

Meentygrannagh Bog SAC (site code 000173)
Conservation objectives supporting document
- blanket bogs and associated habitats

NPWS

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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 EU 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 150m 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 since been completed between 2010 and 2014. The principle aims of the NSUH are to map all habitats within a site and to assess the conservation condition of the relevant Annex I habitats, listed in Table 1 below.

The conservation objectives attributes and targets, which are based on the monitoring criteria developed by the NSUH, have been applied to the Annex I habitats listed as Qualifying Interests for Meentygrannagh Bog SAC (see Table 1 and Section 2).

Meentygrannagh Bog SAC was surveyed by Douglas *et al.* (1990) and Mooney *et al.* (1991) as part of a wider blanket bog survey project across Ireland carried out by NPWS between 1987 and 1991 (see Conaghan, 2000).

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 Meentygrannagh Bog 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 bog)
7140	Transition mires and quaking bogs
7150	Depressions on peat substrates of the Rhynchosporion
7230	Alkaline fens
8110	Siliceous screes 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 Meentygrannagh Bog SAC

Meentygrannagh Bog SAC is a small upland SAC, 530ha in extent. It lies 6km north-west of Cloghan village in central Co. Donegal (O.S. Discovery Series map 6). It is located on a sloping hillside stretching from the summits of Arbatt, Meenirroy and the Altinierin Hills. The SAC is bordered in the east by a tributary of the Elatagh River. The SAC contains the headwaters of several streams including the River Swilly. This SAC is considered to contain one of the best saddle bogs in Co. Donegal. Forestry plantations are the main adjacent habitat. Geologically the site overlies quartzite and termon formations.

1.2 Mapping methodology

A detailed habitat mapping survey of Meentygrannagh Bog 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 were summarised within the GIS files associated with NPWS (2013) and these were utilised to calculate an approximate area for 7130 Blanket bogs (* if active bog) in Meentygrannagh Bog SAC. There were no data with which to estimate the approximate areas of 7140 Transition mires and 7230 Alkaline fens in the SAC.

1.3 Potential for habitat restoration

Restoration management for 7130 Blanket bogs (* if active bog) in this SAC is required, as the conservation objective for the habitat is to restore favourable conservation condition here. 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.

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 of the site-specific attributes and targets for uplands habitats. However, attributes and targets may change/become more refined as further information becomes available.

As no recent detailed survey has been undertaken to assess the area or the structure and functions of the Qualifying Interest habitats in Meentygrannagh Bog SAC, the National Conservation Assessment (NCA) for each Annex I habitat (NPWS, 2013) was instead utilised to indicate condition

of the habitats in the SAC. 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. The NCA for 7130 Blanket bogs (* if active bog) was Unfavourable – Bad for both area and structure and functions. The NCA for 7140 Transition mires was Unfavourable – Inadequate for area and Unfavourable – Bad for structure and functions. The NCA for 7230 Alkaline fens was Unfavourable – Inadequate for area and Unfavourable – Bad for structure and functions.

This document provides supporting information for the attributes of the conservation objectives for 7130 Blanket bogs (* if active bog), 7140 Transition mires and 7230 Alkaline fens given in the main conservation objectives document for Meentygrannagh Bog SAC. The two documents should be read in conjunction with each other.

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

- To restore the favourable conservation condition of Blanket bogs (* if active bog) in Meentygrannagh Bog SAC.
- To restore the favourable conservation condition of Transition mires and quaking bogs in Meentygrannagh Bog SAC.
- To restore the favourable conservation condition of Alkaline fens in Meentygrannagh Bog 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 for 7130 Blanket bogs (* if active bog) in Meentygrannagh Bog SAC. There were no data with which to estimate the approximate areas of 7140 Transition mires and 7230 Alkaline fens in the SAC.

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

Annex I code	Habitat	Approximate area (ha)	% of SAC
7130	Blanket bogs (* if active bog)	417	79
7140	Transition mires	Unknown	Unknown
7230	Alkaline fens	Unknown	Unknown

As mentioned earlier, the area of habitat 7130 comprises active and inactive blanket bogs. The most frequent example of the latter encountered in the NSUH is described in Perrin *et al.* (2014) as a monospecific sward of common cottongrass (*Eriophorum angustifolium*) on eroded bog where a reasonable depth of peat remains. Note, however, that where 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 in detail as no comprehensive mapping of the SAC has been recently undertaken. However, it is documented that 7130 Blanket bogs (* if active bog) occur throughout the SAC (Douglas *et al.*, 1990; Mooney *et al.*, 1991; NPWS internal files). Both 7140 Transition mires and 7230 Alkaline fens occur in the north-eastern section of the SAC (NPWS internal files). 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 blanket bogs and associated 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 Meentygrannagh Bog SAC, the structure and functions of 7130 Blanket bogs (* if active bog), 7140 Transition mires and quaking bogs and 7230 Alkaline fens have not been assessed in the field as there has been no recent detailed habitat survey.

5.1 Ecosystem function

Ecosystem function is assessed primarily through consideration of soil nutrient levels, and also water quality for 7230 Alkaline fens. For 7130 Blanket bogs (* if active bog) and 7230 Alkaline fens, 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 habitats with a view to maintain 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 blanket bogs and all associated 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 bog) and 7230 Alkaline fens is further assessed through peat formation. For 7130 Blanket bogs (*if active bog), 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 results of the monitoring stops data are 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 (European Commission, 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.

For 7230 Alkaline fens, peat formation is dependent on water levels being slightly below or above the soil surface for c. 90% of the time. The target is to maintain active peat formation, where appropriate.

5.1.3 Ecosystem function: hydrology

Ecosystem function of 7130 Blanket bogs (* if active bog) and 7230 Alkaline fens is further assessed through assessment of hydrology. Regarding 7130 Blanket bogs (* if active bog), 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 target for 7230 Alkaline fens is to maintain the appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat.

5.1.4 Ecosystem function: water quality

Ecosystem function of 7230 Alkaline fens is further assessed through assessment of water quality. The target is to maintain the appropriate water quality, particularly nutrient levels, to support the natural structure and functioning of the habitat.

5.2 Community diversity

A variety of blanket bog species and vegetation communities have been recorded from Meentygrannagh Bog SAC (Douglas *et al.*, 1990; Mooney *et al.*, 1991; NPWS internal files). The descriptions of 7130 Blanket bogs (* if active bog) within the sources correspond to the NSUH provisional communities BB3 *Eriophorum vaginatum* – *Sphagnum papillosum* bog, BB4 *Trichophorum germanicum* – *Eriophorum angustifolium* bog, BB5 *Calluna vulgaris* – *Eriophorum* spp. bog and BB7 *Eriophorum angustifolium* – *Sphagnum austinii* bog, as described in the NSUH manual (Perrin *et al.*, 2014). A transition mire vegetation community has been recorded in the SAC (Douglas *et al.*, 1990; NPWS internal files) that corresponds to the NSUH provisional community PFLU5 *Carex rostrata* – *Sphagnum* spp. flush. An alkaline fen vegetation community that corresponds to the NSUH provisional community RFEN1a *Carex rostrata* fen brown moss sub-community has also been recorded in the SAC (Douglas *et al.*, 1990; NPWS internal files).

The target for the SAC is to maintain the variety of vegetation communities within 7130 Blanket bogs (* if active bog), 7140 Transition mires and 7230 Alkaline fens, 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

The attribute for positive indicator species is common to each of the blanket bogs and associated 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 is required. At least seven positive indicator species are required at each monitoring stop for 7130 Blanket bogs (* if active bog).

7140 Transition mires require at least three positive indicator species for infilling pools and flushes and at least six for fens, and also at least one core positive indicator species present at each monitoring stop. In addition, 25% total cover of positive indicator species is required.

7230 Alkaline fens require at least one brown moss positive indicator species at each monitoring stop, and at least two positive vascular plant indicator positive indicator species for small-sedge flushes and at least three for black bog-rush (*Schoenus nigricans*) flush and bottle sedge (*Carex rostrata*) fen. In addition, at least 20% total cover of positive indicator species (brown mosses and vascular plants) is required for small-sedge flushes and at least 75% cover is required for black bog-rush (*Schoenus nigricans*) flush and bottle sedge (*Carex rostrata*) fen.

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 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, such as 7130 Blanket bogs (* if active bog). 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 bog) assessment.

5.3.3 Vegetation composition: negative indicator species

A percentage cover threshold for negative indicator species has been established for blanket bog and associated habitats, including those listed as Qualifying Interests for Meentygrannagh Bog SAC. Habitat-specific negative indicator species lists have been established for each of the habitats and are presented in 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 7130 Blanket bogs (* if active bog), 7140 Transition mires and 7230 Alkaline fens. 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 two of the Qualifying Interest habitats present in Meentygrannagh Bog SAC, 7130 Blanket bogs (* if active bog) and 7230 Alkaline fens, maximum percentage cover thresholds for undesirable native species are also set. These are detailed below.

Native trees and shrubs

Tree and shrub cover is assessed for 7130 Blanket bogs (* if active bog) and 7230 Alkaline fens. 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 and common reed

For 7230 Alkaline fens, the cover of both soft rush (*Juncus effusus*) and common reed (*Phragmites australis*) should collectively be less than 10%.

Potential dominant species

For 7130 Blanket bogs (* if active bog), 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%.

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 and *Sphagnum* condition.

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 7130 Blanket bogs (* if active bog) is for less than 33% of shoots to show signs of browsing. Grazing levels for 7140 Transition mires and 7230 Alkaline fens are assessed through vegetation height (see Section 5.4.4).

5.4.2 Burning

Fires can be part of the natural cycle of heaths and may, under carefully controlled circumstances, be used as an occasional management tool to promote regeneration of, or diversity of growth phases, in ling (*Calluna vulgaris*). However, currently most hill fires in Ireland are intentionally started to encourage grass growth for livestock. Fires that are too intense, too frequent, too extensive or which occur in sensitive areas are damaging to habitats. An assessment of burning is made for 7130 Blanket bogs (* if active bog). Habitat-specific lists of sensitive areas where burning should not occur are presented in Perrin *et al.* (2014).

Targets for 7130 Blanket bogs (* if active bog) comprise 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.

5.4.3 Sphagnum condition

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

5.4.4 Vegetation height

Vegetation height is used as an indication of grazing intensity for 7140 Transition mires and 7230 Alkaline fens. For both habitats, the proportion of live leaves and/or flowering shoots of vascular plants that are more than 15cm above the ground surface should be at least 50%. Vegetation heights lower than these would indicate undesirable levels of grazing.

5.5 Physical structure

The physical structure of the 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 habitats comprise disturbed bare ground, drainage and erosion; these are detailed below.

5.5.1 Disturbed bare ground

This attribute is common to all three habitats listed as Qualifying Interests for Meentygrannagh Bog 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 Tufa formations

For 7230 Alkaline fens, a further measure of disturbance in areas where tufa is present is assessed. The target is that the disturbed proportion of vegetation cover is less than 1%.

5.5.3 Drainage

Drainage can result in loss of characteristic species and transition to drier habitats. This attribute is applied to 7130 Blanket bogs (* if active bog), 7140 Transition mires and 7230 Alkaline fens. For each

habitat, the target is the area showing signs of drainage from heavy trampling, tracking or ditches to be less than 10%.

5.5.4 Erosion

Erosion is assessed for 7130 Blanket bogs (* if active bog) as it 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 is 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

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 the habitat. The target is for no decline in distribution or population sizes of rare, threatened or scarce species associated with the particular habitat.

The EU Habitats Directive Annex II listed, Flora (Protection) Order, 2015 (Statutory Instrument No. 356 of 2015) listed and *Near Threatened* (Lockhart *et al.*, 2012) slender green feather-moss (*Hamatocaulis (Drepanocladus) vernicosus*) occurs pre-dominantly in 7140 Transition mires and is also associated with 7230 Alkaline fens within the SAC (Campbell *et al.*, 2015). Slender green feather-moss is a Qualifying Interest species for Meentygrannagh Bog SAC.

The *Vulnerable* mosses *Tomentypnum nitens* and *Sphagnum warnstorffii* and the *Near Threatened* moss *Sphagnum teres* (Lockhart *et al.*, 2012) can be assigned specifically to 7230 Alkaline fens within Meentygrannagh Bog SAC (Rory Hodd, pers. comm.).

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 the habitat in question.

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.
- Campbell, C., Hodgetts, N. & Lockhart, N. (2015) Monitoring methods for *Hamatocaulis vernicosus* Mitt. Hedenäs (Slender Green feather-moss) in the Republic of Ireland. Irish Wildlife Manuals, No. 91. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.
- Conaghan, J. (ed.) (2000) Distribution, ecology and conservation of blanket bogs in Ireland. A synthesis of the reports of the blanket bog surveys carried out between 1987 and 1991 by the National Parks and Wildlife Service. Unpublished report to National Parks and Wildlife Service.
- Douglas, C., Dunnells, D., Scally, L. & Wyse Jackson, M. (1990) A Survey to Locate Blanket Bogs of Scientific Interest in Counties Donegal, Cavan, Leitrim and Roscommon. National Parks and Wildlife Service internal report.
- European Commission (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.
- Lockhart, N., Hodgetts, N. & Holyoak, D. (2012) Ireland Red List No. 8: Bryophytes. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Mooney, E.P., Goodwillie, R.N. & Douglas, C. (1991) Survey of Mountain Blanket Bogs of Scientific Interest. Unpublished report to the National Parks and Wildlife Service, Dublin.
- 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.
- 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.