 raised bogs** have been given an **Unfavourable Bad–Improving overall assessment**; **3 Unfavourable Bad–Stable** and **2 Unfavourable Bad–Declining**.

**Drainage** both on the high bog and the cutover associated with peat cutting and **peat cutting** itself 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 all 12 raised bogs surveyed. This activity is considered to have a High Importance/Impact at 3 raised bog surveyed (Ballynafagh, All Saints and Kilcarren). **Cutover drainage** (i.e. outside the high bog and functional and/or reduced functional) was deemed to have High Importance/Impact on the high bog habitats at 2 raised bogs (All Saints and Raheenmore).

**Peat cutting** has taken place at 5 out of the 12 raised bog surveyed in the reporting period. Approximately 1ha of high bog has been lost due to this activity. Peat cutting has been phased out at 4 of these 5 raised bogs in the reporting period. The cutting that continues is of a domestic nature and consists of mechanical peat extraction (i.e. Hopper machinery). Although cutting continues at only one (All Saints) of the 12 sites, secondary impacts (i.e. on-going subsidence and drainage related to open face-banks) associated with past cutting continues at all sites, posing a threat to ARB in many of these raised bogs. This activity is considered to have High Importance/Impact at 2 raised bogs surveyed (Ballynafagh and All Saints).

**Burning** has been reported at 5 of the 12 raised bogs surveyed (Ballynafagh, Mongan, Clonfinane, Firville and Kilcarren) in the reporting period. This activity was deemed to have Medium to Low Importance/Impact on raised bog habitats.

**Forestry** (i.e. conifer plantations) on the high bog was reported at only Ballynafagh. Here it is deemed to have High Importance/Impact on high bog habitats. Conifer plantations were also reported on the cutover at another 4 raised bogs (Sharavogue, Ballyduff, Firville and Kilcarren). This activity was deemed to have Low Importance/Impact on high bog habitats.

**Invasive species** were recorded at 10 out of 12 raised bogs surveyed. These are mainly *Pinus* sp., however *Rhododendron ponticum* was also noted at 3 raised bogs. Invasive species are considered to have Low Importance/Impact on high bog habitats.

**Quarrying** although reported at 2 sites (All Saints and Killyconny) is only considered to have High Importance/Impact on high bog habitats at All Saints.

**Restoration works** (e.g. blocking of high bog and cutover drains, dams construction) were undertaken at 9 out of the 12 raised bogs. Killyconny bog was the only bog restored in the reporting period (2004/05-2011) (all other restoration works were carried out previous to this). Evidence of both Active and Degraded Raised Bog improvement was noted in those areas of the high bog where restoration took place. Killyconny is only at an early stage in the recovery process and only improvements on DRB were noted. Thus, overall the results of these restoration works are considered to be highly positive.

The NPWS has also engaged in negotiations with land owners in relation to the purchase of land and turbary right at many of the sites surveyed. This has allowed for the cessation of peat cutting in all sites except for All Saints.

## Recommendations

Further raised bog monitoring surveys at national level are required in order to gather a more representative view of the current status of raised bog EU Habitats in Ireland. The selection of further sites to be surveyed should take into account geographical variation (e.g. sites to the west of the River Shannon); designated sites where peat cutting activity has continued until recent years or may still be taking place (e.g. 2011 peat cutting season) and sites only given national protection status (NHA). The results from the proposed monitoring survey should be used to derive the 2007-2012 national assessments of the conservation status of raised bog Annex I habitats.

A new conservation status assessment method has been developed based on the setting of favourable reference values for both Active and Degraded Raised Bog Area and S&F. Due to the lack of more detailed information, reference values are based on the area of habitat and ecotopes values in 1994, when the EU Habitats Directive came into force in Ireland. These values are only approximate until further topographical and hydrological studies give an improved knowledge of each specific raised bog's capacity to support ARB. Thus these types of studies are recommended both to establish site appropriate FRVs values and as part of a national restoration program.

The results to date support the importance of restoration work in slowing and reversing the loss of ARB and will be essential to achieve future conservation objectives for ARB. A targeted and properly designed and implemented restoration program is required to which will optimise resources used and

effectiveness. This program should also include all designated raised bogs in the country (i.e. SACs and NHAs). 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 necessary in many sites. This is especially true for those sites where a negative assessment and trend has been given (All Saints and Kilcarren) but is also the case in other sites in order to achieve the favourable reference values and thus favourable conservation status.

The individual site assessments have highlighted the potential of cutover areas in some sites to support and develop ARB. This would be 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 is essential 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 evolve into wet heath, wet woodland, 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.



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## Appendix 1: Plant communities of the high bog

Plant communities of the high bog adapted by MacGowan (pers. comm., 2003) from Kelly & Schouten 2002 and included 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

<b>HOLLOWS</b>			
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 <i>Nartheicum ossifragum</i> . 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>Nartheicum 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>
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### 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.

### FLATS

These are more or less flat areas which are intermediate between hollow & hummock communities. They tend to be drier than the above situations.

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>

### HUMMOCKS

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 *Sphagnum* species such as *Sphagnum magellanicum*, *S. capillifolium*, *S. austinii* & *S. fuscum* but other bryophytes such as *Hypnum jutlandicum* & *Leucobryum glaucum* are also important, especially as the hummock grows taller and becomes drier. *Calluna vulgaris* is another important element, as it flourishes where the water table is not at surface level.

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		<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> & Algal mats
3E	Variant with <i>Trichophorum cespitosum</i>	Originally lawns now damaged.	Differential species: <i>Trichophorum cespitosum</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 peat forming (7110) 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 survey was 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 description some of them could be renamed and would correspond to the community complexes under this key. The key is produced to enable a determination down to marginal and sub-marginal ecotope level within degraded raised bog.

The description of each community complex is applicable to a 10m-diameter section 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.

Key		
1	Western indicators <i>Racomitrium lanuginosum</i> , <i>Campylopus atrovirens</i> and large pools with frequent open water all present	3
2	Western indicators <i>Racomitrium lanuginosum</i> , <i>Campylopus atrovirens</i> and large pools with frequent open water absent	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>
6		<b>Sub-central Ecotope</b>
	<i>Narthecium ossifragum</i> > 25%	- <b>Complex 6/35</b>
	<i>Carex panicea</i> >20%	- <b>Complex 3/35</b>

	<i>Rhynchospora alba</i> >20%	- Complex 4/35
	<i>Eriophorum</i> sp. >20%	- Complex 9/35
	None of the above	- Complex 35
5	<i>Sphagnum</i> cover 20-30% and <i>Narthecium ossifragum</i> >20%	Sub-central Ecotope - Complex 6 + P
	<i>Sphagnum</i> cover <20%	Sub-marginal Ecotope
7	<i>Sphagnum</i> cover <10%	8
	<i>Sphagnum</i> cover (10-30%)	9
	<i>Sphagnum</i> cover (30-40%)	10
	<i>Sphagnum</i> cover >40%	11
8	Tall robust <i>Calluna vulgaris</i> (>0.4m / >50% cover) and firm ground, at the edges of the high bog	Face-Bank Ecotope
	<i>Calluna vulgaris</i> not so tall and robust (ca 0.3m) or if so not occurring at >50% cover	Marginal Ecotope
9	Pool cover < 15%	Sub-marginal Ecotope
	Pools cover > 15% and <i>Sphagnum</i> cover 10-20%	Sub-marginal Ecotope
	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> )	Sub-central Ecotope - Complex 6+Pools (or 6/4 + P 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.	Sub-marginal Ecotope
10	Pools cover <15% or absent	12
	Pools cover >15%	13
12	<i>Narthecium ossifragum</i> <30%, ground soft to very soft, hummocks-hollows and sometimes pools. ( <i>Sphagnum</i> cover close to 40%).	14
	<i>N. ossifragum</i> <30%, ground soft to very soft, hummocks-hollows and sometimes pools. ( <i>Sphagnum</i> cover close to 30%).	Sub-marginal Ecotope (e. g. Complex 9/7)
	<i>N. ossifragum</i> >30%, ground firm to soft, hummocks-hollows, and pools <5%. ( <i>Sphagnum</i> cover close to 30%).	Sub-marginal Ecotope (e. g. Complex 9/7/6)
	<i>N. ossifragum</i> >30%, at least one western indicator present and pool cover 10-15%	Sub-central Ecotope - Complex 6 + P
14	<i>Eriophorum angustifolium</i> > 15% and ground very soft	Sub-central Ecotope - Complex 9a/10
	<i>E. vaginatum</i> > 15%	16
	<i>Rhynchospora alba</i> > 15%	Sub-central Ecotope - Complex 4/10
	<i>Carex panicea</i> >15%	Sub-central Ecotope - Complex 3/10
	None of the above. <i>Narthecium ossifragum</i> 15-30%	Sub-central Ecotope - Complex 6/10
<b>(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).</b>		
16	<i>Calluna vulgaris</i> <20%	Sub-central Ecotope - Complex 9/10
	<i>C. vulgaris</i> >20%	17
17	<i>Narthecium ossifragum</i> (<10%)	Sub-central Ecotope - Complex 9/7/10
	<i>Narthecium ossifragum</i> (>10%)	Sub-marginal Ecotope (e.g. Complex



		9/7)
<b>(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>).</b>		
13	<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)	Sub-marginal Ecotope
	None of the above. Well-developed micro-topography present and the <i>Sphagnum</i> cover is close to 40%	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	<i>Narthecium ossifragum</i> (<10% cover)	Sub-central Ecotope - Complex 9 +Pools (or 9a + P when <i>E. angustifolium</i> is dominant)
	<i>N. ossifragum</i> (10- 30% cover)	Sub-central Ecotope - Complex 6/9 +Pools
19	<i>Narthecium ossifragum</i> (<10% cover)	Sub-central Ecotope - Complex 9/7 +Pools
	<i>N. ossifragum</i> (10- 30% cover)	Sub-central Ecotope - Complex 9/7/6 +Pools
20	<i>Narthecium ossifragum</i> (<10% cover)	Sub-central Ecotope - Complex 4 +Pools
	<i>N. ossifragum</i> (10- 30% cover)	Sub-central Ecotope - Complex 6/4 +Pools
21	<i>Narthecium ossifragum</i> (<10% cover)	Sub-central Ecotope - Complex 3 +Pools
	<i>N. ossifragum</i> (10- 30% cover)	Sub-central Ecotope - Complex 6/3 +Pools
11	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	Central Ecotope - Complex 10/15
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	Sub-central Ecotope - Complex 9/7/10
	<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%	Sub-central Ecotope - Complex 10/9/3
	<i>Rhynchospora alba</i> > 15%	Sub-central Ecotope - Complex 10/4
	<i>Carex panicea</i> >15%	Sub-central Ecotope - Complex 10/3

	None of the above. <i>Narthecium ossifragum</i> 15-30%	<b>Sub-central Ecotope - Complex 10/6</b>
<b>26</b>	<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>
<b>23</b>	<i>Sphagnum</i> cover (40-60%)	<b>27</b>
	<i>Sphagnum</i> cover >60%	<b>Central Ecotope - Complex 15 or 4/15 when <i>Rhynchospora alba</i> &gt;15%</b>
<b>27</b>	<i>Eriophorum</i> species >20%	<b>28</b>
	<i>Rhynchospora alba</i> >15%	<b>29</b>
	<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>
<b>28</b>	<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:** 60-100%

**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-.

#### 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 the 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

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Complex 15-

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

**Sphagnum cover:** 30-40%

**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 comprised 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%).

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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:** 40-60%

**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:** 40-50%

**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:** 10-30%

**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**. Other variant corresponds to **complex 10/9/3** where hollows/lawns like and pools < 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:** 30-40%

**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

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### 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 less 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 also ranked according to their **influence**: (-1): negative / (0): neutral / (+1): positive

## Appendix 5: 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 6: 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 3 cm 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 pool dot 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 *Hydnum 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* hum 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* hum 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 cespitosum*

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

*Trichophorum* %

**Note:** An increase in *Trichophorum cespitosum* 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 hummocks or lawns species (*Sphagnum magellanicum*, *S papillosum*, *S. capilifolium*, *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* %: *Nartheceium ossifragum*

**Note:** An increase in *Nartheceium 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 %

Hummocks 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 absent.

Other Notable Species

Other comment

### Bog Woodland (91D0) assessment sheet

Site name	Recorders	Photo no.s	
Stop Number	Date	Grid ref	
<b>Positive indicator species</b>	✓	<b>Negative indicator species</b>	<b>% Cover</b>
<u>Trees and woody species</u> <i>Betula pubescens</i> <i>Pinus sylvestris</i> <i>Salix aurita</i> <u>Herbs &amp; ferns</u> <i>Dryopteris</i> spp. <i>Carex rostrata</i> <i>Juncus effusus</i> <i>Molinia caerulea</i> <i>Vaccinium oxycoccus</i> <i>Empetrum nigrum</i> <i>Vaccinium myrtillus</i> <u>Mosses</u> <i>Polytrichum commune</i> <i>Sphagnum fimbriatum</i> <i>Sphagnum fallax</i> <i>Sphagnum palustre</i> <i>Hylocomium splendens</i>		Non-native conifer species List: <i>Rhododendron ponticum</i> <i>Pteridium aquilinum</i> <i>Rubus</i> agg. Others List:	
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>	<b>Passes</b>
Median canopy height >4m Total canopy cover >30% of plot <i>Betula pubescens</i> >50% of canopy Dwarf shrub layer cover 10-50% Calluna cover <40% % <i>Sphagnum</i> cover (pass = ≥25%) % Bryophyte cover (pass = ≥50%)		Green Amber Red <b>Result</b>	>7 6-7 <6
<b>Target tree species dbh</b>	<b>Result</b>	<b>Old trees &amp; dead wood (any species)</b>	<b>Result</b>
<i>Betula pubescens</i> No. of stems 5-10 cm No. of stems 10-20 cm No. of stems >20 cm <i>Pinus sylvestris</i> No. of stems 5-10 cm No. of stems 10-20 cm No. of stems >20 cm		No. of old/senescing trees >10cm No. of standing dead trees >10cm No. of fallen dead trees >10cm  Potential indicator No. dead stems	
Pass = Over all stops each size class represents at least 15% of total stems		Pass = 1+ old/senescing trees (or dead branches) in >25% of stops and 4+ standing dead or fallen dead	
<i>Betula pubescens</i> regeneration		Native tree regeneration (incl. <i>Pinus</i> )	
Pass = >1 sapling >1m in each plot		Pass = >1 sapling >1m in ≥50% of plots	

*Proposed assessment*

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

## Appendix 7: Typical species list

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

**Vascular plants:** *Andromeda polifolia*, *Calluna vulgaris*, *Drosera anglica*, *D. intermedia*, *D. rotundifolia*, *Erica tetralix*, *Eriophorum angustifolium*, *E. vaginatum*, *Menyanthes trifoliata*, *Narthecium ossifragum*, *Rhynchospora alba*, *R. fusca*, *Trichophorum cespitosum*, *Utricularia minor*, *Vaccinium oxycoccus*.

**Mosses, liverworts and lichens:** *Aulacomnium palustre*, *Cladonia* spp (*C. ciliata* and *C. portentosa*), *Leucobryum glaucum*, *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. oxycoccus*.

**Mosses, liverworts and lichens:** *Aulacomnium palustre*, *Polytrichum commune*, *Sphagnum capillifolium*, *S. fimbriatum*, *S. palustre*, *S. recurvum*, *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&F			FP	Overall
Raheenmore	Assessment	Current (52.31ha) < FRV (119.12ha) (56.09% below FRV)	UB	UI- Increasing	Current (1.68ha) < FRV (26.16ha) (93.58% below FRV)	UB	UI- Improving	UI- Stable	UB- Improving
	Trend	Increasing			Improving				
Killyconny	Assessment	Current (3.91ha) < FRV (3.91ha) (91.41% below FRV)	UB	UB-Stable	Current (0.21ha) < FRV (1.96ha) (89.29% below FRV)	UB	UB-Stable	F- Stable	UB-Stable
	Trend	Stable			Stable				
Mongan	Assessment	Current (48.31ha) < FRV (65.9ha) (26.69% below FRV)	UB	UI- Increasing	Current (42.71ha) > FRV (24.16ha) (176.78% above FRV)	F	F- Stable	F- Improving	UB- Improving
	Trend	Increasing			Stable				
Kilcarren	Assessment	Current (11.9ha) < FRV (130.32ha) (90.87% below FRV)	UB	UB- Decreasing	Current (2.44ha) < FRV (5.95ha) (58.99% below FRV)	UB	UB-Stable	UB- Declining	UB- Declining
	Trend	Decreasing			Stable				

## Appendix 9: 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 on the field after post-processing in the office to obtain sub-meter accuracy.

- RBMP11\_commu\_complex\_dots: This file provides dot 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 dot record; [Date1]: date data recorded.
- RBMP11\_ecotope\_boundary\_dots: This file provides dot 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\_]: other boundary not included in precious field; [Comment]: additional info specific for that dot record; [Date1]: date data recorded; [County].
- RBMP11\_flush\_dots: This file provides dot 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; [Comment]: additional info specific for that dot record; [Date1]: date data recorded; [County].
- RBMP11\_quadrat\_data: This file provides dot records for quadrats recorded. The attribute table fields correspond with heading described under Appendix 6. The quadrat name is reflected in the MS Access database quadrat table.
- RBMP11\_additional\_dots\_data: This file provides dot records for any additional data considered relevant to the survey site. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Comment]: additional info specific for that dot record; [County].
- RBMP11\_drainage\_dots: This file provides dot 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; [Blocked]: blocked drain functionality; [Width]: drain width in m; [Depth]: drain depth in m; [Comment]: additional info specific for that dot record; [County].
- RBMP11\_photo\_records\_dots: This file provides dot records for photographic data. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Photo\_ID]; [Aspect]: photographic aspect; [Type]: detail or overview; [Comment]: additional info specific for that dot record (e.g. quadrat name); [Date1]: date data recorded; [County].

- RBMP11\_invasive\_species\_dots: This file provides dot 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 dot record (e.g. quadrat name); [Other]: additional info; [County].


## Digitised spatial data:

The following are the spatial data files digitised in the office based on raw spatial data recorded on the field and NPWS Designated Raised Bog Orthophotos 2010.

- RBMP11\_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]; [Ecotope]: ecotope type; [Designatio]: designation type (e.g. SAC); [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 related to each active peat forming section, whether it is newly developed, have expanded or de creased.
- RBMP11\_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. Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [2004\_5\_cat]: drain type in 2004\_5; [2011\_cat]: drain type in 2011; [Change]: change in the 2004/05-2011 period in the drain status; [Comment]: additional info related to each specific drain; [County].
- RBMP11\_additional\_data\_map: This file provides additional line data such as dams. Attribute table includes the following field: [Site\_Name]; [Site\_Code]; [Name]: dam name; [County].
- RBMP11\_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; [Comment]: period burnt took place; [Designatio]: designation type (e.g. SAC); [County].
- RBMP11\_high\_bog\_cutaway\_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]; [Area]: area cutaway in m<sup>2</sup>; [Designatio]: designation type (e.g. SAC); [Site\_Code]; [County].
- RBMP05\_ecotope\_map: This file provides polygon data illustrating habitats depicted based on the ecotope vegetation classification provided by Fernandez *et al.* (2005). High bog edge has been re-digitised as part of this project based on the most 2005 ortho-images. This has affected



high bog edge ecotopes area (general face bank and marginal ecotope types). Attribute table includes the following fields: [Site\_Name]; [Site\_Code]; [Ecotope]: ecotope type; [Designatio]: designation type (e.g. SAC); [Area]: ecotope area in m<sup>2</sup>; [County]; [Survey\_Nam]: survey name; [Authors]: map authors; [Survey\_Met]: survey method (e.g. ground survey).



## Appendix 10: Community complexes recorded during 2011 survey

Ecotope	Community complex	Number of records <sup>1</sup>
<b>Central</b>	15	118
	35	99
	10/15	57
	14	14
<b>Sub-central</b>	9/10	550
	9/7/10	486
	6/35	239
	4/10	117
	10/9	101
	10/4	80
	9/7/6+P	71
	9/7+P	68
	9a/10	46
	3/10	34
	4+P	29
	10/9a	22
	6/15	19
	10/6	7
	9/7/10+My	5
	9/7/10+My+Mol	4
<b>Sub-marginal</b>	9/7/6	2488
	9/7	1089
	7/6	329
	6/9+P	211
	3/6/4	206
	6/3	181
	9/7/3	179
	6+P	117
	7/6/4	74
	9/7/6+My	50
	9/7/6+P	38
	6/3+P	26
	7/9	25
	4/9a+P	18
	9/7/6/4	16
	9/7/4	15
	4/9	14
	7/9+Cl	9
	9/7+My	9
	9a/7/3	9
	7/6+My	8
9/7/3+My	8	

	9/7+P	7
	9/7/2	6
	6/7	6
	9/7/3+P	6
	6/3+TP	4
	7/6/4+TP	4
	6/9	3
	6/9+TP+My	3
	9/7+Ph	4
	3/6/4+TP	2
	6/9+TP	2
	9/7+TP	2
	9a/7/6	2
	6/35	1
	7/6/3	1
	9/7/6+TP	1
<b>Marginal</b>	6/7	320
	7/2	294
	3/6	287
	9+BP	23
	3/6+TP	19
	7/6	16
	6/7/2	13
	6/4	11
	3/6+P	11
	6/7+My	9
	7+BP	9
	6/7/3	7
	9/2	6
	3/6+My	4
	6/7+TP	4
	3/6+Mo	1
	7+Ph	1
<b>Face bank</b>	<b>1</b>	<b>56</b>

<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 of that the community complex covers