

Ben Bulbin, Gleniff and Glenade Complex SAC
(site code 000623)

Conservation objectives supporting document
- upland habitats

NPWS

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Please note that this document should be read in conjunction with the following report: NPWS (2021) Conservation Objectives: Ben Bulben, Gleniff and Glenade Complex SAC 000623. Version 1.0. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

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 150 m in altitude.

The Scoping Study and Pilot Survey of Upland Habitats (Perrin *et al.*, 2009) was commissioned by the National Parks and Wildlife Service (NPWS) with the primary remit of devising an appropriate strategy and methodologies for conducting a National Survey of Upland Habitats (NSUH). Four phases of the NSUH have subsequently been conducted between 2010 and 2014. The 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.

Ben Bulbin, Gleniff and Glenade Complex SAC was surveyed as part of the NSUH between June and August 2012. The results of the survey are reported in Perrin *et al.* (2013).

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 Ben Bulbin, Gleniff and Glenade Complex 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 Ben Bulben, Gleniff and Glenade Complex SAC

Ben Bulben, Gleniff and Glenade Complex SAC is a medium sized site, being c.59.8km² in extent. It lies within the Dartry Mountains bordered to the east by the valley of Glenade and to the south by the valley of Glencar where it encompasses Glencar Lough (O.S. Discovery Series map 16). It consists of a high plateau surrounded by tall limestone cliffs. Cutting into the northern side of the SAC is the horseshoe valley of Gleniff. The underlying geology of the main plateau is cherty and mudbank limestone with calcareous shale occurring on the lower slopes. Siliceous caps occur at the peaks of Tievebaun and Truskmore where orthoquartzitic sandstone is banded by shale, laminated carbonate and evaporite. The main peaks are Truskmore (alt. 647m), Tievebaun Mountain (alt. 611m), Slievemore (alt. 597m), Ben Bulben (alt. 526m), Benwisikin (alt. 514m) and King's Mountain (alt. 462m).

1.2 NSUH mapping methodology

A detailed habitat mapping survey of Ben Bulben, Gleniff and Glenade Complex SAC utilising the NSUH methodology presented in Perrin *et al.* (2014) has been conducted. A brief description of the methodology used to map habitats by the NSUH is presented here to elucidate how area was calculated for each of the habitats and to explain how the graduated distribution maps were produced. For full details, see Perrin *et al.* (2014).

The local topography of most upland areas consists of intricate patterns of hollows, rocky outcrops, flushes and terraces. The mosaics of vegetation that have developed on this varying topography is often far too complex to map as individual habitats in the manner possible for more uniform landscapes. Hence the approach adopted by the NSUH was to map units (referred to as polygons) that reflect homogeneous mosaics of vegetation and topography. Attempting to map smaller polygons representing single habitats would have greatly increased the amount of time spent mapping and the number of polygons mapped, and would not ultimately have eliminated the need for recording mosaics at smaller scales. All the habitats and non-vegetated substrates present in each polygon and the approximate percentage of the polygon they occupy were recorded. As the total area of each polygon is known from digitisation, data on the approximate extent of each habitat can be readily calculated. A provisional vegetation classification of upland vegetation types was developed to allow more detailed recording of plant communities than would be possible using a habitat classification scheme such as Fossitt (2000).

It is important to note that the NSUH classified and assessed habitats according to the flora and vegetation communities currently present rather than that which may previously have occurred. For example, on an area of drained deep wet blanket peat the current plant communities may be more akin to wet heath than blanket bog as species sensitive to desiccation may have disappeared after drainage. Such an area would therefore have been mapped as wet heath (current vegetation) rather than drained blanket bog. As a result of this approach, the only vegetation classified and mapped as the inactive component of 7130 Blanket bogs (* if active bog) was *Eriophorum angustifolium* – *Sphagnum fallax* swards on eroded bog where a reasonable depth of peat remains. Where areas of wet heath have developed on drained blanket bog they may retain blanket bog restoration potential and this may need to be assessed as, even though restoration of wet heath is an objective for this SAC, so is restoration of active blanket bog; however, the latter being a priority Annex I habitat is likely to take precedence (see also 1.3). The Fossitt (2000) habitat PB4 Bare peat was used for recently cutover

areas of peat. Where older cutover areas had revegetated to another vegetation community, or supported a non-vegetation cover type, they were recorded under the relevant community.

Note that the NSUH used the most up to date SAC boundary dataset available at the time of survey. For Ben Bulbin, Gleniff and Glenade Complex SAC, this was the boundary available in April 2012, which was based on the Ordnance Survey six-inch map base. Any areas calculated and presented here are based on this boundary version.

1.3 Potential for habitat restoration

Restoration management is required for areas of habitat that are Qualifying Interests in this SAC. The feasibility of restoration of degraded areas will need evaluation and ranking in order of importance and taking into consideration a range of factors including habitat priority status under the Habitats Directive.

Areas that may be restored to the priority Annex I habitat active blanket bog could include for example inactive bog; bare eroding bog; and recently cutover bog; but also areas of drained deep peat or older cutovers that may now be dominated by heath vegetation. These latter areas may currently be mapped as other Annex I habitats (e.g. heath habitats 4010, 4030) on the basis of current vegetation composition. Restoration of priority 7130 habitat could therefore result in reduction in area and distribution of such Annex I habitats which may be Qualifying Interests also. If such scenarios are identified during the process of developing restoration management plans, the conservation objectives for these Qualifying Interests should be adjusted as necessary.

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 based on the parameters 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.

Objectives for habitats have been set with reference to the assessment of those habitats in Perrin *et al.* (2013). 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 for the upland habitats 4010, 4030, 4060, 7130/7130*, 7140, 7230, 8110, 8120 and 8210 within Ben

Bulben, Gleniff and Glenade Complex SAC, 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 Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of European dry heaths in Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of Alpine and Boreal heaths in Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of Blanket bogs (* if active bog) in Ben Bulben, Gleniff and Glenade Complex SAC.
- To maintain the favourable conservation condition of Transition mires and quaking bogs in Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of Alkaline fens in Ben Bulben, Gleniff and Glenade Complex SAC.
- To maintain the favourable conservation condition of Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) in Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of Calcareous and calcshist scree of the montane to alpine levels (*Thlaspietea rotundifolii*) in Ben Bulben, Gleniff and Glenade Complex SAC.
- To restore the favourable conservation condition of Calcareous rocky slopes with chasmophytic vegetation in Ben Bulben, Gleniff and Glenade Complex 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 from the baseline which was established by Perrin *et al.* (2013). These areas are reproduced in Table 2.

Table 2: Mapped extent of the upland Annex I habitats that are listed as Qualifying Interests for in Ben Bulben, Gleniff and Glenade Complex SAC. *denotes priority habitat.

Annex I code	Habitat	Area (ha)	% of SAC
4010	Wet heaths	44.4	0.7
4030	Dry heaths	648.9	10.8
4060	Alpine and Boreal heaths	202.6	3.4
6430	Hydrophilous tall herb communities	1.9	0.03
7130*	Active blanket bogs*	2,083.5	34.8
7130	Inactive blanket bogs	51.0	0.8
7140	Transition mires	4.1	0.1
7230	Alkaline fens	22.7	0.4
8110	Siliceous scree	37.6	0.6
8210	Calcareous rocky slopes	40.7	0.7
8210	Calcareous rocky slopes	58.3	1.0

As mentioned earlier, the area of blanket bog habitat 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, but colonisation by bog cotton plays a valuable early role in stabilising the peat.

Loss of area since 1995 was investigated as part of the NSUH through a comparison of contemporary and past aerial photographs (Perrin *et al.*, 2013). Changes in areas that can be detected through this method are limited to obvious habitat changes such as mechanised turf-cutting, agricultural improvement, afforestation, the development of windfarms, roads or tracks, and large-scale discrete erosion events due to bog bursts or land slips. Where obvious anthropogenic losses have been identified, these are included in the area target.

In the case of 7130 Blanket bogs (* if active bog), it was not practicable within the NSUH survey to distinguish between habitat loss/deterioration due to chronic erosion that occurred prior to 1995 and that since 1995, or the causes of such erosion. Thus, the habitat area mapped, along with obvious losses, is likely to be an underestimate of the total area of 7130 Blanket bogs (* if active bog) present in 1995. See also the peat formation attribute under structure and functions.

4 Range

Each habitat's range at site level, in the form of habitat distribution, has been recorded through the mapping carried out through the NSUH and these are reproduced (see maps 1–9). The target is that there should be no decline from the current distribution.

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 Ben Bulbin, Gleniff and Glenade Complex SAC, the structure and functions of 4010 Wet heaths were assessed as Unfavourable – Bad. A detailed conservation assessment of the habitat was not carried out by Perrin *et al.* (2013) due to the fragmented and marginal nature of the habitat in the SAC; however, as the habitat generally occurred in intimate mosaic with 7130 Blanket bog (* if active bog), the structure and functions were deemed to be the same as 7130 Blanket bog (* if active bog).

The structure and functions of 4030 Dry heaths were assessed as Unfavourable – Bad in the SAC. Reasons for failure included inadequate number of positive indicator species and poor structural diversity of ling (*Calluna vulgaris*) being recorded. Poor physical structure was also an issue due to excessive cover of disturbed bare ground.

The structure and functions of 4060 Alpine and Boreal heaths were assessed as Unfavourable – Inadequate. Poor vegetation structure was the main reason for failure due to excessive grazing within the habitat.

The structure and functions of 7130 Blanket bogs (* if active bog) were assessed as Unfavourable – Bad. Reasons for failure included inadequate cover of bryophytes and lichens, and excessive cover of the potentially dominant species deergrass (*Trichophorum germanicum*). The physical structure was also poor due to excessive erosion and disturbed bare ground.

The structure and functions of 8120 Calcareous screes were assessed as Unfavourable – Inadequate. Reasons for failure include an inadequate number of positive indicator species and an inadequate number of indicative fern or saxifrage (*Saxifraga*) species. Excessive cover of the non-native New Zealand willowherb (*Epilobium brunnescens*) was also a reason for failure.

The structure and functions of 8210 Calcareous rocky slopes were assessed as Unfavourable – Bad. The main reason for failure was due to excessive cover of the non-native New Zealand willowherb (*Epilobium brunnescens*).

The structure and functions of 7140 Transition mires, 7230 Alkaline fens and 8110 Siliceous screes were all assessed as Favourable.

5.1 Ecosystem function

Ecosystem function is assessed primarily through consideration of soil nutrient levels for all habitats, 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 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 pH and nutrient status within the natural ranges.

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 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 process of restoring hydrological integrity of blanket bog may impact areas of heath habitats e.g. where the latter may have colonised drained blanket bogs as discussed in Section 1.3. 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

Perrin *et al.* (2013) recorded habitat information based on a provisional list of vegetation communities which is detailed in the NSUH manual (Perrin *et al.*, 2014). Data is presented in the following tables on the abundance of the various communities that comprise upland Qualifying Interest habitats at Ben Bulbin, Gleniff and Glenade Complex SAC together with the area of each of these communities and the percentage of the SAC that these communities cover (hepatic mats associated with Qualifying Interests are considered under the indicators of local distinctiveness attribute). The rocky Annex I habitats (8110, 8120 and 8210) are each defined by just one provisional vegetation community; therefore, the community diversity attribute is not applied to these habitats.

The target for the SAC is to maintain the variety of vegetation communities within habitats 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths, 7130 Blanket bog (* if active bog), 7140 Transition mires and 7230 Alkaline fens, subject to natural processes.

5.2.1 Community diversity data for 4010 Wet heaths

NSUH code	NSUH community	Area (ha)	% of SAC
WH1a	<i>Schoenus nigricans</i> – <i>Erica tetralix</i> wet heath – continuous cover sub-community	0.004	0.0001
WH2	<i>Trichophorum germanicum</i> – <i>Cladonia</i> spp. – <i>Racomitrium lanuginosum</i> wet heath	0.8	0.01
WH3	<i>Calluna vulgaris</i> – <i>Molinia caerulea</i> – <i>Sphagnum capillifolium</i> wet/damp heath	19.7	0.3
WH4a	<i>Trichophorum germanicum</i> – <i>Eriophorum angustifolium</i> wet heath – typical sub-community	1.9	0.03
WH4b	<i>Trichophorum germanicum</i> – <i>Eriophorum angustifolium</i> wet heath – <i>Calluna vulgaris</i> sub-community	19.2	0.3
WH4c	<i>Trichophorum germanicum</i> – <i>Eriophorum angustifolium</i> wet heath – <i>Juncus squarrosus</i> sub-community	1.2	0.02
WH5	<i>Trichophorum germanicum</i> – <i>Nardus stricta</i> – <i>Racomitrium lanuginosum</i> montane wet heath	1.6	0.03

5.2.2 Community diversity data for 4030 Dry heaths

NSUH code	NSUH community	Area (ha)	% of SAC
DH3	<i>Calluna vulgaris</i> – <i>Erica cinerea</i> dry heath	458.3	7.6
DH4	<i>Calluna vulgaris</i> – <i>Sphagnum capillifolium</i> dry/damp heath	147.3	2.5
DH5	<i>Calluna vulgaris</i> – <i>Antennaria dioica</i> heath	2.4	0.04
DH6	<i>Calluna vulgaris</i> – <i>Vaccinium myrtillus</i> dry heath	40.7	0.7

5.2.3 Community diversity data for 4060 Alpine and Boreal heaths

NSUH code	NSUH community	Area (ha)	% of SAC
MH1a	<i>Calluna vulgaris</i> – <i>Racomitrium lanuginosum</i> montane heath – typical sub-community	58.3	1.0
MH1b	<i>Calluna vulgaris</i> – <i>Racomitrium lanuginosum</i> montane heath – <i>Juncus squarrosus</i> sub-community	87.1	1.5
MH3	<i>Vaccinium myrtillus</i> – <i>Rhytidiadelphus loreus</i> – <i>Anthoxanthum odoratum</i> montane heath	57.2	1.0

5.2.4 Community diversity data for 7130 Blanket bogs*

Only active bog communities are shown.

NSUH code	NSUH community	Area (ha)	% of SAC
BB3	<i>Eriophorum vaginatum</i> – <i>Sphagnum papillosum</i> bog	26.0	0.4
BB4	<i>Trichophorum germanicum</i> – <i>Eriophorum angustifolium</i> bog	855.3	14.3
BB5a	<i>Calluna vulgaris</i> – <i>Eriophorum</i> spp. bog – typical sub-community	871.1	14.5
BB5b	<i>Calluna vulgaris</i> – <i>Eriophorum</i> spp. bog – <i>Juncus squarrosus</i> sub-community	321.6	5.4
BB6a	<i>Eriophorum angustifolium</i> – <i>Juncus squarrosus</i> bog – typical sub-community	0.005	0.0001
HW1i	<i>Sphagnum denticulatum/cuspidatum</i> hollow – upland variant	9.5	0.2
HW1ii	<i>Sphagnum denticulatum/cuspidatum</i> hollow – lowland variant	0.004	0.0001

5.2.5 Community diversity data for 7140 Transition mires

NSUH code	NSUH community	Area (ha)	% of SAC
PO1a	<i>Menyanthes trifoliata</i> – <i>Carex limosa</i> pool community – infilling pool sub-community	0.02	0.0003
PFLU5	<i>Carex rostrata</i> – <i>Sphagnum</i> spp. flush	2.9	0.05
RFEN1b	<i>Carex rostrata</i> fen - species-poor sub-community	1.2	0.02

5.2.6 Community diversity data for 7230 Alkaline fens

NSUH code	NSUH community	Area (ha)	% of SAC
RFLU1a	<i>Carex viridula oedocarpa</i> – <i>Pinguicula vulgaris</i> – <i>Juncus bulbosus</i> flush - brown moss sub-community	18.5	0.3
RFLU2	<i>Eleocharis quinqueflora</i> – <i>Carex viridula</i> flush	0.02	0.0003
RFLU4	<i>Schoenus nigricans</i> – <i>Scorpidium scorpioides</i> flush	1.1	0.02
RFEN1a	<i>Carex rostrata</i> fen - species-rich sub-community	3.1	0.1

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 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 is required. At least seven positive indicator species are required at each monitoring stop for 7130 Blanket bogs (* if active bog). For 8110 Siliceous scree, the positive indicator attribute is only applied to block scree; examples of shaley, small structure scree are not assessed under this attribute. At least one positive indicator species is required to be present within the vicinity of each monitoring stop. The positive indicator list is the same as for 8220 Siliceous rocky slopes. For 8120 Calcareous scree and 8210 Calcareous rocky slopes, at least three positive indicator species should occur within the vicinity of each monitoring stop and at least one fern or *Saxifraga* species from the positive indicator list is required.

7140 Transition mires require at least three positive indicator species for in-filling 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*) fens. 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*) fens.

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. A maximum cover of dwarf shrubs is applied for calcareous heath, which was recorded at Ben Bulbin, Gleniff and Glenade Complex SAC (Perrin *et al.*, 2013), due to the characteristically greater forb (broad-leaved herb) component.

5.3.2 Vegetation composition: other desirable species

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

Lichens and bryophytes

Minimum thresholds for cover of lichens and bryophytes are set for habitats where a plentiful lichen/moss layer is characteristic, such as 4010 Wet heaths and 7130 Blanket bogs (* if active bog), and for 4030 Dry heaths, 4060 Alpine and Boreal heaths and 8110 Siliceous scree. The latter three 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 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.

5.3.3 Vegetation composition: negative indicator species

A percentage cover threshold for negative indicator species has been established for all upland habitats listed as Qualifying Interests for Ben Bulbin, Gleniff and Glenade Complex SAC, except 8210 Calcareous rocky slopes. 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 of the 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, 4030 Dry heaths, 8110 Siliceous scree, 8210 Calcareous scree and 8220 Calcareous rocky slopes. Tree and shrub cover is assessed for 7130 Blanket bogs (* if active bog) and 7230 Alkaline fens.

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. For 8220 Calcareous rocky slopes, high cover of these species indicate that rocky slopes are becoming more vegetated which would impact on the niches of the chasmophytic species.

Grass and dwarf shrubs

For 8110 Siliceous screes and 8120 Calcareous screes, a high cover of grasses or dwarf shrubs would indicate that the scree is becoming less exposed and succeeding to another habitat. The target is for the total cover of grass species and dwarf shrubs to be less than 20%. Blue moor-grass (*Sesleria caerulea*) is excluded from the assessment for 8120 Calcareous screes.

Soft rush and common reed

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%. For 7230 Alkaline fens, the cover of both soft rush 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 (*Trichoporum germanicum*). The target is for cover of each of the potential dominant species to be less than 75%.

Dwarf shrub cover

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

Similarly, the calcareous version of 4030 Dry heaths, which was recorded at Ben Bulbin, Gleniff and Glenade Complex SAC (Perrin *et al.*, 2013), characteristically has a greater component of broad-leaved herbs than siliceous dry heath. A maximum target of 75% is therefore set.

Dwarf shrub composition

The dwarf shrub layer within 4030 Dry heaths should not be composed primarily of bog-myrtle (*Myrica gale*), creeping willow (*Salix repens*) and western gorse (*Ulex gallii*). Bog-myrtle is indicative of flushed conditions and is more characteristic of wet heaths and blanket bogs. Creeping willow is more characteristic of dune heaths. Western gorse is a component of dry heath in some regions, 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) and 7130 Blanket bogs (* if active bog) is for less than 33% of shoots to show signs of grazing. For 8110 Siliceous screes, 8210 Calcareous screes and 8220 Calcareous rocky slopes, live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively should be less than 50%. 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*). The target for 4060 is that less than 10% of the live leaves of the specific graminoids collectively show signs of grazing. 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. Grazing levels for 7140 Transition mires and 7230 Alkaline fens are assessed through vegetation height (see Section 5.4.4).

5.4.2 Burning

Occasional 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) and 7130 Blanket bogs (* if active bog). 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 5cm deep' and 'pools, wet hollows, hags and erosion gullies, and within 5–10m of the edge of watercourses'.

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

5.4.4 Vegetation height

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

5.4.5 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).

5.4.6 Senescent ling

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

5.5 Physical structure

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

5.5.1 Disturbance/Disturbed bare ground

Disturbance applies to 8110 Siliceous screes and 8120 Calcareous screes, and the disturbed bare ground attribute is common to all the other upland habitats listed as Qualifying Interests for Carlingford Mountain SAC, except 8210 Calcareous rocky slopes. Disturbance can include hoof marks, wallows, human footprints, vehicle and machinery tracks and, for 8110 and 8120, scree running. Excessive disturbance can result in loss of characteristic species and presage erosion for heaths and peatlands. Scree is subject to naturally recurrent disturbance, but high levels of disturbance may impact on vegetation cover and diversity.

The target for 8110 and 8120 is set at there being less than 10% ground disturbed by human and animal paths, scree running or vehicles. The target for 4010 Wet heaths, 4030 Dry heaths, 4060 Alpine and Boreal heaths and 7130 Blanket bogs (* if active bog) is set at there being less than 10% disturbed bare ground which, in the case of peatlands, can indicate that such disturbance may be impeding recovery of vegetation on damaged areas.

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), 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%.

5.5.3 Erosion

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

5.5.4 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%.

5.6 Indicators of local distinctiveness

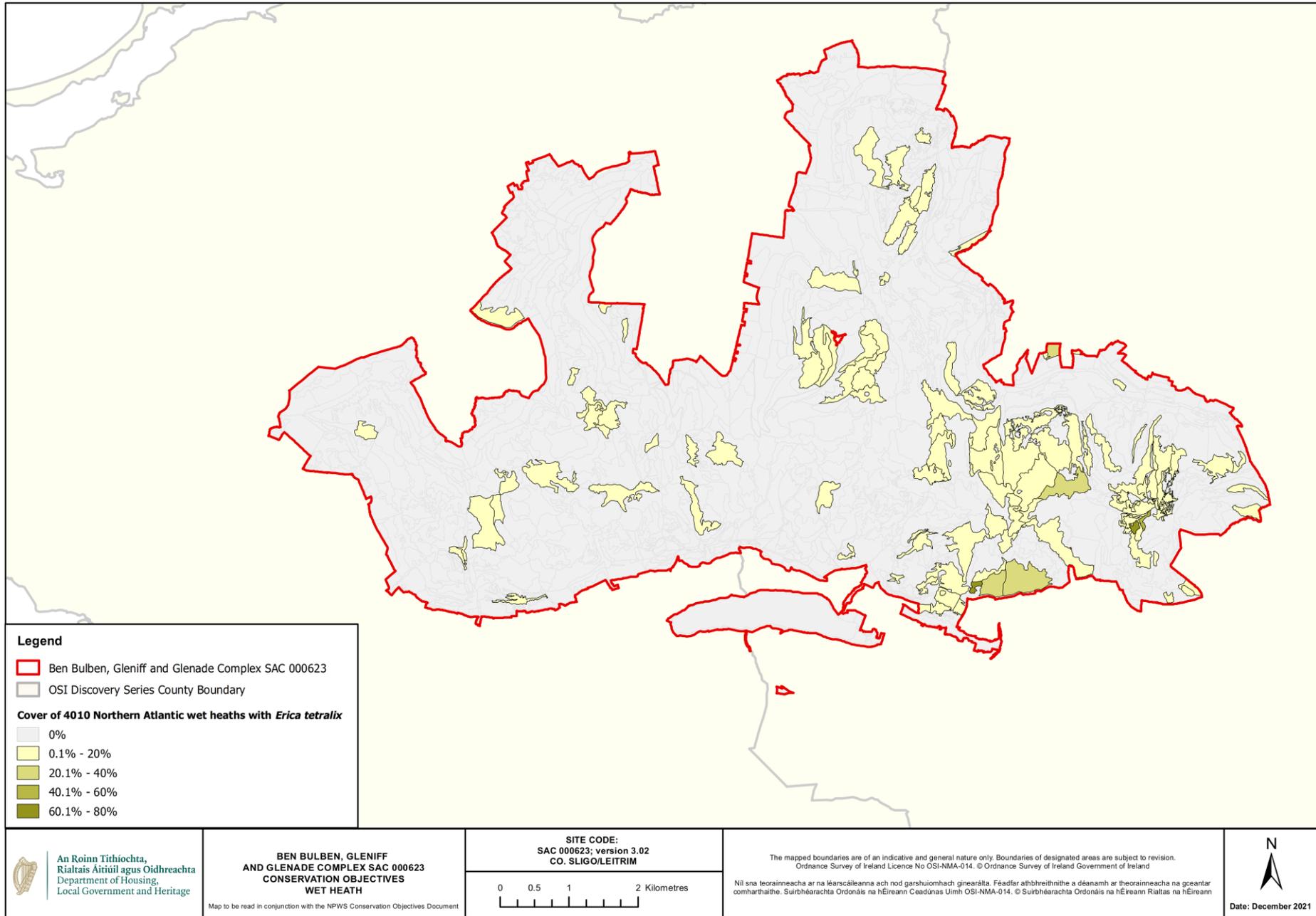
Perrin *et al.* (2013) compiled and mapped existing rare and notable plant records for Ben Bulbin, Gleniff and Glenade Complex SAC and added any new records collected during the NSUH survey. Rare species (those considered at least *Near Threatened* on the appropriate Red List) which could be assigned 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 particular habitat.

Where hepatic mats of the *Calluna vulgaris-Herbertus aduncus* community have been recorded within a particular habitat by Perrin *et al.* (2013), these are also 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.

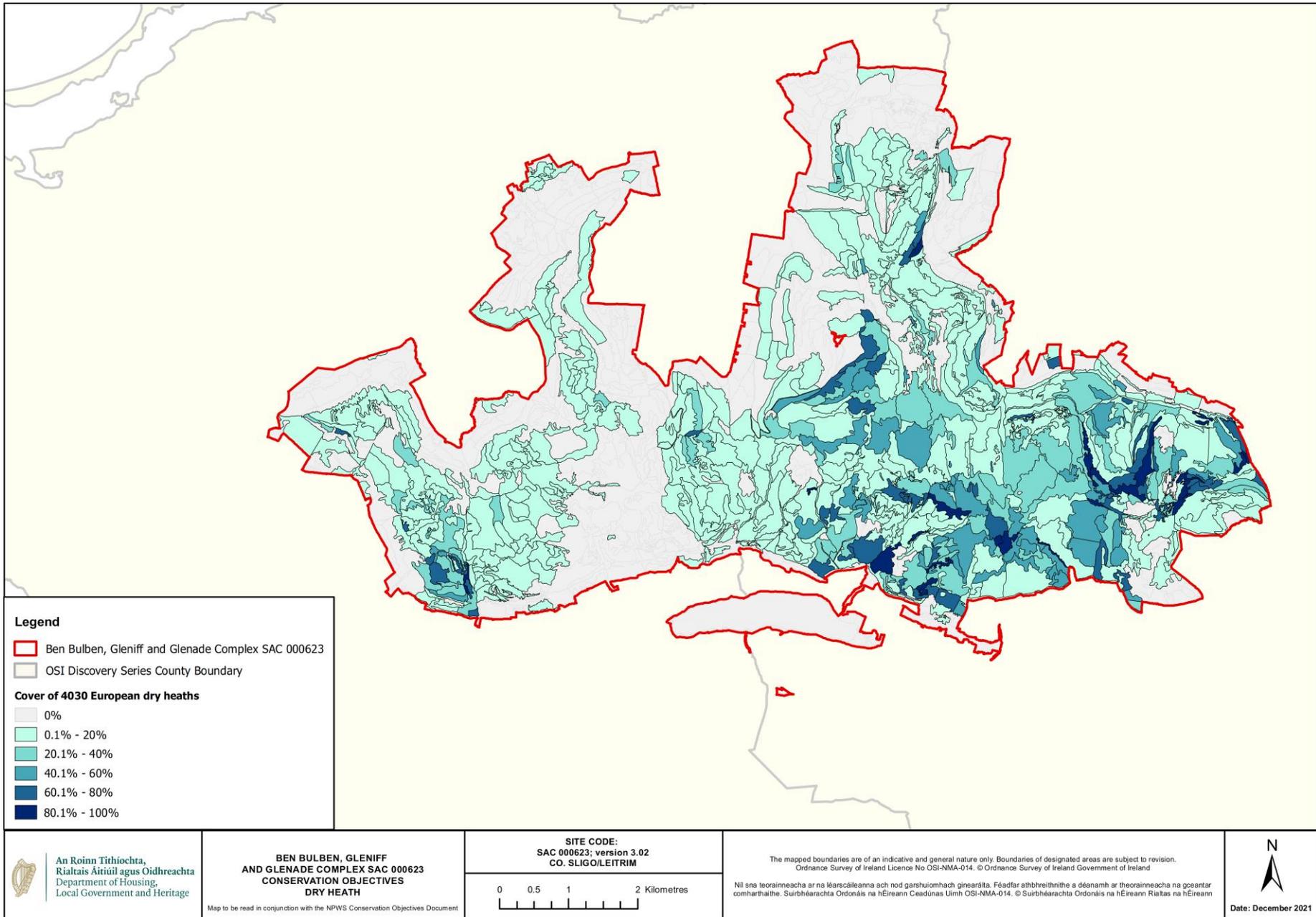
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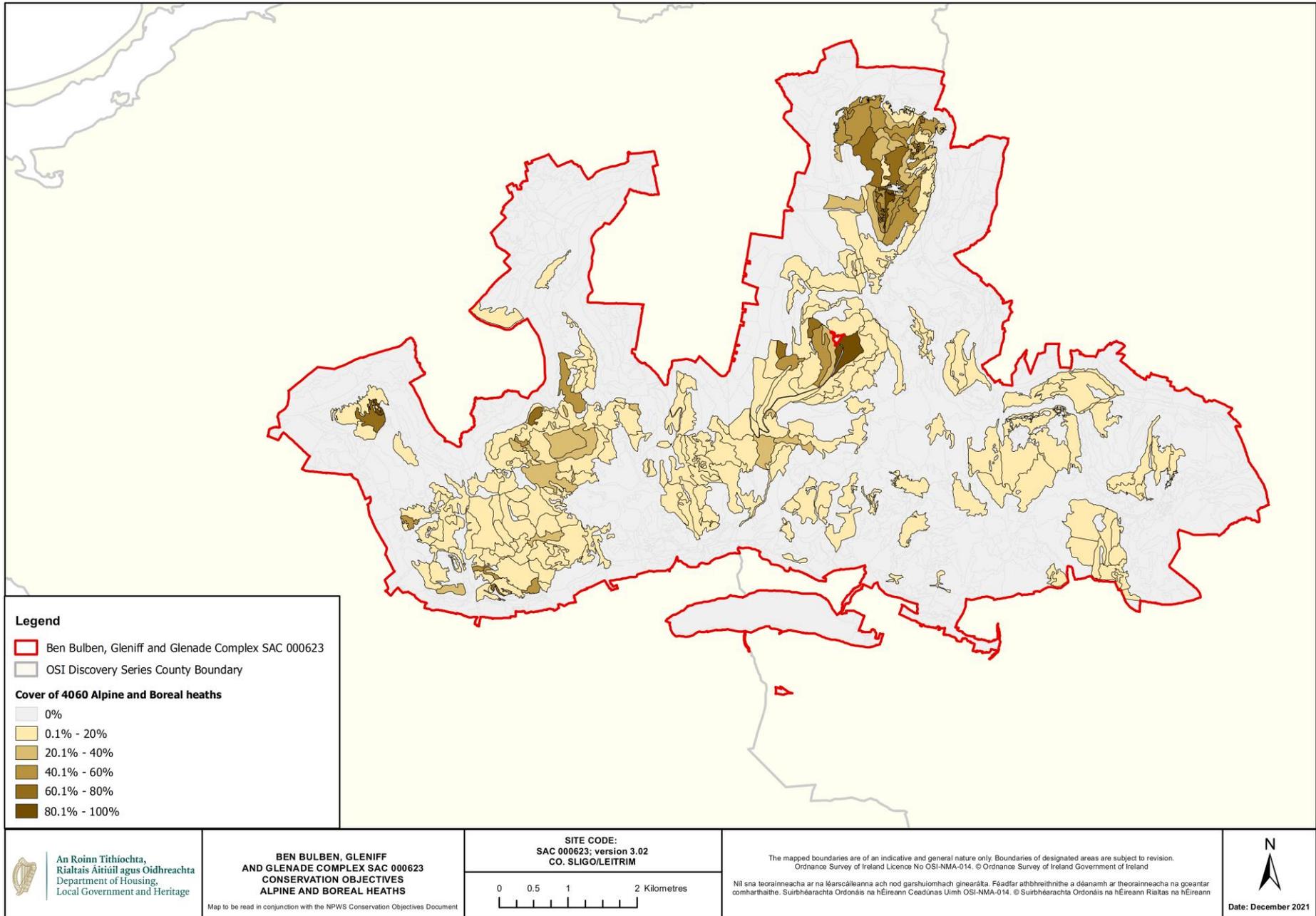
Map 1 Ben Bulbin, Gleniff and Glenade Complex SAC Conservation Objectives – 4010 Wet Heaths



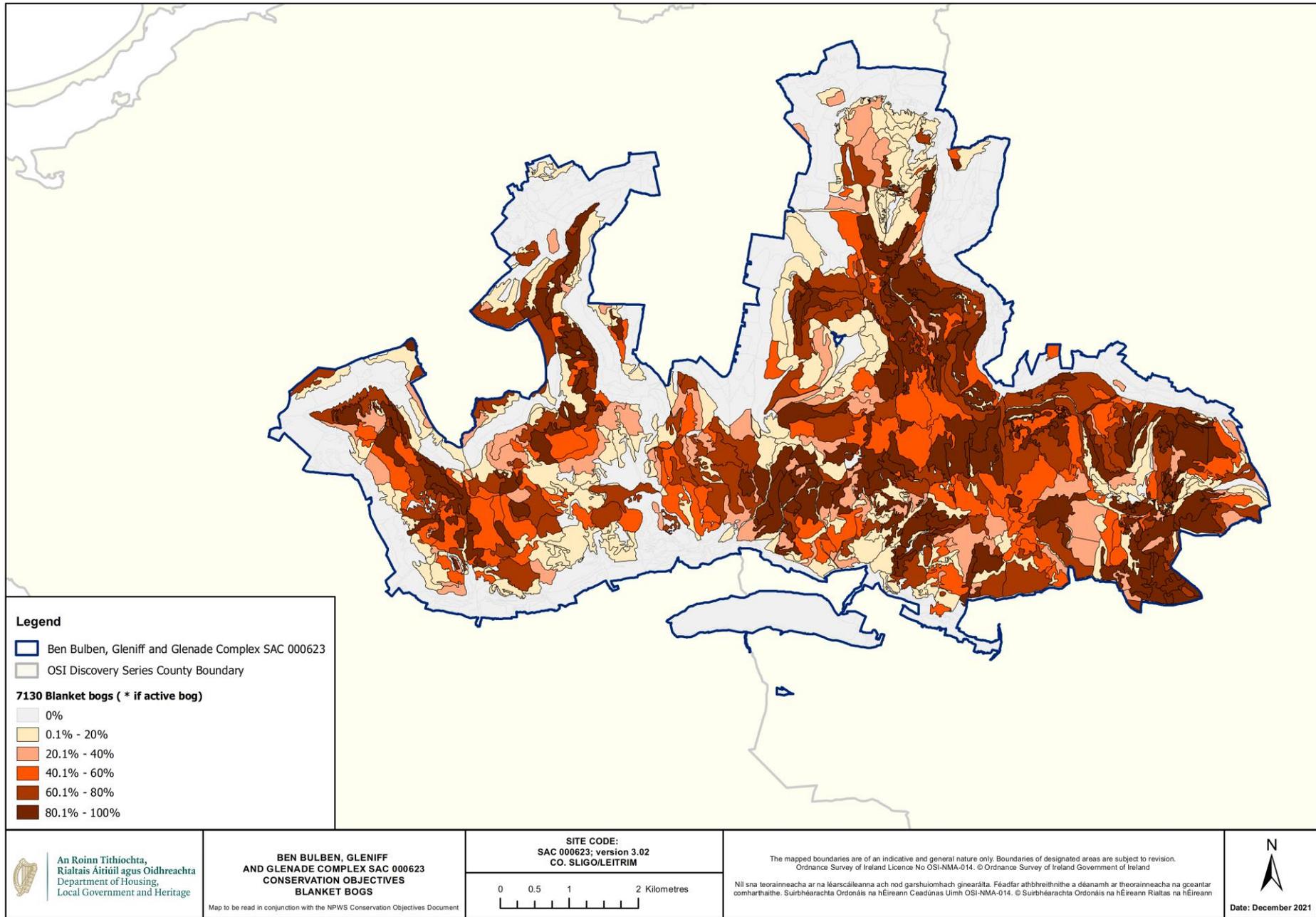
Map 2 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 4030 Dry Heaths



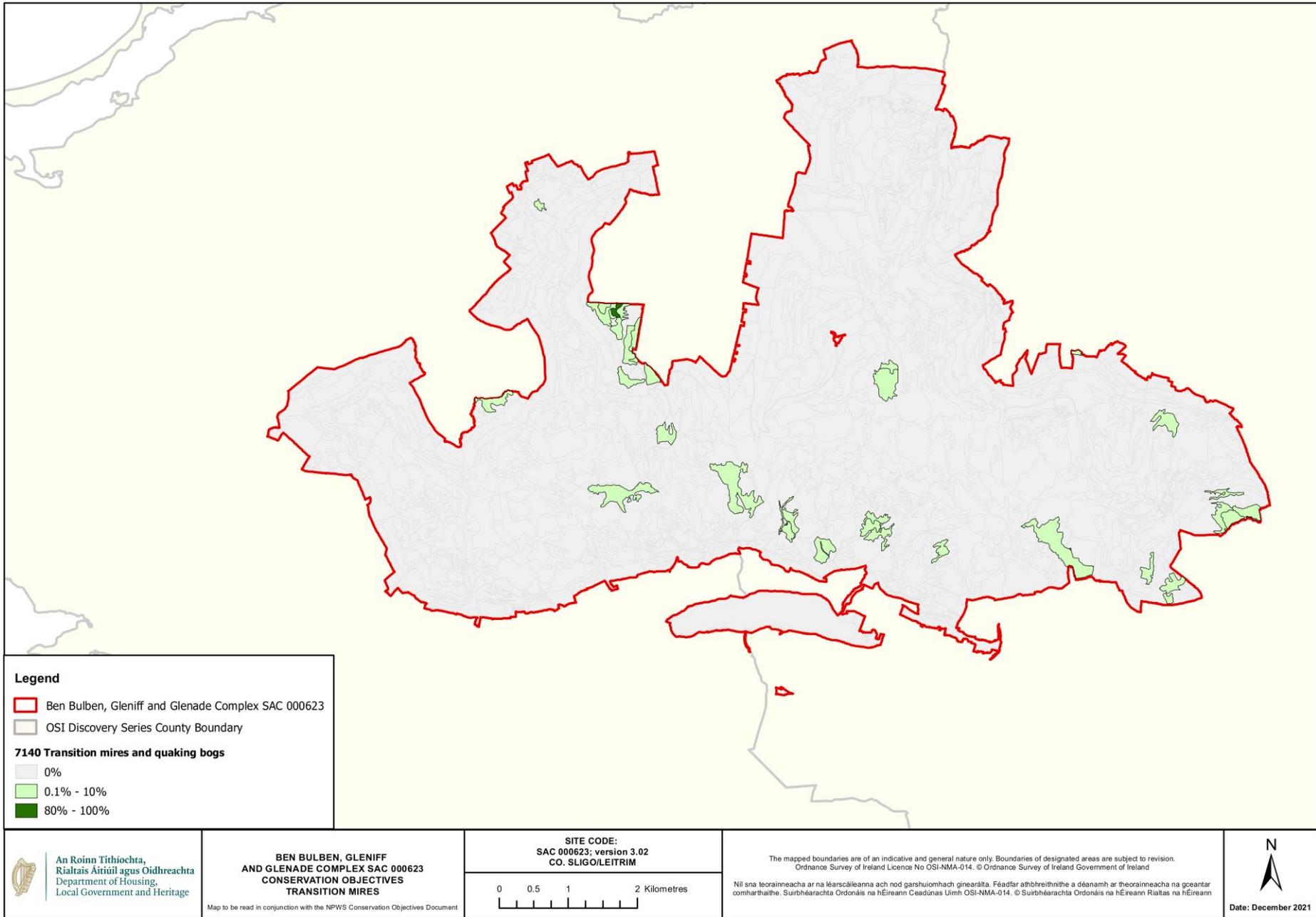
Map 3 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 4060 Alpine and Boreal Heaths



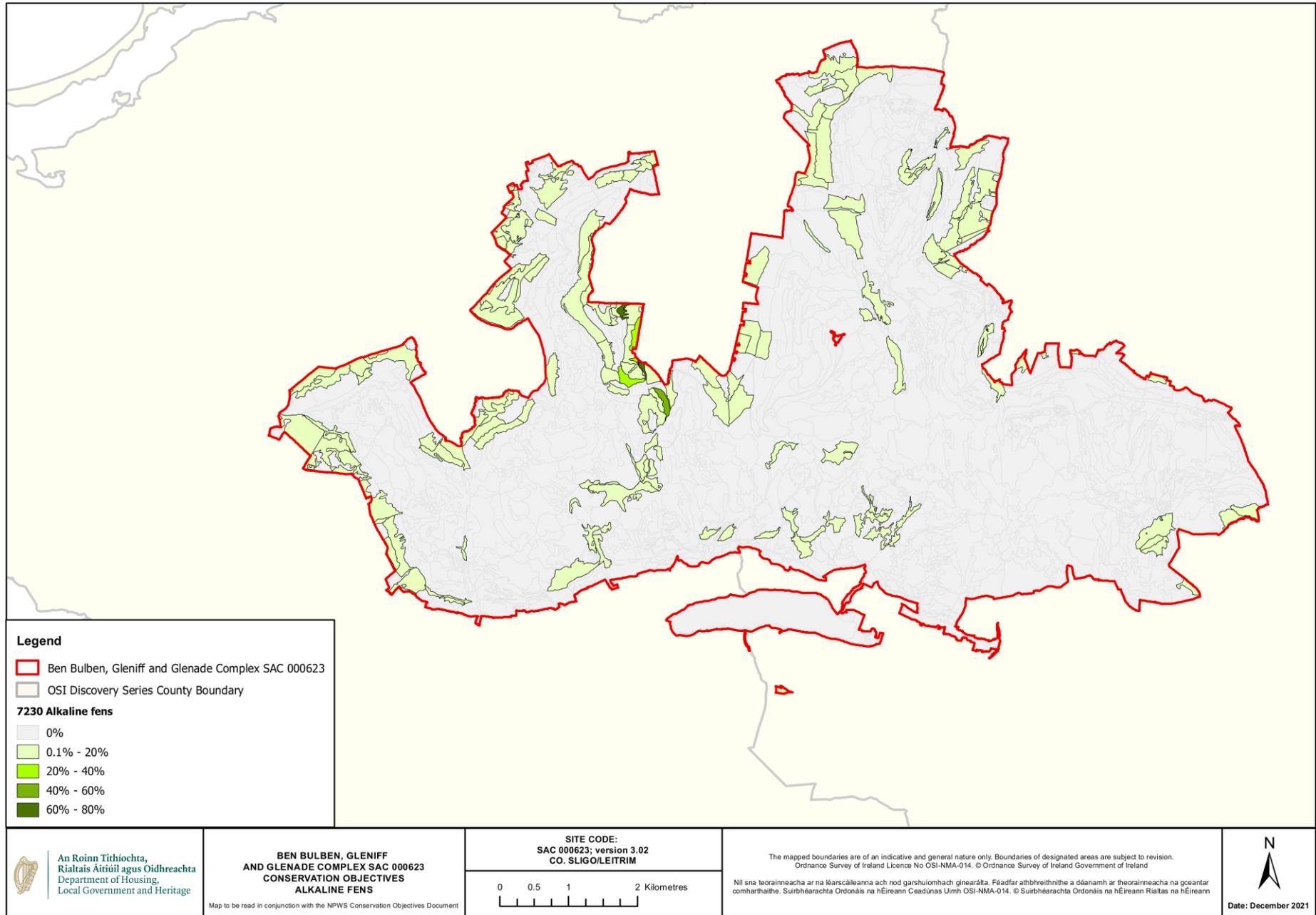
Map 4 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 7130 Blanket Bog (* if active bog)



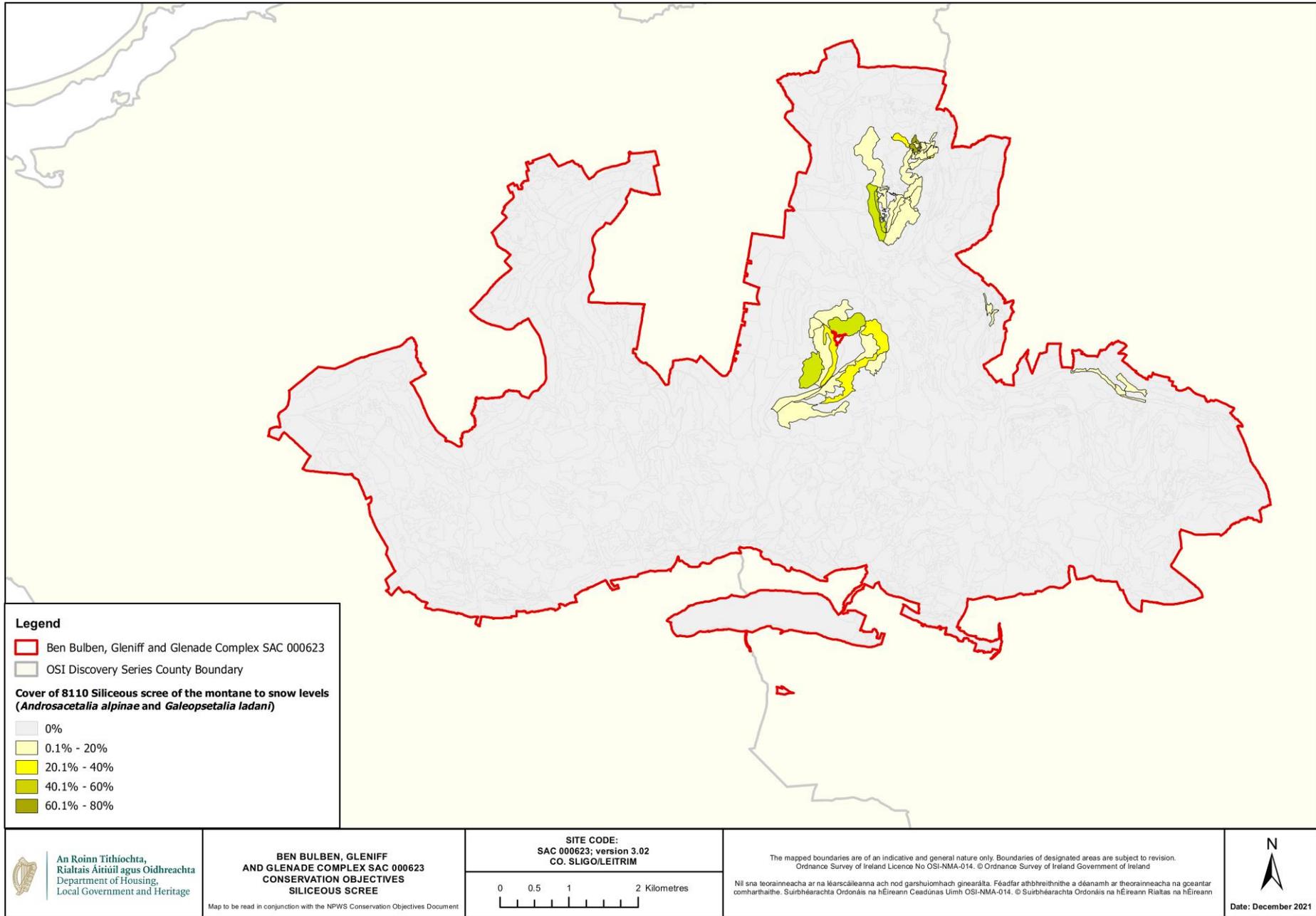
Map 5 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 7140 Transition Mires



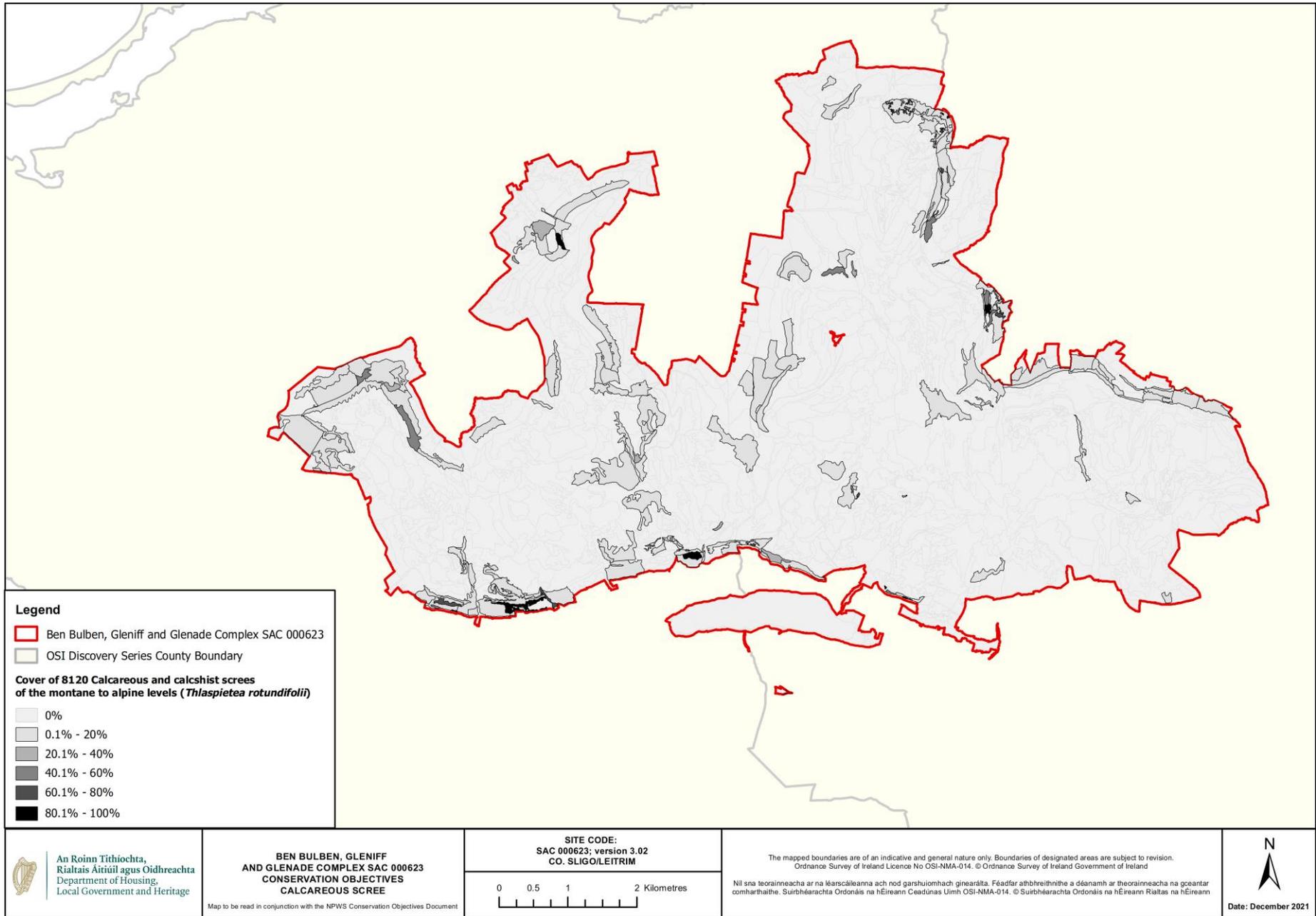
Map 6 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 7230 Alkaline Fens



Map 7 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 8110 Siliceous Screes



Map 8 Ben Bulbin, Gleniff and Glenade Complex SAC Conservation Objectives – 8120 Calcareous Screes



Map 9 Ben Bulben, Gleniff and Glenade Complex SAC Conservation Objectives – 8210 Calcareous Rocky Slopes

