

**Killarney National Park, Macgillicuddy's Reeks and
Caragh River Catchment SAC (site code 000365)**

**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 Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC (see Table 1 and Section 2).

Some of the individual blanket bog sites within Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC were surveyed by Douglas *et al.* (1989) 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).

A habitat map of Killarney National Park was produced by Barron & Perrin (2011). In 2011, the upland habitats in Killarney National Park was surveyed as part of the NSUH (Roche *et al.*, 2012). In contrast to the other sites surveyed during the NSUH, there was no mapping element to the fieldwork. The habitat map of the National Park produced by Barron & Perrin (2011) was instead used as the basis for the distribution of NSUH conservation assessment monitoring stops.

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 Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment 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 Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC

Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC is a large mountainous SAC, 76,478ha in extent. It extends from Caherbarnagh Mountain (681m) in Co. Cork, westwards, to encompass The Paps, Killarney National Park, and all the major mountains and lakes of the Iveragh peninsula in Co. Kerry (O.S. Discovery Series map 70, 78, 79 and 83). The SAC includes Carrauntoohil (1,039m), the central peak in the Macgillycuddy’s Reeks mountain range and the highest peak in Ireland. A wide range of semi-natural habitats are present. Geologically the area is predominately underlain by old red sandstones.

1.2 Mapping methodology

A detailed habitat mapping survey of Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment 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 for the entire SAC.

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 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths and 7130 Blanket bogs (* if active bog) in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC. There were no data with which to estimate the approximate area of 7150 Rhynchosporion depressions 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. These latter areas may 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 that are Qualifying Interests. If such scenarios are identified by restoration management plans, the conservation objectives for these other Qualifying Interests should be adjusted 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 of the site-specific attributes and targets for uplands habitats. However, attributes and targets may change/become more refined as further information becomes available.

No comprehensive survey has been undertaken to assess the area or the structure and functions of the 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths and 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions in Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC. As part of the NSUH, conservation assessments of the Annex I upland habitats in Killarney National Park have been conducted (Roche *et al.*, 2012). However, the results of the National Park's conservation assessments are not deemed representative of the remainder of the SAC, as the National Park is state-owned and managed primarily for nature conservation purposes. Therefore, the National Conservation Assessment (NCA) for each Annex I habitat (NPWS, 2013) was 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 4010 Wet heaths was Unfavourable – Inadequate for area and Unfavourable – Bad for structure and functions. The NCA for 4030 Dry heaths was Unfavourable – Inadequate for area and Unfavourable – Bad for structure and functions. The NCA for 4060 Alpine and Boreal heaths was Favourable for area and Unfavourable – Bad for structure and functions. The NCA for 7130 Blanket bogs (* if active bog) 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.

This document provides supporting information for the attributes of the conservation objectives of 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths, 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions, given in the main conservation objectives document for Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment 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 Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC.
- To restore the favourable conservation condition of European dry heaths in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC.
- To restore the favourable conservation condition of Alpine and Boreal heaths in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC.
- To restore the favourable conservation condition of Blanket bogs (* if active bog) in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC.
- To restore the favourable conservation condition of Depressions on peat substrates of the Rhynchosporion in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment 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 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths and 7130 Blanket bogs (* if active bog) in Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC. There were no data with which to estimate the approximate areas of 7150 Rhynchosporion depressions in the SAC.

Table 2: Estimated extent of blanket bog and associated Annex I habitats that are listed as Qualifying Interests for Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC. *denotes priority habitat.

Annex I code	Habitat	Approximate area (ha)	% of SAC
4010	Wet heaths	12,846	17
4030	Dry heaths	6,894	9
4060	Alpine and Boreal heaths	1,258	2
7130	Blanket bogs (* if active bog)	6,445	8
7150	Rhynchosporion depressions	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 entire SAC has been undertaken. However, it is documented that 4010 Wet heaths occur on hillsides throughout the SAC, often occurring in a mosaic with blanket bog (Barron & Perrin, 2011; NPWS internal files). 4030 Dry heaths are best represented in the eastern part of the SAC, including much of The Paps, Tomies Mountain, Shehy Mountain, Purple Mountain and the southern slopes of the Owenreagh valley (Barron & Perrin, 2011; NPWS internal files). 4030 Dry heaths also dominate some of the hills at the western edge of the SAC near the coast (NPWS internal files). 4060 Alpine and Boreal heaths occur on most of the higher mountains and ridges within the SAC. Good examples are present on Mangerton Mountain, Purple Mountain and parts of the Macgillycuddy's Reeks (Barron & Perrin, 2011; NPWS internal files). 7130 Blanket bogs (* if active bog) occur in both lowland and upland situations within the SAC. Examples of lowland blanket bogs include Cumberagh River Bog, Ballygisheen Bog, Eirk Bog, Dinis Bog, Newfoundland Bog, Meelagh River Bog and Cores Bog. Examples of upland blanket bogs include Coomacheo Bog, Caherbarnagh Bog, Carrig East Bog, Tooreenbreenla Bog, Tooreenealagh Bog, Mangerton Bog, Lough Nambrackdarrig Bog and Oolagh East Bog (Douglas *et al.*, 1989; Mooney *et al.*, 1991; Barron & Perrin, 2011; NPWS internal files). 7150 Rhynchosporion depressions typically occur in the wetter areas of lowland blanket bog. Good examples are present at Ballygisheen Bog, Cores Bog, Oak Island Bog, Dinis Bog, Cumberagh River Bog, Meelagh River Bog, Looscaunagh Bog and Kealduff River Bog (Douglas *et al.*, 1989; Mooney *et al.*, 1991; Barron & Perrin, 2011; Roche *et al.*, 2012). 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 Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, the structure and functions of 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths, 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions have not been assessed in the field as there has been no recent detailed habitat survey of the whole SAC.

5.1 Ecosystem function

Ecosystem function is assessed primarily through consideration of soil nutrient levels. For 7130 Blanket bogs (* if active bog), 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) 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 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.

5.1.3 Ecosystem function: hydrology

Ecosystem function of 7130 Blanket bogs (* if active bog) 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

A variety of wet heath vegetation communities have been recorded in the SAC (Roche *et al.*, 2012; NPWS internal files). Six of the recorded communities correspond to NSUH provisional communities as described in the NSUH manual (Perrin *et al.*, 2014). These comprise WH1 *Schoenus nigricans* – *Erica tetralix* wet heath, WH3 *Calluna vulgaris* – *Molinia caerulea* – *Sphagnum capillifolium* wet/damp heath, WH4 *Trichophorum germanicum* – *Eriophorum angustifolium* wet heath, WH5 *Trichophorum germanicum* – *Nardus stricta* – *Racomitrium lanuginosum* montane wet heath, WH6 *Schoenus nigricans* – *Molinia caerulea* – *Myrica gale* wet heath and WH7 *Molinia caerulea* – *Ulex gallii* wet heath. Roche *et al.* (2012) recorded a variety of dry heath vegetation communities, three of which correspond to NSUH provisional communities. These comprise DH1 *Ulex gallii* – *Erica cinerea* dry heath, DH3 *Calluna vulgaris* – *Erica cinerea* dry heath and DH4 *Calluna vulgaris* – *Sphagnum capillifolium* dry/damp heath. Roche *et al.* (2012) recorded an Alpine and Boreal heath vegetation community that corresponds to the NSUH provisional community MH1 *Calluna vulgaris* – *Racomitrium lanuginosum* montane heath. Douglas *et al.* (1989), Mooney *et al.* (1991) and Roche *et al.* (2012) recorded a variety of blanket bog vegetation communities. Seven of these correspond to NSUH provisional communities. These comprise BB1 *Schoenus nigricans* – *Eriophorum angustifolium* bog, BB2 *Schoenus nigricans* – *Sphagnum* spp. bog, BB3 *Eriophorum vaginatum* – *Sphagnum papillosum* bog, BB4 *Trichophorum germanicum* – *Eriophorum angustifolium* bog, BB5 *Calluna*

vulgaris – *Eriophorum* spp. bog, BB6 *Eriophorum angustifolium* – *Juncus squarrosus* bog and BB7 *Eriophorum angustifolium* – *Sphagnum austinii* bog.

The target for the SAC is to maintain the variety of vegetation communities within 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths and 7130 Blanket bogs (* if active bog), subject to natural processes. 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

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) 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 and at least 66% cover for 4060 Alpine and Boreal heaths.

4030 Dry heaths are 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.

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 bog), and for 4030 Dry heaths and 4060 Alpine and Boreal heaths. The latter two habitats 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 bog) assessment and *Campylopus* and *Polytrichum* mosses are excluded from the 4030 Dry heaths assessment as they can be indicative of disturbed conditions).

Dwarf shrub cover

A minimum threshold cover for dwarf shrubs is set for 4060 Alpine and Boreal heaths. A relatively low threshold of at least 10% is set as loose rock and *Racomitrium lanuginosum* are characteristic elements and are often abundant. A lower cover of dwarf shrubs could indicate that the habitat is transitional to grassland or other montane vegetation. 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 European Commission (2013). Whilst it is seldom abundant in wet heaths, 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

A dwarf shrub layer with ericoid species is characteristic of 4010 Wet heaths (crowberry (*Empetrum nigrum*) 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 at each monitoring stop.

Rhynchospora species

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

5.3.3 Vegetation composition: negative indicator species

A percentage cover threshold for negative indicator species has been established for 7130 Blanket bogs (* if active bog) and all associated habitats listed as Qualifying Interests for Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment 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 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths, 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions. 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 of the blanket bog and associated Qualifying Interest habitats present in Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, 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. Tree and shrub cover is assessed for 7130 Blanket bogs (* if active bog), 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 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. The target is for the cover of soft rush to be less than 10%.

Potential dominant species

For 7130 Blanket bogs (* if active bog) 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 species for 7130 Blanket bogs (* if active bog) 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 for 7130 Blanket bog (* if active bog) is for cover of each of the potential dominant species to be less than 75%. 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 (*Trichophorum germanicum*). 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.

Similarly, the calcareous version of 4030 Dry heaths characteristically has a greater component of broad-leaved herbs than siliceous dry heaths. 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 heaths, 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, 4030 and 4060), 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions is for less than 33% of shoots to show signs of browsing. An additional assessment of grazing of live leaves of specific graminoids is made for 4060 Alpine and Boreal heaths. The specific graminoids are stiff sedge (*Carex bigelowii*), wavy hair-grass (*Deschampsia flexuosa*), sheep's-fescue (*Festuca ovina*) and viviparous sheep's-fescue (*Festuca vivipara*). High levels of grazing of these species in 4060 Alpine and Boreal heaths would be undesirable as grazing is not required to maintain this habitat. The target for 4060 is that less than 10% of the live leaves of specific graminoids collectively show signs of grazing.

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 the heath habitats (4010, 4030 and 4060), 7130 Blanket bogs (* if active bog) and 7150 Rhynchosporion depressions. Habitat-specific lists of sensitive areas where burning should not occur are presented in Perrin *et al.* (2014).

4010 Wet heaths, 7130 Blanket bogs (* if active bog) 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. The target for 4030 Dry heaths is no sign of burning in sensitive areas. The target for 4060 Alpine and Boreal heaths, which does not require burning for the maintenance of the habitat, is for there to be no signs of burning within the habitat.

5.4.3 Sphagnum condition

Disturbance to *Sphagnum* is assessed for habitats 4010 Wet heaths, 7130 Blanket bogs (* if active bog) 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.

5.4.4 Growth phases of ling

The growth phases of ling (*Calluna vulgaris*) are assessed for 4030 Dry heaths. The growth phases are pioneer (<10cm high), building (10-30cm high) and mature (>30cm 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 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 the blanket bogs and associated habitats listed as Qualifying Interests for Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC. Disturbance can include hoof marks, wallows, human foot prints, and 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 bog) 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 bog) 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 both habitats 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

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 *Near Threatened* Kerry lily (*Simethis mattiazzii*) (Wyse Jackson *et al.*, 2016) was recorded from 4030 Dry heaths within the SAC (NPWS internal files). This species is also listed on the Flora (Protection) Order, 2015 (Statutory Instrument No. 356 of 2015).

The *Near Threatened* brown beak-sedge (*Rhynchospora fusca*) (Wyse Jackson *et al.*, 2016) was recorded in 7130 Blanket bogs (*if active bog) and 7150 Rhynchosporion depressions in the SAC (Roche *et al.*, 2012).

The FPO listed and *Near Threatened* slender cottongrass (*Eriophorum gracile*) (Wyse Jackson *et al.*, 2016) has been recorded within the SAC (NPWS internal files), but this species cannot be assigned specifically to 7130 Blanket bogs (*if active bog).

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.

Hepatic mats have been recorded in 4010 Wet heaths and 4060 Alpine and Boreal heaths in the SAC (R. Hodd, pers. comm.).

6 References

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