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Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland

Version 2.0

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Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0

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Health and safety

It should be noted that anyone following these guidelines does so at his/her own risk and neither BEC Consultants Ltd., nor the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, can be held accountable for accident or injury to anyone using them.

Health and safety is a very serious consideration for field surveyors and each surveyor is responsible for his/her own safety and for ensuring that their health and safety procedures are in compliance with all statuotory requirements at all times. The guidance included below is based on common sense and the experience of BEC Consultants Ltd working in upland areas. Working in uplands and in associated habitats requires suitable health and safety procedures and equipment to ensure a safe working environment for all survey personnel. It also requires an above average level of fitness and awareness of the physical environment for those undertaking such work. A detailed risk assessment of potential hazards should be completed each day by surveyors prior to commencement of survey work. Problems can be prevented through training, adherence to appropriate 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.

- Surveyors should be aware of the daily regional weather forecast for the area and arrange work accordingly.
- Surveyors should carry the relevant maps and also aerial imagery at the appropriate scales.
- Surveyors should be aware of their location and orientation 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 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 or satellite transponders may be required 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.
- 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, at a pre-agreed spot, near the vehicles so that 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 nearby, surveyors at relatively low altitudes and not in an exposed location should leave the hill. If in an exposed location, then surveyors should lie down in the nearest concavity until the danger has passed.
- In the event of a surveyor being late to a meeting point, they should not rush to get there as hurrying across upland terrain is likely to result in an injury. Instead, they should contact their colleagues to inform them that they will be late and proceed at normal pace paying due diligence to potential hazards.
- In the event of a surveyor being late to a meeting point and being uncontactable, 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 to 3 hours after failure to return unless it is after 2000 hrs, in which case call immediately. **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.
- In the event of an accident, exhaustion or ill-health, six blasts on an emergency whistle should be sounded, followed by a pause and another six blasts. The response to this signal is three blasts followed by a pause and another three blasts. This procedure is repeated until the responding party has located the person in distress. Surveyors should only seek to respond to distress signals if conditions are good and they can confidently do so without endangering themselves; otherwise they should notify the rescue services. Shouts or torch flashes can be used instead of a whistle.

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Executive Summary

In 2008, the National Parks and Wildlife Service (NPWS) commissioned a Scoping Study and Pilot Survey of Upland Habitats. This was a precursor to the National Survey of Upland Habitats (NSUH) that commenced in 2010. The manual sets out the protocols and methodologies for all aspects of the NSUH. This version is an update of version I (see note p. ix).

Uplands form Ireland's largest expanses of semi-natural landscape and support numerous habitats of high nature conservation value that require conservation under Irish and EU law. For the purposes of this survey upland habitats are defined as unenclosed areas of land over 150 m and contiguous areas of related habitat that extend below this altitude.

The main objectives of the NSUH are to map upland habitats and vegetation and to assess the conservation status of upland habitats listed in Annex I of the EU Habitats Directive. The habitat maps and survey data generated by this survey are required for conservation management purposes at an individual site level and for the identification of appropriate national conservation strategies, as well as to contribute data towards fulfilment of Ireland's reporting obligations to the EU Commission on conservation status of Annex I habitats. This is an ongoing requirement at six yearly intervals, the first report having been submitted in 2007.

Health, safety and navigation are issues of paramount importance when conducting habitat survey work in the uplands. Whilst personal safety is the individual responsibility of each surveyor, general guidance is included in this manual on safety protocols and required equipment; project managers must inform surveyors of any changes in this regard. Advice is also provided on the timing of field surveys, on meeting with landowners and contacting local officials.

Data should be recorded digitally in the field by using Personal Data Assistants or ruggedised mobile mappers supporting mobile platform versions of ArcGIS, Turboveg and Microsoft Excel. This ensures greater consistency of recording between fieldworkers and significantly reduces the amount of post-survey data entry and checking required. Training is essential for maximising consistency and standardisation of methods.

Fieldwork should be conducted by qualified ecologists operating in the field in pairs or larger groups. The survey team at each site should contain a team leader with considerable experience of upland habitats. Survey teams should report to a project co-ordinator who is required to liaise with NPWS. The survey teams and project co-ordinator should be supported during fieldwork and office work by an IT technician with knowledge of all software and hardware employed. All fieldworkers should receive training in the project methodology, equipment and safety protocols employed. Data collection procedures and the required data storage formats are detailed in this manual.

Sites selected for survey should be mapped through field surveying of pre-defined polygon maps produced by interpretation of orthorectified Ordnance Survey aerial photographs or high quality satellite imagery. Individual polygons should reflect areas of consistent vegetation mosaic or topography. Vegetation communities should be recorded following a provisional vegetation classification for the uplands. These communities are categorised in terms of the Annex I habitats (European Commission, 2007) and Fossitt (2000) habitats.

Conservation assessment of key Annex I habitats at a site level should be conducted through examination of data on habitat area, structure and functions and future prospects. Assessment of changes in area is partly a desk-based exercise conducted through comparative examination of aerial photographs and satellite images. Surveyors should also make note in the field of any obvious losses (or potentially, gains) in habitat area, such as through afforestation, agricultural improvement, peat extraction, landslides or new windfarms. As the NSUH is a baseline survey, changes in area since the designation of an SAC should be assessed; in the future, comparisons could be made between monitoring surveys. Structure and functions should be considered in the field through the recording of a series of monitoring stops located using random point co-ordinates. Full botanical relevés should be recorded, and photographs and soil samples taken. Relevé data should be recorded using the latest Irish plant species checklist in TurbovegCE. Monitoring stops should be assessed using indicator species and criteria thresholds specified in this survey manual. Additional relevés should be recorded to adequately describe the variation in vegetation at each site. A standard list of impacts and a recording protocol is provided for assessing future prospects.

An individual report should be written for each site surveyed. This should include a description of the terrain, habitats and vegetation, records of rare and notable species, detailed results of the conservation assessments, maps showing the primary Annex I and Fossitt habitat types and gradated maps for each Annex I habitat showing their frequency across the site. Conservation assessment data should be entered into a Microsoft Access database and guidance on the structure of this database is provided in this manual. Multivariate analysis (e.g. Perrin & Hodd, 2013) of the relevé database will assist in an understanding of the upland communities.

Refinement of the methodologies in this manual may be periodically required during the NSUH however such refinements must not undermine intercomparability of the data between years and between sites which is vital for the detection and assessments of changes in habitat types, areas and condition.

Acknowledgements

The Scoping Study and Pilot Survey of Upland Habitats and the follow-on National Survey of Upland Habitats were commissioned by the National Parks and Wildlife Service (NPWS), formerly of the Department of Environment, Heritage and local Government and currently of the Department of Arts, Heritage and the Gaeltacht. The projects were co-ordinated for NPWS by Caitriona Douglas, who provided scientific advice and co-ordinated scientific/technical input of staff at NPWS.

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Other staff at BEC Consultants Ltd who have assisted: Orla Daly, Fionnuala O'Neill, Jim Martin, Kate McNutt, Rory Hodd.

Note on content of version 2.0 of the manual

Version 2 of the manual is an update of Version 1 (Perrin et al., 2010). It presents amendments to the provisional vegetation classification and habitat assessment procedures that were developed during Phases 1 to 3 of the National Survey of Upland Habitats and present in Version 1. It also contains several new or expanded sections including descriptions and photographs of a range of habitats, and figures to illustrate certain aspects of the project methodology.

1. Introduction

1.1 General background

The uplands support Ireland's largest expanses of semi-natural habitats. They include areas of great scenic beauty, forming inspirational landscapes with a sense of wilderness and space. The uplands (excluding afforested areas) may be broadly defined as the areas of predominantly unimproved lands that occur on hills and mountains above enclosed farmland. They typically occur above 150 m in altitude and are primarily used for rough grazing. Irish upland habitats include blanket bogs, heaths, flushes and springs, semi-natural grasslands, dense bracken and areas of exposed rock and scree. These habitats frequently occur together as mosaics, with transitions from one to another resulting from changes, even over short distances, in topography, edaphic conditions, drainage, management or microclimate. Especially in the west of the country, the uplands may be contiguous with areas of lowland blanket bog which are thus included in the NSUH.

Almost 19% of Ireland can be considered to support upland habitats (Perrin *et al.*, 2009). The importance of these areas for biodiversity conservation is unquestionable, with numerous upland habitat types listed under Annex I of the EU Habitats Directive and many rare and threatened bird and other animal species being associated with these habitats. This is reflected in the fact that, over 40% of the total terrestrial area currently selected for designation as Special Areas of Conservation (SAC) in Ireland lies above 150 m in altitude.

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 upland areas has, in some ways, been less impacted than lowland areas because climate, soil and topographic factors can be less favourable to some forms of land use. However, many activities including drainage, reclamation, agricultural improvement, peat extraction, erosion, burning, afforestation and overstocking have resulted in large scale loss and degradation of upland habitats. The focus of wind energy developments on upland areas has also had serious impacts on sensitive habitats through fragmentation, disturbance, hydrological changes, soil erosion and landslides. An increase in the number and scale of these developments presents a growing threat. Uplands soils are fragile, generally being peat or shallow mineral soils. Upland habitats that have suffered losses of vegetation cover, regenerate slowly in upland climatic conditions and are thus vulnerable to erosion that, once inititated, can be irreversible.

There is therefore a clear need for sustainable land management policies for the uplands that will ensure that upland habitats listed in Annex I of the Habitats Directive attain favourable conservation status and that will prevent the decline of rare or threatened species, including Red Data Book species

and those listed in the Annexes of the EU Habitats Directive and Birds Directive. Accurate spatial habitat data combined with habitat condition data for upland Annex I habitats is also needed to report to the EU Commission on the conservation status of these habitats as required under Article 17 of the Habitats Directive.

To inform the development of upland conservation plans, information on the distribution, extent and conservation status / condition of upland habitats is required, together with a more detailed classification system for the vegetation communities that characterise these habitats. This will ensure that targetted measures are appropriate for the protection of these habitats. There is also a pressing need for upland habitat data to help develop more sustainable land management policies that will ensure protection of the vulnerable soils and natural resources that support the multiple benefits and services of agriculture, biodiversity conservation, water management and recreation derived from sensitively managed upland habitats.

1.2 National Survey of Upland Habitats

The Scoping Study and Pilot Survey of Upland Habitats (Perrin *et al.,* 2009) was commissioned by the National Parks and Wildlife Service (NPWS) with the primary remit of devising an appropriate strategy and methodologies for conducting a National Survey of Upland Habitats (NSUH). The recommendations set out in this survey manual are based on the findings of that project, which should be referred to for the rationale behind the methodology. This document revises and expands on the previous version of the manual (Perrin *et al.,* 2010) and provides step-by-step guidance on conducting the NSUH. It was envisaged that the survey would take several years, or phases, to complete. The manual is structured to address the various stages within each year of the survey, from pre-survey planning, through field survey (including habitat mapping and conservation assessments), to post-survey digitisation, data analysis and report writing. Hence this survey manual should prove useful to a range of personnel involved in an upland habitat survey work including NPWS, fieldworkers, survey co-ordinators and those providing GIS support, as well as those using the resultant data.

A valuable overview and source of information and general guidance on habitat survey and mapping in Ireland is provided by Smith *et al.,* (2011). However it is important to note that the methodologies specified within the current document are devised to meet the particular aims of the NSUH, which are to:

- survey a representative sample of the range of upland habitats in Ireland.
- map the location and extent of habitats defined by Fossitt (2000) and Annex I (European Commission, 2007) of the Habitats Directive.
- conduct baseline conservation assessments of specified Annex I upland habitats.
- identify impacts, threats and trends especially in relation to Annex I habitat condition.
- map the distribution of rare and threatened upland flora records.

- devise a classification system for upland vegetation supported by analyses of vegetation relevés.

1.3 Upland habitats

The Annex I habitats that are the primary focus of the NSUH are listed in Table 1. These are the habitats that require mapping and conservation assessment as part of the NSUH to facilitate habitat conservation management and reporting under Article 17 of the EU Habitats Directive. Note that isolated areas of these habitats that occur below 150 m are not within the remit of the NSUH.

Table 1: Annex I habitats that occur in Irish uplands and which are primary focus habitats for the NSUH.

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 (*if active bog)
7140	Transition mires and quaking bogs
7150	Depressions on peat substrates of the *Rhynchosporion*
7230	Alkaline fens
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

* Denotes a priority habitat under the EU Habitats Directive

Annex I habitats that occur in the uplands but that are not the primary focus of the NSUH are shown in Table 2. These habitats should be mapped but conservation assessments will not generally be conducted. It should be noted there are two Annex I habitats listed in Table 2, 6150 Siliceous alpine and boreal grasslands and 6170 Alpine and sub-alpine calcareous grasslands that had not been recorded in Ireland prior to the pilot survey (Perrin *et al.*, 2009), although they are recognised as occurring in Northern Ireland. Similarly, the habitat 6430 Hydrophilous tall herb communities had previously only been recorded in a lowland context in Ireland but has been recorded during the pilot survey and subsequent phases of the NSUH in an upland ledge context similar to that found in the UK. Descriptions of these communities are given later in this manual.

All habitats encountered within survey areas should be recorded using the classification scheme of Fossitt (2000) including non-Annex I habitats such as dense bracken and poor flushes. The main Fossitt (2000) habitats occurring in the uplands are shown in Table 3.

Upland native woodlands are not to be surveyed in detail or assessed by the NSUH as they are addressed in other NPWS surveys. Similarly, detailed description of forestry plantations are not part

of the remit, although where these occur within survey sites, notes should be made on average canopy height and density.

Table 2: Annex I habitats that are known or thought to occur in Irish uplands which are not primary focus habitats for the NSUH.

Habitat code	Habitat name	Notes
3110	Oligotrophic waters containing very few minerals and sandy plains (*Littorelletalia uniflorae*)	
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	
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	Surveyed by Cooper *et al.*, (2012)
6130	Calaminarian grasslands of the *Violetalia calaminariae*	Surveyed by Holyoak (2008). Subsequently monitored by Campbell (unpublished data)
6150	Siliceous alpine and boreal grasslands	Not recorded in Ireland prior to NSUH
6170	Alpine and subalpine calcareous grasslands	Not recorded in Ireland prior to NSUH
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)	Survey in a lowland context by the Irish Semi-natural Grasslands Survey (Martin *et al.*, 2007, 2008; O'Neill *et al.*, 2009, 2010, 2013)
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Survey in a lowland context by the Irish Semi-natural Grasslands Survey (Martin *et al.*, 2007, 2008; O'Neill *et al.*, 2009, 2010, 2013)
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Only recorded in a lowland context in Ireland prior to NSUH
7210	*Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	
7220	*Petrifying springs with tufa formation (*Cratoneurion*)	Surveyed by Lyons (unpublished data)
8240	*Limestone pavements	Surveyed by Murphy & Fernandez (2009), Wilson & Fernandez (2013)
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) and Woodland Monitoring Survey (O'Neill & Barron 2012)

* Denotes a priority habitat under the EU Habitats Directive

1.4 Personnel

1.4.1 Project co-ordinator

The survey should have a project co-ordinator who is responsible for ongoing project management, budgetary and logistical planning, liaising between NPWS and survey teams, and providing quality assurance throughout all stages of the survey. This person would also be responsible for editing reports and for ensuring that all NSUH project requirements as specified by NPWS would be met.

Table 3: The main Fossitt (2000) habitats that occur in the Irish uplands.

Habitat code	Habitat name	Habitat code	Habitat name
	Freshwater		*Peatlands*
FL1	Dystrophic lakes	PB2	Upland blanket bog
FL2	Acid oligotrophic lakes	PB3	Lowland blanket bog
	Grassland	PB4	Cutover bog
GS3	Dry humid grassland	PB5	Eroding blanket bog
GS4	Wet grassland	PF1	Rich fen and flush
	Heaths	PF2	Poor fen and flush
HH1	Dry siliceous heath	PF3	Transition mire and quaking bog
HH3	Wet heath		*Exposed rock*
HH4	Montane heath	ER1	Exposed siliceous rock
HD1	Dense bracken	ER2	Exposed calcareous rock
	Woodland	ER3	Siliceous scree and loose rock
WD4	Conifer plantation	ER4	Calcareous scree and loose rock

1.4.2 Survey teams

A survey team is defined as the group of surveyors assigned to survey a particular site. There may be multiple survey teams operating on different sites at the same time under the direction of the project co-ordinator. The minimum recommended number of survey team members at a site is four as this number allows flexibility; survey work can safely continue if a team member is working at the field base or office, is ill or otherwise unavailable. Each team should include a team leader with extensive upland field experience, ideally including work on corries and higher mountains (800+ m). At least one member of each survey team should have a competent working knowledge of ArcGIS software (ESRI, Redlands, California).

All surveyors require good botanical identification skills. There should be no more than two surveyors with limited experience on a field team. Common sense and self-reliance in outdoor situations are important prerequisites. The ability to read a map and compass and use a GPS are core skills for navigation and surveyors should have at least some upland navigation experience, although these skills may be further developed during the training period.

1.4.3 Technical support

Survey teams should be supported by at least one person with IT skills who is competent with all the software and hardware being utilised during the survey, including laptops, Personal Digital Assistants (PDAs), mobile mapping computers, differential GPS receivers, ArcMap and ArcPad (ESRI, Redlands, California), Turboveg (PC version) and TurbovegCE (Alterra, Wageningen, The Netherlands), and Microsoft Office. This person could be a member of a survey team or the project coordinator, but would have additional responsibilities such as setting up field recording systems, fixing problems as they arise and assisting in a technical capacity with the post-survey data processing. They would not need to be field-based but must be readily available during the field season.

1.4.4 Landowner liaison

Contacting landowners, commonage shareholders and those with turbary rights prior to fieldwork is a vital part of the survey. Engaging a single person whose primary task is to seek access permission for all lands within the survey sites is recommended as this simplifies communication with the local community. This person should have excellent interpersonal skills and knowledge of farming practices and any issues that are likely to be of concern to farmers and other landusers.

1.4.5 Expert identification support

Arrangements should be made with an expert bryologist and lichenologist to engage them after the fieldwork season to identify voucher specimens that have been collected from relevés or from sites in general. This ensures high quality of data and is time and cost efficient. It is also highly desirable to have at least one surveyor on each team that has expertise in bryology so that potentially diagnostic samples can be referred to them as fieldwork progresses.

1.5 Training requirements for surveyors

Prior to fieldwork proper, a training period should be conducted to familiarise fieldworkers with the habitats that they are likely to encounter in the Irish uplands. Familiarisation with the classification systems of upland habitats in Fossitt (2000), the interpretation manual for Annex I habitats (European Commission, 2007) and the current version of the provisional upland vegetation classification scheme (see Appendix I) is necessary, and it is important that the interpretation of these habitats as described later in this manual is understood. The length of the training period should be tailored to the previous experience of surveyors but even with an experienced team a refresher course is always advisable.

Training for less experienced surveyors should include identification in the field of vegetative grasses, rushes and sedges, (particularly *Carex* spp.), upland lichens (particularly *Cladonia* spp.) and

bryophytes (particularly *Sphagnum* spp. and the "brown mosses" characteristic of base-rich flushes and fens). Training should also include familiarisation and practice with the recommended mapping, relevé and conservation assessment methodologies and the relevant equipment and software.

Training must also involve a briefing on health and safety protocols and field surveyors should be made aware of the required health and safety equipment that they need to carry. Fieldworkers with first aid training should be identified and distributed across survey teams.

1.6 Surveying approaches

During the pilot survey (Perrin *et al.,* 2009), traditional habitat survey methodologies were adapted to suit both the complex nature of upland environments and the specific purposes of a NSUH. The three most significant adaptations are described below.

1.6.1 Mapping mosaics

The local topography of most upland areas consists of intricate patterns of hollows, rocky outcrops, flushes and terraces. The mosaics of vegetation that have developed on this varying topography is often far too complex to map as individual habitats in the manner possible for more uniform landscapes. Hence the approach adopted by the NSUH was to map units (referred to as polygons) that reflect homogeneous mosaics of vegetation and topography. Attempting to map smaller polygons representing single habitats would greatly increase the amount of time spent mapping and the number of polygons mapped, and would not ultimately eliminate the need for recording mosaics at smaller scales. Further guidance on digitising these polygons is given in the section on Preparation of field maps.

When recording the habitats within a mosaic, the dominant habitat in each polygon should not be the only one recorded as information on subordinate elements would be missed out. Habitats that typically occur only as small features (e.g. base-rich flushes, springs and bog hollows) would be systematically under-represented if dominant habitats only were mapped and the relevant polygons would effectively be devalued in terms of their potential biodiversity and conservation interest. Hence, the approach taken by the NSUH is to record *all* the habitats and non-vegetated substrates present in each polygon and the approximate percentage of the polygon they occupy. As the total area of each polygon will be known from digitisation, data on the approximate extent of each habitat can be readily calculated. In practice, the vast majority of polygons contain habitat mosaics.

1.6.2 Provisional upland vegetation classification scheme

The primary aim of the mapping procedure is to record habitats which correspond to the Annex I habitat categories (European Commission, 2007) and also to map the site using the Fossitt (2000)

habitat classification scheme. However, a review of Fossitt (2000) showed that its resolution was insufficient for recording in detail the variations across upland habitats, particularly in the classification of montane vegetation types. Indeed, Fossitt only intended the scheme to be used as "a first-step approach for general habitat recording rather than as a basis for detailed study and evaluation." Conducting mapping solely at this classification level would result in a NSUH dataset with only limited information on the composition and distribution of upland vegetation communities whereas better knowledge of plant community composition and diversity is in fact necessary in order to inform more effective conservation management strategies at local and national scales.

It was therefore deemed essential to produce a provisional classification of upland vegetation types to record more detailed plant community information during the NSUH. Initially, it was subjectively produced and based on White & Doyle (1982), the British National Vegetation Classification (NVC; Rodwell 1991a, 1992) and expert judgement. This was then refined following multivariate analysis of relevé data from the pilot survey of upland habitat and other available relevé datasets from upland habitats (listed in Perrin *et al.,* 2009). The proposed ultimate level of detail of this provisional classification would be equivalent to that of the British NVC, which Rodwell (1991a, 1992) envisaged as a key tool for monitoring habitat change. The provisional classification is presented in Appendix I.

It should be clearly noted that this current classification is a provisional measure based on available data and is designed to facilitate the collection of additional information on upland vegetation during the NSUH. Relevé data collected during the survey will ultimately be used to produce a more comprehensive national classification of upland and associated habitats.

Advantages of this more detailed approach are an improved ability to detect critical changes during monitoring of the vegetation that are likely to be missed by the broader scale habitat classifications, and a reduction in the likelihood of small-scale or unusual habitats of high conservation value, such as hepatic mats, being overlooked.

1.6.3 Digital recording

The use of handheld computers can greatly increase efficiency of data recording in the field and should be used by the NSUH as the primary means of recording relevés, monitoring stops and waypoint data. Mobile mapping computers or "mappers" (e.g. Trimble Nomads) have integrated GPS receivers and are often ruggedised and waterproof. PDAs typically lack integrated GPS receivers and are non-ruggedised but can be accessorised and cost much less. Although the hardware and software needed for digital recording are relatively expensive, this approach minimises the need for post-survey data entry and processing. Careful protocols for storing and backing up data are required however, and paper recording forms should always be carried in case of technical failure.

Three main software applications are recommended for digital recording in the field: Turboveg for relevé data, Microsoft Excel Mobile for monitoring stops, and ArcPad for waypoints. Turboveg is a specialist ecological database for the recording and storing of vegetation relevé data. It consists of two components: a PC version and TurbovegCE that operates on mobile platforms. Use of Turboveg enables relevés to be collected using the current Irish species checklist and standardises nomenclature between surveyors. Turboveg is also the database used by the National Biodiversity Data Centre (NBDC) for the National Vegetation Database; therefore datasets can be readily assimilated. ArcPad is a GIS application that operates on mobile platforms and is a component of the ArcGIS system. Use of ArcPad enables efficient recording of waypoints directly into shapefiles, allows availability of digital maps to fieldworkers and assists in navigation. ArcPad is the recommended GIS application, as NPWS use ArcGIS applications and file formats as standard.

2. Pre-survey stage

This section relates to all work that would be carried out prior to the commencement of field surveys, including desk-based research on survey sites and preparation of the materials necessary to carry out the field survey.

2.1 Site selection

Survey sites should be selected, in agreement with NPWS, from the comprehensive lists of sites identified by Perrin *et al.*, (2009) as candidates for an uplands habitat monitoring network. These lists include SACs with upland habitat, upland SPAs (Special Protection Areas), coastal SPAs with upland habitat, NHAs (Natural Heritage Areas), proposed NHAs and extensive areas of upland habitat outside of designated sites.

Sites within these candidate lists have been prioritised by the following criteria:

- area
- number of upland habitats
- number of Annex I upland habitats that are Qualifying Interests (for SACs only)
- representativity of the Qualifying Interests (for SACs only)
- proportion of site composed of upland habitats
- presence of habitat features which are either rare or particularly important in an international context.

In addition to the ranking of the sites, other factors to be considered during site selection include geographical range, geology and other factors that may be considered important based on expert opinion. Once selected, each site should be assigned a project site number. It will also be necessary to define the actual survey area for each selected site in agreement with NPWS as site boundaries were not defined by Perrin *et al.*, (2009). When dealing with designated sites, the survey area will often conform to the designation boundary, although expanses of upland habitats may continue beyond this boundary. Potential survey areas for undesignated sites would need to be defined with the aid of aerial photograph interpretation and any other relevant data, such as altitude. It is important that there is liaison during site selection with staff managing other current NPWS projects, such as the Irish Semi-natural Grassland Survey, to ensure that there is no overlap. This may be particularly important if selecting undesignated sites for survey.

2.2 Review of literature

A review of the literature should be conducted to obtain relevant background information on the selected sites. This should include: rare vascular, bryophyte and lichen species records for the area held by NPWS, the National Biodiversity Data Centre, the Centre for Environmental Data and

Recording and other organisations; site synopses; Natura 2000 Standard Data Forms and accompanying notes for designated sites; previous survey data including that held in NPWS site files; relevant historical literature; research theses and papers.

2.3 Preparation of field maps

The recommended method of habitat mapping is to pre-define, by reference to aerial imagery, habitat units (polygons) within each selected site which can be subsequently surveyed in the field. As explained in section 1.6, due to the complex mosaics typical of upland vegetation, the conventional lowland approach to vegetation mapping, where a polygon is drawn to represent a single habitat, is unsuitable here. Instead, it is necessary to define polygons that are likely to represent consistent habitat mosaics or, in some cases, consistent topography.

Digitisation of polygons within selected sites should be conducted as a desk-based GIS exercise in good time before the fieldwork period. The imagery used may be recent orthorectified aerial photography or high quality satellite imagery. It is important that the polygons are digitised by experienced upland surveyors who can identify areas of consistent vegetation mosaic or topography. The minimum polygon size should be 0.04 ha (20 m x 20 m), generally used to represent small lakes or patches of scree. In practice, most polygons will be much larger than this with an average size of 8-10 ha. Digitisation of polygons should be carried out at a scale of 1:5,000. 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. Examples of polygons from field maps are shown in Fig. 1. 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 their polygon numbering. 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.

It is common for flanks of mountains and valley sides to be obscured by shadow in aerial photographs. In these cases reference should be made to previous editions of aerial photographs (e.g .year 2000 edition) to effectively digitise these areas.

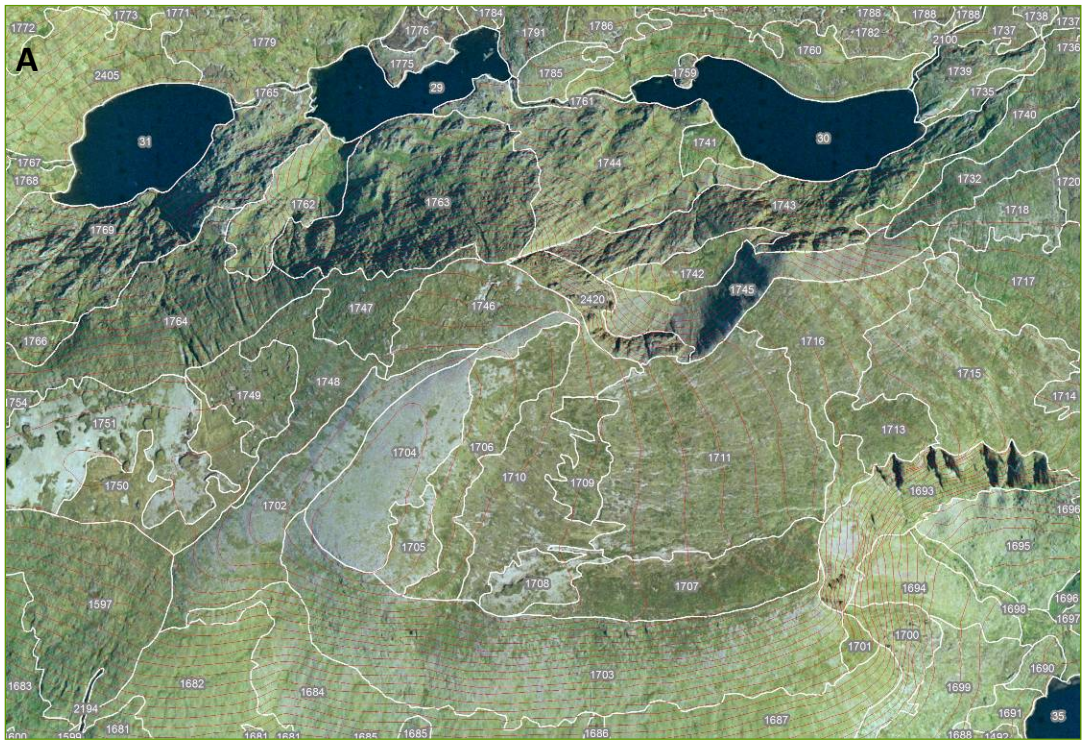
Coloured maps on A3 paper depicting aerial photographs of the site at a 1:10,000 scale, contours, a graticule at 100 m intervals and the pre-defined habitat polygons are preferable for use in the field. Contours should be displayed using red lines thin enough not to obscure the detail underneath. Polygon boundaries should be displayed in a light colour, together with the preliminary polygon number assigned through the GIS. Colour photocopies of the maps should be used in the field as the

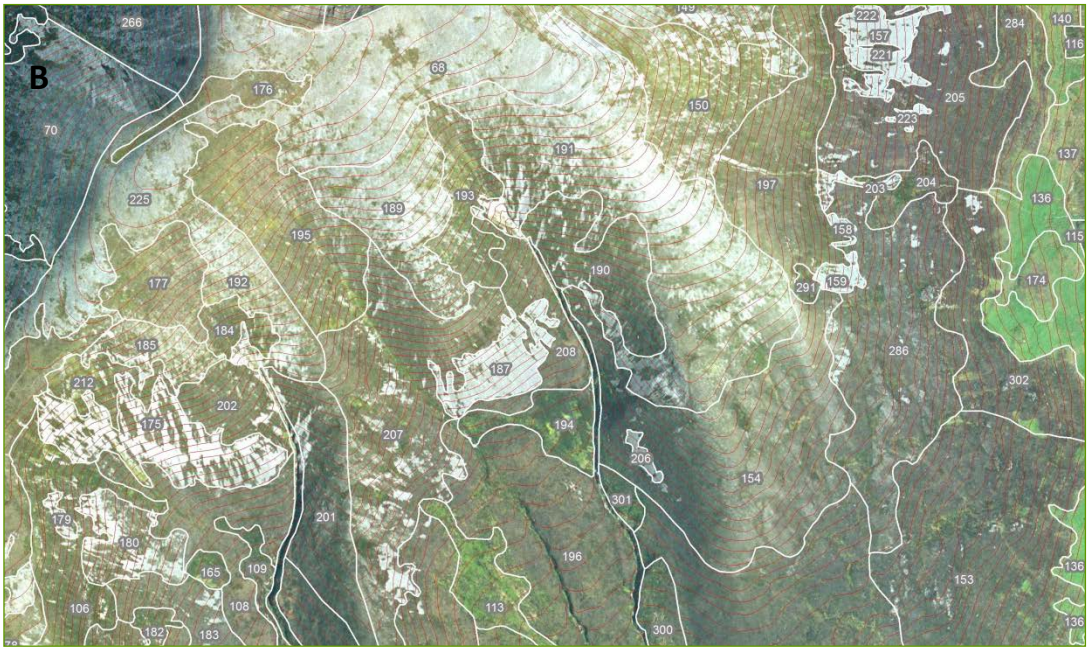
toner used in photocopying is less likely to run or blotch in wet conditions than the ink used in colour printing. The survey area boundary should also be indicated on the field maps.

2.4 Technical provision for surveyors

For the purpose of habitat mapping, fieldworkers should be provided with both paper copies of the field maps and digital versions of the 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 Series 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 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.

Figure 1: Excerpts from field maps demonstrating polygons with consistent vegetation mosaic or topography: a) Mount Brandon SAC, Co. Kerry and b) Nephin Mountain, Co. Mayo. Ordnance Survey Ireland Licence No. EN 0059208 © Ordnance Survey Ireland / Government of Ireland





For the purpose of relevé recording, mappers / PDAs should be installed with TurbovegCE software. This should have a customised NSUH database uploaded, based on the current NBDC species checklist (at time of writing this is Ireland2008v2). The Turboveg header form should be customised to contain the fields detailed in Appendix III. Standardised recording sheets (Appendix IV) should also be provided on waterproof paper as a contingency in case of technical failure.

For the purpose of conservation assessment (Appendix V), 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.

Relevant ecological information on each survey site gathered during the literature review should be collated and provided to fieldworkers. This will improve field surveyors' awareness of the habitats and species they are likely to encounter and allow them to re-survey habitats and species that are of particular conservation interest.

For each site, the following GIS data layers should also be provided as supplementary information:

- 1:10,560 six-inch maps
- 1:100,000 GSI bedrock geology map
- Ordnance Survey Ireland rivers and streams polylines
- NPWS conservation site shape files (SACs, SPAs, NHAs and pNHAs)

2.5 Field equipment

The following is a checklist of health and safety equipment. It is strongly recommended that each of these items would be 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 (double bag if possible)
- 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)
- Head torch (water-resistant)
- Compass
- Ordnance Survey Discovery Series map (laminated A3 printout of the site)

The following is a checklist of items that would also be required by each fieldworker.

- Rucksack with hip belt
- Dry bags
- This survey manual
- Identity card
- Official letter of authorisation from NPWS
- Certificate of insurance
- Wellington boots and walking boots
- Clinometer
- Digital camera (minimum 7.0 megapixels)
- Binoculars (8 x 30 magnification)
- 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)
- Differential GPS unit
- Spare GPS batteries in waterproof bag
- Mapper or augmented PDA (see below)
- Satellite phone or satellite transponder (when in areas with no mobile phone coverage)

- Pencils, eraser, sharpener
- Insect repellent
- Sun protection lotion
- A4 weatherwriter clipboard
- Waterproof paper
- Paper recording sheets

It is essential that all electronic equipment (mobile phones, cameras, PDAs, mappers and GPS units) is fully charged each morning prior to field work. 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 and should ideally support differential correction through EGNOS (European Geostationary Navigation Overlay Service) to improve precision.

2.6 Outreach

Prior to each field season, contact should be made with the relevant NPWS District Conservation Officers providing them with a list of the proposed survey sites. NPWS conservation rangers, local Biodiversity or Heritage Officers and county BSBI recorders should be informed of the survey and consulted for local knowledge that they may have of survey 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. Contact details for regional NPWS offices can be downloaded from the NPWS website.

2.7 Field season planning

It is necessary to make detailed plans in advance of the field season regarding the sites to be surveyed, the time to be spent on each site, the number of surveyors to be allocated to particular sites and the location and booking of field bases. Plans should include a certain degree of flexibility.

2.7.1 Timing of fieldwork

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 resources available and the timing of the project, as determined by NPWS. Optimum times for the conservation assessment of the primary focus Annex I upland habitats are given in Table 4. If assessment is carried out at a sub-optimal time it should be noted accordingly in the report.

Table 4: 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 heaths												
4060 Alpine and Boreal heaths												
6230 *Species-rich *Nardus* grassland												
7130 Blanket bogs (*active only)												
7140 Transition mires												
7150 *Rhynchosporion* depressions												
7230 Alkaline fens												
8110 Siliceous scree												
8120 Calcareous scree												
8210 Calcareous rocky slopes												
8220 Siliceous rocky slopes												

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 voucher specimen identification, data collation, map checking or administration. 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.

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.

2.7.2 Field bases

If the survey teams are 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.

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.

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.

3. Field survey

3.1 Access

Seeking 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 to raise awareness and perhaps generate goodwill towards the survey and conservation management in general. 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
- request site access permission
- ask for relevant background information on the sites
- address any queries that arise
- establish goodwill and respect

Site access permission should be sought by calling to all landowners, active commonage shareholders or those with turbary rights in person. It is essential to inform people that the survey is being carried out for NPWS, of the Department of Arts, Heritage and the Gaeltacht. Copies of letters of introduction from NPWS, identification cards and details of the surveyor's insurance cover should be to hand.

This process should begin at an early stage of fieldwork and the time required should not be underestimated. Contact details for key figures can often be obtained by consulting the local NPWS Conservation Ranger and local IFA representatives. These key figures may also be able to provide the names and addresses of other shareholders. The NPWS project supervisor should be kept informed of any issues arising with regard to access permission.

3.2 Reconnaissance

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 they may present in terms of classification, transitions or species identification.

3.3 Navigation, health and safety

Health and safety is a very serious consideration for field surveyors, especially in the uplands. Problems can be prevented through appropriate training, risk assessments, adherence to health and safety protocols, the use of the correct equipment kept in good condition and attention to weather forecasts and local weather conditions. A comprehensive assessment of potential risks involved with

identification of the appropriate courses of action should be made at the start if each field season with an appropriate risk assessment procedure completed by each surveyor prior to embarking on each day of survey work. Clear communication and accurate navigation are also of paramount importance. In the event of a health and safety incident, surveyors should follow appropriate protocols taking into account common sense as circumstances will vary in every case. In addition to the general health and safety guidance provided at the start of this document, surveyors should adhere to the following minimum safety procedures while being aware that individual safety is the responsibility of each surveyor and that neither BEC Consultants Ltd, nor NPWS or the Department of Arts, Heritage and the Gaeltacht can be held accountable for accident or injury resulting for anyone using them.

3.3.1 Navigation

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. As a primary method of navigation during data recording it is strongly recommended to use ArcPad on the mapper / PDA. With the polygon shapefile and contours shapefile open, the constantly updated realtime position of the surveyor in relation to polygon boundaries and topography is available at a glance, as is direction of travel and altitude. This greatly increases accuracy of data recorded.

In case of technical difficulties with the mapper / PDA (e.g. flat battery, poor satellite coverage) surveyors must be prepared to fall back on using a standard GPS, map and compass to safely navigate off site. Care should be taken to ensure that the compass bearing is not affected by magnetic sources (e.g. a magnetic PDA stylus).

The use of 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.

Dangerously steep areas should be avoided and can be surveyed using binoculars in combination with aerial photographs. A walking pole is necessary for balance on steep slopes, descents and when crossing streams.

3.3.2 Communication

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.

Field surveyors should check in with each other by phone at scheduled times during the day, and more frequently when working in difficult terrain. In upland areas with poor mobile phone reception satellite transponders should be used to enable check in and for emergencies.

In the event of a surveyor being late to a meeting point in the field or at the end of the day and not being contactable by phone, their colleague(s) 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 but 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. The exception is if it is after 2000hrs, in which case call immediately.

3.3.3 Equipment

Surveyors should carry the recommended health and safety equipment listed in section 2.5 at all times. Where appropriate, all items must be checked regularly to ensure that they are fit for purpose.

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.

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.

3.3.4 Miscellaneous

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

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 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. Metal walking poles should be discarded.

3.4 Vegetation mapping

When carrying out vegetation mapping, surveyors should aim to cover 0.75-1.00 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, 0.50-0.75km^2 on average each day would be a more realistic aim.

3.4.1 Traversing polygons

The pre-digitised polygons, each of which represents a consistent vegetation mosaic, should be surveyed by walking a zig-zag 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 or patterning of the aerial imagery can be established.

The nature of the survey method employed for each polygon should also be recorded using the following cateogories

1. Surveyed on the ground in detail
2. Surveyed using binoculars
3. Surveyed using aerial imagery interpretation only
4. Data incorporated from a previous survey (e.g. NPWS coastal surveys)

3.4.2 Data recording

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 for each provisional vegetation type and each non-vegetated substrate (e.g. bare peat, bedrock, loose rock, scree, gravel, open water, running water) recorded within each polygon, heeding the associated Annex I and Fossitt (2000) categories (Appendix I). Where a community is encountered that is not detailed by the provisional classification (e.g. acid oakwoods), it should be recorded as "Not covered", but the relevant Annex I and Fossitt (2000) categories should be added as a note. Cover scores should be recorded to the nearest 5% except for covers of less than 10%; to provide increased detail and consistency, these should be recorded as 0.1%, 0.3%, 0.5%, 0.7%, 1%, 3%, 5% or 7%. As each polygon is

surveyed, the sum of the cover scores should be calculated to ensure that it totals exactly 100%. If additional notes on the polygons are recorded standardised notes and abbreviations should be used as far as possible.

3.4.3 Correspondence between classification schemes

The correspondence between Annex I habitats and the provisional vegetation types as shown in Appendix I follows the guidance provided by the *Interpretation Manual of European Union Habitats* (European Commission, 2007) and *The Status of EU Protected Habitats and Species in Ireland* (NPWS, 2007, 2013) and the latest versions of these sources should be consulted if further information is required. In most cases, the correspondence between the Fossitt classification and the other two schemes is fairly clear and consistent. In a few cases, however, 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 PB3 Lowland blanket bog, but not in HH3 Wet heath. However, European Commission (2007) specifically mentions the M14 *Schoenus nigricans – Narthecium ossifragum* mire of Rodwell (1991a) under 4010 Northern Atlantic wet heaths with *Erica tetralix*, as well as listing the species under *7130/7130 Blanket bogs. Thus, wet heath with *Schoenus nigricans* and *Erica tetralix*, vegetation type WH1 under the provisional classification, is associated with 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 HH3 Wet heath but not in PB2 Upland blanket bog, European Commission (2007) lists M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire under *7130/7130 Blanket bogs, a habitat in which *Juncus squarrosus* may be abundant. Thus, the provisional vegetation type BB5b *Calluna vulgaris – Eriophorum* spp. with *Juncus squarrosus* is associated with habitat *7130 under the Annex I scheme and habitat PB2 under the Fossitt scheme. Whilst Rodwell (1991a) is based on British vegetation, the occurrence of both M14 and M19 type vegetation in Ireland was confirmed by Perrin *et al.,* (2009).

3.4.4 Accuracy checking

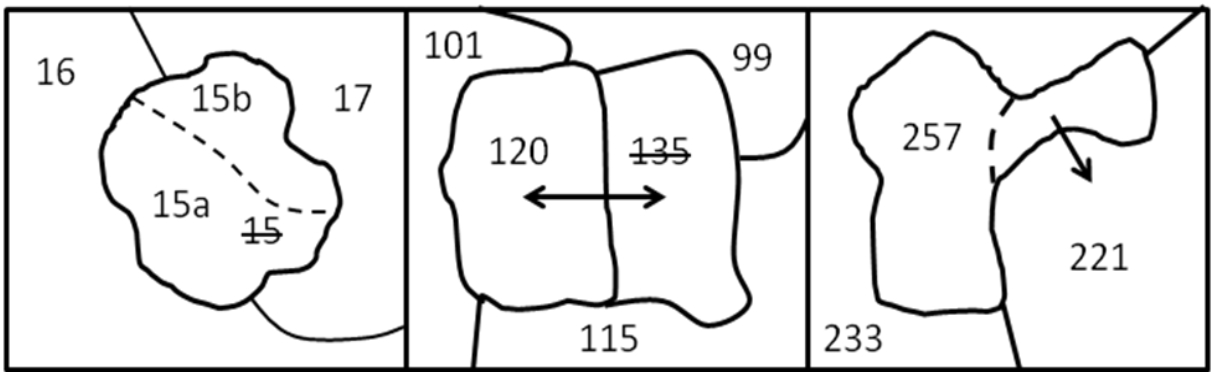
There are many variables associated with the accuracy of these estimates. These include size of polygon, complexity of habitats and mosaics, visibility of the polygon and experience of the surveyors. It is estimated that potential error associated with the percentage cover scores may be up to 10%. Accuracy of the polygon data being collected can be periodically tested to determine the level of error within the data. A polygon or number of polygons would be independently surveyed by all survey team members within a set time period. The team member with the most experience of upland habitat mapping would be given additional time to determine a definitive list of the vegetation

communities present and proportions of these. This definitive list can be used to determine the level of accuracy with which the data is being collected. Feedback from these tests to surveyors would help improve accuracy and an average of the results taken as the level of error within the data across the survey period.

3.4.5 Map amendment

If necessary, the polygon boundaries should be amended on the paper map (Fig. 2). 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 15 is split in two, the two new polygons are labelled 15A and 15B 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.

Figure 2: Recommended annotations for amendment of polygon boundaries in the field.



Splitting Merging Shifting

3.4.6 Waypoints

Waypoints should be used to record specific habitats and species of importance in addition to other features of interest. Waypoint notes should be made for areas of forestry, recording the approximate height of trees and the density of planting, and 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 surveyor's vehicles are parked. Waypoints should be entered digitally using customised forms in ArcPad. Standardised notes and abbreviations should be used as far as possible.

3.5 Interpretation of habitats

This section includes an account of each of the main habitat groups found in the uplands. It seeks to give practical advice to the fieldworker on how to identify and differentiate between the vegetation types and habitats detailed in Appendix I rather than giving an exhaustive description. This section contains codes that denote the provisional vegetation community types as listed in Appendix I which should be consulted in close conjunction with this section. See also Plates 1 to 20.

It is important to note that for this project that the habitats are classified according to the flora and vegetation communities currently present at a site rather than that which may previously have occurred. For example on an area of drained deep wet blanket peat the current plant communities may be more akin to wet heath than blanket bog as species sensitive to desiccation may have disappeared after drainage. Such an area will therefore be mapped as wet heath (current vegetation) rather than drained blanket bog. It may be possible to encourage blanket bog communities to recolonise such areas if the former water regime can be restored and many degraded habitat areas will certainly require rehabilitation. However is it beyond the remit of the NSUH to identify specific areas for restoration as this would need to be considered in a strategic way for example during the setting of conservation objectives for upland habitats at national, regional and local/site scales. The NSUH is recording baseline data on current vegetation and habitats that will form the basis for the setting of habitat and site specific conservation/restoration objectives.

3.5.1 Lakes and pools

There are three main types of lakes and pools in the uplands and associated landscapes: dystrophic pools, lowland oligotrophic lakes and upland oligotrophic lakes. Dystrophic pools (Fossitt category FL1) are highly acidic waterbodies, usually quite small in size, and occur in association with good quality blanket bog. They should have peaty rather than rocky margins. Oligotrophic lakes (Fossitt category FL2) are acidic and low in nutrients and are associated with areas of acidic bedrock; areas of bedrock, loose rock or gravel may occur round the margins. The majority of corrie lakes would be classic examples of oligotrophic lakes.

These lakes and pools usually constitute Annex I habitats corresponding to 3160 Dystrophic pools, 3110 Lowland oligotrophic lakes, or 3130 Upland oligotrophic lakes. However, in areas of degraded bog, shallow pools and areas of flooding may occur as a result of the topographical changes caused by erosion. These pools, which may occur on a rocky or peaty substrate, should not be recorded as Annex I habitat, except in the rare instances where the area of erosion has become stabilised and fully revegetated. Hence, there are six codes for recording areas of open water, an Annex and non-Annex

option for each of the three types of lakes and pools. In the NSUH, upland and lowland oligotrophic lakes have been roughly divided by the 150 m altitude level, but position in the landscape has also been taken into account.

Vegetation associated with lakes and pools should be recorded as a separate element to the open water. Vegetation associated with dystrophic pools that are characterized by *Menyanthes trifoliata* and *Carex limosa* should be recorded as provisional community PO1. This has two sub-communities. The aquatic sub-community comprises floating plants and emergents and relates to the Annex I habitat 3160 Dystrophic pools and the Fossitt (2000) habitat FL1 Dystrophic lakes. The infilling sub-community refers to a terrastrialized zone around dystrophic pools characterized by high *Sphagnum* cover coupled with an appreciable cover of sedges, particularly *Carex limosa* and *Carex lasiocarpa*. This sub-community corresponds to the Annex I habitat 7140 Transition mires and the Fossitt category PF3 Transition mires and quaking bog. Note that *Sphagnum*-rich pool margins that are lacking sedges should be refered to the HW1 hollow community. A submerged or emergent vegetation community, PO2, may occur in the shallows margins of oligotrophic lakes. The characteristic species here are *Littorella uniflora*, *Lobelia dortmanna* and *Eriocaulon aquaticum*. Two variants here allow for vegetation associated with upland and lowland lakes to be recorded appropriately.

3.5.2 Springs and soakways

Springs are usually small, distinct point features in the upland matrix where there is an upwelling of groundwater or a seepage zone. Spring vegetation may extend down below the springhead as it gradually merges into a flush or stream.

Calcareous springs (Fossitt category FP1) are represented in the uplands by the SPG2 community in the provisional classification. The characteristic species are *Palustriella commutata* and *Bryum pseudotriquetrum*, often accompanied by low amounts of *Carex nigra* and *Carex viridula*. There are two variants; where *Palustriella* spp. and tufa formation occurs, the variant referable to Annex I habitat 7220 Petrifying springs should be recorded. Note that *Palustriella commutata* and *Palustriella falcata* are brown mosses that may also occur in RFLU1a where small sedges are typically more abundant.

There are two main communities of non-calcareous springs (Fossitt category FP2), SPG1 and SPG3. SPG1 occurs in two distinct types. The typical sub-community is fairly species-rich and is characterised by *Philonotis fontana*, *Saxifraga stellaris*, *Dicranella palustris*, *Montia fontana* and *Chrysosplenium oppositifolium*. Vegetation referable to this sub-community may also occur alongside stony upland streams where *Chrysosplenium oppositifolium* and *Montia fontana* are prevalent. In the species-poor sub-community many of these species are absent, being replaced by large patches of *Sphagnum denticulatum* or *Sphagnum inundatum*.

Whilst included here as a spring, SPG3 is really a species poor-community of seepage areas on skeletal soils in montane areas. It is characterized by conspicuous cushions of the dense grey-black hepatic *Anthelia julacea* that can cover several square metres. Also found growing here are *Scapania undulata* and *Marsupella emarginata. Anthelia julacea* can occur in small patches in seepage points on vertical faces but these do not constitute the SPG3 community.

The *Potamogeton polygonifolius* soakway, SW1 in the provisional classification, is an easily identified community dominated by *Potamogeton polygonifolius* and often accompanied by the bright yellow flowers of *Hypercium elodes.* It is found amongst wet heath and blanket bog. Other species include *Ranunculus flammula*, *Anagallis tenella* and *Juncus bulbosus.* In the Fossitt classification it is broadly covered by PF2 Poor fen and flush. *Potamogeton polygonifolius* and *Hypericum elodes* may also occur within fen or transition mire with *Carex rostrata* or *Cladium mariscus*; this should not be recorded as SW1.

3.5.3 Flushes and fens

Flushes are maintained by the movement or seepage of groundwater or surface waters and hence usually occur as linear features on sloping ground. Upland flushes are generally narrow features within the matrix of grassland, bog and heath found in mountain areas, however, on gently sloping terrain they can be considerably wider as water flow is more diffuse. Poor flushes have low levels of soil minerals, are fed by acidic waters and typically contain peat-forming species such as *Sphagnum* spp. and *Polytrichum commune* as well as sedges or rushes. Rich flushes are fed by calcareous or mineral-rich waters and typically support small sedge communities but lack rushes.

The provisional classification recognises five poor flush communities. PFLU1 is variable in nature but is characterised by the presence of *Carex echinata* or occassionally *Carex nigra*, accompanied by a mixture of poor flush and bog species. PFLU2 is an easily recognised community being dominated by *Juncus effusus* with *Sphagnum* spp. or *Polytrichum commune* beneath, often forming large hummocks. Both PFLU1 and PFLU2 are referable to the Fossitt (2000) habitat PF2 Poor fen and flush. PFLU3 is included here as it is superficially similar to PFLU2 being dominated by *Juncus effusus* or *Juncus acutiflorus*. However, it is really a wet grassland community rather than a peat-forming one. Amongst the clumps of rushes, species typical of Fossitt's GS4 Wet grassland habitat are found, such as *Rumex acetosa*, *Calliergonella cuspidata* and *Holcus lanatus*.

PFLU4 is a *Molinia*-dominated vegetation type with *Sphagnum* species. Two sub-communities here cover the typical composition and a regional type in which *Erica erigena* occurs. This community corresponds to PF2 Poor fen and flush under Fossitt's scheme. Lastly, PFLU5 is characterised by the occurrence of *Carex rostrata* and *Sphagnum* spp. This community is referable to the Annex I habitat 7140 Transition mires and the Fossitt (2000) category PF3 Transition mire and quaking bogs.

All of the four rich flush communities correspond with the Fossitt (2000) category PF1 Rich fen and flush. Where brown mosses are present the vegetation included here also corresponds with the Annex I habitat 7230 Alkaline fens. The main brown moss species encountered will be *Campylium stellatum*, *Drepanocladus revolvens* and *Scorpidium scorpioides*; a full list is given in Appendix VI. These are key indicators that all fieldworkers should be able to identify in the field. RFLU1 is a common flush type usually occuring in upland grasslands. It is characterised by the presence of *Carex viridula*, *Carex panicea*, *Pinguicula vulgaris* and *Juncus bulbosus*, and usually has conspicuous bare ground or rocky elements. Two sub-communities cover the brown moss flushes and species-poor flushes in which brown mosses are absent. RFLU2 is another brown moss flush but here there are conspicuous amounts of *Eleocharis quinqueflora*. RFLU3 occurs on flat ground at high altitudes and is not really a flush. It is included in this section however as it is characterised by a sparse cover of *Carex viridula* and *Carex panicea*. RFLU4 is defined by the occurrence of *Schoenus nigricans* and brown mosses. It may occur in upland grassland, where the tall nature of the *Schoenus* tussocks make it a conspicuous feature, or it may occur much more subtly in mosaic with *Schoenus* wet heath (WH1) or in lowland blanket bog with *Schoenus* (BB1 and BB2) being differentiated by means of the occurrence of the brown mosses.

Fens are peat-forming systems that are fed by groundwater or surface waters and occur in poorly-drained basins and around the margins of infilling lakes and pools. The provisonal classification recognises only one upland fen community, RFEN1, which is characterised by the dominance of *Carex rostrata*. The brown moss sub-community is referable to the Annex I habitat 7230 Alkaline fens and the Fossitt (2000) habitat PF1 Rich fen and flush whereas where brown mosses are lacking it should be recorded as the Annex I habitat 7140 Transition mires and the Fossitt (2000) category PF3 Transition mire and quaking bogs.

3.5.4 Upland grasslands

Upland grasslands tend to occur on sloping ground on relatively shallow soils. They are generally derived from heathlands as a result of heavy grazing that has removed the dwarf shrub cover and are, thus, dominated by grass species with typical herb species including *Potentilla erecta* and *Galium saxatile*.

There are six upland grassland communities in the provisional classification. UG1 is characterised by the abundance of *Agrostis capillaris* in the sward and represents more productive grasslands that can typically be recognised by the low, bitten nature of the bright green sward. UG2 is characterised by the abundance of *Nardus stricta* and represents relatively unpalatable, coarser swards. Both communities are referable to the Fossitt (2000) category GS3 Dry-humid acid grassland and both have sub-communities to cover variations in which *Juncus squarrosus* or *Sphagnum* spp. are prevalent. Other

species that occur in these communities include *Festuca ovina*, *Anthoxanthum odoratum*, *Danthonia decumbens*, *Rhytidiadelphus squarrosus* and *Hylocomium splendens*. The UG2d sub-community composed chiefly of *Nardus stricta* and *Juncus squarrosus* can occur in areas of eroded bog where there is only a thin covering of peat on the bedrock. It is also common at high altitudes in mosaic with montane habitats.

Both UG1 and UG2 also have two species-rich sub-communities (UG1c, UG1e, UG2c and UG2e), which are referable to the Annex I habitat *6230 Species-rich *Nardus* grasslands. To qualify as Annex I habitat the sward should have a relatively high cover of broadleaved herbs and high species diversity. In sub-communities UG1c and UG2c there is generally some flushing of base-rich water to enrich the sward. Hence, in addition to the standard Nardo-Galion species, more mesophilic species such as *Thymus polytrichus*, *Campanula rotundifolia, Linum catharticum* and *Prunella vulgaris* may occur. In sub-communities UG1e and UG2e this base-rich element does not occur, but the sward is still remarkably species-rich.

UG3 is a rare alpine grassland community of rocky ground and steep slopes in limestone areas referable to the Annex I habitat 6170 Alpine and sub-alpine calcareous grassland and the Fossitt (2000) category GS1 Dry calcareous and neutral grassland. It is characterised by the presence of cushions of *Silene acaulis* or *Arenaria ciliata* and a suite of calcicole species: *Sesleria caerulea, Festuca rubra, Thymus polytrichus, Ctenidium molluscum*, *Alchemilla glabra, Campanula rotundifolia, Saxifraga hypnoides* and *Saxifraga aizoides*. UG4 is a wet, non-Annex grassland community referable to the Fossit (2000) category GS4 Wet grassland and many examples of it are derived from overgrazed wet heath. It is composed of tussocks of *Molinia caerulea*, through which are scattered a few other grass species such as *Nardus stricta*, *Anthoxathum odoratum* or *Festuca* spp. Where *Molinia*-dominated vegetation contains even small amounts of dwarf shrubs such as *Erica tetralix, Calluna vulgaris* or *Myrica gale* it should be recorded as a wet heath. Where *Molinia*-dominated vegetation contains peat-forming species such as *Sphagnum palustre* and *Polytrichum commune* it should be recorded as a PLU4 flush.

UG5 typically occurs on thin, stony soils, where the edaphic conditions are strongly influenced by underlying limestone bedrock. Species include *Linum catharticum*, *Prunella vulgaris, Lotus corniculatus, Thymus praecox, Alchemilla* spp., *Lysimachia nemorum, Saxifraga hypnoides, Ctenidium molluscum, Carex pulicaris, Koeleria macrantha*, *Galium sterneri*. The herb-rich sub-community should have a broafleaf herb cover approaching 20% and should have a smaller component of calcifuge species (e.g. *Nardus stricta*). The herb-poor sub-community is grassier and somewhat transitional to UG1a or UG2a; it may contain a greater proportion of species typical to those sub-communities (e.g. *Nardus stricta*, *Potentilla erecta*). UG5 differs from UG3 in the absence of *Silene acaulis* and *Arenaria ciliata*.

UG6 occurs as a dense, ungrazed sward of *Sesleria caerulea* and *Carex flacca* on rock faces and inaccessible slopes. *Breutelia chrysocoma* forms a thick undercarpet.

Bracken is a common invader of upland grassland and dry heath. Where *Pteridium aquilinum* dominates the vegetation it should be recorded as community BK1. Beneath dense bracken, woodland species such as *Oxalis acetosella* and *Viola riviniana* can thrive.

3.5.5 Dry heaths

Dry heaths comprise vegetation dominated by ericaceous dwarf shrubs and usually occur on well-drained mineral soils or shallow peats on sloping ground (typically less than 50 cm deep). *Calluna vulgaris* is typically the main species but *Erica cinerea*, *Ulex gallii* and *Vaccinium myrtillus* may also be important components. Dwarf shrub cover should be over 25%.

There are six communities of dry heath vegetation in the provisional classification all referable to the Annex I category 4030 Dry heath. Five of the six communities are referable to the Fossitt (2000) habitat HH1 Dry siliceous heath and one to HH2 Dry calcareous heath. Vegetation type DH1 is characterised by the presence of *Ulex gallii*, generally accompanied by *Erica cinerea* or *Calluna vulgaris*; it is typically found in coastal areas. DH2 is a regional type of western Galway and western Mayo and is characterised by the presence of *Erica erigena* and *Calluna vulgaris*; if *Erica erigena* is present but *Calluna vulgaris* is scarce or absent and there is a peat-forming element to the vegetation, refer to PFLU4. DH3 is the most common community and maybe regarded as the 'standard' type of dry heath. It is usually dominated by *Calluna vulgaris* or occassionally *Erica cinerea*, but this latter species need not be present. DH4 is similar to DH3 and often occurs in mosaic with it. It is differentiated by the presence of *Sphagnum capillifolium* or *Sphagnum subnitens* cushions and is somewhat damper than other dry heaths, but generally it is readily identified; where other *Sphagnum* spp. occur, refer to wet heaths and blanket bogs. DH5 is a calcareous heath community characterised by a mixture of heath and calcareous grassland species; it would typically be only recorded in areas of outcropping limestone or rocky, shallow, base-rich soils. DH6 is characterised by an abundance of *Vaccinium myrtillus*, generally with *Calluna vulgaris* on rocky ground. *Vaccinium myrtillus* should account for a minimum of 20% of cover, if cover of this species is less than 20% refer to DH3.

With the exception of DH4, dry heaths should only contain a limited cover of peat-forming species; where *Calluna*-dominated vegetation contains a signficant proportion of *Eriophorum* spp., refer to BB5. For differences between dry heath and montane heath, refer to the section on montane heath. Dry heaths should be differentiated from grassland by the 25% dwarf shrub threshold suggested by Fossitt (2000).

Plate 1: Dystrophic pools in upland blanket bog, Sheeffry Hills, Co. Mayo.
(Annex I: 3160, Fossitt: FL1, Provisional classification: Open DA). Photo: Janice Fuller.

Plate 2: Crotty's Lough, an upland oligotrophic lake in the Comeragh Mountains, Co. Waterford.
(Annex I: 3130, Fossitt: FL2: Provisional classification: Open UA). Photo: Philip Perrin.

Plate 3: (left) *Philonotis fontana – Saxifraga stellaris* springhead Sheeffry Hills, Co. Mayo. (Annex I: None, Fossitt: FP2, Provisional classification: SPG1a). Photo: Joanne Denyer.

Plate 4: (below) Springhead vegetation: *Dicranella palustris*, *Philonotis fontana, Saxifraga stellaris* and *Chrysosplenium oppositifolium*. (Annex I: None, Fossitt: FP2, Provisional classification: SPG1a). Photo: Joanne Denyer.

Plate 5: Soakway with *Potamogeton polygonifolius* and *Hypericum elodes*, Sheeffry Hills, Co. Mayo. (Annex I: None, Fossitt: PF2, Provisional classification: SW1). Photo: Philip Perrin.

Plate 6: Poor flush dominated by *Juncus effusus*, Mweelrea Mountain, Co. Mayo. (Annex I: None, Fossitt: PF2, Provisional classification: PFLU2). Photo: Jenni Roche.

Plate 7: Rich flush with *Carex panicea*, *Carex viridula*, *Pinguicula grandiflora* and *Drepanocladus revolvens*. Mount Brandon, Co. Kerry. (Annex I: 7230, Fossitt: PF1, Provisional classification: RFLU1a). Photo: Philip Perrin.

Plate 8: Expanse of upland grassland derived from dry heath, Comeragh Mountains, Co. Waterford. (Annex I: None, Fossitt: GS3, Provisional classification: UG2a). Photo: Kate McNutt.

Plate 9: Dense bracken on Mweelrea Mountain, Co. Mayo. (Annex I: None, Fossitt: HD1, Provisional classification: BK1). Photo: Brendan O'Hanrahan.

Plate 10: *Calluna vulgaris* dry heath being invaded by *Pinus contorta*, Nephin Mountain, Co. Mayo. (Annex I: 4030, Fossitt: HH1, Provisional classification: DH3). Photo: Deirdre Ninaber.

Plate 11: Wet heath of *Molinia caerulea, Trichophorum germanicum*, *Erica tetralix* and *Calluna vulgaris*, Killarney National Park, Co. Kerry. (Annex I: 4010, Fossitt: HH3, Provisional classification: WH3). Photo: Philip Perrin.

Plate 12: Montane heath with *Calluna vulgaris* and *Racomitrium lanuginosum*, Mount Brandon, Co. Kerry. (Annex I: 4060, Fossitt: HH4, Provisional classification: MH1a). Photo: Philip Perrin.

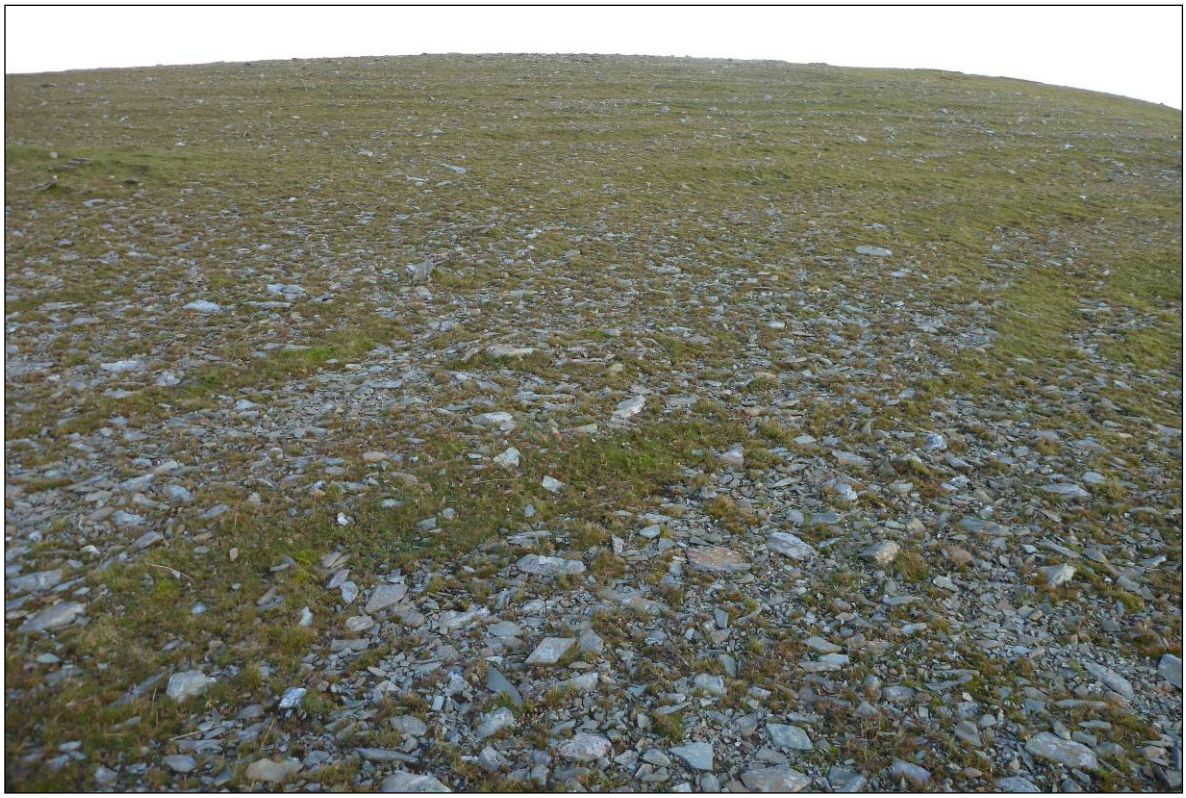


Plate 13: Sparse fell-field type montane vegetation with *Festuca vivipara*, Sheeffry Hills, Co. Mayo. (Annex I: None, Fossitt: HH4, Provisional classification: MH8). Photo: Joanne Denyer.

Plate 14: North Atlantic hepatic mat with *Herbertus aduncus*, *Scapania gracilis* and *Pleurozia purpurea*, Sheeffry Hills, Co. Mayo. (Occurs in various Annex I/Fossitt habitats, Provisional clasification: HM2).
Photo: Philip Perrin.

Plate 15: *Schoenus nigricans* blanket bog, Laghta, Sheeffry Hills, Co. Mayo.

(Annex I: *7130, Fossitt: PB3, Provisional classification: BB1a). Photo: Philip Perrin.

Plate 16: Expanse of degraded bog with *Eriophorum angustifolium*, plateau of Comeragh Mountains, Co. Waterford. (Annex I: 7130, Fossitt PB2, Provisional classification: HW2). Photo: Philip Perrin.

Plate 17: Siliceous scree slope on the ridgeline of the Sheeffry Hills, Co. Mayo. (Annex I: 8110, Fossitt: ER3, Provisional classification: SC1 and SilcScree). Photo: Joanne Denyer.

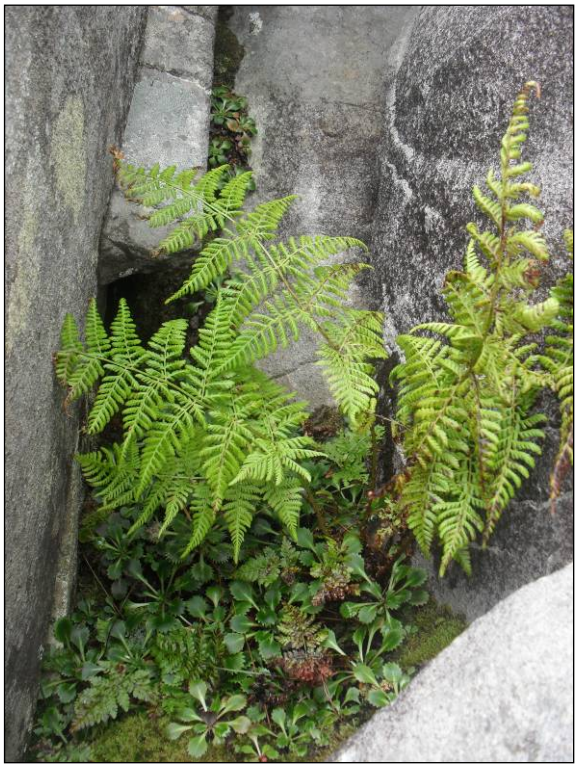


Plate 18: Siliceous rocky cleft with *Dryopteris dilatata* and *Saxifraga spathularis*, Croaghaun, Co. Mayo. (Annex I: 8220, Fossitt: ER1, Provisional classification: RS1). Photo: Orla Daly.

Plate 19: Hydrophilous tall herb ledge community, Sheeffry Hills, Co. Mayo. (Annex I: 6430, Fossitt: ER2, Provisional classification: TH3). Photo: Joanne Denyer.

Plate 20: *Luzula sylvatica – Vaccinium myrtillus* tall herb ledges on Ben Bulben, Co. Sligo.

(Annex I: None, Fossitt ER1, Provisional classification: TH1. Photo: Brendan O'Hanrahan.

Areas of dry heath are prone to fires and occasional fires are part of the natural cycle in many heathland ecosystems. Controlled burning is also sometimes used as a management tool on dry heath habitat to produce a heathland with a variety of heather growth stages important for species such as Red Grouse. Currently in Ireland, however, most heath fires are intentionally started to encourage grass growth for livestock. Recently burnt areas, which may be almost devoid of vegetation, should be recorded under the habitat type which had previously occurred; the burning is treated as the condition of the habitat rather than a change in habitat. Areas where the burning has occurred some years ago (indicated by the presence of scorched heather remains) and which have revegetated should be recorded as dry heath if the vegetation includes active signs of heather regeneration even if dwarf shrub cover is currently less than 25%. Areas which have fully revegetated and where the scorched heather plants have largely broken down, but where no heather regeneration is present should be recorded as the new habitat type; this is typically a form of upland acid grassland. This change in habitat is likely to result from burning regimes that are too intense or frequent. Note that the exception to the 25% dwarf shrub cover threshold is made for areas of burnt heath because the change in vegetation can be short term unless the fire was severe. This exception is not made for areas modified by overgrazing as the impact is generally a continuing one and dwarf shrub cover will not expand unless stock management changes.

Dry heath can form a component of the mosaic of vegetation types present on rocky slopes and corrie walls. In areas suffering from heavy grazing pressure, these patches of dry heath may be the only surviving remnants of the habitat, as elsewhere suppression of dwarf shrubs has led to habitat being replaced by upland grassland.

In areas of blanket bog that have become severely eroded remnant peat haggs may have dried out to the point that they no longer support bog vegetation. A sparse type of dry heath can develop on these haggs characterised by *Erica cinerea* and *Calluna vulgaris*; it should be recorded as DH3.

3.5.6 Wet heaths

Wet heath is a highly variable habitat that is intermediate between dry heath and blanket bog, generally occurring on gently sloping, poorly-draining ground on shallow or intermediate peat depths (typically less than 50 cm deep). It is dominated by a mixture of *Molinia caerulea*, *Erica tetralix*, *Trichophorum germanicum* and *Calluna vulgaris*, although not all of these species need to be present. Unlike dry heaths, there is no minimum threshold for dwarf shrub cover (cf. Fossitt, 2000) as dwarf shrubs may be scarce or absent in degraded examples of wet heath characterised by *Trichophorum germanicum* or *Molinia caerulea*.

There are seven communities of wet heath in the provisional classification all of which are referable to the Annex I habitat 4010 Wet heaths and the Fossitt (2000) category HH3 Wet heath (despite the difference in dwarf shrub cover threshold). Community WH1 is characterised by the presence of *Schoenus nigricans*, usually with clumps of *Molinia caerulea* and scattered sprigs of *Erica tetralix*. It can occur on rather shallow soils amongst exposed bedrock. The open and continuous sub-communities refer to the structure of the vegetation with the open sub-community having gaps or bare ground between the tussocks. WH3 is a common community characterised by the dominance of *Calluna vulgaris*, *Molinia caerulea* and *Sphagnum capillifolium*; *Molinia caerulea* is much more abundant here than in the related DH3 dry heath type. In the three remaining wet heath types, *Trichophorum germanicum* is usually plentiful and may be abundant. In WH4 it is usually accompanied by *Eriophorum angustifolium*; this community is closely related to BB4 blanket bog and is differentiated by the depth of peat and absence of genuine bog mosses such as *Sphagnum papillosum*. Three sub-communities cover the variations where *Calluna vulgaris* or *Juncus squarrosus* may be frequent. WH2 occurs amongst bare rock or bare soil, where *Trichophorum germanicum* occurs with *Cladonia* spp. and some *Racomitrium lanuginosum*. WH5 is a wet heath of high altitudes and exposed slopes where *Nardus stricta* is co-dominant with *Trichophorum germanicum*. WH6 is dominated by *Schoenus nigricans* and *Molinia caerulea*, but is characterised by an abundance of *Myrica gale*, indicative of moving groundwater. Note, however, that *Myrica gale* can also be abundant on blanket bogs and the presence of this species does not in itself mean that the vegetation should be recorded as WH6. The final community, WH7, is unusual in that *Ulex gallii* is an intimate component alongside *Molinia caerulea*.

Wet heaths can be difficult to differentiate from blanket bogs as the two habitats intergrade. Wet heaths tend to occur on shallower peat and have a greater cover of *Molinia caerulea* whilst having lower cover of *Eriophorum* spp. and *Sphagnum* spp. Wet heaths differ from dry heaths by having a typically lower cover of *Calluna vulgaris* and *Erica cinerea* and the presence of *Trichophorum germanicum*, *Molinia caerulea* and *Erica tetralix*.

Wet heaths may become prone to fires during dry spells – see the guidance under dry heath for recording areas of wet heath that have been burned. Wet heath may develop in areas where the peat is shallow having collapsed or been eroded or cut, but subequently revegetated.

3.5.7 Montane heaths

Montane heaths occur at high altitudes, typically over 400 m, and in exposed locations at lower altitudes. They are characterised by the low, wind-clipped or stunted nature of the vegetation and the presence of plants indicative of high altitude. The abundance of *Racomitrium lanuginosum* is a key character of montane heaths which often occur amongst loose rock or exposed bedrock. The bright green stems of *Huperzia selago* also becomes conspicuously frequent here. The provisional

classification divides montane heaths into three groups: montane heaths proper (MH1-4), montane grass-heath (MH5) and montane vegetation (MH6-8). All communities are referable to the Fossitt (2000) category HH4 Montane heath.

Montane heaths proper differ primarily from montane vegetation and grass-heath by having a good cover of dwarf shrubs (typically greater than 10%). All four communities refer to the Annex I habitat 4060 Alpine and Boreal heaths. MH1 is the most common community; here wind-clipped *Calluna vulgaris* is the main dwarf shrub and occurs with *Racomitrium lanuginosum* and *Nardus stricta*. Two sub-communities cover situations where *Juncus squarrosus* is frequent or not. MH2 occurs amongst rocks and is characterised by the dominance of *Vaccinium myrtillus* or *Empetrum nigrum* and the abundance of liverworts such as *Herbertus aduncus.* MH3 is also dominated by *Vaccinium myrtillus* but is differentiated from MH2 by the presence of Nardo-Galion species. MH3 must contain *Racomitrium lanuginosum* or have distinctly wind-clipped dwarf shrubs; vegetation dominated by *Vaccinium myrtillus* with *Rhytiadelphus loreus* and no *Racomitrium lanuginosum* is likely to be referable to DH6.

Where prostrate *Juniperus communis* ssp. *nana* or *Arctostaphylos uva-ursi* occur, the vegetation should be recorded as MH4. This is still referable to Annex I habitat 4060. *Juniperus communis* subsp. *nana* is specifically mentioned by European Commission (2007) under 4060 Alpine and Boreal heath and by Rodwell (1991a) under the comparable H15 *Calluna vulgaris – Juniperus communis* subsp. *nana* heath community. Conversely, the description of 5130 *Juniperus communis* formations on heaths/calcareous grasslands (European Commission, 2007) specifically mentions the W19 *Juniperus communis* subsp. *communis – Oxalis acetosella* woodland community of Rodwell (1991b). Therefore, the approach taken by the NSUH is to refer *Juniperus communis* subsp. *nana* vegetation to Annex I habitat 4060 and *Juniperus communis* subsp. *communis* vegetation, if encountered, to habitat 5130.

MH5 grass-heath is a species-poor community, possibly representing overgrazed versions of other montane habitats. The main components are *Nardus stricta* and *Racomitrium lanuginosum* with *Carex binervis* often frequent; this often occurs in mosaic with UG2 grassland.

Two of the montane vegetation communities, MH6 and MH7 are referable to the Annex I habitat 6150 Siliceous alpine and boreal grasslands, whilst MH8 is a non-Annex community. To qualify as MH6 or MH7, the vegetation should contain at least one genuine arctic-alpine indicative of summit communities; those identified so far in an Irish context are *Diphasiastrum alpinum*, *Persicaria vivipara*, *Salix herbacea*, *Carex bigelowii* and *Cetraria islandica*. Note that where these species occur amongst good dwarf shrub cover (>10%), the vegetation is referable to Annex I habitat 4060 rather than habitat 6150. In the MH7 community, *Nardus stricta* is dominant whilst in MH6 it is typically sparse or absent. Both MH6 and MH7 have sub-communities to cover minor variations in the vegetation. MH8 is a very sparse vegetation type that occurs on rocky or gravelly high altitude plateaux and summits and has some affinities to the *Festuca-vivipara – Oligotrichum hercynicum* fell-field community proposed by

Rodwell *et al,* (2000). *Festuca vivipara*, *Thymus polytrichus* and *Galium saxatile* are the main components although vegetation cover may be less than 5%. Similar vegetation may occur in the context of scree but the MH8 category should be reserved for areas of loose rock on level ground.

3.5.8 Hepatic mats

Northern Atlantic hepatic mats are dense cushions of bryophytes that occur on north-facing slopes in the uplands, often sheltered below cliffs or rocky overhangs within dry, wet and montane heath where they typically occur beneath *Calluna vulgaris* and *Vaccinium myrtillus* (Holyoak, 2006). In particularly sheltered corries they may however also occur in association with outcropping rock in the absence of the dwarf shrubs. They chiefly comprise liverworts, such as *Herbertus aduncus, Mylia taylorii, Diplophyllum albicans* 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 such as *Plagiochila carringtonii*, *Mastigophora woodsii*, *Bazzania pearsonii* and *Scapania ornithopodioides* may occur. Hepatic mats vegetation is hence of international significance but has not been specifically highlighted under the EU Habitats Directive, although it does occur within Annex I habitats including 4030 Dry heath and 8220 Siliceous rocky slopes. 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.

The provisional classification covers two hepatic mats communities. HM1 is a poorer, lower altitude mat in which *Scapania gracilis* is the main hepatic. HM2 is a more genuine Northern Atlantic hepatic mat community characterised by the presence of *Herbertus aduncus*.

3.5.9 Blanket bogs and hollows

Blanket bogs comprise peat-forming vegetation on deep peats (typically more than c. 50 cm deep, often 1-2 m deep in the uplands, though sometimes deeper, and up to 8 m deep in the lowlands) and generally occur on level ground or gentle slopes, although they can occur on steeper ground in the wettest districts. The vegetation can be highly variable but is characterised by the presence of *Eriophorum* spp. and *Sphagnum* spp. There are seven types recognised in the provisional classification. Under the Fossitt (2000) scheme, the upland communities are referable to PB2 Upland blanket bog and the lowland communities are referable to PB3 Lowland blanket bog, however, areas of bogs should be classified primarily on the basis of the vegetation rather than altitude. All seven types are referable to *7130 Blanket bogs, that is they are deemed active bog. The *Interpretation Manual of European Union Habitats* (European Commission 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* spp., *Schoenus nigricans*, *Molinia caerulea* and other moss species such as *Racomitrium lanuginosum* are also reported to be peat-forming.

There are three communities of blanket bog that are more common in lowland areas. BB1 and BB2 are distinguished from the upland communities by the presence of *Schoenus nigricans*. Vegetation type BB1 has a low cover of *Sphagnum* spp. and *Eriophorum angustifolium* is usually conspicuous. The open and continuous sub-communities refer to the structure of the vegetation with the open sub-community having gaps or bare ground between the tussocks. BB2 is a *Sphagnum*-rich bog with cover of bog moss being over 15%. The remaining lowland community, BB7, varies from BB1 and BB2 in the absence of *Schoenus nigricans*. It always occurs on flat bogland, characteristically in areas patterning with dystrophic pools. Hummock-forming lowland sphagna are usually present: *Sphagnum austinii*, *Sphagnum fuscum* or S*phagnum magellanicum*. *Trichophorum germanicum*, *Eriophorum vaginatum* and *Calluna vulgaris* may be present but none of these species are abundant enough to qualify the bog as BB3, BB4 or BB5. BB1, BB2 and BB7 differ from WH1 on depth of peat.

Four types of blanket bog are more common in the uplands. BB3 is a soft bog type in which *Sphagnum papillosum* and *Eriophorum vaginatum* are characteristic, and *Narthecium ossifragum* and *Drosera* spp. are frequent. BB4 is a drier bog typified by an abundance of *Trichophorum germanicum* which is accompanied by *Eriophorum angustifolium*; it is closely related to WH4 but occurs on deeper peats and usually lacks significant cover of *Calluna vulgaris*. BB5 is a high altitude bog that can also be dry, often lacking any appreciable *Sphagnum* cover. Cover of *Calluna vulgaris* is high and it may superficially resemble a dry heath, but is differentiated by the tussocks of *Eriophorum vaginatum* and the depth of the peat. Occasionally *Eriophorum angustifolium* may occur instead and *Empetrum nigrum* is also characteristic. Two sub-communities cover the presence or absence of *Juncus squarossus*. BB6 is a montane type of high altitudes which occurs on relatively shallow peats characterised by *Eriophorum angustifolium, Juncus squarrosus, Sphagnum capillifolium* and *Calluna vulgaris. Racomitrium lanuginosum, Empetrum nigrum* and *Cladonia* spp. are typically present. Two sub-communities cover the presence or absence of strict arctic-alpine species.

The conservation assessments of Irish blanket bogs summarised in *The Status of EU Protected Habitats and Species in Ireland* (NPWS 2007, 2008) did not report separately on active and inactive blanket bog habitats as differentiating them can be difficult however, 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. This is often a monospecific sward and forms a highly characteristic mosaic with haggs and bare peat in areas of eroding bog. Under the current provisional classification scheme this is recorded as HW2, being essentially the same vegetation as is found in some natural bog

hollows or channels. It should contain little or no *Sphagnum* except for *Sphagnum fallax*. Two variants cover its occurrence in upland and lowland bogs.

There are three other types of bog hollow vegetation in the provisional classification. HW1 covers *Sphagnum* bog hollows dominated by *Sphagnum cuspidatum* or *Sphagnum denticulatum*; it may occur in a discrete hollow or around the shallow periphery of a dystrophic pool. Two variants cover its occurrence in upland and lowland bogs, whilst a third covers flushes dominated by these species that do not occur in a bog context. HW3 is a community that covers 7150 *Rhynchosporion* depressions and is strongly dominated by *Rhynchospora alba* (or occassionally *Rhynchospora fusca*); the vegetation is typically low and lacking in any tall plants. It may occur in either small depressions or flushed areas, or as extensive water tracks across the bog, where it may form a mosaic with "islands" of other bog vegetation. In such situations it has the appearance of a *Rhynchospora*-rich bog type rather than a hollow or depression. HW4 covers hollows and flushes in which *Eleocharis multicaulis* is conspicuous; where *Eleocharis quinqeuflora* occurs refer to RFLU2.

In the context of bogs, areas of bare, eroding peat should be recorded as "BarePeatB" which is linked to PB5 Eroding blanket bog under Fossitt (2000). Community DP1 covers situations where the exposed peat has been colonised by the non-native moss *Campylopus introflexus*; this typically occurs in very small scattered patches, but occassionally can cover large areas in mosaic. Community DP2 is used to classify areas of eroding and drying bog where the vegetation has been reduced to scattered tufts of *Nardus stricta*, sometimes with *Eriophorum angustifolium*. This vegetation type usually occurs on small crumbling mounds of peat or round the fringes of larger hags. *Nardus stricta* should not form a continuous sward; if it does refer to upland grasslands.

Where haggs have dried out to the point that they no longer support bog vegetation, they should be recorded under the current vegetation type; this will typically be dry heath or upland grasslands. Between haggs, a mosaic of gravel, bare peat, bare rock, bedrock, streams and flushes is common.

3.5.10 Scree

Scree is an accumulation or piling of rocks and can consist of small material such as gravel and small rock fragments, or much larger rocks when it is often termed block scree or talus. It forms at the base of crags and cliffs or on steeply-sloping ground below summits and ridgelines. Areas characterised by a high cover of scattered rock fragments and low vegetation cover on summits or plateaux are not defined as scree; in some circumstances the exposed loose rock, gravel and bedrock in these locations appears to be the result of blanket bog erosion. For fell-field type habitats see the section on montane heaths. Block scree must consist of an accumulation or pile of rocks and boulders which has created sheltered crevices; a scattering of large rocks across a slope or flat ground with no significant piling is termed a boulder field and should be recorded as "SilcLoose" or "CalcLoose" under the provisional

field classification. Depending on the geological nature of the rock, scree is referable to either 8110 Siliceous scree or 8120 Calcareous scree under Annex I. All examples of scree in the Irish uplands are deemed to be Annex I habitat. 8110 Siliceous scree is by far the more widespread type of scree encountered in Ireland.

The bare rock element of scree should be recorded as "SilcScree" or "CalcScree" under the provisional classification. The vegetation component should be recorded separately as SC1 or SC2 for siliceous or calcareous scree respectively. Scree vegetation is typically sparse with a scattering of bryophytes (e.g. *Racomitrium* spp. and various small stature Polytrichales) and a few graminioids being the main components, although sometimes *Racomitrium lanuginosum* can form extensive patches. Amongst block scree, ferns and *Saxifraga spathularis* are typical in the shaded crevices. However, where scree has become vegetated to the point where a recognisable heath or grassland community has established, that community should be recorded as such rather than SC1 or SC2.

3.5.11 Rocky slopes and ledge vegetation

Corrie walls and crags support a variety of different vegetation communities. Small patches of wet heath, dry heath and grassland are common, but more specialised assemblages may occur in the niches provided by the outcropping rock.

The provisional classification recognises two rocky cleft communities. These are characterised by the presence of ferns, saxifrages and cushion mosses that require the sheltered microhabitat provided by clefts, crevice, fissures and overhangs in the rockface. The RS1 community occurs in siliceous rockfaces and the primary species are *Saxifraga spathularis* and fern species (see Appendix VI). *Andreaea* spp. and *Racomitrium* spp. are common bryophytes found on siliceous rock. Whilst *Sedum rosea* is a common component, the presence of this species alone is not sufficient for this community to be recorded. Note also that *Sedum rosea* is a component of TH3 ledge vegetation. The RS1 community is referable to the Annex I habitat Siliceous rocky slopes (8220) and the Fossitt (2000) category ER1 Exposed siliceous rock. The RS2 community occurs in areas of calcareous rock, but also on narrow bands of calcareous rock in siliceous massifs and where there is base-rich seepage on siliceous rockfaces. These clefts tend to be somewhat richer in species than those of RS1. They should contain at least one fern or saxifrage from the list of positive indicators (*Asplenium viride*, *Asplenium trichomanes*, *Ceterach officanarum*, *Phyllitis scolopendrium*, *Polystichum setiferum, Polystichum aculeatum, Polystichum lonchitis*, *Cystopteris fragilis*, *Asplenium ruta-muraria*, *Saxifraga aizoides* or *Saxifraga oppositifolia*); vegetation composed of only other herbs, graminoids or bryophytes (e.g. *Thymus praecox*, *Hieracium* spp., *Koeleria macrantha*, *Carex pulicaris*) is not included. The RS2 community is referable to the Annex I habitat 8210 Calcareous rocky slopes and the Fossitt (2000) category ER2 Exposed calcareous rock.

Arctic-alpine species are not deemed as requisites for these habitats but where they do occur they represent particularly high conservation status examples.

Where sections of corrie wall or crag contain provisional communities RS1 or RS2, then the whole exposed bedrock element in that section should be recorded as "SilcRockA" or "CalcRockA" to indicate that they are a component of the Annex I habitat. Where no evidence of RS1 or RS2 communities is observed then sections of corrie wall or crags should be recorded as "SilcRockN" or "CalcRockN".

The provisional classification describes three tall herb communities of rocky upland ledges. TH1 occurs on siliceous rock and is dominated by *Luzula sylvatica*, often accompanied by some *Calluna vulgaris, Vaccinium myrtillus, Agrostis vinealis, Deschampsia flexuosa, Festuca vivipara* or *Anthoxanthum odoratum*. It is usually found on rock ledges (where it should be recorded as the variant associated ER1 Exposed siliceous bedrock under Fossitt's scheme) but occasionally on large rocks within dry heath (where it should be recorded as the variant associated with HH1 Dry siliceous heath). It is typically species-poor and lacks hydrophilous species. TH2 is a highly specific vegetation type similar to TH3 below, but *Cochlearia officinalis* agg. (perhaps all referable to *Cochlearia pyrenaica*) is at least co-dominant. TH2 has been recorded from Ben Bulben, where it occurs with *Angelica sylvestris*, *Sesleria caerulea*, *Festuca rubra*, *Sedum rosea*, *Orthothecium rufescens* and *Palustriella commutata*. Under Fossitt's scheme this is an element of ER2 Exposed calcareous rock. TH3 occurs on calcareous rock and apparently base-rich seepage areas on siliceous rock faces. The vegetation is species-rich; *Luzula sylvatica* is usually no more than co-dominant and may be absent. At least two of the following species should be prominent: *Sedum rosea, Angelica sylvestris, Geum rivale, Filipendula ulmaria* and *Alchemilla* spp. Some of the following species are usually present: *Hypericum pulchrum, Succisa pratensis, Festuca rubra, Primula vulgaris* and *Viola riviniana*. Both TH2 and TH3 are referable to the upland ledge aspect of the Annex I habitat 6430 Hydrophilous tall herb communities.

When recording limestone pavement both the exposed rock and associated vegetation of the grykes should be recorded under the same code, "LimePave".

3.6 Assessment of structure and functions

3.6.1 Overview of conservation assessment

Conservation assessments for Annex I habitats at a site level consist of three main aspects: area, future prospects, and structure and functions. Assessment of area and changes in area is partly a desk-based exercise and guidance is given in the post-survey stage section (4.2). When in the field, surveyors should however make notes using waypoints of any obvious losses (or potentially, gains) in habitat, such as to afforestation, turf cutting, landslides or new infrastructural developments such as roads or

windfarms. Future prospects relates to the long-term maintenance of the habitat in favourable condition; assessment is also best left to the post-survey stage once the whole site has been surveyed, but notes should be made in the field of observed land-use, impacts, threats and pressures, such as overgrazing, burning, drainage, turf-cutting (by hand or machine) and invasive species. Structure and functions relates to the vegetation composition (including presence or absence of species characteristic of the habitat and presence of negative floral elements), vegetation stucture and physical structure of the habitat and is assessed largely in the field through the collection of specific, detailed data. Hence, guidance on this aspect is presented here.

3.6.2 Assessment of degraded habitats

The JNCC (2009) guidelines advise that where dry heath communities have been replaced by grassland or invaded by bracken, they should still be assessed as dry heath communities. The same advice is proffered for blanket bog communities that have been replaced by dry heath or grassland, and wet heath communities replaced by grassland or rank *Molinia* mire. Importantly however, these assessments are conditional on restoration to the former habitat being deemed feasible and forming a conservation objective for the site.

Conservation plans have not been completed for the majority of upland SACs in Ireland and where they have been devised there has been no formal assessment of the feasiblity of restoration of many of the Annex I habitats. The Commonage Framework Plans (CFPs) are broadscale restoration plans for heaths and bogs degraded through overstocking and do cover much of the uplands, but they are not spatially explicit in terms of Annex I habitats. Comprehensive plans targeting restoration of degraded areas of Annex I habitats are thus required.

The NSUH provides spatial habitat and condition assessment data on which conservation objectives can be based. Until such time as specific restoration targets for areas within upland sites have been established, conservation assessments of Annex I habitats are best made on the basis of the vegetation that is currently present (as recorded by the mapping process) rather than on the basis of a former vegetation type. Degraded bog that has dried out to the point that it now supports only dry heath vegetation should thus be assessed as dry heath. Areas of species-poor upland grassland should not be assessed for the dry heath habitat that they are likely to have once supported. Resources should not be allocated at this stage to the assessment of habitat features whose restoration feasibility has not been determined and for which no specific restoration measures have been planned.

3.6.3 Scale of assessment

Assessments of structure and functions criteria are intended to be conducted through the recording of a series of monitoring stops generally 2 m x 2 m in size. 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, and is also affected by the weather. Blanket bog, for example, will take longer than alpine and boreal heaths, while siliceous scree can be relatively quick. A full relevé and assessment should take about 40-70 minutes. During the NSUH, assessments should always be accompanied by a full relevé. This data informs the vegetation classification task, and allows for subsequent revision of assessment criteria, should this be deemed necessary. Subsequent monitoring visits can decide, if considered sufficient, to record only the information needed for the assessment.

3.6.4 Number of monitoring stops

Larger or more variable areas of habitat will 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 generally required for larger areas. Guidance on the number of monitoring stops required is presented in Table 5. To facilitate the overall assessment of the structure and functions status of a habitat it is convenient for monitoring stops to be recorded in multiples of four, but this is not essential.

For scree and rocky slope habitats (8110 Siliceous scree, 8120 Calcareous scree, 8210 Calcareous rocky slopes and 8220 Siliceous rocky slopes) the number of stops may be influenced by the degree of safe access. Where a variety of impacts are evident at a site or where it is suspected that the condition of the habitat has recently changed, a greater number of monitoring stops may be required. No distinction is made between active (habitat *7130) or inactive bog (habitat 7130) when conducting or planning monitoring stops.

Table 5: Proposed number of monitoring stops for different areas of habitat.

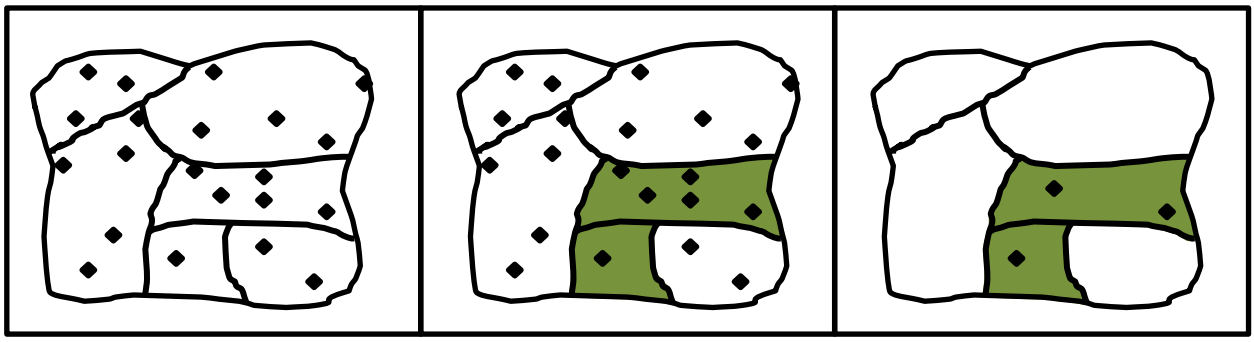
Area of habitat (ha)	Number of monitoring stops
<0.04	1
0.04 - 10	4
10 – 50	8
50 – 100	12
100 – 500	16
500 – 1,000	20
1,000 – 2,000	24
2,000 – 4,000	28
4,000 – 10,000	32
> 10,000	36+

3.6.5 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).

Using GIS, 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 in 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. From the random monitoring points that occur within the sampling area the required number of monitoring stops is randomly selected. The process is demonstrated in Fig. 3.

Figure 3: Simplified example of process for locating monitoring stops across a site divided into polygons.



Set of random points generated for the whole site/section

Sampling area comprises polygons with greater than the threshold area for a habitat

Required number of stops selected randomly from points within the sampling area

For abundant habitats, the surveyor should navigate to the coordinates of each monitoring point in turn using a GPS / mapper. 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 and the stop should be representative of the local extent of the habitat. The GPS location of the actual

monitoring stop must be recorded; stops are not permanent plots but it is important to accurately record the location. 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.

3.6.6 Recording of relevés

At each monitoring stop a comprehensive relevé should be recorded. This should be 2 m x 2 m by default, although it may be necessary to vary the size and shape of the relevé when sampling springs, flushes, rocky clefts or hepatic mats to ensure that a relatively homogeneous sample of one vegetation type is recorded. 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 classification analysis.

Relevé data should be recorded digitally using a database within TurbovegCE (set up by the project IT manager). A proposed structure for the header fields is presented in Appendix III; all fields must be completed, i.e. there should be no blank fields. Where notes on the relevés are being recorded they can be entered in the Remarks section but standardised notes and abbreviations should be used as far as possible.

Aspect should be recorded in numerical degrees. Topography should be recorded as either flat, lower slope, mid-slope, upper slope, near vertical or vertical. Geography should refer to the situation of the relevé in the landscape and should use the features indicated in Fig. 4 or variations of these, for example “valley bottom”, “edge of plateau” or “corrie wall”.

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%.

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.

3.6.7 Soil sampling

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. Around 50 g dry weight is ideal, this is obviously difficult to gauge in the field with wet soils, but larger samples should generally be collected on wetter soils. Soil samples should be later air dried and delivered to NPWS for potential future analysis.

Figure 4: Examples of geographical features: a) Galtee Mountains, Cos. Limerick and Tipperary b) Mangerton Mountain, Co. Kerry and c) Corraun Plateau, Co. Mayo. Darker contours indicate higher altitude.

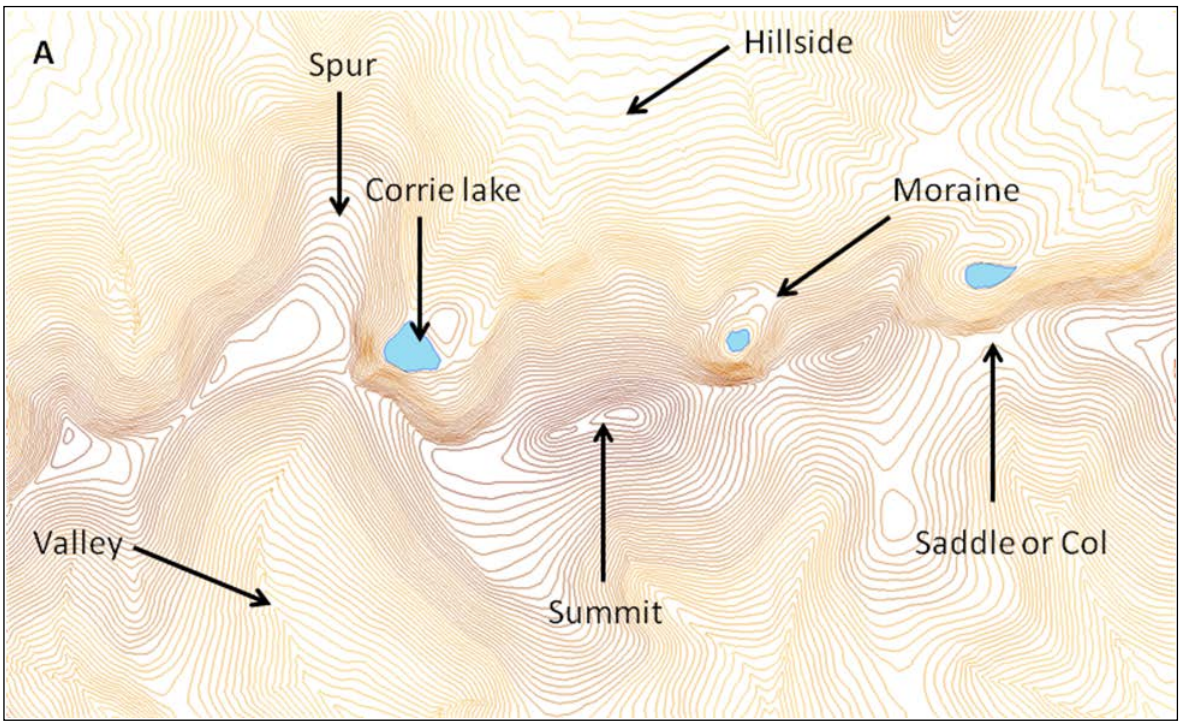
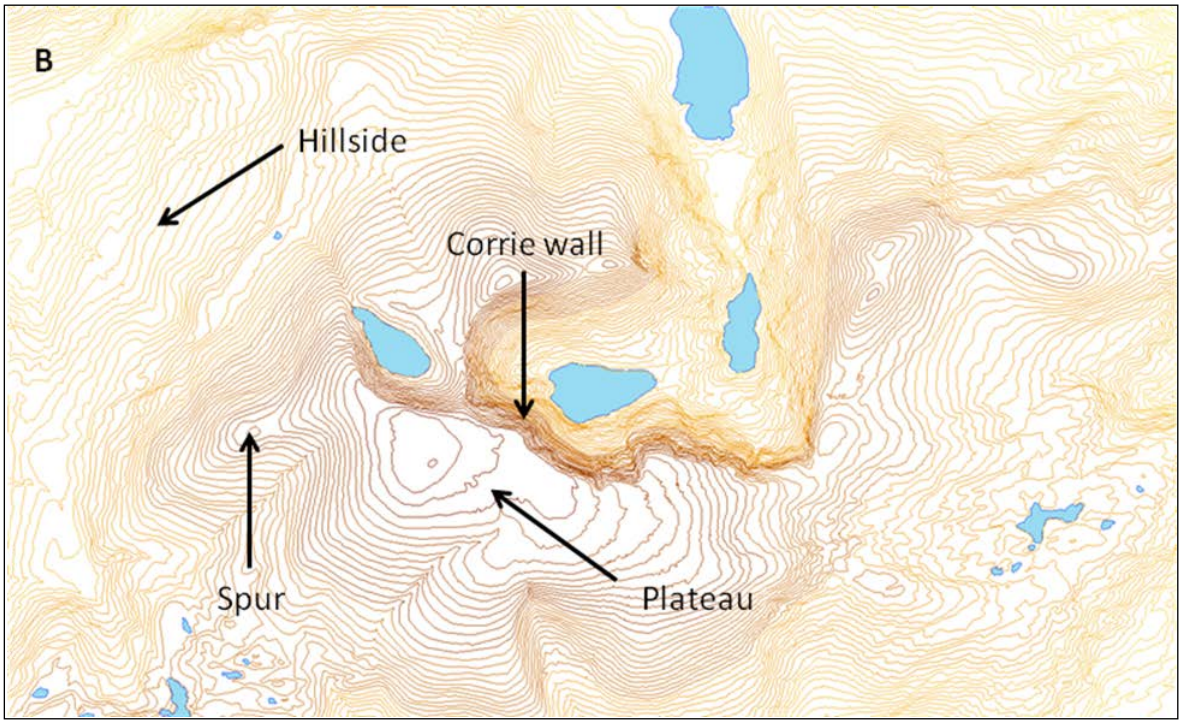
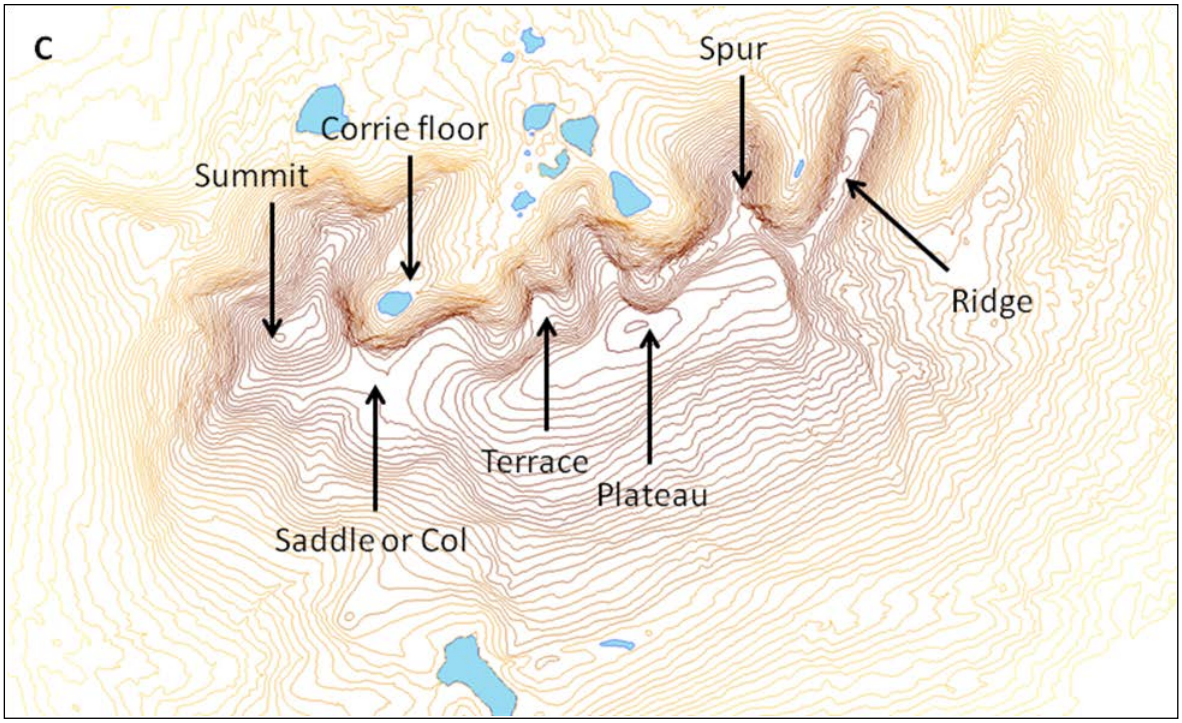


Figure 4: continued





3.6.8 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: [site number]-R[relevé number]-[Photographer's initials]. For example, 009-R004-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 relevé the photograph number should be appended with a, b, c etc., for example, 009-R004a-SB.jpg. Photographs should be sorted and labelled as soon as possible as it can often be difficult to recollect specific relevés at a later date.

3.6.9 Recording of conservation status assessment criteria

There are different sets of criteria for each of the upland Annex I habitats (Appendix V and VI). These are based largely on the guidance of JNCC (2009) with the exception of the criteria for *6230 Species-rich *Nardus* grassland which is adopted from O'Neill *et al.,* (2009). Where necessary, positive indicator species list were modified to reflect differences between Ireland and UK flora. 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 actual value observed should be recorded. This is to enable comparisons to be made between monitoring in different years and also to allow for some amendment of the quantitative thresholds should this be required. Other criteria are qualitative and a simple 'Yes' or 'No' will suffice. Each criterion should be recorded as a Pass or Fail.

3.7 Additional relevés

Further relevés without assessments should be recorded 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. When considering additional relevés, priority should first be given to Annex I habitats that are qualifying interests if the site is a SAC, then to other Annex I habitats and finally to non-Annex habitats, such as dense bracken and poor fen flushes. Recording of data, photography and the collection of soil samples should be conducted in an identical manner to that done for the relevés recorded at full monitoring stops. Note that sampling is *not* required from aquatic or forested habitats, only from terrestrial and wetland habitats.

3.8 Site photographs

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 content and a compass bearing. This will permit site photographs to be subsequently linked to the digital habitat map. Photographs that 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 example, 009-W020a-SB.jpg. 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.

3.9 Data checking and quality assurance

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. This is best achieved by a daily review of collected data.

In addition, 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 misinterpretation 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.

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

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.

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. Surveyors should agree on the authoritative version and transfer these amendments to the set of master-copies held in the field-base.

3.10 Checklists of daily/weekly tasks

In addition to the actual fieldwork, the following tasks must be completed by each surveyor during fieldwork:

3.10.1 Daily tasks

Before fieldwork:

- In collaboration with the other team members, make a list of the polygons or areas that they plan to survey and pass this on to staff not in the field.
- Ensure that they have all of the necessary health and safety and surveying equipment (see section 2.5).

After fieldwork:

- Back up data recorded digitally on mappers / PDAs *every* evening onto a PC (due to the risk of damage or loss of equipment in the field).
- Charge mappers / PDAs, cameras, GPS batteries and mobile phones.
- Either identify or refrigerate voucher specimens of higher plants and set out soil samples for air-drying. Check that all labelling of samples is clear and correct.
- Check for and correct overlaps in relevé or photograph numbering.
- Download photos from cameras and label correctly, delete irrelevant or duplicate photos.

3.10.2 Weekly tasks

- Transfer data from paper recording sheets to digital format.
- Back up all data that is stored on PCs (including relevé data, conservation status assessments, waypoint data, and photos) both on-site and to an off-site location.
- Ensure that all refrigerated voucher specimens of higher plants have been identified.

4. Post-survey stage

4.1 Verification and amalgamation of datasets

Once fieldwork is completed, each fieldworker is responsible for verifying that they have entered all required data into the different databases and spreadsheets in the correct format. Labelling of all photographs should be checked and any remaining lichen or bryophyte voucher specimens forwarded to the Project Co-ordinator for despatch to a taxonomic referee. Once all datasets have been verified as complete, the data collected for each site can be amalgamated. TurbovegCE datasets should be imported into a PC Turboveg database. Checks for errors and missing data should be conducted at this stage, as it will be apparent if there have been any differences in recording between surveyors. Non-standard abbreviations in survey notes should be removed as they are likely to be ambiguous or unintelligible to other workers.

4.2 Conservation status assessment

4.2.1 Overview

As stated previously in section 3.6, conservation status assessments for Annex I habitats consist of three main aspects: area, future prospects, and structure and functions. Data for the assessment of structure and functions is gathered through the recording of the data from monitoring stops as detailed in the field survey section. Here, guidance is given on the assessment of area and future prospects and post-survey assessment of structure and functions. Once each of these aspects has been considered, an overall assessment of the conservation status of an Annex I habitat at a particular site can be made using the criteria in Table 6.

4.2.2 Area

The main difficulty with regard to assessing habitat area is that, as already stated, many of Ireland's upland habitats do not occur as discrete blocks but rather as complex mosaics of often closely related vegetation types across an intricately profiled landscape. A substantial part of a mosaic may consist of vegetation that 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.

As the NSUH is essentially conducting a baseline habitat mapping survey there are further difficulties in assessing this aspect as there are no comparable data to work with. Where possible the conservation assessments should be based on any change in area since the EU Habitats Directive came into force in

1994 and may require comparative assessment of a time series of aerial imagery and other available data. Subsequent monitoring will assess whether there have been any changes since the previous assessment.

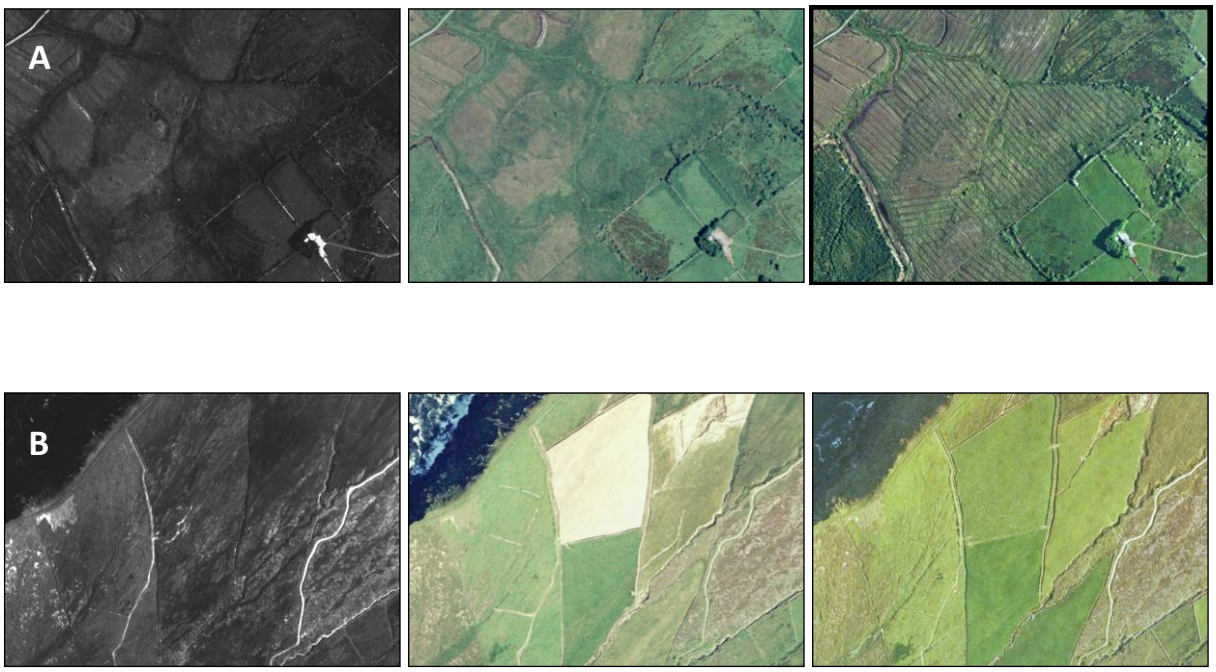
Table 6: General evaluation table for determining conservation status (modified from table in Appendix 1; Annex E, of Dochab 04-03/03-rev.3).

Parameter	**Conservation status**			
	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*
Structure 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; viability over next twelve years assured.	Any other combination	The habitat's prospects are bad, severe impact from threats expected; viability over next twelve years not assured	*No or insufficient reliable information available*
Overall assessment of conservation status	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'

Despite these issues, gross changes in habitat extent will largely be evident during the field survey. Local NPWS staff may also be aware of major changes in the extent of a habitat at a particular site. Such changes would include mechanised turf-cutting of previously intact bogs, agricultural improvement, 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; national sets of aerial photographs are available in digital format for *c.*1995 (in black and white) and *c.*2000 and *c.*2005 (in colour). These changes can then be quantified by digitising the relevant areas. For changes since 2005, use can also be made of high quality satellite imagery available online. The critical threshold established by the EU is a change of 1% (see Table 6). Examples of loss of habitat are shown in Fig. 5.

Figure 5: Examples of loss of habitat area: a) loss of 4010 Wet heath and *7130 Active blanket bog due to afforestation between 2000 and 2005, and b) loss of 4010 Wet heath due to agricultural intensification between 1995 and 2000. The 1995, 2000 and 2005 aerial photographs are displayed from left to right (Ordnance Survey Ireland Licence No. EN 0059208 © Ordnance Survey Ireland).



There may be instances where one habitat has been converted to another through changes in land use. One theoretical scenario in the uplands is where an area of *6230 Species-rich *Nardus* grassland has been replaced by 4030 European dry heaths due to significant reductions in grazing pressure. This would be likely to be deemed an undesirable change as habitat *6230 is a priority Annex I habitat. However, if the replacement habitat was considered to be the preferred habitat according to formally devised conservation objectives for the site, then the loss of an area of the previous habitat may 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 waypoints. 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 heath or hepatic mat vegetation. As always, photographs should be taken from grid-referenced locations.

4.2.3 Structure and functions

A review of all monitoring stops should be conducted after the field survey when an overview of the condition of each Annex I habitat at a site is available. Monitoring stops with no failed criteria automatically pass at the stop level. When monitoring stops have failed one or more criteria, expert judgement of the ecological condition of those stops may be employed to reassess whether any of those stops might legitimately be permitted to pass, for example if there has been a marginal failure of a single criterion. All other stops are deemed to have failed.

Using the results of the monitoring stops, an overall assessment of structure and functions for a habitat can be given following the guidelines in Table 7. An exception to this is where less than four monitoring stops have been recorded. In this instance, expert judgement should be employed as the guidance in Table 7 is less appropriate for small sample sizes. The performance of the habitat at the recorded stops, a general assessment of the habitat across the site, and the reason why a small number of stops were recorded should be taken into account.

Structure and functions for *7130/7130 Blanket bog has an overriding assessment based on the proportion of degraded bog within a site, in case this major issue had not been adequately picked up by the monitoring stops. If more than 1% of the combined area of active bog (Annex I habitat *7130), inactive bog (Annex I habitat 7130), eroded bog (Fossitt habitat PB5) and cutover bog (Fossitt habitat PB4) is inactive, eroded or cutover then it should be assessed as Unfavourable – Inadequate regardless of the number of stop failures, and if more than 5% of the combined area is inactive, eroded or cutover it should be assessed as Unfavourable – Bad.

Table 7: Determining habitat level results for structure and functions.

Conservation status	Favourable (green)	Unfavourable Inadequate (amber)	Unfavourable Bad (red)
Criteria	No stop failures	1-25% of stops failed	> 25% of stops failed

4.2.4 Future prospects

The future prospects assessment refers to the overall outlook for both the area covered by the habitat on the relevant site and for its specific structures and functions in the next twelve years (i.e. two Article 17 reporting cycles). The future prospects assessment 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 observed for the habitat.

Land-use, impacts and threats would mainly be recorded for a site on the basis of observations during field survey, but these would need to be augmented by information from other sources such as NPWS staff, the local community and the Local Authority, including the relevant county development plan. Future sources of potential impacts such as windfarms or other infrastructure, polluting activity or quarries, should only be considered if some actual progress has been made in development plans rather than speculation that they might be developed. For example, zoning of the site in the county development plan as being suitable for windfarm development, or where planning permission for a development has been sought or is likely to be secured should be considered as future sources of potential impact. Consideration of any recorded or predicted impacts of climate change should also be considered amongst the various potential threats and related to the different habitat vulnerabilities.

Equal vulnerabilities of different habitats to different factors should not be assumed. For instance, *Sphagnum*-rich habitats will 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, 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.

Data from the Commonage Framework Plan project (CFP) initiated by NPWS and the Department of Agriculture, Food and Forestry in 1998 can be used to broadly inform the trends aspect of future prospects. See the CFP manual (Anon., 1998) for details of that project's methodology. Where areas of commonage have been surveyed twice by the CFP, comparison of sub-unit damage levels, station damage levels and key indicator variables can be made between the surveys. More tentative comparisons of key indicator variables from the CFP with NSUH data can also be made. Trends identified will apply to 4010 Wet heath, 4030 Dry heath and *7130/7130 Blanket bog, although trends for individual habitats cannot be reliably identified. For a full review of the manner in which the CFP data can been used to inform the NSUH see Perrin (2012).

Land-use, impacts and threats should be recorded using the relevant impact code from the list provided in Appendix VII (Ssymanck, 2011). Following Ssymank (2009), for each of the impacts recorded at a site, the following variables should be recorded and scored where required (scores in parentheses):

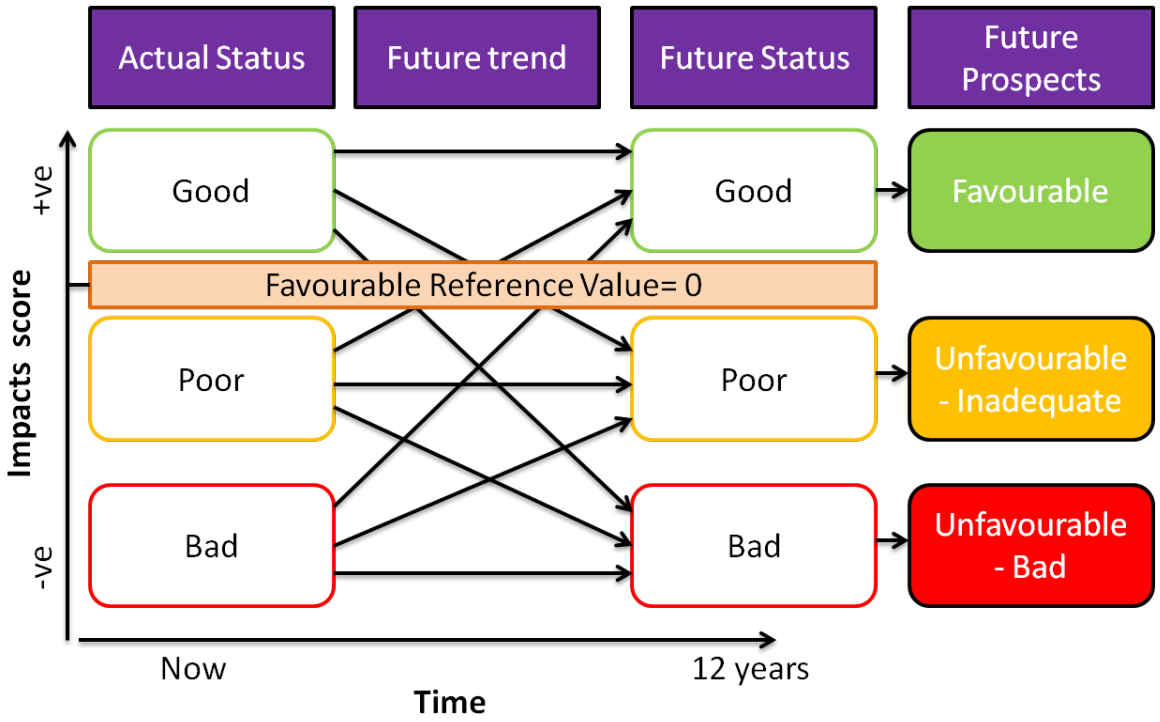
- nature of the impact: positive (+1), neutral (0), or negative (-1)
- intensity of the impact: high (1.5), medium (1), or low (0.5)
- percentage of habitat area impacted:

<1% (0.5)	51-75% (2)
1-25% (1)	76-99% (2.5)
26-50% (1.5)	100% (3)

- source of the impact: inside or outside the survey site (not scored)
- trend in the effect of the impact on the habitat (relative to previous assessments or based on other available data): improving, disimproving, none, or insufficient data (not scored)

Impacts related to habitat loss will typically be assessed as being of high intensity. For each impact the scores should be multiplied together, then for each habitat the results should be summed to gain an overall impacts score for the habitat. This impacts score represents the current actual status of the habitat, where a score of zero is equal to the Favourable Reference Value. Hence, scores above or equal to zero are good, scores below zero are poor and scores significantly below zero are bad. A decision should then be made on the future trend for the habitat. This is a combined future trend for area and structure and functions based on the trends for individual impacts, and may be improving, disimproving or no change. From the actual status and the future trend the status of the habitat (good, poor or bad) in twelve years time can be predicted. This is the future status and is directly related to future prospects. This procedure is shown in Fig. 6 and follows the guidance of Evans & Arvela (2011).

Figure 6: Determining future prospects.



4.2.5 Database

Data pertaining to conservation assessments should be entered into a *NSUH Conservation Assessment Database* in Microsoft Access format. This database should comprise five main tables with fields as detailed in Appendix VIII. All fields must be completed.

4.3 Outputs

The preliminary polygons digitised during the pre-survey stage should be amended or re-digitised to reflect the boundary changes noted in the field and populated with the polygon cover attribute data. These will then form the basis for displaying habitat information.

For each surveyed site, a transportable GIS project should then be produced comprising:

- a fully populated habitat polygon map with fields for the most abundant Fossitt (2000) and Annex I habitat type in each polygon
- a point shapefile detailing waypoints with hyperlinked photographs
- a point shapefile detailing monitoring stops (with assessment results) and additional relevés with hyperlinked photographs
- a point shapefile of existing and new records for rare and notable flora.

For each site a report should be written under direction of the project co-ordinator containing the following elements:

- an executive summary
- a description of habitats within the site
- tabulated data on the extent of Annex I and Fossitt (2000) habitats and of the provisional vegetation communities
- a compilation of rare and threatened flora records for the site
- a detailed account of the conservation assessments for the primary focus Annex I habitats
- a review of the Natura 2000 Standard Data Form (for SACs)
- a list of general recommendations
- a list of all species recorded on the site by the NSUH survey
- a map showing the boundaries of the survey area over Ordnance Survey orthorectified aerial photographs
- a map of the most abundant Annex I habitat type in each polygon
- a map of the most abundant Fossitt (2000) habitat types in each polygon
- gradated maps showing the frequency within polygons of primary focus Annex I habitats
- a map showing location and assessment of monitoring stops and location of additional relevés
- a map showing existing and new records for rare and notable flora (records considered to be sensitive should only be displayed at the 10 km scale)
- maps of baseline CFP data (and where available resurvey data) indicating agricultural subunit and station damage classes

- maps for future use in the field surveys showing the re-digitised polygons overlain on Ordnance Survey orthorectified aerial photographs, with amended polygon numbers, contours and designated site boundaries on A3 sheets at a scale of 1:10,000.

Maps should be prepared at a scale suitable for the clear display of the recorded information. For large sites printing on A0 or A1 sheets may be required. Site reports should all follow the same structure; the report for the Mweelrea, Sheeffry, Erriff Complex cSAC (Perrin *et al.,* 2011) can be used as a template. For each year/phase of the survey, a Turboveg database containing all the recorded relevés and a version of the *NSUH Conservation Assessment Database* (See Appendix VIII) 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.

4.4 Analysis of relevé data

It is important to periodically analyse the collected relevé data from the NSUH together with existing relevés from additional sources. This should be conducted by someone who is experienced in multivariate analysis techniques and Irish upland habitats and vegetation. The results should be used to inform decisions as to whether it is necessary to amend or refine the provisional vegetation classification. The latest revision is Perrin & Hodd (2013) which presents methods adopted for data preparation and analysis.

4.5 Applications of the survey data

Data from the NSUH surveys will feed directly into the national reporting procedure for Annex I habitats under Article 17 of the Habitats Directive. At a site level, the survey data should be utilised in the creation or updating of conservation objectives and management plans for SACs; these should meet the minimum requirements recommended by Evans & Arvela (2011). To facilitate implementation of conservation management plans within surveyed sites, it is recommended that site reports should be made available on the NPWS website and to regional NPWS offices to facilitate access by the public. Relevé data collected by the NSUH will be of significant value in the development of a national vegetation classification for Ireland.

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Appendix I: Provisional classification and key for upland habitats

List of communities

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt
Lakes and pools	*Menyanthes trifoliata - Carex limosa* pool community			
	infilling pool sub-community	PO1a	7140	PF3
	aquatic sub-community	PO1b	3160	FL1
	Littorella uniflora – Lobelia dortmanna lake community			
	upland variant	PO2i	3130	FL2
	lowland variant	PO2ii	3110	FL2
Soakways	*Potamogeton polygonifolius* soakway	SW1	-	PF2
Springs	*Philonotis fontana - Saxifraga stellaris* spring			
	typical sub-community	SPG1a	-	FP2
	species-poor *Sphagnum denticulatum* sub-community	SPG1b	-	FP2
	Palustriella commutata spring			
	Annex I variant	SPG2i	7220	FP1
	non-Annex I variant	SPG2ii	-	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
	Carex rostrata – Sphagnum spp. flush	PFLU5	7140	PF3
Calcareous or mineral-rich flushes and fens	*Carex viridula oedocarpa - Pinguicula vulgaris - Juncus bulbosus* flush			
	brown moss 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
	Schoenus nigricans – Scorpidium scorpioides flush	RFLU4	7230	PF1
	Carex rostrata fen			
	brown moss sub-community	RFEN1a	7230	PF1
	species-poor sub-community	RFEN1b	7140	PF3
Upland grasslands	*Agrostis capillaris - Festuca ovina* upland grassland			
	typical sub-community	UG1a	-	GS3
	Sphagnum spp. sub-community	UG1b	-	GS3
	species-rich calcareous sub-community	UG1c	*6230	GS3
	Juncus squarrosus sub-community	UG1d	-	GS3
	species-rich non-calcareous sub-community	UG1e	*6230	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
	species-rich non-calcareous sub-community	UG2e	*6230	GS3
	Silene acaulis alpine grassland	UG3	6170	GS1
	Molinia caerulea – Anthoxanthum odoratum wet grassland	UG4	-	GS4

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt
	Festuca ovina – Agrostis capillaris - Thymus praecox calcareous grassland			
	herb-rich sub-community	UG5a	6210	GS1
	herb-poor sub-community	UG5b	-	GS1
	Sesleria caerulea – Carex flacca calcareous grassland	UG6	-	GS1
Bracken	*Pteridium aquilinum* community	BK1	-	HD1
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 – Antennaria dioica dry heath	DH5	4030	HH2
	Calluna vulgaris -Vaccinium myrtillus dry heath	DH6	4030	HH1
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
	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	HH3
	Schoenus nigricans – Molinia caerulea – Myrica gale wet heath	WH6	4010	HH3
	Molinia caerulea – Ulex gallii wet heath	WH7	4010	HH3
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
	Festuca vivipara – Thymus polytrichus – Galium saxatile montane vegetation	MH8	-	HH4

Habitats	Provisional communities and sub-communities	Code	Annex I	Fossitt
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
	Eriophorum angustifolium – Sphagnum austinii bog	BB7	*7130	PB3
Hollows	*Sphagnum denticulatum/cuspidatum* hollow			
	upland variant	HW1i	*7130	PB2
	lowland variant	HW1ii	*7130	PB3
	flush variant	HW1iii	-	PF2
	Eriophorum angustifolium - Sphagnum fallax hollow			
	upland variant	HW2i	7130	PB2
	lowland variant	HW2ii	7130	PB3
	Rhynchospora alba hollow	HW3	7150	PB3
	Eleocharis multicaulis hollow			
	bog variant	HW4i	-	PB3
	flush variant	HW4ii	-	PF2
Degraded peat	*Campylopus introflexus - Polytrichum* spp. degraded peat community	DP1	-	ED3
	Nardus stricta – Eriophorum angustifolium degraded peat community	DP2	-	PB5
Tall herbs	*Luzula sylvatica - Vaccinium myrtillus* tall herb vegetation		-	
	rock face variant	TH1i	-	ER1
	dry heath variant	TH1ii	-	HH1
	Cochlearia pyrenaica tall herb vegetation	TH2	6430	ER2
	Sedum rosea - Angelica sylvestris tall herb vegetation	TH3	6430	ER2
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
Hepatic mats	*Calluna vulgaris - Scapania gracilis* hepatic mat			
	non-Annex I grassland variant	HM1i	-	GS3
	Annex I grassland variant	HM1ii	6230	GS3
	dry heath variant	HM1iii	4030	HH1
	wet heath variant	HM1iv	4010	HH3
	montane heath variant	HM1v	4060	HH4
	non-Annex I siliceous rock face variant	HM1vi	-	ER1
	Annex I siliceous rock face variant	HM1vii	8220	ER1
	siliceous scree variant	HM1viii	8110	ER3
	upland blanket bog varients	HM1ix	*7130	PB2
	lowland blanket bog varient	HM1x	*7130	PB3

Non-vegetation cover types		Code	Annex I	Fossitt
Loose rock	- siliceous	SilcLoose	-	ER3
	- calcareous	CalcLoose	-	ER4
Scree	- siliceous	SilcScree	8110	ER3
	- calcareous	CalcScree	8120	ER4
Bedrock	- siliceous non -Annex	SilcRockN	-	ER1
	- calcareous non-Annex	CalcRockN	-	ER2
	- siliceous Annex	SilcRockA	8220	ER1
	- calcareous Annex	CalcRockA	8210	ER2
	- limestone pavement	LimePave	*8240	ER2
Bare peat	- eroding bog	BarePeatB	-	PB5
	- other	BarePeatO	-	ED2
Open water	- dystrophic lakes and pools non –Annex	OpenDN	-	FL1
	- dystrophic lakes and pools Annex	OpenDA	3160	FL1
	- lowland oligotrophic lakes and pools non-Annex	OpenLN	-	FL2
	- lowland oligotrophic lakes and pools Annex	OpenLA	3110	FL2
	- upland oligotrophic lakes and pools non-Annex	OpenUN	-	FL2
	- upland oligotrophic lakes and pools Annex	OpenUA	3130	FL2
Running water	- upland non-Annex	RunUN	-	FW1
	- upland Annex	RunUA	3260	FW1
	- lowland non-Annex	RunLN	-	FW2
	- lowland Annex	RunLA	3260	FW2
Gravel		Gravel	-	ED1
Sand		Sand	-	ED1
Till		Till	-	ED1
Road		Road	-	BL3
Made ground		Made	-	BL3
Stone wall		Stonewall	-	BL1
Bare soil		Baresoil	-	ED2

Sub-communities represent floristically different communities, variants represent the occurrence of essentially the same community in different contexts.

Key to vegetation communities

1a	Vegetation associated with pools, lakes, streams, soakways, springs, flushes and fens	**2**
1b	Vegetation of bogs, heaths, grassland and montane areas	**21**
1c	Vegetation associated with rocky clefts, scree, boulder tops or vegetated rock ledges	**59**
1d	Vegetation patches of sheltered areas in the west dominated by liverworts	**65**
2a	Vegetation associated with pools and lakes, including fens	**3**
2b	Vegetation associated with streams, soakways, springs and flushes	**7**
3a	Fen vegetation dominated by *Carex rostrata*	**13**
3b	Vegetation not dominated by *Carex rostrata*	**4**
4a	Pool margin community characterized by high *Sphagnum* cover	**5**
4b	Aquatic community not characterized by high *Sphagnum* cover	**6**
5a	Infilling pools with high *Sphagnum* cover, also *Menyanthes trifoliata* and significant cover of *Carex* spp., including *Carex limosa* and *Carex lasiocarpa*	**PO1a**
5b	Dystrophic pool margins dominated by *Sphagnum denticulatum* and/or *Sphagnum cuspidatum*, but with no appreciable cover of *Carex* spp.	**HW1**
6a	Submerged or emergent community of oligotrophic lakes characterised by *Littorella uniflora*, *Lobelia dortmanna* or *Eriocaulon aquaticum* (two variants)	**PO2**
6b	Floating or emergent community of dystrophic pools with *Menyanthes trifoliata* and *Carex limosa*	**PO1b**
7a	Vegetation of springheads (typically a point feature but may occur along streamsides)	**8**
7b	Vegetation of streams, soakways and flushes (linear features with movement of water)	**11**
8a	Springs occurring in areas of calcareous bedrock characterized by the occurrence of *Palustriella commutata*; associates may include *Carex nigra*, *Festuca rubra*, *Bryum pseudotriquetrum* or *Carex viridula* ssp. *oedocarpa*	**9**
8b	Springs occuring in areas of non-calcareous bedrock	**10**
9a	*Palustriella commutata* springs with tufa formation (crusty percipitate of calcium carbonate)	**SPG2i**
9b	*Palustriella commutata* springs with no tufa formation	**SPG2ii**
10a	Springheads dominated by a mixture of *Philonotis fontana*, *Saxifraga stellaris*, *Chrysosplenium oppositifolium, Dicranella palustris* and *Montia fontana*	**SPG1a**
10b	Springheads dominated by *Sphagnum denticulatum* and/or *Sphagnum inundatum,* with lesser cover from species listed under 10a	**SPG1b**
10c	Springheads or seepage areas characterised by a dark, sprawling cushion of *Anthelia julacea* often accompanied by conspicuous amounts of mucilaginous algae and sometimes with big cushions of *Scapania undulata*	**SPG3**
11a	Floating vegetation of rivers and streams; should comprise: *Fontinalis antipyretica, Ranunculus* spp. (water-crowfoots), *Callitriche* spp., *Myriophyllum* spp., *Zannichellia palustris*	**RunUA/ RunLA**
11b	Shallow soakways (tracts of moving surface water through bog or heath) characterized by *Potamogeton polygonifolius*; *Hypericum elodes* is often a conspicuous associate	**SW1**
11c	Vegetation of flushes, typically dominated by *Juncus* spp., *Sphagnum* spp. or sedges	**12**

12a	Flush vegetation dominated by *Carex rostrata*	**13**
12b	Vegetation not dominated by *Carex rostrata*	**14**

13a	Vegetation dominated by *Carex rostrata* with a high cover of *Sphagnum* beneath	**PFLU5**
13b	Vegetation dominated by *Carex rostrata* with brown moss species present	**RFEN1a**
13c	Vegetation dominated by *Carex rostrata* with neither high *Sphagnum* cover nor brown moss species present	**RFEN1b**

14a	Poor flush vegetation characterized by high cover of *Sphagnum* spp. or *Polytrichum commune* and/or the dominance of *Juncus* spp.	**15**
14b	Rich flush vegetation characterized by the occurrence of small sedges (e.g. *Carex viridula, Carex panicea, Eleocharis quinqueflora*) and/or brown moss species	**18**

15a	Poor flush vegetation characterized by presence of *Eleocharis multicaulis*	**HW4ii**
15b	Poor flush vegetation composed almost solely of *Sphagnum* spp. particularly *Sphagnum denticulatum* and / or *Sphagnum cuspidatum*	**HW1iii**
15c	Poor flush vegetation dominated by *Juncus effusus* and/or *Juncus acutiflorus*	**16**
15d	Poor flush vegetation dominated by *Molinia caerulea* or with *Carex nigra* and/or *Carex echinata* conspicuous	**17**

16a	*Juncus*-dominated peat-forming poor flush with the bryophyte layer dominated by *Sphagnum* (typically *Sphagnum palustre, Sphagnum denticulatum* or *Sphagnum fallax*) or *Polytrichum commune*	**PFLU2**
16b	*Juncus*-dominated poor flush with the bryophyte later dominated by pleurocarps such as *Calliergonella cuspidata, Hylocomium brevirostre, Brachythecium* spp., *Eurhynchium* spp., or *Rhytidiadelphus squarrosus*	**PFLU3**

17a	Poor flush vegetation dominated by *Molinia caerulea* with a bryophyte layer dominated by *Sphagnum* spp. (typically *Sphagnum palustre, Sphagnum denticulatum* or *Sphagnum fallax*); *Erica erigena* present	**PFLU4b**
17b	Poor flush vegetation dominated by *Molinia caerulea* with a bryophyte layer dominated by *Sphagnum* spp. (typically *Sphagnum palustre, Sphagnum denticulatum* or *Sphagnum fallax*); *Erica erigena* absent	**PFLU4a**
17c	Poor flush vegetation characterized by presence of *Carex nigra* and/or *Carex echinata*; can be somewhat boggy in nature with *Eriophorum angustifolium* plentiful	**PFLU1**

18a	Rich flush vegetation in which *Carex viridula* ssp. *oedocarpa* and/or *Carex panicea* are conspicuous and *Eleocharis quinqueflora* is absent; brown mosses may or may not be present	**19**
18b	Rich flush vegetation characterized by *Schoenus nigricans* or *Eleocharis quinqueflora*; brown moss species should be present	**20**

19a	Rich flush vegetation typically on sloping ground with *Carex viridula* ssp. *oedocarpa*, *Carex panicea, Pinguicula vulgaris* and *Juncus bulbosus*, occasionally with *Carex dioica, Carex hostiana, Pinguicula* spp., *Blindia acuta, Selaginella selaginoides*; brown moss species present	**RFLU1a**
19b	Rich flush vegetation typically on sloping ground with species as in 19a but brown moss species absent	**RFLU1b**
19c	Sparse species-poor vegetation of flushed flat ground at high altitude dominated by *Carex viridula* ssp. *oedocarpa* or *Carex panicea*	**RFLU3**

20a	Rich flush vegetation with conspicuous amounts of *Eleocharis quinqueflora* accompanied by at least some brown mosses; check identification of *Eleocharis* carefully, cf. HW4	**RFLU2**
20b	Rich flush vegetation dominated by *Schoenus nigricans* accompanied by at least some brown mosses; may occur amongst WH1 wet heath	**RFLU4**

21a	Vegetation of relatively intact blanket bogs typically occuring on flat or gently sloping ground on deep peats (≥50 cm)	**22**
21b	Vegetation of degraded or eroding blanket bogs on deep peat or where there is evidence of previous deep peats	**29**
21b	Vegetation of habitats other than blanket bogs either on markedly sloping ground or on shallower soils (<50 cm)	**31**

22a	Bog surface vegetation characterized by the abundance of *Eriophorum* spp. and *Sphagnum* spp.; may be accompanied by *Trichophorum germanicum*, *Molinia caerulea*, *Schoenus nigricans* or *Calluna vulgaris*	**23**
22b	Bog hollow vegetation characterized by abundance of either *Sphagnum* spp., *Eriophorum angustifolium*, *Eleocharis multicaulis* or *Rhynchospora* spp. (also includes *Rhynchospora*-rich bog surface vegetation)	**30**

23a	Typically lowland blanket bog vegetation, in which *Schoenus nigricans* is often conspicuous, but sometimes absent	**24**
23b	Blanket bog vegetation, typically of medium altitudes, in which *Schoenus nigricans* is absent or very rare	**25**
23c	Blanket bog vegetation in which *Schoenus nigricans* is absent or very rare; typically high altitudes and montane areas	**26**

24a	Blanket bog vegetation with *Schoenus nigricans* and *Eriophorum angustifolium* conspicuous and cover of *Sphagnum* spp. poor (<15 %); continuous cover of vegetation	**BB1a**
24b	Blanket bog vegetation with *Schoenus nigricans* and *Eriophorum angustifolium* conspicuous and cover of *Sphagnum* spp. poor (<15 %); gaps and bare ground between *Schoenus* tussocks	**BB1b**
24c	Blanket bog vegetation with *Schoenus nigricans* conspicuous and *Sphagnum* spp. at least frequent (≥15%)	**BB2**
24d	Wet blanket bog vegetation with *Schoenus nigricans* absent and *Calluna vulgaris*, *Eriophorum vaginatum* and *Trichophorum germanicum* never abundant; hummock-forming Sphagna usually form a conspicuous component of the vegetation	**BB7**

25a	*Sphagnum*-rich blanket bog vegetation with *Sphagnum papillosum* conspicuous and tussocks of *Eriophorum vaginatum* abundant; *Narthecium ossifragum* and *Drosera rotundifolia* are usually present	**BB3**
25b	Blanket bog vegetation characterized by abundance of *Trichophorum germanicum* and typically low cover of *Sphagnum*; *Eriophorum* spp. may be present but *Eriophorum vaginatum* should not be abundant	**BB4**

26a	High-altitude blanket bog vegetation composed of mixture of *Calluna vulgaris* and *Eriophorum vaginatum* tussocks (occasionally *Eriophorum angustifolium*)	**27**
26b	Montane bog with *Eriophorum* spp., *Juncus squarrosus, Sphagnum capillifolium* and *Calluna vulgaris* prominent and accompanied by *Racomitrium lanuginosum* and *Empetrum nigrum; Cladonia arbuscula* may occur on exposed ground	**28**

27a	High-altitude blanket bog with *Juncus squarrosus* absent or rare	**BB5a**
27b	High-altitude blanket bog with *Juncus squarrosus* at least frequent	**BB5b**

28a	Montane blanket bog with arctic-alpine species present (*Carex bigelowii, Salix herbacea, Diphasiastrum alpinum, Persicaria vivipara, Cetraria islandica*)	**BB6b**
28b	Montane blanket bog with arctic-alpine species lacking	**BB6a**
	Areas of degraded bog can support a range of other vegetation communities including dry heath, wet heath, rushy flushes and grassland. Communities should be recorded on the basis of present vegetation rather than on the previousbog habitat.	

29a	Degraded peat characterised by the abundance of *Campylopus introflexus*	**DP1**

29b	Eroding peat characterised by a sparsely vegetated community of *Nardus stricta* tufts and *Eriophorum angustifolium*; this typically occurs on crumbling peat and around the edges of haggs, it should not form a continuous sward of vegetation	**DP2**
29c	Eroded but stabilised peats characterised by a sward of *Eriophorum angustifolium* which may be dense or sparse but is often monospecific; either no *Sphagnum* spp. present or only *Sphagnum fallax* present (two variants)	**HW2**

30a	Bog hollows dominated by *Sphagnum denticulatum* and/or *Sphagnum cuspidatum* (two variants)	**HW1**
30b	Bog hollows dominated by *Eriophorum angustifolium* and *Sphagnum fallax* (two variants)	**HW2**
30c	Bog hollows or bog surface vegetation characterised by *Rhynchospora* spp. with *Sphagnum* spp., *Drosera* spp. usually present	**HW3**
30d	Bog hollows dominated by *Eleocharis multicaulis*	**HW4i**

31a	Vegetation dominated by *Pteridium aquilinum* (≥50% cover) although grass species may be abundant beneath the bracken	**BK1**
31b	Vegetation not dominated by *Pteridium aquilinum*	**32**

32a	Heath vegetation of montane areas with low-growing or windclipped dwarf shrubs and/or significant cover of *Racomitrium lanuginosum* (dwarf shrub cover ≥10%)	**33**
32b	Heath vegetation with neither low-growing or windclipped dwarf shrubs nor significant cover of *Racomitrium lanuginosum* (dwarf shrub cover ≥25%)	**37**
32c	Vegetation with neither low-growing or windclipped dwarf shrubs nor significant cover of *Racomitrium lanuginosum* (dwarf shrub cover <25%)	**40**

33a	Montane heath vegetation with *Calluna vulgaris* abundant	**34**
33b	Montane heath vegetation with *Vaccinium myrtillus* and/or *Empetrum nigrum* abundant	**36**

34a	*Juniperus communis* subsp. *nana* and/or *Arctostaphylos uva-ursi* conspicuous (≥5% cover)	**MH4**
34b	*Juniperus communis* subsp. *nana* and/or *Arctostaphylos uva-ursi* rare or absent (<5% cover)	**35**

35a	Montane heath vegetation characterized by *Calluna vulgaris* and *Racomitrium lanuginosum*; *Juncus squarrosus* absent or rare	**MH1a**
35b	Montane heath vegetation characterized by *Calluna vulgaris* and *Racomitrium lanuginosum*; *Juncus squarrosus* at least frequent	**MH1b**

36a	Montane heath of rocky areas 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**
36b	Montane dwarf shrub heath dominated by combination of *Vaccinium myrtillus* with Nardo-Galion species other than *Nardus stricta*, especially *Deschampsia flexuosa*, but also usually some of *Festuca vivipara*, *Anthoxanthum odoratum*, *Agrostis vinealis* and *Agrostis capillaris*; *Racomitrium lanuginosum* often prominent	**MH3**

37a	Dry heath vegetation characterized by *Calluna vulgaris*, *Erica cinerea*, *Erica erigena*, *Vaccinium myrtillus* or *Ulex gallii*; *Schoenus nigricans*, *Molinia caerulea* and *Trichophorum germanicum* rare or absent	**38**
37b	Wet heath vegetation characterized by *Schoenus nigricans*, *Molinia caerulea* or *Trichophorum germanicum*; dwarf shrub species typically *Erica tetralix*, *Calluna vulgaris* or *Myrica gale*, rarely *Ulex gallii*	**41**

38a	Dry heath on limestone or base-rich soils; vegetation a mixture of heathland and calcareous grassland species, e.g. *Hypericum pulchrum*, *Thymus polytrichus*, *Succisa pratensis*, *Lathyrus linifolius*, *Linum catharticum* and *Lotus corniculatus*	**DH5**
38b	Dry heath on siliceous soils; species of calcareous grassland rare or absent	**39**

39a	Dry heath vegetation with *Ulex gallii* accompanied by *Erica cinerea* and/or *Calluna vulgaris*; typically occurs in coastal regions	**DH1**
39b	Dry heath vegetation with *Erica erigena* accompanied by *Calluna vulgaris* and sometimes *Molinia caerulea*	**DH2**
39c	Dry heath vegetation with *Calluna vulgaris* and conspicuous cushions of *Sphagnum capillifolium*	**DH4**
39d	Dry heath vegetation with significant *Vaccinium myrtillus* cover (≥25%) usually co-dominant or subordinate to *Calluna vulgaris*; typically occurs on rocky ground	**DH6**
39e	Dry heath vegetation dominated by *Calluna vulgaris* and/or *Erica cinerea* and lacking all the above characteristics	**DH3**

40a	Vegetation dominated by at least one of following species: *Calluna vulgaris*, *Erica tetralix*, *Schoenus nigricans*, *Molinia caerulea* and *Trichophorum germanicum*	**41**
40b	Vegetation not dominated by these species	**47**

41a	Wet heath vegetation with significant cover of *Trichophorum germanicum*	**42**
41b	Vegetation without significant cover of *Trichophorum germanicum*	**44**

42a	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**
42b	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**
42c	Wet heath on peat dominated by *Trichophorum germanicum* with *Eriophorum angustifolium*; *Sphagnum* cover varies from 0-50% and normally consists of *Sphagnum capillifolium*, *Sphagnum subnitens*, *Sphagnum palustre* or *Sphagnum tenellum*; *Sphagnum papillosum* is usually absent	**43**

43a	*Trichophorum* wet heath with *Calluna vulgaris* frequent	**WH4b**
43b	*Trichophorum* wet heath with *Juncus squarrosus* frequent	**WH4c**
43c	*Trichophorum* wet heath with neither *Calluna vulgaris* nor *Juncus squarrosus* frequent	**WH4a**

44a	Wet heath vegetation with significant cover of *Myrica gale*, usually accompanied by *Schoenus nigricans* and/or *Molinia caerulea*	**WH6**
44b	Wet heath vegetation with significant cover of *Schoenus nigricans*, usually accompanied by *Molinia caerulea* and/or *Erica tetralix*; no significant cover of *Myrica gale*	**45**
44c	Vegetation with significant cover of neither *Schoenus nigricans* nor *Myrica gale*	**46**

45a	*Schoenus* wet heath with continuous cover of vegetation	**WH1a**
45b	*Schoenus* wet heath with gaps or bare ground between the tussocks	**WH1b**

46a	Wet heath vegetation dominated by mixture of *Calluna vulgaris* and *Molinia caerulea*, often with *Sphagnum capillifolium*; dwarf shrubs may be scarce in heavily grazed areas but should be present	**WH3**
46b	Wet heath vegetation dominated by a mixture of *Ulex gallii* and *Molinia caerulea*	**WH7**
46c	Wet grassland vegetation dominated by *Molinia caerulea*, usually accompanied by some other grass species such as *Anthoxanthum odoratum*, *Festuca* spp., or *Nardus stricta*; dwarf shrubs should not be present	**UG4**

47a	Wet grassland vegetation dominated by a mixture of grass species and *Juncus effusus* or *Juncus acutiflorus*	**PFLU3**
47b	Vegetation of relatively well-drained situationswithout significant cover of *Juncus* spp.	**48**
48a	Calcareous grassland vegetation of thin soils, restricted to limestone upland areas, usually with a high cover of calcicolous forbs and bryophytes	**49**
48b	Acidic grassland vegetation which usually lacks a significant forb component; where the vegetation is forb-rich, the underlying bedrock is always siliceous	**50**
49a	Grassland vegetation of broken, rocky ground, with *Silene acaulis* very prominent and *Sesleria caerulea* typically with significant cover; *Arenaria ciliata* is often present	**UG3**
49b	Forb-rich calcareous grassland (forb cover >20%), with *Silene acaulis* absent; indicative species include *Thymus praecox*, *Alchemilla* spp. and *Galium sterneri*	**UG5a**
49c	Calcareous grassland with some calcicolous forb species present, but at low cover, with grass species dominant; often transitioning into acidic grassland	**UG5b**
50a	Vegetation dominated by grass species and with a fairly continuous sward; no significant cover of *Racomitrium lanuginosum*	**51**
50b	Vegetation not dominated by grass species, or if so then cover of *Racomitrium lanuginosum* significant or sward very sparse	**54**
51a	Grassland dominated by mixture of *Agrostis capillaris*, *Festuca ovina*, *Deschampsia flexuosa* and *Anthoxanthum odoratum*; sward typically closely cropped by grazing	**52**
51b	Grassland clearly dominated by *Nardus stricta*; sward usually not closely cropped by grazing	**53**
52a	*Agrostis-Festuca* grassland with *Sphagnum* spp. frequent	**UG1b**
52b	*Agrostis-Festuca* grassland with *Juncus squarrosus* frequent	**UG1d**
52c	Species-rich upland grassland with high forb component; if enriched by base-rich flushing then indicative species include *Linum catharticum*, *Campanula rotundifolia*, *Thymus polytrichus* and *Prunella vulgaris*	**UG1c**
52d	*Agrostis-Festuca* grassland lacking all of the above characteristics	**UG1a**
53a	*Nardus stricta* grassland with *Sphagnum* spp. frequent	**UG2b**
53b	*Nardus stricta* grassland with *Juncus squarrosus* frequent	**UG2d**
53c	Species-rich *Nardus stricta* grassland with high forb component; if enriched by base-rich flushing then indicative species include *Linum catharticum*, *Campanula rotundifolia*, *Thymus polytrichus* and *Prunella vulgaris*	**UG2c**
53d	*Nardus stricta* grassland lacking all of the above characteristics	**UG2a**
54a	Montane vegetation with strict arctic-alpine species (*Carex bigelowii, Salix herbacea, Diphasiastrum alpinum, Persicaria vivipara, Cetraria islandica*) present	**55**
54b	Montane vegetation with strict arctic-alpine species absent	**58**
55a	*Nardus stricta* not dominant	**56**
55b	*Nardus stricta* dominant	**57**
56a	Montane vegetation with *Dicranum fuscescens* present	**MH6b**
56b	Montane vegetation with *Juncus squarrosus* frequent	**MH6c**

56c	Montane vegetation with *Deschampsia flexuosa* frequent	**MH6d**
56d	Montane vegetation lacking all of the above characteristics	**MH6a**

57a	Montane vegetation with *Anthoxanthum odoratum* frequent	**MH7b**
57b	Montane vegetation with *Juncus squarrosus* frequent	**MH7c**
57c	Montane vegetation lacking all of the above characteristics	**MH7a**
58a	Montane grass heath with *Nardus stricta* dominant/co-dominant with conspicuous amounts of *Racomitrium lanuginosum*; *Carex binervis* is typically present	**MH5**
58b	Very sparse montane vegetation on a gravel/loose rock substrate in which the chief species are *Festuca vivipara*, *Thymus polytrichus* and *Galium saxatile*	**MH8**

59a	Vegetation associated with rocky clefts, crevices and overhangs	**60**
59b	Vegetation associated with scree	**61**
59c	Vegetation associated with rock ledges on crags and corrie walls; generally lushly vegetated and often well-irrigated	**62**

60a	Rocky clefts in siliceous bedrock which are occupied by *Saxifraga spathularis* and/or ferns (e.g *Asplenium adiantum-nigrum*, *Hymenophyllum* spp., *Dryopteris dilatata*); bryophytes often abundant	**RS1**
60b	Rocky clefts in calcareous bedrock 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**

	If scree has vegetated to the point that another vegetation community such as dry heath or grassland can be identified that community should be recorded. SC1 and SC2 should be used for assemblages on scree that cannot be readily accomodated elsewhere in the classification.	
61a	Siliceous scree with species such as *Racomitrium lanuginosum* and *Festuca vivipara*; ferns and *Saxifraga spathularis* may occur amongst block scree	**SC1**
61b	Calcareous scree with species such as *Thymus polytrichus, Arenaria ciliata, Saxifraga aizoides, Saxifraga oppositifolia, Breutelia chrysocoma* and *Arabis petraea*	**SC2**

62a	Dense sward of usually dry ledges on limestone cliffs, dominated by *Sesleria caerulea* and *Carex flacca*; tall herb species and *Luzula sylvatica* are sparse or absent	**UG6**
62b	Lush vegetation of calcareous or siliceous rock, *Luzula sylvatica* or tall herbs are always present and form a prominent component of the vegetation	**63**

63a	Tall herb vegetation on siliceous rock dominated by *Luzula sylvatica*, often accompanied by *Calluna vulgaris*, *Vaccinium myrtillus, Agrostis vinealis*, *Deschampsia flexuosa*, *Festuca vivipara* or *Anthoxanthum odoratum*	**64**
63b	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**
63c	Species-rich tall herb vegetation on base-rich rock outcrops or ledges with base-rich flushing, where at least two of *Sedum rosea*, *Angelica sylvestris, Geum rivale*, *Filipendula ulmaria* and *Alchemilla glabra* are prominent; some of *Hypericum pulchrum*, *Succisa pratensis, Festuca rubra, Primula vulgaris* and *Viola riviniana* are usually present; *Luzula sylvatica* is usually no more than co-dominant.	**TH3**

64a	*Luzula*-dominated vegetation on rock face ledges	**TH1i**
64b	*Luzula*-dominated vegetation on top of boulders amongst dry heath	**TH1ii**

65a	Hepatic mats of lower altitudes usually dominated by *Scapania gracilis* or *Diplophyllum albicans*	**HM2**
65b	Hepatics mats of higher altitudes with *Herbertus aduncus* usually prominent	**HM1**

Appendix II: Polygon recording sheet

Site no:	001	**Site name:**	Corraun Plateau	**Surveyor:**	Jenni Roche

Polygon no.	Survey Method	Component 1	%	Component 2	%	Component 3	%	Component 4	%	Component 5	%	Component 6	%	Total %	
1	1	WH1a	20	BB1a	15	WH3	20	WH1b	45					100	
2	2	SilcScree	5	SilcLoose	55	SilcRockN	10	MH4	25	SC1	5			100	
3	1	MH4	5	MH5	5	MH7a	15	Gravel	30	SilcRockN	45			100	
4	1	BB6a	15	MH5	5	RS1	2	WH5	3	SilcRockA	65	Gravel	5	100	
5	1	MH5	65	HM2	5	WH5	20	SilcLoose	10					100	

Appendix III: Structure of NSUH Turboveg database

The standard fields of Date and Relevé area should be used, plus the custom fields below. Standard fields for cover score (e.g. COV_ALGAE) should not be used as they do not record to decimal places.

Description	Field name	Type	Length	Decimal places
Project site number	SITE_NO	C	3	0
Plot number	PLOT_NO	C	5	0
Name of recorders	RECORDERS	C	30	0
Fossitt habitat code	FOSSITT	C	6	0
Annex I code	ANNEX_I	C	6	0
Provisional vegetation type	COMMUNITY	C	25	0
Soil type	SOIL_TYPE	C	25	0
Geography	GEOGRAPHY	C	35	0
Topography	TOPOGRAPHY	C	25	0
Altitude (m)	ALTITUDE_	C	5	0
Aspect (°)	ASPECT	C	5	0
Slope (°)	SLOPE	C	5	0
Cover of bare soil (%)	BARE_SOIL	C	5	0
Cover of bare rock (%)	BARE_ROCK	C	5	0
Cover of surface water (%)	SURF_WATER	C	5	0
Cover of litter (%)	LITTER	C	5	0
Cover of algae (%)	ALGAE_COV	C	5	0
Cover of lichens (%)	LICHE_COV	C	5	0
Cover of bryophytes (%)	BRYO_COV	C	5	0
Cover of field layer (%)	FIELD_COV	C	5	0
Cover of dwarf shrubs (%)	DWARF_COV	C	5	0
Soil / peat depth (cm)	PEAT_DEPTH	C	5	0

Appendix IV: 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		**Relevé size & shape:**		
Eric cine		Plan mari		Junc effu		Arrh elat				Warn exan		Clad cocc				**Fossitt habitat:**		
Eric erig		Poly serp		Junc infl		Dant decu		**Mosses**				Clad cris				**EU Annex I habitat:**		
Eric tetr		Poly vulg		Junc squa		Desc cesp		Andr rupe				Clad fimb				**Annex I assessment stop no:**		
Juni comm		Pote erec		Luzu camp		Desc flex		Aula palu				Clad floe				**Soil ID:**		
Myri gale		Pseu albi		Luzu pilo		Fest ovin		Breu chry				Clad furc				**Site Geography**		
Rhod pont		R. acetosa		Luzu mult		Fest rubr		Call cusp				Clad grac				**Altitude:**		
Sali herb		R. acetose		Luzu sylv		Fest vivi		Camp atro				Clad port				**Aspect:**		
Ulex euro		Saus alpi				Moli caer		Camp flex				Clad pyxi				**Slope:**		
Ulex gall		Saxi oppo				Nard stri		Camp intr				Clad rgfm				**Additional relevé notes:**		
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 V: Monitoring criteria for upland Annex I habitats

North Atlantic wet heaths with *Erica tetralix* (4010)

Criteria		Scale of assessment
Vegetation composition		
1	*Erica tetralix* present	20m radius
2	Cover of positive indicator species ≥ 50% (Appendix VI)	Relevé
3	Total cover of *Cladonia* species, *Sphagnum* species, *Racomitrium lanuginosum* and pleurocarpous mosses ≥ 10%	Relevé
4	Cover of ericoid species and *Empetrum nigrum* ≥ 15%	Relevé
5	Cover of dwarf shrub species < 75%	Relevé
6	Cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Phragmites australis, Ranunculus repens* collectively < 1%	Relevé
7	Cover of non-native species < 1%	Relevé
8	Cover of non-native species < 1%	Local vicinity
9	Cover of scattered native trees and scrub < 20%	Local vicinity
10	Cover of *Pteridium aquilinum* < 10%	Local vicinity
11	Cover of *Juncus effusus* < 10%	Local vicinity
Vegetation structure		
12	Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	Relevé
13	Last complete growing season's shoots of ericoids, *Empetrum nigrum* and *Myrica gale* showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	Relevé
14	No signs of burning into the moss, liverwort or lichen layer, or exposure of peat surface due to burning	Local vicinity
15	No signs of burning inside boundaries of sensitive areas†	Local vicinity
Physical structure		
16	Cover of disturbed bare ground < 10%	Relevé
17	Cover of disturbed bare ground < 10%	Local vicinity
18	Area showing signs of drainage resulting from heavy trampling or tracking or ditches < 10%	Local vicinity

†Sensitive areas
(a) Vegetation severely wind-clipped, mostly forming a mat less than 10 cm thick.
(b) Areas where soils are thin and less than 5 cm deep.
(c) Slopes greater than 1 in 3 (18°) and all the sides of gullies.
(d) Ground with abundant, and/or an almost continuous carpet of *Sphagnum*, liverworts and/or lichens.
(e) Pools, wet hollows, haggs and erosion gullies, and within 5 – 10 m of the edge of watercourses.
(f) Areas above 400 m in altitude.
(g) Areas within 50 m of functioning drains.

European dry heaths (4030)

Criteria		Scale of assessment
Vegetation composition		
1	Number of bryophyte or non-crustose lichen species present, excluding *Campylopus* spp. and *Polytrichum* spp. ≥ 3	Relevé
2	Number of positive indicator species present ≥ 2 (Appendix VI)	Relevé
3a†	DH5 (Calcareous heaths): cover of positive indicator species 50-75%	Relevé
3b†	Siliceous heaths: cover of positive indicator species ≥ 50% (Appendix VI)	
4	Proportion of dwarf shrub cover composed of *Myrica gale, Salix repens, Ulex gallii* collectively < 50%	Relevé
5	Cover of the following weedy negative indicator species: *Cirsium arvense, C. vulgare, Ranunculus repens,* large *Rumex* species (except *R. acetosa*), *Senecio jacobea, Urtica dioica* collectively < 1%	Relevé
6	Cover of non-native species < 1%	Relevé
7	Cover of non-native species < 1%	Local vicinity
8	Cover of scattered native trees and scrub < 20%	Local vicinity
9	Cover of *Pteridium aquilinum* < 10%	Local vicinity
10	Cover of *Juncus effusus* < 10%	Local vicinity
Vegetation structure		
11	Senescent proportion of *Calluna vulgaris* cover < 50%	Relevé
12	Last complete growing season's shoots of ericoids and *Empetrum nigrum* showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	Relevé
13	No signs of burning inside boundaries of sensitive areas‡	Local vicinity
14	Outside boundaries of sensitive areas, all growth phases of *Calluna vulgaris* should occur throughout, with ≥ 10% of cover in mature phase††	Local vicinity
Physical structure		
15	Cover of disturbed bare ground < 10%	Relevé
16	Cover of disturbed bare ground < 10%	Local vicinity

†Assess only the sub-criterion relevant to the community being assessed.

‡Sensitive areas
(a) Areas where soils are thin and less than 5 cm deep.
(b) Hill slopes greater than 1 in 2 (26°), and all the sides of gullies.
(c) Ground with abundant, and/or an almost continuous carpet of *Sphagnum,* liverworts and/or lichens.
(d) Areas of H21 and H22 heath as defined by the NVC (Rodwell 1991a). These are heaths primarily composed of mixtures of *Calluna vulgaris* and *Vaccinium myrtillus* over a moist carpet of bryophytes that often has a high *Sphagnum* content. Within the provisional classification, these communities are comparable to DH4 and damper elements of DH6 respectively.
(e) Areas with noticeably uneven structure, at a spatial scale of around 1 m² or less. The unevenness (e.g. 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.
(f) Pools, wet hollows, haggs and erosion gullies, and within 5 – 10 m of the edge of watercourses.

††*Calluna vulgaris* growth phases
1. Pioneer < 10 cm
2. Building 10 – 30 cm
3. Mature > 30 cm

Alpine and Boreal heaths (4060)

	Criteria	Scale of assessment
Vegetation composition		
1	Number of bryophyte or non-crustose lichen species present ≥ 3	Relevé
2	Cover of positive indicator species ≥ 66% (Appendix VI)	Relevé
3	Cover of dwarf shrubs ≥ 10%	Relevé
4	Cover of the following negative indicator species: *Agrostis capillaris, A. vinealis, Anthoxanthum odoratum, Deschampsia flexuosa, Festuca ovina, F. vivipara, Galium saxatile, Potentilla erecta* and *Poa* spp. (except *Poa alpina*) collectively < 10%	Relevé
5	Cover of non-native species < 1%	Relevé
Vegetation structure		
6	Live leaves of *Carex bigelowii, Deschampsia flexuosa, Festuca ovina, F.vivipara* showing signs of grazing collectively <10%	Relevé
7	Last complete growing season's shoots of ericoids and *Empetrum nigrum* showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	Relevé
8	No signs of burning inside feature	Local vicinity
Physical structure		
9	Cover of disturbed bare ground < 10%	Relevé
10	Cover of disturbed bare ground < 10%	Local vicinity

*Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230)

Criteria		Scale of assessment
Vegetation composition		
1	Number of high quality† and general indicator species ≥ 7 (Appendix VI)	Relevé
2a‡	UG1c/UG2c: Number of high quality species present ≥ 2 (Appendix VI)	Relevé
2b‡	UG1e/UG2e: Number of high quality species present ≥ 1 (Appendix VI)	Relevé
3	Species richness ≥ 25 species	Relevé
4	Cover of non-native species ≤ 1%	Relevé
5	Cover of the following negative indicator species: *Arrhenatherum elatius, Bellis perennis, Cirsium arvense, Cirsium vulgare, Dactylis glomerata, Eriophorum angustifolium, Eriophorum vaginatum, Holcus lanatus, Juncus effusus, Lolium perenne, Narthecium ossifragum, Ranunculus repens, Rumex crispus, Rumex obtusifolius, Senecio jacobea, Trifolium repens, Urtica dioica*, individually ≤ 10%	Relevé
6	Cover of the above negative indicator species collectively ≤ 20%	Relevé
7	Cover of *Sphagnum* species ≤ 10%,	Relevé
8	Cover of *Polytrichum* species ≤ 25%	
9	Cover of scrub, bracken and heath ≤ 5%	Relevé
Vegetation structure		
10	Forb component of forb : graminoid ratio 20-90%	Relevé
11	Proportion of the sward between 5-50 cm tall ≥ 25%	Relevé
12	Litter cover ≤ 20%	Relevé
Physical structure		
13	Cover of disturbed bare ground ≤ 10%	Relevé
14	Area of the habitat showing signs of serious grazing or disturbance <20m²	Local vicinity

† Assess only the criteria relevant to the provisional sub-community (Appendix I) being assessed.
‡ Consider only high quality species listed for relevant provisional sub-community.

Blanket bogs (*active only) (7130)

	Criteria	Scale of assessment
Vegetation composition		
1	Number of positive indicator species present ≥ 7 (Appendix VI)	Relevé
2	Cover of bryophyte or lichen species, excluding *Sphagnum fallax* ≥ 10%	Relevé
3	Cover of each of the following species: *Calluna vulgaris, Eleocharis multicaulis, Eriophorum vaginatum, Molinia caerulea, Schoenus nigricans, Trichophorum germanicum* individually < 75%	Relevé
4	Cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Phragmites australis, Pteridium aquilinum, Ranunculus repens* collectively < 1%	Relevé
5	Cover of non-native species < 1%	Relevé
6	Cover of non-native species < 1%	Local vicinity
7	Cover of scattered native trees and scrub < 10%	Local vicinity
Vegetation structure		
8	Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	Relevé
9	Last complete growing season's shoots of ericoids, *Empetrum nigrum* and *Myrica gale* showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	Relevé
10	No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Local vicinity
11	No signs of burning inside boundaries of sensitive areas†	Local vicinity
Physical structure		
12	Cover of disturbed bare ground < 10%	Relevé
13	Cover of disturbed bare ground < 10%	Local vicinity
14	Area showing signs of drainage resulting from heavy trampling or tracking or ditches or peat cutting < 10%	Local vicinity
15	Cover of erosion gullies and eroded areas within the greater bog mosaic‡ < 5%	Local vicinity

† Sensitive areas
(a) Slopes greater than 1 in 3 (18°), and all the sides of gullies.
(b) Ground with abundant and/or an almost continuous carpet of *Sphagnum*, other mosses, liverworts and/or lichens.
(c) Patterned areas i.e. with pools, wet hollows, haggs and erosion gullies.
(d) Areas within 5-10 m of watercourses.
(e) Areas above 400 m in altitude.
(f) Areas within 50 m of functioning drains.

‡The greater bog mosaic incorporates the Annex I Blanket bog itself and associated vegetation types and non-vegetation cover types that appear to have been derived from former blanket bog, including, but not limited to, HW2, bare peat, loose rock, gravel and running water.

Transition mires (7140)

Criteria		Scale of assessment
Vegetation composition		
1a†	PO1a: number of positive indicator species from Groups i or ii present≥ 3	Relevé
1b†	PFLU5: number of positive indicator species from Groups i or ii present ≥ 3	
1c†	RFEN1b: number of positive indicator species from Groups i or ii present ≥ 6 (Appendix VI)	
2	Number of species from Group i present** ≥ 1 (Appendix VI)	Relevé
3	Cover of the following species: small to medium sized *Carex* spp., *Equisetum fluviatile*, *Hydrocotyle vulgaris*, *Hypericum elodes*, *Mentha aquatica*, *Menyanthes trifoliata*, *Potentilla palustris*, *Sphagnum* spp. collectively ≥ 25%	Relevé
4	Cover of the following species: *Anthoxanthum odoratum*, *Epilobium hirsutum*, *Holcus lanatus* collectively < 1%	Relevé
5	Cover of non-native species < 1%	Relevé
Vegetation structure		
6	*PFLU5/RFEN1b: ≥ 50% of the tips of live leaves and/or flowering shoots of vascular plants should be more than 15 cm above the ground surface	Relevé
Physical structure		
7	Cover of <u>disturbed</u> bare ground < 10%	Relevé
8	Cover of <u>disturbed</u> bare ground < 10%	Local vicinity
9	Area showing signs of <u>drainage</u> resulting from heavy trampling or tracking or ditches < 10%	Local vicinity

†Assess only the criteria relevant to the provisional community (Appendix I) being assessed.

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

	Criteria	Scale of assessment
Vegetation composition		
1	Number of positive indicator species present ≥ 5 (Appendix VI)	Relevé
2	Cover of *Rhynchospora* spp. ≥ 10%	Relevé
3	Cover of each of the following species: *Eleocharis multicaulis*, *Molinia caerulea, Schoenus nigricans, Trichophorum germanicum* individually < 35%	Relevé
4	Cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Phragmites australis, Pteridium aquilinum, Ranunculus repens* collectively < 1%	Relevé
5	Cover of non-native species < 1%	Relevé
6	Cover of scattered native trees and scrub < 10%	Local vicinity
Vegetation structure		
7	Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	Relevé
8	Last complete growing season's shoots of ericoids, *Empetrum nigrum* and *Myrica gale* shrubs showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	Relevé
9	No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Local vicinity
10	No signs of burning inside boundaries of sensitive areas†	Local vicinity
Physical structure		
11	Cover of disturbed bare ground < 10%	Relevé
12	Cover of disturbed bare ground < 10%	Local vicinity
13	Area showing signs of drainage resulting from heavy trampling or tracking or ditches < 10%	Local vicinity
14	Cover of erosion gullies and eroded areas within the greater bog mosaic ‡ < 5%	Local vicinity

†Sensitive areas
(a) Ground with abundant and/or an almost continuous carpet of *Sphagnum.*
(b) Patterned areas (i.e. with pools and wet hollows).
(c) Areas within 50 m of functioning drains.
(d) Areas within 5-10 m of watercourses.

‡The greater bog mosaic incorporates the Annex I habitats *Rhynchosporion* and Blanket Bog as well as associated vegetation types and non-vegetation cover types that appear to have been derived from former blanket bog, including, but not limited to, HW2, bare peat, loose rock, gravel and running water.

Alkaline fens (7230)

Criteria		Scale of assessment
Vegetation composition		
1	At least one brown moss species present (Appendix VI)	Relevé
2a†	RFLU1a/RFLU2: number of positive vascular indicator species present ≥ 2 (Appendix VI)	Relevé
2b†	RFLU4/RFEN1a: number of positive vascular indicator species present ≥ 3 (Appendix VI)	
3a†	RFLU1a/RFLU2: vegetation cover of brown mosses and vascular indicator species ≥ 20% (Appendix VI)	Relevé
3b†	RFLU4/RFEN1a: vegetation cover of brown mosses and vascular indicator species ≥ 75% (Appendix VI)	
4	Total cover of the following species: *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Ranunculus repens* < 1%	Relevé
5	Cover of non-native species < 1%	Relevé
6	Cover of scattered native trees and scrub < 10%	Local vicinity
7	Total cover of *Juncus effusus* and *Phragmites australis* < 10%	Local vicinity
Vegetation structure		
8	At least 50% of the live leaves/flowering shoots are more than 5 cm above ground surface	Relevé
Physical structure		
9	Cover of disturbed, bare ground < 10%	Relevé
10	Cover of disturbed, bare ground < 10%	Local vicinity
11	Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	Local vicinity
12*	Where tufa is present, disturbed proportion of vegetation cover < 1%	Local vicinity

† Assess only the criteria relevant to the provisional community (Appendix I) being assessed.

Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) (8110)

Criteria		Scale of assessment
Vegetation composition		
1	Cover of bryophyte and non-crustose lichen species ≥ 5%	Relevé
2	Proportion of vegetation composed of following negative indicator species: *Cirsium arvense, C. vulgare, Rubus fruticosus* agg., large *Rumex* species (except *R. acetosa*), *Senecio jacobaea, Urtica dioica* collectively < 1%	Relevé
3	Proportion of vegetation composed of non-native species < 1%	Relevé
4†	Block scree: number of positive indicator species for 8220 present ≥ 1 (Appendix VI)	Local vicinity
5	Cover of grass species and dwarf shrubs collectively < 20%	Local vicinity
6	Cover of *Pteridium aquilinum*, native trees and scrub collectively < 25%	Local vicinity
Vegetation structure		
7	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively < 50%	Relevé
Physical structure		
8	Ground disturbed by human & animal paths, scree running, vehicles < 10%	Relevé
9	Ground disturbed by human & animal paths, scree running, vehicles < 10%	Local vicinity

†Assess only the criteria relevant to the scree type being assessed.

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

Criteria		Scale of assessment
Vegetation composition		
1	Number of positive indicator ferns and *Saxifraga* spp. present ≥ 1 (Appendix VI)	Local vicinity
2	Total number of positive indicator species present ≥ 3 (Appendix VI)	Local vicinity
3	Cover of dwarf shrubs and grass species, excluding *Sesleria caerulea* collectively < 20%	Relevé
4	Proportion of vegetation composed of following negative indicator species: *Cirsium arvense, C. vulgare, Pteridium aquilinum, Rubus fruticosus* agg., large *Rumex* species (except *R. acetosa*), *Senecio jacobaea, Urtica dioica* collectively < 1%	Relevé
5	Proportion of vegetation composed of non-native species < 1%	Relevé
6	Cover of *Pteridium aquilinum*, native trees and scrub collectively < 25%	Local vicinity
Vegetation structure		
7	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively < 50%	Relevé
Physical structure		
8	Ground disturbed by human & animal paths, scree running, vehicles < 10%	Relevé
9	Ground disturbed by human & animal paths, scree running, vehicles < 10%	Local vicinity

Calcareous rocky slopes with chasmophytic vegetation (8210)

	Criteria	Scale of assessment
Vegetation composition		
1	Number of positive indicator ferns and *Saxifraga* spp. present ≥ 1 (Appendix VI)	Local vicinity
2	Total number of positive indicator species present ≥ 3 (Appendix VI)	Local vicinity
3	Proportion of vegetation composed of non-native species < 1%	Local vicinity
4	Cover of *Pteridium aquilinum*, native trees and scrub collectively < 25%	Local vicinity
Vegetation structure		
5	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively < 50%	Local vicinity

Siliceous rocky slopes with chasmophytic vegetation (8220)

	Criteria	Scale of assessment
Vegetation composition		
1	Number of positive indicator species present ≥ 1 (Appendix VI)	Local vicinity
2	Proportion of vegetation composed of non-native species < 1%	Local vicinity
3	Cover of *Pteridium aquilinum*, native trees and scrub collectively < 25%	Local vicinity
Vegetation structure		
4	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively < 50%	Local vicinity

Appendix VI: Positive indicator species for upland Annex I habitats

North Atlantic wet heaths with *Erica tetralix* (4010)
Breutelia chrysocoma
Calluna vulgaris
Carex spp.
Diplophyllum albicans
Drosera spp.
Erica erigena
Erica tetralix
Eriophorum angustifolium
Myrica gale
Narthecium ossifragum
Non-crustose lichens
Pedicularis sylvatica
Pleurocarpous mosses
Pleurozia purpurea
Polygala serpyllifolia
Potentilla erecta
Rhynchospora spp.
Salix repens
Schoenus nigricans
Sphagnum spp.
Succisa pratensis
Trichophorum germanicum

European dry heath (4030)
Arctostaphylos uva-ursi
Calluna vulgaris
Daboecia cantabrica
Empetrum nigrum
Erica cinerea
Ulex gallii
Vaccinium myrtillus
Vaccinium vitis-idaea

Alpine and Boreal heath (4060)	*Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230)
Arctostaphylos uva-ursi	**UG1c/UG2c (base-rich type)**
Calluna vulgaris	**High quality species**
Carex bigelowii	*Alchemilla glabra*
Cetraria islandica	*Antennaria dioica*
Cladonia arbuscula	*Campanula rotundifolia*
Cladonia portentosa	*Conopodium majus*
Cladonia rangiferina	*Ctenidium molluscum*
Cladonia uncialis	*Linum catharticum*
Diphasiastrum alpinum	*Lotus corniculatus*
Diplophyllum albicans	*Lysmachia nemorum*
Empetrum nigrum	*Primula vulgaris*
Erica cinerea	*Prunella vulgaris*
Erica tetralix	*Thymus polytrichus*
Herbertus aduncus	**UG1e/UG2e (base-poor type)**
Juniperus communis ssp. *nana*	**High quality species**
Persicaria vivipara	*Breutelia chrysocoma*
Racomitrium lanuginosum	*Carex caryophyllea*
Salix herbacea	*Carex pilulifera*
Scapania gracilis	*Danthonia decumbens*
Solidago virgaurea	*Lathyrus linifolius*
Vaccinium myrtillus	*Pseudorchis albida*
Vaccinium vitis-idaea	*Viola canina*
	Viola riviniana
	General indicators
	Agrostis capillaris
	Anthoxanthum odoratum
	Carex binervis
	Festuca ovina
	Galium saxatile
	Hylocomium splendens
	Luzula multiflora / *L. campestris* (count as one)
	Nardus stricta
	Polygala serpyllifolia
	Potentilla erecta
	Rhytidiadelphus loreus
	Rhytidiadelphus squarrosus
	Veronica officinalis

Blanket bogs (*active only) (7130)

Andromeda polifolia
Breutelia chrysocoma
Calluna vulgaris
Carex bigelowii
Diplophyllum albicans
Drosera spp. (count separately)
Empetrum nigrum
Erica tetralix
Eriophorum angustifolium
Eriophorum vaginatum
Menyanthes trifoliata
Myrica gale
Narthecium ossifragum
Non-crustose lichens (count separately)
Odontoschisma sphagni
Pedicularis sylvatica
Pinguicula lusitanica
Pleurozia purpurea
Polygala serpyllifolia
Racomitrium lanuginosum
Rhynchospora spp. (count separately)
Scapania gracilis
Schoenus nigricans
Sphagnum spp. (count separately, exclude *S. fallax*)
Trichophorum germanicum
Vaccinium myrtillus

Transition mires (7140)

PFLU5 and RFEN1b (*Carex rostrata* fen and flush)
Group i
Caltha palustris
Carex diandra
Carex lasiocarpa
Carex limosa
Carex nigra
Carex rostrata
Carex viridula
Epilobium palustre
Equisetum fluviatile
Galium palustre
Mentha aquatica
Menyanthes trifoliata
Phragmites australis
Potentilla palustris
Sphagnum spp. (count separately)

Group ii
Angelica sylvestris
Cardamine pratensis
Eriophorum angustifolium
Lysimachia vulgaris
Lythrum salicaria
Selaginella selaginoides
Succisa pratensis
Viola palustris

PO1a (infilling pool community)
Group i
Carex canescens
Carex lasiocarpa
Carex limosa
Menyanthes trifoliata
Sphagnum spp. (count separately)

Group ii
Drosera spp. (count separately)
Eriophorum angustifolium
Rhynchospora spp. (count separately)

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

Carex limosa
Carex panicea
Drosera spp. (count separately)
Eleocharis multicaulis
Eriophorum angustifolium
Juncus bulbosus
Menyanthes trifoliata
Narthecium ossifragum
Rhynchospora spp. (count separately)
Sphagnum spp. (count separately, exclude *S. fallax*)
Utricularia spp. (count separately)

Alkaline fens (7230)

Brown mosses
Bryum pseudotriqetrum
Calliergon sarmentosum
Campylium stellatum
Ctenidium molluscum
Drepanocladus revolvens
Fissidens adianthoides
Palustriella commutata
Palustriella falcata
Scorpidium cossonii
Scorpidium scorpioides

RFLU1a and RFLU2 (small-sedge flushes)
Carex panicea
Carex viridula
Eleocharis quinqueflora
Juncus bulbosus
Pinguicula vulgaris

RFLU4 and RFEN1a (*Schoenus* flush and *Carex rostrata* fen)
Anagallis tenella
Carex dioica
Carex lasiocarpa
Carex panicea
Carex viridula
Carex rostrata
Cirsium dissectum
Molinia caerulea
Pinguicula vulgaris
Schoenus nigricans Schoenus nigricans Schoenus nigricans
Selaginella selaginoides

Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*) (8120)
Asplenium adiantum-nigrum
Asplenium ruta-muraria
Asplenium trichomanes
Asplenium viride
Carex pulicaris
Ceterach officinarum
Cystopteris fragilis
Dryas octopetala
Geranium lucidum
Geranium robertianum
Hieracium spp. (count as one)
Koeleria macrantha
Oxalis acetosella
Phegopteris connectilis
Polystichum aculeatum
Polystichum lonchitis
Polystichum setiferum
Saxifraga aizoides
Saxifraga oppositifolia
Silene acaulis
Teucrium scorodonia
Thalictrum alpinum
Tortella tortuosa

Calcareous rocky slopes with chasmophytic vegetation (8210)
Alchemilla alpina
Asplenium adiantum-nigrum
Asplenium ruta-muraria
Asplenium trichomanes
Asplenium viride
Carex pulicaris
Ceterach officinarum
Cystopteris fragilis
Draba incana
Dryas octopetala
Hieracium spp. (count as one)
Koeleria macrantha
Neckera crispa
Orthothecium rufescens
Persicaria vivipara
Phegopteris connectilis
Phyllitis scolopendrium
Polystichum aculeatum
Polystichum lonchitis
Polystichum setiferum
Preissia quadrata
Saxifraga aizoides
Saxifraga hypnoides
Saxifraga oppositifolia
Selaginella selaginoides
Silene acaulis
Thalictrum alpinum
Tortella tortuosa

Siliceous rocky slopes with chasmophytic vegetation (8220) **AND** **Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) (8110)***
Asplenium adiantum-nigrum
Athyrium filix-femina
Blechnum spicant
Dryopteris spp. (count separately)
Hymenophyllum tunbridgense
Hymenophyllum wilsonii
Saxifraga spathularis
Sedum rosea

*Applies only to block scree formations

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
B	***Sylviculture, forestry***
B01	forest planting on open ground
B01.01	forest planting on open ground (native trees)

Code	**Impact**
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
D	***Transportation and service corridors***
D01	Roads, paths and railroads
D01.01	paths, tracks, cycling tracks
D01.02	roads, motorways
D01.03	car parks 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

Code	**Impact**
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
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 resources
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

Code	**Impact**
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	accidental 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, horse-riding and non-motorised vehicles
G01.03	motorised vehicles
G01.03.01	regular motorized driving
G01.03.02	off-road motorized driving
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 manoeuvres
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 parks
G05.04	tree surgery, felling for public safety, removal of roadside trees
G05.05	missing or wrongly directed conservation measures

Code	**Impact**
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 storm overflows 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
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	suppression 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

Code	**Impact**
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	modification of standing water bodies
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 groundwater
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 defence or coast protection works, tidal barrages
J02.11.02	dykes and flooding defence 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 (including 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

Code	**Impact**
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
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	underground 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***

Code	**Impact**
XO	Threats and pressures from outside the Member State
XE	Threats and pressures from outside the EU territory

Appendix VIII: Structure of NSUH Conservation Assessment Database

Table	Field	Values
Site General	NSUH_SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	SITE_NAME	Name of site
	RECORDERS	Initials of all recorders
	DATES_SURVEYED	Range of relevant dates
	SITE_AREA	Area in hectares
	X_COORD	Six figure easting
	Y_COORD	Six figure northing
	NO_STOPS	Total number of monitoring stops
	OWNERSHIP	e.g. Bórd na Móna, NPWS, Private - Multiple
Area	NSUH_SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	ANNEX_I	Annex I habitat code
	START_YEAR	First year of area assessment period
	STOP_YEAR	Last year of area assessment period
	START_AREA	Area (ha) first year of assessment period
	STOP_AREA	Area (ha) last year of assessment period
	CHANGE	Gain, Loss, None, Unknown
	%_PER_YEAR	% of habitat gained or lost per year
Structure Criteria	NSUH_SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	ANNEX_I	Annex I habitat code
	FOSSITT	Fossitt (2000) habitat code
	MONITORING_STOP_NO	Number of monitoring stop
	PERFORMANCE_INDICATOR	e.g. No. bryophytes / lichens present, non-native spp. cover
	TARGET	e.g. 3 spp., <1%
	RESULT	e.g. 6 spp., 5%
	ASSESSMENT	Pass (P) or Fail (F)
	CRITERION_NOTE	Additional notes including relevé number
Monitoring Stops	NSUH_SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	ANNEX_I	Annex I habitat code
	FOSSITT	Fossitt (2000) habitat code
	MONITORING_STOP_NO	Number of monitoring stop
	ALTITUDE	Altitude (m)
	ASPECT	Aspect as None, N, NW, W etc.
	SLOPE	Slope (°)
	X_COORD	Six figure easting
	Y_COORD	Six figure northing
	ASSESSMENT	Pass (P) or Fail (F)
	RATIONALE	Notes on assessment decision
	STOP_NOTE	Additional notes including relevé number
Future Prospects	NSUH_SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	ANNEX_I	Annex I habitat code
	IMPACT_CODE	From most recent EU list
	INTENSITY	High (H), Medium (M) or Low (L)
	INFLUENCE	Positive, Negative or Neutral
	%_HABITAT_AREA	% of habitat impacted upon
	SOURCE	Inside or Outside
	SCORE	Overall impacts score
	TREND	Improving, Disimproving, None or Unknown

Table	Field	Values
Overall Assessment	NSUH _SITE_NO	NSUH site number
	SAC_CODE	(c)SAC code
	ANNEX_I	Annex I habitat code
	HECTARAGE	Area of habitat within survey site
	AREA	Favourable, Unfavourable – Inadequate, Unfavourable - Bad
	FUTURE PROSPECTS	Favourable, Unfavourable – Inadequate, Unfavourable - Bad
	STRUCTURE AND FUNCTIONS	Favourable, Unfavourable – Inadequate, Unfavourable - Bad
	OVERALL ASSESSMENT	Favourable, Unfavourable – Inadequate, Unfavourable - Bad