Scoping study and pilot survey for a national survey and conservation assessment of upland habitats and vegetation in Ireland

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EXECUTIVE SUMMARY

The uplands form our largest expanses of semi-natural habitats. They include areas of great scenic beauty, forming inspirational landscapes with a sense of wilderness and space. Almost 29% of the landmass of Ireland is estimated to be over 150 m in altitude, while almost 19% of the landmass can be considered to support upland habitats. The importance of upland habitats to plant and animal conservation is unquestionable with upwards of fourteen habitat types listed under Annex I of the EU Habitats Directive and many rare and threatened bird and animal species being recorded in these areas. Furthermore, over 40% of the total area designated as candidate Special Area of Conservation (cSAC) in Ireland is estimated to occur within land above 150m altitude.

The primary objectives of the study and pilot survey were to devise an efficient strategy for conducting a National Survey of Upland Habitats (NSUH) in order to classify the vegetation; to map the distribution of the vegetation communities and habitats and to devise a monitoring program for assessing the conservation status of important upland vegetation communities and those associated with Annex I habitats of the EU Habitats Directive.

Through the pilot survey the efficiency of different methodologies and approaches to surveying upland habitats was carried out at two sites: the Mweelrea Mountains and at Corraun Plateau, both in Co. Mayo. An additional eight upland sites were visited to test the suitability of the methods. For use during the pilot survey a provisional list of detailed vegetation types was developed. This was based largely on the phytosociological syntaxon of White & Doyle (1982), the upland communities of the British NVC (Rodwell, 1991, 1992) and experience of the project team. A range of approaches to vegetation mapping, relevé recording and condition assessment were considered. The most appropriate of these were selected for testing in the field. The preferred approaches were then used to complete the pilot field survey. These methods are detailed in the report.

Post-survey data analyses methods, vegetation classification, conservation status assessments and monitoring methodologies are also detailed and the results of the field survey for the Corraun and Mweelrea pilot sites are presented. A series of recommendations are made, based on the field trials of the various techniques and the findings from the field survey. These recommendations are detailed in a Handbook for a National Survey of Upland Habitats. Guidance on field survey equipment and health and safety considerations are also outlined.

A provisional classification of upland vegetation was produced in an objective manner using multivariate statistics. This was based on the relevés collected during the pilot survey and an additional 2000 relevés collated from other sources. Analyses comprised an initial round of cluster analyses which divided the dataset into six broad groups. These were then further divided into 39 more detailed vegetation types. Synoptic tables were produced for the vegetation groups. Collection of further relevés for key habitats will be of importance for the continued refinement of this provisional classification.

A comprehensive suite of upland sites incorporating designated sites and un-designated upland sites from across the country was compiled. These were then ranked using a number of criteria including area, habitats present, and the presence of rare or noteworthy features. From this it is

apparent which the most important sites in the country are. The ranked sites can be used to select sites to form a representative network of upland sites for monitoring conservation status of the Annex 1 and other internationally important habitats.

The final chapter presents the proposed methodology for assessing the conservation status of Annex I habitats which occur in the uplands. Results of the conservation status assessments for the pilot survey sites at Corraun and Mweelrea Mountains are also presented.

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CHAPTER 1: INTRODUCTION

1.1 General background

The uplands form our largest expanses of semi-natural habitats. They include areas of great scenic beauty, forming inspirational landscapes with a sense of wilderness and space. Almost 29% of the landmass of Ireland is estimated to be over 150 m in altitude, while almost 19% of the landmass can be considered to support upland habitats. The importance of upland habitats to plant and animal conservation is unquestionable with upwards of fourteen habitat types listed under Annex I of the EU Habitats Directive and many rare and threatened bird and animal species being recorded in these areas. Furthermore, over 40% of the total area designated as candidate Special Areas of Conservation (cSAC) in Ireland is over 150 m in altitude.

The definition of upland habitat used for the purposes of this study is given in below Box 1. Irish uplands include blanket bog, heath, flushes, grasslands and several habitats associated with exposed rock and scree. Upland areas have been formed by powerful geological and biological processes but have also been shaped by centuries of human activity. The biodiversity value of high altitude areas has in some ways been less impacted than lowland areas because climate, soil and topographic factors are unfavourable for many forms of intensive agriculture. Notwithstanding this however drainage, agricultural improvement, extensive afforestation and overstocking of sheep have resulted in widespread degradation of upland habitats and the fragile nature of their soils makes upland habitats more likely to suffer irreversible damage. Additionally, the recent focus of wind energy developments on upland areas presents a growing threat through increased access and disturbance, fragmentation, hydrological changes, soil erosion and landslides. Increasing evidence of the vulnerabilities of Ireland's uplands to climate change is also emerging.

There is thus a clear need for a sustainable land management policy for the uplands that will ensure that habitats listed in Annex I of the Habitats Directive attain favourable conservation status and to prevent the decline of rare or threatened species, including those listed on Annex II of the Habitats Directive and Annex I of the EU Birds Directive. To achieve this information on the distribution, extent and conservation status / condition of upland habitats is required, together with a detailed classification system for the vegetation communities that characterise these habitats.

Box 1. Definition of upland habitat

For the purposes of this project, upland habitats are defined as unenclosed areas of land over 150 m altitude, and contiguous areas of related habitats that descend below this altitude. The main upland habitats comprise blanket bog, heaths, flushes, dense bracken, habitats of exposed rock and scree, and semi-natural acidic grasslands. Several of these habitats regularly occur together as mosaics, with transitions resulting from changes in topography, edaphic conditions, drainage, management and climate. Unenclosed lands are defined as those outside man-made boundaries that are unimproved and not used for agriculture other than extensive grazing. Unimproved lands demarcated by old or defunct boundaries (e.g. some pre-famine walls) or boundary fencing are not regarded as enclosed and are thus within the remit of this project.

1.2 Aims

This document reports on a scoping study and pilot survey of upland habitats in Ireland, which is a precursor to a proposed National Survey of Upland Habitats (NSUH). The primary objective of the scoping study and pilot survey was to devise an efficient strategy for conducting a NSUH. To this end there were four main aims:

1. To produce an indicative map of upland habitats in Ireland based on existing datasets in order to:
   - Identify the approximate national distribution and extents of the habitats targeted by the NSUH
2. To conduct a pilot field survey of upland habitats in order to :
   - test and select the best of a range of field survey, mapping and data recording methodologies
   - map the distribution and extent of habitats recorded, to produce baseline habitat maps
   - record the vegetation composition of the habitats occurring
   - conduct an assessment of the condition of Annex I upland habitats and other internationally important habitats
   - map the distribution of rare plant species recorded
   - identify areas of conservation value using a range of appropriate criteria
   - identify impacts, threats and trends
3. To prepare for a national classification system for upland habitats based on quantitative vegetation samples through:
   - sourcing available relevé datasets recorded from Irish upland habitats, assessing these and integrating relevant data with those collected during the pilot field survey
   - investigating and defining communities covered by available data through multivariate analysis.
   - preparing synoptic floristic tables identifying key indicator species
   - describing each communtity and making comparisons with Fossitt (2000) communities and Annex I habitats
4. To devise strategies, methodologies and a program of monitoring for upland habitats those listed under Annex I of the EU Habitats Directive using:
   - a monitoring protocol developed for Annex I habitats based on approaches adopted for other Annex I habitats in Ireland and also in the UK
   - a monitoring network developed using a preliminary indicative map of upland habitats based on existing available data, NPWS designated sites and expert opinion.

This project also produced a preliminary indicative map of upland habitats based on a variety of existing datsets of variable reliability and a survey manual detailing habitat survey, mapping and monitoring strategies and methodologies and guidelines on protocols and procedures for all aspects of a national survey of upland habitats.

1.3 Area of interest

For the purposes of this project upland habitats are broadly defined as all areas of unenclosed land over 150 m in altitude and contiguous areas of relevant habitats that extend below 150 m (further detail is given above in Box 1). The habitats which were within the remit of this project are looked at in more detail below but in general heath, blanket bog, unenclosed grassland, dense bracken, fen and flush, and naturally occurring exposed rock and scree were considered to be within the remit of the project. Isolated areas of these habitats below 150 m are not included. Enclosed grassland, limestone pavement, woodland and freshwater habitats, with the exception of dystrophic lakes which form part of blanket bog complexes, are generally not included. Exceptions can however be made for habitats occurring as part of the intimate mosaic of upland habitat. Areas of enclosed grassland are within the remit of the ongoing Irish Semi-natural Grasslands Survey (Martin *et al.* 2009) and the conservation status of limestone pavement in Ireland is part of a separate study (Murphy & Valverde 2009); both of which are commissioned by NPWS. The locations of lakes and watercourses are already available in digital format. Native woodlands have already been comprehensively surveyed by the National Survey of Native Woodlands (Perrin *et al.* 2008a) also commissioned by NPWS. Although forestry plantations are abundant in the Irish uplands, the detailed description of their vegetation is not within the remit of this survey and their ecology has been described elsewhere (e.g. Iremonger *et al.* 2006).

1.4 Vegetation studies of the Irish uplands

The upland vegetation studies that have been carried out in Ireland to date have been fragmentary and limited in scope and have not addressed the full range of upland vegetation types at a national scale. Instead, research has either been focused on a particular region of Ireland, such as Connemara (van Groenendael *et al.* 1983, Horsfield *et al.* 1991, Bleasdale & Sheehy Skeffington 1995), Connemara and Mayo (Hart 1883, Colgan 1900, Roden 1986), Carrowkeel (Webb 1947) or Glenveagh National Park (Weekes 1990, Telford 1977), or more commonly, on particular vegetation types within a particular region. Studies of this nature have included scree slopes in the Macgillycuddy's Reeks (Hodd & Sheehy Skeffington unpublished), upland grasslands and heath in the Burren (Parr *et al.* 2009, Keane & Sheehy Skeffington 1995), peatlands and heath in the Killarney Valley (Mhic Daeid 1976), montane heath and hepatic mat communities in Kerry and Donegal (Hodd unpublished) and lowland blanket bog in Galway and Mayo (Doyle 1982, 1990, MacGowan & Doyle 1996, 1997, 1998). Habitat mapping of upland areas has generally been site specific, concentrating on NPWS designated sites and being used for management plans (O'Donovan 2007, Wolfe-Murphy & Murphy 2002, Barron & Perrin unpublished). A small number of broader studies, such as the Irish Semi-natural Grasslands Survey (Martin *et al.* 2008) and a survey of small sedge communities in Ireland (Ó Críodáin 1988), have incorporated some upland vegetation types. The National Red Grouse Survey (Crushell & O'Callaghan 2008) surveyed one hundred 1 km x 1 km squares many of which were in upland locations and recorded the habitats therein (using Fossitt habitats) and the condition of potential grouse habitat. Land cover reviews which incorporate upland areas are also available in the form of the Corine Land Cover 2000, the Peatland Map of

Ireland (Hammond 1979), and the Derived Ireland Peatland Map (Connolly *et al.* 2007). The accuracy of these varies greatly being based largely on interpreted aerial photographs and satellite imagery rather than through field survey. There are some additional relevant studies which are now outdated (Hart 1883, 1884, 1891, Colgan 1900). Hart (1891) provided botanical details of mountain ranges throughout the country, making it one of the few more national-scale studies, but almost 120 years have now passed since its publication. Though this provides a good source of reference it must be concluded that, to date, the habitats of the Irish uplands have not been adequately described nor their distribution adequately mapped.

1.5 Classification of Irish upland vegetation

The classification of vegetation in Ireland has traditionally followed the central European phytosociological approach favoured by Braun-Blanquet & Tüxen (1952). White and Doyle (1982) provided a phytosociological classification framework for the vegetation of Ireland which included many of the major upland vegetation types. However it was based, in some cases, on speculation as to whether vegetation types known from continental Europe were likely to occur in Irish uplands rather than on empirical data. More recently, the broad-scale habitat classification scheme of Fossitt (2000) has been widely adopted by authorities in Ireland for habitat surveying and mapping purposes. This scheme was originally intended as a first-step approach for general habitat recording, and so is not strictly suitable for detailed study and evaluation. The following habitat categories will be the main ones recorded in upland areas:

- FL1 Dystrophic lakes
- FL2 Acid oligotrophic lakes
- FW1 Eroding / upland streams
- GS3 Dry-humid acid grassland
- GS4 Wet grassland
- HH1 Dry siliceous heath
- HH2 Dry calcareous heath
- HH3 Wet heath
- HH4 Montane heath
- HD1 Dense bracken
- PB2 Upland blanket bog
- PB3 Lowland blanket bog
- PB4 Cutover bog
- PB5 Eroding blanket bog
- PF1 Rich fen and flush
- PF2 Poor fen and flush
- ER1 Exposed siliceous rock
- ER2 Exposed calcareous rock
- ER3 Siliceous scree and loose rock
- ER4 Calcareous scree and loose rock
- WD4 Conifer plantation

Several of these habitats regularly occur together as mosaics, with transitions resulting from changes in topography, edaphic conditions, drainage, management and climate. The location of all habitats within the survey area will be mapped during field work.

The British National Vegetation Classification (NVC: Rodwell, 1991, 1992, Averis *et al.* 2004) does not utilise Irish data and the differences in vegetative communites between the UK and Ireland are significant enough not to apply the system to Ireland. Notwithstanding this however, the NVC approach is broadly useful and the communities outlined within it may be used to provide an *indication* of the range of upland plant communities likely to exist in Ireland in addition to those indentified according to the Phytosociological approach.

1.6 Conservation of Irish upland habitats

In Ireland upland areas are extensively used for grazing livestock, primarily sheep but sometimes cattle. Other uses include peat extraction, afforestation, land reclamation for agriculture, infrastructural developments, hill walking and other forms of recreation. Areas of blanket bog and heath have an additional function in retaining water and regulating the flow of water deposited in the uplands through rainfall into our rivers. In addition, bogs are immense carbon stores and when actively growing act as carbon sinks by capturing atmospheric carbon in the growing peatland vegetation and preserving it within the undecomposed vegetation that forms an accumulating peat soil or 'active bog'. Disturbance of the peat areas can cause a lowering of the water table resulting in the peat drying out and release of the stored carbon.

Threats to upland habitats include afforestation with commercial conifer plantations, drainage, agricultural improvement and overgrazing and erosion caused by overstocking of sheep. Wind energy developments have also severely impacted on some peatland sites and present a growing threat through increased access and disturbance, fragmentation, hydrological changes, soil erosion and landslides. Climate change is also impacting on peatlands and is a source of increasing pressure on montane biodiversity as with limited possibilities for adaptation montane species are the most vulnerable species to the effects of climate change (Berry *et al.* 2003).

Several upland areas of conservation interest are protected in Ireland through conservation designations that vary in the level of protection they provide to the species and habitats found within them. NHAs (Natural Heritage Areas) are designated under national legislation. As not all NHAs have yet been fully designated, pNHA (proposed NHA) is used to distinguish sites that have not yet been accorded full statutory protection. cSACs (candidate Special Areas of Conservation) and SPAs (Special Protection Areas for birds) are designated as a result of EU Directives and provide a higher level of designation. Additional protection is afforded to sites within National Parks and Nature Reserves as they are almost all state-owned and are primarily managed for nature conservation purposes. The term "NPWS conservation sites" is used in this report when referring collectively to cSACs, SPAs, NHAs, pNHAs, National Parks and Nature Reserves.

The EU Habitats Directive has contributed to the conservation of upland habitats in Ireland by listing and defining habitats of conservation importance in Europe. Under this Directive, Ireland

has a responsibility to designate SACs to protect and maintain at a favourable conservation status any of these habitats that occur within the State. Uplands include some of our most natural habitats and support rare and threatened species and vegetation communities. A high proportion of upland habitats are listed under Annex I of the EU Habitats Directive (Tables 1.1 and 1.2).

Table 1.1 Annex I habitats that occur in Irish uplands and which are primary focus habitats for this project.

Habitat code	Habitat name
4010	Northern Atlantic wet heaths with *Erica tetralix*
4030	European dry heaths
4060	Alpine and Boreal heaths
6230	*Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)
7130	Blanket bog (*active only)
7150	Depressions on peat substrates of the *Rhynchosporion*
8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)
8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)
8210	Calcareous rocky slopes with chasmophytic vegetation
8220	Siliceous rocky slopes with chasmophytic vegetation

* Denoted a priority habitat under the EU Habitats Directive

Table 1.2 Annex I habitats that are known or thought to occur in Irish uplands and which are not primary focus habitats for this project.

Habitat code	Habitat name	Notes
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	
3160	Natural dystrophic lakes and ponds	
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	
5130	Juniperus communis formations on heaths or calcareous grasslands	
6130	Calaminarian grasslands of the *Violetalia calaminariae*	
6150	Siliceous alpine and boreal grasslands	Recorded in Northern Ireland
6170	Alpine and subalpine calcareous grasslands	Recorded in Northern Ireland
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)	Ongoing survey in a lowland context by the Irish Semi-natural Grasslands Survey (Martin *et al.* 2007, 2008, O'Neill *et al.* 2009)
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Has been considered in detail by ISGS survey (Martin *et al.* 2008)
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Only recorded in a lowland context in Ireland hitherto
7140	Transition mires and quaking bogs	
7210	Calcareous fens with *Cladium mariscus* and species of the *Caricion davillianae*	
7220	Petrifying springs with tufa formation (*Cratoneurion*)	
7230	Alkaline fens	
8240	*Limestone pavements	
91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	Surveyed by the National Survey of Native Woodlands (Perrin *et al.* 2008a, b)

* Denoted a priority habitat under the EU Habitats Directive

It can be seen from Table 1.2 that some of the Annex I upland habitats which may occur within upland areas are not a primary focus of this study. This includes aquatic habitats and habitats included in other national surveys such as certain grasslands . If these habitats are encountered it was decided that their location was to mapped and the habitat type recorded but it was not deemed necessary to record releve data.

In addition it should be noted there are two habitats listed in Table 1.2 which are not currently recognised as occurring in Ireland (Silicious alpine and boreal grasslands 6150 and Alpine and Sub-alpine calcareous grasslands 6170) but as they have been recorded in upland habitats in Northern Ireland it was considered a possibility that they do occur. Annex I habitat Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430) has only been recorded in a lowland context in Ireland but the possibility of it occurring in an upland context is recognised.

Under Article 17 of the EU Habitats Directive, member states must submit a report on the implementation of the measures taken under the Directive every six years. A summary of the findings of the most recent review of the status of EU protected habitats in Ireland (Anon. 2008) is given in Table 1.3. This puts the current conservation status of the upland Annex I habitats into context. The range of each of the upland habitats was considered to be good but the structure and function, future prospects and overall conservation status of all but one (Depressions on peat substrates of the *Rhynchosporion* 7150) were assessed as being poor or bad which highlights the vulnerability of these habitats. The area assessment for many of the habitats is based on estimates only and for habitat Natural dystrophic lakes and ponds (3160) and of habitat Northern Atlantic wet heaths with *Erica tetralix* (4010) was reported as 'unknown'. This emphasises the paucity of quantified data for many of the upland Annex I habitats and the urgency with which further data for reporting on conservation status is required.

The next Article 17 report is due in 2013. More detailed data on the status of Ireland's upland Annex I habitats will be required in advance of its compilation, in particular improved data on the area and distribution of the habitats. A greater input from field-based assessments is also needed and to this end a monitoring protocol and representative network of sample sites for upland habitats is required. A comprehensive survey of the Irish uplands is thus required to address gaps in the current information to inform conservation management and to fulfil legal requirements under the Habitats Directive. The current project will provide baseline botanical data to characterize the vegetation and habitat occurring, develop a provisional classification scheme for upland vegetation communities, produce habitat maps for the two main pilot survey sites, recommend conservation assessment methodologies and proposals for selection of a representative monitoring network for upland habitats.

Table 1.3 Conservation status of Annex I habitats known or thought to occur in the Irish uplands

Annex I Habitat code	Range	Area	Structure & function	Future prospects	Overall status
3130	Good	Good	Bad	Bad	Bad
3140	Good	Good	Bad	Bad	Bad
3160	Good	Unknown	Bad	Bad	Bad
3260	Good	Good	Bad	Bad	Bad
4010	Good	Unknown	Bad	Bad	Bad
4030	Good	Good	Poor	Poor	Poor
4060	Good	Poor	Poor	Poor	Poor
5130	Good	Poor	Poor	Poor	Poor
6130	Good	Good	Good	Poor	Poor
6150	Good	Bad	Bad	Bad	Bad
6170	Good	Bad	Bad	Bad	Bad
6230	Good	Bad	Bad	Bad	Bad
6410	Good	Bad	Bad	Bad	Bad
6430	Good	Bad	Bad	Bad	Bad
7130	Good	Bad	Bad	Bad	Bad
7140	Good	Good	Bad	Bad	Bad
7150	Good	Good	Good	Good	Good
7220	Good	Good	Bad	Bad	Bad
7230	Good	Good	Bad	Bad	Bad
8110	Good	Poor	Poor	Poor	Poor
8120	Good	Poor	Poor	Poor	Poor
8210	Good	Poor	Poor	Poor	Poor
8220	Good	Poor	Poor	Poor	Poor
8240	Good	Poor	Poor	Poor	Poor

CHAPTER 2: PILOT SURVEY OF UPLAND HABITATS

2.1 Aims

A pilot field survey was needed to examine the feasibility of a NSUH providing detailed ecological data covering relatively large areas of upland habitats. An assessment of the efficiency of different methodologies for surveying upland habitats, including GIS mapping, was integral to the survey. The main aims of the pilot field survey were to:

- test different methodologies for each element of the survey in the field, establishing which ones should be recommended for the NSUH
- survey a representative sample of the full range of upland habitats in Ireland
- map the distribution and extent of habitats recorded on two pilot sites
- map the location of rare plant species recorded on two pilot sites
- gather relevé data from the habitats recorded on the pilot sites
- conduct an assessment of the condition and conservation status of specified Annex I upland habitats
- identify impacts, threats and trends affecting upland habitats on the pilot sites

2.2 Site selection

The pilot field survey focused on the following two upland areas, where detailed vegetation mapping, relevé recording and condition assessment were undertaken:

1. Mweelrea Mountains, County Mayo
2. Corraun Plateau, County Mayo

In the original project brief, the Corraun Plateau and the Bricklieve Mountains in County Sligo had been selected as the two main survey sites. These sites were chosen to represent siliceous and calcareous bedrock respectively and for their relative accessibility, as both are accessible by road and neither one exceeds 550 m in height. However, after careful consideration, it was decided that the Mweelrea Mountains should be selected instead of the Bricklieve Mountains. The Mweelrea Mountains are not easily accessible by road, and their more remote nature would provide a better opportunity to test the practicalities of carrying out survey work in a more extreme montane environment. Furthermore, at over 800 m in height, the Mweelrea Mountains contain a higher proportion of truly montane habitats compared to the Bricklieve Mountains at 359 m. In terms of upland Annex I habitats, the qualifying interests for the Bricklieve Mountains cSAC include only two categories:

- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)

- 8120 Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)

Furthermore, habitat 6210 is not an obligate upland habitat. In contrast, the upland Annex I habitats listed as qualifying interests for the Mweelrea/Sheeffry/Erriff complex cSAC include:

- 3160 Natural dystrophic lakes and ponds
- 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- 4010 Northern Atlantic wet heaths with *Erica tetralix*
- 4030 European dry heaths
- 4060 Alpine and Boreal heaths
- 5130 *Juniperus communis* formations on heaths or calcareous grasslands
- 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
- 7130 Blanket bogs (* if active bog)
- 7140 Transition mires and quaking bogs
- 7150 Depressions on peat substrates of the *Rhynchosporion*
- 7220 *Petrifying springs with tufa formation (*Cratoneurion*)
- 7230 Alkaline fens
- 8210 Calcareous rocky slopes with chasmophytic vegetation
- 8220 Siliceous rocky slopes with chasmophytic vegetation

Hence, there was good evidence that the Mweelrea Mountains would include a far greater variety of upland Annex I habitats than the Bricklieve Mountains and one of the aims of the pilot survey was to sample the full range of upland habitats. Another consideration was that the Mweelrea Mountains were regarded as a potential site for the Annex I habitat Siliceous and alpine boreal grassland (6150). This habitat has been recorded in Northern Ireland but is not currently recognised in the Republic of Ireland.

The Mweelrea/Sheeffry/Erriff complex cSAC is relatively large, covering 20,991 ha. Due to the requirement for a detailed level of mapping and the limited time and personnel available, a subset of the cSAC was selected as the target survey area (Fig. 2.1). This 1,546.6 ha area covered 7.3% of the cSAC and was centred on the main ridge of the Mweelrea Mountains, encompassing the peaks of Mweelrea and Ben Bury and their surrounding slopes. This area was selected with reference to the aerial photographs, contours and geological maps and it was anticipated the selected area would include the majority of the Annex I habitat types listed above. The survey area is entirely within the Mweelrea/Sheeffry/Erriff cSAC.

The Corraun survey area (Fig. 2.2) corresponded to the boundaries of the Corraun Plateau cSAC, covering an area of 3,886.9 ha. It encompassed the plateau itself, Corraun Hill and much of the surrounding slopes, stretching as far as the coast on the southern side. The cSAC area was selected in its entirety for the survey area as it formed an area of suitable size which could be surveyed within the time available.

Figure 2.1 Mweelrea pilot survey area, part of Mweelrea/Sheeffry/Eriff complex cSAC (001932)

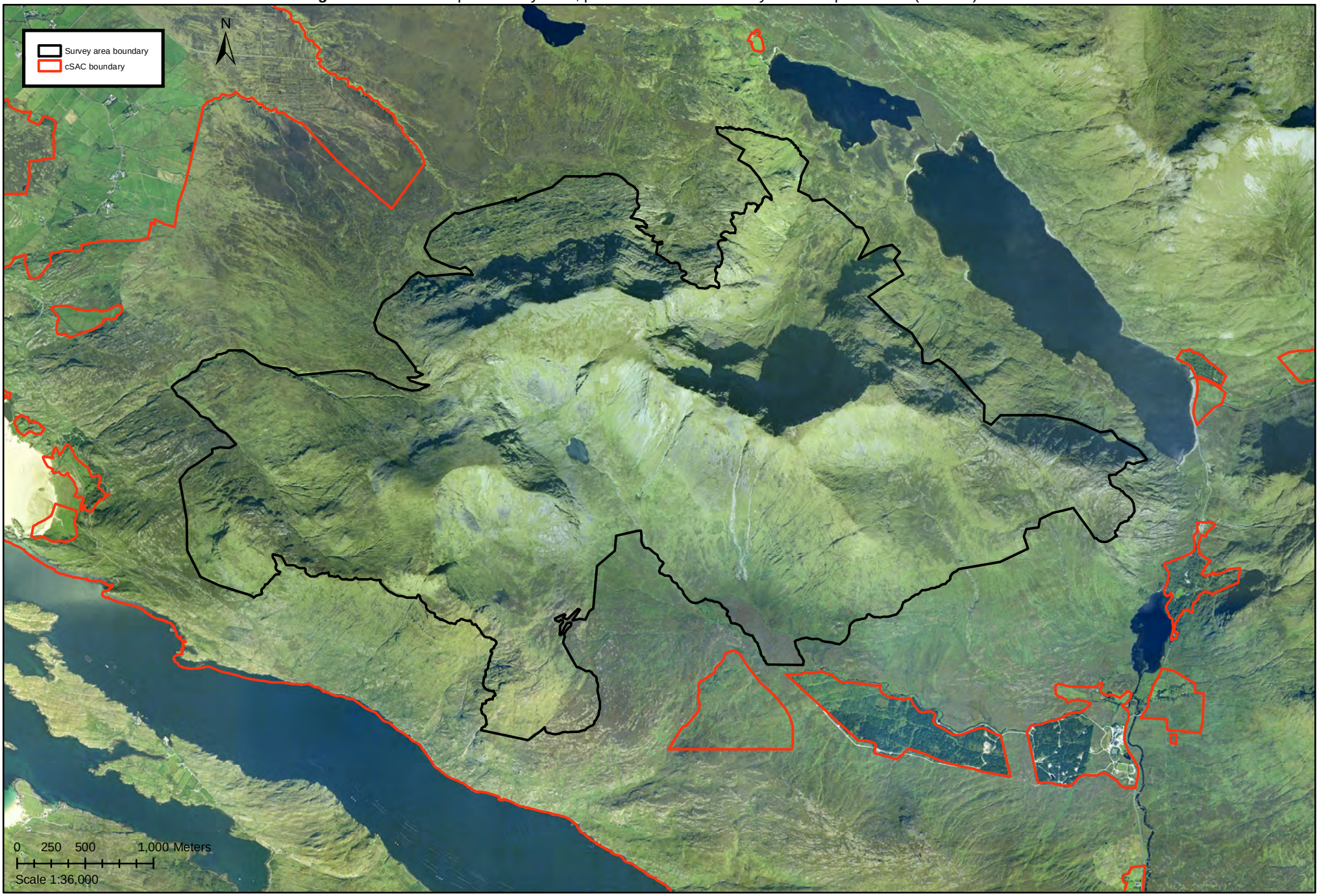

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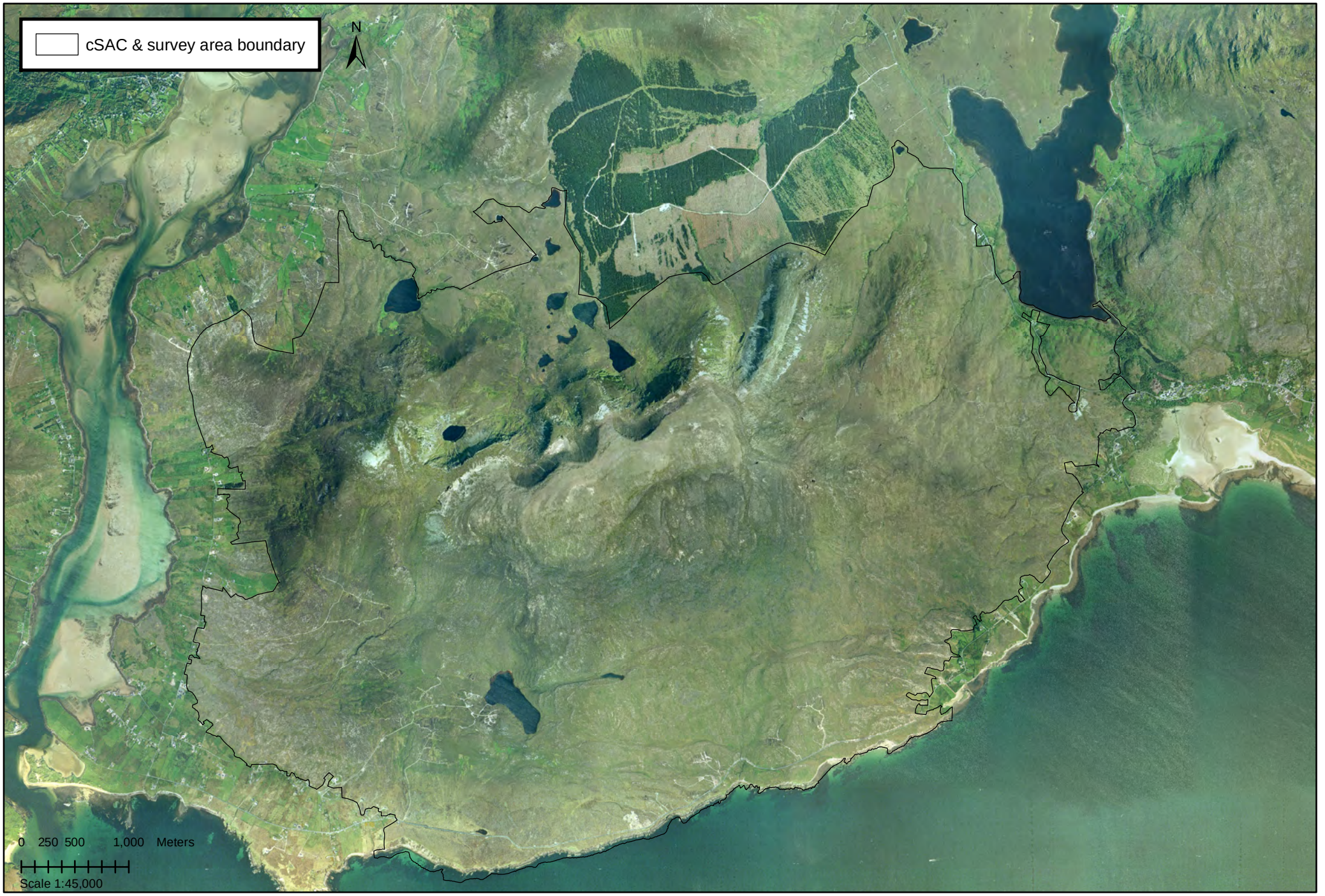
Figure 2.2 Corraun Plateau cSAC (000485) and survey area boundary



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In order to expand the geographical range of the survey and to cover a wider range of Annex I habitats, some additional upland sites listed below were visited. It was also necessary to sample upland areas on calcareous bedrock, as the Corraun Plateau and Mweelrea Mountains are predominantly composed of siliceous bedrock. Limited relevé recording and condition assessment were undertaken at these sites but no mapping was carried out. The location of all the sites surveyed is given in Fig. 2.3.

3. Bricklieve Mountains and Keishcorran, County Sligo
4. Ben Bulben, Gleniff and Glenade Complex, Counties Sligo and Leitrim
5. Slieve League, County Donegal
6. Slieve Bloom Mountains, Counties Offaly and Laois
7. Slieve Mish, County Kerry
8. Mount Brandon, County Kerry
9. Foiltagarriff, County Kerry
10. Sheeffry Hills, County Mayo

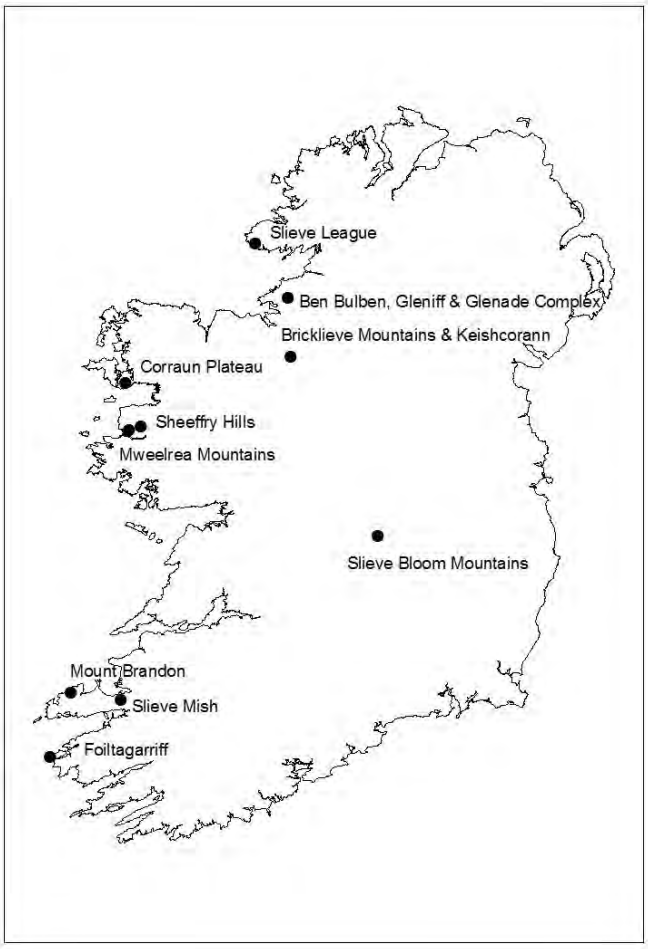

Figure 2.3 Location of sites within the pilot field survey

2.3 Site descriptions

2.3.1 Mweelrea Mountains

The Mweelrea Mountains are located in south Mayo, on the northern side of Killary Harbour (Fig. 2.1). They form part of the Mweelrea/Sheeffry/Erriff Complex cSAC (site code 001932), the qualifying interests of which are listed in Table 2.1. At 814 m, Mweelrea is the highest peak in Connaught. The Mweelrea Mountains are predominantly formed of red sandstone and conglomerate with slate bands (McConnell *et al.* 2009) and feature well developed corries.

2.3.2 Corraun Plateau

The Corraun Plateau is located on the Corraun Peninsula, south-east of Achill Island, County Mayo (Fig. 2.2). It has been designated as a cSAC (site code 000485) and its qualifying interests are listed along with other Annex I habitats present in Table 2.1. At its highest point, the plateau reaches 541 m. The geology is varied but is predominantly composed of Dalradian schist and quartzite. There are well developed corries on the northern side of the massif.

2.3.3 Bricklieve Mountains and Keishcorran

The Bricklieve Mountains (also known as Carrowkeel) and Keishcorran are situated in the south-east of County Sligo, west of Lough Arrow and approximately 6 km north-west of the town of Boyle, County Roscommon. The site has been designated as a cSAC (site code 001656) and its qualifying interests are listed with other Annex I habitats present in Table 2.1. The highest point of the Bricklieve Mountains reaches 317 m. Keishcorran, an outlying hill located approximately 3 km north-west of the Bricklieve Mountains, reaches 359 m. The site consists of a large isolated block of Carboniferous limestone and exhibits many of the typical features of a karst landscape, including caves, dry valleys and limestone pavement. Peat deposits occur on the valley floors and upland slopes.

Table 2.1. Relevant Annex I habitats (as listed on Tables 1.1 & 1.2) which are Qualifying Interests (QI) for the survey sites. * Priority habitat

	cSAC site code and name	001932	000485	001656	000623	000189	000412	000375	002185
		Mweelrea/Sheeffry/Erriff Complex cSAC	Corraun Plateau cSAC	Bricklieve Mountains & Keishcorran cSAC	Ben Bulben, Gleniff & Glenade Complex cSAC	Slieve League cSAC	Slieve Bloom Mountains cSAC	Mount Brandon cSAC	Slieve Mish Mountains cSAC
	Annex I habitat								
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	QI						QI	
3160	Natural dystrophic lakes and ponds	QI							
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	QI			QI				
4010	Northern Atlantic wet heaths with Erica tetralix	QI	QI			QI	QI	QI	QI
4030	European dry heaths	QI	QI		QI				QI
4060	Alpine and Boreal heaths	QI	QI		QI	QI		QI	QI
5130	*Juniperus communis* formations on heaths/calcareous grasslands	QI	QI		QI				
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites)			QI					
6230	* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas								
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)								
7130	Blanket bog (* active only)	QI				QI	QI	QI	
7140	Transition mires and quaking bogs	QI							
7150	Depressions on peat substrates of the *Rhynchosporion*	QI							
7220	* Petrifying springs with tufa formation (*Cratoneurion*)	QI			QI				
7230	Alkaline fens	QI							
8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)								
8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)			QI	QI				
8210	Calcareous rocky slopes with chasmophytic vegetation	QI			QI	QI		QI	
8220	Siliceous rocky slopes with chasmophytic vegetation	QI				QI		QI	QI
8240	* Limestone pavements								

2.3.4 Ben Bulben, Gleniff and Glenade Complex

The Dartry Mountains are located about 7 km north of Sligo town, on the border between Counties Sligo and Leitrim. This site has been designated as the Ben Bulben, Gleniff and Glenade Complex cSAC (site code 000623). The qualifying interests of the cSAC are listed with other Annex I habitats present in Table 2.1. The Dartry Mountains form a high, steep-sided plateau from about 300-450 m with individual peaks such as Troskmore, Tievebaun and Ben Bulben reaching 647, 611 and 526 m respectively. The mountains are formed of Carboniferous limestone with layers of shale. The summit of the plateau is largely covered by blanket peat. An additional reason for the selection of this site was that Ben Bulben was considered as a potential site for the Annex I habitat Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430). This habitat has been recorded in Britain as an upland, cliff ledge habitat. It has been recorded in Ireland only as a lowland habitat but further survey work is required to confirm if this Annex habitat type occurs in an Irish upland context.

2.3.5 Slieve League

Slieve League is located in southern Co. Donegal, approximately 15 km west of Killybegs and forms part of the Slieve League cSAC (site code 000189). The cSAC's qualifying interests are listed with other Annex I habitats present in Table 2.1. Slieve League reaches 595 m and the coastal cliffs on its southern side are among the highest in Europe. It also features a well developed corrie on its northern side. The geology is primarily quartzite but intrusions of schist and dolomite occur in the vicinity of the corrie (Alsop *et al.* 2001). An additional reason for the selection of this site was that Slieve League was considered a potential site for the Annex I habitat Siliceous and alpine boreal grassland (6150).

2.3.6 Slieve Bloom Mountains

The Slieve Bloom Mountains are located on the border of Counties Laois and Offaly, about 7 km north-east of Roscrea, County Tipperary. The site has been designated as a cSAC (site code 000412). The qualifying interests of the cSAC are listed along with other Annex I habitats present in Table 2.1. At 527 m, Arderin is the highest peak in the range. The Slieve Bloom Mountains are composed mainly of sandstone with extensive coverage of upland blanket peat. In contrast with the other survey locations, this upland range is situated inland and is therefore of additional interest.

2.3.7 Slieve Mish

The Slieve Mish Mountains are located on the eastern side of the Dingle Peninsula in west Kerry, about 5 km south-west of Tralee. The site has been designated as a cSAC (site code 002185). The qualifying interests of the cSAC are listed along with other Annex I habitats present in Table 2.1. At 851 m, Baurtregaum is the highest peak in the range. The mountains are composed of sandstone and feature glaciated valleys and several well developed corries.

2.3.8 Mount Brandon

Mount Brandon is located on the Dingle Peninsula in west Kerry, about 10 km north of Dingle town. The site has been designated as an cSAC (site code 000375) and its qualifying interests and other Annex I habitats present are listed in Table 2.1. At 952 m, it is Ireland's highest peak outside of the Macgillycuddy's Reeks. Mount Brandon is composed of sandstone and features well developed corries on its eastern side. An additional reason for the selection of this site was that it was considered a potential site for the Annex I habitat Siliceous and alpine boreal grassland (6150).

2.3.9 Foiltagarriff, Valentia Island

Foiltagarriff is located on the western tip of Valentia Island, about 13 km south-west of Caherciveen, County Kerry. It has not been designated as an NPWS conservation site. Foiltagarriff reaches 239 m in height. It is composed of Valentia slate and features coastal cliffs on its western side.

2.3.10 Sheeffry Hills

The Sheeffry Hills are located in south Mayo to the north-east of the Mweelrea Mountains, from which they are separated by the Dhulough Pass. They also form part of the Mweelrea/Sheeffry/ Erriff Complex cSAC (site code 001932), the qualifying interests of which are listed in Table 2.1. The highest part of the ridge reaches 772 m. The Sheeffry Hills are formed of mudstone, sandstone and tuff.

2.4 Review of potential field methodologies

One of the aims of the pilot field survey was to establish the most cost-effective approach or combination of approaches to efficient and detailed data collection in upland habitats. A range of approaches to vegetation mapping, relevé recording and condition assessment were considered. The most appropriate of these were selected for testing in the field. The preferred approaches were then used to complete the pilot field survey and were used to produce recommendations for the methodology to be employed in the NSUH.

2.4.1 Options considered for vegetation mapping

A range of desk- and field-based approaches to vegetation mapping were considered. For practical and financial reasons, it was not feasible to test all of them in the field therefore their attendant advantages and disadvantages were assessed to select a subset for trialling. Detailed here are the general approaches that were considered, but there is a large number of permutations of the various elements.

Paper mapping

The simplest and most traditional approach to vegetation mapping is to define areas in the field on paper maps or aerial photographs. Advantages of this are that it is a straightforward, inexpensive process which can be used to record habitats in detail firsthand. Paper maps are awkward to use in windy or wet conditions but the use of waterproof paper and WeatherWriter clipboards can ameliorate this. Disadvantages are that considerable time must be spent post-survey digitising the drawn maps and entering attribute data. It can also be difficult on the ground to obtain an overview of the situation which makes dealing with intricate mosaics problematic. Discerning habitat boundaries across an upland landscape in the field can also be challenging and although aerial photographs can assist, interpretation is more difficult in the field than in the office. Where several fieldworkers are mapping the same site there is the risk of overlapping effort without a common framework.

GPS waypoint mapping

Through this fairly basic approach to mapping habitats fieldworkers are provided with GPS units and with paper copies of the aerial photographs for reference purposes. The GPS units are used to record a series of waypoints around habitat boundaries accompanied by written notes. The waypoints are subsequently uploaded to a GIS package and used to create polygons with the aid of aerial photographs. The boundaries of a polygon can be accurately recorded but mapping a site from scratch in the field is a slow process as the fieldworker would need to walk the perimeter of each polygon taking waypoints and, in the uplands, polygons are likely to be several hectares of rugged terrain in area. Polygons can be mapped more quickly and relatively accurately by eye on a paper map or digitally. As previously mentioned, paper maps are awkward to use in windy or wet conditions, but paper maps also provide a wider field of view than digital maps, allowing a surveyor to see their location in the context of the wider landscape. Standard GPS units lack the facility for digitally recording attribute data in the field, resulting in additional post-survey data entry and processing. Several disadvantages to paper mapping in the field also apply to this approach.

Aerial photograph interpretation (API) and digitisation

Experienced ecologists/digitisers can use digital aerial photographs, such as those available from Ordnance Survey Ireland, and GIS to create broad-scale habitat maps of survey sites as a desk-based exercise, prior to field work commencing. This approach allows map units to be delineated and digitised simultaneously in an office situation with access to more powerful computers, larger screen sizes and more sophisticated software than would be available in the field. The quality of the resulting maps is dependent on the validity of the assumptions made and the quality of the aerial photographs and other existing data available for a given site, so it is still necessary to ground-truth these maps to ensure their accuracy. The maps can be given to fieldworkers in digital and/or hard copy format and are then spatially refined and further attributed in the field. This approach is relatively time-consuming initially but reduces the amount of valuable time spent mapping in the field and the associated costs. The overview provided allows habitat mosaics to be

dealt with effectively. By giving fieldworkers maps with a framework of numbered polygons to be ground-truthed it provides a structured approach to fieldwork from the outset.

Handheld computers with GPS and mapping software

Handheld computers with a GPS facility allow spatial and text data to be captured digitally in the field and uploaded directly to GIS. Henceforth, handheld computers with an integrated GPS are termed "mappers" and standard handheld computers are termed "Personal Digital Assistants" (PDAs). Whilst PDAs lack an integrated GPS they may be augmented with GPS capability by connecting a receiver through Bluetooth or by an adapter fitted into a CompactFlash slot. Digital maps are dynamic and allow the surveyor, equipped with a PDA or mapper, to zoom in and out as necessary. However, small screen size can be an issue. The software packages available for this purpose, such as Field Surveyor and ArcPad, can configure waypoints and polygons with custom fields and drop-down lists appropriate to the survey. Field Surveyor is a mapping software package developed and supplied by exeGesIS Spatial Data Management Ltd. (ESDM). The advantages of Field Surveyor are the facility to link photographs taken in the field using its integrated digital camera directly to the relevant records and its relational database capabilities. One of the advantages of ArcPad is that it is directly compatible with the widely used office package ArcMap. Although the hardware and software are relatively expensive, this approach minimises the use of paper maps in the field and the need for post-survey data entry and processing.

Digitising in the field using tablet PCs

It is possible to use tablet PCs for this type of field work. The approach is essentially the same as for the use of mappers and PDAs. Tablet PCs provide the capability to digitise habitats in the field and to view maps and aerial photographs easily on the large screen. These benefits have to be contrasted with the relatively high initial cost of these units (especially those with integrated GPS receivers), the weight of carrying them, the occurrence of screen glare, and possible power management issues. Unless more expensive ruggedised PCs were used there would be a high risk of units being damaged during survey work. It is also a consideration whether it is desirable for large amounts of valuable survey time being spent digitising in the field.

Capturx digital pen mapping

This relatively new technology developed by Adapx combines the benefits of having a hardcopy map in the field with the digital data capture and instant upload benefits of working with a handheld computer. It relies upon specially printed maps with a unique pattern of dots, printed using Adapx software in ArcGIS. A special pen is used that marks the map in ink and also reads the pattern of dots, storing the location of the drawn line in its internal memory. The pen is then synchronised with a PC and with the original .mxd file that the map was printed from, so that the lines are reproduced in ArcGIS. Advantages of this approach are that the use of paper maps in this way is similar to the methodology of many ecological surveys and that it avoids the issue of small screen size inherent in the use of handheld computers. This approach should, in theory, reduce the need for post-survey data capture.

From their discussions with Adapx, ESDM concluded that this method has not been tested for habitat mapping. ESDM attempted to carry out a trial of the software and hardware, which was provided on loan by ESRI UK but the product could not be made to function. However, further review of the product revealed that some drawbacks of this approach are that annotations made to the map cannot be deleted, only one ArcGIS attribute is permitted per feature and it is extremely difficult to make attributes unique, as each attribute requires a separate entry in the map legend. In addition, polygons drawn with the pen cannot be snapped to existing features, polygons must always be completed in a single action, otherwise the pen fails to recognise them, and there is currently no option to integrate with Microsoft Access. When attempting to trial the product the maps failed to print properly and, despite discussions with Adapx technical support, this problem was not resolved. This approach is relatively expensive, costing approximately €3400 for the hardware and software components, plus additional costs for development and the specialised printers that would be required for each field team.

Automated mapping from satellite imagery

Satellite imagery can be used to produce habitat maps of sites by training mapping software to recognise certain points in the spectral range to be representative of certain habitats. Fieldwork is required to provide data to train the software and to ground-truth the map afterwards. Maps created by remote sensing have the advantage of being able to cover large areas efficiently and with high-resolution imagery (e.g. Quickbird's 0.6m pixel resolution) are able to differentiate within intricate mosaics in a fashion that is not possible for ground-based mapping. One of the main problems with this approach is the cost and availability of satellite imagery. Upland sites tend to be large in scale and several image tiles can be required to cover a site with each tile being potentially expensive. Obtaining cloud-free images is also an issue, especially for upland or oceanic areas in a country with Ireland's climate. For example, when mapping the Wicklow Mountains, O'Donovan (2007) intended to utilise high-resolution Quickbird imagery, but due to lack of cloud-free images had to fall back on lower resolution SPOT imagery (5-10 m resolution) for some areas. Ideally both winter and summer images should be utilised as differentiation between habitat types may be greater at different times of the year. Parr *et al.* (2006) concluded that their map of the Burren based on Landsat data (30 m resolution) was more generalised than one that would be derived from field based mapping. O'Donovan (2007) however commented that their Wicklow Mountains map was more detailed than Fossitt, but as that report is unfinished there is no evaluation of the ground-truthing. O'Donovan did highlight, however, that difficulties were experienced in differentiating between some habitats e.g. between *Nardus* grassland, *Molinia*-dominated areas and unimproved grassland and between bracken and improved grassland.

Methods selected for field trials

Having considered the advantages and disadvantaged listed above, it was decided to combine and trial the following two techniques in the field:

- Aerial photo interpretation and digitisation
- Handheld computers with GPS and mapping software

2.4.2 Options considered for relevé recording

Paper recording sheets

The traditional method of using tick sheets to record relevé data is relatively fast in the field. It is a basic method, which avoids some of the problems associated with handheld computers such as battery failure. Paper recording sheets can be awkward to use in wet or windy weather but this can be ameliorated through the use of pencil, waterproof paper and WeatherWriter clipboards. A major disadvantage of this method is the necessity for a lengthy period of post-survey data entry but this does allow entered data to be checked against the field sheets. Where additional species are written on to fieldsheets deciphering the writing afterwards is a perennial problem for analysts

Handheld computers with data entry software

Mappers or PDAs can be used to digitally record relevé data in the field. Microsoft Excel Mobile and TurboVegCE software can be used for this purpose. Both of these packages can be set up with standard recording forms and drop-down lists appropriate to the survey. Both software packages have the advantage of eliminating the need for post-survey data entry, although data entry in the field is marginally slower than using a paper tick sheet. One of the requirements of this project and a future NSUH is the presentation of relevé data in Turboveg format so that it can be easily utilised by both NPWS and inputted into the National Vegetation Database held by the National Biodiversity Data Centre (NBDC). Data captured in Microsoft Excel Mobile must therefore be converted to Turboveg format, which is a time-consuming process. A major advantage of TurboVeg is that its species dataset can be set to match the current NBDC Irish species checklist, thereby preventing issues with species nomenclature. In addition, when Turboveg is run on a GPS-enabled handheld computer the coordinates of the relevé can be recorded automatically. Microsoft Excel Mobile is more flexible for data entry as habitat specific data sheets can be prepared to speed up data entry and the user can add new fields easily. Both these factors can however be regarded as a drawback as consistency of data collection between multiple surveyors becomes an issue. Digital data recording is prone to battery failure, computer malfunction etc. and regular back-ups are necessary to prevent the loss of data hence paper recording sheets and pencils need to be carried as back up.

Methods selected for field trials

Having considered the advantages and disadvantaged listed above, it was decided to test the following techniques in the field:

- Mapper running TurbovegCE software
- PDA running Microsoft Excel Mobile software
- Paper recording sheets

2.4.3 Options considered for recording condition assessments

Handheld computers with Microsoft Excel Mobile

The advantages and disadvantages of this method are similar to those described for relevé recording using handheld computers with Microsoft Excel Mobile as described in section 2.6.2. Standard forms can be created for each habitat type and are easily modified. There is no need for post-survey data entry but data entry in the field is more time-consuming than using paper. Digital data recording is prone to issues such as battery failure and computer malfunction so regular back-ups are necessary to prevent the loss of data.

Paper recording sheets

The advantages and disadvantages of this method are identical to those described for relevé recording using paper recording sheets, as described in section 2.6.2.

Methods selected for field trials

Having considered the advantages and disadvantaged listed above, it was decided to test the following techniques in the field:

1. Handheld computer running Microsoft Excel Mobile software
2. Paper recording sheets

2.4.4 Communication

For communication between field-workers the use of two-way radios was to be tested in the field. In addition mobile phones were to be used and the use of satellite phones was considered. The cost of hiring a mobile phone ranged from €26-€30 per week, while prices for a phone varied from €450 upwards (www.allroadsat.com & www.TS2.pl/en).

2.5 Access

Gaining permission to access any site for survey purposes can be a contentious issue so it is important to respect people's rights and employ good practice in this regard. The Mweelrea and Corraun survey areas are owned and managed as commonages, where the land is either owned collectively or by an estate and where shareholders have traditional rights to grazing and turf cutting. Survey work was carried out in areas with small, rural communities and it was considered important to make contact with local people/landowners/shareholders at an early stage. This was done in order to:

- Raise awareness that the survey was taking place
- Inform people of the aims of the survey
- Ask for site access permission

- Obtain background information on the sites
- Address any queries that arose
- Establish goodwill and respect

While telephoning or writing to shareholders may be an apparently labour-saving approach, it can be very difficult to obtain a full, up-to-date list of contacts, not to mention to actually contact them. In our experience of other large scale ecology surveys, letters and telephone calls often have a poor response rate. Although time-consuming, calling in person to farms or homes is an effective way of contacting owners/shareholders and facilitates less formalised communication and the exchange of information. While not every shareholder will welcome the survey, the majority will appreciate the fact that an effort was made to contact them directly and personally about it..

Local IFA representatives, NPWS Conservation Officers and other naturalists were consulted at the outset of the survey and proved helpful in suggesting which shareholders of a commonage would be a good first point of contact. These shareholders then provided contact information for other shareholders and so on. This was an ongoing process and was carried out in tandem with field work. Despite some local tensions, such as SAC boundary appeals, the reception was found to be generally positive and there were no outright refusals. Several shareholders expressed a wish to see the results of the survey disseminated locally. Regional NPWS staff, local biodiversity or heritage officers and IFA headquarters should also be informed in advance of the survey. This can be done by means of a formal letter.

2.6 Field survey

Field work was conducted from 20th April to 2nd July 2009. Two full-time fieldworkers, one a team leader and the other an assistant ecologist, were employed throughout this period. A small number of additional relevés and condition assessments were recorded in mid-July 2009, after this intensive period of field work.

2.6.1 Vegetation mapping

Aerial photograph interpretation and digitisation

Ordnance Survey, orthorectified, digital aerial photographs taken in 2004 were obtained for each site. A GIS team from ESDM carried out aerial photograph interpretation (API) and delineated and digitised polygons potentially corresponding to habitats. These were labelled with tentative Fossitt (2000) codes and superimposed on the aerial photographs. The field team was provided with digital and paper copies (1:10,000 scale) of the resulting maps. Colour photocopies were made for use in the field as the toner used in photocopying is less likely to run or blotch in wet weather than ink used in colour printing.

However, following reconnaissance of the survey areas and preliminary site surveys, the scale of the polygons was often too large relative to the scale of variation on the ground and this impaired the accuracy of the tentative Fossitt codes attributed to them. Further aerial photograph

interpretation was carried out by the field team and a more detailed set of potential habitat polygons delimited corresponding to apparently consistent vegetation mosaics and, often, consistent topography. No attempt was made to allocate habitat types to the polygons as it was found these tentative habitat types were disregarded during fieldwork and could prove to be misleading. The minimum polygon size was 0.04 ha (20 m x 20 m) as anything smaller than this would not appear clearly on the aerial photographs (1:10,000 scale) used for mapping. In practice, most polygons were be much larger than this. The mean polygon size was 8.3 ha for Mweelrea and 9.5 ha for Corraun. This size reflects the scale of variation in the uplands, where intricate but consistent vegetation mosaics often cover large areas.

Provisional vegetation classification scheme

It was initially intended to record and map habitats using level 3 of Fossitt's (2000) broad-scale habitat classification. However, a review of this scheme showed that its resolution was insufficient for the effective mapping of upland areas as it provides limited scope for the classification of montane vegetation types. Indeed, Fossitt's scheme is intended as "a first-step approach for general habitat recording rather than as a basis for detailed study and evaluation". Conducting mapping purely on this scale would have resulted in important variations in vegetation being omitted and the quality of the data gathered would be insufficient to inform conservation management requirements for the range of plant communities forming upland habitats.

It was therefore decided to compile a provisional list of more detailed vegetation types, based largely on the phytosociological syntaxon of White & Doyle (1982) and the upland communities of the B ritish NVC (Rodwell, 1991, 1992) (see Appendix I for provisional classification and vegetation key) and also on the extensive field experience of one of the survey team and authors (B. O'Hanrahan) in upland habitats. The scale of this classification is equivalent to that of the British NVC, which Rodwell (1991, 1992) envisaged as a key tool for monitoring habitat change.

One advantage of this more detailed approach is an improved ability to detect critical changes in the vegetation that are likely to be missed by the broader approach of Fossitt (2000). On Mweelrea, for example, under this scheme much of the degraded blanket bog was classified as *Trichophorum - Eriophorum angustifolium* blanket bog, a graminoid-dominated type. Although this still qualifies as the priority habitat Active blanket bog (7130) under Annex I of the EU Habitats Directive, it seems to be a modified, degraded version of the *Eriophorum - Sphagnum or Calluna - Eriophorum* blanket bog types. The areas of *Trichophorum - Eriophorum angustifolium* blanket bog observed seem to be recovering well (positive trend in habitat condition) and it would be anticipated that if resurveyed 10 to 30 years from now, they would be classified as either the *Eriophorum - Sphagnum or Calluna - Eriophorum* blanket bog type. This significant change could only be detected by a survey at this level of detail. The more detailed nature of this classification also minimises the likelihood of sensitive or unusual habitats being overlooked. For example, under the scheme of Fossitt (2000) hepatic mat communities (i.e. areas rich in oceanic, leafy liverworts) would be recorded within one of the much broader heath habitats, resulting in the loss of information on the extent and distribution of a particularly sensitive habitat for which Ireland has great responsibility in a European context. The provisional list of vegetation types developed for the pilot survey provides

two specific types under which this habitat could be recorded. Furthermore, in surveys carried out as a part of an Environmental Impact Assessment for potential developments where a broader classification scheme is used, such as Fossitt (2000) or the the British Phase I habitat survey technique (JNCC 2003), the presence of higher quality habitats may not be recorded and this could result in their loss. The proposed more detailed classification system is also of assistance in providing more information on the quality of the vegetation types, especially if the 'open' and 'continuous cover' sub-types are applied. It is intended that this provisional list (See Appendix 1) be the first step in producing a detailed classification system of upland vegetation and habitats for use in the NSUH and hence is termed version 1.2 to allow for additional amendment. Each vegetation type is assigned to the appropriate Fossitt (2000) and, where applicable, an Annex I habitat category.

Mapping of mosaics

Most upland slopes are mosaics, with intricate patterns of hollows, rocky outcrops, scree, flushes and terraces that are far too complex to map separately, hence the approach of mapping polygons that reflect consistent mosaics. However, polygons where no single habitat exceeded 40% of the area were frequently encountered. If such a polygon had been assigned to a single habitat, which may only dominate by a slight margin, data on the remaining 60% of its area would have been lost. The dominant habitat approach would result in the loss of data on the extent and distribution of Annex I habitats when, as is often the case, they do not dominate a polygon.

For example in Fig. 2.4, *Calluna - Eriophorum* blanket bog is present as a subordinate element in a mosaic dominated by *Calluna - Juniperus communis nana* heath. The dominant habitat approach would imply that it was absent from the polygon and hence information on what is a priority habitat (*Active blanket bog 7130) would be lost. This mosaic pattern is typical of upland areas; most blanket bog on sloping terrain occurs as a subordinate element in a mosaic yet it frequently covers 30-40% of such areas. Another example is the recording of smaller features such as *Rhynchosporion* depressions 7150 and upland base-rich flushes that rarely, if ever, occur extensively or conspicuously enough to be mapped separately yet may be widespread within upland mosaics. Such point features can be recording using waypoints but they are then lost from calculations on area and distribution based on polygon data.

Habitats that occur as small features or subordinate elements in mosaic polygons are under-represented through use of the dominant habitat approach, information is lost and these polygons are effectively devalued in terms of their conservation interest. Mapping in even greater detail such that smaller polygons are created would greatly increase the amount of time spent mapping and would not in practical terms eliminate the need for using mosaics.

Hence, the approach taken for recording mosaic polygons was to record all the vegetation types present and the approximate percentage of the polygon they covered. As the total area of each polygon was known, data on the extent of each habitat could easily be calculated.

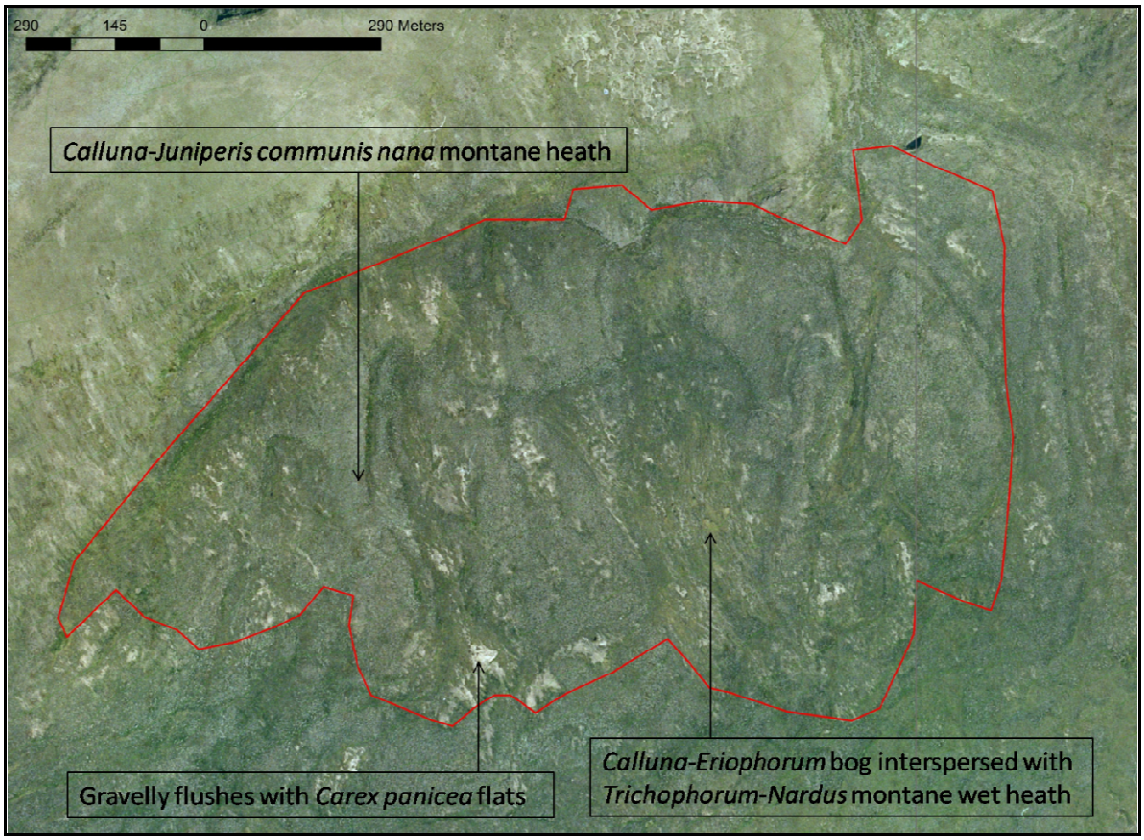

Figure 2.4 Example of the intricate mosaics characteristic of upland areas, Corraun polygon no.377

Field survey technique

Polygons were generally surveyed by walking a zigzag transect across them but binoculars were used to survey a small number of dangerously steep polygons, e.g. corrie walls. The method of surveying used was recorded for each polygon, i.e. walked/viewed with binoculars. Specific features that appeared within a polygon on the aerial photographs, e.g. basins, terraces, flushes, scree or rock outcrops, were investigated to check for additional vegetation types. Whenever possible, surveyors would navigate to a point which gave them a clear view over the whole polygon although in the Irish uplands visibility can often be impeded by topography or adverse conditions such as low light levels, mist or heavy rain. From these vantage points the relationship between the different vegetation types and the colouration of the aerial photograph could be established. Percentage cover scores were assigned to each provisional vegetation type and also to non-vegetated substrates (e.g. bare peat, bedrock, loose rock, gravel, open water, running water) within each polygon. There are many variables associated with the accuracy of these estimates. These include size of polygon, complexity of habitats and mosaics, visibility of the polygon and experience of the surveyors. Though the accuracy of the percentage cover scores was not

independently checked in the field it is estimated that the associated error may be up to 10%. Data on the coverage of vegetation types present within the polygons were recorded using:

- A Trimble Nomad mapper running Microsoft Excel Mobile software and a separate GPS unit
- A standard PDA running Microsoft Excel Mobile software and a separate GPS unit
- Paper recording sheets and a GPS unit

The decisions to redraw the polygon boundaries on paper and switch to provisional vegetation types rather than Fossitt (2000) codes meant that the Field Surveyor mapping software that had been loaded with the digitised polygon boundaries and customised with Fossitt and Annex drop-down lists was no longer applicable for polygon mapping. Following ground-truthing, polygon boundaries were, where necessary, amended in the field annotating the field maps. These amendments were then applied to the digital copies of the polygons on the GIS.

Target notes were recorded as waypoints. A grid coordinate and note on the habitat, species or other feature of interest were recorded using either:

- A Trimble Nomad mapper with integrated GPS running Field Surveyor software
- A Trimble Nomad mapper with integrated GPS running ArcPad software
- A Trimble Nomad mapper running Microsoft Excel Mobile software and a separate GPS unit
- A standard PDA running Microsoft Excel Mobile software and a separate GPS unit
- Paper recording sheets and a GPS unit

All digitally entered data were backed up and the batteries of handheld computers and GPS units were charged daily after field work.

Two-way radios were found to be ineffective for use in upland areas as connection was lost if there was an obstruction between field-workers. In general mobile phone coverage was found to be generally good in the pilot survey areas but this may vary in other parts of the country.

2.6.2 Relevé recording

Relevé recording aimed to encompass the range of vegetation types present at Mweelrea and Corraun. At the other sites visited recording focussed on Annex I habitats not previously recorded. Relevés, by definition, were subjectively placed to be representative of the vegetation type. Generally, 2 m x 2 m relevés were used, but it was sometimes necessary to vary the size and shape of relevés according to the scale and shape of the target vegetation type. The minimum relevé size was 1 m x 1 m and was used for small-scale features such as hollows and pools. Linear features such as flushes often required the use of linear relevés.

All vascular plants, bryophytes and terricolous macrolichens contributing cover in vertical projection within a relevé were identified and recorded. This means that plants need not be rooted within relevés, they need only overhang them. Voucher specimens were taken for all taxa of doubtful identity. Specimen bags and envelopes were labelled with the relevé code and a description of the sample (e.g. *Bryum* sp). The cover of each species identified in a relevé was recorded using a percentage scale. Critical bryophyte voucher specimens that could not be identified with confidence in the lab were sent off for to an expert referee (Dr. D. Holyoak) for identification.

Other data recorded for each relevés comprised: survey date, relevé area (m^2), site number, relevé number, Irish grid coordinates, recorder, Fossitt (2000) habitat code, Annex I habitat code (if applicable), vegetation type, geography, topography, altitude (m), aspect (^{o}), slope (^{o}), vegetation height (cm) of bryophytes, dwarf shrubs and the field layer and the percentage cover of bare soil, bare rock, surface water, litter, algae, bryophytes, dwarf shrubs and the field layer. Remarks on the relevé were also recorded. Digital photographs were taken from each relevé. As discussed in section 2.4.2, relevés were recorded using Microsoft Excel Mobile, TurbovegCE and paper recording sheets. All digitally entered relevé data were backed up daily after field work

Two methods of soil sampling were tested. Firstly, a soil corer was used to extract a 10 cm deep sample from each of the corners and the centre of the relevé. These were then bulked in the field. Secondly, a trowel was used to extract a sample from the centre of the relevé. Soil samples were placed in clearly labelled Ziploc bags and stored in a refrigerator until they could be analysed. Due to the large number of relevés recorded and the limited time available for soil analysis, soil sampling was largely restricted to vegetation types in which data on soil properties would be particularly informative e.g. flushes. As numerous published studies (e.g. Doyle 1982, Boatman 1961) have already addressed the physical and chemical properties of blanket peat, relatively few soil samples were taken from relevés in blanket bog vegetation. Soil sampling was not always possible on rocky substrates.

2.6.3 Condition assessment

Condition assessments were carried out for upland habitats listed under Annex I of the EU Habitats Directive which were considered the primary focus of this project (see Table 1.1). They were generally performed at the point at which a releve was taken. Relevés that were not located within an Annex habitat type do not have associated condition assessment data. The assessment involved the completion of a standardised form for each Annex I habitat, using handheld computers running Microsoft Excel Mobile or paper recording sheets. Further detail is given on this approach in Chapter 5.

It should be noted that the subjective placement of releves meant that this condition assessment methodology is not fully consistent with the random, stratified sampling methodology being recommended. Prior knowledge of the location and extent of the relevant habitats would be required for the recommended method to be applied however this is not possible as condition

assessments were recorded in tandem with the mapping of the habitats . However, the production of habitat maps during a proposed national survey of uplands will mean that the recommended methodology can be applied in future rounds of monitoring.

2.7 Post-survey methodology

2.7.1 Soil analysis

Soil pH was determined in the lab using a Hanna 98128 pH meter. Determinations were carried out on fresh soil within a week of sampling. A mixture of water to soil at 2:1 ratio was prepared, with two replicates for each relevé, and left to settle for five minutes. The pH meter was then placed in this mixture until the meter indicated a stable pH reading. These readings were entered into Microsoft Excel, where the logarithmic pH values were converted to linear hydrogen ion concentrations. A mean of the two replicate values was calculated for each relevé and reconverted to a pH value. The soils were air-dried and stored in case further analyses are required in future.

2.7.2 Digitisation of mapped data

The field maps were used to correct or re-digitise the preliminary polygon data created for the survey sites from API. Where possible the field maps were scanned and registered in GIS, so that amended polygon boundaries could be digitised directly over them. In other cases, boundary changes were digitised by eye. Digitisation involved some amendment of the survey areas boundaries. In some instances, the hand-drawn boundaries for polygons differed between the field maps used by the two fieldworkers. In these cases the boundary digitised was the one field surveyors had highlighted as being the correct one, or a judgement was made on the most likely boundary, which was usually the boundary with the most detail. Each resultant digital polygon was attributed with a number that matched the annotated coding on the field maps.

All polygon cover and waypoint data was converted and collated in Microsoft Excel format. The waypoint / target note locations were then converted to points in ArcGIS, with the textual note data in separate .html files that were hyperlinked to the relevant point. With the polygon cover data the provisional vegetation types were linked to the habitat types listed in Fossitt (2000) and, where relevant, Annex I habitats (see Appendix II: Polygon recording sheet), making the polygon cover data interchangeable between these different classification systems. These data were then used to populate the polygon shapefile attributes table which thus included percentage cover scores under the three schemes, provisional vegetation types, Fossitt (2000) and Annex I habitat types for each polygon. The dominant Fossitt (2000) and Annex I habitat types (or types where a tie occurred) within each polygon were identified for mapping purposes and entered as fields in the attributes table. A polygon area field was included, enabling the calculation of the proportional area of a given polygon occupied by a particular vegetation or habitat type and a survey method field was added to provide information on data quality.

2.8 Appraisal of field methodologies

2.8.1 Aerial photograph interpretation and digitisation

Compared to the original set of polygons digitised by the GIS team, the aerial photograph interpretation carried out by the field surveyors produced smaller polygons containing more consistent vegetation mosaics. This facilitated the mapping process and increased the resolution of the data collected. However, the paper format of these polygons was problematic. When multiple field surveyors worked in the same area, duplicate copies of the map were necessary and the polygons had to be drawn onto each of these by hand. This process was time consuming and resulted in some inconsistencies between the polygon boundaries and numbering on different maps. A period of post-survey polygon digitisation and data processing was also required. In cases where the pencil polygon boundaries were not sufficiently clear to allow the maps to be scanned, they had to be digitised by eye and this introduced potential for additional error regarding the positioning of boundaries. In addition, time spent on aerial photograph interpretation by the fieldworkers reduced the time available for them to gather data in the field.

2.8.2 Paper vs. digital mapping

It was intended that digital mapping was tested in the field using Field Surveyor and ArcPad applications on Trimble Nomad mobile mappers. The benefits of digital polygon mapping in the field include the ability to zoom in and out to view the map at an appropriate level of detail, more accurate data capture due to positioning using the integrated GPS unit and a reduced need for post-survey data processing and digitisation. One of the drawbacks of digital polygon data capture in the field was that the field of view was constrained by the small screen size of the Trimble Nomad mapper. Although Field Surveyor software offers relational database capabilities, these were not required in this instance as relatively simple forms were found to be adequate in recording the necessary data. A disadvantage of the mapping software for polygon mapping was its inflexibility in amending, merging or splitting polygons. These issues, taken with very poor screen visibility in bad weather and low light conditions, made accurate digital polygon mapping in the field very difficult. Though there is an argument for time being saved in post-survey digitisation, time spent in the field is generally more expensive than time spent in the office due to travel time, mileage and subsistence costs. As discussed below, mapping on paper was found to be considerably faster in the field than digital mapping. Although polygons recorded in the field using GPS fixes are more accurate, it would be extremely time consuming to walk the boundaries of each polygon being recorded, especially given the large number of polygons involved. Polygon boundary amendments were frequently necessary in the field and it was found that the mapping software was inflexible in this respect. When technical problems with mapping software were encountered it was often not possible to correct them in the field, resulting in the loss of field survey time. The digitisation of polygons in the field in upland habitats, at least using these methods, was therefore found to be largely inefficient and impractical.

Making boundary amendments to paper maps in the field is quick and efficient. Although paper maps can be awkward to use in windy or wet conditions, the use of WeatherWriter clipboards ameliorated this somewhat. Colour photocopied maps proved to be relatively water resistant

compared to plotter printed maps. The A3 size, 1:10,000 scale paper maps used provided a vastly superior field of view and allowed the surveyors to see their location in the context of the wider landscape. This facilitated both polygon mapping and navigation. A certain level of error is inherent in the delineation of habitat boundaries on paper, by eye without the use of a direct GPS fix, and also in the post-survey digitization of these boundaries. However, given the time efficiency of this approach, and the nature of habitat boundaries in the uplands which tend to gradually merge from one type to another, these minor errors are considered acceptable.

2.8.3 Paper vs. digital data recording

Digital capture of relevés, target notes, condition assessments and polygon attribute data was a vast improvement over the use of paper recording sheets, which have been used by the project team for previous large-scale vegetation surveys (Perrin *et al*. 2008a, Martin *et al.* 2008). Digital species data capture in the field is marginally more time consuming than the use of a tick sheet but it eliminates the need for an additional period of data entry and data checking, resulting in significant time savings. The use of software such as Microsoft Excel Mobile allows calculations, such as the total sum of cover scores for vegetation types within a polygon, to be done quickly and accurately. One drawback of digital data recording is that, due to small screen sizes and the need for scrolling and switching between programs, it can be difficult to get an overview of the data, while recording the data on paper permits a quick overview. However, paper recording sheets proved to be a nuisance in the field due to the difficulty of using them in wet or windy weather. Given the overall time saving that it offers, digital data recording is the preferred option.

2.8.4 Trimble Nomad mapper vs. standard PDA

A major advantage of the Trimble Nomad mapper over a standard PDA was its ruggedised design, which permitted its use in adverse weather conditions, such as heavy rain, without damaging the unit or affecting its operation. The unit had a long battery life, with a fully charged battery always lasting for at least a full day's use in the field. It was relatively easy to back-up data, with data transfer options including Bluetooth, USB and Secure Digital (SD) card. The Trimble Nomad also featured an integrated GPS and digital camera but the photographs taken with the integrated camera were not of sufficient quality. As a result, the fieldworkers found it was often more efficient to use a separate digital camera. The Trimble Nomad was prone to freezing, particularly when multiple programs were operating, and often had to be restarted. This has been attributed to memory leakage, which can occur with any PDA when multiple resource-hungry software packages are in use at once. It is also heavy relative to standard PDAs though more ergonomically designed than other mappers the survey team have used in the past (e.g. Magellan Mobilemappers). As previously outlined, problems with screen visibility were encountered. In wet conditions, rainwater pooled on and obscured the recessed screen of the Trimble Nomad, while its small screen size, combined with the frequent low light conditions of the Irish uplands, hampered the viewing of maps and aerial photos and the digitisation of polygons in the field. The Trimble Nomad 800GLC mapper costs approximately €1690.00 ex. VAT.

An HP iPAQ 214 handheld PDA was also used for data capture in the field. The main advantage of this device was its lower cost at approximately €260.00 ex. VAT. It can be supplemented with a

Bluetooth GPS receiver, an extra long life battery, a high capacity memory card and a waterproof cover for an additional €120 ex. VAT. It is lightweight in comparison with the Trimble Nomad, an advantage when large amounts of equipment must be carried. The obvious drawback of the PDA it is non-ruggedised design but this can be partly ameliorated by the use of a waterproof cover which has been field tested by BEC Consultants on other projects and found to be sufficient.

2.8.5 Waypoint recording: Mapping software vs. Microsoft Excel Mobile

When functioning satisfactorily, the Trimble Nomad's integrated GPS allowed waypoints to be marked easily within the Field Surveyor or ArcPad mapping software using the mark current position function. However, the integrated GPS was frequently slow to provide coordinates, which delayed data entry, and the coordinates were displayed at the corner of the screen in a text size too small to be useful for routine navigation. In Field Surveyor, it was not possible to view coordinates as Irish grid references only as latitude / longitude. As a result, the fieldworkers found it was often more efficient to use a separate GPS unit. For the purpose of target noting species, habitats and other features of interest, the Field Surveyor and ArcPad software performed to a comparable standard. However, it was often quicker and more straightforward to enter waypoints from a separate GPS unit into a Microsoft Excel Mobile spreadsheet. This approach requires post-survey data processing to upload the waypoints to GIS. At approximately €675.00 ex. VAT for each mapper on which it was installed, Field Surveyor software was more expensive than ArcPad software, which costs approximately €400 ex. VAT per unit. Both types of mapping software were expensive in relation to Microsoft Excel Mobile which came as standard with the mapper and PDA. Although the Microsoft Excel Mobile approach requires the use of a separate GPS unit this will be already carried as standard kit by fieldworkers.

2.8.6 Relevé recording: TurbovegCE vs. Microsoft Excel Mobile

Turboveg (the office PC version) and TurbovegCE (the PDA/mapper version) have been developed by Stephan Hennekens of Alterra, Waginegen, The Netherlands, specifically for the purpose of relevé data recording and storage. One of its major advantages is that its species dataset can be set to match the current NBDC Irish species checklist, thereby preventing issues with species nomenclature. Header data files can be customised with the required environmental data fields for which it is possible to produce drop down lists. Data entry was found to be relatively quick and easy in the field and with a GPS enabled device, relevé coordinates are automatically recorded. Uncertain identifications with voucher specimens could be flagged using the otherwise redundant layer data field, e.g. *Sphagnum* species (juvenile).

Data entry with Microsoft Excel Mobile has the advantage of being more flexible as it allows tailored species lists to be formulated for each habitat type or site, reducing the need to scroll through lists of infrequent species. When recording voucher specimens a full descriptive label, e.g. "brown, inundated *Sphagnum*", can be easily entered freehand. However, this flexibility is also Excel's disadvantage as the use of different spreadsheets by different fieldworkers for different habitats increases the likelihood of inconsistencies in data fields, species nomenclature and habitat or vegetation codes. Furthermore one of the requirements of the project is the presentation of relevé data in Turboveg format so that it can be easily utilised by the both NPWS and NBDC. A

significant period of additional data processing is required to merge the numerous Excel spreadsheets and convert them to Turboveg format.

A licence for TurbovegCE, is €450 ex VAT. This is expensive compared to the cost for Microsoft Excel Mobile which comes as standard with most PDAs and mappers. However, given the issues of inconsistency and additional data processing associated with relevé data recording using Microsoft Excel Mobile, TurbovegCE is favoured for the purpose of relevé recording.

2.8.7 Soil sampling

The soil corer was found to be ineffective for sampling upland soils as wet peats created a vacuum which prevented soil samples from being extracted easily. A trowel was found to be much more effective. Field surveyors had to sample fully saturated soils, from flushes for example, using their hands. It was not possible to extract soil samples from many of the habitats on rockier substrates. Due to constraints in the amount of weight a surveyor could carry, soil samples were limited to the capacity of an 18 cm x 20 cm Ziploc bag. The soil corer produced relatively small cores, so samples could be taken from five locations within the relevé and bulked. The trowel produced a larger sample, which meant that it was usually only possible to take a sample from one location in the relevé. Such a sample may not adequately describe variation in soil characteristics within the relevé.

2.9 Results of field survey

2.9.1 Results of Corraun Plateau survey

Summary description

The survey area at Corraun corresponded to the Corraun Plateau cSAC (Code 485) and was dominated by Fossitt habitat categories of **Lowland blanket bog (PB3)** and **Wet heath (HH3)** habitats (Table 2.2). **Lowland blanket bog (PB3)** was most frequent on the lower slopes to the east, south-east and south of the site. **Wet heath (HH3)** also occurred in these areas on the lower slopes but was more frequent to the west of the site. **Montane heath (HH4)** was frequent on the plateau and upper slopes, particularly to the north. **Siliceous scree and loose rock (ER3)** reached particularly high abundances on the Cuillaloughaun ridge, on the upper northern slopes and on Corraun summit. **Upland blanket bog (PB2)** was occasional and occurred on the upper slopes, particularly to the south, south-west and west of the site. **Dry siliceous heath (HH1)** occurred occasionally and was most abundant to the north of the site. **Eroding blanket bog (PB5)** was present that, at higher altitudes and on flat areas to the north of the site, quite severely eroded areas are present that are clearly due to sheep trampling, particularly the "bottleneck" between Lough Laur and the edge of the conifer plantation. Areas of **Cutover bog (PB4)** were also present, ranging from active to old, abandoned, re-vegetating cutovers, although these represented a relatively small area of the site. Small areas of **Dry-humid acid grassland (GS3)**, **Poor fen and flush (PF2)**, **Exposed siliceous rock (ER1)**, **Dystrophic lakes (FL1)** and **Non-calcareous springs**

(FP2) were also present. Hepatic mat communities occurred as an element of **Dry siliceous heath (HH1)** and **Montane heath (HH4)** on the plateau, the slopes and within the corries of Corraun. The rare liverwort *Adelanthus lindenbergianus* was recorded during this survey from hepatic mats at this site. *Erica erigena*, which appears on the Proposed Red Data List of Vascular Plants in Ireland (Anon. 2005), was recorded on the lower slopes in the east and south of the site, where it is locally abundant.

Table 2.2 Extent of Annex I habitats within the Corraun survey area / cSAC

Annex I habitat		Total area (ha)	% of site
3160	Dystrophic lakes	35.6	0.9
3260	Floating river vegetation	2.3	0.06
4010	Wet heath	2077.9	53.5
4030	Dry heath	209.9	5.4
4060	Alpine and boreal heath†	281.9	7.3
6150	Siliceous alpine and boreal grassland	33.6	0.9
6230	Species-rich *Nardus* upland grassland	0.1	0.001
7130	Blanket bog	444.0	11.4
7140	Transition mires and quaking bogs	0.3	0.01
7150	Rhynchosporion depressions	6.5	0.2
7230	Alkaline fens	2.3	0.1
8110	Siliceous scree	28.9	0.7
8210	Calcareous rocky slopes	0.1	0.002
8220	Siliceous rocky slopes	0.9	0.02
91A0	Old oak woodlands	2.9	0.1
Non-Annex I habitats		759.8	19.5
Total site area		*3886.9*	
† Includes montane heath with *Juniperus communis* subsp. *nana*		139.5	3.6

Maps and statistics

Maps illustrating the dominant Fossitt and Annex I habitat types in each survey polygon at Corraun are presented in Figs. 2.5 and 2.6 respectively. These maps must be interpreted with the caveats discussed in section 2.6.1 in mind, as each polygon may contain a range of habitats. A series of colour gradated maps showing abundance of the most widely distributed Fossitt habitats in each polygon is presented in Figs. 2.7-2.12. These demonstrate the complexity of the habitat mosaics within the site which is masked in the overview presented in the maps showing only the dominant habitats.

Figure 2.5 Dominant Fossitt habitats within Corraun Plateau cSAC (000485) survey area

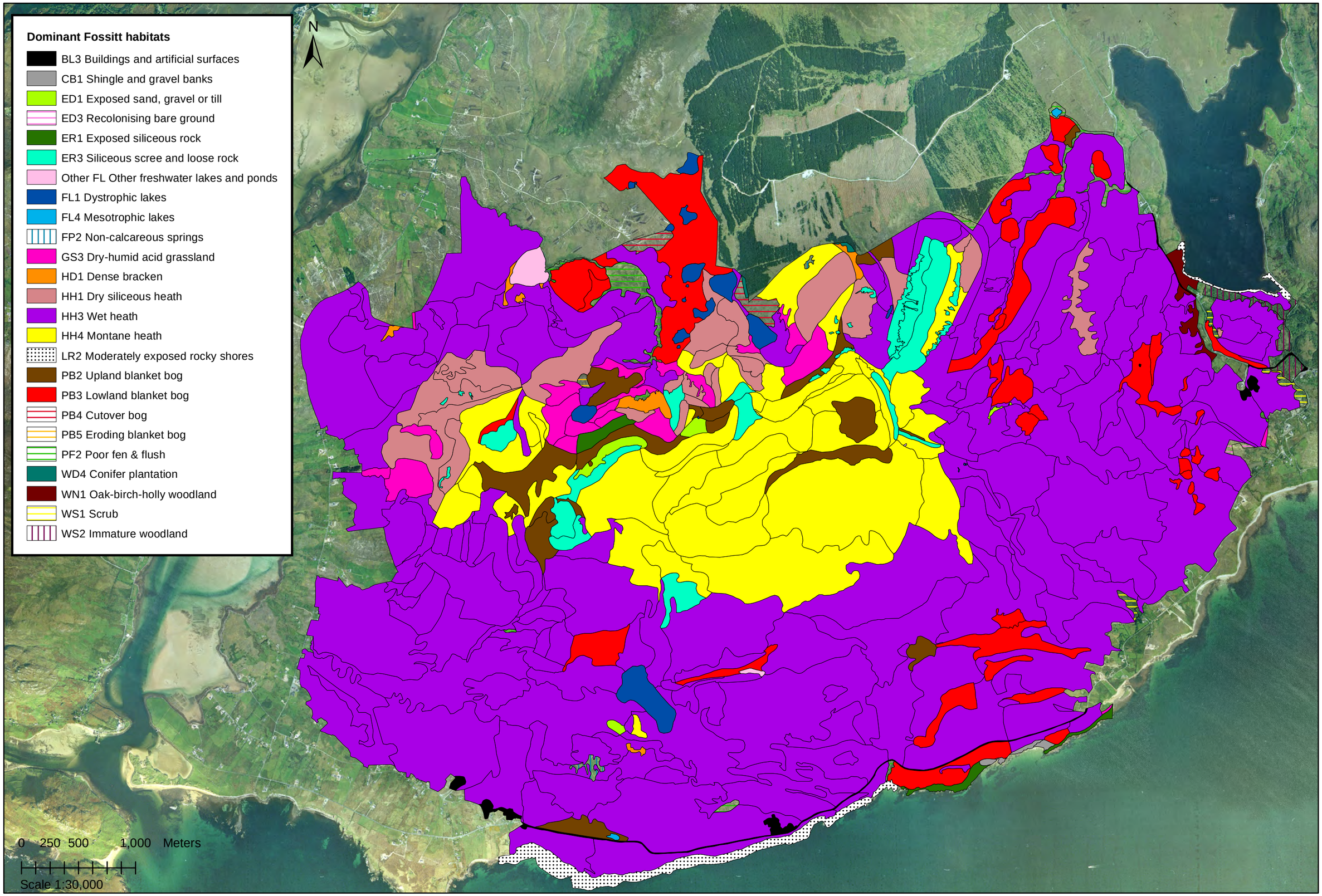

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Figure 2.6 Dominant Annex I habitats within Corraun Plateau cSAC (000485) survey area

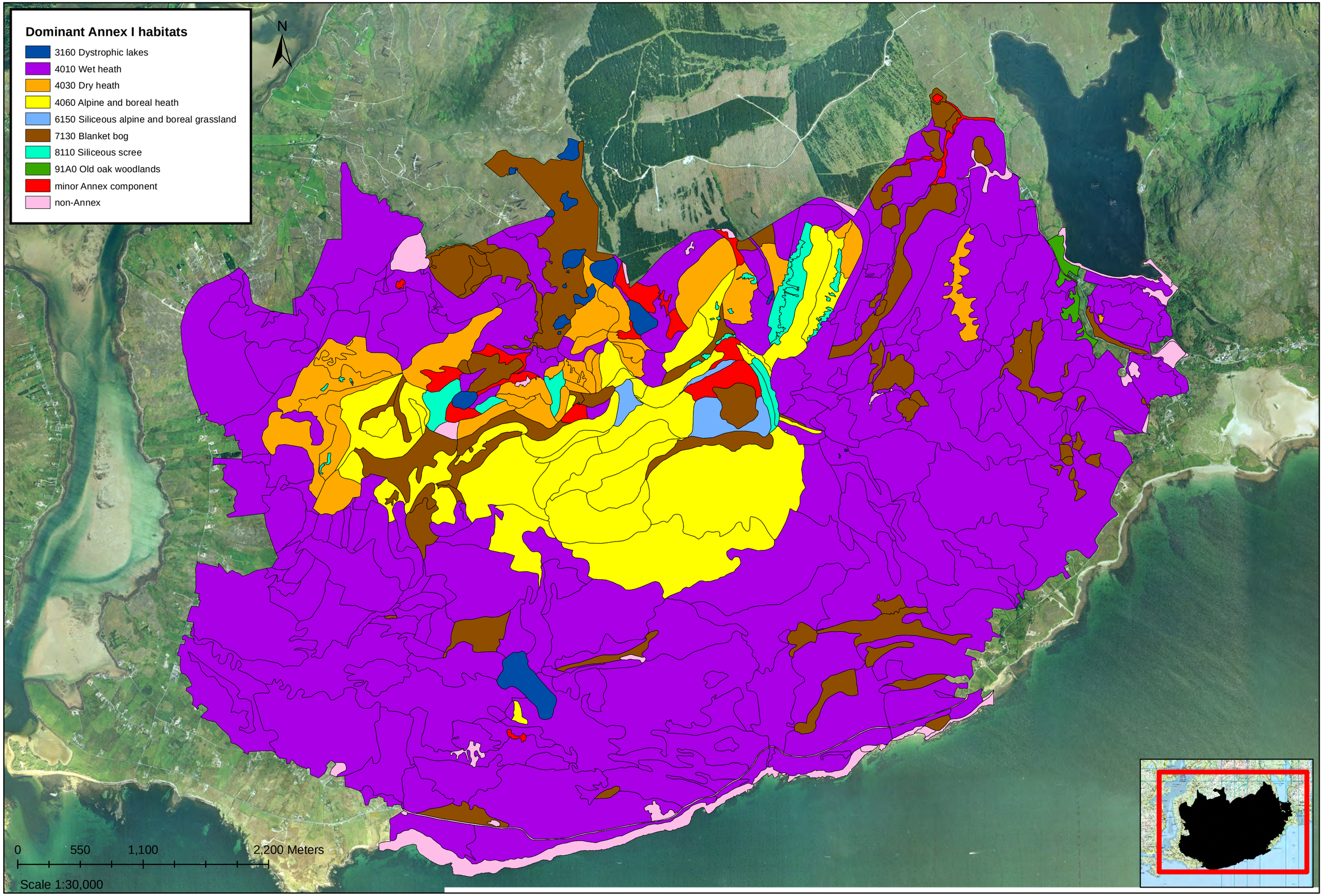

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Figure 2.7 Extent of ER3 siliceous scree and loose rock within Corraun Plateau cSAC (000485) survey area

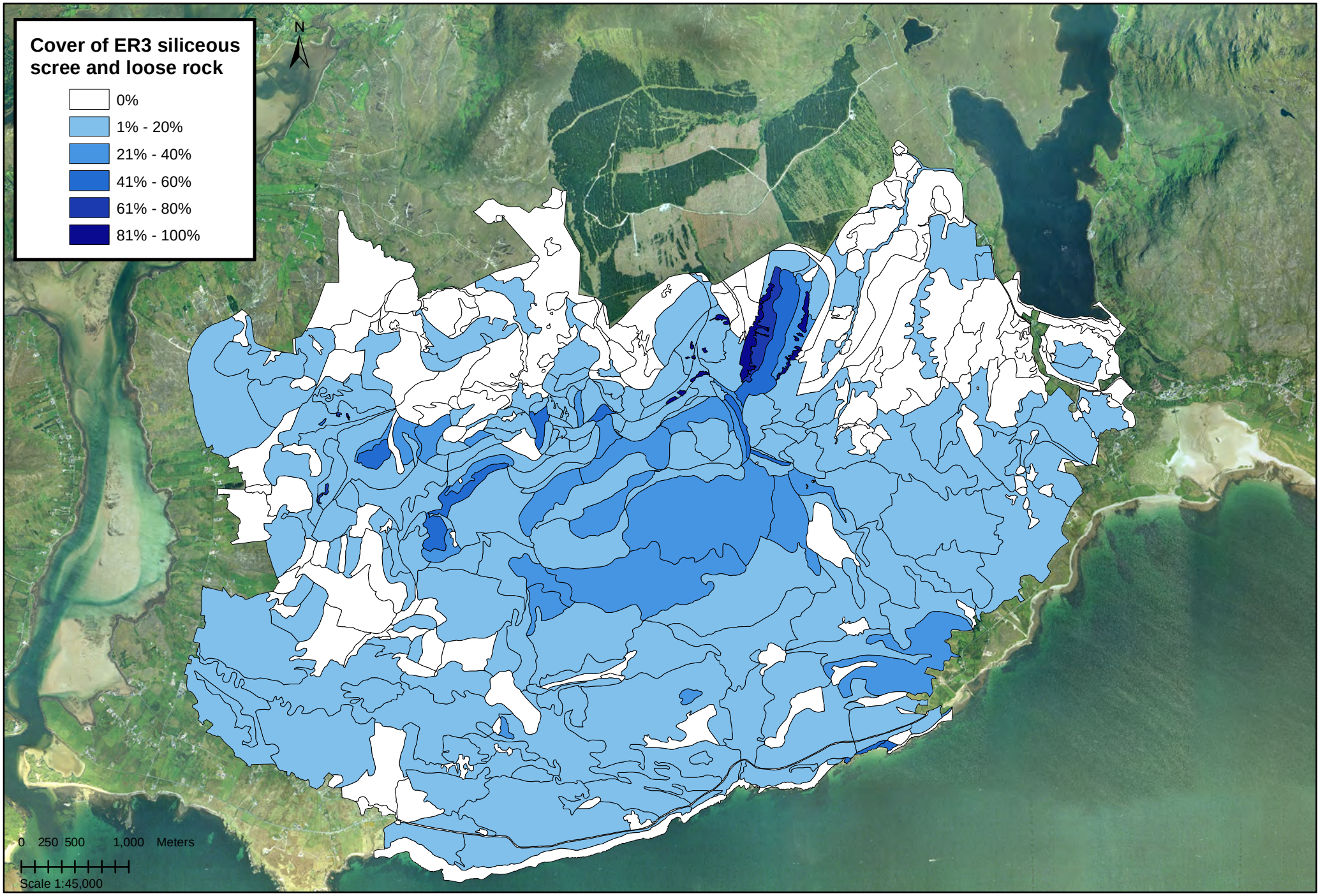

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Figure 2.8 Extent of HH1 dry siliceous heath within Corraun Plateau cSAC (000485) survey area

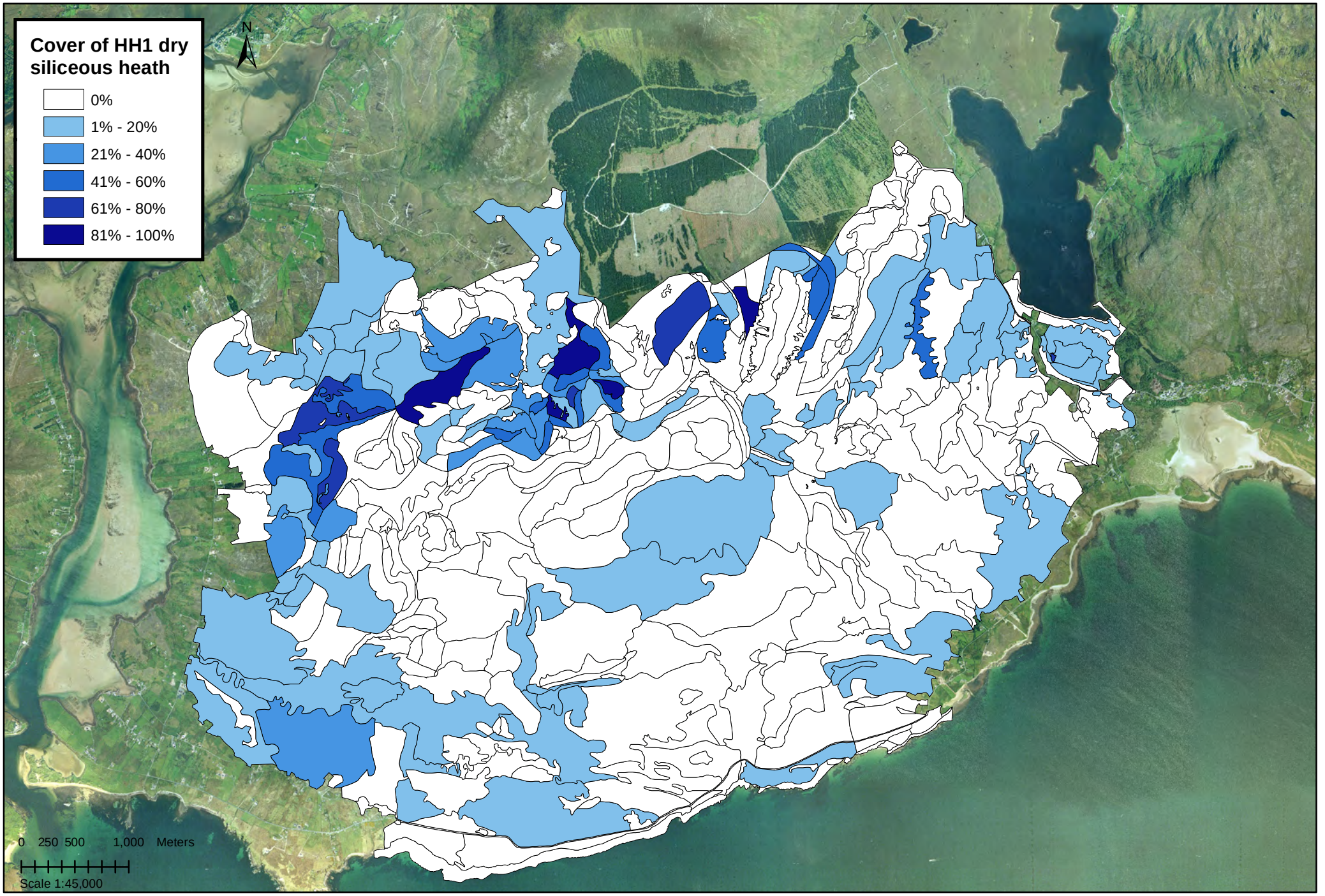

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Figure 2.9 Extent of HH3 wet heath within Corraun Plateau cSAC (000485) survey area

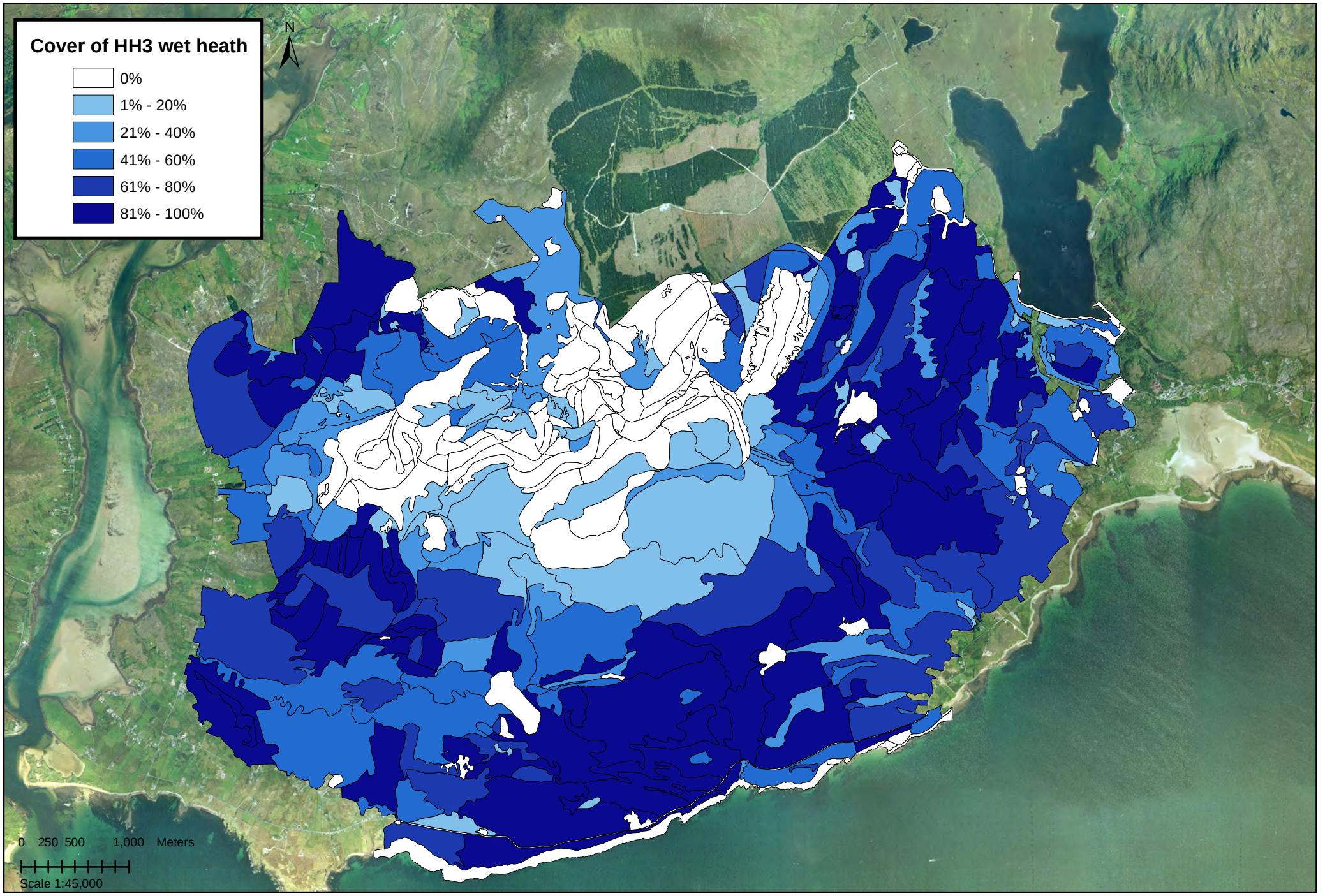

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Figure 2.10 Extent of HH4 montane heath within Corraun Plateau cSAC (000485) survey area

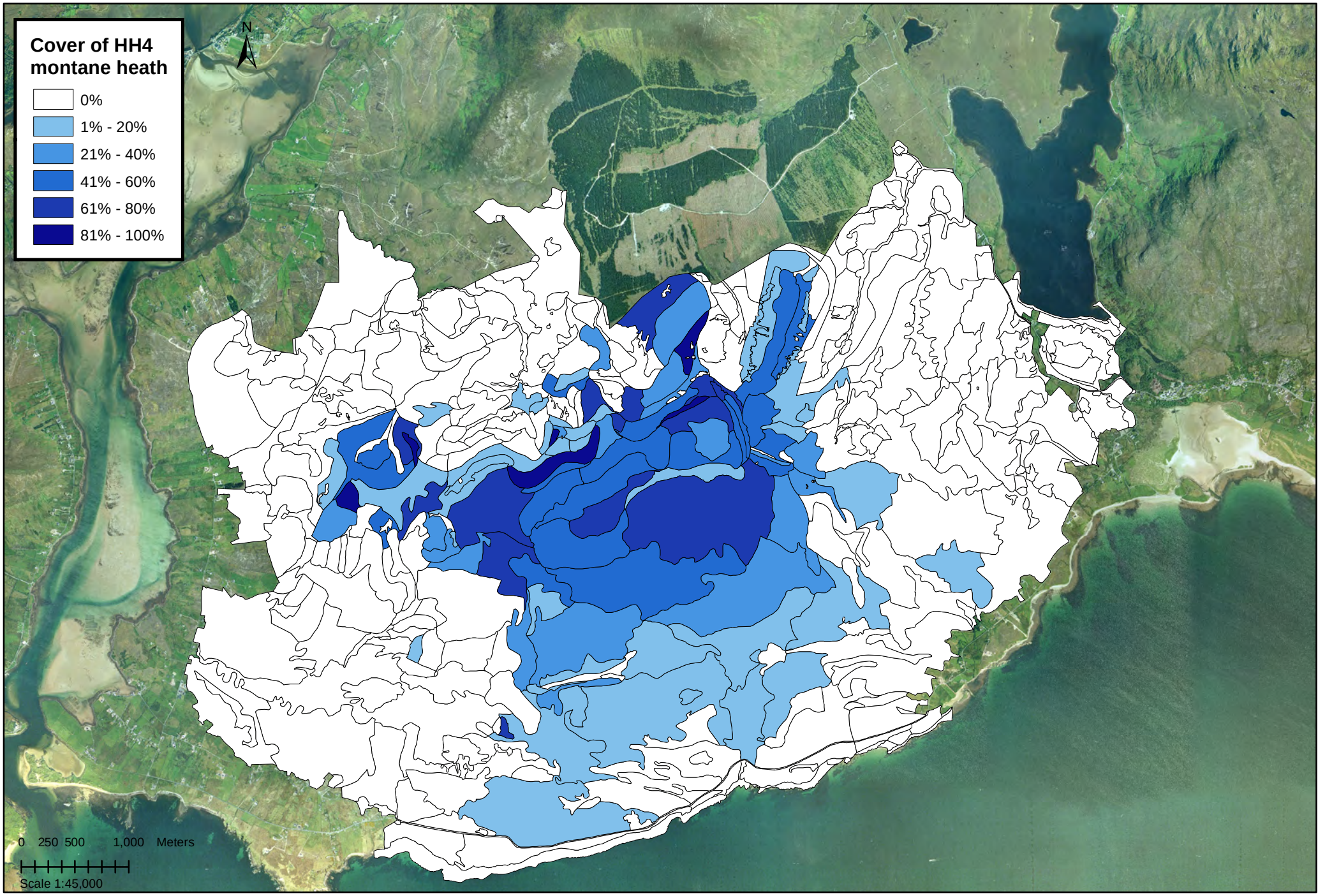

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Figure 2.11 Extent of PB2 upland blanket bog within Corraun Plateau cSAC (000485) survey area

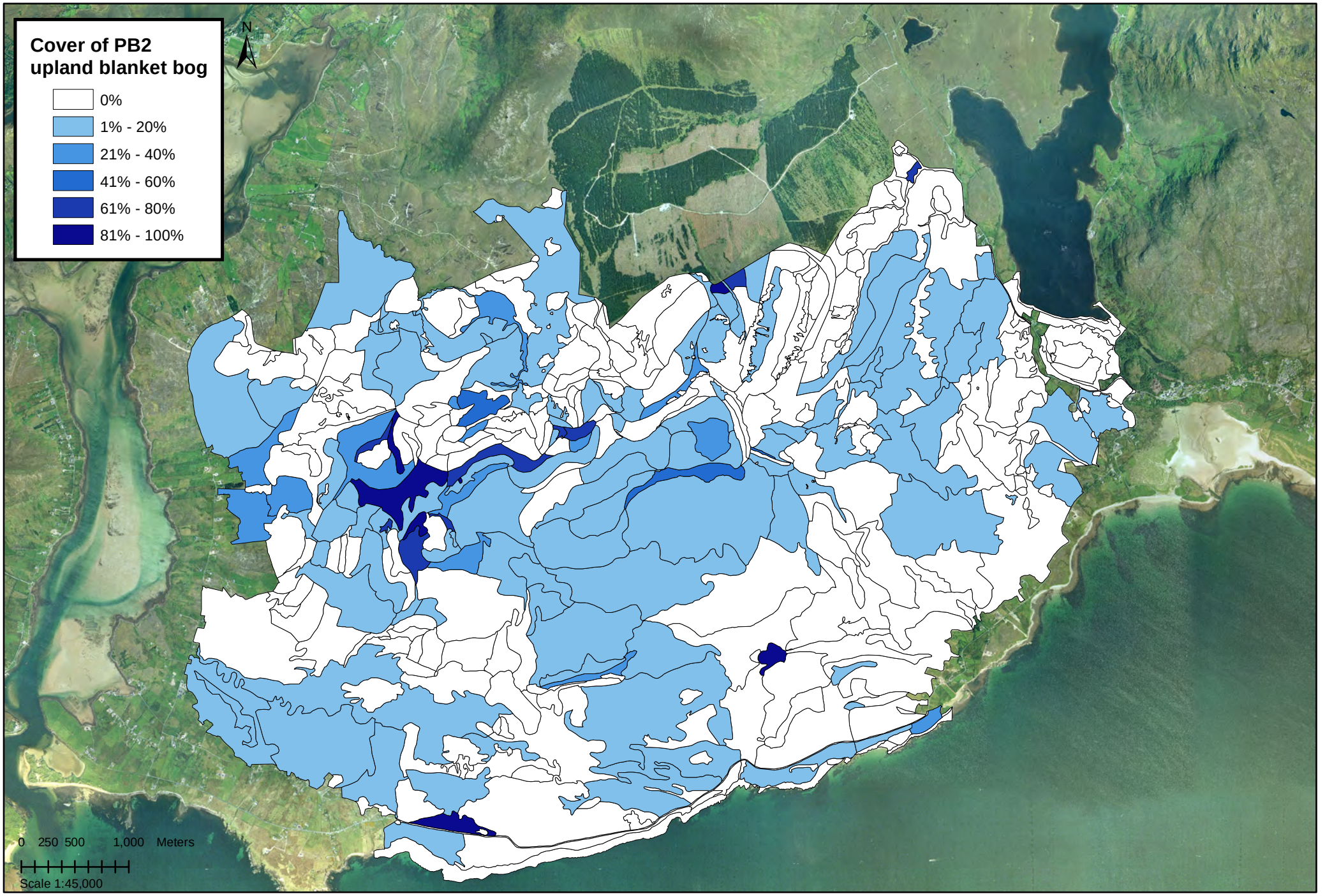

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Figure 2.12 Extent of PB3 lowland blanket bog within Corraun Plateau cSAC (000485) survey area

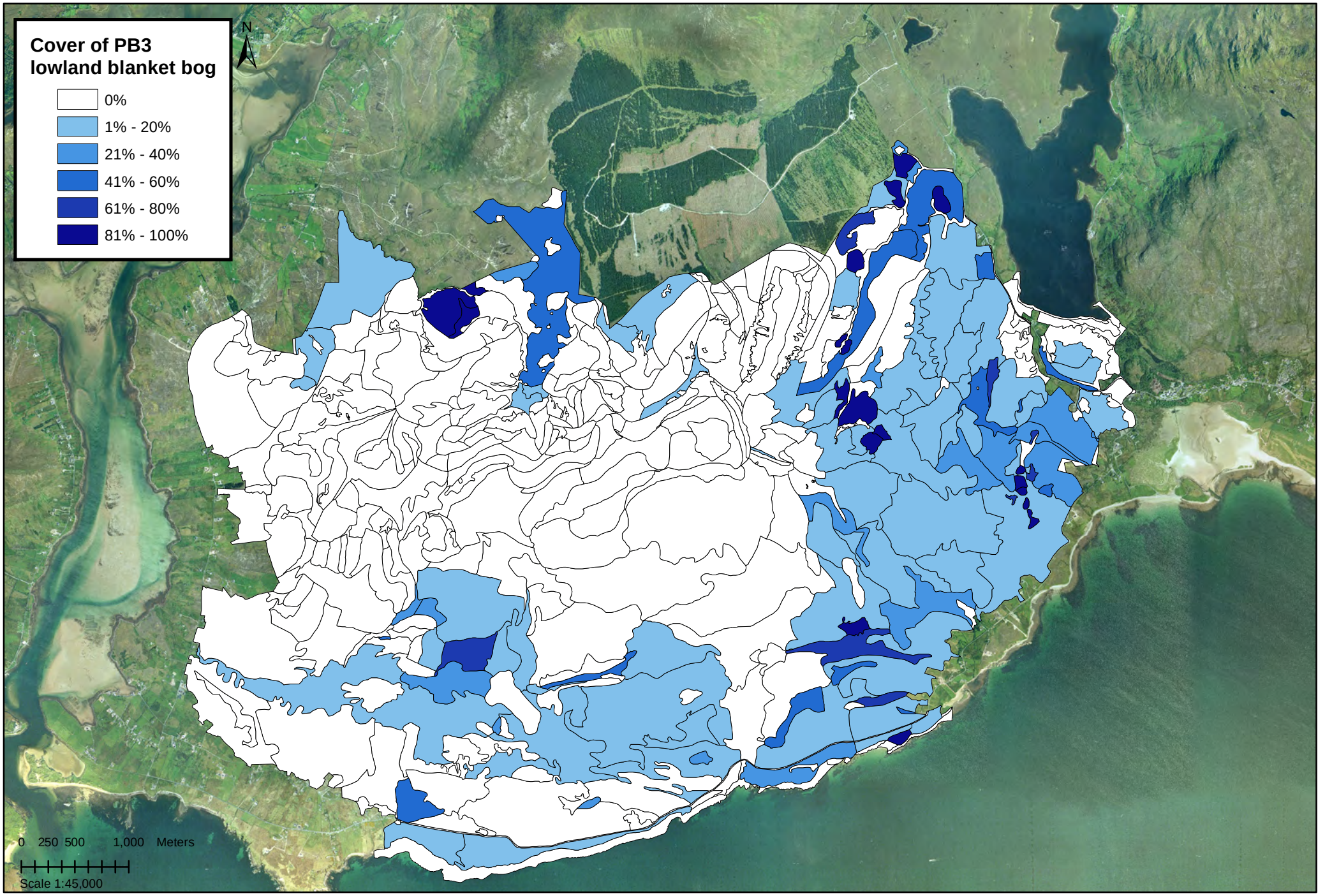

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Figure 2.13 Dominant Fossitt habitats within Mweelrea survey area, part of Mweelrea/Sheeffry/Eriff complex cSAC (001932)

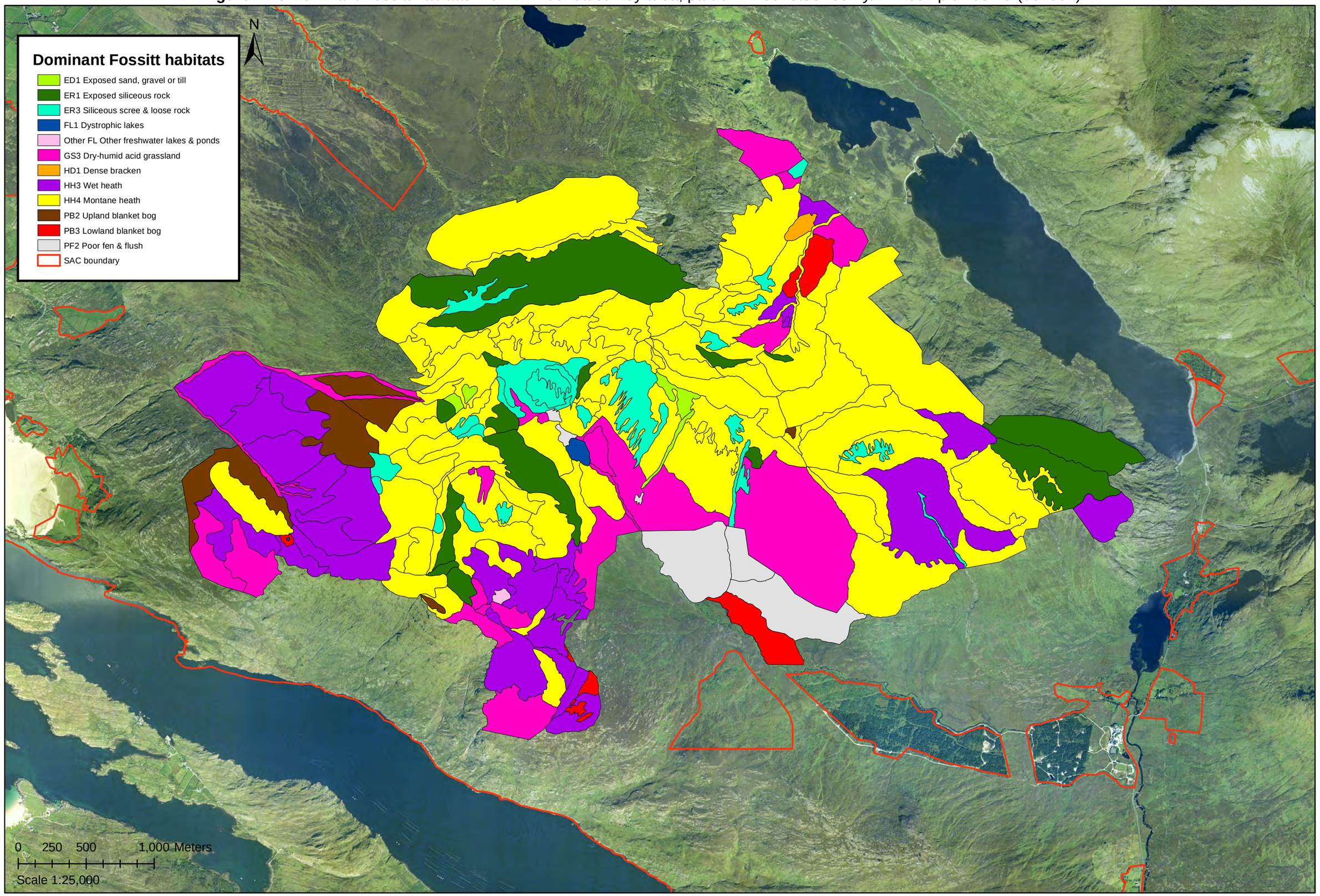

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Figure 2.14 Dominant Annex I habitats within Mweelrea survey area, part of Mweelrea/Sheeffry/Eriff complex cSAC (001932)

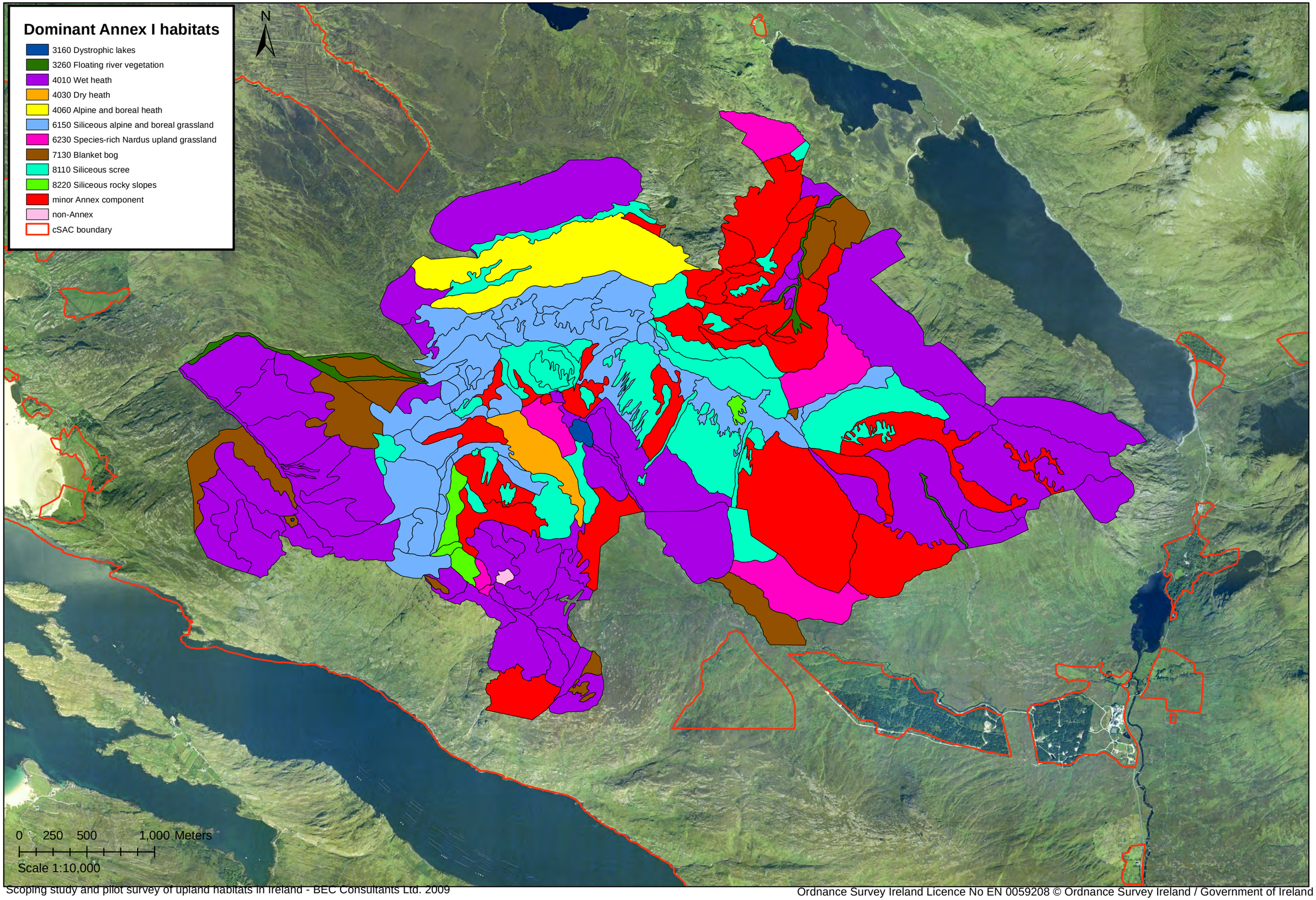

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Figure 2.15 Extent of ER1 exposed siliceous rock within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

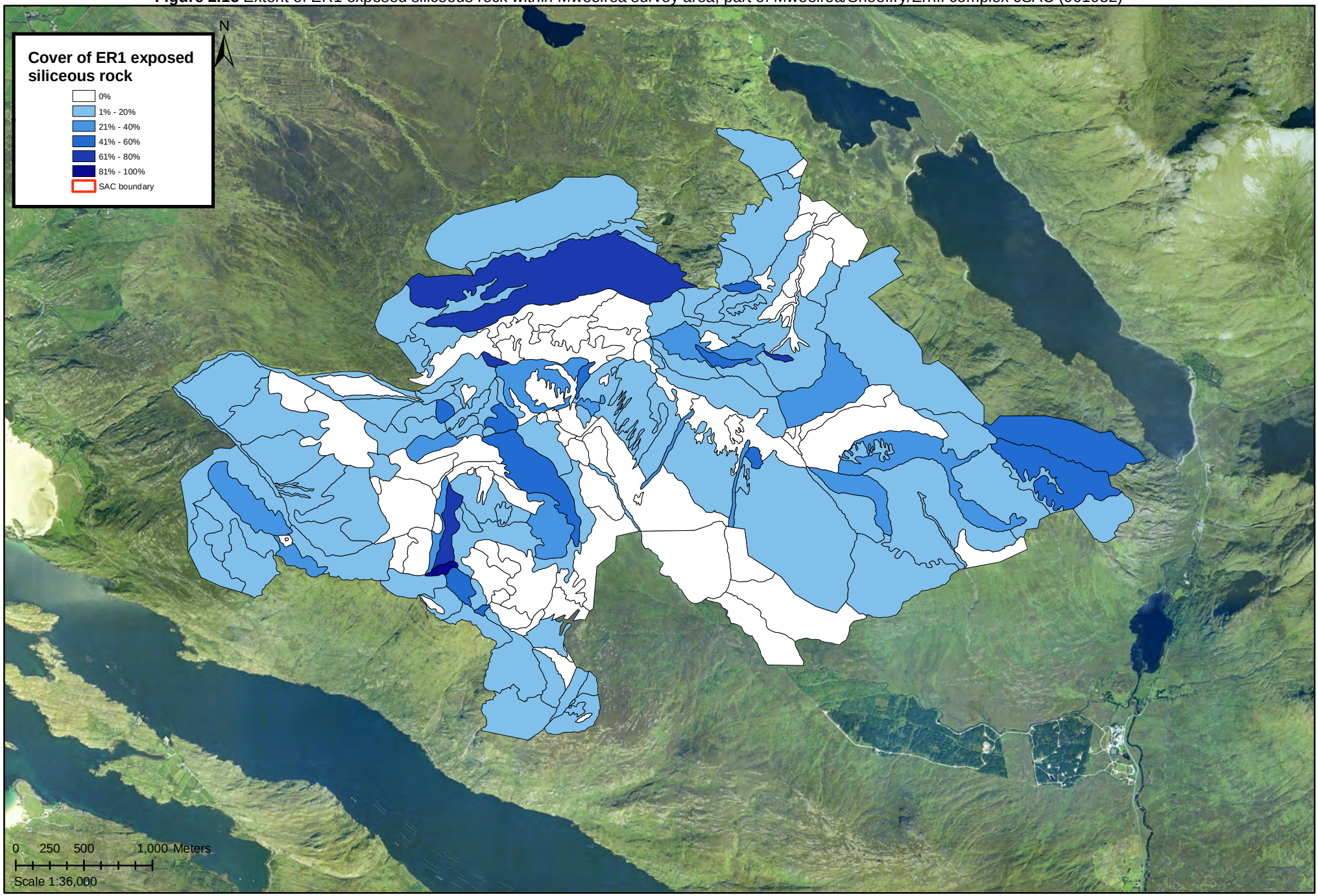

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Figure 2.16 Extent of ER3 siliceous scree and loose rock within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

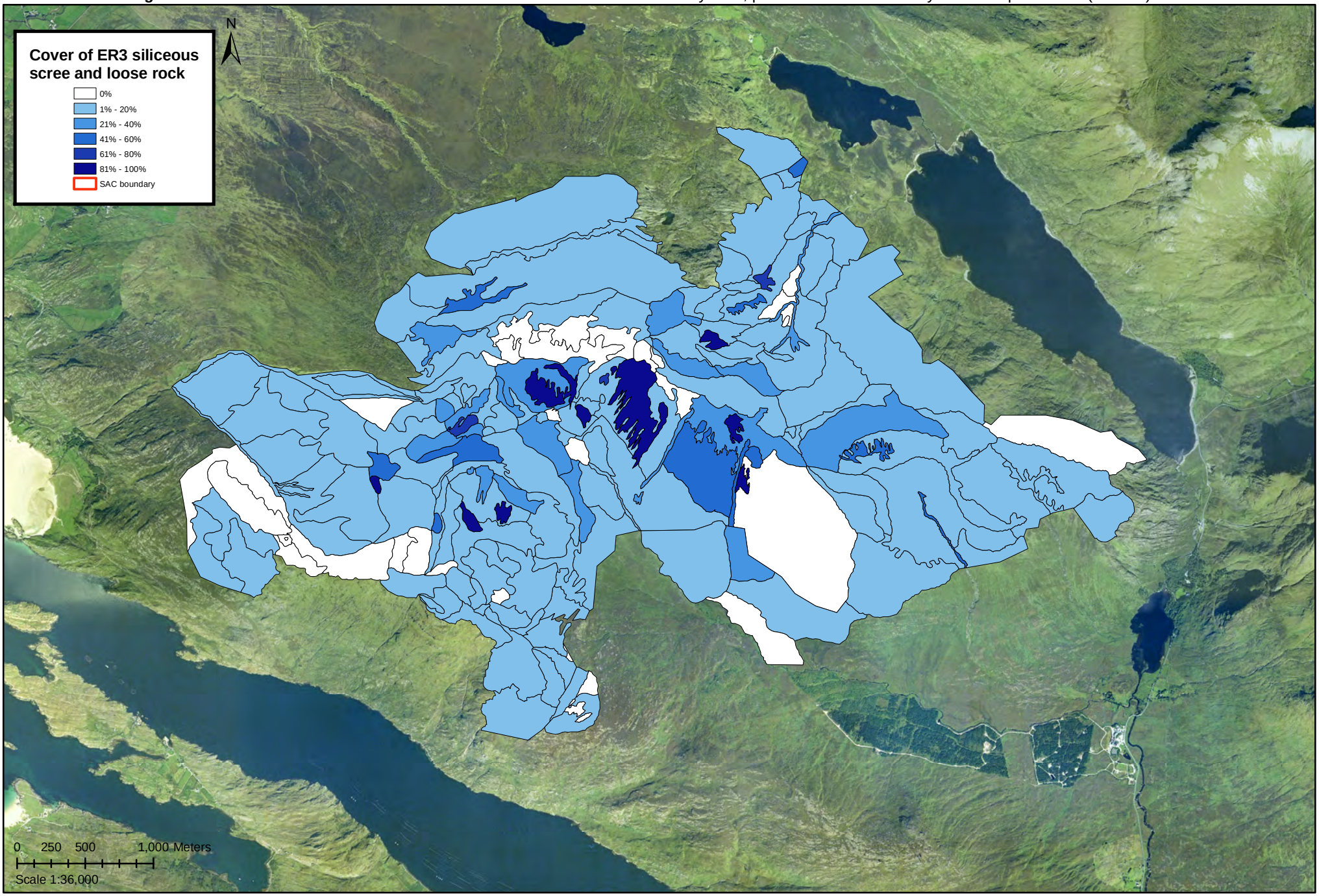

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Figure 2.17 Extent of HH3 wet heath within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

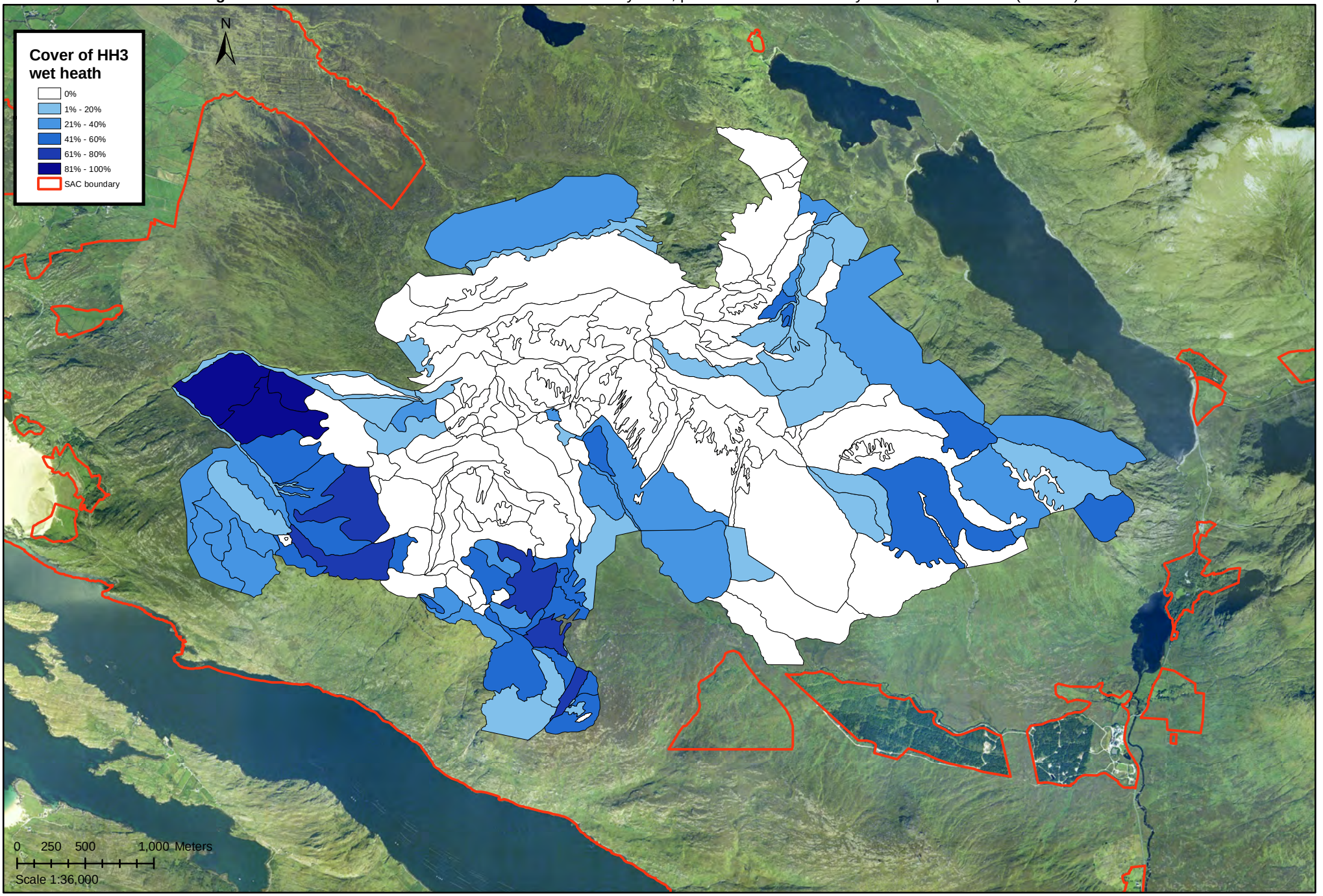

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Figure 2.18 Extent of HH4 montane heath within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

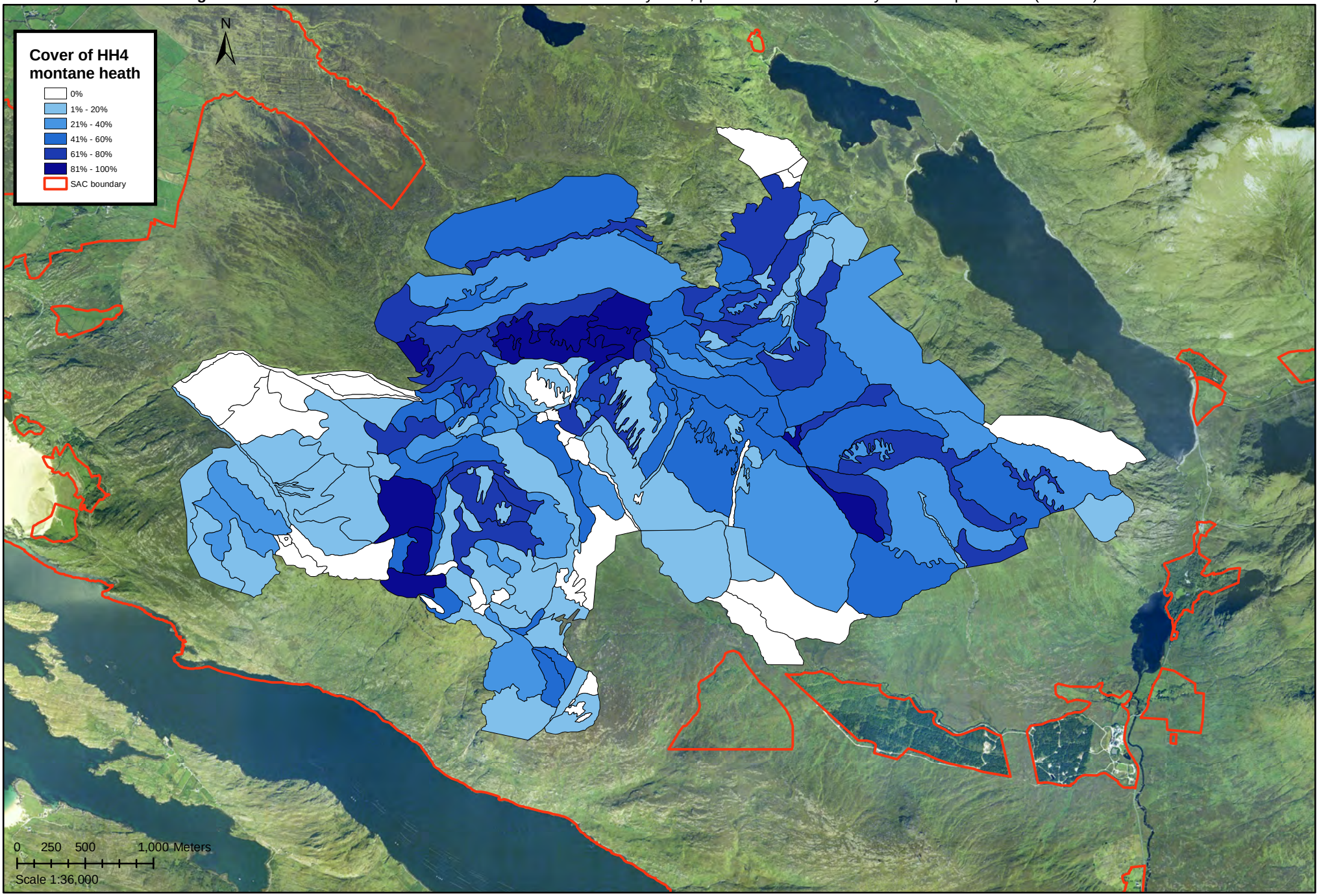

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Figure 2.19 Extent of PB2 upland blanket bog within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

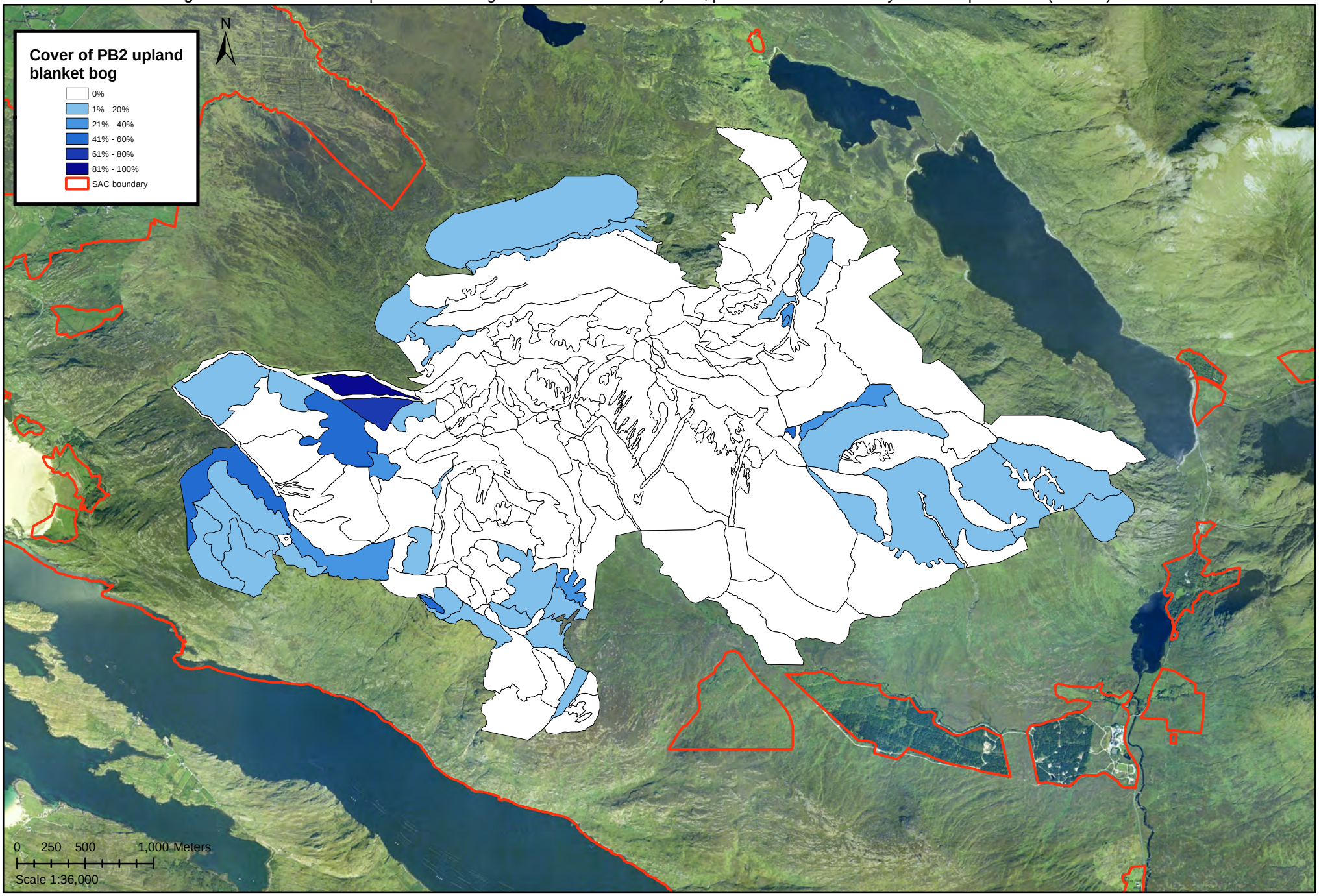

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Figure 2.20 Extent of PB3 lowland blanket bog within Mweelrea survey area, part of Mweelrea/Sheeffry/Erriff complex cSAC (001932)

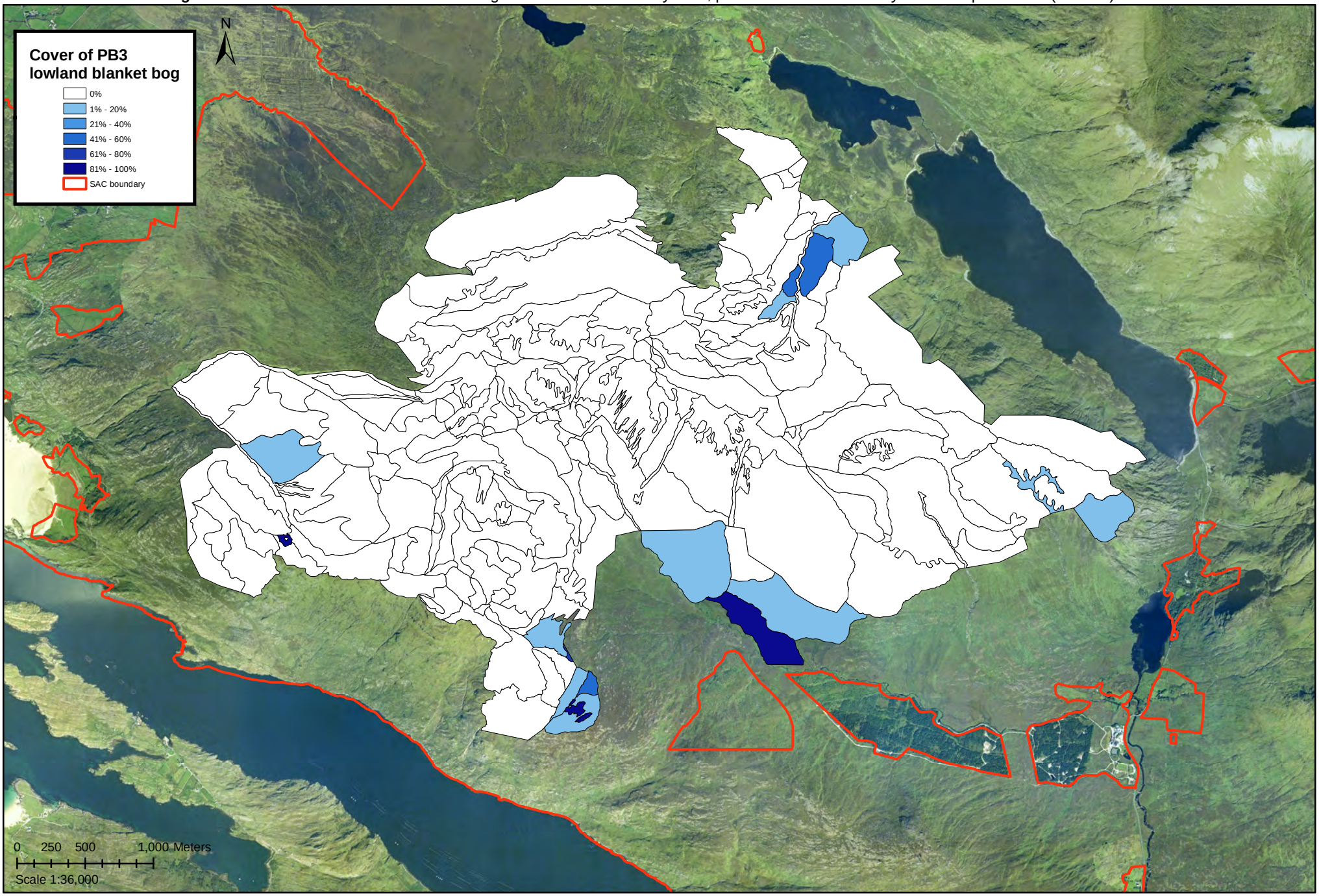

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Table 2.3 Extent of Fossitt (2000) habitats within the Corraun survey area/cSAC

	Fossitt habitat	Total area (ha)	% of site
BL3	Buildings and artificial surfaces	19.1	0.5
CB1	Shingle and gravel banks	2.7	0.1
ED1	Exposed sand, gravel or till	56.8	1.5
ED3	Recolonising bare ground	1.2	0.03
ER1	Exposed siliceous rock	43.9	1.1
ER2	Exposed calcareous rock	0.2	0.004
ER3	Siliceous scree and loose rock	280.4	7.2
FL1	Dystrophic lakes	35.6	0.9
FL4	Mesotrophic lakes	0.9	0.02
FL	Other freshwater lakes and ponds	9.4	0.2
FP2	Non-calcareous springs	4.3	0.1
FW1	Eroding/upland rivers	2.3	0.1
GS3	Dry-humid acid grassland	67.2	1.7
GS4	Wet grassland	3.7	0.1
HD1	Dense bracken	26.7	0.7
HH1	Dry siliceous heath	206.7	5.3
HH3	Wet heath	2007.9	51.7
HH4	Montane heath	416.5	10.7
LR2	Moderately exposed rocky shores	37.0	1.0
PB2	Upland blanket bog	187.1	4.8
PB3	Lowland blanket bog	287.4	7.4
PB4	Cutover bog	34.9	0.9
PB5	Eroding blanket bog	74.3	1.9
PF1	Rich fen and flush	19.7	0.5
PF2	Poor fen and flush	57.5	1.5
PF3	Transition mire and quaking bog	0.4	0.01
WD4	Conifer plantation	1.5	0.04
WN1	Oak-birch-holly woodland	2.9	0.1
WS1	Scrub	6.2	0.2
WS2	Immature woodland	8.5	0.2
WS3	Ornamental/non-native shrub	1.9	0.05
Total site area		*3886.9*	

A total of 15 Annex I habitats were recorded from Corraun (Table 2.2). The most abundant Annex I habitat within the Corraun survey area was **Northern Atlantic wet heath (4010)**. Considerable areas of **Blanket bog (7130)**, **Alpine and boreal heath (4060)** and **Dry heath (4030)** were also present. A small area of the site was described as **Siliceous alpine and boreal grassland (6150)**, a habitat type previously not recorded in the Republic of Ireland. The Annex I habitat *Juniperus communis* formations on heaths/calcareous grasslands (5130) is a qualifying interest for the Corraun Plateau cSAC (Table 2.1). Montane heath containing *Juniperus communis* subsp. *nana* was recorded on Corraun during the course of this survey, primarily on the southern slopes. However, detailed consideration of the definitions and interpretation of Annex I habitats (Anon. 2007), together with common practice in Britain and Germany (Rodwell 1991, Hauke *et al.* 2000), suggests that this vegetation type should instead be categorised as the Annex I habitat **Alpine and boreal heath (4060)**. Unlike ***Juniperus communis* formations on heaths/calcareous grasslands (5130)**, the **Alpine and boreal heath (4060)** category makes specific reference to *Juniperus communis* subsp. *nana* and

the phytosociological alliance *Juniperion nanae*. Therefore in Table 2.2, the extent of **Alpine and boreal heath (4060)** includes the area of montane heath with *Juniperus communis* subsp. *nana*, but the figure for the extent of this habitat is also presented separately at the foot of the table.

A total of 31 Fossitt habitats were recorded from the Corraun survey area/cSAC (Table 2.3). The most abundant was **Wet heath (HH3)**, with considerable areas of **Montane heath (HH4)**, **Lowland blanket bog (PB3)**, **Siliceous scree and loose rock (ER3)**, **Dry heath (HH1)** and **Upland blanket bog (PB2)**.

2.9.2 Results of Mweelrea pilot survey area

Summary description

The Mweelrea pilot survey area is within the Mweelrea/Sheefry/Erriff Complex cSAC. The pilot survey area is 1,546.6 ha in size and covers 7.3% of the total area for the cSAC. It is entirely within the cSAC. The pilot survey area was centred on the main ridge of the Mweelrea Mountains, encompassing the peaks of Mweelrea (814 m) and Ben Bury (795 m) and their surrounding slopes. This area was selected with reference to the aerial photographs, contours and geological maps. It contained a varied mosaic of upland habitats, described here using Fossitt (2000) habitat categories. The area was dominated by **Montane heath (HH4)** which was most abundant on the main ridge and upper slopes. **Wet heath (HH3)** was frequent and occurred in association with smaller areas of **Upland blanket bog (PB2)** on the lower slopes, particularly to the west of the site. **Dry-humid acid grassland (GS3)** was frequent, particularly on the southern slopes. **Exposed siliceous rock (ER1)** tended to occur as craggy outcrops on steep slopes. **Siliceous scree and loose rock (ER3)** areas were most frequent on the upper slopes, immediately below the main ridge. **Poor fen and flush (PF2)** were occasional, occurring as subordinate elements within the mosaic. **Lowland blanket bog (PB3)** was occasional on the lower slopes at the margins of the site. Small areas of **Eroding blanket bog (PB5)** and other habitats were also recorded. Coire Dubh, the large corrie to the north-east of the site, is of particular importance for its rare bryophytes, including the liverwort *Plagiochila carringtonii* which was recorded there during this survey.

Table 2.4 Extent of Annex I habitats within the Mweelrea pilot survey area

	Annex I habitat	Total area (ha)	% of site
3160	Dystrophic lakes	2.4	0.2
3260	Floating river vegetation	4.6	0.3
4010	Wet heath	335.0	21.7
4030	Dry heath	5.1	0.3
4060	Alpine and boreal heath	18.7	1.2
6150	Siliceous alpine and boreal grassland	116.7	7.5
6230	Species rich *Nardus* upland grassland	32.3	2.1
6430	Hydrophilous tall herb communities	0.2	0.02
7130	Blanket bog	75.5	4.9
7150	Rhynchosporion depressions	2.2	0.1
7230	Alkaline fens	0.8	0.05
8110	Siliceous scree	96.4	6.2
8120	Calcareous scree	0.1	0.01
8210	Calcareous rocky slopes	0.9	0.1
8220	Siliceous rocky slopes	13.8	0.9
Non-Annex I habitats		841.8	54.4
Total site area		*1546.6*	

Maps and summary data for Mweelrea pilot survey area

Maps illustrating the survey polygon boundaries and the dominant Fossitt and Annex I habitat types in each survey polygon at Mweelrea are presented in Figs. 2..13 and 2.14 respectively. Again, these maps must be interpreted with the caveats discussed in section 2.6.1 in mind. A series of colour gradated maps showing abundance of selected Fossitt habitats in each polygon is presented in Figs. 2.15-2.20.

A total of 15 Annex I habitats was recorded from the Mweelrea pilot survey area (Table 2.4). In total, 45.6% of the Mweelrea pilot survey area consisted of Annex I habitats. The most abundant Annex I habitat recorded was **Northern Atlantic wet heath (4010)**. Significantly over 116 ha was described as the previously unrecognised habitat **Siliceous alpine and boreal grassland (6150)**. A small area of **Hydrophilous tall herb fringe communities of the montane to alpine levels (6430)** habitat was recorded. This was the upland ledge community aspect of this Annex I habitat rather than the river or woodland edge aspect that has previously been recognised in the Republic of Ireland.

The remaining 54.4% of the survey area was largely composed of non-Annex I montane heath, acid grassland, exposed rock and loose rock. The montane heath was dominated by *Carex bigelowii*, *Racomitrium lanuginosum* or *Nardus stricta*, with lesser amounts of *Dicranum fuscescens*, *Juncus squarrosus*, *Deschampsia flexuosa* and *Anthoxanthum odoratum* and few or no dwarf shrub species. These montane grass/sedge heaths were classified as **Montane heath (HH4)** under Fossitt's scheme

but, due to their low cover of dwarf shrubs, were not deemed to qualify as the Annex I habitat **Alpine and boreal heath (4060)**.

A total of 20 Fossitt categories were recorded from the Mweelrea pilot survey area (Table 2.5). **Montane heath (HH4)**, **Wet heath (HH3)**, **Dry-humid acid grassland (GS3)**, **Exposed siliceous rock (ER1)** and **Siliceous scree and loose rock (ER3)** accounted for the majority of the area.

Table 2.5 Coverage of Fossitt (2000) habitats within the Mweelrea pilot survey area

Fossitt habitat		Total area (ha)	% of site
ED1	Exposed sand, gravel or till	21.3	1.4
ER1	Exposed siliceous rock	184.5	11.9
ER2	Exposed calcareous rock	1.8	0.1
ER3	Siliceous scree and loose rock	153.6	9.9
ER4	Calcareous scree and loose rock	0.1	0.01
FL1	Dystrophic lakes	2.4	0.2
FL	Other freshwater lakes and ponds	1.1	0.1
FP2	Non-calcareous springs	8.3	0.5
FW1	Eroding/upland rivers	4.6	0.3
GS3	Dry-humid acid grassland	227.5	14.7
GS4	Wet grassland	3.4	0.2
HD1	Dense bracken	6.5	0.4
HH1	Dry siliceous heath	5.1	0.3
HH3	Wet heath	255.5	16.5
HH4	Montane heath	519.2	33.6
PB2	Upland blanket bog	53.2	3.4
PB3	Lowland blanket bog	29.2	1.9
PB5	Eroding blanket bog	12.4	0.8
PF1	Rich fen and flush	9.3	0.6
PF2	Poor fen and flush	47.6	3.1
Total site area		*1546.6*	

2.9.3 Summary of relevé recording and condition assessments

In total 199 relevés were recorded from the 11 sites visited during the pilot survey (Table 2.6). Naturally, the majority were recorded from the Mweelrea and Corraun pilot survey areas, but many relevés were also recorded at Ben Bulben, Sligo and Slieve League, Donegal. These relevés were utilised in the vegetation analysis and classification production in Chapter 3. In total 156 condition assessments of Annex I habitats were conducted and are detailed in Chapter 5.

Table 2.6 Number of relevés recorded at each pilot survey site

Site	Number of relevés
1. Mweelrea Mountains	53
2. Corraun Plateau	66
3. Bricklieve Mountains and Keishcorran	9
4. Ben Bulben	23
5. Slieve League	28
6. Slieve Bloom Mountains	6
7. Slieve Mish	5
8. Mount Brandon	6
9. Foiltagarriff	1
10. Sheeffry Hills	2
Total	*199*

2.10 Recommendations

Based on the results of methods trialled during the pilot field survey, experience of surveying upland areas and experience in conducting other large-scale national habitat surveys (Perrin *et al.* 2008a, Martin *et al.* 2008) recommendations for a future NSUH are given below. Additional recommendations relating to the recording of the condition assessments for Annex I habitats are given in Chapter 5.

2.10.1 Recommendations for preparations before field work

Preliminary habitat map creation

1. Aerial photograph interpretation (API) and digitisation of polygons within selected sites should be conducted as a desk-based GIS exercise in good time before the fieldwork period. Polygons should form areas of consistent vegetation mosaic or topography and be mapped using the aerial photograph as the base map. It is preferable for the polygons to be digitised by experienced upland surveyors who can identify these areas. The minimum polygon size should be approximately 20 m x 20 m (0.04 ha) but, in practice, most polygons will be much larger than this with an average size of 8-10 ha. Digitising polygons should be carried out at a scale of 1:5000.

2. API and digitisation should be conducted by a small team overseen by the Project Co-ordinator to ensure consistency of approach and interpretation. Contour polylines should always be used to assist in interpretation of topography. Polygons should be assigned preliminary number codes which can be revised as required in the field as a result of subdivision or merging. Digitisation prior to going into the field will ensure that multiple copies of the paper maps can be created while maintaining consistency in the polygon boundaries and polygon numbering. Where sites are to be surveyed by a team of surveyors this creates a recognised framework for

surveying prior to commencement of fieldwork. There is no requirement for interpreted habitat types to be assigned to polygons at this stage.

3. Coloured maps on A3 paper depicting aerial photographs of the site at a 1:10,000 scale, should be prepared for use in the field showing contours, a graticule at 100 m intervals and the pre-defined vegetation polygons. Contours should be displayed using red lines thin enough not to obscure the detail underneath. Polygon boundaries should be displayed in a light colour, together with the preliminary polygon number assigned through GIS. Colour photocopies of the maps should be used in the field as the toner used in photocopying is less likely to run or blotch in wet conditions than the ink used in colour printing. The boundaries of designated sites should also be indicated on the field maps.

Training period

4. Prior to fieldwork proper, a training period should be conducted to familiarise fieldworkers with the habitats they are likely to encounter in the Irish uplands. Familiarisation with the upland habitats in Fossitt (2000), the interpretation of Annex I habitats and the provisional NSUH vegetation classification scheme (see Appendix I) will be necessary. The length of the training period should be tailored to the previous experience of surveyors.

5. Training should include identification in the field and laboratory of vegetative graminoids (particularly *Carex* spp.), upland lichens (particularly *Cladonia* spp.) and upland bryophytes (particularly *Sphagnum*, *Campylopus*, *Polytrichum* and *Polytrichastrum* spp.). Familiarisation and practice with the mapping, relevé and condition assessment methodologies to be used and the relevant equipment and software should also be covered.

6. Training should also involve a briefing on health and safety protocols and field workers should be made aware of the required health and safety equipment that they need to carry (section 2.11). Fieldworkers with first aid training should be identified and distributed acrss field teams.

Technical provision

7. For the purpose of vegetation mapping, fieldworkers should be provided with both paper and digital copies of the maps of pre-defined polygons detailed above. The mappers / PDAs to be used in the field should be installed with Microsoft Excel Mobile and ArcPad software. Microsoft Excel should have the standardised form for recording polygon vegetation data (Appendix II) uploaded. ArcPad should have the relevant aerial photographs and Ordnance Survey Discovery maps uploaded, as well as the pre-defined polygon layer and contours. ArcPad should have a waypoint recording form customised to include unique waypoint number, date, surveyor and note text data fields, plus drop-down menus listing Annex I categories, Fossitt (2000) habitats and provisional vegetation types. Standardised recording sheets should also be provided on waterproof paper for use in the event of technical failure.

8. For the purpose of relevé recording, mappers / PDAs for use in the field should be installed with TurbovegCE software. This should have a customised NSUH database uploaded, based on the current NBDC species checklist (currently Ireland2008v2). Standardised recording sheets (Appendices II & III) should also be provided on waterproof paper as a contingency in case of technical failure.

9. For the purpose of condition assessment, surveyors should be provided with standardised data recording forms in Microsoft Excel Mobile format. These should also be provided on waterproof paper in case of computer malfunction or battery failure.

10. For each site, the following GIS data layers should also be provided as supplementary information;
    - 1:10,260 six-inch maps,
    - 1:100,000 GSI bedrock geology map
    - Ordnance Survey Ireland rivers and streams polylines,
    - NPWS conservation site shape files (cSACs, SPAs, NHAs and pNHAs).

Review of literature

11. A review of the literature should be conducted to obtain relevant background information on the selected sites. This should include rare vascular and bryophyte species records for the area published or held by NPWS, Site Synopses and lists of qualifying interests for designated sites, previous survey data such as in NHA/SAC files, existing habitat maps, relevant historical literature, theses and research papers. Records of notable habitats, vascular plant or bryophyte species occurring on each site should be collated. This should be collated and provided to fieldworkers.

Outreach

12. Prior to each field season, contact should be made with regional bodies and their officers in the areas in which survey work is to be conducted. This is not only a matter of courtesy but can help to secure co-operation. The relevant NPWS District Conservation Officers should be contacted with a list of the proposed sites. NPWS wildlife rangers, local Biodiversity or Heritage Officers and county BSBI recorders should be approached to tap into any local knowledge that exists of the sites. It is also strongly recommended that details of the survey are sent to the relevant regional offices of the Irish Farmers' Association (IFA) and published in the local farming press, with a request for co-operation and an address to which enquiries may be directed. Publicising the survey through familiar channels can aid requests for access permission.

2.10.2 Field season planning

Timing of fieldwork

13. The field survey season generally spans six months, from April to September. This is the optimum time for field survey due to longer days, more favourable weather conditions and the fact that the majority of higher plants flower during this period, facilitating identification. In theory, upland fieldwork can be conducted outside of this period as the main species of interest can be identified vegetatively, but shorter days and less favourable weather conditions make this an impractical option. However, the length and timing of the field season will be dependent on the funding available and the timing of the NSUH project, as determined by NPWS. Additional recommendations relating to the optimum times for the assessment of the primary Annex I habitats are given in Chapter 5.

14. The cumulative physical wear and tear on upland surveyors should not be underestimated. Problems such as blisters and hamstring, groin, calf or knee strains frequently occur over longer periods of upland fieldwork but are usually not acute enough to render a surveyor out of action, provided they can have a three-day break from fieldwork reasonably often. This break from fieldwork would generally consist of two days off and one day spent at the field base or office working on soil analysis, voucher specimen identification, data collation, map checking or administration.

15. In practice, four consecutive days of fieldwork on larger hills is the ideal period. While five-day periods are reasonable once or perhaps twice a month, they can increase the risk of chronic physical problems being exacerbated.

16. If possible, field surveyors should be encouraged to be flexible in their working schedule to allow, for example, working at a weekend if weather conditions are favourable for fieldwork, then taking a break during the week when the weather window has passed.

Field bases

17. If the survey team is spending a period of some months in one location, it may be possible to rent a house on a short-term lease for use as a field base. If the team is spending only a few weeks in any one area, it may be more appropriate to rent holiday homes. Where fieldwork is being carried out during the busy summer season, it is advisable to book ahead. Where plans allow, it is also advisable to book for a few weeks consecutively as this is often more cost-effective and moving from house to house each week is troublesome and time-consuming.

18. Field bases should be located as close as possible to the survey site, while being within a reasonable distance of a supermarket, post office, internet access, outdoor equipment shop, etc. Staying locally reduces travel time, petrol consumption and mileage expenses, makes it easier to get in contact with landowners and also means that the survey contributes to the local economy.

19. Field bases should ideally have an additional unoccupied room which can be used as a drying room. There should also be adequate space to store equipment, dry soil samples, etc.

2.10.3 Recommendations for fieldwork methods

Access

20. Gaining permission for access to any site for survey purposes can be a contentious issue, so it is important to respect people's rights and employ good practice in this regard. Upland survey work is carried out in areas with small, rural communities and it is considered important to make contact with local people/landowners/shareholders at an early stage. This is done in order to:

    - Raise awareness that the survey is taking place
    - Inform people of the aims of the survey
    - Ask for site access permission
    - Obtain background information on the sites
    - Address any queries that arise
    - Establish goodwill and respect

21. Site access permission should be sought by calling to all landowners or active commonage shareholders in person. This process should begin at an early stage of fieldwork. The contact details for key figures can often be obtained by consulting the local NPWS Conservation Ranger and local IFA representatives. These key figures can provide the names and addresses of other shareholders.

22. While commonage shareholders may not always own the land, they should be treated in the same way as landowners. An informal initial approach should be made without immediately producing official documents. However, it is important to be clear that the survey is being carried out for NPWS, which is part of the Department of Environment, Heritage and Local Government. Copies of letters of introduction from NPWS, identification cards and details of the surveyor's insurance cover should be to hand.

Navigation

23. Surveyors should operate in the field in pairs or larger teams and be no more than 1 km apart from their nearest co-worker at any time.

24. Surveyors should carry a walking pole in one hand and a GPS unit and paper map in the other to ensure they can keep an eye on their location and direction at all times. The walking pole is necessary for balance on steep slopes, descents and when crossing streams, especially when in spate. As a general rule of thumb, surveyors should check their position (compare their current coordinates with the map) at least once every 250 m.

25. Awareness of the relative position of polygon boundaries can be greatly improved by having the polygon shapefile open in ArcPad on the mapper / PDA. ArcPad will constantly update the position of the surveyor and indicate direction of travel. This will both improve the accuracy of the data recorded and assist in navigation.

26. The use of GPS waypoints is recommended when navigating through difficult terrain, especially if there is a possibility of having to return in poor weather conditions or bad light. When a good point for crossing a stream is located, it should be waypointed, making it easier to locate on the return journey. Waypointing the location of the vehicle(s) is also advisable if parked on a featureless track or road.

27. A compass should be within easy reach at all times. Care should be taken to ensure that the compass bearing is not affected by magnetic sources (e.g. a magnetic stylus).

28. Dangerously steep areas should be avoided and can be surveyed using binoculars in combination with aerial photographs.

Communication

29. When carrying out vegetation mapping, surveyors should plan in advance which specific polygons they will survey each day (with contingencies for bad weather when it may be unsafe to survey high altitude areas) and ensure that other surveyors on the same site are aware of their plans. This ensures that there is no duplication of effort but permits fieldworkers to work in relatively close proximity for safety reasons. The numbers of the polygons intended for survey each day should be forwarded to supervisors or staff not in the field in accordance with health and safety protocol.

30. The use of satellite phones should be considered in upland areas with poor mobile phone reception.

31. Field surveyors should check in with each other by phone (not by text) at scheduled midpoints during the day, and more frequently when working in difficult terrain.

32. In the event of a surveyor being late to a meeting point in the field or at the end of the day and can not be contacted by phone, their colleague should wait at the meeting point for at least an hour. They should not go looking for the latecomer because they may put themselves in danger and there is also a likelihood of missing the latecomer if they return by a different route. It is vitally important to remain available for communication, so if there is no mobile phone reception at the meeting point, surveyors should move to a location with a better signal and leave a conspicuous note or sign to show where they have gone. Mountain rescue services should only be alerted 2-3 hours after failure to return, as in practice calls earlier than this will probably be treated as a preliminary alert.

Reconnaissance

33. At the beginning of fieldwork on any major site where detailed mapping is planned there should be an initial 2-4 day reconnaissance period to establish the range of vegetation types present, familiarise the survey team with these types and identify any difficulties that these may present in terms of diagnosis, transitions or species identification.

Planning

34. Surveyors should plan in advance which specific polygons they are surveying each day (with contingencies for bad weather when high altitude areas may be unsurveyable) and ensure that other surveyors on the same site are aware of their plans. This ensures that there is no duplication of effort but permits fieldworkers to work in relative close proximity for safety reasons; fieldworkers should work in pairs and be no more than 2 km apart at any time. There may be times when this is impractical and in such circumstances communication between field surveyors is paramount. On average surveyors should aim to cover 1-1.5 km^2 each day. The general location of field workers must be communicated to supervisors or staff not in the field in accordance with health and safety protocol.

Equipment

35. Surveyors should carry the recommended health and safety equipment listed in section 2.11 at all times. Where appropriate, all items must be checked regularly to ensure that they are fit for purpose.

36. Equipment weight should be minimised where possible to prevent fatigue and for efficiency. A balance must be struck between ensuring that surveyors are well prepared, hence the long list of equipment, and overburdening them. Therefore, the lightest forms of reliable equipment are an essential requirement.

37. Surveyors must carry an adequate supply of water as, due to the high numbers of herbivores present in the uplands, drinking from mountain streams is not recommended.

Miscellaneous

38. A spare key should be left near the vehicle(s) so that all team members can gain immediate access to shelter if they return early or are unwell or fatigued.

39. In case of thunder or lightning, surveyors at relatively low altitudes and not in an exposed location, such as a ridge, spur or plateau, should leave the hill. If lightning is observed or if in an exposed location, then one should lie down in the nearest concavity until the danger has passed, i.e. until there has been no thunder or lightning for 20-30 minutes, intense rain has slackened or cloud has become less dense.

Vegetation mapping

40. Fieldworkers should carry the NSUH Handbook at all times as this will list the provisional upland vegetation types and their corresponding codes and details of the Irish interpretation of Annex I habitats. Copies of the relevant sections of Fossitt (2000) should also be carried for reference. This is available in PDF format on the Heritage Council website (www.heritagecouncil.ie).

41. When carrying out vegetation mapping, surveyors should aim to survey 1.0-1.5 km^2 on average each day on sites which are readily accessible. On more remote sites where a considerable amount of time may be spent hiking to and from the survey area, 0.5-1.0 km^2 on average each day would be a more realistic aim. The pre-digitised polygons, each of which represents a consistent vegetation mosaic, should be surveyed by walking a zigzag transect through them whenever possible. The aim should be for all polygons to be surveyed in detail. In practice, however, some areas may be surveyed in less detail due to bad weather, or by using binoculars if the polygon is dangerously steep (e.g. corrie walls). Specific features that appear within a polygon on the aerial photographs, such as basins, terraces, flushes, scree or rock outcrops, should be investigated to check for additional vegetation types. Whenever possible, surveyors should navigate to a point which gives them a clear view over the whole polygon, although in the Irish uplands visibility can often be impeded by topography or adverse conditions such as low light levels, mist or heavy rain. From these vantage points the relationship between the different vegetation types and the colouration of the aerial photograph can be established.

42. The attributes of the digitised polygons should be recorded digitally on a standardised spreadsheet (Appendix II) in Microsoft Excel Mobile. Percentage cover scores should be assigned to each Annex I and Fossitt (2000) habitat type observed. Cover scores should be recorded to the nearest 5% except for covers of less than 10%; to provide increased detail, these should be recorded as 0.1%, 0.3%, 0.5%, 0.7%, 1%, 3%, 5% or 7%. Cover scores should similarly be assigned for provisional vegetation types (Appendix I). As these refer to vegetation rather than habitats it will also be necessary to record cover of non-vegetated substrates (e.g. bare peat, bedrock, loose rock, gravel, open water, running water) within each polygon. As each polygon is surveyed, the sum of the cover scores for each of the three levels of recording should be calculated to ensure that it totals 100%. Therefore if an area does not correspond to an Annex I habitat it should be recorded as 'non-Annex' and the relevant cover score be added. If additional notes on the polygons are recorded, standardised notes and abbreviations should be used as far as possible.

43. The aim should be for all polygons to be surveyed in detail. However, in practical terms some areas may be surveyed in less detail using binoculars if, for instance, the polygon is very steep. The accuracy of the field survey carried out for each polygon should also be recorded on an arbitrary scale of 1-3:

    1. Surveyed on the ground in detail
    2. Surveyed using binoculars

3. Surveyed using API only

44. If necessary, the polygon boundaries should be amended in pencil on the paper map; it is time-consuming and inaccurate to digitally amend polygons in the field. Where new polygons are created by splitting existing polygons they should be labelled by suffixing A, B, C etc. to the original polygon number rather than labelling with a new number. . Hence, if polygon 6 is split in two, the two new polygons are labelled 6A and 6B on the map and recorded in a similar fashion on the recording sheet. If two or more whole polygons are merged then the new polygon takes the lowest number of the merged polygons; such merges should be marked on the paper maps with double-headed arrows. Single-headed arrows should be use to indicate where only part of a polygon should be merged with another. Surveyors should make amendments on their own copies of paper maps in the field and then transfer these amendments to a set of master-copies held in the field base; these master-copies will be used to correct the GIS polygon data layer.

45. Waypoints should be used to target-note habitats and species of note in addition to other features of interest. Waypoint notes should be made on areas of forestry recording the approximate height of trees and the density of planting. Waypoints should also be used to record the location photos are taken from in addition to helpful navigation points such as the location for safely crossing a stream or where your is parked. Waypoints should be entered digitally using customised forms in ArcPad. Standardised notes and abbreviations should be used as far as possible.

46. To minimise error when recording relevé locations and waypoints all GPS equipment should be set to Irish National Grid projection with the Ireland 1965 datum and should support differential correction through EGNOS (European Geostationary Navigation Overlay Service) to improve precision.

47. Thematic accuracy of the polygon data being collected should be periodically tested to determine the level of error within the data. A polygon or number of polygons should be independently surveyed by all survey team members within a set time period. The team member with the most experience of upland habitat mapping should be given additional time to determine a definitive list of the Annex I habitats, Fossitt (2000) habitats and vegetation communities present and proportions of these. This definitive list will be used to determine the level of accuracy with which the data is being collected. Feedback from these tests to surveyors should help improve accuracy and an average of the results taken as the level of error within the data across the survey period.

48. For some habitats a strict interpretation of the Fossitt classification would result in disparity between the Annex I and Fossitt habitats recorded. Where this occurs, the Annex I interpretation should be given precedence. For example, Fossitt (2000) states that *Schoenus nigricans* should occur in Lowland blanket bog (PB3), but not in Wet heath (HH3). However, Anon. (2007) specifically mentions the M14 *Schoenus nigricans – Narthecium ossifragum* mire of Rodwell (1991) under Northern Atlantic wet heaths with *Erica tetralix* (4010), as well as listing the species under Blanket bogs (7130). Thus, wet heath with *S. nigricans* and *E. tetralix*,

vegetation type WH1 under the provisional classification, should be recorded as habitat 4010 under the Annex I habitat scheme and habitat HH3 under the Fossitt scheme. Similarly, whilst Fossitt (2000) states that *Juncus squarrosus* may occur in Wet heath (HH3) but not in Upland blanket bog (PB2), Anon. (2007) lists M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire under Blanket bogs (7130), a habitat in which *Juncus squarrosus* may be abundant. Thus, the provisional vegetation type BB5b *Calluna vulgaris – Eriophorum* spp. with *Juncus squarrosus* should be recorded as habitat *7130 under the Annex I scheme and habitat PB2 under the Fossitt scheme.

49. Areas of the Annex I habitat Blanket bogs (7130) are priority habitat if they are active. The *Interpretation Manual of European Union Habitats* (Anon. 2007) states that: "The term 'active' must be taken to mean still supporting a significant area of vegetation that is normally peat forming". The main peat forming plants are *Sphagnum* mosses but *Eriophorum vaginatum* and *Racomitrium* spp. are also important in some blanket bog communities. The previous assessment of Irish blanket bogs summarised in *The Status of EU Protected Habitats and Species in Ireland* (Anon. 2008) did not report separately on active and inactive blanket bog habitats but effort should be made in a national survey to distinguish these two elements. The most frequently encountered example of inactive bog is vegetation dominated by *Eriophorum angustifolium* that has developed on eroded bog where a reasonable depth of peat remains. Under the current provisional classification scheme this is recorded as HW2, being essentially the same vegetation as is found in some natural bog hollows. Such vegetation is thus non-priority habitat 7130. Areas of non-eroded bog will typically be active, priority habitat *7130. No distinction is made between active or inactive bog when conducting or planning monitoring stops.

50. Hepatic mats are dense cushions of bryophytes that occur on north-facing slopes in the uplands, within dry, wet and montane heaths. Typically they occur beneath *Calluna vulgaris* and *Vaccinium myrtillus* (Holyoak 2006). They chiefly comprise liverworts, such as *Herbertus aduncus* and *Scapania gracilis* but mosses, particularly *Sphagnum* spp., are also typically present. The rare species *Adelanthus lindbergianus* is virtually restricted in Europe to Irish examples of this vegetation type and other rare bryophyte species may occur. Hepatic mats are hence of international significance but have not been recognised under the EU Habitats Directive. Holyoak (2006) highlights that high stocking levels in the Irish uplands have resulted in the loss of *Calluna* cover and the widespread decline of hepatic mats in recent decades. Where this habitat is encountered, mats should be accurately waypointed and photographed, and dimensions should be recorded. A list of the main species components should be made and any apparent damage or threats recorded. Future surveys should seek to relocate individual hepatic mats where feasible to assess theircondition.

.Recording of relevés

51. Relevé data is generally collected in connection with conservation assessment monitoring stops and the methodology for this approach is given in Chapter 5. Further relevés should, however, be recorded in non-Annex I habitats (e.g. dense bracken and flushes) and in Annex I habitats for which no assessments are being conducted (e.g. Siliceous alpine and boreal

grasslands 6150, Molinia meadows 6410 and Transition mires and quaking bogs 7140), such that the variation in vegetation across the site is adequately sampled. The number of additional relevés is likely to be small compared with the full monitoring stops, which should receive priority. However, recording of data, photography and taking soil samples should be conducted in an identical fashion. Note that relevé sampling is *not* required from aquatic or forested habitats, only from terrestrial and wetland habitats.

52. Comprehensive 2 m x 2 m relevés are recorded. It may exceptionally be necessary to vary the size and shape of relevés according to the structure, scale and shape of the target vegetation type. Where different dimensions are used, this must be recorded. The recording of a relevé will provide most of the data required for the assessment of the monitoring stop, as well as providing valuable data on the variation in vegetation for analysis purposes.

53. Relevé data should be recorded digitally using the NSUH database within TurbovegCE (set up by the project IT manager).

54. All vascular plants, bryophytes and terricolous macrolichens contributing cover in vertical projection within a relevé should be identified to at least species level and recorded. This means that plants need not be rooted within plots, merely overhanging. The cover of each species identified in a relevé should be recorded using a percentage scale. Covers should be recorded to the nearest 5% except for species with covers of less than 10%. In order to provide improved detail, the cover scores of these species should be recorded as 0.1%, 0.3%, 0.5%, 0.7%, 1%, 3%, 5% or 7%.

55. Voucher specimens should be taken for all taxa of doubtful identity. To signify within TurbovegCE that a voucher specimen has been taken, uncertain records (e.g. *Sphagnum* species) should be marked as "7 – Juvenile" in the dropdown vegetation layer menu; the layer field is otherwise unused. Where a genus name cannot even be hazarded, records can be added to the Remarks field (e.g. brown acrocarpous moss 2%). Specimen envelopes / bags must be *clearly labelled* with the date, relevé code and the *exact* same label as entered in TurbovegCE. Each relevé should be coded in the following format: [site number]-R[relevé number]. For example, 009-R004 would be relevé number 4 for site number 9.

Soil sampling

56. Soil samples are not required from every relevé but should be collected from a subset of relevés from each vegetation type. A trowel should be used to collect a sample from the centre of the relevé. It should be placed in a Ziploc bag *clearly* labelled with the date and the plot code as for voucher specimens and stored in a refrigerator until pH analysis is carried out.

57. The pH of field-fresh soil should be analysed as soon as possible, and no longer than one week after the soil sample was taken. Two replicates should be analysed for each soil sample. A 2:1 purified water to soil paste should be prepared and left to settle for five minutes. A pH meter should be used to measure the pH value, once it has stabilised. The pH data should be entered into a Microsoft Excel spreadsheet containing functions to correctly convert

logarithmic pH values to linear hydrogen ion concentrations, calculate the mean of the two replicate values and reconvert this to a pH value. This spreadsheet should be backed up after entering any new data. Once pH analysis has been carried out, the soil samples should be air dried and stored, awaiting further analyses.

Site photographs

58. A series of digital photographs should be taken to record the habitats and topography of each site. A GPS waypoint should be recorded for each photograph, together with a brief description of the view and a compass bearing. This will permit site photographs to be subsequently linked to the digital habitat map. Photographs which are associated with a waypoint should be labelled in the following fashion: [site number]-W[photo number]-[Photographer's initials]. For example, 009-W020-SB.JPG would be the photograph associated with waypoint number 20 for site number 9, taken by Simon Barron. If more than one photo is taken for a particular waypoint, the photograph number should be appended with a,b,c etc. For general site photos which are not associated with a waypoint, these should be labelled [site number]-S[photo number]-[Photographer's initials]. Photographs should be sorted and labelled as soon as possible as it can often be difficult to recollect specific locations at a later date. Additional recommendations are given in Chapter 5 in relation to photos of monitoring stops.

2.10.4 Recommendations for data processing and report writing

59. As many data problems cannot be resolved by other personnel, each fieldworker should be individually responsible for ensuring that all their data are clear, complete, correct and in the right format by the end of the field season or the established deadline.

60. Abbreviations used in notes must follow an accepted standard, e.g. habitat types as Fossitt (2000) codes, species names as unambiguous 4-4 codes as shown on paper recording sheet (Appendix III). Otherwise abbreviations should be removed and written in full.

61. Where critical bryophyte specimens cannot be identified with confidence they should be promptly forwarded to the Project Co-ordinator with clear relevé details. Groups of specimens can then be sent to expert referees for identification. This can be a more cost-effective solution than spending long periods trying to identify difficult samples.

62. Where two different surveyors have been surveying adjacent polygons it is important that any amendments to the common boundaries are reconciled between the two maps. One set of maps must be established as the authoritative version. Before the amendments are digitised, one of the surveyors must mark the authoritative version of such boundaries with a tick in a conspicuous colour.

63. For each surveyed site a GIS project should be produced comprising: a populated habitat polygon map with fields for dominant Annex I habitat types, Fossitt habitats and provisional vegetation community types; waypoint target notes as point shapefiles with hyperlinked text

notes; releve locations as point shapefiles with photographs; condition assessment stops and assessment results.

64. For each surveyed site a separate site report should be written by the project co-ordinator containing the following elements:

- a map showing the boundaries of the survey area over the aerial photographs
- a map of the dominant Annex I habitat types within the survey area
- a map of the dominant Fossitt (2000) habitat types within the survey area
- gradated maps showing the frequency within polygons of selected key Annex I habitats
- maps for use in the field showing the re-digitised polygons over aerial photographs, with amended site numbers, contours and designated site boundaries on A3 sheets at a scale of 1:10,000.
- a written summary site description
- a written analysis of the extent of vegetation or habitat types under Fossitt (2000) and Annex I habitat type schemes
- a written summary of the results of conservation assessment

Where no specific map scale is stated maps should be prepared at a scale suitable for the clear display of the recorded information. An example site summary report was prepared during this project for Corraun Plateau (Roche *et al.* 2009) and the general approach for this site should be followed.

65. For each year/phase of the survey, a Turboveg database containing all the recorded relevés and a version of the *NSUH Conservation Assessment Database* should be produced. All photos being submitted should be correctly labelled and stored in a single folder and a version of the NPWS Image Databank input spreadsheet should be completed.

66. A summary of the survey report should be made available to the landowners / commonage shareholders. Options include online publication of the report including a non-technical summary, posting copies of the report to key local figures who can pass it on to those who are interested, a lecture or seminar that is open to the public or an open day, where members of the field team accompany members of the public to the sites, providing first-hand experience and some interpretation of the ecology. NPWS do not have the facilities for hosting events except in some localities (e.g. National Parks offices); however local Biodiversity or Heritage Officers may also be of help in this respect.

67. As recommended in Smith *et al.* (2010) periodic inspection of the data being collected should be carried out. The main purpose of these inspections is to identify systematic errors at an early stage so that these can be remedied as quickly as possible. Systematic sources of error which can be discovered include routine miscalculation of certain habitat types, regular omission of data from data sheets and misinterpretation of instructions. Time should be set aside within the schedule of the project coordinator to complete these inspections.

2.11 Health and safety / equipment

Health and safety is a very serious consideration for field surveyors. Problems can be prevented through training adherence to health and safety protocols and the use of the correct equipment, kept in good condition. Clear communication and accurate navigation are of paramount importance. In the event of a health and safety incident, common sense is imperative as circumstances will vary in every case. The safety advice given here is based on common sense and our experience of working in upland areas. Further advice can be found at www.mountaineering.ie. People following these guidelines do so at their own risk and neither BEC Consultants Ltd. Nor the National Parks and Wildlife Service can be held accountable for accident or injury to anyone following them.

- Be aware of the regional weather forecast for the area and arrange work accordingly.
- Surveyors should be aware of their location and direction at all times. As a general rule, they should check their position on a map and a GPS receiver at least once every 250 m. A compass should be within easy reach at all times.
- The use of GPS waypoints is recommended when navigating through difficult terrain, especially if there is a possibility of having to return in bad weather conditions or poor light.
- Surveyors should operate in the field in pairs or larger teams and be no more than 1 km apart from their nearest co-worker at any time.
- Surveyors should have carry printed copies of phone numbers of all team members, the project coordinator, Mountain Rescue and regional NPWS staff at all times.
- Surveyors should plan in advance which specific polygons or areas they will survey each day, with contingencies for bad weather when it may be unsafe to survey high altitude areas, and should ensure that other surveyors on the same site and staff not in the field are aware of their plans.
- The use of satellite phones should be considered in upland areas with poor mobile phone reception.
- Surveyors should check in with each other by phone at scheduled times during the day, and more frequently when working in difficult terrain.
- In the event of a surveyor being late to a meeting point, their colleague should wait at the meeting point for at least an hour. They should not go looking for the latecomer. It is vital to remain available for communication, so if there is no mobile phone reception, surveyors should move to a location with a better signal, leaving a conspicuous note or sign to show where they have gone. Mountain rescue services should only be alerted 2-3 hours after failure to return. **Dial 999/112 and ask for "Mountain Rescue".** You will be put through to the local Garda station where the situation will be assessed and the rescue team alerted.

- Dangerously steep areas should be avoided and can be surveyed using binoculars, with reference to aerial photographs.
- Equipment weight should be minimised where possible to prevent fatigue. A balance must be struck between ensuring that surveyors are well prepared and overburdening them. The lightest forms of reliable equipment are therefore an essential requirement.
- Surveyors must carry an adequate supply of water as, due to the high numbers of herbivores present in the uplands, drinking from mountain streams is not recommended.
- A spare key should be left near the vehicles so that other members of the survey team can get immediate access to shelter if they return early, are unwell or fatigued.
- In case of thunder or lightning, surveyors at relatively low altitudes and not in an exposed location should leave the hill. If lightning is observed or if in an exposed location, then surveyors should lie down in the nearest concavity until the danger has passed.

The following list is of health and safety equipment. It is strongly recommended that each of these items is carried by all fieldworkers at all times. Where appropriate, all items must be checked regularly to ensure that they are fit for purpose.

- Trekking pole
- First aid kit
- Whistle
- Survival bag
- High visibility vest
- Quick-drying, breathable clothing
- Waterproof jacket and overtrousers
- Extra top layer
- Gloves
- Warm hat/balaclava
- Emergency food rations
- Water
- Mobile phone (ensure that it is fully charged every morning)
- Torch

The following list of survey equipment will also be required for each field worker:

- This survey manual
- Identity card and code of conduct
- Official letter from NPWS
- Certificate of insurance

- Wellington boots and walking boots
- Compass
- Clinometer
- Digital camera (minimum 7.0 megapixels)
- Binoculars (8 x 30 magnification)
- Large plastic bags (for protection of maps, notebooks etc. in wet weather)
- Small plastic bags (for vascular plant and soil samples)
- Envelopes (for bryophyte samples)
- Permanent marker
- Tent pegs and cord (for marking out relevés)
- Trowel
- Botanical field guides
- Details of upland Annex I and Fossitt (2000) habitats
- Hand lens (x10/x20)
- GPS unit
- Spare GPS batteries in waterproof bag
- Mapper or augmented PDA (see below)
- Pencils, eraser, sharpener
- Insect repellent
- Sun protection lotion
- Ordnance Survey map
- A4 weatherwriter clipboard
- Waterproof paper
- Paper recording sheets
- Waterproof rucksack

It is essential that all electronic equipment (mobile phones, cameras, PDAs, mappers and GPS units) are fully charged every morning. Waterproof covers must be used with non-ruggedised mappers / PDAs. PDAs should be augmented with a Bluetooth or CompactFlash GPS receiver if required. Spare or extended life batteries for mappers / PDAs should be carried if the main battery is insufficient for a full day's usage. High capacity SD (SDHC) cards should be used to enable all required digital data to be available in the field and for backup purposes; 16GB cards are recommended. All GPS equipment should be set to Irish National Grid projection with the Ireland 1965 datum.

CHAPTER 3: ANALYSIS OF UPLAND VEGETATION DATA

3.1 Introduction

The primary habitat classification currently used in Ireland for surveying and mapping of habitats is the Heritage Council's *A Guide to Habitats in Ireland* (Fossitt 2000). It is, however, intended for widespread and general use rather than habitat specific studies as it lacks the resolution and detail to distinguish the range of vegetation communities within the habitats. Where it has previously been employed in national surveys of woodland and grassland habitats (Perrin *et al.* 2008a, Martin *et al.* 2008) more detailed *a posteriori* vegetation classifications have been produced.

Following an initial review of the categorisation of upland habitats in Fossitt (2000) it was clear that a more detailed scheme was needed for a proposed National Survey of Upland Habitats so that the range of variation in vegetation communities could be recorded as this kind of data is a fundamental pre-requisite for the achievement of biodiversity conservation. As mentioned in Chapter 2, a provisional list of communities was subjectively produced for the purposes of the pilot survey fieldwork based on White & Doyle (1982), the British National Vegetation Classification (NVC; Rodwell 1991,1992) and expert judgement. The present chapter includes a more objectively produced, although preliminary, classification using multivariate statistics on an embryonic dataset comprised of releves from the pilot survey fieldwork and a number of other available sources.

3.2. Methods

3.2.1 Data sources

The initial dataset comprised relevé data from upland habitats acquired from the sources listed in Table 3.1. A primary reason for using many of these data sources was that they were already available in digital format.

3.2.2 Data preparation

The data was screened prior to analysis to remove poorly recorded plots and to ensure taxonomic conformity. Some plots representing communities disjunct from the main dataset were also excluded. Only plant records which had been identified to at least the species level were included in the analysis, as records at the genus level (e.g. *Carex* sp., *Sphagnum* sp.) may be amalgams of species with markedly different ecological preferences and therefore meaningless. Plots which contained genus level records with a cover score of greater than 5% were excluded from the analysis due to the lack of accurate data on significant portions of the vegetation. Due to taxonomic changes records within each of the following sets of species were combined: *Agrostis vinealis /Agrostis canina, Sphagnum recurvum /Sphagnum fallax, Sphagnum auriculatum / Sphagnum denticulatum / Sphagnum inundatum.* Records of the mucilagenous algae collective *Zygogonium ericetorum* were excluded as this taxon had not been consistently recorded. To reduce noise, species recorded in fewer than three relevés were also excluded. Domin scores were converted to

percentage cover using the method of Currall (1987) prior to analysis, as mean values cannot be calculated directly from a non-linear scale. Similarly, data recorded using the Braun-Blanquet scale was converted to mid-range percentage values. This preparation resulted in a dataset of 2089 relevés and 379 species for vegetation analysis.

Multivariate outlier analysis was used to examine the resulting dataset. The mean distance of each sample from each other sample was calculated using Quantitative Sørensen (Bray-Curtis) as the distance measure.

Table 3.1 Sources of data used in the provisional classification. No. of relevés refers to the number of relevés used in the analysis following data screening.

Main surveyor(s)	Year(s) of survey	No. of relevés	Main habitats	Reference
Brendan O'Hanrahan Jenni Roche	2009	191	Blanket bog, wet and montane heath, acid grassland, scree and rock cleft communities	Present study
Paul Green	2006	115	Scree and rock cleft communities, acid grassland	O'Donovan (2007)
Catriona Brady Con Breen	2006	35	Montane heath	O'Donovan (2007)
Minna Pollanen	2006	68	Blanket bog, wet and dry heath	O'Donovan (2007)
Monty Loftus	1996	16	Blanket bog, wet and dry heath	Loftus & Scott (1996)
Andrea Webb	2002	32	Blanket bog, wet and dry heath	Webb (2002)
Frank Burke	c. 2001	90	Blanket bog, Wet and dry heath, acid grassland	Burke (2001)
Fiona Dunne	1999-2000	49	Blanket bog, wet and dry heath, acid grassland	Dunne (2000)
Fiona Dunne	c. 1997	180	Blanket bog and wet heath	Unpublished data
Fiona MacGowan	1994-1996	421	Blanket bog	MacGowan (2000)
Catherine Farrell	1996-2004	102	Blanket bog, heath, acid grassland	Farrell (2007)
Catherine Farrell	1998-1999	380	Blanket bog	Farrell (2001)
Peter Foss	1965-1984	65	*Erica erigena* heath	Foss (1986)
Colmán Ó Criodain	c. 1986	147	Fen and flush communities	O Criodain (1988)
BEC Consultants Ltd.	2007-2008	102	Acid grassland	Martin *et al.* (2007, 2008)
Various Dutch recorders	1949	96	Blanket bog, wet and dry heath, rock cleft communities	Various unpublished sources

3.2.3 Analysis techniques

A pair of complementary statistical techniques was used to analyse the dataset. Analysis was conducted using PC-ORD 5 (MjM Software, Oregon) with the aim of defining an objective classification that largely followed the procedures in Perrin *et al.* (2006a, b, 2008a, b) and Martin *et al.* (2007). Perrin *et al.* (2006a, b) also discuss the advantages of these techniques over the more commonly used method of TWINSPAN.

Hierarchical, polythetic, agglomerative cluster analysis. This was the main method selected for grouping the data into vegetation types. From a data matrix of *n* samples x *p* species, an *n* x *n* distance matrix is calculated by measuring the dissimilarity (or similarity) between each pair of samples. The most similar samples, which are selected using a predetermined criterion of minimum distance (linkage method), are merged into a group and their attributes are combined. The procedure is repeated *n* - 1 times until the samples have been merged (clustered) into two groups, with the results being displayed as a dendrogram (McCune & Grace 2002). Quantitative Sørensen (Bray-Curtis) was selected as the distance measure, as it has been shown to be one of the most effective measures for ecological community analysis, being less prone to exaggerating the influence of outliers and retaining greater sensitivity with heterogeneous datasets (McCune & Grace 2002). Flexible beta was used as the linkage method with $\beta = -0.25$ (Lance & Williams 1967). This option is compatible with Sørensen distance and is space-conserving, i.e. properties in theoretical space defined by the original dissimilarity matrix are preserved as groups form during the cluster procedure. Space-distorting strategies can lead to undesirable effects such as high levels of chaining, the sequential addition of single items to existing groups (Legendre & Legendre 1998; McCune & Grace 2002).

Indicator Species Analysis (ISA). This method of Dufrene & Legendre (1997) was used to identify species that differentiated between clusters of samples. ISA produces percentage indicator values (IndVals) for species and works on the concept that, for a predetermined grouping of samples, an ideal indicator species will be found exclusively within one group and will be found in all the samples in that group at maximum abundance. IndVals are thus a simple combination of measures of relative abundance between groups and relative frequency within groups. At any given level of clustering, species are assigned to the group for which their IndVal is maximal. Dufrene & Legendre (1997) concluded that ISA was more sensitive at identifying indicator species than TWINSPAN.

3.3 Results

3.3.1 General

An initial round of cluster analysis divided the dataset into six broad ***groups***. This level of grouping was decided upon after expert judgement was used to analyse the cluster dendrogram for broad groupings with ecological integrity and approximately comparable levels of resolution. Some manual relocation of relevés between groups was conducted to improve ecological integrity. The final six groups are detailed in Table 3.2.

In a second round of cluster analysis the dataset was partitioned according the six groups and each sub-dataset was reanalysed as before. This resulted in 39 more detailed ***vegetation types***. These vegetation types are approximately equivalent to the level of community in the NVC (Rodwell 1991). A summary of these is presented in Table 3.3. Brief accounts of these vegetation types follow, with summary data in synoptic tables (Table 3.4 to 3.9). Each account lists the main

affinities of each vegetation type to the Heritage Council's A Guide to Habitats in Ireland (Fossitt 2000), to Annex I habitats (Anon. 2007) and to the British NVC (Rodwell 1991 *et seq*.).

3.3.2 Synoptic tables

A synoptic table is presented for each group displaying a summary of the floristic data. Data for each vegetation type within the group is presented in a separate column identified by lower case letter with summary data for the group as a whole presented in the final column. Species are included in the table which have 5% or greater frequency in one or more of the vegetation types (and, in the case of the rarer vegetation types, which occur in more than one relevé). Frequency and abundance data are given for each species in each vegetation type. Frequency here refers to the percentage of relevés in which that species occurs irrespective of how much is present and is indicated by Roman numerals, where I = 0.1 – 20.0%, II = 20.1 – 40.0%, III = 40.1 – 60.0%, IV = 60.1 – 80.0% and V = 80.1 – 100%. Abundance refers to the mean cover that species provides within the samples irrespective of frequency and is in percent. Some species have been identified as good indicators for a particular vegetation type and are marked by a number of dots. These ***type indicators*** help differentiate only between the vegetation types within that group and should not be used to make comparisons with vegetation types from other groups. The number of dots denotes the value of the species as an indicator such that: • = 10 – 20.0%, •• = 20.1 – 40.0%, ••• = 40.1 – 60.0%, •••• = 60.1 – 80.0% and ••••• = 80.1 – 100%.

Species are ordered within the table as follows. The first section contains the constant species, which in phytosociological terminology are those with an overall frequency in the group of IV or V. Where constant species are lacking the first section contains frequent species which are those with an overall frequency in the group of III. Within this section species are ordered by their indicator status for each of the vegetation types. The subsequent sections contain the indicator species for each of the vegetation types in turn. Within these sections species are ordered by their value as indicators. After the indicator species the remaining species which do not have any significant affinity for one of the vegetation types are shown. These companion species have been divided in sections according to whether they are woody species, forbs, grasses, sedges and rushes, ferns, bryophytes or lichens and within these sections they are ordered by frequency within the group.

Table 3.2 The six groups of upland vegetation types and the habitat in which they occur defined by cluster analysis. Species listed are the best indicators as defined by Indicator Species Analysis. Percentage figures are Indicator Values

1	***Agrostis capillaris* – *Rhytidiadelphus squarrosus* group** **Acid and montane grasslands and rocky clefts**		
Agrostis capillaris	43.4 %	*Potentilla erecta*	22.4%
Rhytidiadelphus squarrosus	41.4%	*Hylocomium splendens*	22.0%
Anthoxanthum odoratum	40.3%	*Festuca rubra*	21.6%
Nardus stricta	32.0%	*Deschampsia flexuosa*	18.1%
Galium saxatile	27.7%	*Carex pilulifera*	24.8%

2	***Calluna vulgaris* – *Erica cinerea* group** **Dry and montane heathlands**		
Calluna vulgaris	62.0%	*Empetrum nigrum*	17.0%
Erica cinerea	40.4%	*Racomitrium lanuginosum*	16.9%
Vaccinium myrtillus	25.0%	*Pleurozium schreberi*	14.9%
Hypnum cupressiforme	20.8%	*Ulex gallii*	13.4%
Hypnum jutlandicum	19.9%	*Dicranum scoparium*	12.6%

3	***Molinia caerulea* – *Erica tetralix* group** **Wet heathlands and blanket bog**		
Molinia caerulea	53.9%	*Schoenus nigricans*	27.4%
Erica tetralix	50.5%	*Polygala serpyllifolia*	26.1%
Sphagnum capillifolium	36.3%	*Pleurozia purpurea*	22.7%
Trichophorum germanicum	34.4%	*Eriophorum vaginatum*	22.4%
Odontoschisma sphagnii	30.2%	*Cladonia portentosa*	21.6%

4	***Narthecium ossifragum* – *Rhynchospora alba* group** **Blanket bog and bog hollows**		
Rhynchospora alba	40.0%	*Sphagnum cuspidatum*	10.7%
Narthecium ossifragum	34.7%	*Eleocharis multicaulis*	8.7%
Eriophorum angustifolium	32.6%	*Drosera intermedia*	8.1%
Sphagnum auriculatum	11.5%	*Drosera anglica*	5.7%
Campylopus atrovirens	11.1%		

5	***Juncus effusus* – *Carex nigra* group** **Rushy flushes and rush pasture**		
Juncus effusus	81.3%	*Kindbergia praelonga*	18.1%
Polytrichum commune	62.6%	*Holcus lanatus*	17.8%
Campylopus introflexus	35.7%	*Lophocolea bidentata*	17.8%
Sphagnum recurvum agg.	29.2%	*Aulacomnium palustre*	17.0%
Juncus bulbosus	19.6%	*Rumex acetosa*	15.2%

6	***Carex nigra* – *Ranunculus flammula* group** **Flushes, fens and pool communities**		
Carex nigra	55.4%	*Galium palustre*	39.8%
Ranunculus flammula	51.6%	*Caltha palustris*	37.3%
Hydrocotyle vulgaris	47.1%	*Equisetum fluviatile*	35.7%
Mentha aquatica	45.2%	*Menyanthes trifoliata*	34.8%
Juncus articulatus	44.7%	*Lythrum salicaria*	33.2%

Table 3.3 Summary of vegetation types

1		***Agrostis capillaris – Rhytidiadelphus squarrosus* group** **Acid and montane grasslands and rocky clefts**
	1a	*Sesleria caerulea – Campanula rotundifolia* vegetation type
	1b	*Nardus stricta – Carex panicea* vegetation type
	1c	*Festuca ovina* vegetation type
	1d	*Rhytidiadelphus squarrosus – Festuca vivipara* vegetation type
	1e	*Pteridium aquilinum* vegetation type
	1f	*Deschampsia flexuosa – Calluna vulgaris* vegetation type
	1g	*Racomitrium lanuginosum – Diplophyllum albicans* vegetation type
	1h	*Juncus squarrosus* vegetation type
	1i	*Agrostis capillaris – Trifolium repens* vegetation type
2		***Calluna cinerea – Erica cinerea* group** **Dry and montane heathlands**
	2a	*Racomitrium lanuginosum – Cladonia uncialis* vegetation type
	2b	*Calluna vulgaris – Hypnum cupressiforme* vegetation type
	2c	*Eriophorum vaginatum – Eriophorum angustifolium* vegetation type
	2d	*Ulex gallii – Erica cinerea* vegetation type
	2e	Sparse cover *Calluna vulgaris* vegetation type
3		***Molinia caerulea – Erica tetralix* group** **Wet heathlands and blanket bog**
	3a	*Erica tetralix – Pleurozia purpurea* vegetation type
	3b	*Molinia caerulea – Anthoxanthum odoratum* vegetation type
	3c	*Schoenus nigricans – Rhynchospora alba* vegetation type
	3d	*Calluna vulgaris – Sphagnum capillifolium* vegetation type
	3e	*Trichophorum germanicum – Eriophorum vaginatum* vegetation type
	3f	*Erica erigena* vegetation type
	3g	*Sphagnum palustre – Menyanthes trifoliata* vegetation type
4		***Narthecium ossifragum – Rhynchospora alba* group** **Blanket bog and bog hollows**
	4a	*Sphagnum auriculatum – Sphagnum cuspidatum* vegetation type
	4b	*Rhynchospora alba – Eriophorum vaginatum* vegetation type
	4c	*Schoenus nigricans – Erica cinerea* vegetation type
	4d	*Molinia caerulea – Erica tetralix* vegetation type
	4e	*Eriophorum angustifolium* vegetation type
	4f	*Narthecium ossifragum* vegetation type
	4g	Sparse cover *Molinia caerulea – Eriophorum angustifolium* vegetation type
	4h	*Carex panicea – Agrostis stolonifera* vegetation type
5		***Juncus effusus – Polytrichum commune* group** **Rushy flushes and rush pasture**
	5a	*Rumex acetosa – Holcus lanatus* vegetation type
	5b	*Campylopus introflexus* vegetation type
	5c	*Juncus bulbosus – Sphagnum cuspidatum* vegetation type
	5d	*Sphagnum recurvum* agg. *– Agrostis stolonifera* vegetation type
	5e	*Juncus acutiflorus – Potentilla erecta* vegetation type
6		***Carex nigra – Ranunculus flammula* group** **Flushes, fens and pool communities**
	6a	*Carex rostrata – Equisetum fluviatile* vegetation type
	6b	*Potamogeton polygonifolius – Carex echinata* vegetation type
	6c	*Carex nigra –Lythrum salicaria* vegetation type
	6d	*Carex lasiocarpa – Carex limosa* vegetation type
	6e	*Littorella uniflora – Eriocaulon aquaticum* vegetation type

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1a *Sesleria caerulea – Campanula rotundifolia* vegetation type

Included under this category are rocky, calcareous habitats of the uplands. Hence there is a long list of calcicole indicator species (truncated in the synoptic table), the most useful being *Sesleria caerulea*, *Campanula rotundifolia*, *Cystopteris fragilis*, *Sedum rosea* and *Ctenidium molluscum*. *Festuca rubra* is very frequent and often abundant here. In rocky clefts the ferns *Asplenium trichomanes* and *Asplenium viride* may be found and the moss *Breutelia chrysocoma* is locally abundant.

Affinities:

Fossitt:	ER2 Exposed calcareous rock,
	ER4 Calcareous scree and loose rock
Annex I:	8120 Calcareous and calcshist screes of the montane to alpine levels (*Thalaspietea rotundifolii*)
	8210 Calcareous rocky slopes with chasmophytic vegetation
NVC:	OV38 *Gymnocarpion robertianum – Arrhenatherum elatius* community
	OV40 *Asplenium viride – Cystopteris fragilis* community

Figure 3.1 Calcareous scree supporting *Festuca rubra* and *Breutelia chrysocoma*, type 1a, Ben Bulben

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1b *Nardus stricta – Carex panicea* vegetation type

This is an upland acidic grassland community of mineral or shallow organic soils dominated by *Nardus stricta.* Dwarf shrub cover is typically very low (<5%) although a sprigs of *Calluna vulgaris* or *Erica tetralix* are frequently encountered. Apart from *Nardus* this vegetation type lacks strong indicator species; *Carex panicea* and *Trichophorum germanicum* are occasional to frequent and rarely provide much cover. The main grass species are *Anthoxanthum odoratum* and *Agrostis capillaris*, while *Danthonia decumbens*, *Molinia caerluea* and *Agrostis canina* / *A. vinealis* are occasional. Other frequent vascular plants are *Juncus squarrosus*, *Galium saxatile* and *Potentilla erecta*. The moss layer is not extensive with the main species being *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and *Hypnum* spp.

Affinities:	
Fossitt:	GS3 Dry-humid acid grassland
Annex I:	6230 * Species-rich *Nardus* grassland, on siliceous substrates in mountain areas.
NVC:	U5 *Nardus stricta – Galium saxatile* grassland

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1c *Festuca ovina* vegetation type

This is essentially a grassland community of mineral or peaty soils with a sward composed mainly of *Anthoxanthum odoratum*, *Agrostis capillaris*, *Festuca rubra, Nardus stricta* and *Festuca ovina.* However, there is a heathy element to the vegetation and *Molinia caerulea*, *Vaccinium myrtillus*, *Calluna vulgaris* and *Juncus squarrosus* are all frequent. *Potentilla erecta* and *Galium saxatile* are constant forbs. In the bryophyte layer one will most frequently find *Hylocomium splendens*, *Rhytidiadelphus loreus* and *Rhytidiadelphus squarrosus*. Lacking any strong indicator species, this is in many terms a typical upland grassland community.

Affinities:	
Fossitt:	GS3 Dry-humid acid grassland
Annex I:	6230 * Species-rich *Nardus* grassland, on siliceous substrates in mountain areas.
NVC:	U4a *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland typical subcommunity

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1d *Rhytidiadelphus squarrosus – Festuca vivipara* vegetation type

Included under this somewhat broad category is rather wetter vegetation than found elsewhere in this group, usually due to some degree of flushing. The sward is dominated by *Anthoxanthum odoratum*, *Festuca vivipara*, *Agrostis capillaris* and *Holcus lanatus*, but a key character is the high cover of mosses, particularly *Rhytidiadelphus squarrosus* and *Hylocomium splendens*. Other indicators are rather weak but flush species such as *Carex nigra*, *Carex echinata, Juncus effusus* and *Juncus acutiflorus* may all occur. *Potentilla erecta* and *Galium saxatile* are frequent.

Affinities:	
Fossitt:	GS3 Dry-humid acid grassland
Annex I:	No corresponding habitat
NVC:	No corresponding community

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1e *Pteridium aquilinum* vegetation type

This is a readily identifiable vegetation type representing as it does dry, bracken-dominated areas of mineral or peaty soils within the uplands. *Pteridium aquilinum* is the naturally the main dominant and cover should be at least 25% but is often much greater. Beneath the bracken is a grassland flora of *Anthoxanthum odoratum*, *Agrostis capillaris*, *Holcus lanatus* and *Rhytidiadelphus squarrosus* with *Galium saxatile* a frequent broadleaf herb. The shaded conditions yield indicator species more commonly found in woodland in the guise of *Kindbergia praelonga* and *Oxalis acetosella*.

Affinities:	
Fossitt:	HD1 Dense bracken
Annex I:	No corresponding habitat
NVC:	U20 *Pteridium aquilinum – Galium saxatile* community

Figure 3.2 Vegetation dominated by *Pteridium aquilinum*, type 1e, Mweelrea

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1f *Deschampsia flexuosa – Calluna vulgaris* vegetation type

This is a rather species-poor heathy grassland type of acidic soils. *Calluna vulgaris* is a constant species here and *Erica cinerea* is also frequent, but heather cover is much lower than in the group 2. The sward is dominated by *Deschampsia flexuosa* with *Nardus stricta* and *Molinia caerulea* frequent elements and hence can be fairly tussocky in nature. The cover of bryophytes is rather poor and as usual the only frequent broadleaf herbs are *Potentilla erecta* and *Galium saxatile*.

Affinities:

Fossitt:	GS3 Dry-humid acid grassland
Annex I:	No corresponding habitat
NVC:	U2 *Deschampsia flexuosa* grassland

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1g *Racomitrium lanuginosum – Diplophyllum albicans* vegetation type

This vegetation type represents montane grassland and grass - heath communities. It occurs typically on shallow well-drained high altitude soils and the vegetation is typically rather open. The main grass species is *Nardus stricta* with smaller cover contributions made by *Agrostis capillaris*, *Agrostis canina* / *A. vinealis*, and *Festuca vivipara*. *Vaccinium myrtillus* is the most frequent dwarf shrub but provides sparse cover. *Empetrum nigrum* is an occasional component. The only frequent broadleaf herbs are *Potentilla erecta* and *Galium saxatile.* The chief indicator species for this vegetation type is the moss *Racomitrium lanuginosum* which is typically plentiful. Other indicative bryophyte species are *Diplophyllum albicans*, *Scapania gracilis*, *Pleurozia purpurea*, *Rhytidiadelphus loreus* and *Campylopus atrovirens.* The club mosses, *Huperzia selago* and *Diphasiastrum alpinum* are also noticeable features. The montane sedge *Carex bigelowii* whilst indicative of this habitat is only an occasional record within the relevés gathered here and appears to less prevalent than in the corresponding habitat in Britain.

This vegetation type is closely related to the montane heath community of vegetation type 2a, but differs in the lower cover of *Calluna vulgaris*, higher cover of *Nardus stricta* and lower cover of *Cladonia* species.

Affinities:	
Fossitt:	HH3 Montane heath
Annex I:	6150 Siliceous alpine and boreal grasslands
NVC:	U7 *Nardus stricta – Carex bigelowii* grass heath
	U10 *Carex bigelowii – Racomitrium lanuginosum* moss heath

Figure 3.3 Sparsely vegetated grassland with *Racomitrium lanuginosum*, type 1g, Slieve League

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1h *Juncus squarrosus* vegetation type

This is a rather poorly defined group containing a residue of grassland samples which do not fit well elsewhere in this group. Included here is low, open vegetation of peaty soils in which *Juncus squarrosus* is the principal species and also rather sparse cover vegetation of rocky ground in which grass species (*Anthoxanthum odoratum* and *Agrostis capillaris*) are the main element (q.v. type 2e).

Affinities:	
Fossitt:	GS3 Dry-humid acid grassland, ER1 Exposed siliceous rock
A*nnex I:*	*No corresponding habitat*
NVC:	*corresponding community*

1 *Agrostis capillaris – Rhytidiadelphus squarrosus* group **see Table 3.4**

1i *Agrostis capillaris – Trifolium repens* vegetation type

This is a grassland community in which the sward is strongly dominated by *Agrostis capillaris* with *Anthoxanthum odoratum* and *Holcus lanatus* frequent. *Festuca ovina* and *Nardus stricta* are occasional but the latter species is far less plentiful here than in vegetation type 1b. *Galium saxatile* and *Potentilla erecta* are unsurprisingly the most frequent broadleaved herbaceous species. In the lower reaches of the uplands, closer to farmsteads, the sward may contain species indicative of agricultural improvement such as *Lolium perenne*, *Trifolium repens* and *Cerastium fontanum* although this improvement is unlikely to be intensive. The bryophyte layer contains *Hylocomium splendens*, *Rhytidiadelphus squarrosus* and some *Thuidium tamariscinum.*

Two subtypes are defined:

1i-i *Agrostis capillaris* subtype: Species indicative of agricultural improvement largely absent

1i-ii *Trifolium repens* subtype: Species indicative of agricultural improvement frequent

Affinities:	
Fossitt:	GS3 Dry-humid acid grassland
A*nnex I:*	6230 *Species-rich *Nardus* grassland, on siliceous substrates in mountain areas.
NVC:	U4b *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland *Holcus - Trifolium* subcommunity

Figure 3.4 Tightly-grazed grassland dominated by *Agrostis capillaris* with *Festuca ovina*, type 1i, Slieve League

2 *Calluna vulgaris – Erica cinerea* group **see Table 3.5**

2a *Racomitrium lanuginosum – Cladonia uncialis* vegetation type

These samples are of montane heathland of the high uplands, typically on shallow soils with large amounts of exposed or loose rock, including scree. The overall cover of vegetation is typically not high. The dominant woody shrub is *Calluna vulgaris* with *Empetrum nigrum* and *Erica cinerea* both frequent. Herbaceous species primarily comprise *Potentilla erecta*, *Eriophorum angustifolium* and *Molinia caerulea*. One of the key indicator species is the moss *Racomitrium lanuginosum* which is abundant and forms extensive patches not found in other vegetation types in this group. *Diplophyllum albicans* and *Hypnum cupressiforme* (*sensu lato*) may also be conspicuous. Also indicative of this habitat is the high frequency of foliose lichens particularly *Cladonia* species, of which *Cladonia uncialis* and *Cladonia portentosa* are the most frequent.

Affinities:	
Fossitt:	HH4 Montane heath, ER3 Siliceous scree and loose rock
Annex I:	4060 Alpine and boreal heaths
	8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsetalia ladani*)
NVC:	H14 *Calluna vulgaris – Racomitrium lanuginosum* heath

Figure 3.5 Montane heath dominated by *Calluna vulgaris* with *Juniperus communis*, *Artctostaphylos uva-ursi*, Corraun

2 *Calluna vulgaris – Erica cinerea* group	**see Table 3.5**
2b *Calluna vulgaris – Hypnum cupressiforme* vegetation type	

This category may be regarded as the standard dry acidic heath community. *Calluna vulgaris* is a very strong dominant to the degree that this is a rather species-poor community. The shrubs *Erica cinerea, Vaccinium myrtillus* and *Erica tetralix* are all fairly frequent but none tends to be abundant here. *Molinia caerulea* is the chief grass species and *Potentilla erecta* is the only frequent herb. The moss layer may include *Hylocomium splendens*, *Rhytidiadelphus loreus*, *Pleurozium schreberi*, *Dicranum scoparium* and some *Sphagnum capillifolium*, but the main bryophyte species is *Hypnum cupressiforme* (*sensu lato*) much of which is likely to be *Hypnum jutlandicum* growing on the woody stems and ericaceous litter.

Affinities:	
Fossitt:	HH1 Dry siliceous heath
Annex I:	4030 European dry heaths
NVC:	H10 *Calluna vulgaris – Erica cinerea* heath

Figure 3.6 *Calluna vulgaris*-dominated dry heath community, type 2b, Carrowkeel

2 *Calluna vulgaris – Erica cinerea* group **see Table 3.5**

2c *Eriophorum vaginatum – Eriophorum angustifolium* vegetation type

This vegetation type is the wettest of those in this group. *Calluna vulgaris* is still the dominant shrub species, but *Erica tetralix* is rather more prevalent and *Erica cinerea* somewhat less so. *Vaccinium myrtillus* is common in low amounts. Frequent indicator species characteristic of damper ground include *Eriophorum vaginatum*, *Eriophorum angustifolium* and *Trichophorum germanicum*. *Juncus squarrosus* and *Narthecium ossifragum* may also occur amongst the heather. Grasses comprise mainly *Molinia caerulea* and *Nardus stricta*. The bryophyte layer has a reasonable *Sphagnum* component to it with *Sphagnum capillifolium* and *Sphagnum subnitens* being the most common species. *Hylocomium splendens* may be locally abundant and at higher altitudes *Racomitrium lanuginosum* can occur.

Affinities:	
Fossitt:	HH3 Wet heath
Annex I:	4010 Northern Atlantic wet heaths with *Erica tetralix*
NVC:	M15 *Scirpus cespitosus – Erica tetralix* wet heath

Figure 3.7 Low heath community dominated by *Calluna vulgaris, Juncus squarrosus* and *Eriophorum vaginatum*, type 2c, Slieve League

2 *Calluna vulgaris – Erica cinerea* group	**see Table 3.5**
2d *Ulex gallii – Erica cinerea* vegetation type	

This vegetation type is a dry acidic heath variant in which *Ulex gallii* is usually dominant or co-dominant with *Calluna vulgaris*. In the north of the country, where *Ulex gallii* is largely absent, the abundance of *Erica cinerea* will serve to identify this community as it is far more prevalent here than in the other vegetation types in this group, as is *Molinia caerulea*. Other frequent grass species are *Festuca vivipara, Anthoxanthum odoratum, Agrostis canina / A.vinealis* and *Agrostis capillaris. Potentilla erecta, Galium saxatile* and *Carex binervis* are frequent components. The main moss species are *Thuidium tamariscinum*, *Hypnum jutlandicum*, *Hylocomium splendens* and *Pleurozium schreberi* with *Sphagnum* species being conspicuous in their absence.

Affinities:	
Fossitt:	HH1 Dry siliceous heath
Annex I:	4030 European dry heaths
NVC:	H8 *Calluna vulgaris – Ulex gallii* heath

Figure 3.8 *Ulex gallii* dominated dry heath with *Erica cinerea*, type 2d, Valentia

2 *Calluna vulgaris – Erica cinerea* group	**see Table 3.5**
2e Sparse cover *Calluna vulgaris* vegetation type	

This vegetation type comprises sparsely distributed dry heath vegetation and chiefly occurs over siliceous rocks on slopes, but occasionally may occur scattered across bare peat. There are no specific indicator species and *Calluna vulgaris* is the only constant species. *Erica cinerea* and *Vaccinium myrtillus* frequently occur as scattered sprigs. Many other dry heath species may occur but are occasional at best.

Affinities:	
Fossitt:	HH1 Dry siliceous heath, ER1 Exposed siliceous rock
Annex I:	4030 European dry heaths
	8220 Siliceous rocky slopes with chasmophytic vegetation.
NVC:	H10 *Calluna vulgaris – Erica cinerea* heath

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3a *Erica tetralix – Pleurozia purpurea* vegetation type

Essentially, this very common vegetation type is the standard wet heath community lacking as it does the extremes of cover values found elsewhere in group 3. Hence it is rather weakly defined in terms of indicator species. *Molinia caerulea* is the dominant species, constantly accompanied by *Calluna vulgaris* and *Erica tetralix*. The trinity of wet heath sedges, *Eriophorum angustifolium*, *Eriophorum vaginatum* and *Trichophorum germanicum* are all frequent or very frequent and provide good cover. *Schoenus nigricans* and *Narthecium ossifragum* are also frequent. Of the broadleaved herbs, *Potentilla erecta* is naturally the most prolific, but *Polygala serpyllifolia* is somewhat more plentiful than normal here. The bryophyte layer chiefly comprises *Sphagnum capillifolium, Hypnum jutlandicum, Racomitrium lanuginosum, Odonotoschisma sphagni, Sphagnum subnitens, Sphagnum papillosum* and *Pleurozia purpurea. Cladonia portentosa* is a frequent lichen.

Affinities:	
Fossitt:	HH3 Wet heath
Annex I:	4010 North Atlantic wet heaths with *Erica tetralix*
NVC:	M15 *Scirpus cespitosus – Erica tetralix* wet heath

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3b *Molinia caerulea – Anthoxanthum odoratum* vegetation type

Tussocks of *Molinia caerulea* overwhelmingly dominate this species-poor community, usually providing >80% cover. Included here are *Molinia*-dominated flushes and similar vegetation of wet heaths. *Calluna vulgaris* and *Erica tetralix* are frequent but of subsidiary cover and the other main indicators are *Anthoxanthum odoratum*, *Calypogeia fissa*, *Kindbergia* praelonga and *Potentilla erecta*; this last species is particularly prevalent here. *Eriophorum angustifolium* is far less frequent than elsewhere in this group and *Schoenus nigricans* is only occasional. *Myrica gale* is locally abundant where there is moving groundwater. The bryophyte layer is typically poor consisting of *Sphagnum capillifolium* and *Hypnum cupressiforme* (*sensu lato*) for the most part.

Affinities:	
Fossitt:	HH3 Wet heath, PF2 Poor fen and flush
Annex I:	4010 North Atlantic wet heaths with *Erica tetralix*
NVC:	M25 *Molinia caerulea – Potentilla erecta* mire

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3c *Schoenus nigricans – Rhynchospora alba* vegetation type

This vegetation type typical of lowland blanket bog is characterised by the prevalence of *Schoenus nigricans* with cover of this species usually being at least 35%. The other main species are *Molinia caerulea*, *Erica tetralix*, *Trichophorum germanicum*, *Eriophorum angustifolium* and *Calluna vulgaris*. *Rhynchospora alba* is frequently present and serves well to distinguish this community from the other vegetation types in this group. *Narthecium ossifragum* and *Drosera rotundifolia* are also frequently found here. The bryophyte layer is formed by *Sphagnum auriculatum*, *Sphagnum tenellum*, *Sphagnum capillifolium*, *Racomitrium lanuginosum* and *Campylopus atrovirens.*

This vegetation type differs from others in which *Rhynchospora alba* is common (q.v. vegetation types 4a and 4b) in the higher cover of *Schoenus nigricans* and *Molinia caerulea*.

Affinities:

Fossitt:	PB3 Lowland blanket bog
Annex I	7130 Blanket bog
NVC:	M14 *Schoenus nigricans – Narthecium ossifragum* mire

Figure 3.9 Vegetation dominated by *Schoenus nigricans* and *Molinia caerulea*, type 3c, Corraun

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3d *Calluna vulgaris – Sphagnum capillifolium* vegetation type

This is a damp heath community of upland peats characterised by the high covers of *Molinia caerulea*, *Calluna vulgaris* and *Sphagnum capillifolium*. *Erica tetralix* is a constant associate but affords lesser cover, whilst *Erica cinerea* is only occasional. *Potentilla erecta* and *Eriophorum angustifolium* are very regular elements of the flora. Other frequently occurring species are *Hypnum jutlandicum*, *Cladonia portentosa*, *Odontoschisma sphagnii, Racomitrium lanuginosum, Polygala serpyllifolia, Trichophorum germanicum, Narthecium ossifragum* and *Eriophorum vaginatum*. *Sphagnum subnitens* can be locally abundant.

This vegetation type differs from others in group 3 in the relatively high abundance of *Calluna vulgaris*. It is distinguished from those in group 2 by the high abundance of *Molinia caerulea* and *Sphagnum capillifolium.*

Affinities:	
Fossitt:	HH3 Wet heath
Annex I:	4010 North Atlantic wet heaths with *Erica tetralix*
NVC:	M15 *Scirpus cespitosus – Erica tetralix* wet heath

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3e *Trichophorum germanicum – Eriophorum vaginatum* vegetation type

This vegetation type represents a sedge-rich bog / wet heath community of wet, peaty soils. The majority of cover is provided by a mixture of *Trichophorum germanicum*, *Calluna vulgaris, Eriopohorum angustifolium* and *Eriophorum vaginatum*. *Molinia caerulea* is much less frequent here than elsewhere in group 3, but *Erica tetralix* is still a frequent component. *Narthecium ossifragum* and *Potentilla erecta* are the most frequent forbs whilst typical bryophytes are *Sphagnum capillifolium*, *Sphagnum subnitens* and *Racomitrium lanuginosum*.

Affinities:	
Fossitt:	HH3 Wet heath, PB2 Upland blanket bog, PB3, Lowland blanket bog
Annex I:	4010 North Atlantic wet heaths with *Erica tetralix* 7130 Blanket bog
NVC:	M15 *Scirpus cespitosus – Erica tetralix* wet heath

Figure 3.10 Vegetation dominated by *Trichophorum germanicum, Eriophorum angustifolium* and *Calluna vulgaris*, type 3e, Ben Bulben

3 *Molinia caerulea – Erica tetralix* group	**see Table 3.6**
3f *Erica erigena* vegetation type	

This vegetation type is a regional variation in which *Erica erigena* is the one of the principal dwarf shrubs and hence is restricted to western Mayo and Connemara. It typically occurs in a wet heath context, but is also frequent along streams and lakeshores and hence there is a rather long, disparate list of indicators species (truncated in the synoptic table) that should not really be needed to identify the vegetation type. *Molinia caerulea* is a constant associate, and along with *Schoenus nigricans,* it tends to make up the balance of the vegetation cover. *Calluna vulgaris* and *Erica tetralix* are also constants here but provide less cover. The main indicator species are *Anagallis tenella*, *Carex panicea*, *Eleocharis multicaulis*, *Succisa pratensis* and *Myrica gale*, this last species often being abundant. Other frequent species are *Narthecium ossifragum*, *Carex echinata* and *Potentilla erecta*.

Affinities:	
Fossitt:	HH3 Wet heath
Annex I:	4010 North Atlantic wet heaths with *Erica tetralix*
NVC:	No corresponding community

3 *Molinia caerulea – Erica tetralix* group **see Table 3.6**

3g *Sphagnum palustre – Menyanthes trifoliata* vegetation type

This slightly disparate category includes vegetation from flushes and, potentially, bog hollows where *Molinia caerulea* is found in combination with *Sphagnum* species (usually *Sphagnum palustre*, occasionally *Sphagnum recurvum* agg.) or *Carex echinata*. *Menyanthes trifoliata* is frequently found where pooling occurs. *Calluna vulgaris, Potentilla erecta* and *Eriophorum angustifolium* are all frequent but less abundant than in the other group 3 vegetation types. Other indicator species include *Potentilla palustris, Juncus bulbosus, Carex nigra* and *Juncus effusus* and suggest that this type is transitional in nature to those of groups 5 and 6.

Affinities:

Fossitt:	PF2 Poor fen and flush
Annex I:	No corresponding habitat
NVC:	No corresponding community

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4a *Sphagnum auriculatum – Sphagnum cuspidatum* vegetation type

This category includes *Sphagnum*-dominated vegetation of bogs hollows, peaty pools and inundated depressions which can occur on both intact and degraded bogs. The two main species are *Sphagnum auriculatum* and *Sphagnum cuspidatum* although *Sphagnum magellanicum* and *Sphagnum papillosum* are occasional. Other indicative species are *Menyanthes trifoliata*, *Utricularia minor* and *Eleocharis multicaulis*. *Eriophorum angustifolium* is typically plentiful. Frequent components of the vegetation are *Molinia caerulea*, *Narthecium ossifragum*, *Rhynchospora alba, Drosera intermedia and D. anglica*. *Schoenus nigricans* is occasional.

Affinities:

Fossitt:	FL1 Dystrophic lakes, PB2 Upland blanket bog, PB3 Lowland blanket bog, PB4 Cutover bog
Annex I:	3160 Natural dystrophic lakes and ponds, 7130 Blanket bog, 7150 Depressions on peat substrate of the *Rhynchosporion*
NVC:	M1 *Sphagnum auriculatum* bog pool community M2 *Sphagnum cuspidatum / recurvum* bog pool community

Figure 3.11 Inundated bog depression with *Sphagnum auriculatum, S. cuspidatum* and *Eleocharis multicaulis*, type 4a, Mweelrea

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4b *Rhynchospora alba – Eriophorum vaginatum* vegetation type

This blanket bog community shares with the bog hollows and pools of vegetation type 4a an affinity with the Rhynchosporion alliance, although here *Rhynchospora alba* is both more frequent and abundant than in the former category. However, this vegetation type appears to be more related to shallow bog depressions rather than pools lacking as it does any significant cover of *Sphagnum cuspidatum, Sphagnum auriculatum* or the other more aquatic species indicative of type 4a (q.v). Instead the vegetation is composed chiefly of *Moliniea caerulea*, *Schoenus nigricans*, *Eriophorum vaginatum*, *Eriophorum angustifolium* and *Narthecium ossifragum.* Dwarf shrubs are frequent but provide scant cover. Sundews (*Drosera* spp.) are occasional.

Affinities:	
Fossitt:	PB2 Upland blanket bog, PB3 Lowland blanket bog, PB4 Cutover bog
Annex I:	7150 Depressions on peat substrate of the Rhynchosporion
NVC:	No corresponding community

Figure 3.12 Vegetation dominated by *Molinea caerulea, Schoenus nigricans* and *Eriophorum vaginatum*, type 4b, Corraun

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4c *Schoenus nigricans – Erica cinerea* vegetation type

This is a rather open-structure bog vegetation type of peats in which *Schoenus nigricans* is the principal species. *Molinia caerulea, Narthecium ossifragum* and *Eriophorum angustifolium* are also usually present and provide much of the remaining vegetation cover. Other constant species are *Rhynchospora alba* and *Erica tetralix*. *Calluna vulgaris* is frequent. There is typically little in the way of a bryophyte layer with the most likely species to be encountered being *Campylopus atrovirens* and *Racomitrium lanuginosum*, although *Cladonia portentosa* and *Cladonia uncialis* are occasional.

This vegetation type is related to type 3c. The present vegetation type may be distinguished by its lower total cover, lower cover of *Schoenus nigricans* and *Molinia caerulea* and the relative paucity of the bryophytes, particularly *Sphagnum* species.

Affinities:

Fossitt:	PB3 Lowland blanket bog
Annex I:	7130 Blanket bog
NVC:	M14 *Schoenus nigricans – Narthecium ossifragum* mire

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4d *Molinia caerulea – Erica tetralix* vegetation type

This community is rather heathier than others in this group and may be seen as transitional to those of group 3. *Molinia caerulea* is the main species here, with *Erica tetralix*, *Eriophorum angustifolium*, *Narthecium ossifragum*, and *Calluna vulgaris* all constant. Other frequent species are *Schoenus nigricans, Trichophroum cespitosum, Carex panicea, Potentilla erecta* and *Drosera rotundifolia*.

Affinities:

Fossitt:	PB3 Lowland blanket bog
Annex I:	7130 Blanket bog
NVC:	No corresponding community

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4e *Eriophorum angustifolium* vegetation type

Included under this category is the vegetation of natural bog hollows, erosion channels and degraded bog areas where *Eriophorum angustifolium* is a dominant or co-dominant species. Cover of this sedge has been found to increase under the impacts of grazing or cutting (MacGowan & Doyle 1997) and for inclusion here cover should typically exceed 35%. The other group constants, *Molinia caerulea*, *Calluna vulgaris*, *Narthecium ossifragum* and *Erica tetralix* are only occasional. *Polytrichum commune* and *Campylopus introflexus* can be locally abundant. *Juncus effusus*, *Holcus lanatus* and *Trichophorum germanicum* are occasional elements.

This vegetation type is related to the degraded bog types 5b and 5c. The present vegetation type may be distinguished by the greater abundance of *Eriophorum angustifolium* and the subsidiary role of *Juncus bulbosus* and *Campylopus introflexus*.

Affinities:	
Fossitt:	PB2 Upland blanket bog, PB3 Lowland blanket bog, PB4 Cutover bog, PB5 Eroded bog
Annex I:	7130 Blanket bog
NVC:	M3 *Eriophorum angustifolium* bog pool community

Figure 3.13 *Eriophorum angustifolium* dominated vegetation, type 4e, Slieve League

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4f *Narthecium ossifragum* vegetation type

This vegetation type is poorly defined in terms of indicators but is related to the type 4e. Cover of *Eriophorum angustifolium* is not as high here, however, and indeed over all cover may be rather sparse often not exceeding 60%. *Molinia caerulea* is very frequent but it is *Narthecium ossifragum* and *Rhynchospora alba* which make up a good proportion of the vegetation. Cover of *Sphagnum* species is poor.

Affinities:	
Fossitt:	PB2 Upland blanket bog, PB3 Lowland blanket bog, PB4 Cutover bog
Annex I:	7130 Blanket bog
NVC:	No corresponding community

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4g Sparse cover *Molinia caerulea – Eriophorum angustifolium* vegetation type

This category contains sparse vegetation of degraded wet heaths and bogs in which total cover rarely exceeds 20%. Degradation may be due to cutting, trampling or overgrazing. *Molinia caerulea, Eriophorum angustifolium, Calluna vulgaris* and *Narthecium ossifragum* are constant species with *Schoenus nigricans*, *Rhyncospora alba*, *Erica tetralix* and *Potentilla erecta* frequent.

Affinities:	
Fossitt:	PB4 Cutover bog, PB5 Eroded bog
Annex I:	7130 Blanket bog
NVC:	No corresponding community

4 *Narthecium ossifragum – Rhynchospora alba* group **see Table 3.7**

4h *Carex panicea – Agrostis stolonifera* vegetation type

This vegetation comprises degraded areas of bog which have chiefly been damaged due to trampling. Unlike type 4g, the present vegetation type retains a reasonably high total cover of plants. The group constants, *Molinia caerulea, Eriophorum angustifolium, Narthecium ossifragum, Erica tetralix* and *Calluna vulgaris*, are constant here too. However, *Carex panicea* is also major component of the vegetation. There is a long list of indicator species (truncated in the synoptic table) of which the most useful include *Agrostis stolonifera*, *Carex viridula*, *Juncus bulbosus*, *Campylopus flexuosus* and *Hypnum jutlandicum*. *Campylopus introflexus* is also very frequent. The bryophyte layer includes *Sphagnum palustre* and *Sphagnum papillosum*.

Affinities:

Fossitt:	PB2 Upland blanket bog, PB3 Lowland blanket bog, PB5 Eroded bog
Annex I:	7130 Blanket bog
NVC:	No corresponding

5 *Juncus effusus – Polytrichum commune* group **see Table 3.8**

5a *Rumex acetosa – Holcus lanatus* vegetation type

This is a rather broad, rushy community of flushes and degraded bogs where there is some groundwater seepage. *Juncus effusus* is the dominant species frequently joined by *Rumex acetosa, Holcus lanatus* and *Anthoxathum odoratum* lending the vegetation something of a wet grassland character. Other indicators include *Potentilla palustris, Equisetum palustre, Angelica sylvestris* and *Galium palustre*. The main bryophyte species are *Kindbergia praelonga* and *Polytrichum commune*.

Affinities:	
Fossitt:	GS4 Wet grassland, PB4 Cutover bog
Annex I :	No corresponding habitat
NVC:	No corresponding community

5 *Juncus effusus – Polytrichum commune* group **see Table 3.8**

5b *Campylopus introflexus* vegetation type

This is a community of degraded bogs where the non-native moss *Campylopus introflexus* has colonised the bare peat and formed extensive patches. First recorded in Ireland in 1942, this species has rapidly spread across the country and is a common feature of heathland, bog and forestry plantations (Smith 2004). Degradation may be due to peat cutting or overgrazing. *Juncus effusus* and *Polytrichum commune* are also constant species here. *Dryopteris carthusiana* is an occasional species indicating the relatively dry nature of the peat in places. Other frequent species are *Juncus bulbosus, Lophocolea bidentata and Aulacomnium palustre* but they are not as plentiful here as in the vegetation type 5c which also includes vegetation from degraded peat. *Eriophorum angustifolium* is locally abundant.

Affinities:	
Fossitt:	PB4 Cutover bog
Annex I:	No corresponding habitat
NVC:	No corresponding community

5 *Juncus effusus – Polytrichum commune* group **see Table 3.8**

5c *Juncus bulbosus – Sphagnum cuspidatum* vegetation type

This category comprises rushy vegetation from degraded peat sites colonised by *Campylopus introflexus* and is related to vegetation type 5b. Key differences are the greater abundance here of *Juncus effusus*, *Juncus bulbosus* and bryophytes and the corresponding lower abundance of *Campylopus introflexus*. The main moss species is again *Polytrichum commune* but other frequent bryophytes include *Lophocolea bidentanta*, *Kindbergia praelonga*, *Aulacomnium palustre*, *Sphagnum cuspidatum*, *Sphagnum auriculatum* and *Pellia neesiana.* Potentially this vegetation type represents less degraded sites or sites where the bog is recovering from degradation.

Affinities:	
Fossitt:	PB4 Cutover bog
Annex I:	No corresponding habitat
NVC:	No corresponding community

5 *Juncus effusus – Polytrichum commune* group **see Table 3.8**

5d *Sphagnum recurvum* agg. – *Agrostis stolonifera* vegetation type

This frequent vegetation type represents species-poor *Juncus effusus*-dominated flushes of sloping ground in the uplands. These flushes commonly form relatively narrow linear features in the folds of the landscape where there is flow of acidic water and occur in mosaic with heath and grassland communities. Sometimes, however, broader expanses may occur where whole hillsides are flushed. *Juncus effusus* is the chief species and forms large tussocks but *Juncus acutiflorus* can occur occasionally. These are typically peat-forming flushes and beneath the rushes a dense carpet composed mainly of *Sphagnum recurvum* agg. and *Polytrichum commune* is found, although other *Sphagnum* species may be present. *Agrostis stolonifera* is the most characteristic grass but *Holcus lanatus, Festuca ovina*, *Molinia caerulea* and *Agrostis capillaris* may all occur, whilst broadleaf herbs consist primarily of the upland mainstays *Potentilla erecta* and *Galium saxatile*. Sedges are not plentiful but *Carex nigra*, *Carex echinata* and *Carex rostrata* may feature.

This vegetation type is distinguished from rushy grasslands (q.v. vegetation type 5a) by the high abundance of *Polytrichum commune* and *Sphagnum* species and the relatively low cover of grasses.

Affinities:	
Fossitt:	PF2 Poor fen and flush
Annex I:	No corresponding habitat
NVC:	M6ci *Carex echinata – Sphagnum recurvum / auriculatum* mire *Juncus effusus* subcommunity, *Sphagnum recurvum* variant

5 *Juncus effusus – Polytrichum commune* group **see Table 3.8**

5e *Juncus acutiflorus – Potentilla erecta* vegetation type

This is flush or wet grassland community in which *Juncus acutiflorus* dominates rather than *Juncus effusus*. *Molinia caerulea* may sometimes be co-dominant. *Sphagnum subnitens* is occasional but can dominate the bryophyte layer. Other important species here are *Anthoxanthum odoratum*, *Agrostis capillaris*, *Galium saxatile* and *Potentilla erecta*.

Affinities:	
Fossitt:	PF2 Poor fen and flush, GS4 Wet grassland
Annex I :	No corresponding habitat
NVC:	M23 *Juncus effusus / acutiflorus – Galium palustre*

6 *Carex nigra – Ranunculus flammula* group **see Table 3.9**

6a *Carex rostrata – Equisetum fluviatile* vegetation type

This is a rather broad category comprising vegetation dominated strongly by *Carex rostrata* and potentially includes fens, flushes and transition mires. *Equisetum fluviatile* is a constant associate whilst other frequent species are *Menyanthes trifoliata* (often abundant), *Potentilla palustris, Hydrocotyle vulgaris*, *Ranunculus flammula*, *Juncus articulatus*, *Galium palustre*, and *Mentha aquatica*. *Calliergonella cuspidata* can be abundant in some contexts but cover of *Sphagnum* species is typically low. The inclusion of this vegetation type as an upland habitat is hitherto rather speculative but it potentially may occur as a lake margin community around upland lakes

Affinities:	
Fossitt:	PF2 Poor fen and flush, PF3 Transition mire and quaking bogs
Annex I:	7140 Transition mire and quaking bogs
NVC:	M9 *Carex rostrata – Calliergon cuspidatum / giganteum* mire
	S9 *Carex rostrata* swamp

6 *Carex nigra – Ranunculus flammula* group **see Table 3.9**

6b *Potamogeton polygonifolius – Carex echinata* vegetation type

This is a rather broad category gathering together various flush and soakway communities. The most frequent species are *Ranunculus flammula*, *Potamogeton polygonifolius*, *Carex echinata*, *Carex viridula*, *Juncus bulbosus*, *Eriophorum angustifolium* and *Molinia caerulea.* Included here, however, is the highly distinctive Hyperico – Potametum polygonifolii soakway association (Rodwell 1991) that is dominated by *Hyperium elodes* and *Potamogeton polygonifolius*. *Campylium stellatum*, *Sphagnum palustre* and *Sphagnum auriculatum* are occasional in the vegetation type as a whole.

Two subtypes are defined:

6b-i: *Hypericum elodes* subtype: *Hypercium elodes* and *Potamogeton polygonifolius* dominant

6b-ii: Typical subtype: Not as above

Affinities:	
Fossitt:	PF1 Rich fens and flushes, PF2 Poor fens and flushes
Annex I:	No corresponding habitat
NVC:	M29 *Hypercium elodes - Potamogeton polygonifolius* soakway

6 *Carex nigra – Ranunculus flammula* group **see Table 3.9**

6c *Carex nigra –Lythrum salicaria* vegetation type

This broad vegetation type contains fen and flush communities with some marshy elements. *Carex nigra* is a strong dominant and is typically accompanied by *Ranunculus flammula, Hydrocotyle vulgaris, Juncus articulatus, Galium palustre, Mentha aquatica, Agrostis stolonifera* and *Caltha palustris*. *Lythrum salicaria* is also frequent. *Calliergonella cuspidata* is typically abundant when it occurs. As with type 6a, the frequent occurrence of this vegetation type in upland habitats is hitherto rather speculative.

Affinities:	
Fossitt:	PF1 Rich fens and flushes, PF2 Poor fens and flushes
Annex I:	No corresponding habitat
NVC:	No corresponding community

6 *Carex nigra – Ranunculus flammula* group **see Table 3.9**

6d *Carex lasiocarpa – Carex limosa* vegetation type

This is a bog pool community dominated by *Carex lasiocarpa*, *Carex limosa* and *Menyanthes trifoliata*. *Myrica gale* is typically present and *Molinia caerulea* is often found fringing the pools. Occasional indicator species are *Utricularia intermedia, Phragmites australis* and *Schoenus nigricans*. Whilst *Erica erigena* is listed as a strong indicator, this is likely to be a result of the small sample size on which this vegetation type is based and it is very likely that this pool community occurs in a wider context in the absence of this species. *Sphagnum palustre* and *Sphagnum auriculatum* may be locally abundant.

Affinities:	
Fossitt:	FL1 Dystrophic pools
Annex I:	3160 Natural dystrophic lakes and ponds
NVC:	No corresponding community

6 *Carex nigra – Ranunculus flammula* group **see Table 3.9**

6e *Littorella uniflora – Eriocaulon aquaticum* vegetation type

This is an aquatic community characteristic of acid oligotrophic lakes and pools of the uplands. *Littorella uniflora* is the chief species growing on stony ground in shallow water around the margins of the pools. Where this habitat is found in western counties, the localised *Eriocaulon aquaticum* may also be found, but this plant is rarely found at higher altitudes. *Lobelia dortmanna* and *Isoetes lacustris* are also characteristic of this vegetation type in western counties. The other main species that are likely to be found here are *Ranunculus flammula* and *Juncus bulbosus.*

Being characteristic of acid oligotrophic lakes, this vegetation type assists in distinguishing these water bodies from dystrophic waters which often contain characteristic assemblages of their own (q.v. vegetation type 4a).

Affinities:

Fossitt:	FL2 Acid oligotrophic lakes
Annex I:	3130 Oligotrophic to mesotrophic waters with vegetation of the *Littorella uniflorae* and / or of the *Isoeto-Nanojuncetea*
NVC:	A22 *Littorella uniflora – Lobelia dortmanna* community

3.4 Discussion

In interpreting an analysis such as this it is important to take several considerations into account. Firstly, this is essentially a vegetation classification, *not* a habitat classification. The groupings have been arrived at using floristic data only. Environmental data such as edaphic conditions, geography, topography, flooding regime and management have been used to interpret the groupings but not to define them. Secondly, no special weighting was given to any species which may *a priori* have been regarded as important indicators. Thirdly, species from the same genus were not regarded as any more similar than species from different genera. Hence *Sphagnum palustre* was not regarded as more similar to *Sphagnum recurvum agg.* than it was to, for example, *Carex bigelowii*. Finally, and perhaps most importantly, it should be remembered that the scheme presented here is inherently artificial and its aim is to simplify a highly complex dataset for applied and research purposes. It is not seeking to identify real divisions in nature between definite stand types. Thus, it should always be borne in mind that many vegetation samples which are successional, modified, or otherwise transitional may well be referable to more than one vegetation type. Furthermore, the affinities listed are not exhaustive nor do they indicate synonymous relationships between schemes. Classification of communities should be conducted independently for each scheme on a first principles basis.

Table 3.4 Synoptic Table for *Agrostis capillaris - Rhytidiadelphus squarrosus* group

Frequent species	a	b	c	d	e	f	g	h	i	Group
Anthoxanthum odoratum	II 0.7	III 3.8	V 12.6	V 22.6 ••	V 21.3	I 0.8	II 0.9	III 2.4	IV 8.4	III 8.2
Potentilla erecta	I <0.05	IV 4.8	V 6.9 •	III 8.5	III 1.0	IV 3.0	III 0.3	II 3.3	IV 4.1	III 4.2
Agrostis capillaris	I 0.1	III 4.5	IV 11.0	IV 19.6	III 11.6	I 0.9	III 1.5	III 3.5	V 45.8 •••	III 14.0
Galium saxatile	I 0.2	III 4.2	IV 2.9	III 7.5	III 4.1	III 1.3	III 2.2	III 1.5	III 4.9	III 3.5
Rhytidiadelphus squarrosus	I <0.05	III 4.5	IV 6.7	V 48.8 •••	III 13.6	II 0.4	I <0.05	II 0.3	IV 6.6	III 9.1
Nardus stricta		V 41.6 •••	III 4.2	I 0.5	I 0.5	IV 9.5	III 18.1	II 1.0	II 3.8	III 10.5
Hylocomium splendens	I 0.4	II 5.1	IV 7.7	IV 21.2 ••	II 0.8	I 1.4	III 1.2	II 0.3	III 3.7	III 5.4
Calluna vulgaris	I 1.6	III 3.4	III 6.4	I 3.4	I 1.0	V 8.5 ••	II 1.3	III 0.6	II 1.4	III 3.2
a) *Sesleria caerulea - Campanula rotundifolia* vegetation type indicators										
Sesleria caerulea	IV 8.9 ••••									I 0.8
Campanula rotundifolia	III 0.7 •••	I <0.05	I <0.05					I <0.05	I <0.05	I 0.1
Cystopteris fragilis	III 0.4 •••									I 0.0
Sedum rosea	II 3.1 •••									I 0.3
Ctenidium molluscum	II 1.8 •••	I <0.05						I 0.1		I 0.2
Epilobium brunnescens	II 0.7 ••		I <0.05	I <0.05						I 0.1
Saxifraga aizoides	II 0.3 ••									I 0.0
Tortella tortuosa	II 0.8 ••									I 0.1
Asplenium viride	II 0.3 ••									I 0.0
Asplenium trichomanes	II 0.3 ••									I 0.0
Breutelia chrysocoma	III 5.1 ••	II 1.6	I 0.4		I <0.05	I 0.1	II 1.5		I <0.05	I 0.9
Saxifraga hypnoides	II 0.7 ••									I 0.1
Geranium robertianum	II 0.7 ••									I 0.1
Orthothecium rufescens	II 2.7 ••									I 0.2
Angelica sylvestris	I 0.4 ••									I 0.0
Primula vulgaris	I 0.1 ••		I <0.05							I 0.0
Festuca rubra	IV 7.1 ••	I 3.1	III 6.1	I 0.1	I 0.6	I 0.1			II 3.4	II 2.8
Neckera crispa	II 1.0 ••									I 0.1
Palustriella commutata	II 4.5 ••									I 0.4
b) ***Nardus stricta - Carex panicea* vegetation type indicators**										
Carex panicea		III 1.9 •	II 0.7	I 1.8	I <0.05	II 1.1	I 0.1	I 0.1	I 0.6	II 0.8
Erica tetralix		II 0.6 •	I 0.1	I 0.1		I 0.2		I 0.1	I <0.05	I 0.1
Trichophorum cespitosum		II 1.9 •	I 0.8			II 0.5	II 2.0	I 0.7	I <0.05	I 0.7
Campylopus flexuosus		I 0.6 •	I <0.05	I <0.05	I <0.05	I 0.2	I <0.05	I <0.05	I <0.05	I 0.1

	a	b	c	d	e	f	g	h	i	Group
c) *Festuca ovina* vegetation type indicators										
Festuca ovina	I 0.5	I 1.5	III 9.9 ••	I 0.6	II 0.4		I 0.6	II 1.4	II 6.7	II 3.5
Vaccinium myrtillus	I 0.5	II 2.0	III 9.2 •	I 0.4	II 2.8	II 2.5	IV 6.1	II 0.1	I 0.4	II 3.0
Luzula campestris	I <0.05	I 0.1	I 0.4 •		I <0.05	I <0.05			I <0.05	I 0.1
Carex caryophyllea		I 0.2	II 1.1 •			I 0.4				I 0.2
d) *Rhytidiadelphus squarrosus - Festuca vivipara* vegetation type indicators										
Festuca vivipara		I 0.4	I 0.1	III 25.3 ••	II 2.8	I 1.9	III 2.7	II 3.4	I <0.05	I 3.6
Juncus effusus		I <0.05	II 0.6	II 10.2 ••	I 0.1	I 0.1		I 1.4	I 0.8	I 1.5
Holcus lanatus	I <0.05	I <0.05	II 1.9	IV 12.2 ••	III 9.8	I <0.05			IV 6.4	II 3.3
Luzula multiflora		I 0.2	II 0.6	III 1.0 •	I <0.05		I <0.05	I 0.1	II 0.6	II 0.4
Carex nigra		I 0.2	I 0.5	I 3.0 •		I <0.05			I 0.1	I 0.5
Juncus acutiflorus		I 0.3	I 0.8	II 3.9 •		I 0.1		I 0.5	I 1.1	I 0.8
Thuidium tamariscinum	I <0.05	I 1.3	I 1.2	II 6.2 •	II 4.9	I 0.5	II 0.2	I <0.05	II 2.2	II 1.8
Epilobium palustre	I 0.1			I 0.7 •						I 0.1
Carex rostrata				I 4.8 •						I 0.5
Deschampsia cespitosa				I 2.0 •				I <0.05		I 0.2
Scleropodium purum	I 0.2	I 0.2	II 0.8	II 1.8 •	I 0.0	I <0.05			I 0.5	I 0.5
Succisa pratensis	I 0.2	I <0.05	I 0.5	I 4.4 •		I <0.05	I <0.05	I <0.05	I 0.6	I 0.7
Carex echinata		II 0.6	I 0.6	II 3.5 •		I 1.5		I 0.3	I <0.05	I 0.7
Peltigera polydactlya	I <0.05			I 0.6 •						I 0.1
Potentilla palustris				I 5.5 •						I 0.6
Pellia neesiana				I 5.5 •						I 0.6
Carex curta				I 2.9 •						I 0.3
e) *Pteridium aquilinum* vegetation type indicators										
Pteridium aquilinum		I 0.2	I 0.2	II 5.8	V 75.1 •••••				I 0.1	I 4.4
Oxalis acetosella	I 0.1		I <0.05	I <0.05	II 1.8 ••					I 0.1
Kindbergia praelonga		I <0.05	I <0.05	I 1.0	II 5.5 •	I 0.1			I 0.1	I 0.4
f) *Deschampsia flexuosa - Calluna vulgaris* vegetation type indicators										
Deschampsia flexuosa	I 0.1	II 1.1	II 3.6	I 0.1	I 0.1	V 37.0 ••••	II 0.7	II 0.5	I 0.2	II 3.3
Erica cinerea		I 0.4	I 0.6		I 0.3	III 2.5 ••	I 0.4	I <0.05	I 0.1	I 0.4
Molinia caerulea		II 2.2	III 9.4	I 1.2	I 4.3	III 12.7 ••		I 0.1	I 0.6	I 3.3
Eriophorum angustifolium		I 0.1	I 0.1	I 0.2		II 1.3 •	I 0.1	I 0.4		I 0.2

	a	b	c	d	e	f	g	h	i	Group
g) *Racomitrium lanuginosum - Diplophyllum albicans* vegetation type indicators										
Racomitrium lanuginosum	I 0.1	II 1.2	I <0.05	I <0.05	I <0.05	II 0.6	V 27.5 •••••	II 2.3	I 0.9	II 3.2
Diplophyllum albicans		I 0.2	I <0.05		I <0.05	II 0.1	IV 0.6 ••	II 0.2	I <0.05	I 0.1
Scapania gracilis	I <0.05	I <0.05	I <0.05		I <0.05		III 0.4 ••	I <0.05	I 0.1	I 0.1
Carex bigelowii		I <0.05	I 0.1				II 3.9 •	I 0.5		I 0.4
Empetrum nigrum	I 0.1		I 0.3				II 1.5 •			I 0.2
Pleurozia purpurea	I <0.05	I <0.05					I 0.3 •	I <0.05		I 0.0
Diphasiastrum alpinum							I 2.7 •		I 0.2	I 0.3
Rhytidiadelphus loreus	I 0.1	II 1.7	II 2.4	I 0.1		I 0.2	III 2.5 •	II 1.3	II 1.1	II 1.3
Huperzia selago		I 0.3				I <0.05	II 0.4 •	I <0.05	I 0.2	I 0.1
Campylopus atrovirens		I <0.05				I <0.05	I 0.7 •	I <0.05		I 0.1
h) *Juncus squarrosus* vegetation type indicators										
Juncus squarrosus		III 4.2	III 3.3	I 0.1		I 0.5	II 1.4	III 13.9 ••	I 0.7	II 2.7
Sphagnum capillifolium		I 0.5	I <0.05			I 0.1	I 1.4	II 4.7 •	I 0.2	I 0.6
Juncus bulbosus		I 0.4	I <0.05	I <0.05		I <0.05	I 0.3	II 0.7 •	I 0.1	I 0.2
i) *Agrostis capillaris - Trifolium repens* vegetation type										
Lolium perenne									II 2.7 27.9 ••	I 0.5
Trifolium repens			I 0.3	I 2.0	I 1.8				III 3.6 23.1 ••	I 1.0
Cerastium fontanum	I 0.2	I <0.05	I <0.05	I 0.1	I <0.05				II 0.3 16.5 •	I 0.1
Ranunculus repens			I <0.05	I 0.1					I 0.5 15.3 •	I 0.1
Plantago lanceolata		I 0.1	I 0.1	I 0.3	I 0.4	I 0.3		I 0.2	II 1.8 14.3 •	I 0.4
Lotus corniculatus		I <0.05	I 0.1						I 0.4 11.6 •	I 0.1
Polytrichastrum formosum		I 0.1	I 0.1	I <0.05		I 0.1	I <0.05	I <0.05	I 0.5 10.0 •	I 0.1
Other woody species										
Ulex gallii		I 0.4	I <0.05	I 0.8	I <0.05	I <0.05		I 0.3		I 0.2
Rhododendron ponticum	I 0.1	I <0.05								I 0.0
Sorbus aucuparia			I <0.05						I <0.05	I 0.0
Vaccinium oxycoccos				I 0.2				<0.05		I 0.0
Hedera helix	I 0.1									I 0.0

	a	b	c	d	e	f	g	h	i	Group
Other forbs										
Rumex acetosa	I 0.1	I <0.05	I 1.1	I 1.2	II 1.8				II 1.0	I 0.6
Cirsium palustre	II 0.1	I 0.1	II 0.5	I 0.1	I 0.1			I <0.05	I 0.4	I 0.2
Polygala serpyllifolia		II 0.4	I 0.2			II 0.2	I <0.05	I <0.05	I 0.1	I 0.1
Viola riviniana	I <0.05	I 0.1	I 0.2	I 0.1	I 0.1		I <0.05	I <0.05	I <0.05	I 0.1
Rumex acetosella	I 0.1	I 0.2	I 0.6	I 0.5	I 0.9		I <0.05		I 0.1	I 0.3
Thymus polytrichus	II 1.3	I 0.7	I 0.1			I 0.1	I 0.2	I 1.4	I 0.2	I 0.4
Pedicularis sylvatica	I <0.05	I <0.05	I 0.2	I 0.6				I <0.05	I <0.05	I 0.1
Viola palustris		I 0.5	I <0.05		I 0.2	I 0.9		I <0.05	I <0.05	I 0.2
Narthecium ossifragum		I 0.2					I 0.1	I <0.05		I 0.0
Prunella vulgaris	I 0.1	I <0.05	I <0.05	I <0.05	I 0.2			I <0.05	I 0.2	I 0.1
Lotus pedunculatus	I <0.05		I 0.2	I 0.2					I 0.4	I 0.1
Bellis perennis	I 0.1		I 0.1					I <0.05	I 0.1	I 0.0
Achillea millefolium	I 0.2		I <0.05	I 0.7					I 0.2	I 0.1
Cardamine pratensis	I <0.05		I <0.05	I 0.6					I 0.1	I 0.1
Ranunculus acris	II 0.8			I 0.4					I 0.3	I 0.2
Hypochaeris radicata			I <0.05	I 0.1					I 0.4	I 0.1
Anagallis tenella		I 0.6	I <0.05	I <0.05		I 0.1		I <0.05	I <0.05	I 0.1
Solidago virgaurea	I 0.1					I <0.05	I <0.05	I <0.05		I 0.0
Taraxacum officinalis agg.	I <0.05	I <0.05	I <0.05	I 0.1					I 0.1	I 0.0
Senecio jacobea	I 0.3			I 0.2					I <0.05	I 0.1
Alchemilla glabra	I 0.5		I <0.05					I <0.05		I 0.0
Lysimachia nemorum	I <0.05		I 0.1					I <0.05	I <0.05	I 0.0
Euphrasia officinalis agg.	I 0.2	I <0.05	I <0.05					I <0.05	I <0.05	I 0.0
Polygala vulgaris			I <0.05		I <0.05	I <0.05			I <0.05	I 0.0
Crepis paludosa	I 0.4			I 0.5						I 0.1
Linum catharticum	I 0.1	I <0.05	I 0.1							I 0.0
Hypericum pulchrum	I <0.05	I <0.05	I <0.05					I <0.05		I 0.0
Trifolium pratense	I <0.05								I 0.3	I 0.1
Sagina procumbens	I <0.05			I <0.05				I <0.05		I 0.0
Dactylorhiza maculata	I <0.05		I <0.05					I <0.05	I <0.05	I 0.0
Galium palustre		I 0.1		I 0.2				I 0.3		I 0.1
Cochlearia pyrenaica	I 2.2									I 0.2
Arenaria ciliata	I 0.3									I 0.0
Chrysosplenium oppositifolium	I 0.3									I 0.0
Draba incana	I 0.1									I 0.0
Centaurea nigra									I 0.4	I 0.1
Stellaria graminea									I 0.1	I 0.0
Cirsium arvense				I <0.05					I 0.5	I 0.1
Veronica chamaedrys	I 0.2								I 0.1	I 0.0
Conopodium majus		I <0.05	I <0.05						I 0.1	I 0.0
Potentilla anglica		I 0.2	I 0.2						I <0.05	I 0.1
Veronica officinalis		I 0.4			I <0.05				I <0.05	I 0.1

	a	b	c	d	e	f	g	h	i	Group
Drosera rotundifolia		I 0.1						I 0.1		I 0.0
Anthriscus sylvestris	I 0.9									I 0.1
Valeriana officinalis	I 0.2									I 0.0
Crepis capillaris		I <0.05							I 0.1	I 0.0
Ranunculus flammula	I 0.1			I 0.4					I <0.05	I 0.1
Plantago coronopus			I <0.05					I <0.05	I <0.05	I 0.0
Leontodon autumnalis	I 0.1	I <0.05							I <0.05	I 0.0
Lychnis flos-cuculi				I 1.1	I 3.7					I 0.3
Silene acaulis	I 1.9									I 0.2
Silene dioica	I 0.3									I 0.0
Euphrasia salisburgensis	I <0.05									I 0.0
Cirsium vulgare				I <0.05					I <0.05	I 0.0
Teucrium scorodonia	I <0.05									I 0.0

Other grasses, sedges and rushes

Agrostis canina / A. vinealis		II 1.7	II 2.5	II 2.4	I 0.9	II 3.6	IV 1.6	II 3.6	I 0.7	II 1.8
Carex binervis		II 2.1	II 0.9	I 0.2		I 0.8	II 1.3	I 0.2	II 1.4	II 0.9
Danthonia decumbens	I 0.1	II 2.3	II 1.1	II 1.0					II 2.0	I 1.0
Carex pilulifera		II 0.7	I 0.2	II 0.5	I <0.05	II 0.4	II 0.9	I 0.5	I 0.1	I 0.4
Carex viridula	I 0.1	II 1.3	I 0.1			I 0.9	I 0.4	I 3.0	I 0.2	I 0.6
Luzula sylvatica	II 3.6	I 0.1	I 0.9		I <0.05	I 0.2	I 0.0	I 0.1	I <0.05	I 0.5
Agrostis stolonifera	II 1.9	I 0.2	I 0.7	I 0.2	I <0.05			I 0.3	I 0.5	I 0.4
Carex pulicaris	II 0.2	I 0.2	I 0.2	I 1.3		I 0.1		I 0.3	I <0.05	I 0.3
Eriophorum vaginatum		I 0.1	I 0.5	I 0.4	I <0.05	I 3.0	I 0.3	I 0.6	I <0.05	I 0.4
Carex flacca	I 1.0	I 0.2	I 0.3	I 1.0				I 0.7	I 0.1	I 0.4
Cynosurus cristatus			I 0.2	I <0.05				I <0.05	I 0.4	I 0.1
Dactylis glomerata			I <0.05						I 1.1	I 0.2
Deschampsia setacea	I <0.05	I 0.2	I 0.5							I 0.1
Lathyrus pratensis			I <0.05						I <0.05	I 0.0
Poa annua			I <0.05					I <0.05	I <0.05	I 0.0
Arrhenatherum elatius		I 0.2	I <0.05						I <0.05	I 0.0
Eleocharis multicaulis	I 0.3	I 0.1								I 0.0
Poa trivialis				I 0.1					I <0.05	I 0.0
Carex lasiocarpa	I 0.2									I 0.0
Poa alpina	I 0.2									I 0.0
Rhynchospora alba	I 0.1							I 0.1		I 0.0
Poa pratensis	I <0.05								I <0.05	I 0.0
Koeleria macrantha	I <0.05									I 0.0
Eleocharis palustris	I <0.05									I 0.0

	a	b	c	d	e	f	g	h	i	Group
Other ferns and horsetails										
Blechnum spicant		I <0.05	I <0.05		I <0.05		I 0.1	I <0.05	I <0.05	I 0.0
Dryopteris dilatata	I 0.2						I 0.1	I <0.05		I 0.0
Dryopteris affinis	I 1.2									I 0.1
Phyllitis scolopendrium	I 0.1									I 0.0
Equisetum fluviatile				I 0.9						I 0.1
Equisetum palustre	I <0.05			I 0.1						I 0.0
Asplenium ruta-muraria	I <0.05									I 0.0
Polypodium interjectum	I <0.05									I 0.0
Other bryophytes										
Polytrichum commune	I <0.05	I 0.8	II 1.6	II 0.3	I <0.05	I <0.05	I <0.05	I 0.5	I 1.3	I 0.7
Hypnum jutlandicum	I <0.05	I 1.3	I 0.1	I <0.05	I 0.6	I <0.05	III 0.5	I 0.1	I 0.3	I 0.4
Dicranum scoparium	I <0.05	I 0.1	I <0.05			I <0.05	II 0.1	I 0.1	I 0.2	I 0.1
Hypnum cupressiforme		I 1.7	II 0.2	I <0.05		I 0.2			I 0.1	I 0.3
Campylopus introflexus	I <0.05	I 0.4	I <0.05	I 0.1		I <0.05	I <0.05	I <0.05	I <0.05	I 0.1
Pleuroziumschreberi		I <0.05	I 0.3	I 1.0		I 1.1	I <0.05	I 0.5	I 0.1	I 0.3
Calliergonella cuspidata	I 0.1	I 0.0	I 0.0	I 1.3					I 0.3	I 0.2
Sphagnum subnitens		I 0.4	I 0.7			I 0.0		I 0.4		I 0.2
Plagiothecium undulatum		I <0.05	I <0.05				I <0.05	I <0.05	I <0.05	I 0.0
Sphagnum palustre		I 0.6	I <0.05	I 1.7	I <0.05	I 0.1		I 1.9	I 0.2	I 0.5
Sphagnum auriculatum		I 0.3	I <0.05			I 0.5	I 0.1	I 0.5		I 0.1
Sphagnum papillosum		I 0.7	I <0.05			I <0.05	I <0.05	I 0.8		I 0.2
Lophocolea bidentata			I <0.05	I 0.2	I 0.1		I <0.05		I <0.05	I 0.0
Sphagnum tenellum		I <0.05	I <0.05				I 0.1	I 0.6		I 0.1
Pseudotaxiphyllum elegans		I <0.05	I <0.05		I <0.05	I <0.05		I <0.05		I 0.0
Brachythecium rutabulum		I <0.05	I <0.05						I <0.05	I 0.0
Plagiomnium undulatum	I <0.05		I <0.05						I <0.05	I 0.0
Sphagnum recurvum agg.		I 0.3	I 0.1	I 0.4		I 0.2		I 0.2		I 0.1
Calypogeia fissa		I <0.05	I <0.05	I 0.1					I <0.05	I 0.0
Pellia epiphylla		I <0.05		I 0.4			I <0.05	I 0.1		I 0.1
Rhytidiadelphus triquetrus	I 0.1		I <0.05							I 0.0
Anomobryum julaceum	I 0.2	I <0.05	I <0.05					I <0.05		I 0.0
Polytrichastrum alpinum							I 0.2	I 0.2	I <0.05	I 0.0
Polytrichum juniperinum	I <0.05		I <0.05	I <0.05					I <0.05	I 0.0
Hypnum lacunosum									I 0.4	I 0.1
Frullania tamarisci		I <0.05					I <0.05		I <0.05	I 0.0
Sphagnum subsecundum		I <0.05					I 0.3			I 0.0
Saccogyna viticulosa		I <0.05					I <0.05			I 0.0
Fissidens dubius	I <0.05						I <0.05			I 0.0
Dichodontium pellucidum	I 0.4									I 0.0

	a	b	c	d	e	f	g	h	i	Group
Herbertus aduncus							I 0.2			I 0.0
Cephalozia bicuspidata							I 0.1	I <0.05		I 0.0
Lophozia ventricosa	I <0.05						I 0.1			I 0.0
Sphagnum cuspidatum		I 0.1								I 0.0
Bryum pseudotriquetrum	I 0.2									I 0.0
Philonotis calcarea	I 0.2									I 0.0
Marsupella emarginata							I 0.1		I <0.05	I 0.0
Scapania nemorea		I <0.05							I <0.05	I 0.0
Nowellia curvifolia							I <0.05			I 0.0
Hymenostylium recurvirostrum	I 0.1									I 0.0
Anoectangium aestivum	I <0.05									I 0.0
Sphagnum quinquefarium									I <0.05	I 0.0
Other lichens										
Cladonia uncialis		I <0.05				I <0.05	I <0.05	I <0.05		I 0.0
Cladonia cervicornis				I 0.1			I 0.1			I 0.0
Peltigera canina				I 0.9	I 0.2					I 0.1
Peltigera membranacea	I <0.05	I <0.05	I <0.05							I 0.0
Cladonia rangiferina	I <0.05	I <0.05								I 0.0
Cladonia mitis	I 0.1									I 0.0
Cladonia fimbriata									I 0.1	I 0.0
Cladonia strepsilis							I <0.05	I <0.05		I 0.0
Number of relevés	30	54	59	37	17	22	32	29	61	341

Table 3.5 Synoptic table for the *Calluna vulgaris - Erica cinerea* group

Constants	a		b		c		d		e		Group	
Calluna vulgaris	V	34.2	V	73.9 ••	V	43.1	V	28.5	V	7.1	V	47.1
a) *Racomitrium lanuginosum - Cladonia uncialis* vegetation type indicators												
Racomitrium lanuginosum	V	30.5 ••••	I	1.0	III	4.2	I	0.2	I	0.1	II	6.4
Cladonia uncialis	III	2.6 •••	I	0.1	II	0.3	I	<0.05	I	<0.05	I	0.5
Cladonia portentosa	III	9.5 ••	II	1.6	II	0.6	I	0.4	I	<0.05	II	2.3
Empetrum nigrum	III	8.6 ••	I	0.8	II	2.3					I	2.2
Diplophyllum albicans	III	2.0 ••	I	0.7	I	0.1	II	0.1			II	0.6
b) *Calluna vulgaris - Hypnum cupressiforme* vegetation type indicators												
Hypnum cupressiforme (sensu lato)	II	5.4	III	8.2 •	II	4.7			I	0.3	II	5.0
c) *Eriophorum vaginatum - Eriophorum angustifolium* vegetation type indicators												
Eriophorum vaginatum	II	0.5	II	2.0	IV	11.1 •••			I	0.2	II	3.2
Eriophorum angustifolium	III	3.0	II	2.8	IV	7.5 ••	I	0.2	I	0.5	II	3.2
Trichophorum cespitosum	II	3.6	II	1.6	IV	9.1 ••	I	0.1	II	1.0	II	3.3
Juncus squarrosus	II	2.7	I	0.7	III	7.4 ••	I	0.1	II	1.2	II	2.5
Sphagnum capillifolium	II	1.3	II	2.4	III	7.0 ••	I	1.0			II	2.8
Sphagnum subnitens	I	0.7	I	1.0	II	3.4 ••			I	0.1	I	1.2
Erica tetralix	II	1.9	III	2.3	III	4.6 •	II	1.6	I	0.7	II	2.5
Narthecium ossifragum	I	0.5	I	0.2	II	1.2 •			I	<0.05	I	0.4
Deschampsia flexuosa	II	0.6	II	0.3	II	1.8 •	I	0.7	II	0.6	II	0.8
Sphagnum cuspidatum	I	0.1	I	<0.05	I	0.3 •					I	0.1
d) *Ulex gallii - Erica cinerea* vegetation type indicators												
Ulex gallii			I	0.5	I	0.2	V	40.4 •••••	I	0.4	I	5.7
Erica cinerea	III	3.3	III	4.3	II	2.9	V	33.4 ••••	III	4.1	III	7.7
Festuca vivipara	I	0.5	I	<0.05			III	3.0 ••	I	0.1	I	0.5
Molinia caerulea	III	5.5	III	8.9	III	5.6	V	19.5 ••	II	0.8	III	8.2
Thuidium tamariscinum	I	0.3	I	1.3	I	<0.05	III	2.2 ••	I	<0.05	I	0.8
Agrostis canina / A. vinealis	II	1.0	I	0.2	I	3.0	III	6.1 ••	I	0.1	II	1.7
Anthoxanthum odoratum			I	0.4	I	0.2	III	1.5 ••	I	0.5	I	0.5
Potentilla erecta	IV	1.2	III	1.8	III	2.1	V	2.4 ••	II	0.3	III	1.7

	a		b		c		d		e		Group
Agrostis capillaris	I	0.4	I	0.1	I	0.7	II	4.7 ••	I	0.7	I	1.0
Hypnum jutlandicum	II	0.8	II	5.0	III	1.4	IV	3.8 ••	I	0.1	II	2.8
e) Sparse cover *Calluna vulgaris* vegetation type - no specific indicator species												
Other woody plants												
Vaccinium myrtillus	II	3.5	III	4.2	IV	4.1	II	2.8	III	2.8	III	3.7
Juniperus communis	I	2.0	I	0.1			I	0.3	I	0.1	I	0.4
Arctostaphylos uva-ursi	I	0.6	I	0.4					I	0.3	I	0.3
Sorbus aucuparia			I	0.1	I	<0.05	I	<0.05	I	<0.05	I	<0.05
Other forbs												
Galium saxatile	I	0.4	I	0.2	II	0.8	III	0.3	II	0.1	II	0.4
Polygala serpyllifolia	II	0.1	I	0.0	I	0.1	I	0.1	I	<0.05	I	0.1
Succisa pratensis	I	0.1	I	0.1			I	0.1	I	<0.05	I	0.1
Drosera rotundifolia	I	0.1	I	<0.05	I	<0.05			I	<0.05	I	0.0
Pedicularis sylvatica	I	0.1	I	<0.05	I	0.1	I	<0.05			I	0.1
Dactylorhiza maculata	I	<0.05	I	<0.05	I	<0.05			I	<0.05	I	<0.05
Solidago virgaurea	I	<0.05			I	<0.05			I	<0.05	I	<0.05
Jasione montana	I	0.1					I	<0.05			I	<0.05
Viola riviniana							I	<0.05			I	<0.05
Hypericum pulchrum							I	<0.05			I	<0.05
Saxifraga stellaris									I	<0.05	I	<0.05
Other grasses, sedges and rushes												
Nardus stricta	II	3.1	I	0.8	II	7.7	I	0.1	II	0.8	I	2.6
Carex binervis	I	1.0	I	1.1	I	0.3	III	0.6	I	0.4	I	0.7
Carex panicea	I	0.2	I	0.4	I	0.2	I	0.5	I	<0.05	I	0.3
Festuca ovina	I	0.2	I	0.2	I	0.4	I	<0.05	I	<0.05	I	0.2
Trichophorum x foersteri	I	0.8	I	0.7	I	0.4	I	0.2			I	0.5
Danthonia decumbens			I	0.0			II	1.3	I	0.1	I	0.2
Luzula sylvatica			I	0.5	I	0.1	I	<0.05	I	0.2	I	0.2
Agrostis stolonifera	I	0.6	I	0.3					I	<0.05	I	0.2
Luzula multiflora			I	0.1			I	0.1	I	<0.05	I	0.1
Juncus effusus			I	<0.05	I	<0.05	I	0.2	I	<0.05	I	<0.05
Festuca rubra			I	<0.05	I	0.1	I	0.1			I	<0.05

	a		b		c		d		e		Group
Carex pilulifera	I	<0.05	I	<0.05			I	<0.05	I	<0.05	I	<0.05
Holcus lanatus					I	<0.05	I	0.3	I	0.1	I	0.1
Carex bigelowii	I	1.1	I	0.1	I	0.4					I	0.3
Schoenus nigricans	I	0.1			I	1.0					I	0.2
Juncus bulbosus	I	<0.05	I	<0.05	I	<0.05			I	<0.05	I	<0.05
Carex echinata			I	<0.05	I	0.1			I	<0.05	I	<0.05
Carex viridula	I	0.3	I	0.1							I	0.1
Other ferns, horsetails and clubmosses												
Blechnum spicant	I	<0.05	I	0.1			II	0.2	II	0.2	I	0.1
Huperzia selago	II	0.1	I	0.1	I	<0.05			I	<0.05	I	0.1
Pteridium aquilinum			I	1.8			I	1.4	I	0.1	I	0.9
Diphasiastrum alpinum	I	0.2									I	<0.05
Dryopteris dilatata			I	<0.01					I	<0.05	I	<0.05
Other bryophytes												
Hylocomium splendens	II	2.3	II	5.0	II	5.4	III	2.0	I	<0.05	II	3.7
Rhytidiadelphus loreus	II	1.8	II	3.5	II	2.5	II	1.1			II	2.3
Pleurozium schreberi	II	2.4	II	3.2	I	0.2	III	1.4			II	1.8
Dicranum scoparium	II	1.1	II	1.4	I	<0.05	II	2.4			I	1.0
Rhytidiadelphus squarrosus	I	0.3	I	0.2	II	2.2	II	0.2	I	0.1	I	0.6
Polytrichum commune	I	<0.05	I	0.5	I	0.7	I	0.1	I	0.1	I	0.4
Scleropodium purum			I	0.7	I	0.1	II	0.3	I	<0.05	I	0.3
Pleurozia purpurea	II	0.4	I	0.2	I	0.6	I	<0.05	I	<0.05	I	0.3
Scapania gracilis	I	0.1	I	<0.05	I	0.2	I	0.4	I	<0.05	I	0.1
Campylopus introflexus	I	0.3	I	0.6	I	<0.05	I	0.2	I	<0.05	I	0.3
Breutelia chrysocoma	I	0.3	I	0.6	I	0.1	I	0.1	I	<0.05	I	0.3
Campylopus flexuosus	I	0.3	I	<0.05	I	0.3	I	0.1	I	<0.05	I	0.1
Sphagnum papillosum	I	0.6	I	<0.05	I	0.5			I	0.1	I	0.2
Plagiothecium undulatum	I	<0.05	I	<0.05	I	0.2	I	0.1			I	0.1
Frullania tamarisci	I	0.4	I	0.4			I	3.0	I	<0.05	I	0.6
Leucobryum glaucum	I	0.1	I	0.8	I	0.1	I	0.3			I	0.4
Odontoschisma sphagni	I	<0.05	I	0.1	I	0.1	I	<0.05			I	<0.05
Sphagnum tenellum	I	0.1	I	<0.05	I	0.2			I	0.1	I	0.1
Mylia anomala	I	0.2	I	0.1	I	0.1					I	0.1
Kindbergia praelonga			I	1.3							I	0.5
Calypogeia fissa	I	0.3	I	0.6	I	<0.05					I	0.3
Herbertus aduncus	I	0.5	I	0.2	I	<0.05					I	0.1
Sphagnum palustre			I	<0.05	I	0.6			I	<0.05	I	0.1

	a	b	c	d	e	Group
Anomobryum julaceum	I 0.1	I <0.05		I <0.05		I <0.05
Pseudotaxiphyllum elegans	I <0.05	I <0.05			I <0.05	I <0.05
Sphagnum auriculatum agg.	I 0.5	I <0.05	I 0.2		I <0.05	I 0.1
Campylopus atrovirens	I <0.05		I <0.05		I 0.1	I <0.05
Lophocolea bidentata		I <0.05		I 0.1		I <0.05
Polytrichastrum formosum	I <0.05	I <0.05			I 0.1	I <0.05
Polytrichum juniperinum				I <0.05		I <0.05
Other lichens						
Cladonia arbuscula	II 0.5	I 0.7	I 2.1	I 0.1		I 0.8
Cladonia pyxidata	I 0.4	I 0.1	I <0.05			I 0.1
Cladonia diversa		I <0.05	I 0.1		I <0.05	I <0.05
Cetrelia olivetorum	I 0.1	I 0.3				I 0.1
Cladonia furcata	I <0.05		I <0.05		I <0.05	I <0.05
Cladonia cervicornis	I <0.05					I <0.05
Number of relevés	59	131	77	48	39	354

Table 3.6 Synoptic table for the *Molinia caerulea - Erica tetralix* group

	a		b		c		d		e		f		g		Group	
Constants																
Molinia caerulea	V	41.1	V	86.2 ••	V	19.7	V	46.1	III	5.8	V	38.1	V	31.8	V	38.2
Calluna vulgaris	V	15.1	IV	6.9	V	12.9	V	48.3 •••	V	18.5	IV	6.5	III	9.5	V	20.6
Erica tetralix	V	8.8 ••	III	2.8	V	3.4	V	9.1	IV	5.0	IV	7.3	II	3.9	V	7.2
Potentilla erecta	V	1.9	V	5.5 ••	IV	0.6	V	2.5	III	1.0	V	4.3	III	1.3	IV	2.3
Eriophorum angustifolium	IV	9.1	I	0.4	V	6.9	IV	8.3	V	15.2 ••	III	5.1	III	8.7	IV	8.6
a) *Erica tetralix - Pleurozia purpurea* vegetation type indicators																
Pleurozia purpurea	II	4.2 •	I	1.3	III	2.1	I	0.4	II	1.0	I	<0.05			II	2.2
Polygala serpyllifolia	III	0.5 •	II	0.6	III	0.3	III	0.5	I	0.1	II	0.5	I	0.2	III	0.4
b) *Molinia caerulea - Anthoxanthum odoratum* vegetation type indicators																
Kindbergia praleonga	I	0.1	III	8.0 •••			I	0.3			I	0.1	I	<0.05	I	0.7
Calypogeia fissa	I	0.1	II	4.5 ••	I	<0.05	I	0.3	I	<0.05	I	0.1	I	0.3	I	0.4
Anthoxanthum odoratum	I	0.2	II	9.5 ••	I	0.1	I	0.4	I	<0.05	II	3.2	III	2.0	I	1.1
Luzula multiflora	I	<0.05	I	1.4 •			I	<0.05					I	0.8	I	0.1
Rumex acetosa	I	<0.05	I	0.7 •							I	<0.05			I	0.1
c) *Schoenus nigricans - Rhynchospora alba* vegetation type indicators																
Schoenus nigricans	III	12.1	II	3.9	V	45.8 •••	II	3.8	I	0.8	IV	22.1	I	3.1	III	10.5
Rhynchospora alba	II	1.0			IV	5.9 •••	I	0.9	I	0.2	I	0.8	I	1.0	I	1.1
Campylopus atrovirens	I	1.1	I	<0.05	III	2.0 ••	I	0.3	I	0.1	I	<0.05			I	0.7
Racomitrium lanuginosum	III	3.9	I	0.1	IV	3.8 •	III	3.6	III	3.0	I	<0.05			III	3.0
Sphagnum auriculatum	II	2.1	I	0.4	III	4.3 •	II	1.5	I	0.6	II	2.0	II	2.9	II	1.8
Sphagnum tenellum	II	1.6	I	0.1	III	1.7 •	II	1.7	II	0.6	I	0.1			II	1.3
Campylopus flexuosus	I	0.6	I	<0.05	I	1.0 •	I	0.1	I	<0.05					I	0.3
d) *Calluna vulgaris - Sphagnum capillifolium* vegetation type indicators																
Sphagnum capillifolium	III	7.5	II	3.6	III	4.0	IV	26.3 •••	III	2.8	II	1.1	I	0.2	III	9.6
Hypnum jutlandicum	III	1.4	II	0.9	IV	0.7	III	4.4 ••	II	0.7	II	0.6	I	0.7	III	1.7
Cladonia portentosa	III	4.0	I	0.1	III	3.5	III	4.5 •	I	0.3	I	0.8			III	2.9
Odontoschisma sphagni	III	0.8	I	1.0	II	0.6	III	1.7 •	I	0.2	II	0.5			II	0.8
Pleurozium schreberi	I	0.1	I	0.1	I	0.1	II	1.6 •	I	0.1	I	<0.05	I	0.7	I	0.4

	a		b		c		d		e		f		g		Group
Erica cinerea	I	1.2	II	3.4	I	0.2	II	4.3 •	I	0.5	I	0.3	I	0.1	II	1.7
Pedicularis sylvatica	I	0.2	I	<0.05	II	0.1	II	0.5 •	I	<0.05	I	0.1	I	<0.05	I	0.2
Rhytidiadelphus loreus	I	0.2	I	0.3			II	0.8 •	I	0.2	I	<0.05	I	0.1	I	0.4
Leucobryum glaucum	I	0.4	I	0.2	I	0.3	I	1.3 •	I	0.1					I	0.5
e) *Trichophorum cespitosum - Eriophorum vaginatum* vegetation type indicators																
Trichophorum cespitosum	IV	9.6	I	0.9	IV	6.1	III	6.7	V	30.2 •••	I	0.1	I	0.7	III	10.0
Eriophorum vaginatum	III	3.9	II	1.1	III	1.0	III	5.6	IV	16.1 ••	I	1.0	I	3.9	III	5.3
Vaccinium myrtillus	I	0.2	I	<0.05			I	0.1	I	1.2 •			I	<0.05	I	0.3
f) *Erica erigena* vegetation type indicators																
Erica erigena	I	0.1	I	0.6	I	3.1	I	0.1			V	41.1 •••••			I	2.8
Anagallis tenella	I	<0.05			I	0.3					IV	2.3 •••	I	0.7	I	0.2
Carex panicea	II	1.2	I	0.2	I	1.2	I	0.6	I	0.4	IV	7.8 ••	II	1.8	II	1.3
Eleocharis multicaulis	I	0.4					I	0.2	I	0.0	III	8.7 ••	I	0.8	I	0.8
Myrica gale	I	2.2	II	7.5	I	1.1	I	1.5	I	<0.05	IV	15.2 ••	II	4.4	I	2.9
Succisa pratensis	I	0.7	II	2.2	I	0.7	I	0.3	I	<0.05	IV	6.0 ••	III	2.2	I	1.0
Pellia epiphylla					I	<0.05					II	0.5 ••			I	<0.05
Cirsium dissectum	I	0.2									II	3.5 ••			I	0.3
Filipendula ulmaria											II	1.9 ••			I	0.1
Selaginella selaginoides	I	<0.05									II	1.9 ••	I	0.1	I	0.1
Linum catharticum											II	1.7 ••			I	0.1
Fissidens adianthoides					I	<0.05					II	0.4 ••			I	<0.05
Campylium stellatum	I	<0.05			I	0.1	I	0.0			II	0.7 ••			I	0.1
Prunella vulgaris					I	0.3					II	2.5 ••			I	0.2
g) *Sphagnum palustre - Menyanthes trifoliata* vegetation type indicators																
Sphagnum palustre	I	0.7	I	1.5	I	0.2	I	0.1	I	1.5	I	2.2	IV	28.5 •••	I	1.7
Menyanthes trifoliata	I	0.2	I	0.3	I	0.1	I	0.2			II	2.3	III	19.3 •••	I	0.8
Carex echinata	I	0.4	I	0.4	I	0.3	I	0.1	I	0.1	III	6.3	IV	17.9 •••	I	1.2
Juncus bulbosus	I	0.1			I	0.2	I	<0.05	I	0.3	II	2.2	III	5.3 ••	I	0.4
Potentilla palustris			I	0.3									II	6.9 ••	I	0.2
Carex nigra	I	<0.05	I	0.1	I	0.1	I	<0.05	I	<0.05	I	1.4	II	12.5 ••	I	0.5
Sphagnum recurvum agg.	I	0.1	I	0.3	I	0.4	I	0.3	I	0.4	I	0.9	II	7.7 ••	I	0.5
Aulacomnium palustre	I	<0.05	I	<0.05	I	0.3	I	0.1	I	<0.05	I	0.7	II	5.6 ••	I	0.3
Juncus effusus	I	0.2	I	0.8					I	<0.05	I	1.0	II	4.6 ••	I	0.4
Ranunculus flammula											I	0.1	II	1.7 ••	I	0.1

	a		b		c		d		e		f		g		Group
Carex limosa											I	0.3	II	1.0 •	I <0.05
Agrostis canina / A. vinealis	I	0.1	I	0.3			I	<0.05	I	0.2			II	0.8 •	I 0.1
Sphagnum magellanicum	I	1.1			I	0.2	I	0.1	I	0.2			I	5.4 •	I 0.7
Phragmites australis	I	0.1	I	0.1	I	0.2	I	<0.05			I	1.6	II	2.9 •	I 0.3
Other woody species															
Ulex gallii	I	0.6	I	2.9			I	1.2	I	0.2					I 0.7
Empetrum nigrum	I	0.1					I	0.2	I	0.4					I 0.1
Alnus glutinosa					I	<0.05					I	1.0			I 0.1
Ulex europaeus	I	<0.05									I	0.9			I 0.1
Rubus fruticosus											I	0.7			I <0.05
Other forbs															
Galium saxatile	I	<0.05	I	1.3			I	0.2	I	<0.05	I	0.1	I	0.7	I 0.2
Narthecium ossifragum	III	4.0	I	0.6	V	3.7	III	3.4	III	2.6	III	6.8	III	6.3	III 3.6
Drosera rotundifolia	III	0.7	I	0.1	IV	0.7	II	0.7	I	0.2	III	1.3	II	0.4	II 0.6
Dactylorhiza maculata	I	<0.05	I	<0.05			I	0.1	I	<0.05	II	0.3	I	0.1	I <0.05
Drosera anglica	I	0.1									I	0.5	I	<0.05	I 0.1
Viola riviniana	I	<0.05	I	<0.05							I	0.4			I <0.05
Drosera intermedia	I	<0.05			I	0.1					I	<0.05			I <0.05
Galium palustre	I	<0.05	I	<0.05							I	0.8	I	0.5	I 0.1
Potamogeton polygonifolius											I	2.2	I	2.4	I 0.2
Hydrocotyle vulgaris											I	0.5	I	1.4	I 0.1
Pinguicula vulgaris	I	<0.05			I	0.1	I	0.1			I	0.1	I	<0.05	I <0.05
Plantago lanceolata	I	<0.05	I	<0.05							I	1.0			I 0.1
Melampyrum pratense	I	<0.05			I	<0.05					I	0.8			I 0.1
Viola palustris			I	<0.05							I	0.4	I	0.8	I 0.1
Mentha aquatica											I	0.7			I <0.05
Hypericum pulchrum			I	<0.05			I	<0.05			I	0.2			I <0.05
Angelica sylvestris											I	0.3			I <0.05
Andromeda polifolia							I	<0.05	I	0.1					I <0.05
Leontodon autumnalis					I	0.1					I	0.2			I <0.05
Trifolium repens			I	<0.05							I	0.5			I <0.05
Lotus pedunculatus											I	0.5			I <0.05
Achillea ptarmica					I	0.3					I	0.2			I <0.05
Iris pseudacorus											I	0.5			I <0.05
Centaurea nigra											I	0.2			I <0.05
Pedicularis palustris											I	0.1	I	0.2	I <0.05
Crepis paludosa											I	0.1			I <0.05
Taraxacum officinalis agg.											I	<0.05			I <0.05

	a	b	c	d	e	f	g	Group
Valeriana officinalis						I 0.4		I <0.05
Lythrum salicaria						I 0.1		I <0.05
Cirsium palustre						I <0.05		I <0.05
Cardamine pratensis							I 0.8	I <0.05
Other grasses, sedges and rushes								
Juncus squarrosus	I 1.0	I <0.05	I 0.1	I 0.9	II 1.0			I 1.3
Luzula sylvatica				I <0.05	I 0.2			I <0.05
Nardus stricta	I 0.2		I 0.4	I 0.5	I 0.5	I 0.9	I <0.05	I 0.3
Carex viridula	I <0.05	I <0.05	I 0.4	I <0.05	I <0.05	II 2.3	I 0.7	I 0.2
Carex binervis	I <0.05	I <0.05		I 0.1	I 0.3	I 0.3		I 0.1
Carex pulicaris	I <0.05	I 0.1				II 3.9	II 1.8	I 0.3
Juncus acutiflorus	I 0.2	I 0.3		I 0.1		I 1.9		I 0.2
Deschampsia flexuosa	I 0.1	I 0.2		I 0.3	I 0.2			I 0.1
Agrostis capillaris	I 0.2	I 0.1		I <0.05		I 0.1		I 0.1
Holcus lanatus	I <0.05	I 1.8		I <0.05		I 0.5	I 0.3	I 0.2
Agrostis stolonifera	I 0.1	I 0.1		I 0.2		I 1.2		I 0.2
Juncus conglomeratus	I <0.05	I 0.1				I 1.6		I 0.1
Festuca rubra	I <0.05	I <0.05		I <0.05		I 0.8		I 0.1
Juncus articulatus			I 0.3			I 0.5		I 0.1
Carex dioica						I 0.9		I 0.1
Carex hostiana						I 1.2		I 0.1
Dactylis glomerata						I 0.7		I <0.05
Carex curta						I <0.05	I 1.4	I <0.05
Juncus bufonius						I <0.05		I <0.05
Carex rostrata							I 0.8	I <0.05
Other ferns, horsetails and clubmosses								
Blechnum spicant	I <0.05	I <0.05		I 0.1		I 0.8		I 0.1
Osmunda regalis	I <0.05			I <0.05		I <0.05		I <0.05
Equisetum palustre		I 0.1				I <0.05		I <0.05
Other bryophytes								
Anomobryum julaceum	I <0.05							I <0.05
Sphagnum subnitens	III 4.8	I 2.1	II 0.7	II 5.6	III 3.6	II 2.6	I 0.2	II 4.0
Sphagnum papillosum	II 2.6	I 0.8	II 1.8	II 1.2	III 4.3	I 2.8	II 6.0	II 2.5
Diplophyllum albicans	I 0.3	I 1.6	I 0.2	II 1.0	I 0.4	I 0.1	I 0.1	I 0.5

	a	b	c	d	e	f	g	Group
Hylocomium splendens	I 0.2	I 0.8	I <0.05	II 1.1	I <0.05	I 0.5	I 1.8	I 0.5
Mylia anomala	I 0.5		II 0.4	II 1.0	I <0.05		I 1.4	I 0.5
Sphagnum cuspidatum	I 1.2	I <0.05	I 0.6	I <0.05	II 0.8	I 0.8	I <0.05	I 0.7
Breutelia chrysocoma	I 0.3	I 0.5	I 0.2	I 1.0	I 0.1	I 1.6	I <0.05	I 0.5
Hypnum cupressiforme(sensu lato)	I 0.7	I 3.9	I 0.1	II 2.6	I 0.4	I <0.05		I 1.2
Rhytidiadelphus squarrosus	I 0.1	I 0.9		I 0.1	I <0.05	II 0.3	I 0.8	I 0.2
Dicranum scoparium	I 0.1	I 0.1	I <0.05	I 0.7	I <0.05		I 1.7	I 0.2
Thuidium tamariscinum	I 0.2	I 0.2		I <0.05	I <0.05	I 0.3	I 0.1	I 0.1
Kurzia pauciflora	I 0.1		I <0.05	I 0.2	I <0.05	I <0.05		I 0.1
Polytrichum commune	I <0.05	I 0.4	I 0.1	I <0.05	I 0.2	I <0.05	I 1.5	I 0.1
Cephalozia connivens	I 0.1	I <0.05	I 0.1	I 0.2	I <0.05	I <0.05		I 0.1
Campylopus introflexus	I 0.1	I 0.3	I 0.1	I 0.3	I 0.1	I 0.3		I 0.2
Plagiothecium undulatum	I <0.05	I <0.05		I 0.1	I <0.05			I <0.05
Sphagnum compactum	I 0.1		I 0.2	I 0.2	I 0.1			I 0.1
Scleropodium purum	I 0.1	I 0.6		I 0.2	I <0.05	II 0.4	I 0.7	I 0.2
Scapania gracilis	I <0.05			I 0.1	I <0.05	I <0.05		I <0.05
Calypogeia sphagnicola	I <0.05	I <0.05		I <0.05	I <0.05	I 0.2		I <0.05
Calypogeia muelleriana	I <0.05			I <0.05		I 0.1		I <0.05
Calliergonella cuspidata			I <0.05	I <0.05		II 0.8	I 0.7	I 0.1
Cephalozia bicuspidata	I <0.05			I <0.05	I <0.05	I 0.2		I <0.05
Frullania tamarisci	I 0.1			I <0.05		I 0.1		I <0.05
Lophocolea bidentata	I <0.05	I 0.5	I <0.05	I <0.05	I <0.05	I <0.05		I 0.1
Aneura pinguis	I <0.05		I 0.1			I 0.1		I <0.05
Sphagnum subsecundum	I <0.05		I <0.05	I 0.6	I <0.05	I <0.05		I 0.1
Ctenidium molluscum			I <0.05			I 0.6		I <0.05
Riccardia multifida				I <0.05		I 0.2		I <0.05
Scapania undulata			I <0.05			I 0.1		I <0.05
Saccogyna viticulosa				I <0.05	I <0.05	I 0.1		I <0.05
Bryum pallens			I <0.05			I 0.1		I <0.05
Plagiomnium undulatum			I <0.05	I <0.05		I 0.1		I <0.05
Scorpidium revolvens	I 0.0					I <0.05		I <0.05
Scorpidium scorpioides						I 1.0		I 0.1
Rhizomnium punctatum						I <0.05		I <0.05
Scapania nemorea	I 0.0					I <0.05		I <0.05
Warnstorfia fluitans							I 0.2	I <0.05
Other lichens								
Cladonia uncialis	III 1.2	I 0.1	III 0.8	II 1.5	II 0.3			II 0.9
Cladonia diversa	I <0.05		I <0.05	I <0.05	I 0.1			I <0.05
Number of relevés	313	54	46	150	100	46	22	731

Table 3.7 Synoptic table for the *Narthecium ossifragum - Rhynchospora alba* group

Constants	a		b		c		d		e		f		g		h		Group	
Molinia caerulea	III	5.7	IV	10.8	V	10.0	V	16.3 ••	II	1.9	IV	1.3	V	1.6	V	14.5	V	8.8
Eriophorum angustifolium	V	17.9	IV	6.4	V	6.1	IV	4.1	V	68.9 •••	V	12.8	IV	1.2	V	8.1	V	4.6
Narthecium ossifragum	III	4.9	IV	5.3	V	3.9	IV	6.4	II	1.3	IV	7.4 •	IV	0.9	IV	6.0	IV	1.9
Erica tetralix	II	1.3	III	1.9	IV	1.6	V	3.9 ••	II	0.2	III	1.1	III	0.5	IV	4.1	IV	0.9
Calluna vulgaris	II	1.4	III	2.6	III	0.9	IV	3.1	III	1.0	III	1.2	IV	0.5	IV	6.7	IV	5.3
a) *Sphagnum auriculatum - Sphagnum cuspidatum* vegetation type indicators																		
Sphagnum auriculatum	V	43.8 •••••	I	1.2	I	<0.05	I	0.1	I	1.3	I	0.2			I	0.4	II	<0.05
Sphagnum cuspidatum	V	34.5 ••••	I	0.8	I	0.1	I	<0.05	I	1.6	I	0.1					I	<0.05
Menyanthes trifoliata	III	7.1 •••	I	0.1							I	<0.05					I	0.1
Utricularia minor	II	6.3 ••															I	<0.05
Eleocharis multicaulis	II	6.6 •	I	1.8	I	0.2	II	1.7	I	0.1	I	0.1	I	0.1	II	3.3	I	0.2
Sphagnum magellanicum	II	1.2 •	I	0.3			I	0.2			I	0.5					I	0.1
b) *Rhynchospora alba - Eriophorum vaginatum* vegetation type indicators																		
Rhynchospora alba	III	7.7	IV	16.7 •••	IV	1.2	II	0.7			III	3.6	III	0.5	II	1.9	III	1.2
Eriophorum vaginatum	I	0.3	III	7.6 ••	II	0.7	II	0.6	I	2.6	II	1.3	II	0.4	I	0.2	II	0.2
Drosera intermedia	II	0.8	II	0.9 •	I	0.2	I	0.1			II	0.5	I	0.2			II	<0.05
Drosera anglica	I	0.2	I	0.6 •	I	0.1					I	0.3	I	<0.05			I	0.2
Pleurozia purpurea	I	0.4	II	0.6 •	II	0.3	I	0.2	I	0.2	I	<0.05			I	0.2	I	0.1
Leucobryum glaucum			I	0.5 •	I	<0.05	I	0.1			I	0.1	I	0.2			I	0.2
c) *Schoenus nigricans - Erica cinerea* vegetation type indicators																		
Schoenus nigricans	II	5.9	III	8.2	V	15.5 •••	III	2.4	I	1.1	II	2.0	III	0.6	II	2.1	III	1.9
Erica cinerea			I	0.1	II	0.7 •	I	0.2			I	<0.05	I	<0.05	I	0.3	I	0.1
d) *Molinia caerulea - Erica tetralix* vegetation type indicators																		
Trichophorum cespitosum	II	0.8	II	3.6	II	1.1	III	5.0 •	II	0.5	II	0.9	II	0.5	III	2.7	II	1.4

	a		b		c		d		e		f		g		h		Group	
e) *Eriophorum angustifolium* vegetation type indicators																		
Polytrichum commune			I	<0.05			I	0.5	II	9.8 ••	I	0.5			II	1.1	I	0.3
Campylopus introflexus			I	0.7	I	0.2	II	0.5	II	10.0 ••	I	0.1	II	0.1	IV	7.8	II	2.2
Holcus lanatus							I	<0.05	II	2.7 ••					I	0.2	I	<0.05
Marchantia polymorpha									I	4.6 •							I	0.2
Juncus effusus	I	0.3					I	0.3	II	2.1 •	I	<0.05	I	<0.05	I	0.7	I	0.3
Calliergonella cuspidata									I	4.0 •							I	0.2
Pellia neesiana									I	4.0 •							I	0.1
Stellaria uliginosa									I	3.4 •							I	<0.05
Calypogeia fissa	I	0.1					I	<0.05	I	0.9 •							I	<0.05
f) *Narthecium ossifragum* vegetation type indicators - see constants																		
g) Sparse *Molinia caerulea - Eriphorum angustifolium* vegetation type - no specific indicators																		
h) *Carex panicea - Agrostis stolonifera* vegetation type indicators																		
Carex panicea	II	0.7	I	0.3	I	0.1	III	1.9	I	4.0	I	<0.05	I	<0.05	V	18.9 ••••	II	11.2
Agrostis stolonifera	I	<0.05					I	0.5					I	<0.05	III	6.0 •••	I	0.6
Carex viridula	I	0.6	I	<0.05	I	<0.05	II	0.9							IV	5.9 •••	I	1.9
Juncus bulbosus	I	1.2	I	0.6	I	0.1	II	2.3	II	1.6	II	1.0	I	0.2	V	9.2 ••	II	1.9
Potentilla erecta	I	0.1	II	0.3	III	0.4	IV	2.0	II	0.8	II	0.3	III	0.2	IV	7.2 ••	III	4.8
Danthonia decumbens							I	0.3			I	<0.05			III	2.8 ••	I	0.4
Succisa pratensis			I	<0.05	I	<0.05	I	0.1	I	<0.05					II	2.5 ••	I	7.0
Hypnum jutlandicum	I	0.4	II	0.3	I	0.1	II	0.6	I	<0.05	I	<0.05	I	0.1	IV	3.8 ••	II	0.5
Hylocomium splendens	I	<0.05	I	<0.05	I	<0.05	I	0.2			I	<0.05			II	3.4 ••	I	0.3
Campylopus flexuosus	I	0.1	I	0.4	I	0.1	I	0.1	I	<0.05	I	0.2	I	0.1	III	2.8 ••	I	1.2
Carex echinata	I	0.2	I	0.1			I	0.9							II	3.3 ••	I	0.8
Rhododendron ponticum							I	<0.05							II	1.2 ••	I	1.1
Thuidium tamariscinum			I	<0.05			I	0.1							II	1.7 ••	I	0.1
Other woody plants																		
Sorbus aucuparia							I	<0.05					I	<0.05	I	0.4	I	0.2
Myrica gale	I	0.6	I	0.2	I	0.0	I	0.3	I	<0.05			I	0.1	I	0.2	I	0.0

	a		b		c		d		e		f		g		h		Group	
Other forbs																		
Drosera rotundifolia	III	0.9	II	0.6	II	0.2	III	0.5	I	0.8	II	0.1	I	0.2	II	1.4	II	0.4
Hypochaeris radicata							I	0.1	I	0.3	I	0.5			II	1.1	I	0.1
Pinguicula lusitanica			I	<0.05			I	<0.05							II	1.0	I	0.2
Pedicularis sylvatica			I	<0.05	I	<0.05	I	0.1							I	0.8	I	0.4
Polygala serpyllifolia	I	0.1	I	<0.05	I	<0.05	I	<0.05			I	<0.05			I	0.4	I	<0.05
Cirsium palustre							I	<0.05							I	1.0	I	0.1
Dactylorhiza maculata							I	<0.05							I	0.4	I	0.2
Potamogeton polygonifolius	I	0.6													I	0.5	I	<0.05
Tussilago farfara									I	1.3	I	0.1					I	0.2
Epilobium palustre									I	0.1							I	<0.05
Other grasses, sedges and rushes																		
Nardus stricta	I	1.4	I	0.5	I	0.4	II	2.8			I	<0.05	I	<0.05	III	3.2	I	1.8
Anthoxanthum odoratum							I	0.1	I	0.7					II	2.4	I	0.1
Agrostis capillaris	I	<0.05			I	0.1	I	0.2	I	0.1			I	<0.05	I	0.8	I	1.1
Juncus squarrosus	I	0.1					I	1.0			I	0.3	I	<0.05	I	0.7	I	0.2
Festuca vivipara	I	<0.05	I	<0.05			I	0.3			I	<0.05			I	0.4	I	0.1
Agrostis canina / A. vinealis	I	<0.05					I	0.3							I	0.5	I	0.1
Luzula multiflora															I	0.6	I	0.1
Carex limosa	I	0.2	I	<0.05													I	<0.05
Other ferns																		
Dryopteris carthusiana									I	<0.05							I	<0.05
Dryopteris dilatata									I	<0.05							I	<0.05
Other mosses																		
Sphagnum papillosum	II	3.7	II	1.3	I	<0.05	I	0.3	II	2.7	I	0.6	I	0.1	II	2.4	II	5.5
Racomitrium lanuginosum	I	0.5	II	0.6	III	1.1	II	0.7	II	0.4	III	1.0	II	0.3	II	1.0	II	0.2
Rhytidiadelphus squarrosus			I	<0.05			I	0.1	I	0.1					II	2.8	I	0.5
Sphagnum palustre	I	0.9	I	0.3	I	0.1	I	0.6			I	<0.05	I	0.1	II	3.4	I	0.5
Sphagnum subnitens	I	0.1	I	0.1	I	0.1	I	0.5	I	<0.05	I	0.2			I	1.5	I	0.2
Scapanis gracilis			I	<0.05			I	<0.05	I	<0.05					I	0.8	I	<0.05
Breutelia chrysocoma	I	0.3	I	0.3			I	0.4							I	1.0	I	0.2
Pleurozium schreberi			I	<0.05			I	<0.05							I	1.6	I	0.8
Sphagnum capillifolium	I	0.7	I	0.4	I	0.1	I	0.1	I	0.2	I	0.3	I	<0.05	I	0.8	I	0.3
Sphagnum tenellum	I	0.5	I	0.2	I	0.1	I	0.1	I	<0.05	I	<0.05	I	<0.05	I	0.7	I	0.2

	a	b	c	d	e	f	g	h	Group
Dicranum scoparium		I <0.05		I <0.05	I 0.1	I 0.1		I 0.6	I 0.1
Pellia epiphylla				I <0.05				I 0.7	I <0.05
Campylopus atrovirens	I 1.2	II 1.3	II 0.4	II 1.1	I 0.7	I 0.3	I 0.1	I 0.2	II 1.0
Diplophyllum albicans		I <0.05	I 0.0	I <0.05	I <0.05				I 0.1
Cephalozia bicuspidata	I 0.1			I <0.05	I 0.8	I <0.05			I 0.3
Kurzia pauciflora		I <0.05		I <0.05	I <0.05	I 0.1			I <0.05
Lophocolea bidentata				I <0.05	I 2.3				I 0.1
Aneura pinguis					I 0.1				I <0.05
Odontoschisma sphagni	I 0.3	I 0.1	I 0.1	I 0.1	I <0.05				I <0.05
Sphagnum compactum	I <0.05	I 0.2	I 0.1	I 0.1					I <0.05
Rhytidiadelphus loreus		I <0.05	I <0.05	I <0.05			I <0.05		I 0.1
Mylia anomala	I 0.2	I <0.05	I <0.05	I <0.05					I 0.1
Cephalozia connivens	I 0.2								I <0.05
Dicranella heteromalla						I 0.6			I 0.1
Other lichens									
Cladonia portentosa	I 0.4	I 0.1	II 0.4	I 0.1		I 0.1	I <0.05	I 0.8	I 0.2
Cladonia diversa		I <0.05	I <0.05	I <0.05		I 0.1	I <0.05	I 0.4	I 0.4
Cladonia uncialis	I 0.2	I 0.1	II 0.1	I 0.1	I 0.0	I 0.1	I <0.05		I <0.05
Number of relevés	58	67	49	87	23	30	42	23	379

Table 3.8 Synoptic table for *Juncus effusus - Polytrichum commune* group

	a		b		c		d		e		Group	
Constants												
Juncus effusus	V	28.7	V	23.6	V	44.4 ••	V	48.1	I	0.1	V	36.9
Polytrichum commune	II	3.8	V	19.2	V	19.3	IV	25.9	II	2.8	IV	3.0
a) *Rumex acetosa - Holcus lanatus* vegetation type indicators												
Rumex acetosa	III	5.2 ••					II	2.1			II	0.9
Holcus lanatus	III	11.2 ••	II	0.9	II	3.0	III	2.7	I	0.1	II	18.6
Senecio jacobea	II	1.8 ••			I	0.1					I	0.5
Potentilla palustris	II	8.0 ••					I	0.2			I	<0.05
Equisetum palustre	II	1.6 ••									I	<0.05
Angelica sylvestris	II	10.3 ••									I	<0.05
Galium palustre	II	0.8 ••					I	0.7			I	5.1
Deschampsia cespitosa	I	11.2 •	I	0.1							I	0.5
Ranunculus flammula	I	3.3 •					I	0.2	II	0.1	I	16.6
Cardamine pratensis	I	0.5 •					I	0.1			I	0.9
Carex paniculata	I	4.2 •									I	0.8
Rubus fruticosus	I	9.1 •	I	0.5							I	0.6
b) *Campylopus introflexus* vegetation type indicators												
Campylopus introflexus	I	1.4	V	55.2 ••••	V	23.2					III	4.3
Dryopteris carthusiana	I	<0.05	II	0.2 ••	I	<0.05					I	0.2
c) *Juncus bulbosus - Sphagnum cuspidatum* vegetation type indicators												
Juncus bulbosus	I	1.1	III	2.9	IV	27.3 •••	I	0.7	II	0.8	II	1.0
Lophocolea bidentata	I	0.3	III	2.4	III	6.4 ••	I	<0.05			II	2.1
Aulacomnium palustre	I	<0.05	III	2.5	III	6.6 ••	I	0.4			II	1.6
Sphagnum cuspidatum			I	<0.05	II	8.8 ••	I	0.1	II	0.1	I	<0.05
Pellia neesiana	I	0.4	II	4.5	III	6.4 ••	I	0.3			I	1.2
Cephalozia bicuspidata			I	0.2	II	2.2 ••					I	<0.05
Hypochaeris radicata	I	0.1	II	0.4	II	2.2 ••					I	1.4
Sphagnum auriculatum			I	1.9	II	8.7 ••	I	0.3			I	3.4
Plagiomnium undulatum			I	0.1	II	1.0 ••	I	<0.05			I	0.2
Sphagnum squarrosum			I	1.9	II	3.3 •					I	<0.05

	a		b		c		d		e		Group	
d) *Sphagnum recurvum* agg. - *Agrostis stolonifera* vegetation type indicators												
Sphagnum recurvum agg.	I	0.5					IV	41.6 ••••			II	0.7
Agrostis stolonifera	I	2.3	I	0.2			II	10.3 ••	I	0.1	II	3.7
Carex nigra	I	0.4					II	2.3 ••	I	0.1	I	0.1
e) *Juncus acutiflorus - Potentilla erecta* vegetation type indicators												
Juncus acutiflorus	I	1.5					II	10.0	V	55.4 ••••	I	0.3
Potentilla erecta	II	2.0			I	0.1	III	2.9	V	5.8 •••	II	6.0
Polygala serpyllifolia							I	<0.05	II	0.3 ••	I	0.3
Sphagnum subnitens	I	0.2	I	0.6	I	1.2	I	1.4	II	25.9 ••	I	<0.05
Carex panicea	I	0.1					I	0.1	II	1.0 ••	I	2.0
Viola palustris	I	0.1					I	0.6	II	2.3 ••	I	3.3
Agrostis capillaris	I	1.8	I	0.7	I	0.1	III	6.2	III	8.7 ••	II	0.3
Anthoxanthum odoratum	III	5.5	I	0.1			II	1.8	IV	4.2 ••	II	0.4
Other woody species												
Vaccinium myrtillus	I	0.1					I	0.8	II	0.3	I	<0.05
Calluna vulgaris	I	3.2	II	0.2	I	<0.05	I	0.9			I	0.1
Myrica gale	I	3.1									I	<0.05
Sorbus aucuparia	I	1.5									I	<0.05
Other forbs												
Galium saxatile	I	3.6	I	<0.05			II	5.6	III	3.1	II	0.6
Narthecium ossifragum									II	2.8	I	0.6
Viola canina									II	1.0	I	0.3
Succisa pratensis	I	0.2					I	0.7	I	0.1	I	<0.05
Rumex acetosella	I	<0.05	II	0.3	I	0.7	I	0.3	I	0.1	I	1.7
Epilobium palustre	I	0.3	I	<0.05	I	0.1	I	0.3			I	1.8
Hydrocotyle vulgaris	I	0.6	I	0.5	I	0.6	I	0.7			I	1.7
Menyanthes trifoliata	I	0.6					I	0.4			I	<0.05
Stellaria uliginosa	I	0.3					I	0.1			I	<0.05
Persicaria hydropiper							I	0.5			I	<0.05
Ranunculus acris	I	0.4					I	0.3			I	<0.05
Plantago lanceolata	I	0.7					I	0.1			I	<0.05
Drosera rotundifolia	I	<0.05	I	0.2	I	0.3					I	<0.05
Tussilago farfara	I	0.7			I	0.1					I	1.8

	a		b		c		d		e		Group	
Sagina procumbens	I	2.1	I	0.7							I	0.3
Caltha palustris	I	1.8									I	0.2
Filipendula ulmaria	I	1.8									I	<0.05
Crepis paludosa	I	1.3									I	0.5
Ranunculus bulbosus	I	0.2									I	0.3
Other grasses, sedges and rushes												
Molinia caerulea	II	9.2	I	<0.05			II	5.9	II	9.9	II	1.7
Festuca ovina	II	3.3					II	6.2	II	0.1	I	0.2
Agrostis canina / A. vinealis	I	1.3	I	3.2			II	2.1	I	0.1	I	16.1
Carex echinata	I	1.2			I	0.1	II	2.3	I	0.7	I	1.0
Carex rostrata	I	1.3	I	4.1	I	2.4	I	8.9			I	0.1
Eriophorum angustifolium	I	2.5	II	8.3	I	1.8	I	1.2			I	<0.05
Juncus squarrosus			I	0.6			I	1.7			I	6.5
Juncus articulatus	I	3.0	I	0.5			I	0.8			I	<0.05
Luzula multiflora	I	0.7	I	0.1	I	0.2	I	<0.05			I	3.0
Aira praecox	I	<0.05	I	0.2	I	0.1					I	<0.05
Glyceria fluitans	I	2.2									I	0.3
Other ferns and horsetails												
Equisetum fluviatile	I	0.6	I	<0.05			I	0.3			I	0.3
Osmunda regalis	I	<0.05	I	0.1	I	0.3					I	3.0
Dryopteris dilatata			I	<0.05	I	0.2					I	0.4
Dropteris aemula	I	2.7	I	<0.05							I	<0.05
Other bryophytes												
Rhytidiadelphus squarrosus	I	1.2	II	0.3	I	1.3	I	0.9	II	1.6	I	1.7
Sphagnum palustre							I	4.9	I	1.5	I	0.1
Hypnum cupressiforme (sensu lato)	I	1.7	I	0.1	I	0.1	I	0.5	I	0.1	I	2.2
Racomitrium lanuginosum	I	<0.05							I	0.1	I	1.0
Rhytidiadelphus loreus	I	0.5	I	0.1			II	1.0			I	1.2
Calliergon stramineum							I	0.3			I	0.2
Scleropodium purum	I	3.0					I	0.3			I	0.3
Hylocomium splendens	I	<0.05			I	0.1	I	0.9			I	<0.05
Kindbergia praelonga	III	9.0	II	1.4	III	7.6	I	0.5			II	4.5
Calliergonella cuspidata	I	2.5	I	<0.05	I	3.6	I	0.3			I	<0.05
Calypogeia fissa					I	1.0	I	0.7			I	0.2

	a	b	c	d	e	Group
Aneura pinguis	I <0.05	I 0.4	I 0.4			I <0.05
Warnstorfia fluitans		I 0.5	I 2.2			I 0.1
Mylia taylorii		I 1.5	I 1.7			I <0.05
Dicranella heteromalla	I 0.8	I 0.7	I 0.2			I 0.5
Hypnum jutlandicum	I 0.3	I 0.2	I 0.2			I 2.0
Bryum pallens	I 0.5	I 0.7	I <0.05			I <0.05
Dicranum scoparium	I 0.1		I 0.6			I 0.4
Sphagnum papillosum		I 0.2				I <0.05
Other lichens						
Peltigera polydactyla	I 2.8	I 0.2	I 0.3			I 1.8
Cladonia portentosa	I <0.05	II 0.3	I 0.2			I <0.05
Cladonia gracilis		I 0.1	I <0.05			I 0.1
Number of relevés	25	31	26	58	6	146

Table 3.9 Synoptic table for *Carex nigra - Ranunculus flammula* group

Frequent species	a		b		c		d		e		Group	
Ranunculus flammula	III	5.0	III	0.3	IV	4.7	II	3.8	II	4.0	IV	3.9
Carex nigra	I	1.8			V	47.5 •••••	II	2.3	I	1.2	III	27.0
Hydrocotyle vulgaris	III	12.2			IV	10.2 ••	II	0.1			III	7.2
Juncus articulatus	III	9.1	I	0.8	IV	13.1 ••			I	1.8	III	8.7
Galium palustre	III	2.6	I	0.2	IV	4.1 •••	II	0.1	I	<0.05	III	2.6
Mentha aquatica	III	8.4			IV	6.9 ••			I	<0.05	III	4.9
Agrostis stolonifera	II	3.2	I	0.5	IV	7.3 •••					III	4.5
Menyanthes trifoliata	III	20.3	I	2.0	III	10.8	V	31.1 •••	I	2.7	III	10.9
Caltha palustris	II	1.4	I	<0.05	IV	4.8 •••					III	2.9
a) *Carex rostrata - Equisetum fluviatile* vegetation type indicators												
Carex rostrata	V	73.3 •••••	I	2.5	I	2.8	II	8.5			II	11.4
Equisetum fluviatile	IV	8.8 ••			III	4.1	II	2.3	I	1.1	II	3.6
Calluna vulgaris	II	1.3 ••	I	<0.05							I	0.2
Aneura pinguis	II	2.9 ••	I	0.8	I	0.1					I	0.5
Drosera rotundifolia	II	0.7 ••	I	0.2	I	<0.05					I	0.1
Kindbergia praelonga	I	1.9 •									I	0.2
b) *Potamogeton polygonifolius - Carex echinata* vegetation type indicators												
Potamogeton polygonifolius	I	1.1	III	10.9 •••	I	1.0	II	0.4			I	2.4
Nardus stricta			II	1.0 ••							I	0.1
Rhynchospora alba			II	1.2 ••							I	0.2
Hypericum elodes	I	0.9	II	11.0 ••							I	1.8
Carex echinata	I	0.0	III	4.8 ••	I	0.7	II	4.1			I	1.4
Drosera intermedia	I	0.1	II	2.9 ••					I	1.0	I	0.6
Anthoxanthum odoratum	I	<0.05	II	1.5 ••	I	0.3					I	0.4
Viola palustris	I	<0.05	II	1.0 •			I	0.4	I	0.1	I	0.2
Hylocomium splendens			I	2.5 •							I	0.4
Carex binervis			I	0.6 •							I	0.1
Festuca vivipara			I	0.5 •							I	0.1
Cirsium palustre			I	0.2 •							I	<0.05
Philonotis fontana			I	3.3 •							I	0.5

	a		b		c		d		e		Group	
c) *Carex nigra - Lythrum salicaria* vegetation type indicators												
Lythrum salicaria	I	0.2			III	1.8 •••					II	1.0
Senecio aquaticus	I	0.0			II	1.0 ••					II	0.6
Eleocharis palustris	I	0.2			III	5.5 ••	II	2.3			II	3.2
Agrostis canina / A. vinealis	I	0.2	II	0.3	III	1.7 ••					II	1.0
Ranunculus repens	I	0.0			II	1.3 ••					I	0.7
d) *Carex lasiocarpa - Carex limosa* vegetation type indicators												
Carex lasiocarpa							V	66.1 •••••			I	3.8
Erica erigena			I	<0.05			V	13.4 •••••			I	0.8
Carex limosa	I	0.4	I	2.2			V	18.9 ••••			I	1.5
Myrica gale	I	0.1	I	0.7	I	0.1	V	7.7 ••••	I	0.2	I	0.6
Molinia caerulea	II	0.8	III	4.1	I	1.0	IV	18.0 •••	II	1.3	II	2.5
Utricularia intermedia							II	2.0 ••			I	0.1
Phragmites australis	I	1.1			II	0.7	II	5.6 •	I	0.3	I	0.9
Schoenus nigricans			II	1.2			II	8.3 •	I	1.0	I	0.8
e) *Littorella uniflora - Eriocaulon aquaticum* vegetation type indicators												
Littorella uniflora			I	<0.05					V	34.6 •••••	I	3.8
Eriocaulon aquaticum			I	<0.05					II	10.3 ••	I	1.1
Isoetes lacustris									II	1.6 ••	I	0.2
Lobelia dortmanna			I	<0.05					I	2.0 •	I	0.2
Other woody species												
Salix repens					I	1.6	I	1.9			I	1.0
Ilex aquifolium					I	0.1					I	0.1
Erica tetralix	I	0.4	I	0.1	I	<0.05					I	0.1
Other forbs												
Leontodon autumnalis	I	<0.05			II	0.6			I	1.2	I	0.5
Succisa pratensis	I	<0.05	I	1.0	I	0.6	I	0.4	I	1.0	I	0.6
Plantago lanceolata					I	0.2			I	0.4	I	0.1
Utricularia minor	I	0.9							I	0.2	I	0.1
Prunella vulgaris									I	2.7	I	0.3

	a		b		c		d		e		Group	
Achillea ptarmica									I	0.2	I	<0.05
Potentilla erecta	I	<0.05	II	0.3	I	<0.05	II	0.8	I	1.0	I	0.2
Anagallis tenella	I	0.4	I	1.5	I	1.0			I	1.0	I	0.9
Filipendula ulmaria	I	0.1			I	0.4			I	<0.05	I	0.3
Narthecium ossifragum	II	2.1	II	2.7	I	0.0			I	0.2	I	0.7
Potentilla palustris	III	8.4	I	1.6	II	5.8	II	2.3			II	4.6
Pedicularis sylvatica			I	0.0	I	1.0	II	0.4			I	0.6
Cirsium dissectum			I	0.1			I	0.1			I	<0.05
Dactylorhiza maculata	I	0.2					I	0.1			I	<0.05
Cardamine pratensis	II	0.4	I	0.2	II	0.3					II	0.2
Iris pseudacorus					I	0.9					I	0.5
Myosotis laxa	I	0.2			I	0.2					I	0.2
Triglochin palustre	I	0.2			I	0.8					I	0.5
Apium nodiflorum					I	0.7					I	0.4
Rorippa nasturtium-aquaticum					I	0.4					I	0.2
Potentilla anserina					I	1.7					I	0.9
Triglochin maritimum					I	0.3					I	0.2
Epilobium palustre	II	0.6	I	0.1	I	0.4					I	0.3
Samolus valerandi	I	<0.05			I	0.1					I	0.1
Veronica scutellata	I	0.2	I	<0.05	I	0.3					I	0.2
Baldellia ranunculoides	I	0.2			I	0.5					I	0.3
Sagina nodosa	I	<0.05			I	0.1					I	0.1
Oenanthe lachenalii					I	0.1					I	<0.05
Utricularia australis					I	0.4					I	0.2
Persicaria amphibium					I	0.2					I	0.1
Oenanthe fistulosa					I	2.2					I	1.2
Sparganium erectum					I	0.3					I	0.2
Ranunculus acris					I	<0.05					I	<0.05
Angelica sylvestris	I	<0.05	I	0.3	I	0.2					I	0.2
Myosotis scorpioides	I	3.9	I	<0.05	I	0.2					I	0.6
Epilobium brunnescens	I	0.9	I	0.9							I	0.2
Polygala serpyllifolia	I	0.2	I	0.1							I	<0.05
Pinguicula lusitanica	I	0.2	I	<0.05							I	<0.05
Hypochaeris radicata	I	<0.05									I	<0.05
Other grasses, sedges and rushes												
Juncus bulbosus	II	0.4	III	4.6	I	1.2	II	9.5	II	4.8	II	2.5
Carex viridula	I	3.1	III	2.6	I	2.1	II	5.6	I	2.2	II	2.5
Eleocharis multicaulis	I	2.4	II	2.4	I	0.1	II	2.6	I	1.4	I	1.0
Carex panicea	II	1.1	II	0.8	II	1.8	II	8.5	I	1.0	II	1.9
Juncus acutiflorus	I	0.9	I	3.3	I	0.2			I	0.1	I	0.7

	a		b		c		d		e		Group	
Eriophorum angustifolium	II	3.9	III	3.5	I	1.1	II	2.3			II	1.8
Holcus lanatus	I	0.9	II	0.3	I	1.3					I	0.9
Juncus effusus	I	1.1	I	0.3	I	0.5					I	0.5
Carex curta					I	2.2					I	1.2
Eleocharis quinqueflora			I	1.3	I	0.3					I	0.4
Carex ovalis					I	0.5					I	0.3
Blysmus rufus					I	0.5					I	0.3
Schoenoplectus lacustris	I	0.2			I	<0.05					I	<0.05
Eleogiton fluitans	I	0.2			I	0.3					I	0.2
Deschampsia flexuosa			I	<0.05	I	<0.05					I	<0.05
Festuca rubra			I	0.1	I	0.2					I	0.1
Festuca ovina			I	0.3							I	<0.05
Trichophorum cespitosum			I	0.4							I	0.1
Juncus squarrosus			I	0.4							I	0.1
Carex pulicaris			I	0.2							I	<0.05
Deschampsia cespitosa	I	0.4	I	0.7							I	0.2
Other horsetails and clubmosses												
Equisetum palustre	I	0.2	I	<0.05	I	0.4					I	0.2
Selaginella selaginoides	I	<0.05	I	<0.05							I	<0.05
Other bryophytes												
Sphagnum cuspidatum	I	1.8	I	0.7					I	2.7	I	0.6
Sphagnum palustre			II	7.3			II	9.8			I	1.7
Sphagnum auriculatum	II	2.7	II	5.0			I	4.8			I	1.4
Calliergonella cuspidata	II	19.4	I	0.3	III	15.1					II	10.9
Campylium stellatum	I	0.9	II	2.8	I	1.1					I	1.1
Scorpidium revolvens			I	<0.05	I	1.3					I	0.7
Leptodictyum ripariodes	I	<0.05			I	0.4					I	0.2
Rhizomnium punctatum					I	0.1					I	0.1
Brachythecium rutabulum					I	0.4					I	0.2
Scorpidium scorpioides			I	0.3	I	0.1					I	0.1
Rhytidiadelphus squarrosus	I	0.2	I	1.0	I	0.4					I	0.4
Polytrichum commune			I	<0.05							I	<0.05
Sphagnum subnitens			I	0.8							I	0.1
Scleropodium purum			I	<0.05							I	<0.05
Campylopus introflexus	I	2.4	I	0.1							I	0.3
Sphagnum magellanicum	I	1.8									I	0.2
Dicranum scoparium	I	0.4									I	<0.05
Number of relevés		17		21		77		8		15		138

CHAPTER 4: UPLANDS MONITORING NETWORK

4.1 Introduction

This section develops a national monitoring network of upland sites designed to meet part of Ireland's obligations under Articles 6, 11 and 17 of the Habitats Directive (92/43/EEC). The associated monitoring programme will detect deterioration or improvement in the conservation status of Annex I habitats and hence these sites should be seen as priorities for future baseline survey by the proposed National Survey of Upland Habitats. There is a requirement for the results of this monitoring to be transmitted to the European Commission every six years. Although these obligations under the Habitats Directive place particular emphasis on the protection of Annex I habitats within the Natura 2000 network, the reporting requirement is not limited to cSACs as information on the status of the national resource of Annex I habitats is required. Therefore, the occurrence of Annex I habitats outside the cSAC network must also be subject to this programme of surveillance.

In developing this network the occurrence of upland Annex I habitats in Ireland was established by identifying the following sites: i) cSACs designated for upland Annex I habitats; ii) cSACs containing upland Annex I habitats but not primarily designated for them; iii), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs) and Nature Reserves containing upland Annex I habitats; and iv) areas with no conservation designation that contain upland Annex I habitats. This was completed through the creation of a GIS project that accompanies this report. An evaluation was made through comparison with a preliminary indicative map of upland habitats generated by ESDM as to whether these sites covered what could be regarded as an acceptable and representative proportion of the total national extent of upland habitat. The list of sites generated was then prioritised; the application of this tier system is discussed.

4.2 Identifying pool of potential sites for the monitoring network

4.2.1 Relevant habitats

A list of upland Annex I habitats was compiled and divided into 'primary' habitats that generally occur only in the uplands and comprise the vast majority of open habitats there (Table 4.1) and 'secondary' habitats that may also occur elsewhere (Table 4.2).

Table 4.1: Primary upland Annex I habitats

Habitat code	Habitat name
3160	Dystrophic lakes
4010	Atlantic wet heath
4030	European dry heath*
4060	Alpine and boreal heath
6230	Species-rich *Nardus* grassland
7130	Blanket bog
7150	*Rhynchosporion* depressions†
8110	Siliceous scree
8120	Calcareous scree
8210	Calcareous rocky slopes
8220	Siliceous rocky slopes

*Considered primary where not occurring in a coastal or lowland context

†Considered primary where occurring within a blanket bog context

Table 4.2: Secondary upland Annex I habitats

Habitat Code	Habitat name
3110	Oligotrophic waters of sandy plains
3130	Oligotrophic to mesotrophic standing waters
5130	*Juniperus communis* formations on heaths or calcareous grasslands
6130	Calaminarian grasslands
7140	Transition mires and quaking bogs
7220	Petrifying springs
7230	Alkaline fens
8240	Limestone pavements

European dry heath can occur as a coastal and lowland habitat but can also be a significant component in an upland context. For this reason it is considered a primary habitat when occurring in an upland context. During the pilot survey, the following habitats new to Ireland were recorded: Siliceous alpine and boreal grasslands (6150); Alpine and subalpine calcareous grasslands (6170); and the upland version of Hydrophilous tall herb fringe communities (6430). If accepted by NPWS as valid Annex I habitats in the Irish context these would also be categorised as primary habitats.

4.2.2 Identifying upland cSACs

All cSACs were identified for which primary upland Annex I habitats were qualifying interests. Sites where *Rhynchosporion* depressions (7150) were the only relevant qualifying interest were reviewed using the NHA Habitats Review Matrix to investigate if it occurred in a blanket bog or raised bog context. Where this habitat occurred with raised bog these cSACs were removed. Sites which only contained European dry heath were viewed in conjunction with the upland area of

interest generated by ESDM. This area of interest comprises all areas above 150 m altitude together with any adjacent areas for which there is existing mapping data suggesting upland habitat occurs there. Where no part of the cSAC area occurred within the area of interest then the cSAC was eliminated. This removed many of the coastal habitats from the list. The resulting list of 99 sites constituted the core upland cSAC group (Appendix IVa).

4.2.3 Identifying other designated areas with upland habitats

Sites which had been designated for non-upland habitats only were reviewed using the NHA Habitat Review Matrix. From this group sites were identified which contained at least some of the primary upland habitats listed in Table 4.1. Areas which only contained dry heath from the primary list were checked against the area of interest as defined above. Those which were entirely outside this area were eliminated. A total of 29 sites were identified and are listed in Appendix IVb.

A preliminary review of the SPA list revealed that there were two groups of these sites which might contain upland habitats: extensive hill sites and coastal sites (Appendix IVc). A further six SPAs overlap considerably with cSACs. These include Killarney National Park, Owenduff/Nephin Complex, Clare Island and Lough Nillan/Carrickatlieve. The non-cSAC areas that the SPAs contribute are generally rather small. Therefore these areas were treated as extensions of the cSACs rather than as independent sites.

The most important SPA sites in terms of upland habitats that do not overlap with cSACs are six extensive hill sites in the southwest, west and midlands designated for Hen Harriers. These potentially constitute important extra areas of designated uplands which can be incorporated into the monitoring programme. However, due to requirements for Hen Harrier conservation these designations encompass entire hill ranges, including areas of forestry and improved agricultural grassland in addition to upland habitats. Areas of forestry within each site were obtained from the SPA project team at NPWS. Areas given in Appendix IVc exclude the areas of forestry.

Coastal SPAs were reviewed using the NHA Habitat Review Matrix searching for sites containing primary upland habitat. This was supplemented with personal knowledge of some of the sites. Sites only containing dry heath which were outside the upland area of interest as defined above were removed. This left 7 sites. As with coastal cSACs that contain upland habitats, the true upland character of these sites varies considerably. The Beara Peninsula site contains significant areas of standard upland mosaic habitat while others, such as the Cliffs of Moher will contain very little upland habitat.

The NHA Habitat review database from 2005 was systematically searched for any occurrences of primary upland habitats. Although the main check involved looking for occurrences of the Annex I habitats themselves, supplementary checks were made for equivalent Fossitt categories. It transpired that, for example, Lowland blanket bog (PB3) was listed for some sites for which no record of the Annex I habitat Blanket bog (7130) was entered. A list of 72 NHAs with primary upland habitat was generated (Appendix IVd). Although the majority of these comprise relatively small sites of better quality blanket bog habitat within the wider countryside, some sites are

dominated by wet or dry heath. In addition there are several more extensive sites, such as Slieve Rushen, Slievenamon, Slieve Aughty Bog and Crockauns/Keelogyboy.

Seven of these NHAs completely overlap with much larger upland SPAs. Four are within the Slieve Aughty SPA and three are within the Slieve Felim to Silvermines Mountains SPA. In these cases, the NHAs have been given precedence as they identify discrete areas of upland habitat whereas the SPA boundaries also contain extensive forestry. In addition, Eshbrack NHA in Monaghan is almost entirely within the Slieve Beagh SPA. However, in this case the SPA has been given precedence because it does not contain any forestry, it is larger and it has a higher-order designation.

Nature Reserves proved to be of limited use. All but one of the few Nature Reserves which contained upland habitats were part of an area with a higher-order designation. The exception was Capel Island and Knockadoon Head, Co. Cork, which has been considered with the pNHAs.

A list of 19 pNHAs was compiled that contained primary uplands habitats (Appendix IVe). These contain several important and extensive areas of upland habitat, as well as an assortment of much smaller sites. One or two sites from this list appear to contain upland habitats of recognised quality, but which have not yet received formal NHA designation (e.g. Croagh Patrick pNHA).

The most important pNHA site in terms of area is the massive Maumtrasna Complex in north Galway (12,887 ha), but Croagh Patrick, Co. Mayo (1,168 ha), Coguish Bog, Co. Donegal (1,467 ha), and Lough Unna/Lough Unshagh Bogs, Co. Donegal (1,692 ha) are also all substantial sites. Apparently less important sites on this list include smaller hill pNHA sites such as Tory Hill, Co. Limerick, the Great Sugar Loaf, Co. Wicklow and St. John's Hill, Co. Carlow.

4.2.4 Identifying areas of extensive upland habitat outside designated areas

The total estimated area of upland habitats covered by the core upland cSACs and the other designated sites detailed above comes to approximately 700,000 ha. This compares to the total area estimated in a preliminary indicative map of upland habitats (prepared by ESDM) of over 2,000,000 ha. Even allowing for the highly likely overestimation by the map, it was apparent that there must still be very substantial areas of upland habitat which carried no kind of designation. It was therefore necessary to find the most effective means of identifying as much as possible of this remaining upland area, particularly large, discrete areas of the upland habitat types.

Despite the phenomenon of altitudinal descent of habitats that is widespread in the west of Ireland, altitude is still the most useful simple environmental variable associated with the distribution of upland habitat. The 150 m contour was used to delineate uplands on the preliminary indicative map of upland habitats and it was felt this resulted in the inclusion of too much improved agricultural ground, especially in counties such as Kilkenny, Laois, Cavan and Tipperary. For the purposes of this component of the scoping study a higher altitude contour was thought to be more useful, and the 250 m contour was selected.

Using GIS, the designated sites identified above were compared with the 250 m contour. This highlighted extensive areas above this altitude outside of designated nature conservation sites.

Initially, areas larger than 10km² were investigated further. However this threshold was subsequently reduced to enable identification of semi-natural areas in districts/localities with limited amounts of upland habitat. In areas with larger expanses of upland habitat, such as Donegal, Kerry and Mayo, this threshold was largely retained however.

Three broadly different types of area emerged from this process:

1) Extensive areas of habitat away from upland cSACs or SPAs. Most of these were in Donegal and the Cork/Kerry areas.

2) Areas of higher ground which effectively extended existing cSACs or, in some cases, surrounded NHAs. These included several examples from the Cork/Kerry border, but also from the Dingle Peninsula, the Maumtrasna area in Galway/Mayo and Keelogyboy in Leitrim.

3) Smaller, conspicuous hills from a variety of places, e.g. Brandon Hill in Kilkenny, Tonregee in West Mayo, Bloody Foreland in Donegal and Bentee in Kerry. Nephin in Mayo would be a much larger example of this kind of hill.

Ortho-rectified aerial photographs from 2005 were reviewed to further investigate the suitability of these areas. In most cases they proved to be suitable, with the exception of some areas in the Kerry/Cork/Limerick region where forestry was so densely planted that the fragments of upland habitat remaining were too small and dispersed to be included in the study. The boundaries of these areas were digitised with the aid of the aerial photographs. The boundaries were intended to mark the junction of clearly unenclosed upland habitat with clearly enclosed land. Enclosed land is generally more intensively managed and is typically within walls, hedges or fences. In some cases the boundaries were approximate due to due to the occurrence of complex mosaics of the habitats. Digitising for this element of the project was carried out at a scale of approximately 1:15,000.

In total, 45 undesignated sites were identified (Appendix IVf). Of these, 38 were more or less independent of the existing set of designated sites, apart from a few cases where they were close to much smaller NHAs. The biggest sites were in Donegal and the Cork/Kerry area, especially in and around the Bluestacks, the Rosses, the south end of the Inishowen Peninsula around Slieve Snaght, and the Caha, Shehy, Derrynasaggart and Boggeragh ranges in the southwest. One additional large area was that of the Knockmealdowns in Waterford and Tipperary. The other seven sites were relatively small extensions to designated sites such as Croagh Patrick, Dough/Thur Mountains, Croaghmoyle in Mayo and Benbo/Crockauns/Keelogyboy in Leitrim. These 45 sites comprise a further 127,000 ha of clearly unenclosed upland habitat.

4.2.5 Estimating area of upland habitats

To provide reasonably accurate areas for the various different types of upland sites identified it was necessary to deal with any significant overlaps between designated sites. The general principle applied was that cSACs took precedence over SPAs, which took precedence over NHAs, which took precedence over pNHAs.

It was also necessary to exclude any substantial areas of non-upland habitat from the sites. This was simply done for sites containing lakes or areas of the sea by digitising around the water features. For sites containing large rivers estimates were made of the terrestrial area and for large upland SPAs estimates were made of the area of forestry present which was then excluded. For upland cSACs, raw estimates of the proportion of upland habitats were made; it is accepted that these will vary in accuracy. The estimated areas for the pool of potential sites for uplands monitoring are presented in Table 4.3; they total 748,236.74 ha.

Table 4.3: Details of areas contributed by different site categories to pool of potential monitoring sites

Category	Percentage of total area of pool of sites	Amendments made to area	Amended area (ha)
Upland cSACs	63.0	Each area has been individually assessed and the area of upland habitat within each site estimated.	466,859.7
cSACs designated for non-upland habitats	0.5	Large waterbodies have been removed and 20% of remaining area is estimated to contain upland habitat	3,990.81
Upland SPAs and SPAs forming effective extensions to cSACs	12.1	Overall area reduced through removal of forestry on a site by site basis	89366.27
Coastal SPAs with unknown proportion of upland habitats	0.3	Estimate of 15% of total area is thought to contain upland habitat	2,392.17
NHAs (blanket bog and some hill sites)	4.9		36,132.78
pNHAs with upland habitats	3.0		22,322.47
Undesignated upland areas	17.2		127,172.54
Subtotal	100		**748,236.74**

4.3 Comparison with the Indicative Map of Upland Habitats

It was necessary to evaluate whether the pool of sites compiled above represents an acceptable proportion of the total extent of upland habitat in the country. Comparisons were therefore made with an indicative map of upland habitats produced by ESDM.

4.3.1 Area of primary upland habitats within the Indicative Map of Upland Habitats

The area within the indicative map was totalled for polygons where the preferred habitat combination included one or more of the following Fossitt types: ER1-4, FL1-2, PF1-2, FP1-2, GS3, HD1, HH1-4 or PB2-5. This resulted in an area for upland habitats of 1,300,439 ha, 64.5% of the total indicative map area of 2,017,600 ha (equivalent to 18.6% of the total landmass in Ireland; 6,988,200 ha). The main types of area excluded by this process were forestry and improved agricultural grassland. Other categories excluded include arable crops, native woodland and scrub.

4.3.2 Potential errors

Due to the difference in figures for area of primary upland habitats produced by the two approaches (1,300,439 ha and 746,279.48 ha), closer examination of the data was conducted to identify possible errors. It was found that substantial areas of often well-established coniferous forestry occurred within polygons of the preliminary indicative map of upland habitats purported to exclude forests. This is considered to be largely due to the rules based approach to selecting which habitat was the 'preferred' habitat when data sources conflicted. Through this process, data recorded to Level 3 of the Fossitt classification was given precedence over data of a lower level of detail. In this particular case much of the forestry had been given the generic WD for Highly modified / non-native woodland. Even though the confidence score awarded to this classification was relatively high – usually 10 – it was superseded, in a large proportion of the cases, by the presence of a confidence score of 2 or 3 for PB2 or PB3 from the DIPM.

A further source of error is the probable over-estimation of dry heath in the country which was incorporated into the map from Hewins and Lush (2001). Extensive areas in north Kilkenny and Laois are shown on the map as dry heath when in fact such areas exist only as tiny fragments in a wider mosaic of improved or damp acid grassland. This over-estimation appears particularly widespread in the east, southeast and midlands.

4.3.3 Coverage of the potential monitoring sites

The total area of the pool of upland sites for potential monitoring is 748,236.74 ha which equates to 57.4% of the uplands area identified from the indicative map. Due to the apparent underestimation of forestry cover and the overestimation of dry heath, this should be regarded as a minimum estimate. A figure closer to 70 or 80% is considered likely to be more realistic. The remaining area is likely to be scattered, fragmentary areas of upland habitat, much of which is likely to be marginal in its qualification as Annex I habitat, although it may represent locally important occurrences of upland habitats.

4.4 Prioritisation of sites for monitoring

Clearly, it is not practical to directly monitor every one of the potential monitoring sites identified. It was therefore necessary to prioritise sites by developing a points system which assigns relative values. Although all sites should be given some form of comparable ranking, in practice the core upland cSACs constitute the highest priority group. Therefore a more detailed system to ascribe value to these sites is proposed, whereas a simpler system is used for the other sites. This also reflects, perforce, the relatively poorer state of information on many of the other sites. It is however recognised that there is a need for information on the national resource of Annex I habitats and not just on areas within the cSACs.

4.4.1 Main criteria for ranking sites

The main criteria used for ranking sites within the monitoring network are as follows:

- area
- number of 'primary' upland habitats present, especially if notified for the site
- number of 'secondary' upland habitats present
- quality and representivity of the notified habitats present
- presence of habitat features which are either rare or particularly important in an international context
- proportion of site composed of upland habitats

There are a number of other possible criteria which were considered but have not been utilised at this stage. These include the number of non-upland habitats present, the current perceived condition of the majority of the habitats on site, the shape of the site (i.e. big block versus long and narrow), the perceived vulnerability to climate change, the imminence of any development threat, and some reflection of the value of the upland species associated with the site. This last criterion mostly works only for birds and they are catered for through the SPA monitoring system. The presence of patterning in our most oceanic blanket bogs is also of recognised importance and could perhaps be rewarded. Other possible elements which could be used in this manner might be the presence of well-developed upland calcareous flushes, the presence of good lichen flora or the presence of particularly good examples of intact alpine or boreal heath at low altitudes.

4.4.2 Application of criteria

Area (all sites)

The scheme adopted for area gives points to each site which is greater than 1,000 ha in size. Additional points are awarded for larger areas up to 50,000 ha, beyond which point there is no further reward for extra size. The scheme is presented in Table 4.4

.**Table 4.4:** Points awarded according to area

Area (ha)	Points awarded
1 - 999	0
1000 – 4999	1
5000 – 9999	2
10,000 – 19,999	3
20,000 – 29,999	4
30,000 – 49,999	5
50,000 or greater	6

Number of habitats (core upland cSACs)

For the core upland cSACs, 1 point was awarded for each primary uplands habitat present that was a qualifying interest, up to a maximum of seven points; only the Mweelrea/Sheeffry/Erriff Complex cSAC and the Wicklow Mountains cSAC actually have more than seven relevant habitats.

For each qualifying secondary habitat 0.3 points were awarded, and for each non-qualifying primary or secondary habitat 0.2 points were awarded. The NHA review database that records the occurrence of habitats was often incomplete but it was possible to add a large number of habitats to the lists for sites from personal knowledge.

Number of habitats (other sites)

For sites other than the core upland cSACs, 0.5 points were awarded for each upland habitat present; this reflects the assumed lower quality of these non-designated habitats. The occurrence of habitats within these sites was primarily researched using the NHA review database, with some augmentation from personal knowledge of sites where appropriate. Information was often lacking for many sites so it must be recognised that the current state of information usually considerably underestimates the habitat diversity on many of these sites.

Representativity (core upland cSACs)

Scores for the representativity of qualifying interests are given in the Qualifying Interest spreadsheet prepared by NPWS. Each qualifying interest is ranked as either A, B or C with A being the most representative. For each A score 1.75 points were awarded. For each B score 0.25 points were awarded but only if a site had two or more B scores.

Rarity/international importance (all sites)

Qualities in the qualifying habitats were identified which are recognised as being particularly important in the context of the Atlantic biogeographical zone. One of these is the presence of the 'mixed north Atlantic hepatic mat'[1] *sensu* Ratcliffe (1968). These assemblages of liverworts (with one or two characteristic associated mosses) are best developed close to the western seaboard of Ireland and Scotland, with their best expression in terms of diversity seen at higher altitudes. These mats can be astonishingly rich in species and reflect the combination of humidity and exposure that is so characteristic of Irish upland sites, at least in the west. Sites were awarded points on the nominal scale of 1, 0.5 or 0.25 based on available information.

Another distinctive habitat type which is almost completely confined to Ireland is the *Schoenus*-dominated bogs of the west. Although *Schoenus* can be prominent in some Scottish bogs they always appears to have at least some element of soligenous influence. This is not the case in Ireland and there is certainly no doubt that this habitat is best developed here (see Horsfield *et al.* 1991 for a discussion of the uniqueness of these bogs in a European context). Sites were awarded an additional 0.5 points if this habitat type is present.

Another distinctive feature of our uplands is the scattered presence, despite the relative warmth of our temperate climate, of a small but distinguished group of arctic-alpine relict vascular plants, marooned here after the retreat of the glaciers at the end of the last Ice Age. Species such as *Arenaria ciliata*, *Dryas octoptala*, *Arabis petraea*, *Alchemilla alpina* and several *Saxifraga* species form a very important, sensitive and valuable part of our flora. The presence of a significant selection of

[1] The south Atlantic hepatic mat also occurs but only in a woodland context

arctic-alpine plants was awarded points on the nominal scale of 1, 0.5 or 0.25, based on available information.

Proportion of site composed of upland habitats (core upland cSACs)

Since it will be more efficient to devote resources to sites where a greater proportion of the site area is actually composed of upland habitats, an overall modifier was used to reward sites which are overwhelmingly upland in character, and effectively penalise sites which have only minor proportions of these habitats (Table 4.5).

Table 4.5: Modifier for proportion of site composed of upland habitats

Proportion of site	Modifier
≥ 80% upland habitat	1.5
50% - 79% upland habitat	1
20% - 49% upland habitat	0.5
< 20% upland habitat	0.2

4.4.3 Application of the tier system

The points awarded to the core upland cSAC sites varied from 0.26 to 35.03 with the Mweelrea/ Sheeffry/ Erriff Complex cSAC scoring the highest (Appendix IV). The sites have been placed into four tiers, corresponding approximately to a score of 20-36 for tier I, 12-20 for tier II, 6-12 for tier III and up to 5 for tier IV. Some expert judgement has been applied to the tiering of the sites with, for instance site Aran Island (Donegal) Cliffs being demoted due to the mainly maritime character of this site, similarly River Finn is demoted as most of the area is riverine. The core upland cSACs have been ranked such that there are **12 sites in tier I**, **12 sites in tier II**, **23 sites in tier III** and **52 in tier IV**.

For the other sites, the points awarded varied from 8.5 to 0.5. The sites have again been placed into four tiers but note that due to the different scoring system direct comparisons should not be made with the core upland cSAC tiers. Note also that expert judgement has been used to adjust the tiers applied to many sites to account for factors not in the scoring system, for example, the abundance of forestry in many SPAs. It should be emphasised that this tiering system is preliminary and it can be easily altered.

Using this tiering system, sites can be prioritised for inclusion in a monitoring network. This approach will maximise the efficiency of fieldwork by focussing on the more important sites. Evidently, the number and size of sites selected depends on the resources available to NPWS at the time. An example proposal might be that during each six-year reporting cycle at least the top 50% of core upland cSACs, and at least 25% of the total sites from the other categories be monitored.

CHAPTER 5: CONDITION ASSESSMENT OF ANNEX I HABITATS

5.1 Introduction

The proposed methodology for assessing the conservation status of Annex I habitats which occur in the uplands is presented in this section. Condition assessments consist of three main aspects: area, structure and functions and future prospects. Details of how these will be assessed are presented here. Whilst it was not within the remit of the project to conduct comprehensive assessments of the pilot survey sites, the relevant data that were collected during the survey are presented to demonstrate the procedure.

5.1.1 General overview

Establishing a monitoring system involves a series of compromises between maximising information and minimising the cost of collecting this information in financial, time and labour terms. It is obviously important to be as secure as possible in the verdicts as to whether Annex I habitats are in favourable conservation status or not, yet without being unrealistic in terms of the sample sizes chosen and the number of targets on which a habitat may be assessed.

It is also important to build some flexibility into the system, both to allow revision of either targets or thresholds once sufficient information from the first rounds of monitoring becomes available, but also to take regional variation into account. Thus, while standardisation is important, there are also clear geographical differences in both the intrinsic nature of habitats, for example their floristics, and in extrinsic factors, such as the severity of the climate, with its concomitant influence on susceptibility to erosion.

This monitoring methodology leans heavily on the systems established in Britain, principally by Angus MacDonald, with modifications introduced under the supervision of Graham Sullivan, but it has also been influenced by the joint NPWS and Department of Agriculture methodology for monitoring upland habitats, the conservation assessment methodologies developed for a range of Irish habitat groups (e.g. Valverde 2008, Murphy & Fernandez Valverde 2009, Ryle *et al.* 2009), the Swedish Annex I habitat monitoring methodology (Abenius *et al.* 2000) and the German methodology (Sachtleben & Behrens 2009) for the same purpose. In addition, experience gained by the one of the authors through monitoring land management impacts in the Scottish uplands and applying the British upland condition monitoring methods to cSACs and SSSIs, provided a considerable foundation on which to construct the proposed system.

The field testing of modified versions of JNCC targets (JNCC 2009) was carried out during fieldwork on the pilot sites. This was conducted in detail on the two main sites, Mweelrea and Corraun, and on a more *ad hoc* basis for the other eight sites. The application of the monitoring criteria on as broad a range of the habitat types as possible helped to hone the sets of attributes and targets.

5.1.2 Principal parameters of assessment

According to Article 1 of the EU Habitats Directive, "[the] conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species". The Directive goes on to define this to be 'favourable' when its natural range and areas covered are stable or increasing; when the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future and the conservation status of its typical species is also favourable.

At a site level this translates into three principal parameters of an Annex I habitat that Article 17 of the Habitats Directive requires each member country to report upon: area, structure and functions and future prospects. Further guidance from the EU requires that these parameters are assessed using the scheme presented in Table 5.1. Although the range of the habitat is also a parameter to be reported on, it is assessed at a national level and does not come into the remit of this pilot but may be a component of a proposed national survey of upland habitats.

Structure, in the case of upland habitats, covers parameters such as the relative cover of graminoids or dwarf shrubs, the presence or absence of an intact bryophyte layer, the presence of a continuously vegetated surface in blanket bog, the presence of pool system on areas of bog and the absence of serious disturbance in most habitats. Function relates largely to the maintenance of the habitat-typical floristics and it also covers the maintenance of a natural balance between dominant and sub-dominant species, such that, for example, there is no reduction in the species diversity as a result of the overwhelming dominance of one or two species.

Table 5.1: General evaluation table for determining conservation status (simplified from table in Appendix 1; Annex E, of Dochab 04-03/03-rev.3)

Parameter	**Conservation status (CS)**			
	Favourable (green)	Unfavourable Inadequate (amber)	Unfavourable –Bad (red)	Unknown (insufficient information to make an assessment)
Area	Stable (loss and expansion in balance)	Any other combination	Large decrease in surface area: Equivalent to a loss of more than **1%** per year	*No or insufficient reliable information available*
Structures and functions	Structures and functions (including typical species) in good condition and no significant deteriorations / pressures.	Any other combination	More than **25%** of the area is unfavourable as regards its specific structures and functions (including typical species)	*No or insufficient reliable information available*
Future prospects	The habitat's prospects for its future are excellent / good, no significant impact from threats expected; long-term viability assured.	Any other combination	The habitat's prospects are bad, severe impact from threats expected; long-term viability not assured	*No or insufficient reliable information available*
Overall assessment of CS	All 'green' OR two 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all "unknown'

5.1.3 Annex I habitats covered by this methodology

The habitats which this methodology is intended to cover are as shown in Table 5.2. It was necessary to develop a monitoring scheme for each of the habitats listed in Table 5.2, except Species-rich *Nardus* grasslands (6230). A monitoring scheme for this habitat had already been devised by Dwyer *et al*. (2007), and modified by Martin *et al*. (2008) with the addition of some indicator species. The monitoring criteria developed for habitats are detailed in Appendix V with accompanying lists of appropriate indicator species in Appendix VI. Assessing Dystrophic lakes (3160) was not within the remit of this project.

Table 5.2: Annex I upland habitats to be assessed

Habitat code	Habitat name
4010	Atlantic wet heath
4030	European dry heath
4060	Alpine & boreal heath
6230	Species-rich *Nardus* grasslands
7130	Blanket bog
7150	*Rhynchosporion* depressions
8110	Siliceous scree
8120	Calcareous scree
8210	Calcareous rocky slopes
8220	Siliceous rocky slopes

Assessment criteria are still to be developed for habitat Siliceous rocky slopes with chasmophytic vegetation (8220). Many of the species listed by Wilson & Curtis (2006) are either more associated with relatively base-rich rock outcrops (e.g., *Saussurea alpina*, *Persicaria vivipara*, *Crepis paludosa*) or have no particular association with this habitat (e.g., *Agrostis canina*, *Listera cordata*, *Pedicularis sylvatica*). Only a small number of examples of this habitat were surveyed in detail during the pilot survey. More field data are therefore required before a list of indicators and thresholds can be compiled. The recording of comprehensive relevés will permit retrospective assessments at a later date.

5.1.4 Optimal times for monitoring different Annex I habitats

The field survey season generally spans six months, from April to September. This is the optimum time for field survey due to longer days, more favourable weather conditions and the fact that the majority of higher plants flower during this period, facilitating identification. In theory, upland fieldwork can be conducted outside of this period as the main species of interest can be identified vegetatively, but shorter days and less favourable weather conditions make this an impractical option. However, the length and timing of the field season will be dependent on the funding available and the timing of the NSUH project, as determined by NPWS. Optimum times for the assessment of the primary Annex I habitats are given in Table 5.3. If assessment is carried out at a sub-optimal time it should be noted accordingly in the report.

Table 5.3: Optimal months for assessing Annex I habitats. Dark grey denotes ideal months for assessing the relevant habitats. Light grey denotes other acceptable months. (Adapted from JNCC 2009).

Habitat	J	F	M	A	M	J	J	A	S	O	N	D
4010 Atlantic wet heath												
4030 European dry heath												
4060 Alpine and boreal heaths												
6230 Species-rich *Nardus* grassland												
7130 Blanket bogs												
7150 *Rhynchosporion* depressions												
8110 Siliceous scree												
8120 Calcareous scree												
8210 Calcareous rocky slopes												
8220 Siliceous rocky slopes												

5.2 Area

The main difficulty with regard to assessing habitat area is that, as already stated, much of Ireland's upland habitat does not occur as discrete blocks but rather as a complex mosaic of often closely related vegetation types across an intricately profiled landscape. A substantial part of the mosaic consists of vegetation which is so close to the median dividing line between two closely related habitats, such as wet heath and blanket bog, that it is either difficult to delineate the boundary between the habitats or this area should simply be regarded as transitional between them. In such cases it is highly problematic to accurately estimate a habitat's area and to reliably state if the area has changed or not.

Therefore, unless they have occurred at a landscape level it can be difficult to detect changes in the area of a particular habitat in an upland context. The critical threshold established by the EU is a change of 1% (see Table 5.1), but in practice it will usually only be possible to detect changes in habitat area of the order of 5% or perhaps, on larger sites, even 10%.

As the NSUH will essentially be conducting a baseline survey there are even greater difficulties in assessing this aspect as there are no comparable data to work with. Theoretically, the assessment should be based on any change in area since the EU Habitats Directive came into force in Ireland in 1997; subsequent monitoring will assess whether there has been any change since the previous assessment.

Despite these issues, gross changes in habitat extent will largely be evident during field survey. Such changes would include mechanised turf-cutting of previously intact bogs, afforestation, the development of windfarms, roads or tracks, and large-scale erosion due to bog bursts or land slips. These changes may also be detected through a comparison of contemporary and past aerial photographs, which will ease quantification; national sets of aerial photographs are available in digital format for *c.*2000 and *c.*2005. Areas of the scree habitats (Siliceous scree 8110 and Calcareous

scree 8120) tend to occur as obviously discrete areas and should prove easier to assess using aerial photographs. Local NPWS staff may also be aware of major changes in the extent of a habitat at a particular site. As a rule-of-thumb, the NSUH should assess a habitat as favourable in terms of area unless there is obvious evidence of recent habitat loss. Once monitoring stops have been established, any changes in the habitat found at these stops in future monitoring cycles could also feed into the assessment of area.

There may be instances where one habitat has been converted to another through the action of natural processes. The most likely scenario in the uplands is where Species-rich *Nardus* grasslands (6230) are replaced by European dry heaths (4030) due to significant reductions in grazing pressure. If the new habitat is the preferred habitat according to the conservation objectives of the site, for example as outlined in a cSAC management plan, then the loss of area of the old habitat should not automatically be assessed as unfavourable.

To provide baseline data for subsequent assessments it may be helpful during fieldwork to take a series of panoramic camera shots from recorded points. This will be of particular use for steep slopes, such as corrie walls, which are often obscured by shadow on aerial photographs, and sensitive areas such as alpine or heath hepatic mats. As always, photographs should be taken from grid-referenced locations.

5.3 Structure and function

5.3.1 Main attributes to be assessed

For full details of the proposed sets criteria and targets for each relevant habitat, see Appendix V, with accompanying lists of appropriate indicator species in Appendix VI.

Checking for the presence of assemblages of typical or indicator species for each habitat provides the most immediate means of assessing the structure and function of a habitat. Several habitats are characterised by key groups of species or genera, which are crucial to maintaining the structure of these habitats such as *Calluna vulgaris* in European dry heaths (4030), *Sphagnum* spp., *Trichophorum germanicum* and *Eriophorum* spp. in Blanket bogs (7130) and *Rhynchospora* spp. in *Rhynchosporion* depressions (7150).

The absence of peat erosion is one of the key elements to maintaining favourable structure and function for the peat-based habitats Atlantic wet heath (4010), Blanket bog (7130) and *Rhynchosporion* depressions (7150), as erosion may lead to either the disappearance of these habitats or their possibly irreversible deterioration.

The invasion of undesirable species may also jeopardise maintenance of some of these habitats, or at least be at the expense of the typical desirable species. One of the best examples of this is the increasing prevalence of the invasive alien willowherb *Epilobium brunnescens*, which was noted as being co-dominant or abundant at some of the locations assessed for the Calcareous rocky slopes (8210) habitat during the fieldwork for this pilot project. It was thus occupying niches that might

otherwise have been used by some of the typical species for this habitat, which include several nationally scarce arctic-alpines. Other species that may be undesirable in certain upland habitats include bracken, *Pteridium aquilinum* and grass species, such as *Nardus stricta*, *Anthoxanthum odoratum* and *Deschampsia flexuosa.*

The maintenance of hydrological integrity for blanket bogs is a crucial function. However, it is not easily assessed in the field without using hydrological monitoring equipment, the use of which can be time-consuming and labour-intensive. Thus, indirect measures of this are proposed instead, on the principle that if the bog surface is drying out, this will be reflected in both changes in species assemblage and probably in an increase in the amount of bare peat. This is consistent with the approach taken in the UK (JNCC 2009).

For the generally more extensive habitats Blanket bogs (7130), Wet heaths (4010), Dry heaths (4030) and Alpine and boreal heaths (4060), browsing of palatable dwarf shrubs is used as an attribute even though both *Calluna vulgaris* and *Vaccinium myrtillus* are relatively tolerant of low to moderate or even short-term high levels of browsing (Grant *et al.* 1981, Grant & Hunter 1965). This is because, when they are subject to sustained heavy browsing, particularly if combined with trampling, insect or exposure damage, they can quickly experience high mortality. This is particularly true of *C. vulgaris*.

Many of the species listed in the supporting documents for Siliceous rocky slopes with chasmophytic vegetation (8220) (Wilson & Curtis 2006) were found to be either more associated with relatively base-rich rock outcrops (e.g., *Saussurea alpina*, *Persicaria vivipara*, *Crepis paludosa*) or to have no particular association with this habitat (e.g., *Agrostis canina*, *Listera cordata*, *Pedicularis sylvatica*). Only a small number of examples of this habitat were surveyed in detail during the pilot survey. It was therefore felt that it would be premature to compile list of indicators and thresholds until further information had been gathered in the field.

5.3.2 Scale of assessment

Assessments of structure and function criteria are intended to be conducted through the recording of a series of monitoring stops generally 2 m x 2 m in size (see Chapter 2). Most criteria are assessed within the plots themselves, but some are assessed within the local vicinity; the area of the habitat that can be meaningfully seen from the plot. This area will vary considerably, but will tend to be in the order of a 50-100 m radius. The time taken to complete the assessment stop will vary by habitat and surveyor experience. Blanket bog, for example, will take longer than alpine and boreal heaths, while siliceous scree will be relatively quick. Assessments will usually be accompanied by a full relevé. As some of the relevé data is used for the assessment it should take 5-10 minutes to assess a stop where a relevé has already been recorded. If no relevé has been recorded the assessment should take 15-20 minutes.

5.3.3 Number of monitoring stops

Larger areas of habitat will evidently require a greater number of monitoring stops for adequate assessment. However, as the variability in a habitat does not increase linearly with area there are also diminishing returns on the value of the data collected as the number of monitoring stops

increases. Thus, proportionately fewer monitoring stops are required for larger areas. Guidance on the number of monitoring stops required is presented in Table 5.4. To facilitate the final assessment of the status of a habitat according to the parameters given in Table 5.1, monitoring stops should be recorded in multiples of four, but this is not essential.

For scree and rocky slope habitats (Siliceous scree 8110, Calcareous scree 8120, Calcareous rocky slopes and Siliceous rocky slopes 8220) the number of stops may be influenced by the degree of safe access. Siliceous scree (8110) and Siliceous rocky slopes (8220) are generally very robust and unattractive to herbivores, therefore fewer monitoring stops may be required. Where specific impacts are evident at a site or where it is suspected that the condition of the habitat has changed, a greater number of monitoring stops may be required.

Table 5.4: Proposed number of monitoring stops for different areas of habitat

Area of habitat (ha)	Number of monitoring stops
<0.04	1
0.04 - 1	4
1 – 5	8
5 – 10	12
10 -100	16
100 – 1,000	20
1,000 – 2,000	24
2,000 – 4,000	28
4,000 – 10,000	32
> 10,000	36+

5.3.4 Establishing the distribution of monitoring stops across a site

Ideally, the vegetation mapping for a site will be completed before conservation assessments are conducted. This will enable the number and distribution of monitoring stops to be carefully planned. For larger sites, however, it may be more practical to complete the site in sections, conducting conservation assessments as each section is mapped. This should reduce the number of times the field base needs to be relocated, but will make it more difficult to determine the number of stops required and set useful threshold levels (see below).

A large number of random monitoring points should be generated at the site or section level, approximately 500-1000 points for every 10 km^2. For each Annex I habitat to be assessed a threshold area should be decided upon based subjectively on the total area of that habitat at the site/section. The use of thresholds should ensure that monitoring is focussed on the larger areas of a given habitat. Polygons that contain greater than this threshold area of habitat form a sampling area. For abundant habitats a threshold area of 10-20 ha could be used, whereas for rarer habitats a threshold of 0.5 ha or less may be suitable. Within the sampling area, a number of monitoring points are selected equal to the number of required monitoring stops, starting with the point with the lowest number.

For abundant habitats, the surveyor should navigate to the coordinates of each monitoring point in turn using a GPS. If the habitat to be monitored does not occur at those co-ordinates it will be necessary to radiate out from this point until the relevant habitat is found; if it is not found within 200 m the surveyor should proceed to the nearest random monitoring point within the sampling

area that has not yet been selected. The first example of the target habitat encountered should be monitored, though care should be taken not to assess marginal or transitional examples of the habitat. The GPS location of the actual monitoring stop must be recorded. It will then be evident when the monitoring stop location is different from the randomly generated point. For rarer habitats, the surveyor should simply use available information, such as aerial photographs, waypoints, and what can be seen on the ground to locate the nearest example of the habitat to a given monitoring point. Exact positions of monitoring stops should be decided upon on an arbitrary basis but without preconceived bias. For scree and rocky slope habitats (8120, 8110, 8210 and 8220) placement of plots will also be influenced by the degree of safe access.

5.3.5 Recording of conservation assessment criteria

There are different sets of criteria for each of the upland Annex I habitats (Appendix V and VI). These were developed during this project, with the exception of the criteria for Species-rich *Nardus* grassland (6230) which is adopted from O'Neill *et al.* (2009). Data should be recorded using standardised forms within Microsoft Mobile Excel. No section of the form should be left blank. For quantitative criteria (e.g. area of bare soil, number of positive indicator species) the relevant value observed should be recorded. This is to enable comparisons to be made between monitoring in different years and also to allow some amendment of the thresholds if this is required. Other criteria are qualitative and a simple 'Yes' or 'No' will suffice. Each criterion should be recorded as a Pass or Fail.

5.3.6 Monitoring stop photographs

Several digital photographs should be taken of each monitoring stop to record the vegetation, and the best ones should be retained. All photographs should be labelled in the following fashion: RP[site number]-[relevé number]-[Photographer's initials]. For example, RP009-04-SB.jpg would be the photograph for relevé number 4 at site number 9, taken by Simon Barron. If more than one photograph is taken for a particular waypoint the photograph number should be appended with a,b,c etc. Photographs should be sorted and labelled as soon as possible as it can often be difficult to recollect specific relevés at a later date.

5.3.7 Rules-based approach to determining structure and functions

Having assessed the structure and function of the habitat through applying the criteria detailed in Appendix V it is necessary to determine whether a habitat is at favourable or unfavourable conservation status for a site. The approach taken here is principally adapted from a combination of that outlined in Murphy & Fernandez Valverde (2009) for limestone pavement, the coastal habitat monitoring system (Ryle *et al.* 2009) and the general JNCC approach for upland habitats employed in the UK (JNCC 2009). The UK approach is at least initially a very strict one whereby any failure of any target for a habitat results in that habitat being deemed to have failed for the entire site. Therefore the site is regarded as being at unfavourable conservation status, though mitigating evidence collected during field survey may be allowed to alter that verdict. The approach taken for other Irish habitat groups has been similar – e.g., for woodlands (Perrin *et al.* 2008) and grasslands (Dwyer *et al.* 2007), with any failed targets at a monitoring stop resulting in

that stop failing. However, in the case of upland habitats, natural variation, such as spatial variation in the structure and species composition of blanket bog (Schouten 1984, Cooper *et al.* 1997), should be accommodated within the system without triggering automatic failure if only one or, in some cases, two or three targets failed at a monitoring stop. The maximum number of targets allowed to fail without resulting in failure of the monitoring stop is given in Table 5.5.

Table 5.5: No. of targets for each Annex I habitat and maximum no. of targets allowed to fail without resulting in failure of the monitoring stop.

Habitat	No. of targets	Max. no. of failures
4010 North Atlantic wet heaths	19	3
4030 European dry heaths	16 *	2
4060 Alpine and boreal heaths	9	1
6230 Species-rich *Nardus* grasslands	11	0
7130 Blanket bogs	15	2
7150 *Rhynchosporion* depressions	11	2
8110 Siliceous scree	8	0
8120 Calcareous and calcschist screes	9	0
8210 Calcareous rocky slopes	5	0

*Only 14 targets applicable to any one regional variant

The two siliceous rock habitats (Siliceous scree 8110 and Siliceous rocky slopes 8220) are judged to be both relatively unlikely to fail and by their nature are both stable and robust and have therefore not been awarded any failure 'allowance'. The significantly smaller sample size proposed for these two habitats was also a factor in this decision. Since Calcareous rocky slopes (8210) has only four targets, it has been similarly treated.

The status of the monitoring stop is then determined by applying the scheme outlined in Table 5.6.

Table 5.6: Determining monitoring stop level results for structure and function.

Parameter	Conservation status (CS)		
	Favourable Good (green)	Unfavourable Inadequate (amber)	Unfavourable Bad (amber)
Structure and functions	No failed targets	Failed targets, but within allowance	Stop failed

Once all monitoring stops for a particular habitat have been completed at a site, an overall assessment of structure and function for that habitat can be given, following the guidelines in Table 5.7.

Table 5.7: Determining site level results for structure and function.

Parameter	**Conservation status (CS)**		
	Favourable Good (green)	Unfavourable Inadequate (amber)	Unfavourable Bad (amber)
Structure and functions	No stop failures	1-25% of stops failed	> 25% of stops failed

5.4 Future prospects

5.4.1 Overview

The future prospects assessment refers to the overall outlook for both the area covered by the habitat on the relevant site and its specific structures and functions. The future prospects verdict for a habitat, using the guidance given in Table 5.1, should be made by somebody who combines experience of the habitat with the best possible overview of the site – ideally in consultation with other surveyors who have also spent time on the site. The verdict should be based on an overall assessment of the relative importance of the negative impacts / threats and positive influences recorded. Inevitably a certain amount of expert judgement will be required.

5.4.2 Recording of impacts and threats

Impacts and threats should be recorded using the relevant impact code from the list used on Natura 2000 Standard Data Forms (Ssymank 2009); this list is presented in Appendix VII. For each of the impact recorded at a site the nature of the influence should also be recorded as positive, neutral or negative. The intensity of effect should be indicated as high, medium or low. The percentage area of the habitat impacted upon should be recorded and if there is a discernible trend in the intensity of the impact or activity relative to previous assessments or based on other available data, then this should also be noted as positive (more beneficial) or negative (more detrimental). In addition, whether the source of the impact is inside the site or outside the site should be recorded.

Land-use, impacts and threats would mainly be recorded for a site on the basis of observations during field survey, but these may occasionally be augmented by information from other sources such as local NPWS staff, local residents or farmers. Future impacts such as windfarms or quarries should only be considered if some actual progress has been made towards their development, rather than just speculation that they might be developed.

Equal vulnerabilities of different habitats to different factors should not be assumed. For instance, hepatic mat communities or *Sphagnum*-rich habitats are likely to be much more vulnerable to high levels of trampling than *Nardus* or wind-clipped *Calluna*-dominated habitats.

Positive impacts, such as the clearance of invasive shrubs or occurrence of appropriate grazing levels, should be recorded where they are actually observed on the ground. Best intentions proposed in site management plans or agri-environment agreements are not sufficient.

5.4.3 Commonage station data

Maximum use should be made of the data collected by recent commonage surveys and subsequent re-surveys which facilitated the drawing up of Commonage Framework Plans (CFPs) by NPWS and Department of Agriculture, Food and Forestry. These surveys sampled more than 450,000 of land that consists primarily of upland, blanket bog and heath in order to evaluate impacts of stock on these areas and to recommend stock reductions or other measures to allow recovery of degraded areas.

5.5 Assessment of sites in the pilot survey

Whilst it was not within the remit of the project to conduct comprehensive assessments of the survey sites, the relevant data that were collected are presented to demonstrate the procedure. In total, 128 monitoring stops were conducted during the pilot survey. An example of the data recorded at an individual monitoring stop is presented in Table 5.8. A summary of all monitoring stop results is presented in Table 5.9. Habitats were only given an overall assessment for structure and function if four or more monitoring stops had been recorded as this was regarded as a threshold for sufficient data. Future prospects were only assessed for the two main pilot survey sites of Mweelrea and Corraun. Again, it should be noted this is to demonstrate the procedure and should not be considered a definitive assessment of these sites. An example of a future prospects assessment is presented in Table 5.10. The main negative impacts on each site were overgrazing by sheep and erosion. Both sites are also in cSACs. No attempt was made to assess changes in area of individual habitats at these two sites as detailed data on the past extent of the relevant habitats were not available (this would however be required as part of the assessment within a proposed NSUH). This resulted in there being insufficient data for overall assessments for many of the habitats. Nevertheless several of the habitats were, tentatively, categorised as Unfavourable – Bad overall. A summary of the overall results for Mweelrea and Corraun are given in Tables 5.11 and 5.12. Full details of all assessments are presented in a Microsoft Access database that accompanies the report.

Table 5.8: Example of data recorded at a monitoring stop for habitat 6230 species-rich *Nardus* grassland at Corraun (stop no. 1). The stop failed overall as no fails are permitted for this habitat.

Criteria	Target	Result	Assessment
No. of positive indicator species	7	9	PASS
Cover of each negative indicator species <10%	YES	YES	PASS
Non-native species cover	<5%	0%	PASS
Scrub/bracken/ heath cover	<5%	0%	PASS
Bare ground cover	<10%	1.5%	PASS
Forb component of forb,grass,sedge,rush cover	20-90%	<20%	FAIL
Litter cover	<20%	20%	FAIL
Height of at least 25% of sward	5-50 cm	22 cm	PASS
Seriously disturbed area around stop	<20 m²	Not assessed	-

Table 5.9 Assessment of monitoring stops for each assessed Annex I habitat by site. T denotes total number of stops assessed; P denotes number of stops that passed. Where more than four stops were conducted for a habitat at a site structure and function status was assessed: green indicates Favourable, amber indicates Unfavourable – Inadequate and red indicates Unfavourable – Bad.

		Mweelrea		Corraun		Bricklieve		Ben Bulben		Slieve League		Slieve Blooms		Slieve Mish		Mount Brandon		Foiltagarrif		Sheeffry Hills	
	Habitat	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**
4010	Atlantic wet heath	8	7	15	14	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1
4030	European dry heath	0	0	4	1	3	3	1	1	3	3	1	1	0	0	0	0	1	1	0	0
4060	Alpine & boreal heath	3	3	16	14	0	0	1	1	2	2	0	0	0	0	2	2	0	0	0	0
6230	*Nardus* grassland	3	1	1	0	2	0	0	0	2	0	0	0	0	0	2	1	0	0	0	0
*7130	Blanket bog	6	6	13	13	0	0	4	4	2	1	5	5	1	1	0	0	0	0	0	0
7150	*Rhynchosporion* depressions	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8110	Siliceous scree	2	0	1	1	0	0	0	0	3	2	0	0	0	0	1	1	0	0	0	0
8120	Calcareous scree	0	0	0	0	4	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0
8210	Calcareous rocky slopes	0	0	0	0	1	0	4	0	1	1	0	0	0	0	0	0	0	0	0	0

Table 5.10 Example of future prospects assessments for habitat Wet heath (4010) at Mweelrea pilot survey area. An overall assessment of Unfavourable – Bad was made.

Impact	**Impact code**	**Intensity**	**Influence**	**% of habitat area**	**Trend**	**Source**
Overgrazing by sheep	A04.01.02	M	Negative	100	Insufficient data	Inside
Erosion	K01.01	M	Negative	3	Insufficient data	Inside

Table 5.11 Summary of assessments for Annex I habitats at Mweelrea pilot survey area.

Site	Habitat Code	Area (ha)	Area	Future Prospects	Structure & Functions	Overall Score
Mweelrea	4010	335.0	Insufficient data	Unfavourable -bad	Unfavourable -inadequate	Unfavourable -bad
Mweelrea	4030	5.1	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Mweelrea	4060	18.7	Insufficient data	Unfavourable -inadequate	Insufficient data	Insufficient data
Mweelrea	6230	32.3	Insufficient data	Unfavourable -inadequate	Insufficient data	Insufficient data
Mweelrea	7130	75.5	Insufficient data	Unfavourable -bad	Favourable	Unfavourable -bad
Mweelrea	7150	2.2	Insufficient data	Unfavourable -inadequate	Insufficient data	Insufficient data
Mweelrea	8110	96.4	Insufficient data	Favourable	Insufficient data	Insufficient data
Mweelrea	8210	0.9	Insufficient data	Insufficient data	Insufficient data	Insufficient data

Table 5.12 Summary of assessments for Annex I habitats at Corraun.

Site	Habitat Code	Area (ha)	Area	Future Prospects	Structure & Functions	Overall Score
Corraun	4010	2077.9	Insufficient data	Unfavourable -bad	Unfavourable -inadequate	Unfavourable -bad
Corraun	4030	209.9	Insufficient data	Unfavourable -bad	Unfavourable -bad	Unfavourable -bad
Corraun	4060	281.9	Insufficient data	Unfavourable -inadequate	Unfavourable -inadequate	Unfavourable -inadequate
Corraun	6230	0.1	Insufficient data	Unfavourable -inadequate	Insufficient data	Insufficient data
Corraun	7130	444.0	Insufficient data	Unfavourable -bad	Favourable	Unfavourable -bad
Corraun	7150	6.5	Insufficient data	Unfavourable -inadequate	Insufficient data	Insufficient data
Corraun	8110	28.9	Insufficient data	Favourable	Insufficient data	Insufficient data
Corraun	8210	0.1	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Corraun	8220	0.9	Insufficient data	Insufficient data	Insufficient data	Insufficient data

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APPENDIX I: PROVISIONAL CLASSIFICATION OF UPLAND HABITATS VERSION 1.2

List of communities

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt*
Pools	*Menyanthes trifoliata - Carex limosa* pools			
	infilling pool sub-community	PO1a	7140	PF3
	open water sub-community	PO1b	3160	FL1
Soakways	*Potamogeton polygonifolius* soakway	SW1	-	*PF2 (PF3)*
Springs	*Philonotis fontana - Saxifraga stellaris* spring			
	typical sub-community	SPG1a	-	FP2
	species-poor *Sphagnum denticulatum* sub-community	SPG1b	-	FP2
	Palustriella commutata spring	SPG2	7220	FP1
	Anthelia julacea - Sphagnum inundatum spring	SPG3	-	FP2
Poor flushes	*Carex nigra/echinata - Sphagnum denticulatum* flush	PFLU1	-	PF2
	Juncus effusus - Sphagnum cuspidatum/palustre flush	PFLU2	-	PF2
	Juncus acutiflorus/effusus - Calliergonella cuspidata flush	PFLU3	-	GS4
	Molinia caerulea - Sphagnum palustre flush			
	typical sub-community	PFLU4a	-	*PF2*
	Erica erigena sub-community	PFLU4b	-	PF2
Calcareous or mineral-rich flushes	*Carex viridula oedocarpa - Pinguicula vulgaris - Juncus bulbosus* flush			
	typical sub-community	RFLU1a	7230	PF1
	species-poor sub-community	RFLU1b	-	PF1
	Eleocharis quinqueflora - Carex viridula flush	RFLU2	7230	PF1
	Carex panicea - Carex viridula subsp. *oedocarpa* flush	RFLU3	-	PF1
Upland grasslands	*Agrostis capillaris - Festuca ovina* upland grassland			
	typical sub-community	UG1a	-	GS3
	Sphagnum spp. sub-community	UG1b	-	GS3
	species-rich sub-community	UG1c	6230	GS3
	Juncus squarrosus sub-community	UG1d	-	GS3
	Nardus stricta - Galium saxatile upland grassland			
	typical sub-community	UG2a	-	GS3
	Sphagnum spp. sub-community	UG2b	-	GS3
	species-rich sub-community	UG2c	6230	GS3
	Juncus squarrosus sub-community	UG2d	-	GS3
	Silene acaulis alpine grassland	UG3	6170	*GS1*
Dry heaths	*Ulex gallii - Erica cinerea* dry heath	DH1	4030	HH1
	Calluna vulgaris - Erica erigena - Molinia caerulea dry heath	DH2	4030	HH1
	Calluna vulgaris - Erica cinerea dry heath	DH3	4030	HH1
	Calluna vulgaris - Sphagnum capillifolium dry /damp heath	DH4	4030	*HH1*
	Calluna vulgaris - Succisa pratensis dry heath	DH5	4030	HH2
Wet heaths	*Schoenus nigricans - Erica tetralix* wet heath			
	continuous cover sub-community	WH1a	4010	*HH3*
	open sub-community	WH1b	4010	*HH3*
	Trichophorum germanicum - Cladonia spp. - *Racomitrium lanuginosum* wet heath	WH2	4010	*HH3*
	Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium wet/damp heath	WH3	4010	*HH3*

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt*
	Trichophorum germanicum- Eriophorum angustifolium wet heath			
	typical sub-community	WH4a	4010	*HH3*
	Calluna vulgaris sub-community	WH4b	4010	*HH3*
	Juncus squarrosus sub-community	WH4c	4010	*HH3*
	Trichophorum germanicum - Nardus stricta - Racomitrium lanuginosum montane wet heath	WH5	4010	*HH4*
Montane heaths	*Calluna vulgaris - Racomitrium lanuginosum* montane heath			
	typical sub-community	MH1a	4060	HH4
	Juncus squarrosus sub-community	MH1b	4060	HH4
	Vaccinium myrtillus - Racomitrium lanuginosum - Herbertus aduncus montane heath	MH2	4060	*HH4*
	Vaccinium myrtillus - Rhytidiadelphus loreus - Anthoxanthum odoratum montane heath	MH3	4060	*HH4*
	Calluna vulgaris - Juniperus communis subsp. *nana* montane heath	MH4	4060	HH4
	Nardus stricta - Carex binervis - Racomitrium lanuginosum montane grass-heath	MH5	-	HH4
	Carex bigelowii - Racomitrium lanuginosum montane vegetation			
	typical sub-community	MH6a	6150	*HH4*
	Dicranum fuscescens sub-community	MH6b	6150	*HH4*
	Juncus squarrosus sub-community	MH6c	6150	*HH4*
	Deschampsia flexuosa sub-community	MH6d	6150	*HH4*
	Nardus stricta - Carex bigelowii montane vegetation			
	typical sub-community	MH7a	6150	*HH4*
	Anthoxanthum odoratum sub-community	MH7b	6150	*HH4*
	Juncus squarrosus sub-community	MH7c	6150	*HH4*
Hepatic mats	*Calluna vulgaris - Scapania gracilis* hepatic mat	HM1	4010/4030	*HH1/HH3*
	Calluna vulgaris - Herbertus aduncus hepatic mat	HM2	4010/4030/ 4060	*HH1/HH3 /HH4*
Blanket bogs	*Schoenus nigricans - Eriophorum angustifolium* bog			
	continuous cover sub-community	BB1a	7130	PB3
	open sub-community	BB1b	7130	PB3
	Schoenus nigricans – Sphagnum spp. bog	BB2	7130	PB3
	Eriophorum vaginatum – Sphagnum papillosum bog	BB3	7130	PB2
	Trichophorum germanicum - Eriophorum angustifolium bog	BB4	7130	PB2
	Calluna vulgaris - Eriophorum spp. bog			
	typical sub-community	BB5a	7130	PB2
	Juncus squarrosus sub-community	BB5b	7130	PB2
	Eriophorum angustifolium - Juncus squarrosus bog			
	typical sub-community	BB6a	7130	*PB2*
	arctic-alpine sub-community	BB6b	7130	*PB2*
Hollows	*Sphagnum denticulatum/cuspidatum* hollow	HW1	-	*PB3 (PB2)*
	Eriophorum angustifolium - Sphagnum fallax hollow	HW2	-	*PB2 (PB3)*
	Rhynchospora alba hollow	HW3	7150	PB3
	Eleocharis multicaulis hollow	HW4	-	*PB3/PF2*

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt*
Degraded peat	*Campylopus introflexus - Polytrichum* spp. degraded peat community	DP1	-	ED3
Tall herbs	*Luzula sylvatica - Vaccinium myrtillus* tall herb vegetation	TH1	-	*ER1(HH1)*
	Cochlearia pyrenaica tall herb vegetation	TH2	6430	*ER2*
	Sedum rosea - Angelica sylvestris tall herb vegetation	TH3	6430	*ER2/ER4*
Bracken	*Pteridium aquilinum* community	BK1	-	HD1
Scree	Siliceous scree community	SC1	8110	ER3
	Calcareous scree community	SC2	8120	ER4
Rock clefts and rocky slopes	*Saxifraga spathularis - Asplenium adiantum-nigrum* rock cleft community	RS1	8220	ER1
	Saxifraga aizoides – Asplenium spp. - *Orthothecium rufescens* rock cleft community	RS2	8210	ER2

*Italics indicate where correlation with Fossitt scheme is weak. Habitat codes in brackets are potential but less likely correlations.

Non-vegetation cover types: Road; Made ground (other than roads); Sand; Shingle; Foreshore; Loose rock; Scree, Bedrock; Gravel; Open water; Running water; Bare peat.

Key to provisional communities of upland vegetation

1a	Pools, hollows or soakways in bog or wet heath (open areas dominated by *Carex viridula* subsp. *oedocarpa, C. panicea* or *E. quinqueflora* not included here)	**2**
1b	Bog, wet, damp or dry heath, montane vegetation, grassland, flushes or springs	**7**
1c	Well-irrigated, usually lushly vegetated ledges (or sometimes clefts) on rock outcrops	**33**
1d	Rock outcrops, loose rock, gravel or scree	**34**
2a	Shallow soakways / pools where *Potamogeton polygonifolius* is the most conspicuous species	**SW1**
2b	Not as above	**3**
3a	Obvious pools with *Menyanthes trifoliata* and, occasionally, *Carex limosa.*	**PO1**
3b	Hollows in bog or bog pools with no *Menyanthes trifoliata*	**4**
4a	Vegetation dominated by *Eleocharis multicaulis*	**HW4**
4b	*Eleocharis multicaulis* if present, only as a few scattered patches	**5**
5a	*Rhynchospora alba* (or *R. fusca*) conspicuous	**HW3**
5b	*Rhynchospora* spp. either absent or rare	**6**
6a	*Eriophorum angustifolium* overwhelmingly dominant with either no *Sphagnum* present or only *Sphagnum fallax* present	**HW2**
6b	*Sphagnum denticulatum* and/or *S. cuspidatum* dominant, usually accompanied by some *Trichophorum germanicum, Molinia caerulea, Narthecium ossifragum* or *Schoenus nigricans*	**HW1**
7a	Vegetation dominated by Nardo-Galion grass species (*Agrostis capillaris*, *Nardus stricta, Festuca ovina, Anthoxanthum odoratum* and *Deschampsia flexuosa)* or *Pteridium aquilinum* or grassy with both *Sesleria caerulea* and *Silene acaulis* prominent, **and** lacking any significant amounts of *Racomitrium lanuginosum*	**8**
7b	Vegetation not as above	**9**

8a	Grassland clearly dominated by *Nardus stricta*	**UG2**
8b	Grassland dominated by mixture of *Agrostis capillaris*, *Festuca ovina*, *Deschampsia flexuosa* and *Anthoxanthum odoratum* (N.B.: Very species-poor vegetation like this on summit plateaux (generally with *Festuca vivipara* or *D. flexuosa* dominant, accompanied by *Agrostis vinealis* and, occasionally, *Thymus polytrichus*) may be derived from formerly *Racomitrium lanuginosum*-rich montane vegetation – cf MH6d)	**UG1**
8c	Vegetation dominated by mix of forbs and grasses, with *Silene acaulis* very prominent, *Sesleria caerulea* present at significant cover and, sometimes, *Arenaria ciliata* (confined to Sligo and Leitrim on limestone)	**UG3**
8d	Vegetation dominated by *Pteridium aquilinum*, although grass species may be abundant beneath the bracken	**BK1**

9a	Flush dominated by one of *Molinia caerulea*, *Juncus effusus/acutiflorus, Carex nigra/echinata* with bryophyte understorey composed largely of either *Sphagnum palustre/denticulatum/fallax* or *Calliergonella cuspidata, Hylocomium brevirostre, Brachythecium* spp. *Eurhynchium* spp. *or Rhytidiadelphus squarrosus*	**10**
9b	Vegetation not as above	**13**

10a	Flush dominated by *Molinia caerulea* with a bryophyte layer dominated by *Sphagnum palustre/fallax/denticulatum; Sphagnum subnitens/capillifolium* may dominant if vegetation is species-poor; *Myrica gale* may occasionally dominate	**PFLU4**
10b	Flush dominated by *Carex nigra/echinata* or *Juncus* spp., sometimes accompanied by prominent *C. panicea*	**11**

11a	Vegetation dominated by *Carex nigra/echinata*, sometimes accompanied by prominent *C. panicea*	**PFLU1**
11b	Vegetation dominated by *Juncus effusus*, *J. acutiflorus* or (very rarely) *J. articulatus*	**12**

12a	Bryophyte understorey dominated by *Sphagnum* spp.	**PFLU2**
12b	Bryophyte understorey dominated by one or some of *Calliergonella cuspidata*, *Hylocomium brevirostre*, *Brachythecium* spp., *Eurhynchium* spp., or *Rhytidiadelphus squarrosus*	**PFLU3**

13a	Flush or spring dominated by *Eleocharis quinqueflora*, *Carex viridula/panicea, Sphagnum denticulatum/inundatum*, *Philonotis fontana*, *Chrysosplenium oppositifolium*, *Palustriella commutata* or *Anthelia julacea*	**14**
13b	Vegetation not as above	**18**

14a	Spring or spring-like flush dominated by one or some of *Sphagnum denticulatum/inundatum*, *Philonotis fontana, Chrysosplenium oppositifolium, Anthelia julacea* and *Palustriella commutata;* usually either bright green or golden/bronze-coloured or with the white/grey/blue cushions of *Anthelia*	**15**
14b	Vegetation dominated by *Carex* spp. or *Eleocharis quinqueflora*	**16**

15a	*Anthelia julacea* either co-dominant or at least very conspicuous, often accompanied by conspicuous amounts of mucilaginous algae and sometimes with big cushions of *Scapania undulata;* where *Anthelia julacea* occurs on more or less vertical rocks with seepage refer to RS1	**SPG3**
15b	*Anthelia julacea* absent or rare, vegetation dominated by extensive cushions of *Sphagnum inundatum/denticulatum, Philonotis fontana or Montia fontana. Dichodontium palustre* and *Chrysosplenium oppositifolium* are occasionally abundant	**SPG1**

15c	*Anthelia julacea* absent; vegetation dominated by the conspicuous golden/bronze-coloured moss *Palustriella commutata*; associates may include some of *Carex nigra, Festuca rubra*, *Bryum pseudotriquetrum*, *Carex viridula oedocarpa*	**SPG2**
16a	Sparse species-poor vegetation of flushed flat ground dominated by *Carex viridula/panicea*	**RFLU3**
16b	Relatively species-rich flush dominated by *Carex viridula/panicea* or *E. quinqueflora* with associates other than occasional bits of *Nardus stricta, Trichophorum germanicum* or *Juncus bulbosus*	**17**
17a	Flush with conspicuous amounts of *Eleocharis quinqueflora* accompanied by at least some brown mosses including *Campylium stellatum, Drepanocladus* spp. or *Scorpidium* spp.	**RFLU2**
17b	Flush lacking conspicuous amounts of *Eleocharis quinqueflora; Carex viridula* subsp. *oedocarpa* or *brachyrrhyncha* usually abundant and at least some brown mosses present. Other associates are *Carex dioica/hostiana, Pinguicula* spp., *Blindia acuta, Selaginella selaginoides*	**RFLU1**
18a	Bog vegetation on fairly deep peat (> 40 cm) or montane bog vegetation on shallower peat (> 10 cm) where at least three of *Eriophorum* spp., *Juncus squarrosus*, *Sphagnum capillifolium* and *Calluna vulgaris* are prominent	**19**
18b	Not as above - heath or montane vegetation	**23**
19a	Montane bog with at least three of *Eriophorum spp., Juncus squarrosus, Sphagnum capillifolium and Calluna vulgaris* prominent and accompanied by *Racomitrium lanuginosum* and *Empetrum nigrum* (*Cladonia arbuscula* also on higher summit ridges).	**BB6**
19b	Bog vegetation not as above	**20**
20a	*Schoenus nigricans* absent or very rare	**21**
20b	*Schoenus nigricans* conspicuous	**22**
21a	Bog vegetation dominated by mixture of *Calluna vulgaris* and *Eriophorum* spp.	**BB5**
21b	Relatively dry bog lacking any significant amounts of dwarf-shrubs and dominated by *Eriophorum* spp., *Trichophorum germanicum* and/or *Juncus squarrosus*	**BB4**
21c	Soft *Sphagnum*-rich bog with *Sphagnum papillosum* conspicuous and *Eriophorum vaginatum* present; *Narthecium ossifragum* and *Drosera rotundifolia* are usually present	**BB3**
21d	Degraded bog covered by often fragmented species-poor carpet of mosses: *Campylopus introflexus/flexuosus* and/or *Polytrichum* spp. dominant, sometimes accompanied by squamose *Cladonia*. Although typical of deeper peats, may occur on peat < 40 cm.	**DP1**
22a	*Schoenus nigricans* conspicuous and *Sphagnum* spp. at least frequent	**BB2**
22b	*Schoenus nigricans* conspicuous but *Sphagnum* spp. cover poor (deep peats)	**BB1**
23a	*Schoenus nigricans* conspicuous	**WH1**
23b	*Ulex gallii* conspicuous and/or *Daboecia cantabrica* present	**DH1**
23c	Prostate *Juniperus communis* subsp. nana and/or *Arctostaphylos uva-ursi* conspicuous (>5% cover)	**MH4**
23d	Vegetation not as above	**24**

24a	Strict arctic-alpine species (e.g. *Carex bigelowii, Salix herbacea, Diphasiastrum alpinum, Cetraria islandica*) present **and** no significant cover of dwarf shrubs	**25**
24b	Strict arctic-alpine species absent **or** if present then significant dwarf shrub cover present	**26**

25a	*Nardus stricta* dominant	**MH7**
25b	*Nardus stricta* not dominant	**MH6**

26a	Conspicuous amounts of *Sphagnum* spp. or hepatics present	**27**
26c	Vegetation not as above	**29**

27a	*Sphagnum* (mainly *S. capillifolium* or *S. subnitens*) present as a dominant understorey to *Calluna vulgaris*, usually on at least moderate slopes; *Molinia caerulea* absent or very subordinate element of vegetation	**DH4**
27b	Vegetation dominated by mixture of *Calluna vulgaris* and *Molinia caerulea*	**WH3**
27c	Vegetation comprises relatively small, discrete species-rich mats of bryophytes with high component of liverworts including *Diplophyllum albicans, Herbertus aduncus* and *Scapania gracilis*	**28**

28a	Hepatic mats of lower altitudes usually dominated by *Scapania gracilis* or *Diplophyllum albicans*	**HM2**
28b	Hepatics mats of higher altitudes with *Herbertus aduncus* usually prominent	**HM1**

29a	Dry heath dominated by *Calluna vulgaris* with conspicuous amounts of *Nardus stricta* and *Erica cinerea*	**DH3**
29b	Damp-dry heath with *Calluna vulgari*s and conspicuous *Erica erigena*	**DH2**
29c	Species-rich dry heath, featuring at least some of *Hypericum pulchrum*, *Thymus polytrichus*, *Succisa pratensis*, *Lathyrus linifolius*, *Danthonia decumbens*, *Viola riviniana*, *Linum catharticum* and *Lotus corniculatus*.	**DH5**
29d	Vegetation not as above	**30**

30a	*Trichophorum germanicum* conspicuous (or *Eriophorum angustifolium* prominent)	**31**
30b	*Trichophorum germanicum* no more than occasional	**32**

31a	Montane wet heath *with Nardus stricta* dominant/co-dominant with *Trichophorum germanicum;* also present *Calluna vulgaris*, *Carex panicea*, some *Narthecium ossifragum*, scattered *Eriophorum angustifolium* and *Sphagnum denticulatum*; nearly always on slopes which are either very exposed or at altitudes > 250 m	**WH5**
31b	Wet heath with conspicuous *Trichophorum germanicum* but little *Nardus stricta*; vegetation is typically open with either rocks or bare peat patches frequent; other major species include *Cladonia* spp. and *Racomitrium lanuginosum*	**WH2**
31c	Wet heath on peat (rocks absent); dominated by at least two of following species: *Trichophorum germanicum*, *Eriophorum angustifolium*, *Calluna vulgaris*, *Juncus squarrosus*. *Sphagnum* cover varies from 0-50(-60)% and normally consists of *Sphagnum capillifolium*, *Sphagnum subnitens*, *Sphagnum palustre* or *Sphagnum tenellum – Sphagnum papillosum* is usually absent.	**WH4**

32a	Montane heath with *Nardus stricta* dominant/co-dominant with conspicuous amounts of *Racomitrium lanuginosum*; *Carex binervis* is typically present; *Trichophorum germanicum* should be present in either small amounts or otherwise clearly subordinate to *Nardus*.	**MH5**
32b	Montane dwarf shrub heath; *Nardus stricta* not dominant/co-dominant but vegetation still with conspicuous amounts of *Racomitrium lanuginosum; Calluna vulgaris* cover > 10% and typically wind-clipped	**MH1**

32c	Montane dwarf shrub heath on rocky areas, where *Nardus* absent or clearly sub-dominant; dominated by mixture of either *Vaccinium myrtillus* or *Empetrum nigrum* with *Racomitrium lanuginosum*; *Herbertus aduncus* or other hepatics often prominent; *Calluna vulgaris* absent or clearly subordinate to *Vaccinium myrtillus* /*Empetrum nigrum*	**MH2**
32d	Montane dwarf shrub heath, where *Nardus* absent or minor element of vegetation; dominated by combination of *Vaccinium myrtillus* with Nardo-Galion species, especially *Deschampsia flexuosa*, but also usually some of *Festuca vivipara*, *Anthoxanthum odoratum*, *Agrostis vinealis* and *Agrostis capillaris*; *Racomitrium lanuginosum* often prominent.	**MH3**

33a	Tall herb vegetation on siliceous rock dominated by *Luzula sylvatica*, often accompanied by some of *Calluna vulgaris*, *Vaccinium myrtillus*, *Agrostis vinealis*, *Deschampsia flexuosa*, *Festuca vivipara* or *Anthoxanthum* odoratum	**TH1**
33b	Tall herb vegetation on at least moderately base-rich rock with *Cochlearia officinalis* agg. (perhaps all referable to *C. pyrenaica*) at least co-dominant	**TH2**
33c	Species-rich tall herb vegetation on base-rich rock outcrops, where at least two of *Sedum rosea, Angelica sylvestris, Geum rivale, Filipendula ulmaria* and *Alchemilla glabra* prominent; some of *Hypericum pulchrum, Succisa pratensis, Festuca rubra, Primula vulgaris* and *Viola riviniana* usually present; *Luzula sylvatica* usually no more than co-dominant.	**TH3**

34a	Bedrock outcropping	**35**
34b	Bedrock not outcropping	**36**

35a	Rock outcrops without significant clefts or if present then largely bereft of plants	**Bedrock**
35b	Siliceous rock outcrops with significant clefts, some of which are occupied by conspicuous cover of bryophytes and/or ferns; *Saxifraga spathularis* and *Asplenium adiantum-nigrum* often present	**RS1**
35c	Calcareous rock outcrops with significant clefts, some of which occupied by bryophytes and ferns or flowering plants; *Orthothecium rufescens, Tortella tortuosa*, *Anoectangium aestivum*, *Cystopteris fragilis, Asplenium trichomanes* or *Saxifraga aizoides* may be present	**RS2**

36a	Rock occurring as area of gravel or, at biggest, large pebbles but with no calcareous indicator plants	**Gravel**
36b	Calcareous rock occurring as body of large pebbles /small rocks with species such as *Thymus polytrichus, Arenaria ciliata, Saxifraga aizoides, Saxifraga oppositifolia, Breutelia chrysocoma* and *Arabis petraea*	**SC2**
36c	Siliceous rock occurring as coherent bodies of rocks, boulders or large blocks; often associated with dwarf shrub communities or hepatic mats.	**SC1**
36d	Rocks scattered, loose across landscape	**Loose rock**

Appendix II: Polygon recording sheet

Site no: 001 **Site name:** Corraun **Surveyor:** BOH & JR **Date:** 12 April '09

Polygon no.	Hab	Component 1	%	Component 2	%	Component 3	%	Component 4	%	Component 5	%	Component 6	%	Component 7	%
21	Veg	ScniWHcc	75	ScniBGcc	15	CaMolDH	5	ScniWHop	5						
	Fos	PB3		PB3		HH3		PB3							
	Anx	4010		4010		4030		4010							
22	Veg	LsRK	34	SScreeRK	5	BedRK	34	CaJuconaMH	60						
	Fos	ER3		ER3		ER1		HH4							
	Anx			8110				4060							
23	Veg	CaJuconaMH	30	CaRacoMH	10	NsRacoGD	10	SScreeRK	5	LsRK	45				
	Fos	HH4		HH4		HH4		ER3		ER3					
	Anx	4060		4060				8110							
24	Veg	SScreeRK	90	CaJuconaMH	10										
	Fos	ER3		HH4											
	Anx	8110		4060											
25	Veg	SScreeRK	100												
	Fos	ER3													
	Anx	8110													
26	Veg	SScreeRK	100												
	Fos	ER3													
	Anx	8110													
27	Veg	SScreeRK	90	CaJuconaMH	10										
	Fos	ER3		HH4											
	Anx	8110		4060											
28	Veg	SScreeRK	90	CaJuconaMH	10										
	Fos	ER3		HH4											
	Anx	8110		4060											
29	Veg	EangJsqBG	35	NsRacoGD	10	SdeScuHW	5	TcNsMWH	15	BedRK	10	GravelRK	10	LsRK	15
	Fos			HH4		PB3		HH4		ER1		ED1		ER3	
	Anx					7130		4010							
30	Veg	NsRacoGD	15	CaHerbaMH	60	TcNsMWH		LsRK	20						
	Fos	HH4				HH4		ER3							
	Anx					4010									

APPENDIX III: RECORDING SHEET FOR RELEVÉ DATA

Woody sp.		**Herbs**		**Rushes**		**Grasses**		**Clubmosses**		**Mosses**		**Lichens**		**Topography**	✓	**Site ID:**
Arct u-u		Pedi palu		Junc acut		Agro cani		Diph alpi		Spha squa		Cetr acul		Flat		**Relevé ID:**
Call vulg		Pedi sylv		Junc arti		Agro capi		Hupe sela		Spha subn		Cetr isla		Summit		**Surveyor ID:**
Crat mono		Ping lusi		Junc bufo		Agro stol		Sela sela		Spha tene		Clad arbu		Upper slope		**Date:**
Dabo cant		Ping vulg		Junc bulb		Agro vine				Spha warn		Clad bell		Mid-slope		**Grid Ref:** ±
Empe nigr		Plan lanc		Junc cong		Anth odor				Thui tama		Clad chlo		Lower slope		**Fossitt habitat:**
Eric cine		Plan mari		Junc effu		Arrh elat				Warn exan		Clad cocc				**EU Annex I habitat:**
Eric erig		Poly serp		Junc infl		Dant decu		**Mosses**				Clad cris				**Annex I assessment stop no:**
Eric tetr		Poly vulg		Junc squa		Desc cesp		Andr rupe				Clad fimb				**Soil ID:**
Juni comm		Pote erec		Luzu camp		Desc flex		Aula palu				Clad floe				**Site Geography**
Myri gale		Pseu albi		Luzu pilo		Fest ovin		Breu chry				Clad furc				**Altitude:**
Rhod pont		R. acetosa		Luzu mult		Fest rubr		Call cusp				Clad grac				**Aspect:**
Sali herb		R. acetose		Luzu sylv		Fest vivi		Camp atro				Clad port				**Slope:**
Ulex euro		Saus alpi				Moli caer		Camp flex				Clad pyxi				**Additional relevé notes:**
Ulex gall		Saxi oppo				Nard stri		Camp intr				Clad rgfm				
Vacc myrt		Saxi spat						Dicr fusc				Clad rgfn				
Vacc v-i		Saxi stel						Dicr scop				Clad squa				
		Sedu rose		**Sedges**				Dich palu				Clad subs				
		Soli virg		Care bige				Dcrd unci				Clad unci				
Herbs		Succ prat		Care bine		**Ferns**		Hylo sple		**Liverworts**		Ptil cili				
Achi mill		Thal alpi		Care dioi		Aspl r-m		Hypn cupr		Adel lind		Spha glob				
Achi ptar		Thal minu		Care echi		Aspl tric		Hypn jutl		Bazz pear				**Other sp. (write names in full)**		**Other relevé data**
Alch glab		Thym poly		Care flac		Aspl viri		Leuc glau		Bazz tric						Cover score (DOMIN)
Ange sylv		Trif repe		Care host		Blec spic		Tric hibe		Caly fiss						Bare soil
Ante dioi		Vero offi		Care lasi		Cyst frag		Para recu		Caly muel						Bare rock
Arme mari		Viol cani		Care limo		Dryo aem		Plag undu		Ceph bicu						Surface water
Camp rotu		Viol palu		Care nigr		Dryo affi		Pleu schr		Cono coni						Litter
Coch offi		Viol rivi		Care oval		Dryo dila		Phil font		Dipl albi						Bryophyte layer
Crep palu				Care pcea		Dryo feli		Poly alpi		Loph opac						Field layer
Dros angl				Care pilu		Hyme tunb		Poly comm		Loph vent						Dwarf shrub layer
Dros inte				Care puli		Hyme wils		Ptil c-c		Mast wood						
Dros rotu				Care rost		Oreo limb		Raco lanu		Myli anom						
Drya octo				Care viri ssp.		Pheg conn		Rhyt lore		Myli taylorii						Median veg. height (cm)
Epil brun				brac		Phly scol		Rhyt squa		Odon spha						Field layer
Euph offi				oedo		Poly lonc		Scle puru		Plag carr						Dwarf shrub layer
Gali saxa				viri		Poly seti		Spha aust		Pleu purp						Ground layer
Hype pulc				Eleo mult		Pter aqui		Spha capi		Scap grac						
Hype macu				Eleo quin				Spha comp		Scap nimb						Soil pH
Lath lini				Erio angu				Spha cusp		Scap ulig						Sample 1
Lotu corn				Erio vagi				Spha dent								Sample 2
Meny trif				Rhyn alba				Spha fall								Mean
Mont font				Rhyn fusc				Spha mage								
Nart ossi				Scho nigr				Spha palu								Peat depth (cm)
Oxyr digy				Tric cesp				Spha papi								

Appendix IVa Pool of sites for the monitoring network - upland SACs

Site code	Site name	County	Total area (ha)	Area points	Primary qualifying habitats points	Secondary qualifying habitats points	Non-qualifying habitat points	A scores	B scores	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Initial total	Upland character multipier	Corrected total	Tier
001932	Mweelrea/Sheeffry/Erriff Complex	ma	20991.24	4	7	1.5	0.6	7	1.25	1	0.5	0.5	23.35	1.5	35.03	**I**
002031	The Twelve Bens/Garraun Complex	ga	16109.84	3	6	0.3	1.4	7	0.5	1	0.5	0.5	20.2	1.5	30.30	**I**
000365	Killarney National Park, Macgillycud	ke	76479.75	6	6	0.9	0.8	5.25	0.5	1	0.5	0.5	21.45	1.5	32.18	**I**
002122	Wicklow Mountains	wi	32945.71	5	7	0	0.4	7	0.75	0	0	0.5	20.65	1.5	30.98	**I**
002047	Cloghernagore Bog and Glenveagh N	dg	33459.83	5	5	0.3	0.6	5.25	0.5	1	0.5	0	18.15	1.5	27.23	**I**
000375	Mount Brandon	ke	14355.30	3	6	0	0.6	5.25	0.5	1	0.5	0.5	17.35	1.5	26.03	**I**
002034	Connemara Bog Complex	ga	49230.44	5	5	0.9	0.4	5.25	0.5	0.25	0.5	0	17.8	1.5	26.70	**I**
000623	Ben Bulben, Gleniff and Glenade Com	sl	5983.81	2	5	0.6	1.2	5.25	0	0.5	0.5	1	16.05	1.5	24.08	**I**
000189	Slieve League	dg	3925.96	1	5	0	2	3.5	0.75	0.5	0.5	0.5	13.75	1.5	20.63	**I**
000534	Owenduff/Nephin Complex	ma	27063.61	4	4	0.9	1.2	3.5	0.5	0.5	0.5	0	15.1	1.5	22.65	**I**
000485	Corraun Plateau	ma	3886.96	1	5	0.3	1.4	1.75	0.75	1	0.5	0.5	12.2	1.5	18.30	**II**
000500	Glenamoy Bog Complex	ma	12901.80	3	4	0.6	0.4	5.25	0	0	0.5	0	13.75	1.5	20.63	**I**
002006	Ox Mountains Bogs	sl	10570.31	3	4	0.3	0.2	5.25	0	0.5	0.5	0	13.75	1.5	20.63	**I**
000584	Cuilcagh - Anierin Uplands	le	9739.71	2	6	0	0.6	1.75	1	0	0	0	11.35	1.5	17.03	**II**
002185	Slieve Mish Mountains	ke	9791.75	2	4	0	1.6	0	0.75	1	0	0.25	9.6	1.5	14.40	**II**
001922	Bellacorick Bog Complex	ma	9523.83	2	4	0.3	0	5.25	0	0	0.5	0	12.05	1.5	18.08	**II**
002008	Maumturk Mountains	ga	13493.44	3	5	0.3	0.6	0	0.75	1	0.5	0	11.15	1.5	16.73	**II**
000646	Galtee Mountains	ti	6421.78	2	6	0	0.6	0	1.25	0	0	0.5	10.35	1.5	15.53	**II**
001403	Arroo Mountain	le	3967.89	1	4	0.3	1	3.5	0	0	0	0	9.8	1.5	14.70	**II**
000093	Caha Mountains	ke	6859.09	2	5	0.3	1	0	1	0.5	0.5	0	10.3	1.5	15.45	**II**
001955	Croaghaun/Slievemore	ma	3295.22	1	4	0	0.8	1.75	0	1	0	0	8.55	1.5	12.83	**II**
001952	Comeragh Mountains	wa	6293.17	2	5	0.3	0.6	0	0.75	0	0	0	8.65	1.5	12.98	**II**
000140	Fawnboy Bog/Lough Nacung	dg	1105.40	1	3	0	0.4	3.5	0	0	0.5	0	8.4	1.5	12.60	**II**
001179	Muckish Mountain	dg	1522.80	1	2	0	1	0	0.5	1	0.5	0.5	6.5	1.5	9.75	**III**
001992	Tamur Bog	dg	1277.92	1	3	0	0	3.5	0	0	0.5	0	8	1.5	12.00	**II**
000770	Blackstairs Mountains	wx	5052.95	2	2	0	0.8	1.75	0	0	0	0	6.55	1.5	9.83	**III**
000453	Carlingford Mountain	lh	3101.18	1	4	0	1	0	0	0	0	0	6	1.5	9.00	**III**
000190	Slieve Tooey/Tormore Island/Loughrc	dg	9435.49	2	2	0	0.8	0	0.5	0.5	0.5	0	6.3	1.5	9.45	**III**
002312	Slieve Bernagh Bog	cl	1974.82	1	3	0	0	1.75	0.5	0	0.5	0	6.75	1.5	10.13	**III**
000412	Slieve Bloom Mountains	of	4879.20	1	2	0	0.8	1.75	0	0	0	0	5.55	1.5	8.33	**III**
001125	Dunragh Loughs/Pettigo Plateau	dg	2023.35	1	2	0	0.8	0	0.5	0.25	0	0	4.55	1.5	6.83	**III**
000111	Aran Island (Donegal) Cliffs	dg	517.92	0	4	0	0.2	3.5	0	0.5	0	0	8.2	1	8.20	**IV**
002258	Silvermines Mountains West	ti	612.36	0	4	0	0.2	0	0.5	0	0	0	4.7	1.5	7.05	**III**
000168	Magheradrumman Bog	dg	997.70	0	2	0	0.2	1.75	0	0	0.5	0	4.45	1.5	6.68	**III**
000102	Sheep's Head	co	3132.75	1	2	0	0.2	3.5	0	0	0	0	6.7	1	6.70	**III**
000476	Carrowmore Lake Complex	ma	3648.34	1	2	0	0.2	0	0.5	0	0.5	0	4.2	1.5	6.30	**III**

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Site code	Site name	County	Total area (ha)	Area points	Primary qualifying habitats points	Secondary qualifying habitats points	Non-qualifying habitat points	A scores	B scores	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Initial total	Upland character multipier	Corrected total	Tier
001197	Keeper Hill	ti	413.71	0	3	0	0.4	0	0.5	0	0	0	3.9	1.5	5.85	**III**
000934	Kilduff, Devilsbit Mountain	ti	134.28	0	2	0	0.2	1.75	0	0	0	0	3.95	1.5	5.93	**III**
001669	Knockalongy And Knockachree Cliffs	sl	111.37	0	4	0.3	0	0	0	0.25	0	0	4.55	1.5	6.83	**III**
002032	Boleybrack Mountain	le	4244.14	1	4	0	0.2	0	0.75		0	0	5.95	1	5.95	**III**
002036	Ballyhoura Mountains	li	747.03	0	3	0	0	0	0.75	0.25	0	0	4	1.5	6.00	**III**
000330	Tully Mountain	ga	473.50	0	3	0	0.4	0	0	0	0	0	3.4	1.5	5.10	**III**
002126	Pollagoona Bog	cl	55.05	0	1	0	0.4	1.75	0	0	0	0	3.15	1.5	4.73	**III**
002301	River Finn	dg	5501.79	2	2	0.6	0.2	0	0.5	0	0.5	0	5.8	1	5.80	**IV**
002124	Bolingbrook Hill	ti	206.03	0	3	0	0	0	0.5	0	0	0	3.5	1.5	5.25	**III**
000142	Gannivegil Bog	dg	2153.65	1	2	0.3	0	0	0	0	0.5	0	3.8	1.5	5.70	**III**
000324	Rosroe Bog	ga	262.04	0	2	0	0.2	0	0.5	0	0.5	0	3.2	1.5	4.80	**III**
000197	West Of Ardara/Maas Road	dg	6739.04	2	5	0.9	0	1.75	1	0	0.5	0	11.15	0.5	5.58	**III**
001513	Keel Machair/Menaun Cliffs	ma	1616.02	1	1	0	1	0	0	0.25	0	0	3.25	1	3.25	**IV**
001656	Bricklieve Mountains & Keishcorran	sl	1696.20	1	1	0	1	0	0	0	0	0	3	1	3.00	**IV**
001873	Derryclogher (Knockboy) Bog	co	1712.96	1	1	0	0.4	0	0	0	0	0	2.4	1.5	3.60	**IV**
002173	Blackwater River (Kerry)	ke	5902.74	2	1	0	0.4	0	0	0	0	0	3.4	1	3.40	**IV**
001879	Glanmore Bog	ke	1148.28	1	2	0.3	0.2	0	0	0	0.5	0	4	1	4.00	**IV**
002118	Barnahallia Lough	ga	44.50	0	1	0.3	0.4	0	0	0	0.5	0	2.2	1.5	3.30	**IV**
000522	Lough Gall Bog	ma	362.74	0	2	0	0	0	0	0	0.5	0	2.5	1.5	3.75	**IV**
002164	Lough Golagh And Breesy Hill	dg	799.17	0	1	0	0.4	0	0	0	0.5	0	1.9	1.5	2.85	**IV**
000165	Lough Nillan Bog (Carrickatlieve)	dg	4157.79	1	1	0.3	0	0	0	0	0.5	0	2.8	1.5	4.20	**IV**
002257	Moanour Mountain	ti	47.39	0	1	0	0.6	0	0	0	0	0	1.6	1.5	2.40	**IV**
000542	Slieve Fyagh Bog	ma	2391.88	1	1	0	0	0	0	0	0.5	0	2.5	1.5	3.75	**IV**
002144	Newport River	ma	1403.12	1	2	0	0	0	0	0	0.5	0	3.5	1	3.50	**IV**
002037	Carrigeenamronety Hill	li	101.57	0	1	0	0.4	0	0	0.25	0	0	1.65	1.5	2.48	**IV**
001141	Gweedore Bay And Islands	dg	6016.12	2	2	0.6	0.2	1.75	0	0	0	0	6.55	0.5	3.28	**IV**
002177	Lough Dahybaun	ma	76.13	0	1	0.3	0.2	0	0	0	0.5	0	2	1.5	3.00	**IV**
000633	Lough Hoe Bog	sl	3215.41	1	1	0.3	0	0	0	0	0	0	2.3	1.5	3.45	**IV**
000634	Lough Nabrickkeagh Bog	sl	271.94	0	1	0	0.4	0	0	0	0	0	1.4	1.5	2.10	**IV**
001880	Meenaguse Scragh	dg	627.39	0	1	0	0.4	0	0	0	0	0	1.4	1.5	2.10	**IV**
000939	Silvermine Mountains	ti	24.83	0	2	0	0	0	0	0	0	0	2	1.5	3.00	**IV**
002074	Slyne Head Peninsula	ga	4028.28	1	1	0.9	0.4	0	0	0	0	0	3.3	1	3.30	**IV**
002158	Kenmare River	co	19615.98	3	1	0.3	0	1.75	0	0	0	0	6.05	0.5	3.03	**IV**
001926	East Burren Complex	ga	18159.56	3	1	1.2	0.6	0	0	0	0	0	5.8	0.5	2.90	**III**
002012	North Inishowen Coast	dg	4973.05	1	1	0	0.2	0	0	0	0	0	2.2	1	2.20	**IV**
000054	Moneen Mountain	cl	6107.45	2	1	1.2	0	1.75	0	0	0	0	5.95	0.5	2.98	**IV**

Appendix IVa Pool of sites for the monitoring network - upland SACs

Site code	Site name	County	Total area (ha)	Area points	Primary qualifying habitats points	Secondary qualifying habitats points	Non-qualifying habitat points	A scores	B scores	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Initial total	Upland character multipier	Corrected total	**Tier**
002125	Anglesey Road	ti	33.25	0	1	0	0.2	0	0	0	0	0	1.2	1.5	1.80	**IV**
001107	Coolvoy Bog	dg	306.68	0	1	0	0	0	0	0	0.5	0	1.5	1.5	2.25	**IV**
000129	Croaghonagh Bog	dg	248.98	0	1	0	0.2	0	0	0	0	0	1.2	1.5	1.80	**IV**
001912	Glendree Bog	cl	340.07	0	1	0	0.2	0	0	0	0	0	1.2	1.5	1.80	**IV**
001881	Maulagowna Bog	ke	426.08	0	1	0	0	0	0	0	0.5	0	1.5	1.5	2.25	**IV**
002243	Clare Island Cliffs	ma	354.32	0	2	0	0.6	0	0.5	0.25	0	0	3.35	0.5	1.68	**IV**
000020	Black Head-Poulsallagh Complex	cl	7805.35	2	1	0.9	0.4	0	0	0	0	0	4.3	0.5	2.15	**IV**
000308	Loughatorick South Bog	ga	615.88	0	1	0	0	0	0	0	0	0	1	1.5	1.50	**IV**
000172	Meenaguse/Ardbane Bog	dg	668.52	0	1	0	0	0	0	0	0	0	1	1.5	1.50	**IV**
001890	Mullaghanish Bog	ke	70.05	0	1	0	0	0	0	0	0	0	1	1.5	1.50	**IV**
001913	Sonnagh Bog	ga	464.92	0	1	0	0	0	0	0	0	0	1	1.5	1.50	**IV**
001774	Lough Carra/Mask Complex	ma	13515.22	3	1	0.9	0.4	0	0	0.25	0	0	5.55	0.2	1.11	**IV**
002172	Blasket Islands	ke	720.43	0	1	0	0	0	0	0	0	0	1	0.5	0.50	**IV**
000202	Howth Head	du	374.88	0	1	0	0	0	0	0	0	0	1	1	1.00	**IV**
000173	Meentygrannagh Bog	dg	530.02	0	1	0.6	0	0	0	0	0	0	1.6	1	1.60	**IV**
001228	Aughrusbeg Machair and Lakes	ga	427.65	0	1	0.3	0.2	0	0	0	0	0	1.5	0.5	0.75	**IV**
002244	Ardrahan Grassland	ga	201.08	0	1	0.6	0	0	0	0.25	0	0	1.85	0.5	0.93	**IV**
001043	Cleanderry Wood	co	61.09	0	2	0	0.4	0	0	0	0	0	2.4	0.2	0.48	**IV**
001040	Barley Cove To Ballyrisode Point	co	795.02	0	1	0	0	0	0	0	0	0	1	0.5	0.50	**IV**
000714	Bray Head	wi	264.30	0	1	0	0	0	0	0	0	0	1	0.5	0.50	**IV**
000242	Castletaylor Complex	ga	145.62	0	1	0.6	0	0	0	0	0	0	1.6	0.5	0.80	**IV**
000668	Nier Valley Woodlands	wa	94.10	0	1	0	0	0	0	0	0	0	1	0.5	0.50	**IV**
000109	Three Castle Head To Mizen Head	co	341.66	0	1	0	0	0	0	0	0	0	1	0.5	0.50	**IV**
002162	River Barrow And River Nore	wx	3211.14	1	1	0.3	0	0	0	0	0	0	2.3	0.2	0.46	**IV**
000194	Tranarossan And Melmore Lough	dg	653.63	0	2	0	0	0	0	0	0	0	2	0.2	0.40	**IV**
000606	Lough Fingall Complex	ga	607.04	0	1	0.6	0.2	0	0	0	0	0	1.8	0.2	0.36	**IV**
000212	Inishmaan Island	ga	793.00	0	1	0.3	0	0	0	0	0	0	1.3	0.2	0.26	**IV**

Site name	County	Estimated area (ha)	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	Tier
Newhall and Edenvale Complex	CL	136.65	0	1	0.5	0	0	0	0.5	**IV**
Bandon River	CO	32.13	0	1	0.5	0	0	0	0.5	**IV**
Glengarriff Harbour And Woodland	CO	1305.78	1	2	1	0	0	0	2.0	**IV**
Lough Hyne Nature Reserve And Environs	CO	175.68	0	1	0.5	0	0	0	0.5	**IV**
Ballyarr Wood	DO	30.20	0	1	0.5	0	0	0	0.5	**IV**
Ballyhoorisky Point to Fanad Head	DO	688.29	0	1	0.5	0	0.5	0	1.0	**IV**
Ballyness Bay	DO	167.52	0	1	0.5	0	0	0	0.5	**IV**
Horn Head And Rinclevan	DO	1832.43	1	1	0.5	0	0.5	0	2.0	**IV**
Leannan River	DO	173.49	0	3	1.5	0	0	0	1.5	**IV**
Lough Eske And Ardnamona Wood	DO	860.71	0	2	1	0	0	0	1.0	**IV**
Lough Nageage	DO	218.05	0	3	1.5	0	0	0	1.5	**IV**
Sessiagh Lough	DO	72.20	0	1	0.5	0	0	0	0.5	**IV**
Caherglassaun Turlough	GA	165.65	0	1	0.5	0	1	0	1.5	**IV**
Drummin Wood	GA	84.52	0	1	0.5	0	0	0	0.5	**IV**
Kilkieran Bay And Islands	GA	992.62	0	4	2	0	0.5	0	2.5	**IV**
Lough Corrib	GA	1262.41	1	2	1	0	0.5	0	2.5	**IV**
Lough Nageeron	GA	19.49	0	2	1	0	0	0	1.0	**IV**
Murvey Machair	GA	80.16	0	1	0.5	0	0	0	0.5	**IV**
Tully Lough	GA	143.12	0	2	1	0	0	0	1.0	**IV**
Cloonee and Inchiquin Loughs	KE	1154.55	1	3	1.5	0	0	0	2.5	**IV**
Lough Yganavan And Lough Nambrackdarrig	KE	271.72	0	1	0.5	0	0	0	0.5	**IV**
Tralee Bay And Magharees Peninsula, West To Cloghane	KE	1224.13	1	2	1	0	0	0	2.0	**IV**
Lower River Shannon	KE/LI	2605.14	1	2	1	0	0	0	2.0	**IV**
Spahill And Clomantagh Hill	KK	146.54	0	1	0.5	0	0	0	0.5	**IV**
Lough Melvin	LE/DO	113.49	0	1	0.5	0	0	0	0.5	**IV**
Bellacorick Iron Flush	MA	17.36	0	1	0.5	0	1	0	1.5	**IV**
Cloughmoyne	MA	97.80	0	1	0.5	0	0	0	0.5	**IV**
River Moy	MA/SL	5389.35	2	4	2	0	0	0	4.0	**IV**
Templehouse and Cloonacleigha Loughs	SL	492.85	0	1	0.5	0	0	0	0.5	**IV**

Appendix IVc Pool of sites for the monitoring network - SPAs

Site name	County	Estimated area (ha)	Area points	Habitat no. points	Modified Habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	Tier
Upland SPAs										
Stacks To Mullaghareirk Mountains	KE	31107.25	5	6	3	0	0.5	0	8.5	**III**
Slievefelim To Silvermines Mountains	LI/TP	10373.03	3	5	2.5	0	0	0	5.5	**IV**
Slieve Bloom Mountains	OF/LA	8721.81	2	5	2.5	0	0	0	4.5	**IV**
Mullaghanish To Musheramore Mountains	CO	3465.65	1	5	2.5	0	0	0	3.5	**IV**
Slieve Aughty Mountains	CL/GA	31623.08	5	3	1.5	0	0	0	6.5	**IV**
Slieve Beagh	MO	2118.19	1	3	1.5	0	0	0	2.5	**IV**
SPAs which are effectively extensions to SACs										
Clare Island	MA	221.41		87409.01						
Killarney National Park	KE/LI	121.68		1957.25						
Lough Nillanbog (Carrickatlieve)	DO	113.54		89366.26						
Owenduff/Nephin Complex	MA	1105.97								
Sligo/Leitrim Uplands	SL/LE	24.90								
Wicklow Mountains	WI/DU	369.74								
Coastal SPAs										
Beara Peninsula	CO	2378.49	1	4	2	0	0	0	3.0	**IV**
Dingle Peninsula	KE	2121.12	1	4	2	0	0	0	3.0	**IV**
Sheep'S Head To Toe Head	CO	1648.44	1	2	1	0	0	0	2.0	**IV**
Iveragh Peninsula	KE	3459.14	1	1	0.5	0	0	0	1.5	**IV**
West Donegal Coast	DO	796.11	0	3	1.5	0	0	0	1.5	**IV**
Cliffs Of Moher	CL	874.18	0	2	1	0	0	0	1.0	**IV**
Horn Head To Fanad Head	DO	683.37	0	1	0.5	0	0	0	0.5	**IV**
		11960.85								

Appendix IVd Pool of sites for the monitoring network- NHAs

Site name	County	Area (ha)	Estimated no. of upland habitats	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	Tier
Crockauns/Keelogyboy Bogs	SL	1310.7367	8	1	6	3	0	0	0	4.0	**III**
Croaghmoyle Mountain	MA	1492.5930	5	1	5	2.5	0	0	0	3.5	**III**
Crocknamurrin Mountain Bog	DG	648.8976	5	0	5	2.5	0	1	0	3.5	**III**
Moycullen Bogs	GA	3201.6089	3	1	3	1.5	0	1	0	3.5	**IV**
Oughterard District Bog	GA	1692.3665	3	1	3	1.5	0	1	0	3.5	**IV**
Slievenamon Bog	TI	1785.2686	5	1	5	2.5	0	0	0	3.5	**III**
Barnesmore Bog	DG	2193.1146	4	1	4	2	0.25	0	0	3.3	**III**
Aghavoghil Bog	LE	961.6625	8	0	6	3	0	0	0	3.0	**III**
Cloon And Laghtanabba Bog	GA	353.5733	4	0	4	2	0	1	0	3.0	**IV**
Doogort East Bog	MA	833.1561	4	0	4	2	0	1	0	3.0	**IV**
Forrew Bog	MA	179.8900	4	0	4	2	0	1	0	3.0	**IV**
Knockatarriv/Knockariddera Bogs	KE	208.9839	4	0	4	2	0	1	0	3.0	**IV**
Lough Acrow Bogs	CL	511.6399	4	0	4	2	0	1	0	3.0	**IV**
Oysterman's Marsh *	CL	398.0969	4	0	4	2	0	1	0	3.0	**IV**
Slieve Snaght Bogs	DG	163.2682	4	0	4	2	0	1	0	3.0	**IV**
Tristia Bog	MA	689.7956	4	0	4	2	0	1	0	3.0	**IV**
Tullaghan Bay And Bog	MA	2851.9413	2	1	2	1	0	1	0	3.0	**IV**
Carna Heath And Bog	GA	32.0072	3	0	3	1.5	0	1	0	2.5	**IV**
Corry Mountain Bog	RO	1204.8668	3	1	3	1.5	0	0	0	2.5	**IV**
Cragnashingaun Bogs	CL	209.0602	3	0	3	1.5	0	1	0	2.5	**IV**
Cunnagher More Bog	MA	511.5721	3	0	3	1.5	0	1	0	2.5	**IV**
Derryoober Bog *	GA	1018.4844	3	1	3	1.5	0	0	0	2.5	**IV**
Ederglen Bog	MA	588.9245	3	0	3	1.5	0	1	0	2.5	**IV**
Hungry Hill Bog	KE	466.8353	5	0	5	2.5	0	0	0	2.5	**IV**
Inagh Bog	MA	613.0716	3	0	3	1.5	0	1	0	2.5	**IV**
Loughatorick District Bogs *	CL	198.6770	3	0	3	1.5	0	1	0	2.5	**IV**
Pulleen Harbour Bog	CO	56.6493	3	0	3	1.5	0	1	0	2.5	**IV**
Sillahertane Bog	KE	254.4561	3	0	3	1.5	0	1	0	2.5	**IV**
Slieve Aughty Bog *	GA	1139.0983	3	1	3	1.5	0	0	0	2.5	**IV**
Sraheens Bog	MA	188.0823	3	0	3	1.5	0	0.5	0	2.0	**IV**
Tawnymackan Bog	MA	177.7888	3	0	3	1.5	0	0.5	0	2.0	**IV**
Tooreen Bog	GA	354.4681	3	0	3	1.5	0	0.5	0	2.0	**IV**
Umrycam Bog	DG	62.0099	3	0	3	1.5	0	0.5	0	2.0	**IV**
Cashelnavean Bog	DG	344.9702	4	0	4	2	0	0	0	2.0	**IV**
Lough Fad Bog	DG	543.4095	4	0	4	2	0	0	0	2.0	**IV**
Lough Naminna Bog	CL	110.4250	4	0	4	2	0	0	0	2.0	**IV**
Meenmore West Bog	DG	327.3015	4	0	4	2	0	0	0	2.0	**IV**
Derreennatra Bog	CO	34.9255	2	0	2	1	0	0.5	0	1.5	**IV**

Appendix IVd Pool of sites for the monitoring network- NHAs

Site name	County	Area (ha)	Estimated no. of upland habitats	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	**Tier**
Glenturk More Bog	MA	65.0664	2	0	2	1	0	0.5	0	1.5	**IV**
Knockroe Bog	KE	203.3833	2	0	2	1	0	0.5	0	1.5	**IV**
Moyreen Bog	LI	21.4257	2	0	2	1	0	0.5	0	1.5	**IV**
Slaheny River Bog	KE	128.5369	2	0	2	1	0	0.5	0	1.5	**IV**
Woodcock Hill Bog	CL	238.6585	2	0	2	1	0	0.5	0	1.5	**IV**
Bangor Erris Bog	MA	246.7481	2	0	2	1	0	0.5	0	1.5	**IV**
Bleanbeg Bog *	TI	136.2058	3	0	3	1.5	0	0	0	1.5	**IV**
Boggeragh Mountains	CO	352.5898	3	0	3	1.5	0	0	0	1.5	**IV**
Conigar Bog	CO	436.4962	3	0	3	1.5	0	0	0	1.5	**IV**
Corveen Bog	DG	425.4116	3	0	3	1.5	0	0	0	1.5	**IV**
Doughill Bog	KE	186.5528	3	0	3	1.5	0	0	0	1.5	**IV**
Gortacullin Bog	CL	137.9650	3	0	3	1.5	0	0	0	1.5	**IV**
Illies Hill Bog	DG	90.3736	3	0	3	1.5	0	0	0	1.5	**IV**
Lough Hill Bog	DG	95.4357	3	0	3	1.5	0	0	0	1.5	**IV**
Maghera Mountain Bogs *	CL	177.2310	3	0	3	1.5	0	0	0	1.5	**IV**
Mauherslieve Bog *	TI	132.5694	3	0	3	1.5	0	0	0	1.5	**IV**
Meenagarranroe Bog	DG	129.5969	3	0	3	1.5	0	0	0	1.5	**IV**
Mount Eagle Bogs	KE	449.1798	3	0	3	1.5	0	0	0	1.5	**IV**
Slieve Rushen Bog	CV	674.9678	3	0	3	1.5	0	0	0	1.5	**IV**
Slieveward Bog	SL	320.0582	3	0	3	1.5	0	0	0	1.5	**IV**
Ummerantarry Bog	MA	419.3721	3	0	3	1.5	0	0	0	1.5	**IV**
Carrigkerry Bogs	LI	61.8613	1	0	1	0.5	0	0.5	0	1.0	**IV**
Dough/Thur Mountains	LE	896.8162	1	0	1	0.5	0	0.5	0	1.0	**IV**
Pollatomish Bog	MA	289.7238	1	0	1	0.5	0	0.5	0	1.0	**IV**
Camowen River Bog	DG	258.2355	2	0	2	1	0	0	0	1.0	**IV**
Grageen Fen and Bog	LI	47.6140	2	0	2	1	0	0	0	1.0	**IV**
Lough Gay Bog	LI	41.6139	2	0	2	1	0	0	0	1.0	**IV**
Slievecallan Mountain Bog	CL	89.2453	2	0	2	1	0	0	0	1.0	**IV**
Kilronan Mountain Bog	RO	443.5718	2	0	2	1	0	0	0	1.0	**IV**
Carrane Hill Bog	SL	525.6337	1	0	1	0.5	0	0	0	0.5	**IV**
Coan Bogs	KK	34.8319	1	0	1	0.5	0	0	0	0.5	**IV**
Leahill Bog	CO	195.1879	1	0	1	0.5	0	0	0	0.5	**IV**
Lough Greney Bog	MA	209.0361	1	0	1	0.5	0	0	0	0.5	**IV**
Trafrask Bog	CO	57.9102	1	0	1	0.5	0	0	0	0.5	**IV**

* denotes site within an SPA

Site name	County	Area (ha)	Estimated no. of upland habitats	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	Tier
Maumtrasna Mountain Complex	GA/MA	12886.93	6	3	6	3	0.5	0.5	0	7.0	**II**
Croagh Patrick	MA	1667.48	5	1	5	2.5	0.5	0	0	4.0	**III**
Knocknarea Mountain And Glen	SL	207.10	3	0	3	1.5	0	0	1	2.5	**IV**
Coguish Bog	DG	1467.27	2	1	2	1	0	0.5	0	2.5	**IV**
Lough Unna/Lough Unshagh Bogs	DG	1691.91	2	1	2	1	0	0.5	0	2.5	**IV**
Curragh (Kildare)	KD	1902.83	2	1	2	1	0	0	0	2.0	**IV**
Capel Island and Knockadoon Head (Nature Reserve)	CO	1925.46	2	1	2	1	0	0	0	2.0	**IV**
Bulbin Mountain	DG	423.20	3	0	3	1.5	0	0	0	1.5	**IV**
Meenaguse/Ardbane Bog	DG	217.93	1	0	1	0.5	0	0.5	0	1.0	**IV**
Forth Mountain	WX	69.19	2	0	2	1	0	0	0	1.0	**IV**
Great Sugar Loaf	WI	338.09	2	0	2	1	0	0	0	1.0	**IV**
Knockmaa Hill	GA	41.99	2	0	2	1	0	0	0	1.0	**IV**
Bruse Hill	CV	98.44	2	0	2	1	0	0	0	1.0	**IV**
The Great Heath Of Portlaoise	LA	118.21	2	0	2	1	0	0	0	1.0	**IV**
Ballagh Bog	CO	740.00	1	0	1	0.5	0	0	0	0.5	**IV**
Ballinacor Wood	WI	277.70	1	0	1	0.5	0	0	0	0.5	**IV**
Carndonagh Wood	DG	46.30	1	0	1	0.5	0	0	0	0.5	**IV**
John's Hill	CW	45.10	1	0	1	0.5	0	0	0	0.5	**IV**
Tory Hill	LI	76.90	1	0	1	0.5	0	0	0	0.5	**IV**

Area name		Area (ha)	Estimated no. of upland habitats	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	**Tier**
Essentially independent sites											
Croghan Mountain	WI/DU	576.75	3	0	3	1.5	0	0	0	1.5	**IV**
Butter Mountain	WI/DU	166.61	2	0	2	1	0	0	0	1.0	**IV**
Croaghanmoira, Fananierin & Ballinacor	WI	1320.93	2	1	2	1	0	0	0	2.0	**IV**
Cullentragh Mountain & Mullacor	WI	444.55	2	0	2	1	0	0	0	1.0	**IV**
Keadeen	WI	855.72	2	0	2	1	0	0	0	1.0	**IV**
Knockmealdowns	WA/TP	7678.72	3	2	3	1.5	0	0	0	3.5	**IV**
Northern Comeraghs	WA	3207.27	3	1	3	1.5	0	0	0	2.5	**IV**
Birreencorragh	MA	5582.81	5	2	5	2.5	0.5	0.5	0	5.5	**III**
Nephin	MA	1228.41	6	1	6	3	0.5	0	0	4.5	**II**
Tonregee	MA	743.54	4	0	4	2	0.5	1	0	3.5	**IV**
Cullaun	LI	173.69	2	0	2	1	0	0	0	1.0	**IV**
Carran Hill	LE	400.18	1	0	1	0.5	0	0	0	0.5	**IV**
Brandon Hill	KK	718.11	2	0	2	1	0	0	0	1.0	**IV**
Sliabh an Iolair & Cruach Mhárthain	KE	1281.31	5	1	5	2.5	0.5	0.5	0	4.5	**III**
Knocknakilton, Cummeen & Reamore East	KE	1649.55	4	1	4	2	0.5	0.5	0	4.0	**III**
Knockaskereighta	KE	1534.09	4	1	4	2	0.25	0.5	0	3.8	**III**
Beenduff/Foilclogh & Knockavahaun	KE	1556.14	4	1	4	2	0	0.5	0	3.5	**III**
Bentee	KE	302.96	5	0	5	2.5	0	0.5	0	3.0	**IV**
Hill behind Cloghanelineghan	KE	210.91	3	0	3	1.5	0	0.5	0	2.0	**IV**
Bunnacunneen, Ben Beg and Lugnabrick	GA	262.83	4	0	4	2	0.5	0.5	0	3.0	**IV**
Two Rock Mountain	DU	440.51	2	0	2	1	0	0	0	1.0	**IV**
Slieve Snaght et al	DO	20893.32	6	4	6	3	0.5	0.5	0	8.0	**II**
Killybegs-Carrick-Glencolumbkille Hills	DO	12232.23	6	3	6	3	0.5	0.5	0	7.0	**III**
Bluestacks	DO	10232.84	4	3	4	2	0.5	0.5	0	6.0	**III**
The Rosses to Grogan More W	DO	6424.38	5	2	5	2.5	0.5	0.5	0	5.5	**III**
Aghla Mountain	DO	2899.21	4	1	4	2	0.5	0.5	0	4.0	**III**
Clogher Hill-Barnesmore-Croaghanirwore	DO	4634.65	4	1	4	2	0.5	0.5	0	4.0	**III**
Meenalargan-Gafarretmoyle-Croaghleheen	DO	3134.41	4	1	4	2	0.5	0.5	0	4.0	**III**
Tievealehid, Cronalaght & Carntreena	DO	2351.00	4	1	4	2	0.5	0.5	0	4.0	**III**
Tievearragan/Croaghegly/Croaghnamaddy	DO	1050.80	4	1	4	2	0.25	0.5	0	3.8	**III**
Bloody Foreland	DO	379.81	5	0	5	2.5	0.25	0.5	0	3.3	**III**
Crockaughrim & Coolcross Hill	DO	448.22	3	0	3	1.5	0.5	0.5	0	2.5	**IV**

Appendix IVf Pool of sites for the monitoring network - undesignated sites

Area name		Area (ha)	Estimated no. of upland habitats	Area points	Habitat no. points	Modified habitat points (x 0.5)	Hepatic mat points	Schoenus bog points	Arctic-alpine relicts points	Total	**Tier**
Aran Island - Interior	DO	658.21	3	0	3	1.5	0	0	0	1.5	**IV**
Shehy Mts (& Eastern Caha Mts)	CO/KE	13054.09	5	3	5	2.5	0	0.5	0	6.0	**III**
Western Derrynasaggarts	CO/KE	1967.18	3	1	3	1.5	0.5	0.5	0	3.5	**III**
Eastern Derrynasaggarts (Mullaghanish)	CO/KE	662.11	2	0	2	1	0	0	0	1.0	**IV**
S Shehy Mts & Maughanaclea Hills	CO	6605.95	4	2	4	2	0	0	0	4.0	**III**
Boggeraghs	Co	688.09	2	0	2	1	0	0	0	1.0	**IV**
Sites which are effectively extensions to designated sites											
Benbo, Crockauns & Keelogyboy	LE/SL	2455.79	9	1	6	3	0	0	0	4.0	**ungraded**
Croagh Patrick	MA	204.35	4	0	4	2	0.5	0	0	2.5	**ungraded**
Croaghmoyle	MA	90.83	3	0	3	1.5	0.5	0.5	0	2.5	**ungraded**
Maumtrasna and Partry Hills	MA/GA	5134.96	7	2	6	3	0.5	0.5	0	6.0	**ungraded**
Slieve Rushen	CA	527.69	1	0	1	0.5	0	0	0	0.5	**ungraded**
Slievenamon	TP	33.04	3	0	3	1.5	0	0	0	1.5	**ungraded**
Dough Mountain	LE	73.77	2	0	2	1	0	0	0	1.0	**ungraded**

APPENDIX V: MONITORING CRITERIA FOR UPLAND ANNEX I HABITATS

North Atlantic wet heaths (4010)

Target	Scale(s) of assessment
Erica tetralix present	20m radius
Cover of positive indicator species ≥ 50% (Appendix VII)	4m²
Cover of ericoid species ≥ 20%	4m²
Cover of scattered native trees & shrubs < 20%	All visible
Cover of *Pteridium aquilinum* < 10%	All visible
Cover of non-native species < 1%	All visible
Total cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Phragmites australis, Ranunculus repens, Deschampsia flexuosa* < 1%	4m²
Cover of *Juncus effusus* < 10%	All visible
Cover of dwarf shrub species < 75%	4m²
Cover of graminoid species < 75%	4m²
Total cover of *Sphagnum* species, *Racomitrium lanuginosum*, *Cladonia* species and pleurocarpous mosses ≥ 10%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
Myrica gale shoots showing signs of browsing < 66%	4m²
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	All visible
No signs of burning inside boundaries of sensitive areas	All visible
Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	All visible
Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	All visible

List of sensitive habitats associated with North Atlantic wet heaths

- Vegetation severely wind-clipped, mostly forming a mat less than 10 cm deep.
- Areas where soils are thin and less than 5 cm deep.
- Slopes greater than 1 in 3 (c. 20°).
- Hepatic mats
- Pools, wet hollows, haggs and erosion gullies.
- Within 5 – 10 m of the edge of watercourses.
- Wet heath above 400 m asl.
- Wet heath within 50 m of functioning drains.

European dry heath (4030)

Target	Scale(s) of assessment
Number of bryophyte or non-crustose lichen species present ≥ 2	4m²
Number of positive indicator species present ≥ 2 (Appendix VII)	4m²
Calcareous heaths: cover of positive indicator species 25-75% (Appendix VII)	4m²
Exposed western heaths rich in *Racomitrium lanuginosum* or *Cladonia* species: cover of positive indicator species ≥ 33% (Appendix VII)	4m²
Other heaths: cover of positive indicator species ≥ 60% (Appendix VII)	4m²
Cover of dwarf shrub indicator species ≥ 25% (Appendix VII)	4m²
Cover of non-native species < 1%	All visible
Cover of *Pteridium aquilinum* < 10%	All visible
Cover of scattered native trees & shrubs < 20%	All visible
Total cover of the following weedy negative indicator species: *Cirsium arvense*, *C. vulgare*, large *Rumex species*, *Senecio jacobea*, *Ranunculus repens*, *Urtica dioica* < 1%	4m²
Cover of *Juncus effusus* < 10%	All visible
No signs of burning inside boundaries of sensitive areas	All visible
Cover of senescent *Calluna vulgaris* < 50%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	All visible

List of sensitive habitats associated with European dry heaths

- Vegetation severely wind-clipped, mostly forming a mat less than 10 cm deep.
- Areas where soils are thin and less than 5 cm deep.
- Hill slopes greater than 1 in 2 (c. 25°).
- Hepatic mats
- Areas of NVC communities H21 and H22.
- Areas with noticeably uneven structure, at a spatial scale of around 1 m² or less. The unevenness (eg. more commonly found in very old heather stands) will relate to distinct, often large, spreading dwarf-shrub bushes. The dwarf-shrub canopy will not be completely continuous, and some of its upper surface may be twice as high as other parts. Layering is likely to be present and may be common.
- Pools, wet hollows, haggs and erosion gullies, and within 5 – 10 metres of the edge of watercourses.

Alpine & sub-Alpine heath (4060)

Target	Scale(s) of assessment
Number of bryophyte or non-crustose lichen species present ≥ 3	4m²
Cover of positive indicator species ≥ 66% (Appendix VII)	4m²
Cover of non-native species < 1%	4m²
Total cover of the following negative indicator species: *Agrostis capillaris, Cirsium arvense, C. vulgare, Holcus lanatus, Senecio jacobea, Ranunculus repens, Urtica dioica,* large *Rumex* species (except *R. acetosa*) < 20%	4m²
Live leaves of *Carex bigelowii, Deschampsia flexuosa, Festuca ovina, F.vivipara* showing signs of grazing collectively <10%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris, Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
No signs of burning inside feature	All visible
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	All visible

Blanket bog (Active) (7130)

Target	Scale(s) of assessment
Number of positive indicator species present ≥ 7 (Appendix VII)	4m²
Cover of each of the following species: *Trichophorum germanicum*, *Molinia caerulea, Schoenus nigricans, Eleocharis multicaulis, Eriophorum vaginatum, Calluna vulgaris* < 70%	4m²
Cover of bryophyte or lichen species > 10%	4m²
Cover of non-native species < 1%	4m²
Cover of scattered native trees & shrubs < 10%	All visible
Total cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Deschampsia flexuosa*, *Phragmites australis, Pteridium aquilinum, Ranunculus repens* < 1%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
Myrica gale shoots showing signs of browsing < 66%	4m²
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	All visible
No signs of burning or other disturbance inside boundaries of sensitive areas	All visible
Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	All visible
Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	All visible
No patches of intensely disturbed bare ground or bare peat with a hard rubbery or ashed surface present ≥ 200m²	All visible

List of sensitive habitats associated with Blanket bogs

- Slopes greater than 1 in 3 (c. 20°).
- Ground with abundant and/or an almost continuous carpet of *Sphagnum*, other mosses, liverworts and/or lichens.
- Patterned areas (i.e., with pools), wet hollows, haggs and erosion gullies.
- Within 10 metres of the edge of watercourses.
- Blanket bog above 400 m asl.
- Blanket bog within 50 m of functioning drains.

Depressions on peat substrates of the *Rhynchosporion* (7150)

Target	Scale(s) of assessment
Number of positive indicator species present ≥ 4 (Appendix VII)	4m²
Cover of each of the following species: *Trichophorum germanicum, Molinia caerulea, Schoenus nigricans, Eleocharis multicaulis* < 70%	4m²
Cover of *Sphagnum* species excluding *S. fallax* ≥ 25%	4m²
Cover of non-native species < 1%	4m²
Myrica gale shoots showing signs of browsing < 66%	4m²
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	All visible
No signs of burning or other disturbance inside boundaries of sensitive areas	All visible
Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	All visible
Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	All visible

List of sensitive habitats associated with depressions on peat substrates on the *Rhynchosporion*

(a) Ground with abundant and/or an almost continuous carpet of Sphagnum.
(b) Patterned areas (i.e., with pools), wet hollows.
(c) Areas within 50 m of functioning drains.

Siliceous scree (8110)

Target	Scale(s) of assessment
Cover of bryophyte or non-crustose lichen species ≥ 10%	4m²
Cover of non-native species < 1%	4m²
Cover of *Pteridium aquilinum*, native trees & shrubs < 25%	All visible
Total cover of the following negative indicator species: *Cirsium arvense, C. vulgare, Pteridium aquilinum,* large *Rumex* species (except *R. acetosa*), *Rubus fruticosus* agg., *Senecio jacobaea, Urtica dioica* <1%	4m²
Cover of grass species < 10%	4m²
Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing collectively <50%	4m²
Cover of ground disturbed by human & animal paths, scree running, vehicles <10%	4m² / All visible

Calcareous and calchist scree (8120)

Target	Scale(s) of assessment
Number of positive indicator species present ≥ 4 (Appendix VII)	4m²
Cover of non-native species < 1%	4m²
Cover of *Pteridium aquilinum*, native trees & shrubs < 25%	All visible
Total cover of the following negative indicator species: *Cirsium arvense, C. vulgare, Pteridium aquilinum,* large *Rumex* species (except *R. acetosa*), *Rubus fruticosus* agg., *Senecio jacobaea, Urtica dioica* <1%	4m²
Cover of grass species excluding *Sesleria caerulea* < 15%	4m²
Cover of vascular plants <66%	4m²
Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing collectively <50%	4m²
Cover of ground disturbed by human & animal paths, scree running, vehicles <10%	4m² / All visible

Calcareous rocky slopes (8210)

Target	Scale(s) of assessment
Number of positive indicator species present ≥ 4 (Appendix VII)	4m²
Cover of non-native species < 1%	4m²
Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing collectively <50%	4m²
Cover of disturbed, bare soil < 15%	4m² / All visible

APPENDIX VI: PROVISIONAL LISTS OF INDICATOR SPECIES FOR ANNEX I HABITATS ASSESSED

North Atlantic wet heaths (4010)

Arctostaphylos uva-ursi
Breutelia chrysocoma
Calluna vulgaris
Campylopus atrovirens
Carex spp.
Diplophyllum albicans
Drosera spp.
Eleocharis multicaulis
Empetrum nigrum
Erica spp.
Eriophorum angustifolium
Eriophorum vaginatum
Gloeocapsa magna
Myrica gale
Narthecium ossifragum
Non-crustose lichens
Pedicularis sylvatica
Pleurocarpous mosses
Pleurozia purpurea
Polygala serpyllifolia
Racomitrium lanuginosum
Rhynchospora spp.
Salix repens
Schoenus nigricans
Sphagnum spp.
Succisa pratensis
Trichophorum cespitosum
Vaccinium spp.

European dry heath (4030)

Arctostaphylos uva-ursi
Calluna vulgaris
Daboecia cantabrica
Erica spp.
Empetrum nigrum
Racomitrium lanuginosum
Vaccinium spp.

Depressions on peat substrates of the Rhynchosporion (7150)

Carex limosa
Carex panicea
Eleocharis multicaulis
Eriophorum angustifolium
Drosera anglica
Drosera intermedia
Juncus bulbosus
Menyanthes trifoliata
Narthecium ossifragum
.*Rhynchospora* spp.
Sphagnum spp
Utricularia spp.
Warnstorfia fluitans

Alpine & sub-Alpine heath (4060)

Antennaria dioica
Arctostaphylos uva-ursi
Calluna vulgaris
Carex bigelowii
Cetraria islandica
Cladonia arbuscula
Cladonia portentosa
Cladonia rangiferina
Cladonia uncialis
Diphasiastrum alpinum
Diplophyllum albicans
Empetrum nigrum
Erica cinerea
Erica tetralix
Herbertus aduncus
Hymenophyllum wilsonii
Juniperus communis ssp. *nana*
Racomitrium lanuginosum
Salix herbacea
Scapania gracilis
Solidago virgaurea
Sphagnum capillifolium
Vaccinium myrtillus
Vaccinium vitis-idaea

Blanket bog (Active) (7130)

Andromeda polifolia
Arctostaphylos uva-ursi
Breutelia chrysocoma
Calluna vulgaris
Campylopus atrovirens
Carex bigelowii
Carex limosa
Diplophyllum albicans
Drosera spp.
Eleocharis multicaulis
Empetrum nigrum
Erica spp.
Eriophorum angustifolium
Eriophorum vaginatum
Menyanthes trifoliata
Mylia spp.
Myrica gale
Narthecium ossifragum
Non-crustose lichens
Odontoschisma sphagnii
Pedicularis sylvatica
Pinguicula lusitanica
Pleurocarpous mosses
Pleurozia purpurea
Polygala serpyllifolia
Racomitrium lanuginosum
Rhynchospora spp.
Scapania gracilis
Schoenus nigricans
Sphagnum spp.
Trichophorum cespitosum
Vaccinium spp.
Zygogonium ericetorum

Calcareous rocky slopes (8210)

Alchemilla alpina
Arenaria serpyllifolia
Asplenium adiantum-nigrum
Asplenium ruta-muraria
Asplenium trichomanes
Asplenium viride
Carex pulicaris
Ceterach officinarum
Cystopteris fragilis
Draba incana
Dryas octopetala
Hieracium spp.
Koeleria macrantha
Neckera crispa
Persicaria vivipara
Phyllitis scolopendrium
Polystichum aculeatum
Polystichum lonchitis
Polystichum setiferum
Saxifraga aizoides
Saxifraga hypnoides
Saxifraga oppositifolia
Sedum acre
Selaginella selaginoides
Silene acaulis
Thalictrum alpinum
Thymus polytrichus

Calcareous and calchist scree (8120)

Alchemilla alpina
Arenaria serpyllifolia
Asplenium adiantum-nigrum
Asplenium ruta-muraria
Asplenium trichomanes
Asplenium viride
Carex pulicaris
Ceterach officinarum
Cystopteris fragilis
Dryas octopetala
Geranium lucidum
Geranium robertianum
Gymnocarpium robertianum
Hieracium spp.
Koeleria macrantha
Oxalis acetosella
Polystichum aculeatum
Polystichum lonchitis
Polystichum setiferum
Persicaria vivipara
Saxifraga aizoides
Saxifraga oppositifolia
Sedum acre
Selaginella selaginoides
Silene acaulis
Teucrium scorodonia
Thalictrum alpinum
Thymus polytrichus
Linum catharticum

APPENDIX VII: IMPACTS AND CODES FOR FUTURE PROSPECTS ASSESSMENT

Code	Impact
A	***Agriculture***
A01	Cultivation
A02	modification of cultivation practices
A02.01	agricultural intensification
A02.02	crop change
A02.03	grassland removal for arable land
A03	mowing / cutting of grassland
A03.01	intensive mowing or intensification
A03.02	non intensive mowing
A03.02	abandonment / lack of mowing
A04	grazing
A04.01	intensive grazing
A04.01.01	intensive cattle grazing
A04.01.02	intensive sheep grazing
A04.01.03	intensive horse grazing
A04.01.04	intensive goat grazing
A04.01.05	intensive mixed animal grazing
A04.02	non intensive grazing
A04.02.01	non intensive cattle grazing
A04.02.02	non intensive sheep grazing
A04.02.03	non intensive horse grazing
A04.02.04	non intensive goat grazing
A04.02.05	non intensive mixed animal grazing
A04.03	abandonment of pastoral systems, lack of grazing
A05	livestock farming and animal breeding (without grazing)
A05.01	Animal breeding,
A05.02	stock feeding
A05.03	Lack of animal breeding
A06	annual and perennial non-timber crops
A06.01	annual crops for food production
A06.01.01	intensive annual crops for food production/ intensification
A06.01.02	non- intensive annual crops for food production
A06.02	perennial non-timber crops
A06.02.01	intensive perennial non-timber crops/intensification
A06.02.02	non-intensive perennial non-timber crops
A06.03	biofuel-production
A06.04	abandonment of crop production
A07	use of biocides, hormones and chemicals
A08	Fertilisation
A09	Irrigation
A10	Restructuring agricultural land holding
A10.01	removal of hedges and copses or scrub
A10.02	removal of stone walls and embankments
A11	Agriculture activities not referred to above

Code	Impact
B	***Sylviculture, forestry***
B01	forest planting on open ground
B01.01	forest planting on open ground (native trees)
B01.02	artificial planting on open ground (non-native trees)
B02	Forest and Plantation management & use
B02.01	forest replanting
B02.01.01	forest replanting (native trees)
B02.01.02	forest replanting (non native trees)
B02.02	forestry clearance
B02.02	removal of forest undergrowth
B02.04	removal of dead and dying trees
B02.05	non- intensive timber production (leaving dead wood/ old trees untouched)
B02.06	thinning of tree layer
B03	forest exploitation without replanting or natural regrowth
B04	use of biocides, hormones and chemicals (forestry)
B05	use of fertilizers (forestry)
B06	grazing in forests/ woodland
B07	Forestry activities not referred to above
C	***Mining, extraction of materials and energy production***
C01	Mining and quarrying
C01.01	Sand and gravel extraction
C01.01.01	sand and gravel quarries
C01.01.02	removal of beach materials
C01.02	Loam and clay pits
C01.03	Peat extraction
C01.03.01	hand cutting of peat
C01.03.02	mechanical removal of peat
C01.04	Mines
C01.04.01	open cast mining
C01.04.01	underground mining
C01.05	Salt works
C01.05.01	abandonment of saltpans (salinas)
C01.05.02	conversion of saltpans
C01.06	Geotechnical survey
C01.07	Mining and extraction activities not referred to above
C02	Exploration and extraction of oil or gas
C02.01	exploration drilling
C02.02	production drilling
C02.03	jack-up drilling rig
C02.04	semi-submersible rig
C02.05	drill ship
C03	Renewable abiotic energy use
C03.01	geothermal power production
C03.02	solar energy production
C03.03	wind energy production
C03.04	tidal energy production

Code	Impact
D	***Transportation and service corridors***
D01	Roads, paths and railroads
D01.01	paths, tracks, cycling tracks
D01.02	roads, motorways
D01.03	car parcs and parking areas
D01.04	railway lines, TGV
D01.05	bridge, viaduct
D01.06	tunnel
D02	Utility and service lines
D02.01	electricity and phone lines
D02.01.01	suspended electricity and phone lines
D02.01.02	underground electricity and phone lines
D02.02	pipe lines
D02.03	communication masts and antennas
D02.09	other forms of energy transport
D03	shipping lanes, ports, marine constructions
D03.01	port areas
D03.01.01	slipways
D03.01.02	piers
D03.01.03	fishing harbours
D03.01.04	industrial ports
D03.02	Shipping
D03.03	marine constructions
D04	airports, flightpaths
D04.01	airport
D04.02	aerodrome, heliport
D04.03	flight paths
D05	Improved access to site
D06	Other forms of transportation and communication
E	***Urbanisation, residential and commercial development***
E01	Urbanised areas, human habitation
E01.01	continuous urbanisation
E01.02	discontinuous urbanisation
E01.03	dispersed habitation
E01.04	other patterns of habitation
E02	Industrial or commercial areas
E02.01	factory
E02.02	industrial stockage
E02.03	other industrial / commercial area
E03	Discharges
E03.01	disposal of household waste
E03.02	disposal of industrial waste
E03.03	disposal of inert materials
E03.04	Other discharges
E03.04.01	costal sand suppletion/ beach nourishment
E04	Structures, buildings in the landscape
E04.01	Agricultural structures, buildings in the landscape
E04.02	Military constructions and buildings in the landscape
E05	Storage of materials

Code	Impact
E06	Other urbanisation, industrial and similar activities
E06.01	demolishment of buildings & human structures
E06.02	reconstruction, renovation of buildings
F	***Biological resource use other than agriculture & forestry***
F01	Marine and Freshwater Aquaculture
F01.01	intensive fish farming, intensification
F01.02	suspension culture
F01.03	bottom culture
F02	Fishing and harvesting aquatic ressources
F02.01	Professional passive fishing
F02.01.01	potting
F02.01.02	netting
F02.01.03	demersal longlining
F02.01.04	pelagic longlining
F02.02	Professional active fishing
F02.02.01	benthic or demersal trawling
F02.02.02	pelagic trawling
F02.02.03	demersal seining
F02.02.04	purse seining
F02.02.05	benthic dredging
F02.03	Leisure fishing
F02.03.01	bait digging
F03	Hunting and collection of wild animals (terrestrial)
F03.01	Hunting
F03.01.01	damage caused by game (excess population density)
F03.02	Taking and removal of animals (terrestrial)
F03.02.01	collection of animals (insects, reptiles, amphibians.....)
F03.02.02	taking from nest (e.g. falcons)
F03.02.03	trapping, poisoning, poaching
F03.02.04	predator control
F03.02.05	accidential capture
F03.02.09	other forms of taking animals
F04	Taking / Removal of terrestrial plants, general
F04.01	pillaging of floristic stations
F04.02	collection (fungi, lichen, berries etc.)
F04.02.01	hand raking
F04.02.02	hand collection
F05	Hunting, fishing or collecting activities not referred to above
F05.01	game/ bird breeding station
G	***Human intrusions and disturbances***
G01	Outdoor sports and leisure activities, recreational activities
G01.01	nautical sports
G01.01.01	motorized nautical sports
G01.01.02	non-motorized nautical sports
G01.02	walking, horseriding and non-motorised vehicles
G01.03	motorised vehicles
G01.03.01	regular motorized driving
G01.03.02	off-road motorized driving

Code	Impact
G01.04	mountaineering, rock climbing, speleology
G01.04.01	mountaineering & rock climbing
G01.04.02	speleology
G01.05	gliding, delta plane, paragliding, ballooning
G01.06	skiing, off-piste
G01.07	other outdoor sports and leisure activities
G02	Sport and leisure structures
G02.01	golf course
G02.02	skiing complex
G02.03	stadium
G02.04	circuit, track
G02.05	hippodrome
G02.06	attraction park
G02.06	sports pitch
G02.07	camping and caravans
G02.08	wildlife watching
G02.09	other sport / leisure complexes
G03	Interpretative centres
G04	Military use and civil unrest
G04.01	Military manouvres
G04.02	abandonment of military use
G05	Other human intrusions and disturbances
G05.01	Trampling, overuse
G05.02	Vandalism
G05.03	intensive maintenance of public parcs
G05.04	tree surgery, felling for public safety, removal of roadside trees
G05.05	missing or wrongly directed conservation measures
G05.06	closures of caves or galleries
G05.07	fences, fencing
G05.08	overflying with aircrafts (agricultural)
H	***Pollution***
H01	Pollution to surface waters (limnic & terrestrial)
H01.01	pollution to surface waters by industrial plants
H01.02	pollution to surface waters by storm overflows
H01.03	other point source pollution to surface water
H01.04	diffuse pollution to surface waters via strom overlows or urban run-off
H01.05	diffuse pollution to surface waters due to agricultural and forestry activities
H01.06	diffuse pollution to surface waters due to transport and infrastructure without connection to canalization/sweepers
H01.07	diffuse pollution to surface waters due to abandoned industrial sites
H01.08	diffuse pollution to surface waters due to household sewage and waste waters
H01.09	diffuse pollution to surface waters due to other sources not listed
H02	Pollution to groundwater (point sources and diffuse sources)
H02.01	groundwater pollution by leakages from contaminated sites
H02.02	groundwater pollution by leakages from waste disposal sites
H02.03	groundwater pollution associated with oil industry infrastructure
H02.04	groundwater pollution by mine water discharges
H02.05	groundwater pollution by discharge to ground such as disposal of contaminated water to soakaways

Code	Impact
H02.06	diffuse groundwater pollution due to agricultural and forestry activities
H02.07	diffuse groundwater pollution due to non-sewered population
H02.08	diffuse groundwater pollution due to urban land use
H03	Marine water pollution
H03.01	oil spills in the sea
H04	Air pollution, air-borne pollutants
H04.01	Acid rain
H04.02	Nitrogen-input
H04.03	other air pollution
H05	Soil pollution and solid waste (excluding discharges)
H05.01	garbage and solid waste
H06	excess energy
H06.01	Noise nuisance, noise pollution
H06.01.01	point source or irregular noise pollution
H06.01.02	diffuse or permanent noise pollution
H06.02	Light pollution
H06.03	Thermal heating of water bodies
H07	Other forms of pollution
I	***Invasive, other problematic species and genes***
I01	invasive non-native species
I02	problematic native species
I03	introduced genetic material, GMO
I03.01	genetic pollution (animals)
I03.02	genetic pollution (plants)
J	***Natural System modifications***
J01	fire and fire suppression
J01.01	burning down
J01.02	supression of natural fires
J01.03	lack of fires
J02	human induced changes in hydraulic conditions
J02.01	Landfill, land reclamation and drying out, general
J02.01.01	polderisation
J02.01.02	reclamation of land from sea, estuary or marsh
J02.01.03	infilling of ditches, dykes, ponds, pools, marshes or pits
J02.01.04	recultivation of mining areas
J02.02	Removal of sediments (mud...)
J02.02.01	dredging/ removal of limnic sediments
J02.02.02	estuarine and coastal dredging
J02.03	Canalisation & water deviation
J02.03.01	large scale water deviation
J02.03.02	canalisation
J02.04	Flooding modifications
J02.04.01	flooding
J02.04.02	lack of flooding
J02.05	Modification of hydrographic functioning, general
J02.05.01	modification of marine currents
J02.05.02	modifying structures of inland water courses
J02.05.03	mofification of standing water bodies

Code	Impact
J02.05.04	reservoirs
J02.05.05	small hydropower projects, weirs
J02.06	Water abstractions from surface waters
J02.06.01	surface water abstractions for agriculture
J02.06.02	surface water abstractions for public water supply
J02.06.03	surface water abstractions by manufacturing industry
J02.06.04	surface water abstractions for the production of electricity (cooling)
J02.06.05	surface water abstractions by fish farms
J02.06.06	surface water abstractions by hydro-energy
J02.06.07	surface water abstractions by quarries/ open cast (coal) sites
J02.06.08	surface water abstractions for navigation
J02.06.09	surface water abstractions for water transfer
J02.06.10	other major surface water abstractions
J02.07	Water abstractions from groundwater
J02.07.01	groundwater abstractions for agriculture
J02.07.02	groundwater abstractions for public water supply
J02.07.03	groundwater abstractions by industry
J02.07.04	groundwater abstractions by quarries/open cast (coal)sites
J02.07.05	other major groundwater abstractions from groundwater for agriculture
J02.08	Raising the groundwater table /artificial recharge of goundwater
J02.08.01	discharges to groundwater for artificial recharge purposes
J02.08.02	returns of groundwater to GWB from which it was abstracted
J02.08.03	mine water rebound
J02.08.04	other major groundwater recharge
J02.09.	Saltwater intrusion of groundwater
J02.09.01	saltwater intrusion
J02.09.02	other intrusion
J02.10	management of aquatic and bank vegetation for drainage purposes
J02.11	Dumping, depositing of dredged deposits
J02.11	Dykes, embankments, artificial beaches, general
J02.11.01	sea defense or coast protection works, tidal barrages
J02.11.02	dykes and flooding defense in inland water systems
J02.12	Abandonment of management of water bodies
J02.13	Other human induced changes in hydraulic conditions
J03	Other ecosystem modifications
J03.01	reduction or loss of specific habitat features
J03.01.01	reduction of prey availability (inluding carcasses)
J03.02	anthropogenic reduction of habitat connectivity
J03.02.01	reduction in migration/ migration barriers
J03.02.02	reduction in dispersal
J03.02.03	reduction in genetic exchange
J03.03	reduction, lack or prevention of erosion
J03.04	applied (industrial) destructive research
K	***Natural biotic and abiotic processes (without catastrophes)***
K01	abiotic (slow) natural processes
K01.01	Erosion
K01.02	Silting up
K01.03	Drying out
K01.04	Submersion

Code	Impact
K01.05	Soil salinization
K02	Biocenotic evolution, succession
K02.01	species composition change (succession)
K02.02	accumulation of organic material
K02.03	eutrophication (natural)
K02.04	acidification (natural)
K03	Interspecific faunal relations
K03.01	competition (fauna)
K03.02	parasitism (fauna)
K03.03	introduction of disease
K03.04	predation
K03.05	antagonism arising from introduction of species
K03.06	antagonism with domestic animals
K03.07	other forms of interspecific faunal competition
K04	Interspecific floral relations
K04.01	competition (flora)
K04.02	parasitism (flora)
K04.03	introduction of disease
K04.04	lack of pollinating agents
K04.05	damage by herbivores (including game species)
K05	reduced fecundity/ genetic depression
K05.01	reduced fecundity/ genetic depression in animals (inbreeding)
K05.02	reduced fecundity/ genetic depression in plants (incl. endogamy)
K06	other forms or mixed forms of interspecific floral competition
L	***Geological events, natural catastrophes***
L01	volcanic activity
L02	tidal wave, tsunamis
L03	earthquake
L04	avalanche
L05	collapse of terrain, landslide
L06	undergound collapses
L07	storm, cyclone
L08	inundation (natural processes)
L09	fire (natural)
L10	other natural catastrophes
M	***Climate change***
M01	Changes in abiotic conditions
M01.01	rise of temperature & extremes
M01.02	droughts and less precipitations
M01.03	flooding and rising precipitations
M02	Changes in biotic conditions
M02.01	habitat shifting and alteration
M02.02	desynchronisation of processes
M02.03	decline or extinction of species
M02.04	migration of species (natural newcomers)
X	***No threats or pressures***
XO	Threats and pressures from outside the Member State
XE	Threats and pressures from outside the EU territory