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

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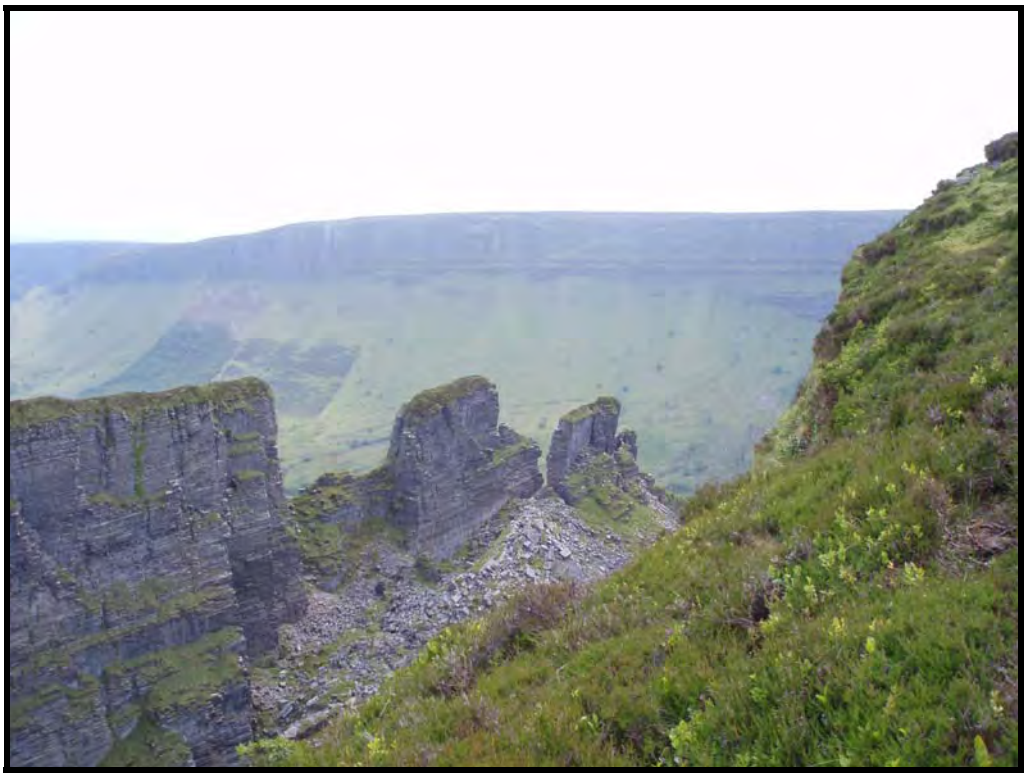

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Environment, Heritage and Local Government

Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland.
Version 1.0

April 2010

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HEALTH AND SAFETY

Health and safety is a very serious consideration for field surveyors. The following guidance is based on common sense and the experience of BEC Consultants Ltd. working in upland areas. Please note that people following these guidelines do so at their own risk and neither BEC Consultants Ltd. nor the Department of the Environment, Heritage & Local Government can be held accountable for accident or injury to anyone following them.

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 health and safety statement to reflect the survey methodology should be completed by surveyors prior to commencement of surveys. Problems can be prevented through training, adherence to health and safety protocols and the use of the correct equipment, kept in good condition. Clear communication and accurate navigation are of paramount importance. In the event of a health and safety incident, common sense is imperative as circumstances will vary in every case.

- Surveyors should be aware of the regional weather forecast for the area and arrange work accordingly.
- Surveyors should be aware of their location and direction at all times. As a general rule, they should check their position on a map and a GPS receiver at least once every 250 m. A compass should be within easy reach at all times.
- The use of GPS waypoints is recommended when navigating through difficult terrain, especially if there is a possibility of having to return in bad weather conditions or poor light.
- Surveyors should operate in the field in pairs or larger teams and be no more than 1 km apart from their nearest co-worker at any time.
- Surveyors should carry printed copies of phone numbers of all team members, the project coordinator, Mountain Rescue and regional NPWS staff at all times.
- Surveyors should plan in advance which specific polygons or areas they will survey each day, with contingencies for bad weather when it may be unsafe to survey high altitude areas, and should ensure that other surveyors on the same site and staff not in the field are aware of their plans.
- The use of satellite phones should be considered in upland areas with poor mobile phone reception.
- Surveyors should check in with each other by phone at scheduled times during the day, and more frequently when working in difficult terrain.
- Dangerously steep areas should be avoided and can be surveyed using binoculars, with reference to aerial photographs.
- Equipment weight should be minimised where possible to prevent fatigue. A balance must be struck between ensuring that surveyors are well prepared and overburdening them. The lightest forms of reliable equipment are therefore an essential requirement.
- Surveyors must carry an adequate supply of water as, due to the high numbers of herbivores present in the uplands, drinking from mountain streams is not recommended.

- A spare key should be left near the vehicles so that other members of the survey team can get immediate access to shelter if they return early, are unwell or fatigued.

- In case of thunder or lightning, surveyors at relatively low altitudes and not in an exposed location should leave the hill. If lightning is observed or if in an exposed location, then surveyors should lie down in the nearest concavity until the danger has passed.

- In the event of a surveyor being late to a meeting point, their colleague should wait at the meeting point for at least an hour. They should not go looking for the latecomer. It is vital to remain available for communication, so if there is no mobile phone reception, surveyors should move to a location with a better signal, leaving a conspicuous note or sign to show where they have gone. Mountain rescue services should only be alerted 2-3 hours after failure to return. **Dial 999/112 and ask for "Mountain Rescue".** You will be put through to the local Garda station where the situation will be assessed and the rescue team alerted.

CONTENTS

EXECUTIVE SUMMARY

Uplands form our largest expanses of semi-natural landscape and support numerous habitats listed under Annex I of the EU Habitats Directive. Upland habitats are defined as unenclosed areas of land over 150 m and contiguous areas of related habitat that extend below this altitude. This manual provides guidance on conducting a proposed National Survey of Upland Habitats (NSUH) in Ireland that will focus on mapping, recording and assessing their vegetation and habitat conservation status. The survey maps and data would assist National Parks and Wildlife Service (NPWS) in meeting Ireland's conservation obligations for upland habitats under the Habitats Directive, and contribute significantly towards the production of a classification system for upland plant communities.

Guidance is provided on health, safety and navigation which are of paramount importance when conducting fieldwork in upland habitats. All fieldworkers must be aware of the project's safety protocols and be suitably equipped. Advice is provided on the timing of field surveys, negotiating with landowners, required equipment and contacting local officials.

Advantage should be made throughout the field survey of digital recording in the field by utilising Personal Data Assistants and 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 working in survey teams of at least four people, one of whom should be a team leader with considerable experience of upland habitats. The survey teams should report to a project co-ordinator who would liaise with NPWS. The survey teams and project co-ordinator should be supported in and out of the field by an IT technician with knowledge of all software and hardware employed. All fieldworkers should receive training in the methodology, equipment and safety protocols employed. Advice is provided on data collection procedures and data storage formats.

Selected sites should be mapped through ground-truthing of pre-defined polygon maps produced by aerial photograph interpretation prior to fieldwork. Polygons should reflect areas of consistent vegetation mosaic or topography. Habitats Directive Annex I and Fossitt (2000) habitat categories should be mapped. Additional information on vegetation communities should be recorded through the use of a provisional vegetation classification that can be refined as more relevé data accumulates.

Conservation assessment of key Annex I habitats at a site level should be conducted through examination of data on area, future prospects, and structure and function. Assessment of area and changes in area is partly a desk-based exercise. Surveyors should make note of any obvious losses (or potentially, gains) in habitat, such as afforestation, landslides or new windfarms. Structure and function 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 digitally using the latest Irish species checklist in TurbovegCE. Monitoring stops should be assessed using indicator species and

criteria thresholds detailed 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, summary data on conservation assessment and extent of habitats present, with maps showing the dominant Annex I and Fossitt habitat types and other site data as required by NPWS. Feedback in the form of non-technical summaries should be made available to interested landowners. Conservation assessment data should be entered into a Microsoft Access database and guidance is provided on the structure of this database. Regular multivariate analysis of the relevé database as it expands should be undertaken to refine the provisional vegetation classification system.

NPWS may qualify, augment or update these guidelines as deemed necessary at any stage, hence this edition of the manual is version 1.0.

ACKNOWLEDGEMENTS

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The authors would like to extend their gratitude to the following people who assisted in the compilation of this survey manual and in the *Scoping Study and Pilot Survey for a National Survey and Conservation Assessment of Upland Vegetation and Habitats in Ireland* (Perrin *et al.* 2009) on which it is largely based:

landowners/shareholders who provided site information and permitted access to their lands for the purposes of the pilot surveys;

all staff at NPWS who contributed to this project including Caitriona Douglas, (Naomi Kingston, Deirdre Lynn, Gemma Weir, Marie Dromey, Rebecca Jeffrey, Neil Lockhart, Rob Ovington, Mel Conway, Terence O' Rourke, Noreen Grealis, Lee McDaid, Sue Callaghan, Eoin McGreal, Tim Roderick. Gratitude for assistance is also extended to the following people: Orla Daly, Fionnuala O'Neill, Jim Martin, Kate McNutt, Una Fitzpatrick, David Holyoak, Rory Hodd, John Douglass, Catherine Farrell, Colmán Ó Críodáin, Fiona Dunne, Anne-Marie McKee, Alistair Headley, Angus McDonald and Graham Sullivan.

INTRODUCTION

General background

The uplands form our largest expanses of semi-natural habitats. They include areas of great scenic beauty, forming inspirational landscapes with a sense of wilderness and space. Irish upland habitats include blanket bog, heath, flushes, grassland and communities associated with exposed rock and scree. Almost 19% of Ireland can be considered to support upland habitats (Perrin *et al.* 2009). The importance of these areas to plant and animal conservation is unquestionable, with numerous habitat types listed under Annex I of the EU Habitats Directive and many rare and threatened bird and animal species being recorded in these areas. Furthermore, over 40% of the total terrestrial area designated as candidate Special Area of Conservation (cSAC) in Ireland is over 150 m in altitude.

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

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

Box 1. Definition of upland habitat

For the purposes of proposed upland survey, upland habitats are defined as unenclosed areas of land over 150 m altitude, and contiguous lowland areas of related habitats. The principal upland habitats comprise blanket bog, heaths, flushes, dense bracken, habitats of exposed rock and scree, and semi-natural grasslands. Several of these regularly occur together as mosaics, with transitions resulting from changes in topography, edaphic conditions, drainage, management or microclimate. Unenclosed lands are defined as those outside man-made boundaries that are semi-improved or unimproved – they tend to be used primarily for rough grazing. Semi-improved or unimproved lands demarcated by ineffective boundaries are also regarded as 'unenclosed' and thus within the remit of proposed survey. Fencing to denote property boundaries is a relatively recent phenomenon in the uplands and may contain significant areas of unimproved or semi-improved lands that are considered within the remit of proposed survey.

National Survey of Upland Habitats

A National Survey of Upland Habitats (NSUH) has been proposed by the National Parks and Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government.

The main aims of a proposed NSUH are to:

- survey a representative sample of the national resource of the full range of upland habitats in Ireland
- map the location, extent and condition of habitats recorded and to produce baseline maps
- map the distribution of rare and threatened upland flora
- conduct a baseline conservation assessment of Annex I upland habitats
- devise a classification system for upland vegetation based on analyses of vegetation relevés
- provide data to facilitate comparative evaluation of conservation value
- identify impacts, threats and trends especially in relation to Annex I habitat condition

A *Scoping Study and Pilot Survey for a National Survey and Conservation Assessment of Upland Vegetation and Habitats in Ireland* (Perrin *et al.* 2009), was commissioned by NPWS and completed by BEC Consultants Ltd. with the primary remit of devising an efficient strategy for conducting an NSUH. The recommendations set out in this survey manual are based on the findings of that scoping study and pilot survey, which should be referred to for the rationale behind the recommended methodology. The manual provides step-by-step guidance on conducting a national survey of upland habitats in Ireland. It is 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 a proposed survey, from pre-survey planning, through field survey and conservation assessment, to post-survey digitisation, data analysis and report writing. Hence this survey manual should be relevant to all personnel involved in an upland survey including NPWS, fieldworkers, survey co-ordinators and those providing GIS support.

A valuable overview and source of information and general guidance on habitat survey and mapping in Ireland is provided by Smith *et al.* (2010), however it is important to note that the methodologies as specified within the current document are devised to meet the particular objectives, as summarized above, of a proposed national survey of upland habitats.

Upland habitats

Habitats listed under Annex I of the EU Habitats Directive that occur in the Irish uplands are presented in Tables 1 and 2. The habitats that are the primary focus of the proposed NSUH are shown in Table 1; these are the habitats that require mapping and conservation assessment as part of a NSUH to facilitate habitat conservation management and reporting under Article 17 of the EU Habitats Directive. Isolated areas of these habitats that occur below 150 m are not within the remit of the project.

For the Annex I habitats that occur in the uplands but which are not the primary focus of this survey (Table 2), the location and extent of these habitats will be mapped but conservation assessments will not generally be conducted. Vegetation of Annex 1 habitat upland alkaline fens should be recorded. Non-Annex I habitats such as dense bracken and poor fen flushes should also

be mapped, but again there will be no conservation assessment of these habitats. Detailed description of forestry plantations is not required but their location and average canopy height should be recorded where they occur within a surveyed cSAC or designated site.

It should be noted there are two Annex 1 habitats listed in the Table 2, Siliceous alpine and boreal grasslands (6150) and Alpine and Sub-alpine calcareous grasslands (6170) which were not recorded in Ireland prior to Perrin *et al.* (2009), although they are recognised as occurring in Northern Ireland. Similarly, the habitat Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430) had previously only been recorded in a lowland context in Ireland but Perrin *et al.* (2009) recorded it in an upland ledge context similar to that found in the UK.

Table 1 Annex I habitats that occur in Irish uplands and which are primary focus habitats for this project.

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

* Denotes a priority habitat under the EU Habitats Directive

All habitats encountered within survey areas are to be recorded using the classification scheme of Fossitt (2000). The following habitat categories will be the main ones recorded in upland areas:

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

Table 2 Annex I habitats that are known or thought to in Irish uplands which are not primary focus habitats for this project.

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

* Denotes a priority habitat under the EU Habitats Directive

Survey structure

Project co-ordinator

A national survey of upland habitats should have a project co-ordinator who is responsible for ongoing project management 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 would be met.

The quality assurance aspect of this role would require the project co-ordinator to carry out periodic quality control checks on survey procedures, species identification and data recording techniques and to ensure that each surveyor or team of surveyors is producing consistent and comparable output. This would involve a period spent accompanying the survey team(s) during

each field survey season and also overseeing the post-survey collation of datasets and preparation of site survey maps.

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 as 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 would need to have a competant working knowledge of ArcGIS software (ESRI, Redlands, California).

If for any reason there are surveyors with limited upland experience engaged at any stage of a proposed survey there should be no more than two 'trainees' per team. All surveyors would require good botanical identification skills. The ability to identify vegetative grasses, sedges, (particularly *Carex* spp.), upland lichens (particularly *Cladonia* spp.) and bryophytes (particularly *Campylopus, Polytrichum, Polytrichastrum* and *Sphagnum* spp.) is desirable. 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. Potential candidates should have at least some navigation experience, although these skills can be further developed during the training period.

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 the 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.

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 (Anon. 2007) and the current version of the provisional upland vegetation classification scheme (see Appendix I) would be necessary. The length of the training period should be tailored to the previous experience of surveyors.

Training should include identification in the field and laboratory of vegetative graminoids upland lichens and upland bryophytes. Training should also include familiarisation and practice with the

recommended mapping, relevé and conservation assessment methodologies and the relevant equipment and software.

Training should 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 field teams.

Surveying approaches

During the *Scoping Study and Pilot Survey of Upland Habitats in Ireland* (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.

Mapping mosaics

Most upland slopes are mosaics, with intricate patterns of hollows, rocky outcrops, flushes and terraces that are far too complex to map separately in the conventional fashion, hence the adoption of an approach of mapping polygons that reflect consistent mosaics. 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 using mosaics.

When recording the habitats that occur within mosaic polygons, the dominant habitat approach should *not* be taken. Habitats that typically occur as small features (e.g. base-rich flushes and bog hollows) and other subordinate elements in mosaic polygons are under-represented through use of the dominant habitat approach, information is lost and these polygons are effectively devalued in terms of their conservation interest. Hence, the approach taken for recording mosaic polygons is to record *all* the vegetation types present and the approximate percentage of the polygon they cover. As the total area of each polygon will be known, data on the approximate extent of each habitat can be readily calculated.

Provisional upland vegetation classification scheme

The primary aim of the mapping procedure is to record habitats using Annex I categories and those of Fossitt (2000). 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 purely on this scale during a NSUH would result in a missed opportunity to record information on the nature and distribution of upland vegetation that would provide the basis for effective conservation management at site and national scales.

It was therefore decided to produce a provisional classification of upland vegetation types to record supplementary information during a proposed NSUH. Initially, it was subjectively produced and based on White & Doyle (1982), the British National Vegetation Classification (NVC; Rodwell 1991, 1992) and expert judgement. This was then refined following multivariate analysis

of relevé data from the pilot survey and other available relevé datasets from upland habitats (Perrin *et al.* 2009). The level of detail of this provisional classification is equivalent to that of the British NVC, which Rodwell (1991, 1992) envisaged as a key tool for monitoring habitat change. It is presented in Appendix I.

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 broad scale habitat classification of Fossitt (2000), and a reduction in the likelihood of sensitive or unusual habitats of high conservation value, such as hepatic mats, being overlooked.

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 a NSUH. Relevé data collected during such a survey would ultimately be used to produce a more comprehensive national classification.

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 are much less expensive. 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.

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 the preparation of the materials necessary to carry out the field survey.

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 upland monitoring network. These lists include candidate 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 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 cSACs only)
- representativity of the Qualifying Interests (for cSACs 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 spread, geology and 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; 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 sometimes part of the area of unenclosed upland habitats may extend beyond the designated site boundary. Conversely, many designated sites will contain areas of lowland or enclosed habitats that are outside the remit of the proposed survey and should be excluded. Potential survey areas for undesignated sites would need to be defined with the aid of aerial photograph interpretation and any other available, relevant data. It is important that there is liaison during site selection with staff managing other ongoing NPWS projects, such as the Irish Semi-natural Grassland Survey, to ensure that there is no overlap. This may be particularly important when selecting undesignated sites.

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 and the National Biodiversity Data Centre; Site Synopses and the lists of Qualifying Interests for designated sites; previous survey data; relevant historical literature and research theses and papers.

Preparation of pre-survey maps

The recommended method of vegetation or habitat mapping is to pre-define vegetation or habitat units (polygons) within each selected site, which field surveyors can subsequently ground-truth. As explained on page 10, 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 vegetation type, is inappropriate here. Instead, it is necessary to draw polygons that represent consistent vegetation mosaics or, in some cases, consistent topography.

Aerial photograph interpretation (API) and digitisation of polygons within selected sites should be conducted as a desk-based GIS exercise in good time before the fieldwork period. 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 1:5000. API and digitisation should be conducted by a small team overseen by the project co-ordinator to ensure consistency of approach and interpretation. Contour polylines should always be used to assist in interpretation of topography. Polygons should be assigned preliminary number codes which can be revised as required in the field as a result of subdivision or merging. Digitisation prior to going into the field will ensure that multiple copies of the paper maps can be created while maintaining consistency in the polygon boundaries and their polygon numbering. Where sites are to be surveyed by a team of surveyors this creates a recognised framework for surveying prior to commencement of fieldwork. There is no requirement for interpreted habitat types to be assigned to polygons at this stage.

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 vegetation or 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 boundaries of designated sites should also be indicated on the field maps.

Technical provision for surveyors

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

vegetation types. Standardised recording sheets should also be provided on waterproof paper for use in the event of technical failure.

For the purpose of relevé recording, mappers / PDAs for use in the field should be installed with TurbovegCE software. This should have a customised NSUH database uploaded, based on the current NBDC species checklist (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, 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:

- 1:10,260 six-inch maps
- 1:100,000 GSI bedrock geology map
- Ordnance Survey Ireland rivers and streams polylines
- NPWS conservation site shape files (cSACs, SPAs, NHAs and pNHAs)

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

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

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

It would be essential that all electronic equipment (mobile phones, cameras, PDAs, mappers and GPS units) are 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 support differential correction through EGNOS (European Geostationary Navigation Overlay Service) to improve precision.

Outreach

Prior to each field season, contact should be made with regional bodies and their officers in the areas in which survey work is to be conducted. This is not only a matter of courtesy but can help to increase understanding and co-operation. The relevant NPWS District Conservation Officers

should be contacted with a list of the proposed survey sites. NPWS wildlife 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: www.npws.ie/en/ContactUs.

Field season planning

It would be 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.

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 Annex I upland habitats are given in Table 3. If assessment is carried out at a sub-optimal time it should be noted accordingly in the report.

Table 3. Optimal months for assessing Annex I habitats. Dark grey denotes ideal months for assessing the relevant habitats. Light grey denotes other acceptable months. (Adapted from JNCC 2009)

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

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

Field bases

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

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.

FIELD SURVEY

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 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 or active commonage shareholders in person. This process should begin at an early stage of fieldwork and the time required should not be underestimated. The contact details for key figures can often be obtained by consulting the local NPWS Conservation Ranger and local IFA representatives. These key figures can provide the names and addresses of other shareholders.

It is important to inform people that the survey is being carried out for NPWS, which is part of the Department of Environment, Heritage and Local Government. Copies of letters of introduction from NPWS, identification cards and details of the surveyor's insurance cover should be to hand.

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.

Navigation, health and safety

Health and safety is a very serious consideration for field surveyors, especially in the uplands. Problems can be prevented through training, adherence to health and safety protocols, the use of the correct equipment kept in good condition and adherence to weather forecasts and local weather conditions. 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. In addition to the health and safety advice given at the start of this document, surveyors should adhere to the following safety procedures.

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.

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

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

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

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

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

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.

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

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

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

hours after failure to return, as in practice calls earlier than this will probably be treated as a preliminary alert.

Equipment

Surveyors should carry the recommended health and safety equipment listed on pages 14-15 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.

Miscellaneous

A spare vehicle key should be left at an agreed location 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 lightning is observed or if in an exposed location, then one should lie down in the nearest concavity until the danger has passed, i.e. until there has been no thunder or lightning for 20-30 minutes, intense rain has slackened or cloud has become less dense.

Vegetation mapping

The pre-digitised polygons, each of which represents a consistent vegetation mosaic, should be surveyed by walking a zigzag transect through them whenever possible. The aim should be for all polygons to be surveyed in detail. In practice, however, some areas may be surveyed in less detail due to bad weather, or by using binoculars if the polygon is dangerously steep (e.g. corrie walls). Specific features that appear within a polygon on the aerial photographs, such as basins, terraces, flushes, scree or rock outcrops, should be investigated to check for additional vegetation types. Whenever possible, surveyors should navigate to a point which gives them a clear view over the whole polygon, although in the Irish uplands visibility can often be impeded by topography or adverse conditions such as low light levels, mist or heavy rain. From these vantage points the relationship between the different vegetation types and the colouration of the aerial photograph can be established.

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 (Appendix I) and each non-vegetated substrate (e.g. bare peat, bedrock, loose rock, scree, gravel, open water, running water) recorded within each polygon. For each element recorded the relevant Annex I and Fossitt (2000) habitat types should be noted, heeding the guidance provided in Appendix I and Boxes 2 and 3. 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 for each of the three levels of recording should be calculated to ensure that it totals 100%. Therefore if an element does not correspond to an Annex I habitat it should be recorded as 'non-Annex' and the relevant cover score be added. If additional notes on the polygons are recorded standardised notes and abbreviations should be used as far as possible.

Box 2. Active and inactive blanket bog

Areas of the Annex I habitat Blanket bogs (7130) are priority habitat if they are active. 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. and several other species higher plant and moss species e.g. *Racomitrium lanuginosum* are also reported to be peat-forming. The conservation assessment of Irish blanket bogs summarised in *The Status of EU Protected Habitats and Species in Ireland* (NPWS 2008) did not report separately on active and inactive blanket bog habitats but effort should be made in a national survey to distinguish these two elements. Areas of non-eroding bog with characteristic blanket bog species will typically be active, priority habitat *7130. No distinction is made between active or inactive bog when conducting or planning monitoring stops.

The intensity of the survey carried out for each polygon should also be recorded on an arbitrary scale of 1-3:

1. Surveyed on the ground in detail
2. Surveyed using binoculars
3. Surveyed using API only

The aim should be for all polygons to be surveyed in detail. However, in practical terms some areas may be surveyed in less detail using binoculars if, for instance, the polygon is very steep.

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

Box 3. Correspondence of Annex I habitats, Fossitt habitats and provisional vegetation types

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 2008) and these sources should be referred to 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 Lowland blanket bog (PB3), but not in Wet heath (HH3). However, Anon. (2007) specifically mentions the M14 *Schoenus nigricans – Narthecium ossifragum* mire of Rodwell (1991) under Northern Atlantic wet heaths with *Erica tetralix* (4010), as well as listing the species under Blanket bogs (7130). Thus, wet heath with *S. nigricans* and *E. tetralix*, vegetation type WH1 under the provisional classification, should be recorded as habitat 4010 under the Annex I habitat scheme and habitat HH3 under the Fossitt scheme. Similarly, whilst Fossitt (2000) states that *Juncus squarrosus* may occur in Wet heath (HH3) but not in Upland blanket bog (PB2), Anon. (2007) lists M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire under Blanket bogs (7130), a habitat in which *Juncus squarrosus* may be abundant. Thus, the provisional vegetation type BB5b *Calluna vulgaris – Eriophorum* spp. with *Juncus squarrosus* should be recorded as habitat *7130 under the Annex I scheme and habitat PB2 under the Fossitt scheme. Whilst Rodwell (1991) is based on British vegetation, the occurrence of both M14 and M19 type vegetation in Ireland was confirmed by Perrin *et al.* (2009).

Waypoints should be used to target-note habitats and species of note in addition to other features of interest. Hepatic mats should be recorded using waypoints and guidance nots for this internationally important habitat are given in Box 4. Waypoint notes should be made on areas of forestry, recording the approximate height of trees and the density of planting. Waypoints should also be used to record the location photos are taken from in addition to helpful navigation points such as the location for safely crossing a stream or where 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.

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

Box 4. Northern hepatic mats

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

Assessment of structure and function

Overview of conservation assessment

Conservation assessments for Annex I habitats consist of three main aspects: area, future prospects, and structure and function. Assessment of area and changes in area is partly a desk-based exercise and guidance is given in the post-survey section on page 31. When in the field, surveyors should however make note using waypoints of any obvious losses (or potentially, gains) in habitat, such as afforestation, landslides or new 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, turf-cutting and invasive species. Structure and function relates to the occurrence of habitat-typical floristics and environmental parameters and is assessed largely in the field through the collection of specific, detailed data. Hence, guidance on this aspect is presented here.

Scale of assessment

Assessments of structure and function criteria are intended to be conducted through the recording of a series of monitoring stops generally 2 m x 2 m in size (see page 25). Most criteria are assessed within the plots themselves, but some are assessed within the local vicinity; the area of the habitat that can be meaningfully seen from the plot. This area will vary considerably, but will tend to be in the order of a 50-100 m radius. The time taken to complete the assessment stop will vary by habitat and surveyor experience. Blanket bog, for example, will take longer than alpine and boreal heaths, while siliceous scree will be relatively quick. Assessments will usually be accompanied by a full relevé. As some of the relevé data is used for the assessment it should take 5-10 minutes to assess a

stop where a relevé has already been recorded. If no relevé has been recorded the assessment should take 15-20 minutes.

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 required for larger areas. Guidance on the number of monitoring stops required is presented in Table 4. To facilitate the overall assessment of the structure and function status of a habitat (page 34), it is convenient for monitoring stops to be recorded in multiples of four, but this is not essential.

For scree and rocky slope habitats (Siliceous scree 8110, Calcareous scree 8120, Calcareous rocky slopes 8210 and Siliceous rocky slopes 8220) the number of stops may be influenced by the degree of safe access. Siliceous scree (8110) and Siliceous rocky slopes (8220) are generally very robust and unattractive to herbivores, therefore fewer monitoring stops may be required. Where specific impacts are evident at a site or where it is suspected that the condition of the habitat has changed, a greater number of monitoring stops may be required.

Table 4. Proposed number of monitoring stops for different areas of habitat

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

Establishing the distribution of monitoring stops across a site

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

A large number of random monitoring points should be generated at the site or section level, approximately 500-1000 points for every 10 km^2. For each Annex I habitat to be assessed a threshold area should be decided upon based subjectively on the total area of that habitat at the site/section. The use of thresholds should ensure that monitoring is focussed on the larger areas of a given habitat. Polygons that contain greater than this threshold area of habitat form a sampling

area. For abundant habitats a threshold area of 10-20 ha could be used, whereas for rarer habitats a threshold of 0.5 ha or less may be suitable. Within the sampling area, a number of monitoring points are selected equal to the number of required monitoring stops, starting with the point with the lowest number.

For abundant habitats, the surveyor should navigate to the coordinates of each monitoring point in turn using a GPS. If the habitat to be monitored does not occur at those co-ordinates it will be necessary to radiate out from this point until the relevant habitat is found; if it is not found within 200 m the surveyor should proceed to the nearest random monitoring point within the sampling area that has not yet been selected. The first example of the target habitat encountered should be monitored, though care should be taken not to assess marginal or transitional examples of the habitat. The GPS location of the actual monitoring stop must be recorded. It will then be evident when the monitoring stop location is different from the randomly generated point. For rarer habitats, the surveyor should simply use available information, such as aerial photographs, waypoints, and what can be seen on the ground to locate the nearest example of the habitat to a given monitoring point. Exact positions of monitoring stops should be decided upon on an arbitrary basis but without preconceived bias. For scree and rocky slope habitats (8120, 8110, 8210 and 8220) placement of plots will also be influenced by the degree of safe access.

Recording of relevés

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

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.

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.

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 and stored in a refrigerator until pH analysis is carried out.

The pH of field-fresh soil should be analysed as soon as possible, and no longer than one week after the soil sample was taken. Two replicates should be analysed for each soil sample. A 2:1 purified water to soil paste should be prepared and left to settle for five minutes. A pH meter should be used to measure the pH value, once it has stabilised. The pH data should be entered into a Microsoft Excel spreadsheet containing functions to correctly convert logarithmic pH values to linear hydrogen ion concentrations, calculate the mean of the two replicate values and reconvert this to a pH value. This spreadsheet should be backed up after entering any new data. Once pH analysis has been carried out, the soil samples should be air dried and delivered to NPWS for potential future analysis.

Monitoring stop photographs

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

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

Box 5. Assessment of Siliceous rocky slopes and chasmophytic vegetation (8220)

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

Assessing monitoring stops

Once all of the relevant criteria for a monitoring stop have been recorded, the stop can be given an overall assessment of Pass or Fail. Due to the natural variation in upland habitats, a certain number of criteria failures are permitted without triggering automatic failure for the monitoring stop. This varies by habitat as shown in Table 5. The three rocky habitats, (8110, 8120 and 8210) are judged to be relatively stable and robust and have therefore not been awarded any failure allowance. Similarly, the criteria developed by O'Neill *et al.* (2009) for Species rich *Nardus* grasslands (6230) do not permit any failure criteria.

Table 5. No. of criteria for each Annex I habitat and maximum no. of criteria allowed to fail without resulting in failure of the monitoring stop.

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

*Only 14 targets applicable to any one regional variant

(Note: Assessment criteria have yet to be devised for Silicious Rocky Slopes (Annex1 Habitat Code 8220)

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 cSAC, 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 taking of soil samples should be conducted in an identical fashion to the full monitoring stops. Note that sampling is *not* required from aquatic or forested habitats, only from terrestrial and wetland habitats.

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 view and a compass bearing. This will permit site photographs to be subsequently linked to the digital habitat map. Photographs which are associated with a waypoint should be labelled in the following fashion: [site number]-W[photo number]-[Photographer's initials]. For example, 009-W020-SB.jpg would be the photograph associated with waypoint number 20 for site number 9, taken by Simon Barron. If more than one photo is taken for a particular waypoint, the photograph number should be appended with a,b,c etc. For general site photos which are not associated with a waypoint, these should be labelled [site number]-S[photo number]-[Photographer's initials]. Photographs should be sorted and labelled as soon as possible as it can often be difficult to recollect specific locations at a later date.

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.

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, species names as unambiguous 4-4 codes as shown on paper recording sheet (Appendix IV). Otherwise they should be removed and 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.

Checklists of daily/weekly tasks

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

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 pages 14-15).

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 refrigerate soil samples. 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 with irrelevant or duplicate photos being deleted.

Weekly tasks

- Transfer data from paper recording sheets to digital format.
- Back up all data that is stored on PCs (including relevé data, conservation assessments, waypoint data, and photos) both on-site and to an off-site location.
- Conduct soil pH analysis within one week of the soil sample being taken.
- Ensure that all refrigerated voucher specimens of higher plants have been identified.

POST-SURVEY STAGE

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, errant soil samples analysed and any remaining lichen or bryophyte voucher specimens forwarded to the Project Co-ordinator for despatch to a 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.

Conservation status assessment

Overview

As stated above on page 23, conservation assessments for Annex I habitats consist of three main aspects: area, future prospects, and structure and function. Data for the assessment of structure and function is gathered through the recording of 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 function. Once each of these aspects has been considered, an overall assessment of the conservation status of a habitat at a particular site can be made using the criteria in Table 6.

Area

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

Therefore, unless they have occurred at a landscape level it can be difficult to detect changes in the area of a particular habitat in an upland context. The critical threshold established by the EU is a change of 1% (see Table 6) but in practice it will usually only be possible to detect changes in habitat area of the order of 5% or perhaps, on larger sites, even 10%.

As a proposed NSUH would essentially be conducting a baseline habitat mapping survey there are even greater difficulties in assessing this aspect as there are no comparable data to work with. Theoretically, the assessment should be based on any change in area since the EU Habitats

Directive came into force in 1994; subsequent monitoring will assess whether there has been any change since the previous assessment.

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

Parameter	**Conservation status**			
	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 function	Structures and functions (including typical species) in good condition and no significant deteriorations / pressures.	Any other combination	More than **25%** of the area is unfavourable as regards its specific structures and functions (including typical species)	*No or insufficient reliable information available*
Future prospects	The habitat's prospects for its future are excellent / good, no significant impact from threats expected; long-term viability assured.	Any other combination	The habitat's prospects are bad, severe impact from threats expected; long-term viability not assured	*No or insufficient reliable information available*
Overall assessment of 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 field survey. Such changes would include mechanised turf-cutting of previously intact bogs, afforestation, the development of windfarms, roads or tracks, and large-scale erosion due to bog bursts or land slips. These changes may also be detected through a comparison of contemporary and past aerial photographs, which will ease quantification; national sets of aerial photographs are available in digital format for *c.*2000 and *c.*2005. Areas of the scree habitats (8110 and 8120) tend to occur as obviously discrete areas and should prove easier to assess using aerial photographs. Local NPWS staff may also be aware of major changes in the extent of a habitat at a particular site. As a rule of thumb, the proposed NSUH should assess a habitat as favourable in terms of area unless there is obvious evidence of recent habitat loss. Once monitoring stops have been established, any changes

in the habitat found at these stops in future monitoring cycles could also contribute to the assessment of area.

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

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

Future prospects

The future prospects assessment refers to the overall outlook for both the area covered by the habitat on the relevant site and its specific structures and functions. The future prospects 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 should be recorded using the relevant impact code from the list provided in Appendix VII. Following Ssymank (2009), for each of the impacts recorded at a site the nature of the influence should also be recorded as positive, neutral or negative. The intensity of effect should be indicated as high, medium or low. The percentage area of the habitat impacted upon should be recorded and if there is a discernible trend in the intensity of the impact or activity relative to previous assessments or based on other available data, then this should also be noted as increasing or decreasing. In addition, the source of the impact, whether inside or outside the habitat, should be recorded.

Land-use, impacts and threats would mainly be recorded for a site on the basis of observations during field survey, but these would need to be augmented by information from other sources such as local NPWS staff, local residents and farmers 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 towards their development 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 if 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, hepatic mat communities or *Sphagnum*-rich habitats are likely to be much more vulnerable to high levels of trampling than *Nardus* or wind-clipped *Calluna*-dominated habitats.

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

Maximum use should be made of the data collected by recent commonage surveys and subsequent re-surveys which facilitated the drawing up of Commonage Framework Plans (CFPs) by NPWS and Department of Agriculture, Food and Forestry. These surveys sampled more than 450,000 of land that consists primarily of upland, blanket bog and heath in order to evaluate impacts of stock on these areas and to recommend stock reductions or other measures to allow recovery of degraded areas. The CFP manual (Anon. 1998) should be referred to for further information.

Structure and function

Using the results of the monitoring stops, an overall assessment of structure and function for a habitat can be given following the guidelines in Table 7.

Table 7. Determining site level results for structure and function.

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

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.

Outputs

The preliminary polygons digitised by API 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 GIS project should then be produced comprising:

- a fully populated habitat polygon map with additional fields for dominant provisional vegetation type, Fossitt (2000) and Annex I habitat types
- waypoint target notes with hyperlinked notes and site photographs
- monitoring stops as point shapefiles with hyperlinked photographs and assessment results
- additional relevé locations as point shapefiles with hyperlinked photographs

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

- a map showing the boundaries of the survey area over the aerial photographs
- a map of the dominant Annex I habitat types within the survey area
- a map of the dominant Fossitt (2000) habitat types within the survey area
- a map showing location and summary results of monitoring stops and location of relevés, existing and new survey records for rare and threatened species, survey photographs and target notes recorded
- gradated maps showing the frequency within polygons of Annex I habitats and selected Fossitt habitats
- maps for use in the field showing the re-digitised polygons over Ordnance Survey orthorectified aerial photographs, with amended site numbers, habitat identification code, contours and designated site boundaries on A3 sheets at a scale of 1:10,000.
- Infromative map titles, clear labeling including full cSAC name, county and Natura Code.
-
- a written summary site description of the site
- a written analysis of the extent of vegetation or habitat types under Fossitt (2000) and Annex I habitat type schemes
- A summary of rare and threatened flora occurring on the site and threat status/protection status
- a written summary of the results of the conservation assessments for the Annex 1 habitats

Maps should be displayed on the Ordnance Survey raster series as a mapping base, however reduced to a manageable scale recommended by NPWS as 1:15,000. Where no specific map scale is stated maps should be prepared at a scale suitable for the clear display of the recorded information. For large sites printing on A0 sheets may be required. An example site summary report was prepared during the scoping study and pilot survey for Corraun Plateau (Roche *et al.* 2009) and the general approach for this site should be followed. For each year/phase of the survey, a Turboveg database containing all the recorded relevés and a version of the *NSUH Conservation Assessment Database* should be produced. All photos being submitted should be correctly labelled and stored in a single folder and a version of the NPWS Image Databank input spreadsheet should be completed.

Information dissemination

Non-technical summaries of site reports should be made available to interested landowners/commonage shareholders and an approach to this would have to be agreed with NPWS. Options include online publication of summaries alongside the main reports, posting copies of the summaries / reports to key local figures who can pass them on to those who are interested, a lecture or seminar that is open to the public or an open day, where NPWS local staff and members of the field team accompany members of the public to the sites, providing first-hand experience and some interpretation of the ecology. NPWS do not have the facilities for hosting

events except in some localities (e.g. National Parks offices); however local Biodiversity or Heritage Officers may also be of help in this respect.

Analysis of vegetation data

It would be important to periodically analyse the collected relevé data from the NSUH together with existing relevés from additional sources. The methods adopted for data preparation and analysis methods during the pilot survey are detailed in Perrin *et al.* (2009). Analysis should be conducted by someone who is experienced in multivariate analysis techniques. The results should be used to inform decisions as to whether it is necessary to amend or refine the provisional vegetation classification.

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APPENDIX I: PROVISIONAL CLASSIFICATION AND KEY FOR UPLAND HABITATS; VERSION 1.2

List of communities

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

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

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

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

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

Key to communities

1a	Pools, hollows or soakways in bog or wet heath (open areas dominated by *Carex viridula* subsp. *oedocarpa, C. panicea* or *E. quinqueflora* not included here)	**2**
1b	Bog, wet, damp or dry heath, montane vegetation, grassland, flushes or springs	**7**
1c	Well-irrigated, usually lushly vegetated ledges (or sometimes clefts) on rock outcrops	**33**
1d	Rock outcrops, loose rock, gravel or scree	**34**

2a	Shallow soakways / pools where *Potamogeton polygonifolius* is the most conspicuous species	**SW1**
2b	Not as above	**3**

3a	Obvious pools with *Menyanthes trifoliata* and, occasionally, *Carex limosa*.	**PO1**
3b	Hollows in bog or bog pools with no *Menyanthes trifoliata*	**4**

4a	Vegetation dominated by *Eleocharis multicaulis*	**HW4**
4b	*Eleocharis multicaulis* if present, only as a few scattered patches	**5**

5a	*Rhynchospora alba* (or *R. fusca*) conspicuous	**HW3**
5b	*Rhynchospora* spp. either absent or rare	**6**

6a	*Eriophorum angustifolium* overwhelmingly dominant with either no *Sphagnum* present or only *Sphagnum fallax* present	**HW2**
6b	*Sphagnum denticulatum* and/or *S. cuspidatum* dominant, usually accompanied by some *Trichophorum germanicum, Molinia caerulea, Narthecium ossifragum* or *Schoenus nigricans*	**HW1**

7a	Vegetation dominated by Nardo-Galion grass species (*Agrostis capillaris, Nardus stricta, Festuca ovina, Anthoxanthum odoratum* and *Deschampsia flexuosa)* or *Pteridium aquilinum* or grassy with both *Sesleria caerulea* and *Silene acaulis* prominent, **and** lacking any significant amounts of *Racomitrium lanuginosum*	**8**
7b	Vegetation not as above	**9**

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

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

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

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

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

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

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

15a	*Anthelia julacea* either co-dominant or at least very conspicuous, often accompanied by conspicuous amounts of mucilaginous algae and sometimes with big cushions of *Scapania undulata;* where *Anthelia julacea* occurs on more or less vertical rocks with seepage refer to RS1	**SPG3**

15b	*Anthelia julacea* absent or rare, vegetation dominated by extensive cushions of *Sphagnum inundatum/denticulatum, Philonotis fontana or Montia fontana. Dichodontium palustre* and *Chrysosplenium oppositifolium* are occasionally abundant	**SPG1**
15c	*Anthelia julacea* absent; vegetation dominated by the conspicuous golden/bronze-coloured moss *Palustriella commutata*; associates may include some of *Carex nigra, Festuca rubra, Bryum pseudotriquetrum, Carex viridula oedocarpa*	**SPG2**

16a	Sparse species-poor vegetation of flushed flat ground dominated by *Carex viridula/panice*a	**RFLU3**
16b	Relatively species-rich flush dominated by *Carex viridula/panicea* or *E. quinqueflora* with associates other than occasional bits of *Nardus stricta, Trichophorum germanicum* or *Juncus bulbosus*	**17**

17a	Flush with conspicuous amounts of *Eleocharis quinqueflora* accompanied by at least some brown mosses including *Campylium stellatum, Drepanocladus* spp. or *Scorpidium* spp.	**RFLU2**
17b	Flush lacking conspicuous amounts of *Eleocharis quinqueflora; Carex viridula* subsp. *oedocarpa* or *brachyrrhyncha* usually abundant and at least some brown mosses present. Other associates are *Carex dioica/hostiana, Pinguicula* spp., *Blindia acuta, Selaginella selaginoides*	**RFLU1**

18a	Bog vegetation on fairly deep peat (> 40 cm) or montane bog vegetation on shallower peat (> 10 cm) where at least three of *Eriophorum* spp., *Juncus squarrosus, Sphagnum capillifolium* and *Calluna vulgaris* are prominent	**19**
18b	Not as above - heath or montane vegetation	**23**

19a	Montane bog with at least three of *Eriophorum spp., Juncus squarrosus, Sphagnum capillifolium and Calluna vulgaris* prominent and accompanied by *Racomitrium lanuginosum* and *Empetrum nigrum* (*Cladonia arbuscula* also on higher summit ridges).	**BB6**
19b	Bog vegetation not as above	**20**

20a	*Schoenus nigricans* absent or very rare	**21**
20b	*Schoenus nigricans* conspicuous	**22**

21a	Bog vegetation dominated by mixture of *Calluna vulgaris* and *Eriophorum* spp.	**BB5**
21b	Relatively dry bog lacking any significant amounts of dwarf-shrubs and dominated by *Eriophorum* spp., *Trichophorum germanicum* and/or *Juncus squarrosus*	**BB4**
21c	Soft *Sphagnum*-rich bog with *Sphagnum papillosum* conspicuous and *Eriophorum vaginatum* present; *Narthecium ossifragum* and *Drosera rotundifolia* are usually present	**BB3**
21d	Degraded bog covered by often fragmented species-poor carpet of mosses: *Campylopus introflexus/flexuosus* and/or *Polytrichum* spp. dominant, sometimes accompanied by squamose *Cladonia*. Although typical of deeper peats, may occur on peat < 40 cm.	**DP1**

22a	*Schoenus nigricans* conspicuous and *Sphagnum* spp. at least frequent	**BB2**
22b	*Schoenus nigricans* conspicuous but *Sphagnum* spp. cover poor (deep peats)	**BB1**

23a	*Schoenus nigricans* conspicuous	**WH1**
23b	*Ulex gallii* conspicuous and/or *Daboecia cantabrica* present	**DH1**
23c	Prostate *Juniperus communis* subsp. nana and/or *Arctostaphylos uva-ursi* conspicuous (>5% cover)	**MH4**
23d	Vegetation not as above	**24**

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

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

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

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

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

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

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

31a	Montane wet heath *with Nardus stricta* dominant/co-dominant with *Trichophorum germanicum;* also present *Calluna vulgaris*, *Carex panicea*, some *Narthecium ossifragum*, scattered *Eriophorum angustifolium* and *Sphagnum denticulatum*; nearly always on slopes which are either very exposed or at altitudes > 250 m	**WH5**
31b	Wet heath with conspicuous *Trichophorum germanicum* but little *Nardus stricta*; vegetation is typically open with either rocks or bare peat patches frequent; other major species include *Cladonia* spp. and *Racomitrium lanuginosum*	**WH2**

31c	Wet heath on peat (rocks absent); dominated by at least two of following species: *Trichophorum germanicum*, *Eriophorum angustifolium*, *Calluna vulgaris*, *Juncus squarrosus*. *Sphagnum* cover varies from 0-50(-60)% and normally consists of *Sphagnum capillifolium*, *Sphagnum subnitens*, *Sphagnum palustre* or *Sphagnum tenellum – Sphagnum papillosum* is usually absent.	**WH4**

32a	Montane heath with *Nardus stricta* dominant/co-dominant with conspicuous amounts of *Racomitrium lanuginosum*; *Carex binervis* is typically present; *Trichophorum germanicum* should be present in either small amounts or otherwise clearly subordinate to *Nardus*.	**MH5**
32b	Montane dwarf shrub heath; *Nardus stricta* not dominant/co-dominant but vegetation still with conspicuous amounts of *Racomitrium lanuginosum; Calluna vulgaris* cover > 10% and typically wind-clipped	**MH1**
32c	Montane dwarf shrub heath on rocky areas, where *Nardus* absent or clearly sub-dominant; dominated by mixture of either *Vaccinium myrtillus* or *Empetrum nigrum* with *Racomitrium lanuginosum*; *Herbertus aduncus* or other hepatics often prominent; *Calluna vulgaris* absent or clearly subordinate to *Vaccinium myrtillus /Empetrum nigrum*	**MH2**
32d	Montane dwarf shrub heath, where *Nardus* absent or minor element of vegetation; dominated by combination of *Vaccinium myrtillus* with Nardo-Galion species, especially *Deschampsia flexuosa*, but also usually some of *Festuca vivipara*, *Anthoxanthum odoratum*, *Agrostis vinealis* and *Agrostis capillaris*; *Racomitrium lanuginosum* often prominent.	**MH3**

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

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

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

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

APPENDIX II: POLYGON RECORDING SHEET

Site no: 001 **Site name:** Corraun plateau **Surveyor:** Jenni Roche/Brendan O'Hanrahan

Polygon no.	Hab	Component 1	%	Component 2	%	Component 3	%	Component 4	%	Component 5	%	Component 6	%	Component 7	%
1	**Anx**	4010	20	7130	15	4010	20	4010	45						
	Fos	HH3	20	PB3	15	HH3	20	HH3	45						
	Veg	WH1a	20	BB1a	15	WH3	20	WH1b	45						
2	**Anx**	8110	10	8110	55	Non-annex		4060	25						
	Fos	ER3	10	ER3	55	ER1	10	HH4	25						
	Veg	SC1	10	Loose rock	55	Bedrock	10	MH4	25						
3	**Anx**	4060	5	4060	5	6150	15	8110	30	8110	45				
	Fos	HH4	5	HH4	5	HH4	15	ER3	30	ER3	45				
	Veg	MH4	5	MH5	5	MH7a	15	SC1	30	Loose rock	45				
4	**Anx**	8110	65	4060	35										
	Fos	ER3	65	HH4	35										
	Veg	SC1	65	MH4	35										
5	**Anx**	8110	100												
	Fos	ER3	100												
	Veg	SC1	100												
6	**Anx**	8110	100												
	Fos	ER3	100												
	Veg	SC1	100												
7	**Anx**	8110	50	4060	50										
	Fos	ER3	50	HH4	50										
	Veg	SC1	50	MH4	50										
8	**Anx**	8110	75	4060	25										
	Fos	ER3	75	HH4	25										
	Veg	SC1	75	MH4	25										
9	**Anx**	7130	15	Non-annex		Non-annex		4010	3	Non-annex		Non-annex		Non-annex	
	Fos	PB2	15	HH4	5	PB3	2	HH4	3	ER1	65	ED1	5	ER3	5
	Veg	BB6a	15	MH5	5	HW1	2	WH5	3	Bedrock	65	Gravel	5	Loose rock	5
10	**Anx**	Non-annex		4030	15	4010	10	Non-annex							
	Fos	HH4	65	HH3	15	HH4	10	ER3	10						
	Veg	MH5	65	HM2	15	WH5	10	Loose rock	10						

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(s) of assessment
Erica tetralix present	20m radius
Cover of positive indicator species ≥ 50% (Appendix VII)	4m²
Cover of ericoid species ≥ 20%	4m²
Cover of scattered native trees & shrubs < 20%	Local vicinity
Cover of *Pteridium aquilinum* < 10%	Local vicinity
Cover of non-native species < 1%	Local vicinity
Total cover of the following negative indicator species: *Agrostis capillaris, Holcus lanatus, Phragmites australis, Ranunculus repens, Deschampsia flexuosa* < 1%	4m²
Cover of *Juncus effusus* < 10%	Local vicinity
Cover of dwarf shrub species < 75%	4m²
Cover of graminoid species < 75%	4m²
Total cover of *Sphagnum* species, *Racomitrium lanuginosum*, *Cladonia* species and pleurocarpous mosses ≥ 10%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
Myrica gale shoots showing signs of browsing < 66%	4m²
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Local vicinity
No signs of burning inside boundaries of sensitive areas	Local vicinity
Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	Local vicinity
Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	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 within 5-10 m of watercourses.
(g) Areas above 400 m in altitude.
(h) Areas within 50 m of functioning drains.

European dry heaths (4030)

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

* Assess only the criteria relative to the regional variant being assessed.

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

Alpine and Boreal heaths (4060)

Criteria	Scale(s) of assessment
Number of bryophyte or non-crustose lichen species present ≥ 3	4m²
Cover of positive indicator species ≥ 66% (Appendix VII)	4m²
Cover of non-native species < 1%	4m²
Total cover of the following negative indicator species: *Agrostis capillaris, Cirsium arvense, C. vulgare, Holcus lanatus, Senecio jacobea, Ranunculus repens, Urtica dioica,* large *Rumex* species (except *R. acetosa*) < 20%	4m²
Live leaves of *Carex bigelowii, Deschampsia flexuosa, Festuca ovina, F.vivipara* showing signs of grazing collectively <10%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
No signs of burning inside feature	Local vicinity
Cover of disturbed, bare ground < 10%	4m²
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(s) of assessment
Number of positive indicator species present ≥ 7, one of these must be a high quality habitat indicator (Appendix VII)	4m²
Cover of non-native species ≤ 10%	4m²
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,* collective cover ≤ 20%, individual cover ≤ 10%	4m²
Total cover of the following negative bryophyte indicators: *Sphagnum* species ≤ 10%, *Polytrichum* species ≤ 25% cover	4m²
Forb component of Forb : graminoid ratio is from 20-90%	4m²
≥ 25% of the sward is from 5 to 50 cm tall	4m²
Cover of scrub, bracken, and heath ≤ 5%	4m²
Litter cover ≤ 20%	4m²
Cover of disturbed, bare ground ≤ 10%	4m²
No more than 20m² of the habitat is showing signs of serious grazing or disturbance	Local vicinity

Blanket bogs (*active only) (7130)

Criteria	Scale(s) of assessment
Number of positive indicator species present ≥ 7 (Appendix VII)	4m²
Cover of each of the following species: *Trichophorum germanicum*, *Molinia caerulea*, *Schoenus nigricans*, *Eleocharis multicaulis*, *Eriophorum vaginatum*, *Calluna vulgaris* < 70%	4m²
Cover of bryophyte or lichen species > 10%	4m²
Cover of non-native species < 1%	4m²
Cover of scattered native trees & shrubs < 10%	Local vicinity
Total cover of the following negative indicator species: *Agrostis capillaris*, *Holcus lanatus*, *Deschampsia flexuosa*, *Phragmites australis*, *Pteridium aquilinum*, *Ranunculus repens* < 1%	4m²
Long shoots of palatable dwarf shrubs (*Calluna vulgaris*, *Erica cinerea* & *Vaccinium myrtillus*) showing signs of browsing collectively < 33%. (There must be a minimum of 10 plants of the species present for this target to be assessed)	4m²
Myrica gale shoots showing signs of browsing < 66%	4m²
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Local vicinity
No signs of burning or other disturbance inside boundaries of sensitive areas	Local vicinity
Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	Local vicinity
Crushed, broken and/or pulled up *Sphagnum* species < 10% of *Sphagnum* cover	4m²
Cover of disturbed, bare ground < 10%	4m²
Cover of disturbed, bare ground < 10%	Local vicinity
No patches of intensely disturbed bare ground or bare peat with a hard rubbery or ashed surface present ≥ 200m²	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.
(f) Areas within 5-10 m of watercourses.
(g) Areas above 400 m in altitude.
(h) Areas within 50 m of functioning drains.

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

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

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

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

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

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

Calcareous rocky slopes with chasmophytic vegetation (8210)

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

APPENDIX VI: POSITIVE INDICATOR SPECIES FOR UPLAND ANNEX I HABITATS

North Atlantic wet heaths with *Erica tetralix* (4010)	European dry heath (4030)
Arctostaphylos uva-ursi	*Arctostaphylos uva-ursi*
Breutelia chrysocoma	*Calluna vulgaris*
Calluna vulgaris	*Daboecia cantabrica*
Campylopus atrovirens	*Erica* spp.
Carex spp.	*Empetrum nigrum*
Diplophyllum albicans	*Racomitrium lanuginosum*
Drosera spp.	*Vaccinium* spp.
Eleocharis multicaulis	
Empetrum nigrum	
Erica spp.	
Eriophorum angustifolium	
Eriophorum vaginatum	
Gloeocapsa magna	
Myrica gale	
Narthecium ossifragum	
Non-crustose lichens	
Pedicularis sylvatica	
Pleurocarpous mosses	
Pleurozia purpurea	
Polygala serpyllifolia	
Racomitrium lanuginosum	
Rhynchospora spp.	
Salix repens	
Schoenus nigricans	
Sphagnum spp.	
Succisa pratensis	
Trichophorum germanicum	
Vaccinium spp.	

Alpine and Boreal heath (4060)
Antennaria dioica
Arctostaphylos uva-ursi
Calluna vulgaris
Carex bigelowii
Cetraria islandica
Cladonia arbuscula
Cladonia portentosa
Cladonia rangiferina
Cladonia uncialis
Diphasiastrum alpinum
Diplophyllum albicans
Empetrum nigrum
Erica cinerea
Erica tetralix
Herbertus aduncus
Hymenophyllum wilsonii
Juniperus communis ssp. *nana*
Racomitrium lanuginosum
Salix herbacea
Scapania gracilis
Solidago virgaurea
Luzula multiflora
Vaccinium myrtillus
Vaccinium vitis-idaea

***Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230)**
High quality habitat species
Carex binervis
Carex pilulifera
Danthonia decumbens
Lathyrus linifolius
Pseudorchis albida
Polygala serpyllifolia
Polygala vulgaris
Viola canina
Viola riviniana
Other species
Achillea millefolium
Agrostis capillaris
Anthoxanthum odoratum
Festuca ovina
Festuca vivipara
Galium saxatile
Hylocomium splendens
Hypericum maculatum
Juncus squarrosus
Nardus stricta
Pedicularis sylvatica
Potentilla erecta
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus
Succisa pratensis
Veronica officinalis

Blanket bogs (*active only) (7130)
Andromeda polifolia
Arctostaphylos uva-ursi
Breutelia chrysocoma
Calluna vulgaris
Campylopus atrovirens
Carex bigelowii
Carex limosa
Diplophyllum albicans
Drosera spp.
Eleocharis multicaulis
Empetrum nigrum
Erica spp.
Eriophorum angustifolium
Eriophorum vaginatum
Menyanthes trifoliata
Mylia spp.
Myrica gale
Narthecium ossifragum
Non-crustose lichens
Odontoschisma sphagni
Pedicularis sylvatica
Pinguicula lusitanica
Pleurocarpous mosses
Pleurozia purpurea
Polygala serpyllifolia
Racomitrium lanuginosum
Rhynchospora spp.
Scapania gracilis
Schoenus nigricans
Sphagnum spp.
Trichophorum germanicum
Vaccinium spp.

Depressions on peat substrates of the *Rhynchosporion* (7150)
Carex limosa
Carex panicea
Eleocharis multicaulis
Eriophorum angustifolium
Drosera spp.
Juncus bulbosus
Menyanthes trifoliata
Narthecium ossifragum
Rhynchospora spp.
Sphagnum spp.
Utricularia spp.
Warnstorfia fluitans

Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*) (8120)	**Calcareous rocky slopes with chasmophytic vegetation (8210)**
Alchemilla alpina	*Alchemilla alpina*
Arenaria serpyllifolia	*Arenaria serpyllifolia*
Asplenium adiantum-nigrum	*Asplenium adiantum-nigrum*
Asplenium ruta-muraria	*Asplenium ruta-muraria*
Asplenium trichomanes	*Asplenium trichomanes*
Asplenium viride	*Asplenium viride*
Carex pulicaris	*Carex pulicaris*
Ceterach officinarum	*Ceterach officinarum*
Cystopteris fragilis	*Cystopteris fragilis*
Dryas octopetala	*Draba incana*
Geranium lucidum	*Dryas octopetala*
Geranium robertianum	*Hieracium* spp.
Gymnocarpium robertianum	*Koeleria macrantha*
Hieracium spp.	*Neckera crispa*
Koeleria macrantha	*Persicaria vivipara*
Oxalis acetosella	*Phyllitis scolopendrium*
Polystichum aculeatum	*Polystichum aculeatum*
Polystichum lonchitis	*Polystichum lonchitis*
Polystichum setiferum	*Polystichum setiferum*
Persicaria vivipara	*Saxifraga aizoides*
Saxifraga aizoides	*Saxifraga hypnoides*
Saxifraga oppositifolia	*Saxifraga oppositifolia*
Sedum acre	*Sedum acre*
Selaginella selaginoides	*Selaginella selaginoides*
Silene acaulis	*Silene acaulis*
Teucrium scorodonia	*Thalictrum alpinum*
Thalictrum alpinum	*Thymus polytrichus*
Thymus polytrichus	
Linum catharticum	

APPENDIX VII: IMPACTS AND CODES FOR FUTURE PROSPECTS ASSESSMENT

Code	Impact
A	***Agriculture***
A01	Cultivation
A02	modification of cultivation practices
A02.01	agricultural intensification
A02.02	crop change
A02.03	grassland removal for arable land
A03	mowing / cutting of grassland
A03.01	intensive mowing or intensification
A03.02	non intensive mowing
A03.02	abandonment / lack of mowing
A04	grazing
A04.01	intensive grazing
A04.01.01	intensive cattle grazing
A04.01.02	intensive sheep grazing
A04.01.03	intensive horse grazing
A04.01.04	intensive goat grazing
A04.01.05	intensive mixed animal grazing
A04.02	non intensive grazing
A04.02.01	non intensive cattle grazing
A04.02.02	non intensive sheep grazing
A04.02.03	non intensive horse grazing
A04.02.04	non intensive goat grazing
A04.02.05	non intensive mixed animal grazing
A04.03	abandonment of pastoral systems, lack of grazing
A05	livestock farming and animal breeding (without grazing)
A05.01	Animal breeding,
A05.02	stock feeding
A05.03	Lack of animal breeding
A06	annual and perennial non-timber crops
A06.01	annual crops for food production
A06.01.01	intensive annual crops for food production/ intensification
A06.01.02	non- intensive annual crops for food production
A06.02	perennial non-timber crops
A06.02.01	intensive perennial non-timber crops/intensification
A06.02.02	non-intensive perennial non-timber crops
A06.03	biofuel-production
A06.04	abandonment of crop production
A07	use of biocides, hormones and chemicals
A08	Fertilisation
A09	Irrigation
A10	Restructuring agricultural land holding
A10.01	removal of hedges and copses or scrub
A10.02	removal of stone walls and embankments
A11	Agriculture activities not referred to above
B	***Sylviculture, forestry***
B01	forest planting on open ground
B01.01	forest planting on open ground (native trees)
B01.02	artificial planting on open ground (non-native trees)
B02	Forest and Plantation management & use
B02.01	forest replanting
B02.01.01	forest replanting (native trees)

Code	Impact
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
D02.01.02	underground electricity and phone lines
D02.02	pipe lines

Code	Impact
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

Code	Impact
G05.04	tree surgery, felling for public safety, removal of roadside trees
G05.05	missing or wrongly directed conservation measures
G05.06	closures of caves or galleries
G05.07	fences, fencing
G05.08	overflying with aircrafts (agricultural)
H	***Pollution***
H01	Pollution to surface waters (limnic & terrestrial)
H01.01	pollution to surface waters by industrial plants
H01.02	pollution to surface waters by storm overflows
H01.03	other point source pollution to surface water
H01.04	diffuse pollution to surface waters via 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

Code	Impact
J02	human induced changes in hydraulic conditions
J02.01	Landfill, land reclamation and drying out, general
J02.01.01	polderisation
J02.01.02	reclamation of land from sea, estuary or marsh
J02.01.03	infilling of ditches, dykes, ponds, pools, marshes or pits
J02.01.04	recultivation of mining areas
J02.02	Removal of sediments (mud...)
J02.02.01	dredging/ removal of limnic sediments
J02.02.02	estuarine and coastal dredging
J02.03	Canalisation & water deviation
J02.03.01	large scale water deviation
J02.03.02	canalisation
J02.04	Flooding modifications
J02.04.01	flooding
J02.04.02	lack of flooding
J02.05	Modification of hydrographic functioning, general
J02.05.01	modification of marine currents
J02.05.02	modifying structures of inland water courses
J02.05.03	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

Code	Impact
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
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

Code	Impact
M01.02	droughts and less precipitations
M01.03	flooding and rising precipitations
M02	Changes in biotic conditions
M02.01	habitat shifting and alteration
M02.02	desynchronisation of processes
M02.03	decline or extinction of species
M02.04	migration of species (natural newcomers)
X	***No threats or pressures***
XO	Threats and pressures from outside the Member State
XE	Threats and pressures from outside the EU territory

APPENDIX VIII: STRUCTURE OF NSUH CONDITION ASSESSMENT DATA DICTIONARY

Table	Field	Values
Site General	NSUH Site No	NSUH site number
	Designated Site Code	SAC /NHA /SPA code
	Site Name	Name of site
	Ecologists	Initials of all surveyors
	Dates Surveyed	Range of relevant dates
	Site Area	Area in hectares
	National Grid	12 figure grid reference
	No Releves	Total number of relevés
	Ownership	e.g. Bórd na Móna, NPWS, Private - Multiple
Structure Criteria	Site No	NSUH site number
	Designated Site Code	SAC /NHA /SPA code
	Annex I Code	Annex I habitat code
	Fossitt	Fossitt (2000) habitat code
	Monitoring Stop No	Relevé 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 or Fail
	Stop description	Additional notes
Monitoring Stops	Site No	NSUH site number
	Designated Site Code	SAC /NHA /SPA code
	Annex I Code	Annex I habitat code
	Fossitt	Fossitt (2000) habitat code
	Monitoring Stop No	Relevé number of monitoring stop
	Altitude	Altitude (m)
	Aspect	Aspect as N, NW, W etc.
	Slope	Slope (°)
	National Grid	12 figure grid reference
	Assessment	Pass or Fail
Future Prospects	NSUH Site No	NSUH site number
	Designated Site Code	SAC /NHA /SPA code
	Annex I Code	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
	Trend	Increasing, Decreasing, None or Unknown
	Source	Inside or Outside
Overall Assessment	NSUH Site No	NSUH site number
	Designated Site Code	SAC /NHA /SPA code
	Annex I Code	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