

**Fawnboy Bog/Lough Nacung SAC (site code 140)**  
**Conservation objectives supporting document**  
**- upland habitats**

**NPWS**

**Version 1**

**September 2016**

## Contents

1	Introduction .....	1
1.1	Fawnboy Bog/Lough Nacung SAC .....	1
1.2	Mapping methodology .....	2
1.3	Potential for habitat restoration .....	2
2	Conservation objectives .....	2
3	Area .....	3
4	Range .....	4
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 .....	6
5.3.5	Vegetation composition: undesirable native species .....	7
5.4	Vegetation structure .....	7
5.4.1	Browsing and grazing .....	7
5.4.2	Burning .....	8
5.4.3	<i>Sphagnum</i> condition .....	8
5.5	Physical structure .....	8
5.5.1	Disturbed bare ground .....	8
5.5.2	Drainage .....	8
5.5.3	Erosion .....	9
5.6	Indicators of local distinctiveness .....	9
6	References .....	10

## 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 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 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, Fawnboy Bog/Lough Nacung 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 Fawnboy Bog/Lough Nacung SAC.

Habitat code	Habitat name
<b>4010</b>	<b>Northern Atlantic wet heaths with <i>Erica tetralix</i></b>
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)*
<b>7130</b>	<b>Blanket bogs (* if active)</b>
7140	Transition mires and quaking bogs
<b>7150</b>	<b>Depressions on peat substrates of the <i>Rhynchosporion</i></b>
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 Fawnboy Bog/Lough Nacung SAC

Fawnboy Bog/Lough Nacung SAC was surveyed in 1990. The results of this survey are reported in Douglas *et al.* (1990).

It is a small upland SAC, 11.1 km<sup>2</sup> in extent. This is some of the most north-westerly blanket bog in the country and lies within 10 km of Bloody Foreland and 2 km east of Gweedore, Co. Donegal (O.S.

Discovery Series map 1). It lies at the western foothills of Errigal Mountain (751 m). The SAC descends from Fawnaboy in the north, at approximately 180 m, to the shores of Lough Nacung in the south. Lough Nacung and other lakes and rivers make up a large portion of the SAC. The SAC is bounded on the north-west by the road to Gortahork, in the east by farmland, and in the south by the shores of Lough Nacung Upper and forestry plantations. Geologically the area is underlain by black graphitic metamorphic sediments overlying metamorphosed limestones and calcareous siltstones.

## **1.2 Mapping methodology**

A detailed habitat survey of Fawnboy Bog/Lough Nacung 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 Wet heaths (4010), one of the three Annex I upland habitats listed as Qualifying Interests for the SAC that are primary focus habitats for the NSUH. An approximate area for 7130 Blanket bogs (\* if active) was calculated from the area drawn by Douglas *et al.* (1990). There were no data with which to estimate the approximate area of 7150 Rhynchosporion depressions, the third Annex I upland habitat listed as a Qualifying Interest for the SAC.

## **1.3 Potential for habitat restoration**

Restoration management for 7130 Blanket bogs (\* if active) at 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. 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 of 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 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. The NCA for 7150 Rhynchosporion depressions was Unfavourable – Inadequate 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 objective 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 Fawnboy Bog/Lough Nacung SAC.
- To restore the favourable conservation condition of Blanket bogs (\* if active) in Fawnboy Bog/Lough Nacung SAC.
- To restore the favourable conservation condition of Depressions on peat substrates of the Rhynchosporion in Fawnboy Bog/Lough Nacung 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 Wet heaths and Blanket bogs (\* if active), there were no data with which to estimate the approximate area of 7150 Rhynchosporion depressions.

**Table 2:** Estimated extent of Annex I habitats that are listed as Qualifying Interests for Fawnboy Bog/Lough Nacung SAC. \*denotes priority habitat.

Annex I code	Habitat	Area (ha)	% of SAC
4010	Wet heaths	150	14
7130	Blanket bogs (* if active)	250	23
7150	Rhynchosporion depressions	Unknown	Unknown

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 Fawnboy Bog/Lough Nacung 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 7130 Blanket bogs (\* if active) have also not been assessed in the field as there has been no recent detailed habitat survey.

The structure and functions of 7150 Rhynchosporion depressions have not been assessed in the field either as there has been no recent 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 is 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**

Douglas *et al.* (1990) recorded a significant range of active blanket bog and closely associated flush communities and species from Fawnboy Bog/Lough Nacung SAC. One of the recorded communities corresponds to NSUH provisional community BB2 – *Schoenus nigricans* - *Sphagnum* spp. bog (active bog). 4010 Wet heath vegetation is not documented in Douglas *et al.* (1990) but this is not surprising as that survey specifically targeted blanket bog habitat and additional vegetation communities may well be present. The target for the SAC is to maintain the variety of vegetation communities within the 4010 Wet heaths and 7130 Blanket bogs (\* if active), subject to natural processes. The 7150 Rhynchosporion depressions are defined by just one provisional vegetation community; therefore the community diversity attribute does not apply to this habitat.

## **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) and at least five are required for 7150 Rhynchosporion depressions.

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

### **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, such as 4010 Wet heaths and 7130 Blanket bogs (\* if active). 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).

#### **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 European Commission (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 20m 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.

#### ***Rhynchospora* species**

A relatively plentiful cover of *Rhynchospora* spp. is characteristic of 7150 Rhynchosporion depressions. The target is for at least 10% cover of these species.

### **5.3.3 Vegetation composition: negative indicator species**

A percentage cover threshold for negative indicator species has been established for the three upland habitats listed as Qualifying Interests for Fawnboy Bog/Lough Nacung 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. Tree and shrub cover is assessed for 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions. 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 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) and 7150 Rhynchosporion depressions a maximum threshold is given for bog species which could potentially dominate the habitat, reflecting a reduction in diversity. The selected bog species for 7130 Blanket bogs (\* if active) 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 (*Trichoporum germanicum*). For 7150 Rhynchosporion depressions, the potentially dominant species are many-stalked spike-rush (*Eleocharis multicaulis*), purple moor-grass (*Molinia caerulea*), black bog-rush (*Schoenus nigricans*) and deergrass (*Trichoporum germanicum*). For 7130 Blanket bogs (\* if active) the target is for cover of each of the potential dominant species to be less than 75% and for 7150 Rhynchosporion depressions the cover of each of the potential dominant species should be less than 35%.

#### **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.

## **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 4010 Wet heaths, 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions 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 4010 Wet heaths, 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions. 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, 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions 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.

#### **5.4.3 Sphagnum condition**

Disturbance to *Sphagnum* is assessed for habitats 4010 Wet heaths, 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions. High levels of disturbed *Sphagnum* would indicate undesirable levels of grazers. For each habitat the target is for less than 10% of the *Sphagnum* cover to be crushed, broken and/or pulled up.

### **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 Fawnboy Bog/Lough Nacung 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, 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions. For each habitat the target is the area showing signs of drainage from heavy trampling, tracking or ditches to be less than 10%.

### **5.5.3 Erosion**

Erosion is assessed for 7130 Blanket bogs (\* if active) and 7150 Rhynchosporion depressions. 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 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**

Douglas *et al.* (1990) recorded rare and notable plant records 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 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.
- Douglas, C., Dunnells, D., Scally, L. & Wyse-Jackson, M. (1990) A survey to locate lowland blanket bogs of scientific interest in county Donegal and upland blanket bogs in counties Cavan, Leitrim and Roscommon. Unpublished report to National Parks and Wildlife Service, Office of Public Works, Dublin, Ireland.
- 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.
- JNCC (2009) Common Standards Monitoring guidance for upland habitats. JNCC, Peterborough, UK.
- 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.