

Ballyhoura Mountains SAC (site code 2036)
Conservation objectives supporting document
- upland habitats

NPWS

Version 1

August 2016

Contents

1	Introduction	1
1.1	Ballyhoura Mountains SAC	1
1.2	Mapping methodology	2
1.3	Potential for habitat restoration.....	2
2	Conservation objectives.....	2
3	Area.....	3
4	Range	3
5	Structure and functions	4
5.1	Ecosystem function	4
5.1.1	Ecosystem function: soil nutrients	4
5.1.2	Ecosystem function: peat formation	4
5.1.3	Ecosystem function: hydrology	5
5.2	Community diversity	5
5.3	Vegetation composition	5
5.3.1	Vegetation composition: positive indicator species.....	5
5.3.2	Vegetation composition: other desirable species.....	6
5.3.3	Vegetation composition: negative indicator species	6
5.3.4	Vegetation composition: non-native species.....	7
5.3.5	Vegetation composition: undesirable native species.....	7
5.4	Vegetation structure	8
5.4.1	Browsing and grazing.....	8
5.4.2	Burning.....	8
5.4.3	<i>Sphagnum</i> condition.....	8
5.4.4	Growth phases of ling.....	9
5.4.5	Senescent ling	9
5.5	Physical structure	9
5.5.1	Disturbed bare ground	9
5.5.2	Drainage.....	9
5.5.3	Erosion	9
5.6	Indicators of local distinctiveness	10
6	References.....	11

1 Introduction

Achieving Favourable Conservation Status (FCS) is the overall objective to be reached for all Annex I habitat types and Annex II species of European Community interest listed in the Habitats Directive 92/43/EEC. It is defined in positive terms, such that a habitat type or species must be prospering and have good prospects of continuing to do so.

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

The Scoping Study and Pilot Survey of Upland Habitats (Perrin *et al.*, 2009) was commissioned by the National Parks and Wildlife Service (NPWS) with the primary remit of devising an appropriate strategy and methodologies for conducting a National Survey of Upland Habitats (NSUH). Four phases of the NSUH have subsequently been conducted between 2010 and 2014. The Annex I habitats that are the primary focus of the NSUH are listed in Table 1. To date, Ballyhoura Mountains SAC has not been surveyed as part of the NSUH.

Table 1: Annex I habitats that occur in Irish uplands and which are primary focus habitats for the NSUH. Habitats in bold are those that are listed as Qualifying Interests for Ballyhoura Mountains SAC.

Habitat code	Habitat name
4010	Northern Atlantic wet heaths with <i>Erica tetralix</i>
4030	European dry heaths
4060	Alpine and Boreal heaths
6230	Species-rich <i>Nardus</i> grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)*
7130	Blanket bogs (* if active)
7140	Transition mires and quaking bogs
7150	Depressions on peat substrates of the Rhynchosporion
7230	Alkaline fens
8110	Siliceous scree of the montane to snow levels (<i>Androsacetalia alpinae</i> and <i>Galeopsietalia ladani</i>)
8120	Calcareous and calcshist screes of the montane to alpine levels (<i>Thlaspietea rotundifolii</i>)
8210	Calcareous rocky slopes with chasmophytic vegetation
8220	Siliceous rocky slopes with chasmophytic vegetation

* Denotes a priority habitat under the EU Habitats Directive

1.1 Ballyhoura Mountains SAC

Ballyhoura Mountains SAC was surveyed in 2005 and the results of this survey are reported in Lynch (2005).

It is a small upland SAC, 7.5 km² in extent. The Ballyhoura Mountains SAC is located on the border between counties Cork and Limerick and is situated about 10 km south of Kilmallock (O.S. Discovery

Series map 73). The SAC comprises the unafforested summit ridges within the mountain range extending from Carron Mountain in the west towards Long Mountain and Seefin Mountain in the centre of the SAC and Carrigeenamronety Mountain in the east. Seefin Mountain is the highest summit in the mountain range reaching an elevation of 528 m. This mountain range has been intensively afforested over the past 50 years and forestry plantations surround much of the SAC. Old Red Sandstone dominates the bedrock geology of the SAC.

1.2 Mapping methodology

A detailed habitat survey of Ballyhoura Mountains SAC, utilising the methodology presented in Perrin *et al.* (2014), has not been conducted. Therefore, the data currently available are not sufficient to facilitate the production of an accurate habitat map.

All current relevant datasets for Annex I habitats that occur in Irish uplands were summarised within the GIS files associated with NPWS (2013) and these were utilised to calculate an approximate area for the three Annex I upland habitats listed as Qualifying Interests for the SAC that are primary focus habitats for the NSUH.

1.3 Potential for habitat restoration

Restoration management for 7130 Blanket bogs (* if active) in this SAC is required, as the conservation objective for the habitat here is to restore favourable conservation condition. Areas that might be restored to active blanket bog could include inactive bog, bare eroding bog and recent cutover bog, and also areas of drained deep peat or older cutovers which currently support other types of vegetation such as heath. These latter areas may currently be classified as other Annex I habitats (e.g. 4010). Restoration of priority 7130 habitat may therefore result in loss in the area and distribution of other Annex I habitats which are Qualifying Interests. If such scenarios are identified by restoration management plans, the conservation objectives for these other Qualifying Interests should be amended accordingly.

2 Conservation objectives

A site-specific conservation objective aims to define the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of Favourable Conservation Status (FCS) of those habitats and species at a national level.

Conservation objectives are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable status, namely area, range, and structure and functions.

The *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland* (Perrin *et al.*, 2014) have been used as a basis for setting most site-specific attributes and targets for uplands habitats. Attributes and targets may change/become more refined as further information becomes available.

Objectives for habitats have been set with reference to Perrin *et al.* (2014). To date no detailed survey has been undertaken to assess the area or structure and functions of the Qualifying Interests

within this SAC. Therefore, in the absence of site-specific data, the National Conservation Assessment (NCA) for each Annex I habitat (NPWS, 2013) was utilised to indicate the condition of the habitats in the SAC. The NCA for Wet heaths and Dry heaths was Unfavourable – Inadequate for area and Unfavourable – Bad for structure and functions. The NCA for Blanket bogs (* if active) was Unfavourable – Bad for both area and structure and functions. If area and structure and functions were both assessed as “Favourable”, the objective for that habitat is to maintain favourable conservation condition. If either parameter was assessed as “Unfavourable – Inadequate” or “Unfavourable – Bad”, the objective for that habitat is to restore favourable conservation condition.

This document provides supporting information for the attributes of the conservation objectives of upland habitats, given in the main conservation objectives document for the SAC. The two documents should be read in conjunction with each other.

The conservation objectives for each of the Annex I habitats dealt with in this supporting document are as follows:

- To restore the favourable conservation condition of Northern Atlantic wet heaths with *Erica tetralix* in Ballyhoura Mountains SAC.
- To restore the favourable conservation condition of European dry heaths in Ballyhoura Mountains SAC.
- To restore the favourable conservation condition of Blanket bogs (* if active) in Ballyhoura Mountains SAC.

3 Area

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. The target is for the habitat area to be stable or increasing. Approximate baseline figures are presented in Table 2.

Table 2: Estimated extent of Annex I habitats that are listed as Qualifying Interests for Ballyhoura Mountains SAC. *denotes priority habitat.

Annex I code	Habitat	Area (ha)	% of SAC
4010	Wet heaths	310	41
4030	Dry heaths	170	23
7130	Blanket bogs (* if active)	190	25

As mentioned earlier, the area of habitat 7130 comprises active and inactive blanket bog. The most frequent example of the latter encountered in the NSUH is described in Perrin *et al.* (2014) as a monospecific sward of *Eriophorum angustifolium* on eroded bog where a reasonable depth of peat remains. Note however, that while examples of this community occur on re-deposited, eroded peat, these areas will not have the structural, hydrological or functional characteristics of naturally formed blanket bog.

4 Range

Each habitat’s range at site level, in the form of habitat distribution, has not been recorded as no detailed mapping of the SAC has been undertaken. The target is that there should be no decline.

5 Structure and functions

Structure and functions relates to the physical components of a habitat (“structure”) and the ecological processes that drive it (“functions”). For upland habitats these include a range of aspects such as soil chemistry, vegetation composition, hydrological regime, community diversity, habitat quality, species occurrence, indicators of local distinctiveness, disturbed ground, evidence of burning and negative species occurrence. These structure and functions are expanded on in the sections below.

At Ballyhoura Mountains SAC the structure and functions of 4010 Wet heaths have not been assessed in the field as there has been no detailed habitat survey.

The structure and functions of 4030 Dry heaths have also not been assessed in the field as there has been no detailed habitat survey.

The structure and functions of 7130 Blanket bogs (* if active) have not been assessed in the field either as there has been no detailed habitat survey.

5.1 Ecosystem function

Ecosystem function is assessed primarily through consideration of soil nutrient levels. For 7130 Blanket bogs (*if active), additional consideration is given to peat formation and hydrology.

5.1.1 Ecosystem function: soil nutrients

An attribute to assess the soil nutrients is common to each of the upland habitats with a view to maintaining the soil nutrient status within the natural range suited to the habitat. Relevant nutrients and natural ranges have yet to be defined. Nitrogen deposition and associated acidification are noted as being relevant to all upland habitats in NPWS (2013). The target for each habitat is to maintain the soil nutrients status within the natural range.

5.1.2 Ecosystem function: peat formation

Ecosystem function of 7130 Blanket bogs (* if active) is further assessed through peat formation. Perrin *et al.* (2014) established an overriding assessment of blanket bog structure and functions based on the proportion of degraded bog within a site which includes eroding bog and cutover bog which would previously have been this Annex I habitat. If more than 1% of the combined area of active bog (Annex I habitat *7130), inactive bog (Annex I habitat 7130), eroded bog (habitat category PB5 – Fossitt, 2000) and recently cutover bog (habitat PB4 – Fossitt, 2000) is inactive, eroded or cutover then it should be assessed as Unfavourable – Inadequate even if the result of the monitoring stops were more positive. If more than 5% of the combined area is inactive, eroded or cutover it is assessed as Unfavourable – Bad.

The EU habitats interpretation manual (EC, 2013) defines active blanket bog as “still supporting a significant area of vegetation that is normally peat-forming”. For the purposes of defining favourable conservation condition of the Annex I habitat, the target is that at least 99% of the total Annex I blanket bog area is active bog.

5.1.3 Ecosystem function: hydrology

Ecosystem function of 7130 Blanket bogs (* if active) is further assessed through assessment of hydrology. Drains (cut for purposes of peat cutting, afforestation etc.) and erosion gullies impact on the hydrology of blanket bog in the local vicinity. The target is for the natural hydrology to be unaffected by drains and erosion gullies. The process of restoring hydrological integrity may impact areas of heath habitats as discussed in Section 1.3.

5.2 Community diversity

Lynch (2005) recorded habitat and plant species data from Ballyhoura Mountains SAC. Some of the vegetation data collected by Lynch (2005) appear to correspond to the provisional list of vegetation communities detailed in the NSUH manual (Perrin *et al.*, 2014). From the data presented in Lynch (2005), it is clear that vegetation community diversity does exist within the site, with some vegetation plots appearing to correspond to 4010 Wet heaths communities WH3 - *Calluna vulgaris* - *Molinia caerulea* - *Sphagnum capillifolium* wet/damp heath and WH4 - *Trichophorum germanicum* - *Eriophorum angustifolium* wet heath; 4030 Dry heath communities DH3 - *Calluna vulgaris* - *Sphagnum capillifolium* dry/damp heath and DH6 - *Calluna vulgaris* - *Vaccinium myrtillus* dry heath; and 7130 Blanket bogs* BB5 - *Calluna vulgaris* - *Eriophorum* spp. bog. The target is to maintain the variety of vegetation communities within the 4010 Wet heaths, 4030 Dry heaths and 7130 Blanket bogs (* if active), subject to natural processes.

5.3 Vegetation composition

Vegetation composition is assessed through a range of attributes tailored to each of the habitats. In general terms they establish minimum thresholds for the occurrence, or cover, of desirable species and maximum thresholds for undesirable species.

5.3.1 Vegetation composition: positive indicator species

An attribute for positive indicator species is common to each of the upland Annex I habitats and habitat-specific lists of the positive indicator species are presented in the NSUH manual (Perrin *et al.* 2014). A positive species criterion is set to ensure that vegetation remains representative of the habitat and is not degrading or succeeding to a different habitat. The target by which this attribute is measured varies between habitats. Descriptions of these habitats can be found in the NSUH manual (Perrin *et al.*, 2014).

For some habitats a certain number of positive indicator species are required. At least seven positive indicator species are required for 7130 Blanket bogs (* if active).

For some other habitats a percentage threshold is set. At least 50% cover of positive indicators is required for 4010 Wet heaths.

4030 Dry heaths were assessed through the number of positive indicator species present and through the percentage cover of these. The positive indicator list is composed of dwarf shrub species. Only two species are required to meet the number of positive indicator species target as dry heaths are not necessarily rich in these species. However, vegetation supporting and possibly dominated by only one dwarf shrub species is not desirable. Low cover of dwarf shrubs would

indicate that the habitat is transitional, usually to grassland. A maximum cover of dwarf shrubs is applied for calcareous heath, due to the characteristically greater forb (broad-leaved herb) component.

5.3.2 Vegetation composition: other desirable species

Other elements of vegetation composition which can collectively be regarded as being desirable are also established with a range of habitat-specific targets set.

Lichens and bryophytes

Minimum thresholds for cover of lichens and bryophytes are set for habitats where a plentiful lichen/moss layer is characteristic, including 4010 Wet heaths, 7130 Blanket bogs (* if active) and 4030 Dry heaths. Dry heaths are not necessarily rich in lichen and bryophyte species, but a minimum amount should still be present. Within the habitat-specific targets for these attributes the specific species, or groups of species which are required, are listed together with any exclusions (e.g. *Sphagnum fallax* can be indicative of degraded bog so is excluded from the 7130 Blanket bogs (* if active) assessment and *Campylopus* and *Polytrichum* mosses are excluded from 4030 Dry heaths as they can be indicative of disturbed conditions).

Dwarf shrub cover

Note that minimum dwarf shrub cover within 4030 Dry heaths is addressed by the positive indicator species attribute.

Cross-leaved heath

Cross-leaved heath (*Erica tetralix*) is specifically mentioned in the formal title of habitat 4010 Wet heaths and is the only characteristic species listed in EC (2013). Whilst it is seldom abundant in wet heath, its presence at high frequencies is considered one of the few characteristics common between the varied communities of this habitat (JNCC, 2009). The target is for the presence of cross-leaved heath within a 20 m radius of each monitoring stop.

Ericoid species and crowberry (*Empetrum nigrum*)

A dwarf shrub layer with ericoid species is characteristic of 4010 Wet heaths (crowberry is only rarely present). Low cover of these species would be indicative of chronic overgrazing, burning etc. The target is for at least 15% cover of these species.

5.3.3 Vegetation composition: negative indicator species

A percentage cover threshold for negative indicator species has been established for all upland habitats listed as Qualifying Interests for Ballyhoura Mountains SAC. Habitat-specific negative indicator species lists have been established for each of the habitats (Perrin *et al.*, 2014). Presence of these species would likely indicate undesirable impacts of management such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. The percentage threshold is generally set quite low such that impacts can be reversed before they become more severe.

5.3.4 Vegetation composition: non-native species

An attribute for non-native species is common to each of the upland Annex I habitats. Non-native species can be invasive and have deleterious effects on native vegetation. The target for each habitat is for the total cover of non-native species to be less than 1%. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances.

5.3.5 Vegetation composition: undesirable native species

For many habitats maximum percentage cover thresholds for undesirable native species are also set. These are detailed below.

Bracken, native trees and shrubs

The cover of bracken (*Pteridium aquilinum*) and native trees and shrubs is assessed for 4010 Wet heaths and 4030 Dry heaths. Native tree and shrub cover is assessed for 7130 Blanket bogs (* if active). High cover of bracken would indicate that the habitat may be succeeding towards a dense bracken community, and high cover of native trees and shrubs would indicate that the habitat may be succeeding towards scrub or woodland due to lack of grazing or, for bog habitats, due to the habitat drying out.

Soft rush

High cover of soft rush (*Juncus effusus*) in 4010 Wet heaths or 4030 Dry heaths would suggest undesirable hydrological conditions. Note, however, that poor flushes dominated by soft rush often naturally occur in mosaic with these habitats. Discrete areas of this separate habitat should not be considered here.

Potential dominant species

For 7130 Blanket bogs (* if active), a maximum threshold is given for bog species which could potentially dominate the habitat, reflecting a reduction in diversity. The selected species are ling (*Calluna vulgaris*), many-stalked spike-rush (*Eleocharis multicaulis*), hare's-tail cottongrass (*Eriophorum vaginatum*), purple moor-grass (*Molinia caerulea*), black bog-rush (*Schoenus nigricans*) and deergrass (*Trichophorum germanicum*). The target is for cover of each of the potential dominant species to be less than 75%.

Dwarf shrub cover

A dwarf shrub layer is characteristic of 4010 Wet heaths, but the vegetation should be a mixture of dwarf shrub and graminoid species with higher cover of dwarf shrubs being potentially indicative of drainage. A maximum target of 75% is therefore set.

Similarly, the calcareous version of 4030 Dry heaths characteristically has a greater component of broad-leaved herbs than siliceous dry heath. A maximum target of 75% is therefore set.

Dwarf shrub composition

The dwarf shrub layer within 4030 Dry heaths should not be composed primarily of bog-myrtle (*Myrica gale*), creeping willow (*Salix repens*) and western gorse (*Ulex gallii*). Bog-myrtle is indicative of flushed conditions and is more characteristic of wet heaths and blanket bogs. Creeping willow is more characteristic of dune heaths. Western gorse is a component of dry heath, but high proportions of it may indicate a history of undesirable levels of grazing. The target for 4030 Dry heaths is for the proportion of dwarf shrub composed of these species to be collectively less than 50%.

5.4 Vegetation structure

Vegetation structure is assessed through a number of attributes tailored to each of the habitats. These measures assess levels of grazing and browsing, burning, *Sphagnum* condition and, for 4030 Dry heaths, growth phases of ling (*Calluna vulgaris*).

5.4.1 Browsing and grazing

Browsing is generally measured through viewing the last complete season's shoots of particular species and assessing the proportion which shows signs of having been browsed. The species which are assessed for browsing are generally the dwarf shrub species: ericoids, crowberry (*Empetrum nigrum*) and bog-myrtle (*Myrica gale*). The target for the heath habitats (4010 and 4030) and 7130 Blanket bogs (* if active) is for less than 33% of shoots to show signs of grazing.

5.4.2 Burning

Fires can be part of the natural cycle of heath and peatlands and may also be used as a valuable management tool to promote a diversity of growth phases in ling. However, currently most hill fires in Ireland are intentionally started to encourage grass growth for livestock. Fires which are too intense, too frequent, too extensive or which occur in sensitive areas are damaging to habitats. An assessment of burning is made for the heath habitats (4010 and 4030) and 7130 Blanket bogs (* if active). Habitat-specific lists of sensitive areas where burning should not occur are presented in Perrin *et al.* (2014). Examples of sensitive areas are: 'areas where soils are thin and less than 5 cm deep' and 'pools, wet hollows, hags and erosion gullies, and within 5-10 m of the edge of watercourses'.

4010 Wet heaths and 7130 Blanket bogs (* if active) have the same targets relating to there being no signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning and no signs of burning in sensitive areas. The target for 4030 Dry heaths is no sign of burning in sensitive areas.

5.4.3 Sphagnum condition

Disturbance to *Sphagnum* is assessed for habitats 4010 Wet heaths and 7130 Blanket bogs (* if active). High levels of disturbed *Sphagnum* would indicate undesirable levels of grazers. For both habitats the target is for less than 10% of the *Sphagnum* cover to be crushed, broken and/or pulled up.

5.4.4 Growth phases of ling

The growth phases of ling (*Calluna vulgaris*) are assessed for 4030 Dry heaths. The growth phases are pioneer (<10 cm high), building (10-30 cm high) and mature (>30 cm high). The target is that all growth phases of ling should occur throughout the habitat, outside sensitive areas, with at least 10% of cover in the mature phase. As burning is undesirable within sensitive areas, it is not reasonable to require the stated diversity of growth phases within these areas. The list of sensitive areas is presented in the NSUH manual (Perrin *et al.*, 2014).

5.4.5 Senescent ling

The cover of senescent ling (*Calluna vulgaris*) in 4030 Dry heaths is also assessed. Senescence is part of the natural cycle of ling but a dominance of ling in the senescent phase would indicate a lack of management (appropriate grazing or burning) to promote ling regeneration. The target is that the cover of senescent ling should be less than 50%.

5.5 Physical structure

The physical structure of upland habitats can be damaged by drainage, walking trails, unsuitable levels of grazing and erosion. Physical structure is assessed through a number of attributes tailored to each of the habitats. Elements which are assessed for the various habitats comprise disturbed bare ground, drainage and erosion; these are detailed below.

5.5.1 Disturbed bare ground

This attribute is common to all the upland habitats listed as Qualifying Interests for Ballyhoura Mountains SAC. Disturbance can include hoof marks, wallows, human foot prints, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for heaths and peatlands. The target for each habitat is set at there being less than 10% disturbed ground.

5.5.2 Drainage

Drainage can result in loss of characteristic species and transition to drier habitats. This attribute is applied to 4010 Wet heaths and 7130 Blanket bogs (* if active). For both habitats the target is the area showing signs of drainage from heavy trampling, tracking or ditches to be less than 10%.

5.5.3 Erosion

Erosion is assessed for 7130 Blanket bogs (* if active). Erosion leads to loss of peat from the blanket bog system, increases in peat sediment in nearby water courses, loss of blanket bog habitat and drainage. The target for the habitat is that less than 5% of the greater bog mosaic comprises erosion gullies and eroded areas. The greater bog mosaic incorporates the blanket bog itself and associated vegetation types and non-vegetation cover types that appear to have been derived from former blanket bog, including, but not limited to bare peat, loose rock, gravel and running water.

5.6 Indicators of local distinctiveness

No rare plant records were found for the SAC. Rare species (those considered at least Near Threatened on the appropriate Red Data List) which can be assigned to a particular habitat should be considered indicators of local distinctiveness for habitats. The target is for no decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.

Where hepatic mats of the *Calluna vulgaris-Herbertus aduncus* community have been recorded within a particular habitat these should also be listed as indicators of local distinctiveness. No assessment of the conservation status of this community has been conducted but proposals for such an assessment are presented in Barron & Perrin (2014). The target for these hepatic mats is for no decline in status of hepatic mats associated with this habitat.

6 References

- Barron, S.J. & Perrin, P.M. (2014) National Survey of Upland Habitats (Phase 4, 2013-2014) – Summary report. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- EC (2013) Interpretation manual of European Union habitats EUR 28, European Commission, DG Environment.
- Fossitt, J.A. (2000) A guide to habitats in Ireland. The Heritage Council, Kilkenny, Ireland.
- JNCC (2009) Common Standards Monitoring guidance for upland habitats. Joint Nature Conservation Committee, Peterborough, UK.
- Lynch, R. (2005) The vegetation of the Ballyhoura Mountains, Co. Limerick. Unpublished Report for the Heritage Council, Kilkenny, Ireland.
- NPWS (2013) The status of EU protected habitats and species in Ireland. Vol. 2. Habitat assessments. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Perrin, P.M., O’Hanrahan, B., Roche, J.R. & Barron, S.J. (2009) Scoping Study and Pilot Survey for a National Survey and Conservation Assessment of Upland Vegetation and Habitats in Ireland. Unpublished report to National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Perrin, P.M., Barron, S.J., Roche, J.R. & O’Hanrahan, B. (2014) Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.