



# **Penwith Moors SSSI**

## **Supporting Information**

Issued by Natural England's Cornwall & Isles of Scilly Team on 7 October 2022

## Contact points and further information

This supplement is intended to be read in conjunction with the notification document for owners, occupiers and other notified parties.

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## **Contents**

### Summary

- [1. Explanation of how Penwith Moors meets the SSSI Selection Guidelines.](#)
- [2. Assessment of the condition of Penwith Moors SSSI.](#)
- [3. Selection of 'operations requiring Natural England's consent'.](#)

[Annex 1. Information used to support the selection of Penwith Moors SSSI.](#)

[Annex 2. Map showing location of all notified habitats and species.](#)

## Summary

Penwith Moors Site of Special Scientific Interest (SSSI) is notified under Section 28 of the Wildlife and Countryside Act 1981. The site supports a diverse mosaic of semi-natural habitats, including heath, fen, grassland, bracken, scrub, rocky outcrops, ponds and man-made historic track-ways. It is of special interest for the following nationally important features that occur within and are supported by the wider habitat mosaic:

- lowland heathland;
- fens, including habitats often referred to as mires and transitions to wet woodland;
- lowland dry acid grassland;
- populations of the plants coral-necklace *Illecebrum verticillatum*, pale dog-violet *Viola lactea*, pillwort *Pilularia globulifera* and Cornish moneywort *Sibthorpia europaea*;
- a lichen assemblage associated with non-montane acid rock;
- an invertebrate assemblage associated with scrub-heath and moorland; and
- a population of breeding Dartford warbler *Curruca undata*.

## 1. Explanation of how Penwith Moors meets the SSSI selection guidelines

This section explains how the information listed in [Annex 1](#) has informed the decision to notify the SSSI, according to the Guidelines for the selection of Biological SSSIs. These are [Part 1: Rationale](#), Operational Approach and Criteria for Site Selection (Bainbridge et al. 2013) and Part 2: Detailed Guidelines for Habitats and Species Groups, hereafter referred to as ‘the Guidelines’.

Data from the National Vegetation Classification<sup>1</sup> (NVC) surveys listed in Annex 1 has been used to assess the heathland, grassland and wetland habitat at Penwith Moors SSSI. The majority of the land now notified as Penwith Moors SSSI was surveyed between 2012 and 2014. Given the time that has passed since these surveys were carried out a proportion of the 50 sites surveyed from 2012-2014 were re-visited in 2019, by the Natural England Field Unit, to check for major changes in habitat extent and condition. The 2019 survey (Natural England Research Report NERR091) was targeted to areas most vulnerable to adverse change. The parameters used to prioritise survey sites were agreed with Natural England’s habitat specialists as follows:

- Priority 1 - all sites with less than 10ha of lowland heath, lowland dry acid grassland and/or mire irrespective of their management status.
- Priority 2 - all sites with 10ha or more of lowland heath, lowland dry acid grassland and/or mire but less than 50% of the area under an agreed conservation management scheme.
- Priority 3 - all sites with 10ha or more of lowland heath, lowland dry acid grassland and/or mire and 50% or more of the area under an agreed conservation management scheme.

In total 40 survey sites were re-visited to assess whether there had been any significant change in the mosaic of habitat present or the condition of the habitat. The results of these surveys are summarised in Table 1.

**Table 1. Results of 2019 validation surveys.**

Habitat	Change in extent and condition
Lowland Heath	<p>40 survey parcels revisited.</p> <p><b>Habitat extent</b>            35 parcels – no apparent loss in vegetation.            3 parcels – minor successional changes.            1 parcel – subject to significant development but no habitat loss.            1 parcel – significant management change.</p> <p><b>Habitat condition</b>            All 40 survey parcels assessed as unfavourable in 2012-2014.            In 2019 39 of the survey parcels were assessed as unfavourable and 1 survey parcel had moved into favourable condition.</p>
Lowland dry acid grassland	<p>7 survey parcels revisited.</p> <p><b>Habitat extent</b>            5 parcels – no apparent loss in vegetation.</p>

<sup>1</sup> The British National Vegetation Classification or NVC is a system of classifying natural habitat types in Great Britain according to the vegetation they contain.

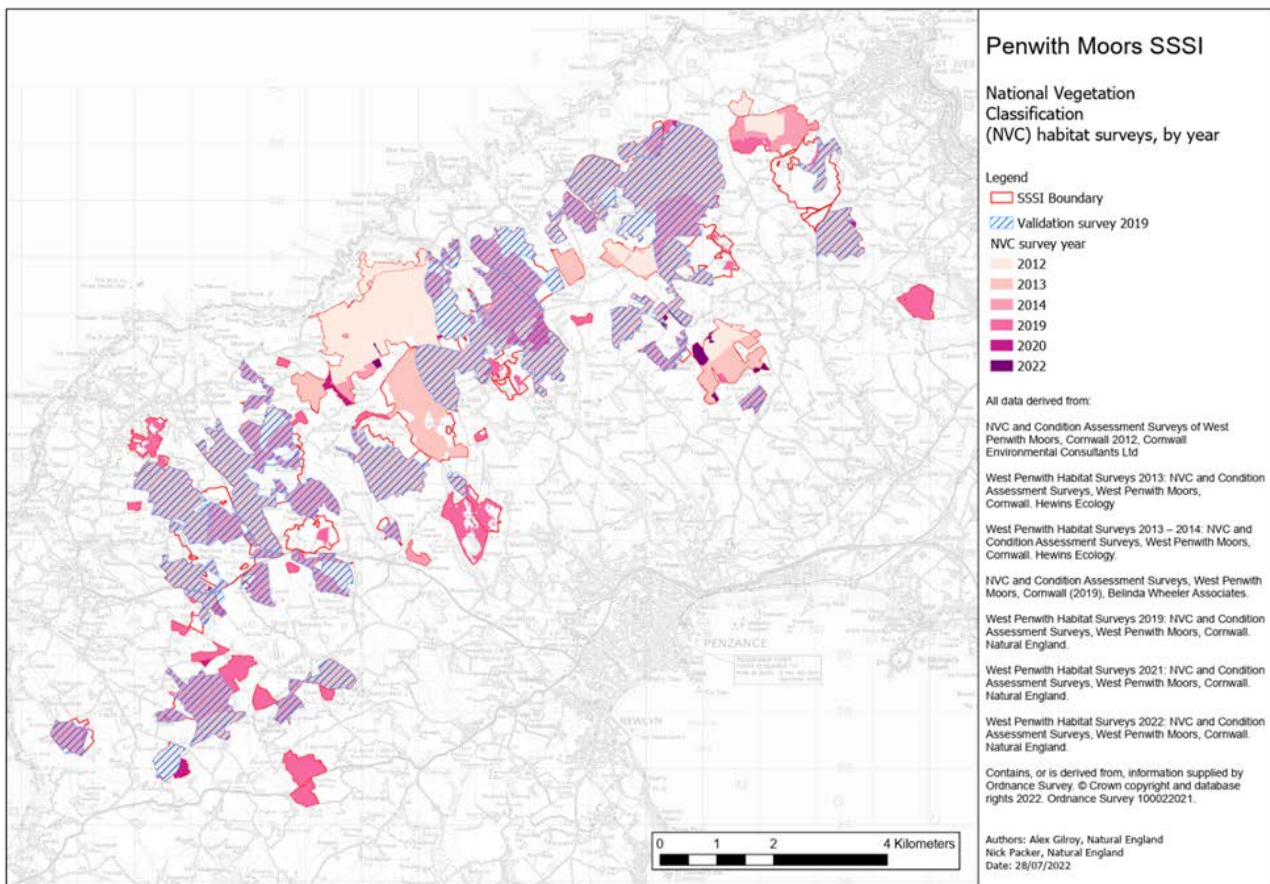
Habitat	Change in extent and condition
	<p>2 parcels – significant agricultural change due to supplementary feeding.</p> <p><b>Habitat condition</b>  All 7 survey parcels assessed as unfavourable in 2012-2014.  In 2019 4 of the survey parcels were assessed as unfavourable and 3 survey parcels had moved into favourable condition.</p>
Lowland fen	<p>18 survey parcels revisited.</p> <p><b>Habitat extent</b>  13 parcels – no apparent loss in vegetation.  2 parcels – minor management changes.  1 parcel – minor successional change.  2 parcels – could not be assessed due to difficulties of access.</p> <p><b>Habitat condition</b>  In 2012-2014 5 of the survey parcels were assessed as favourable and 13 were assessed as unfavourable.  In 2019 12 parcels were re-assessed for condition. 8 were assessed as unfavourable and 4 as favourable.</p>

[Map 1](#) shows the NVC survey areas by year surveyed and the area covered by the 2019 validation survey. In total <1% of the area surveyed had undergone significant change, which gives confidence that the 2012, 2013 and 2014 NVC surveys remain robust and reliable. The majority of the area which had undergone significant change was assessed as:

- still predominantly semi-natural vegetation; and/or
- part of a larger management unit; and/or
- to have potential to be restored.

Removal of one small area (0.33 ha at Trink Hill) was considered. It has been retained within the boundary on the advice of senior specialists due to its proximity to adjacent semi-natural habitat. Consequently, no boundary changes were made as a result of the 2019 validation survey.

**Map 1. NVC survey areas by year surveyed and area covered by the 2019 validation survey.**



## 1.1 Lowland Heathland

Lowland heathland is a broadly open habitat on impoverished, acidic mineral and shallow peat soil, characterised by the presence of heathers and dwarf gorses. There have been significant historical losses of lowland heathland throughout its range in Great Britain. Farrell (1993) reported regional heathland losses from the 1800s to the mid-1980s, with an average loss of 80%, for six major heathland areas, largely as a result of conversion to arable/improved grassland, afforestation, lack of appropriate management and development. Lowland heathland has also become increasingly fragmented and remaining patches are often isolated within intensively managed agricultural landscapes.

The NVC reports ascribe the heathland communities in Penwith Moors SSSI primarily to H4 western gorse *Ulex gallii* - bristle bent *Agrostis curtisii* heath and H8 common heather *Calluna vulgaris* - western gorse *Ulex gallii* heath (Rodwell, et al., 1991).

Although mostly located in unenclosed situations the heathlands in Penwith Moors SSSI are considered to be lowland habitats on the basis of their altitude. Typically the altitude range of the moors is 75 – 250m with the highest point at 252m. [Chapter 4 \(Lowland Heathland\)](#) of the guidelines therefore applies to Penwith Moors SSSI.

The Guidelines ([Part 2, Chapter 4, section 4.4, p.5](#)) state:

“Annex 1 addresses the application of the “diversity” and “rarity” criteria by describing 15 lowland heathland National Vegetation Classification (NVC) types and selection recommendations for each depending on the size of individual occurrences.”

For the predominant NVC communities present in Penwith Moors SSSI (H4 and H8) Annex 1 recommends the following:

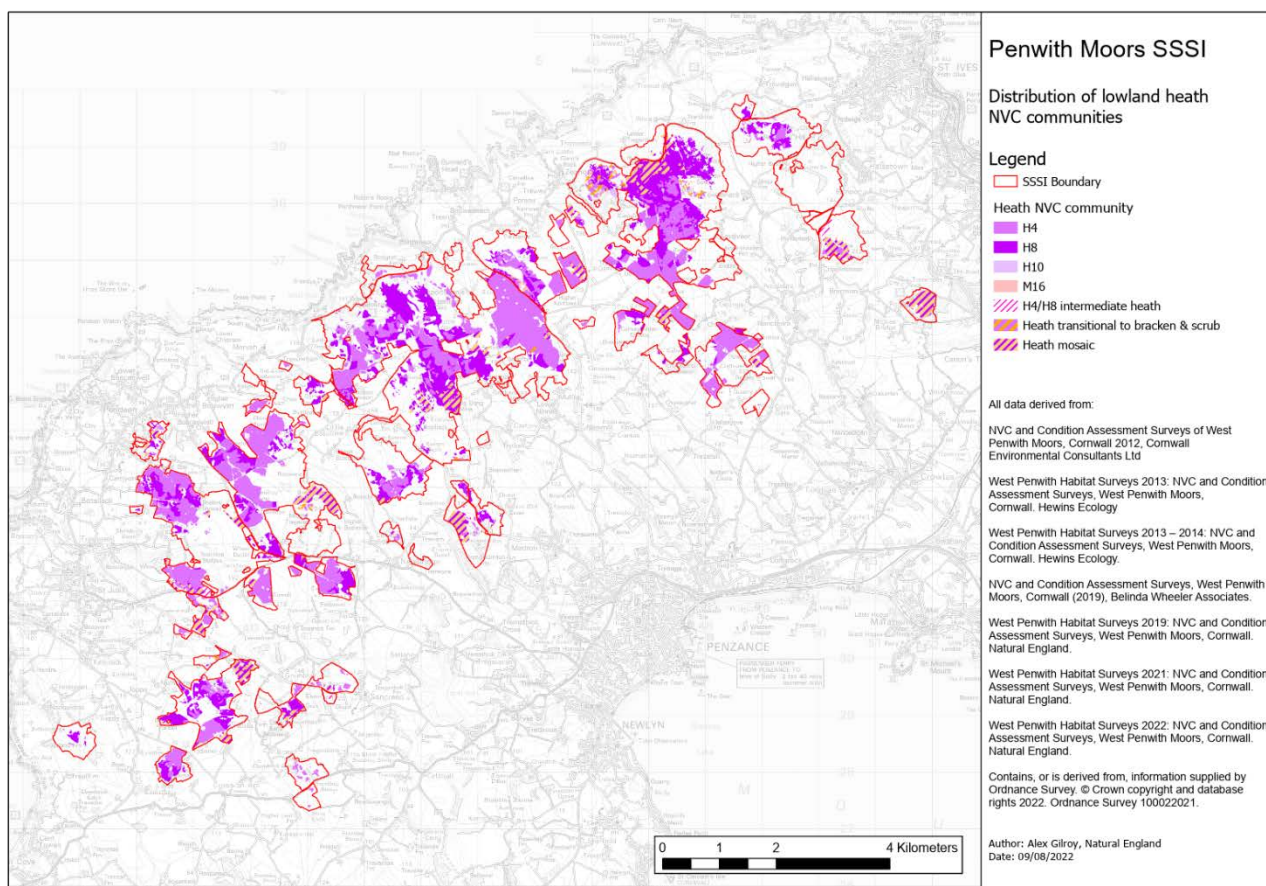
- H4 *Ulex gallii*-*Agrostis curtisii* heath - select all areas above 5ha.
- H8 *Calluna vulgaris*-*Ulex gallii* heath - select all areas above 5ha, except for rare chalk/limestone heathland (mostly H8c) and river shingle heathland stands where smaller areas can be selected.

The Guidelines ([Part 2, Chapter 4, section 4.5, p.5](#)) also state:

“There is clearly a premium on size of area in the selection of lowland heathland SSSI features (section 1). All the larger remaining examples are important, and fragments in proximity may be combined in single sites...Given the scarce and fragmented nature of the habitat, in most cases all heathland parcels larger than 5ha in extent should be recommended for selection ([Annex 1](#)).”

[Table 2](#) summarises the area of each heathland NVC community within Penwith Moors SSSI. [Map 2](#) shows their distribution across the site. The area of lowland heathland habitat within Penwith Moors SSSI significantly exceeds the minimum area threshold for selection under the Guidelines.

### Map 2. Distribution of lowland heath NVC communities across Penwith Moors SSSI.



**Table 2. Area of heathland NVC communities within Penwith Moors SSSI (figures rounded to whole numbers).**

NVC Community	Area (ha)
H4 (all sub-communities combined)	674
H8 (all sub-communities combined)	468
H4/H8 intermediate heath	23
H10 - <i>Calluna vulgaris</i> - <i>Erica cinerea</i> heath	2



NVC Community	Area (ha)
Recently burned - NVC communities could not be assigned	7
M16 Erica tetralix-Sphagnum compactum wet heath	4
Heath in transition with bracken and scrub	24
Total area of heathland NVC communities	1202

Penwith Moors SSSI includes a wider mosaic of habitats including acid grassland, mire and scrub. The guidelines ([Part 2, Chapter 4, section 4.7, p5](#)) state:

“Mosaics and transitions are ecologically valuable, diverse and important as a variety of species associated with heathland use different habitats at different stages in their life cycle or for other reasons (e.g. hunting or thermoregulation). A habitat mosaic including heathland will be considered to be of special value where there is clear evidence that associated heathland species such as adder *Vipera berus*, specialised invertebrates or breeding birds are dependent upon each habitat for part of their life cycle or feeding/resting/territorial behaviour. Where the habitat components are collectively of interest or form part of a practical management unit, even though they may be limited in individual size, the whole area can be treated as a mosaic feature”.

In the case of Penwith Moors SSSI an invertebrate assemblage associated with scrub-heath and moorland and breeding Dartford Warbler are present and also notified features.

The guidelines ([Part 2, Chapter 4, section 4.10, page 6](#)) also state:

“The two smaller gorse species, western gorse *Ulex gallii* and dwarf gorse *U. minor*, are important components of certain oceanic and southern heaths, and selection should ensure that these heathlands are well represented in the heathland SSSI series”.

Western gorse *Ulex gallii* is a community constant of both H4 and H8, which characterise the lowland heathland of Penwith Moors SSSI. H4 and H8 both occur across south-west England, with H8 also found more sporadically in the southern Pennine fringes and the East Anglian coast. Penwith Moors SSSI represents one of the most extensive areas of these community types in a lowland context in South West<sup>2</sup> England. A comparison of the extent of lowland heathland in SSSIs and Special Areas of Conservation (SACs)<sup>3</sup> within the West Penwith Area of Search<sup>4</sup> and South West England demonstrates the importance of Penwith Moors SSSI ([see Table 3](#)). Extent data for SACs is taken from the JNCC standard data form<sup>5</sup>. With the exception of Porthgwarra to Pordenack Point SSSI data for

<sup>2</sup> South West England includes the counties of Cornwall, Devon, Somerset and Dorset.

<sup>3</sup> Special Areas of Conservation (SACs) are important high-quality conservation sites that make a significant contribution to conserving the habitats and species identified in Annexes I and II, respectively, of [European Council Directive 92/43/EEC](#) on the conservation of natural habitats and of wild fauna and flora, known as the Habitats Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level.

<sup>4</sup> To provide good representation of the range and diversity of “best example” sites across Great Britain, SSSI selection has been carried out since 1979 on a basis which subdivides Britain into a number of geographical units. These are called “Areas of Search (AoS)”. In England AoS are defined as National Character Areas (NCAs). NCAs divide England into 159 natural areas, each defined by a unique combination of landscape, biodiversity, geodiversity, economic and cultural activity. For more information see <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles#ncas-in-south-west-england>.

<sup>5</sup> Each SAC has a Standard Data Form containing site-specific information. Forms can be accessed at <https://sac.jncc.gov.uk/#>.

SSSIs is taken from either the notification package or the monitoring specification. Data for Porthgwarra to Pordenack Point SSSI is taken from the Priority Habitat Inventory (PHI)<sup>6</sup>.

**Table 3. Comparison of the extent of lowland heathland in SSSIs and SACs within the West Penwith Area of Search and South West England.**

Site name	Location	Extent of lowland heathland (ha)
Dorset Heaths SAC	Dorset	3,609 ha
The Lizard SAC	Cornwall	1,833 ha
Dorset Heaths (Purbeck and Wareham) and Studland Dunes SAC	Dorset	1,517 ha
<b>Penwith Moors SSSI</b>	<b>West Penwith AoS</b>	<b>1,202 ha</b>
The Quantocks SSSI	Somerset	1,020 ha
East Devon Pebblebed Heaths SAC	Devon	787 ha
Mid Cornwall Moors SSSI	Cornwall	179 ha
Godrevy Head to St Agnes SAC	Cornwall	120 ha
Trelow Downs SSSI	Cornwall	119 ha
Aire Point to Carrick Du SSSI	West Penwith AoS	111 ha
Porthgwarra to Pordenack Point SSSI	West Penwith AoS	110.13 ha
Newlyn Downs SAC	Cornwall	81 ha
Haldon Forest SSSI	Devon	49 ha
Carrine Common SAC	Cornwall	28 ha
Treen Cliff SSSI	West Penwith AoS	26.45 ha

<sup>6</sup> The Priority Habitat Inventory is a spatial dataset that describes the geographic extent and location of Natural Environment and Rural Communities Act (2006) Section 41 habitats of principal importance. <https://www.data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england>.

**Photo 1. Lowland Heath. Photo courtesy of Alan Orange.**



## 1.2 Lowland fen

Fens occur in waterlogged situations where nutrients are received from the surrounding catchment and rainfall. The catchment, hydrological situation and hydrological characteristics are fundamental influences upon the fen vegetation types present. Waterlogging may result from 'ponding up' of water by topography, surface emergence of ground water as seepages or springs or a combination of both. The geology of soils of the catchment strongly influences the chemical properties of the water supply and creates a range of variation in fen vegetation. Fen vegetation consists of a range of plant types varying in their adaptation to the water table from completely aquatic and free floating to those which tolerate only seasonal root waterlogging.

Lowland fens have been subject to significant modification and destruction as a result of afforestation and drainage. Even where they remain, they may dry out irreversibly as a result of lowering of water tables in surrounding land or be subject to eutrophication from inward drainage of water enriched by nitrogen and phosphate fertilisers.

Data from the NVC surveys listed in [Annex 1](#) has been used to determine the qualifying lowland fen habitat at Penwith Moors SSSI. [The guidelines \(Part 2, Chapter 7, Table 19\)](#) list and describe the NVC communities which occur within fen systems. The following NVC communities, listed in [Table 19](#), are present within Penwith Moors SSSI:

- M6 star sedge *Carex echinata* – *Sphagnum recurvum/auriculatum* mire;
- M21 bog asphodel *Narthecium ossifragum* – *papillose* bog-moss *Sphagnum papillosum* valley mire;
- M23 soft-rush *Juncus effusus*/sharp-flowered rush *J. acutiflorus* – common marsh-bedstraw *Galium palustre* rush-pasture;
- M25 purple moor-grass *Molinia caerulea* – tormentil *Potentilla erecta* mire;

- M29 marsh St John's-wort *Hypericum elodes* – bog pondweed *Potamogeton polygonifolius* soakaway community; and
- W1 grey willow *Salix cinerea* - common marsh-bedstraw *Galium palustre* wet woodland.

In addition, M14 black bog-rush *Schoenus nigricans* – bog asphodel *Narthecium ossifragum* mire has been recorded at a single location (Nanquidno) where it occurs in an intermediate/transitional state with M25.

The NVC communities found at Penwith Moors SSSI are characteristic of a soligenous<sup>7</sup> valley mire fed by acid ground-water. Valley mire systems within heathland ecosystems often have clear hydro-topographical transitions and patterns along gradients of wetness and nutrient availability (Rose, 1953). Higher up slopes, dry or humid heath may occur, with wetter heaths appearing downslope in areas of intermittent groundwater seepage, and vegetation of increasingly wet conditions developing downslope, from *Molinia* mire (M25) through to *Sphagnum*-dominated permanently saturated conditions (M21 and M6) closer to the centre of the mire, often associated with shallow, vegetated sinuous natural watercourses (M29) and bog pools (M1). Fen-meadows (M23 and M25) and wet woodland (W1) are also components of mire systems. Where parts of the system have been claimed for agriculture rush-dominated mire (M23) occurs in zones of intermittent seepage and grazing can encourage the spread of rush into wetter mires.

While M23 and M25 are also listed in the SSSI selection guidelines for lowland grassland ([Part 2, Chapter 3, Annex 1, p21](#)) as having high botanical nature conservation value, and therefore worthy of notification, they are included here as components of the valley mire system as recommended in the lowland grassland guidelines ([Part 2, Chapter 3, Annex 1, p21](#)) which state:

“Where these types occur predominantly on deep peat, within or closely associated with extensive fen/mire systems and largely separated from the farmed landscape, they should be assessed using the Fens or Bogs SSSI Selection Guidelines”.

The largest, continuous and/or most intact valley mire systems in Penwith Moors SSSI are located at Bostraze, Boswens, Tregerest, Boswarva, between Lanyon and Men-an-Tol, Bosilliack, between Bodrifty and Bosporthenis, Tredinneck, Gear and Chyembro Commons, Embla and Bussow Moor. [Table 4](#) below summarises the area of each mire NVC community within Penwith Moors SSSI. [Map 3](#) shows their distribution across the site.

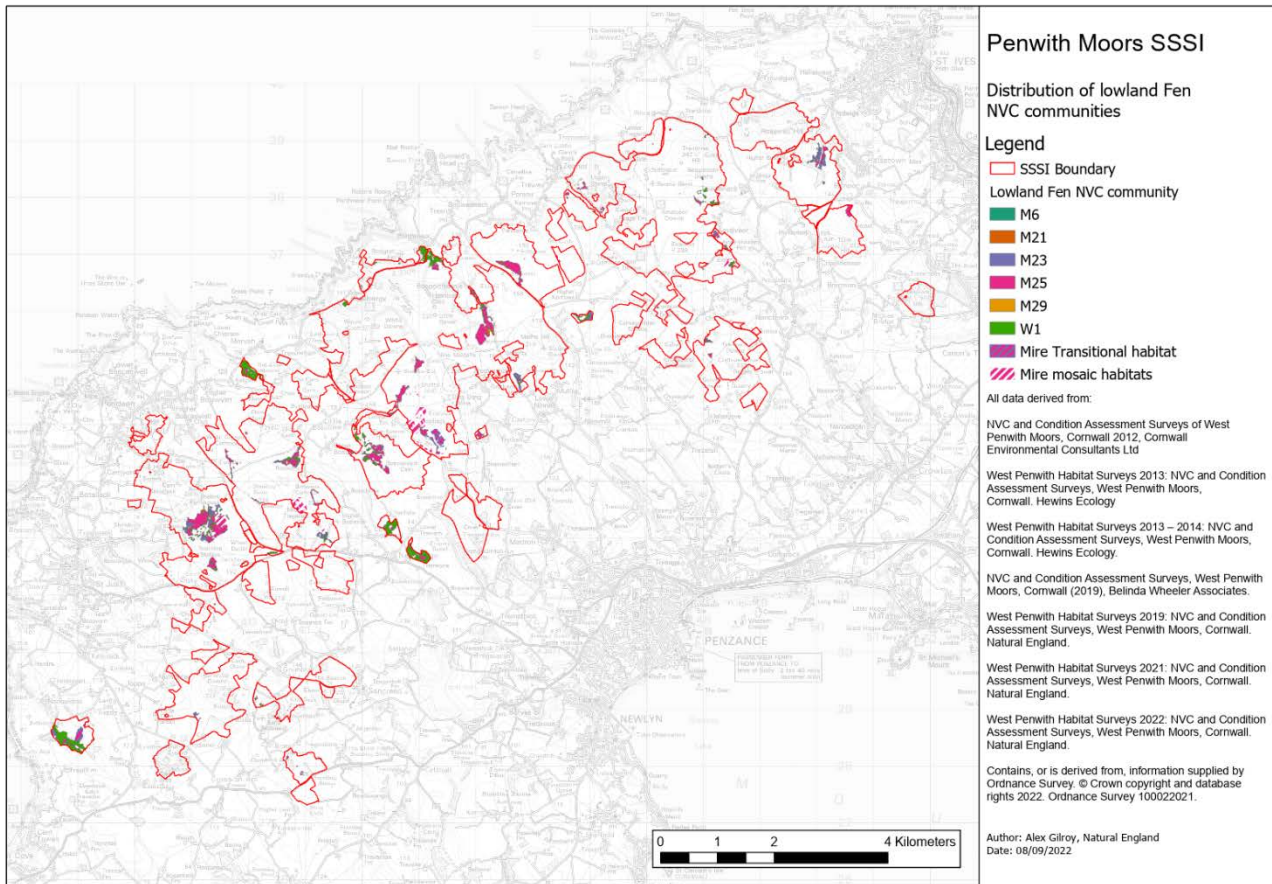
**Table 4. Area of mire NVC communities within Penwith Moors SSSI.**

NVC Community	Area (ha)
M6 (all sub-communities combined)	1.38
M21 (all sub-communities combined)	1.87
M23 (all sub-communities combined)	22.22
M25 (all sub-communities combined)	61.15
M29 (all sub-communities combined)	0.75
W1 (all sub-communities combined)	43.91
M14/M25 transitional	2.22
Other transitional mire communities	6.46

<sup>7</sup> Produced by groundwater or an inflow of surface water, and not by local precipitation.

NVC Community	Area (ha)
Total area of mire NVC communities	139.96

**Map 3. Distribution of mire NVC communities across Penwith Moors SSSI.**



The guidelines ([Part 2, Chapter 7, Para 3.3](#)) provide guidance for site selection of fens. The guidance which applies to the valley mire communities at Penwith Moors SSSI is as follows:

“3.3.1 Within each AoS, at least one (preferably the best) example of every plant community listed in Table 19 that occurs in the AoS should be selected within each topographical/hydrological fen type in which it occurs”.

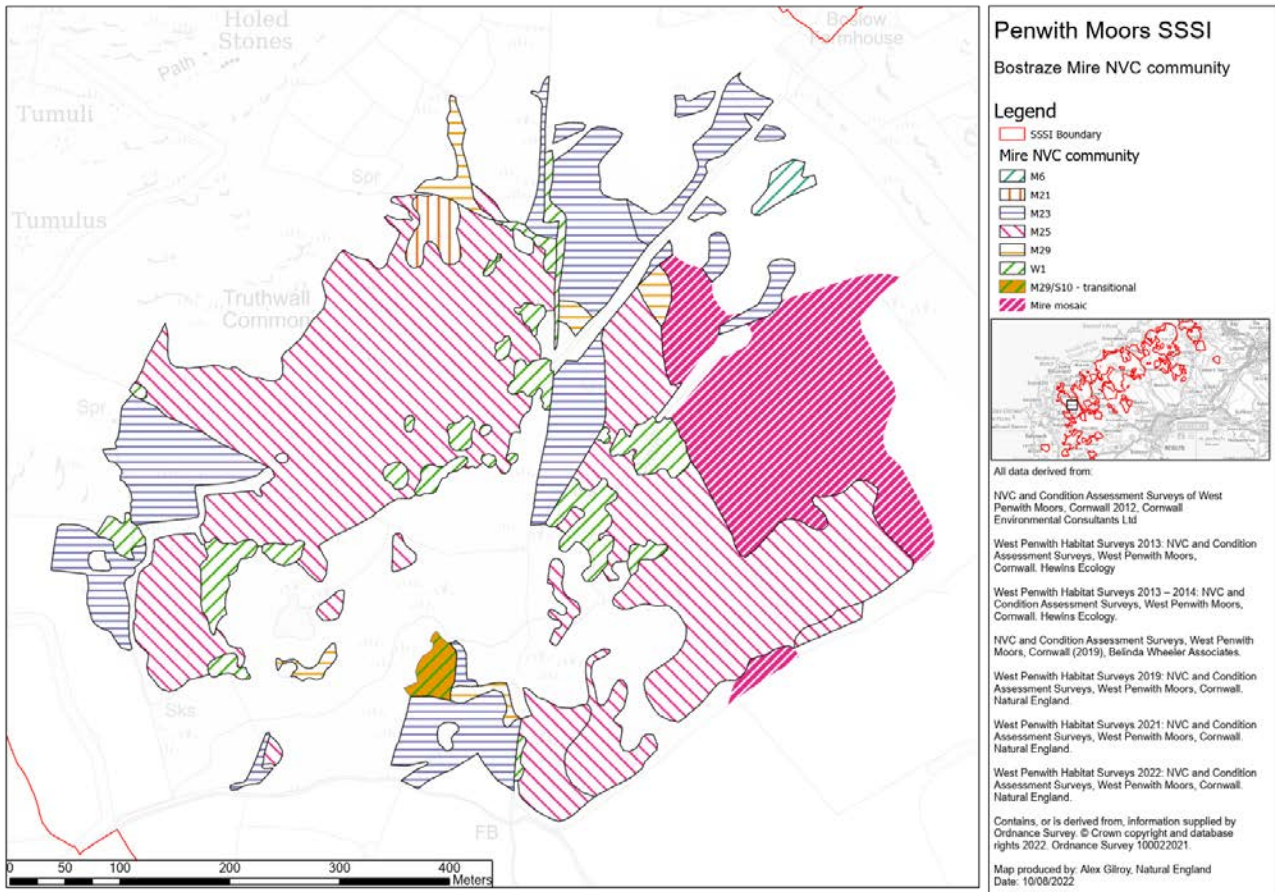
The mire communities M6, M14, M21, M23, M25, M29 and W1 have been recorded at Penwith Moors SSSI. The total extent of these vegetation types is 139.96 ha, including 8.68 ha of mire vegetation transitional to other semi-natural habitats. The most extensive mire vegetation community is M25 *Molinia caerulea* – *Potentilla erecta* mire which contributes 61.15 ha to the total resource. The only SSSI in the AoS (West Penwith NCA) notified for its mire vegetation is Aire Point to Carrick Du SSSI where 27ha of M23 and M25 has been recorded. Given the scale of mire vegetation within Penwith Moors SSSI and the degree of enclosure and agricultural improvement of land it is the most extensive example within the AoS.

“3.3.2 Within each AoS, the best examples should be selected of clearly developed vegetation mosaics which represent hydroseral zonation or combinations of two or more fen types”.

The range, scale and complexity of the wetland vegetation at Penwith Moors SSSI is unmatched within the AoS. It includes a range of features from open water through to

bryophyte-rich wet wooded (W1) and clear hydro-topographical transitions to wet and dry heath. Although the influence of drainage, enclosure and agricultural management has led to loss of some features and localised reduction in diversity of wetland vegetation, the remaining semi-natural mire vegetation is species-rich. By way of example [Map 4](#) shows the mosaic of wetland vegetation within the mire at Bostraze.

**Map 4. Mosaic of wetland vegetation within the mire at Bostraze.**



“3.3.3 All examples of the rare or highly localised communities and sub-communities marked \* in [Table 19](#) should be considered for selection, within the total fen mosaic of which they are a part. If any of these prove to be more common in any part of the country than is currently known, the CSD fen/and specialist should be consulted”.

M21 is identified as a rare or highly localised community and thus all examples are recommended for selection. 1.87 ha of M21 has been recorded at Penwith Moors SSSI, the largest stand of which is located between Bodrifty and Bosporthennis. M14 is also identified as a rare or highly localised community. At Penwith Moors SSSI its only occurrence is in an intermediate state with M25. It is therefore not specifically selected under this section of the guidelines. There is potential to increase the extent and distribution of M14 and M21 at Penwith Moors SSSI through improved site management and restoration of more natural hydrological function.

“3.3.4 Sites which may characterise either the geographical limits or the core of the national distribution of any fen community should be considered for selection”.

The mires within Penwith Moors SSSI are the most south west example of valley mire systems in England.

“3.3.8 Transitions to other types of non-peatland habitat are also features of some significance in the selection process...”.

Penwith Moors SSSI features transitions from mires to wet heaths, dry heaths, drier grassland and scrub, in addition to fen woodland.

**Photo 2. Drone photograph of Bosiliack catchment flying north, upstream along the watercourse. Photo courtesy of Atkins.**



### 1.3 Lowland grassland

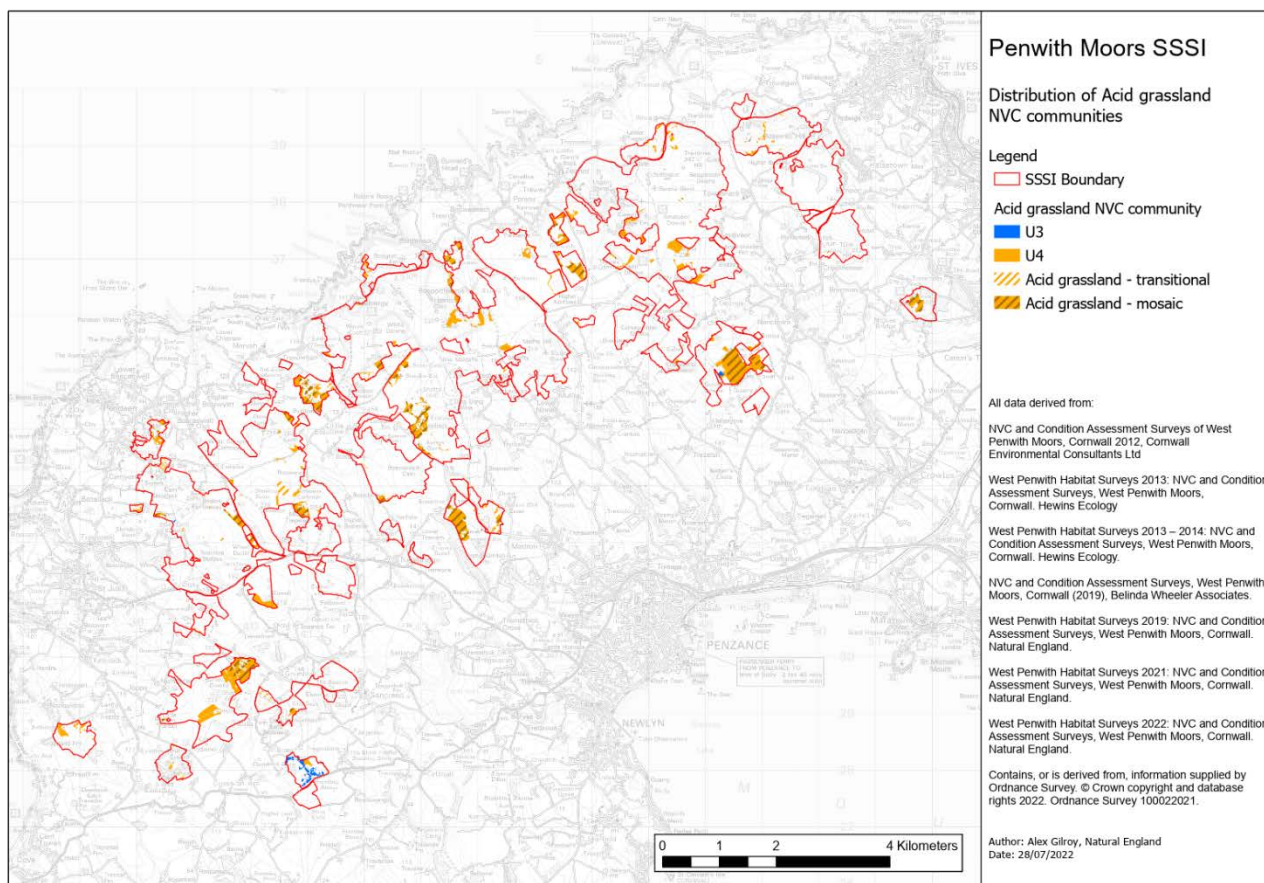
Lowland semi-natural grasslands are largely the product of human activity, having originally been created by woodland clearance and wetland drainage. They occur in both enclosed and unenclosed situations but typically below an altitude of 300m. They are mostly ancient communities composed almost entirely of native species. Some grassland plant species are ubiquitous, but many have specific ecological requirements and restricted geographical distribution. Soil characteristics, both physical and chemical, together with hydrology and location within Great Britain play a major role in influencing sward composition.

Large areas of semi natural lowland grassland have been lost as a result of agricultural intensification, abandonment or inadequate management. It has been estimated that in England and Wales 97% of lowland unimproved grassland has been lost between 1930 and 1984 (Fuller 1987). What remains has become increasingly fragmented and isolated often surviving as isolated fields, inaccessible parts of intensively managed fields or small groups of fields in the possession of elderly farmers.

Data from the NVC surveys listed in [Annex 1](#) has been used to determine the qualifying lowland grassland habitat at Penwith Moors SSSI. The following lowland dry acid grassland NVC communities are present. [Map 5](#) shows their distribution across Penwith Moors SSSI:

- U3 bristle bent- *Agrostis curtisii* grassland; and
- U4 sheep's fescue *Festuca ovina* – common bent *Agrostis capillaris* – heath bedstraw *Galium saxatile* grassland.

## Map 5. Distribution of U3 and U4 across Penwith Moors SSSI.



The Guidelines ([Part 2, Chapter 3, section 4.10, p.7](#)) state:

“The national extent of any grassland type should be taken into account during the selection of sites for notification from those that qualify for selection. For those grassland communities that are now rare (less than 10,000 ha in Great Britain or less than 10,000 ha in the British lowlands, as shown in section A of Annex 1) the presumption is that all examples which are at least 0.5 ha should be selected for notification, singly or in combination.”

U3 is listed in Section A of Annex 1 as a community estimated to cover less than 10,000 ha in Great Britain. Penwith Moors SSSI supports 5.8 ha of U3 grassland and a further 0.76 ha in a transitional state with the heathland community H4. It therefore exceeds the 0.5 ha threshold above which there is a presumption for notification.

The Guidelines ([Part 2, Chapter 3, section 4.11, p.7](#)) also state:

“For those grassland types where the total British resource exceeds 10,000 ha (as shown in section A of Annex 1), an exemplar approach to the selection of sites should be taken. The selection should include the best examples within an AOS, ensuring representation of the range of sub-communities and other significant variation. There should be a general presumption to select sites of 5 ha or more, although in the upland fringes and in AOS with extensive representation of the habitat, selection should focus on the largest, diverse and least modified examples.”

U4 is listed in Section A of Annex 1 as a grassland type that whilst rare, exceeds 10,000 ha in Great Britain. Penwith Moors SSSI supports 118.66 ha of U4 grassland and therefore significantly exceeds the 5 ha threshold above which there is a presumption for notification. Penwith Moors SSSI is the only site with extensive lowland dry acid grassland



within the West Penwith AoS. Areas of lowland dry acid grassland within the AoS, identified by the Priority Habitat Inventory (PHI) are predominantly included within the SSSI boundary. Based upon aerial photographs and vegetation surveys the remaining sites in the PHI do not support lowland dry acid grassland or are coastal. No other SSSIs within the AoS are notified for acid grassland. Penwith Moors SSSI supports two sub-communities of U4 grassland (a and b) so also constitutes a diverse example.

The Guidelines ([Part 2, Chapter 3, Section 4.18, p.9](#)) further state:

“Sites with a complex of semi-natural habitats reflecting variation in particular environmental parameters or exhibiting transitions between habitats are considered to have greater value.”

The U3 and U4 grasslands at Penwith Moors SSSI frequently form mosaics with and transitions between lowland heath, lowland fen and bracken.

**Photo 3. Lowland acid grassland. Photo courtesy of Mark Beard, Natural England.**



#### **1.4 Vascular plants**

The mosaic of semi-natural habitat across Penwith Moors SSSI supports a number of declining (threatened on either the Great Britain or England Red Lists<sup>8</sup>) and restricted range (Nationally Rare or Nationally Scarce<sup>9</sup>) species of vascular plant. Data from the following surveys and sources has been used to determine the vascular plant interest within Penwith Moors SSSI:

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<sup>8</sup> Red lists are a globally recognised way of identifying the threat of extinction to species, using the internationally accepted Red List guidelines developed by the International Union for Conservation of Nature (IUCN). Red list assessments are objective and based on scientific information and ongoing research.

<sup>9</sup> At the GB level, Rare species are those occurring in 1 to 15 hectads and Scarce species occur in 16 to 100 hectads (Wiggington 1999).

- Collation and analysis of records from the ERICA<sup>10</sup> database from 2000 to 2021.
- A survey for five species of vascular plant carried out in 2019.

#### 1.4.1 Nationally Rare, Scarce, Endangered and Vulnerable Species

The Guidelines ([Part 2, Chapter 11, section 4.1.1, p8](#)) state that:

“Restricted Range (GB or country-level Rare/Scarce) threatened taxa qualifying as CR, EN or VU under IUCN criteria A, B, C and/or D, IUCN (2012a). All localities with sustainable populations should be considered for selection.”

Populations of three vascular plant species listed as Nationally Rare/Scarce in Great Britain have been recorded at Penwith Moors SSSI. They are also assessed as either Endangered (EN<sup>11</sup>) or Vulnerable (VU<sup>12</sup>) under IUCN criterion A2c.

The species are:

- Coral necklace *Illecebrum verticillatum* – Nationally Rare (GB), IUCN Endangered (GB and England). This species has recently been re-classified as Nationally Rare, following an assessment of its status which concluded that only the relatively few populations in Cornwall should be treated as native. Also listed as a ‘species of principal importance in England’ under section 41 of the Natural Environment and Rural Communities Act (2006).
- Pale dog-violet *Viola lactea* – Nationally Scarce (GB), IUCN Vulnerable (GB) and Endangered (England). Also listed as a ‘species of principal importance in England’ under section 41 of the Natural Environment and Rural Communities Act (2006).
- Pillwort *Pilularia globulifera* – Nationally Scarce (GB), IUCN Vulnerable (England). Also listed as a ‘species of principal importance in England’ under section 41 of the Natural Environment and Rural Communities Act (2006).

[Map 6](#) shows records of these species from 2000 to 2021 across Penwith Moors SSSI.

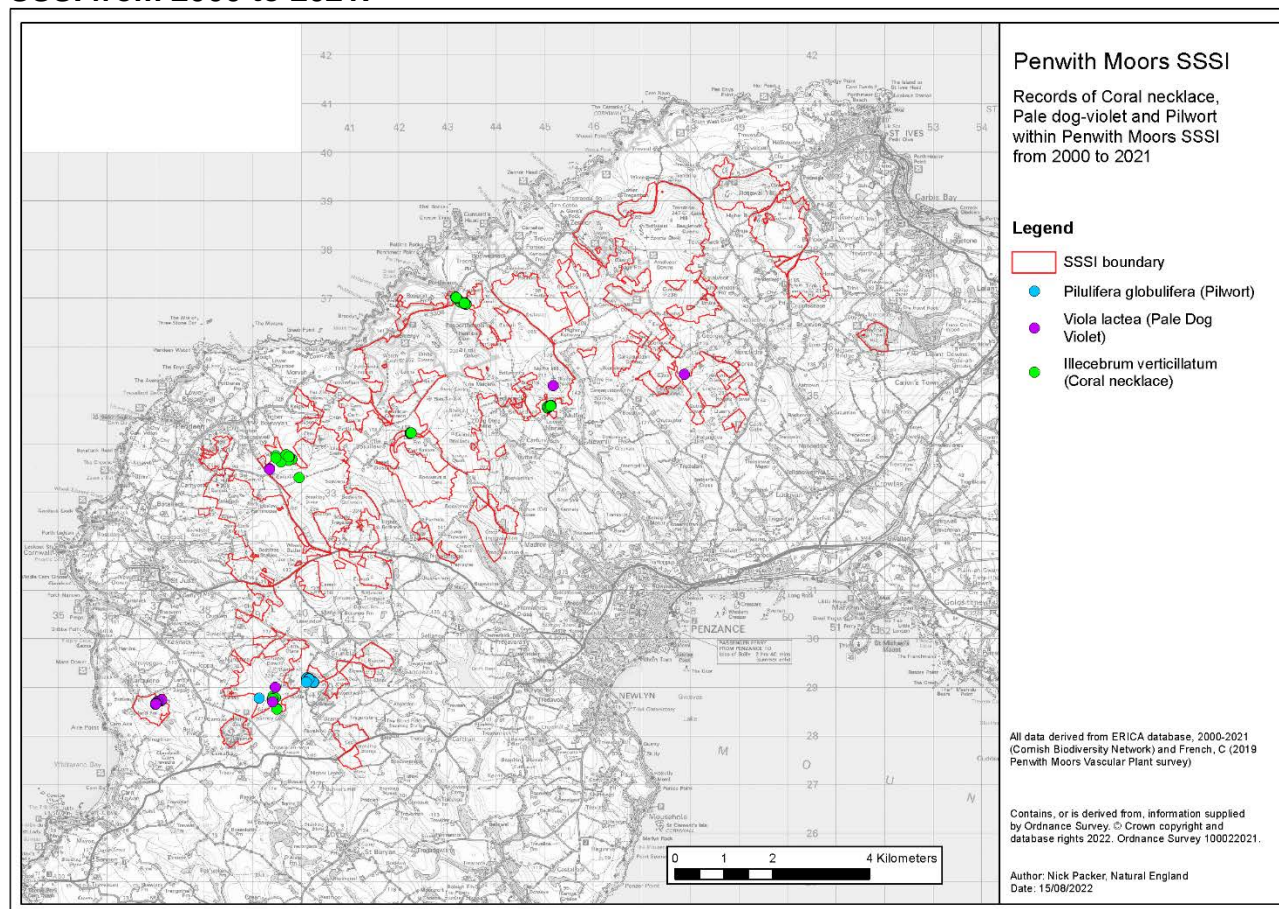
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<sup>10</sup> Database hosted by the Cornish Biodiversity Network which holds biological records for Cornwall.

<sup>11</sup> Endangered (EN) – IUCN Red List category where the best available evidence indicates that a species meets any of the criteria A to E and is therefore considered to be facing a very high risk of extinction in the wild.

<sup>12</sup> Vulnerable (VU) – IUCN Red List category where the best available evidence indicates that a species meets any of the criteria A to E and is therefore considered to be facing a high risk of extinction in the wild.

## Map 6. Records of Coral necklace, Pale dog-violet and Pillwort within Penwith Moors SSSI from 2000 to 2021.



In addition to the selection guidelines stated above, the Guidelines ([Chapter 11, section 4, p7](#)) provide the following guidance on sustainable populations:

“As in previous versions of these guidelines, much emphasis is placed here on assessments of population size and a population’s likely ‘sustainability’. Sustainability is hard to define, and in many cases population size will have to serve as a ‘proxy’ measure of its sustainability – the assumption being that a large population is likely to be more ‘sustainable’ than a small one. Evidence of a population being long-established, whether through its long-recorded history or (in the case of long-lived perennial taxa) the presence of old plants along with cohorts of younger plants of different ages, will also be helpful in ascertaining its likely sustainability. Further supporting evidence could include observations of plants flowering and setting seed, the presence of seedlings and an understanding of seed bank viability. Evidence of long continuity of suitable habitat, and appropriate habitat management, may also be important”.

An assessment of the sustainability of populations of the above three species within Penwith Moors SSSI is provided below. The assessment takes account of population size, continuity, mechanism of propagation, current location and supporting habitat. All three species are considered to be native to Cornwall.

### 1.4.1.1 Coral necklace sustainability assessment

Penwith Moors SSSI is one of the few remaining ‘strongholds’ for this species within its native range. It is a frost sensitive annual and a poor competitor. It favours damp open ground in or by pools and seasonally wet sandy, or gravelly areas, such as tracks and heathy lawns on neutral to acid soils of low nutrient status. Changes in land use practices

such as grazing and increased competition from more vigorous plants are likely to have contributed to its decline throughout its native range.

This species has been recorded within west Cornwall since 1836 (herbariaunited.org)<sup>13</sup>. Since 2000 it has been recorded at five locations within Penwith Moors SSSI (Map 6) although in 2019 only four of these were confirmed as remaining. The loss of coral necklace from Higher Ninnis is likely to be due to habitat succession resulting from a lack of disturbance. The population recorded across the four sites in 2019 was 60-3000 flowering stems.

With suitable management the remaining four populations are considered to be sustainable. Appropriate grazing, or other forms of ground disturbance and acceptance of seasonal inundation and fluctuating water levels in small pools and hollows, would provide recruitment opportunities sufficient to sustain the species.

Coral necklace spreads mainly by seed but has been known to grow from vegetative fragments. Dispersal by birds, animals and human activities could lead to recolonisation of other parts of Penwith Moors SSSI where conditions are suitable. Unsurfaced tracks through heathland are key habitat and dispersal corridors for this species. Such tracks are present throughout Penwith Moors SSSI but could be enhanced to promote a larger, more dynamic and connected population.

It is not known how long seed of this species remains viable in soil but in storage at the Millennium Seed Bank, Kew, it has been recorded as germinating with 100% viability after 23 years (pers comm. S. Miles, 2021). This indicates there is potential for the regeneration of previous populations given appropriate environmental conditions.

#### **1.4.1.2 Pale dog-violet sustainability assessment**

In England pale dog-violet is confined to humid heathland and grass heath in an area extending from the Thames basin to Cornwall. This species favours areas with short vegetation and considerable bare ground which provide recruitment opportunities and good growing conditions for its creeping stems which compete poorly with more vigorous vegetation.

Pale dog-violet has been recorded at West Penwith since at least 1951 (BSBI distribution database) and historic records suggest it was more widespread. Habitat change from heathland to forestry, productive grassland and arable together with reductions in grazing and traditional heathland management are responsible for this decline.

Climate change and changes in heathland management may also be driving an increase in the population of a hybrid of common dog-violet and pale dog-violet. This hybrid occupies the same habitat as pale dog-violet but is more vigorous and competitive. The hybrid is generally sterile and does not produce seeds. Where the hybrid threatens pale dog-violet management including rotational clearance and/or soil disturbance to stimulate germination of the pale dog-violet seedbank will benefit pale dog-violet.

Since 2000 pale dog-violet has been recorded at four locations within Penwith Moors SSSI (ERICA database - Map 8) although in 2019 only two of these were confirmed as remaining. Its loss from two of the locations is due to vegetation succession. The population recorded across the two sites in 2019 was 12-104 plants.

Pale dog-violet is a perennial species. Its seeds can remain viable within the seed bank for decades, albeit often in small quantities. The remaining populations in Penwith Moors SSSI are considered to be sustainable given appropriate management i.e. restoring early-

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<sup>13</sup> <https://herbariaunited.org>. This site provides links to on-line UK herbarium resources including a collaborative database which aims to combine the data from all UK and Irish herbaria.

successional communities by disturbance, stripping or burning followed by extensive grazing, cutting and/or mowing to maintain open short vegetation and bare areas. Well-managed small-patch winter burning will facilitate restoration of this species from soil seedbank populations to its former locations. The large mosaic of habitats in Penwith Moors SSSI provides opportunities for recruitment through reinstatement of populations via the soil seedbank and dispersal of seed by wind, animals and human activity.

#### **1.4.1.3 Pillwort sustainability assessment**

Pillwort is the UK's only native aquatic fern. It is declining rapidly throughout its north-west European range. The UK holds a substantial proportion of the global population which is restricted to a small number of scattered locations although it still has some strongholds, including the New Forest.

Pillwort has been recorded within the Penwith area since 1841 (BSBI distribution database). Historic records suggest it was formerly more widespread. Since 2000 Pillwort has been recorded within two ponds at Caer Bran ([Map 6](#)). It was also recorded within a pond on Tredinney Common in 2021. These two locations are likely to support a single population as they are in close proximity and connected via a watercourse. The population recorded across the two sites comprises thousands of plants.

Pillwort is a perennial species well adapted to temporary and fluctuating waterbodies. Desiccation resistant 'pills' are formed in response to stress. Fertile spores from these pills can develop quickly into new plants. Therefore given suitable conditions Pillwort can rapidly occupy open damp mud exposed by declining water levels but will eventually decline as other plants colonise and/or if conditions become drier. Young plants can persist indefinitely where there is less competition e.g. where submerged in nutrient-poor water, or on pool margins which are frequently disturbed by poaching. It is unknown how long the pills can remain viable but several decades is likely based on results of conservation actions (Bremer, 2002). Fertile spores float as a primary means of dispersal and there is potential for this to be aided over longer distances in wind-blown sediment and spores/vegetative fragments attached to animals.

New Zealand pigmyweed is reported to have been present within the ponds at Caer Bran since 1994. Despite the potential competition from this non-native plant the Pillwort appears to be maintaining a stable population. The population within Penwith Moors SSSI is therefore considered to be sustainable. Taking into account the dispersal potential of pills and spores and their longevity, Pillwort could colonise or recolonise other areas of suitable habitat within Penwith Moors SSSI. Opportunities for recruitment will be aided by suitable management such as grazing and other forms of disturbance that provide open damp ground in the drawdown zone of ponds or other temporary pools or water bodies with fluctuating water levels.

**Photo 4 – Pale dog-violet. Courtesy of Colin French.**



### **1.4.2 Nationally Scarce Species**

The Guidelines ([Part 2, Chapter 11, section 4.4, p9](#)) state that:

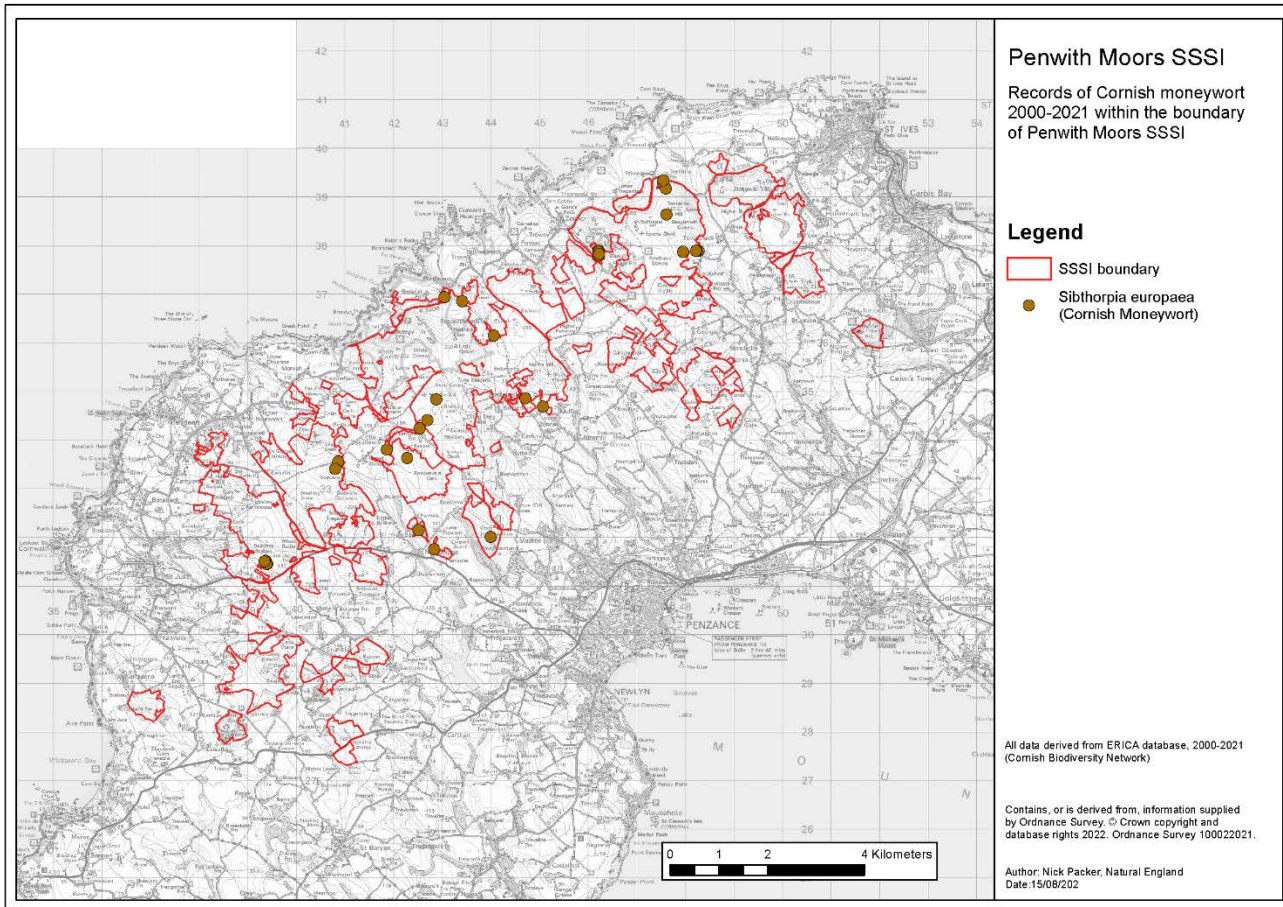
“A locality with a sustainable population of one GB or country-level Scarce taxon should be considered for selection if any of the following applies:

- 4.4.1 In the case of a GB Scarce taxon, it is one of the three largest populations in GB.
- 4.4.2 In the case of either a GB or country-level Scarce taxon, it is the largest (or only) sustainable population within an AoS”.

Cornish moneywort *Sibthorpia europaea* is Nationally Scarce within Great Britain. This species is a diminutive evergreen perennial, which creeps over damp acidic soils, rocks in shaded humid sheltered habitats, humid mossy heathland/acid grassland and where cattle poached hollows provide the moist, sheltered microclimate it needs. Its tiny flowers are self-pollinating enabling it to set seed well. Little appears to be documented about the reproductive and dispersal strategies employed by this species except that it produces viable seed and also forms clonal stands via its creeping stems. Seed is likely to be important for dispersal between locations and for persistence at established locations. Vegetative spread is likely to be important for maintaining stands and as a secondary dispersal method i.e. via fragmentation of the plant into moving water or attached to animals.

Cornish moneywort has been recorded within the AoS since 1824 (BSBI distribution database) and records (ERICA database 2000-2021) demonstrate it is widespread within the AoS. 33% of these records are from within the boundary of Penwith Moors SSSI ([Map 7](#)).

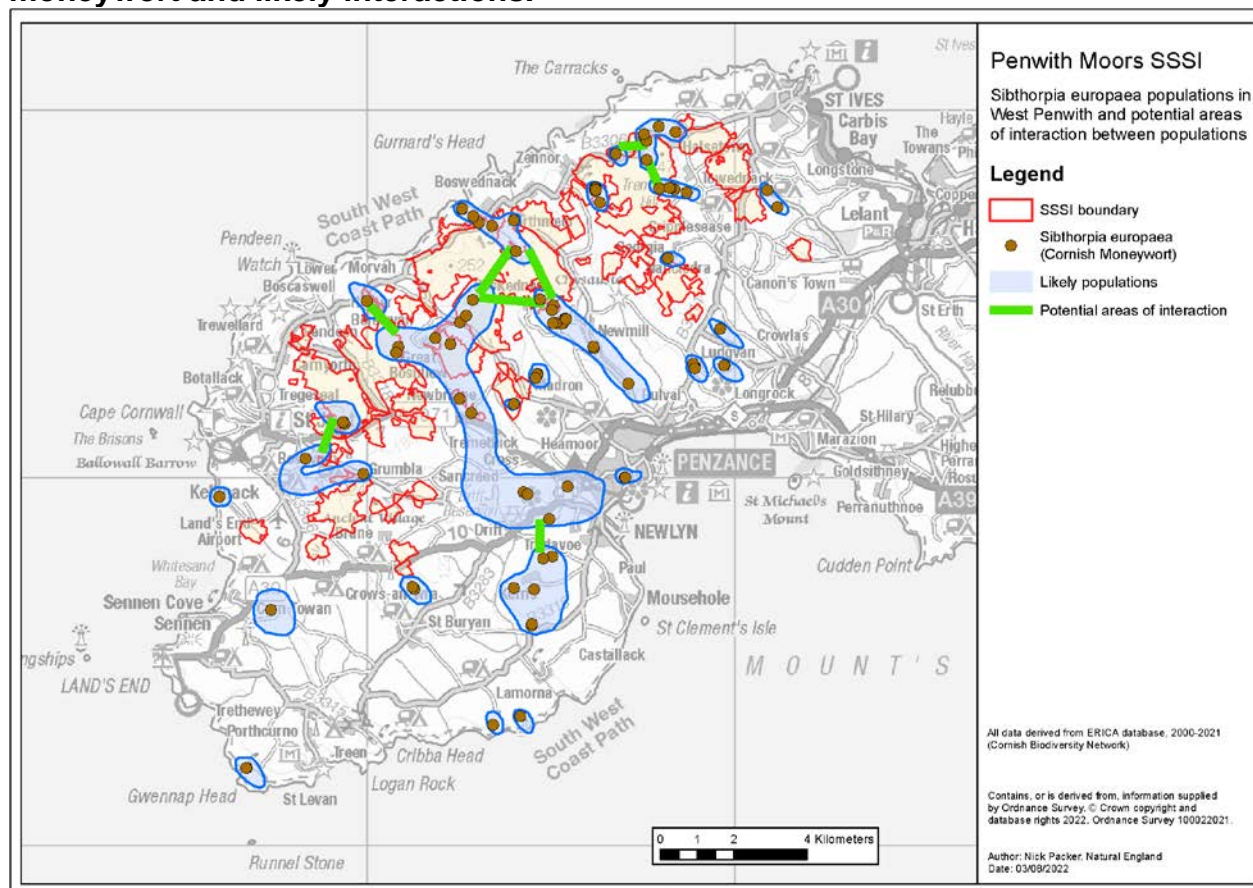
## Map 7. Records of Cornish moneywort 2000-2021 within the boundary of Penwith Moors SSSI.



Within the boundary of Penwith Moors SSSI, records are mostly at headwater locations associated with springs. Locations in the wider AoS are largely associated with woodland alongside the middle reaches of watercourses/springs, wells, road verges and ditch banks, which may be unsustainable without regular recharge of propagules from upstream.

Penwith Moors SSSI contains the densest clustering of records in the AoS. Its topography brings catchment-associated populations closer together and the populations within the boundary are likely to have the greatest opportunities for gene exchange and sustainability. Penwith Moors SSSI is the only location within the AoS where several populations can potentially interact, including the three largest populations within the AoS. Penwith Moors SSSI is therefore considered to support the largest sustainable populations within the AoS. [Map 8](#) shows the clusters of records which are considered to form discrete populations and potential areas of interaction between populations.

**Map 8. Clusters of records considered to form discrete populations of Cornish moneywort and likely interactions.**



## 1.5 Invertebrates

### 1.5.1 Scrub-heath and moorland invertebrate assemblage

Data from the following invertebrate surveys has been used to determine the invertebrate interest within Penwith Moors SSSI:

- Invertebrate sample survey for broad and specific assemblage type identification – September 2013 and July 2014.
- West Penwith Moors targeted rare insect species survey 2014 and 2015.

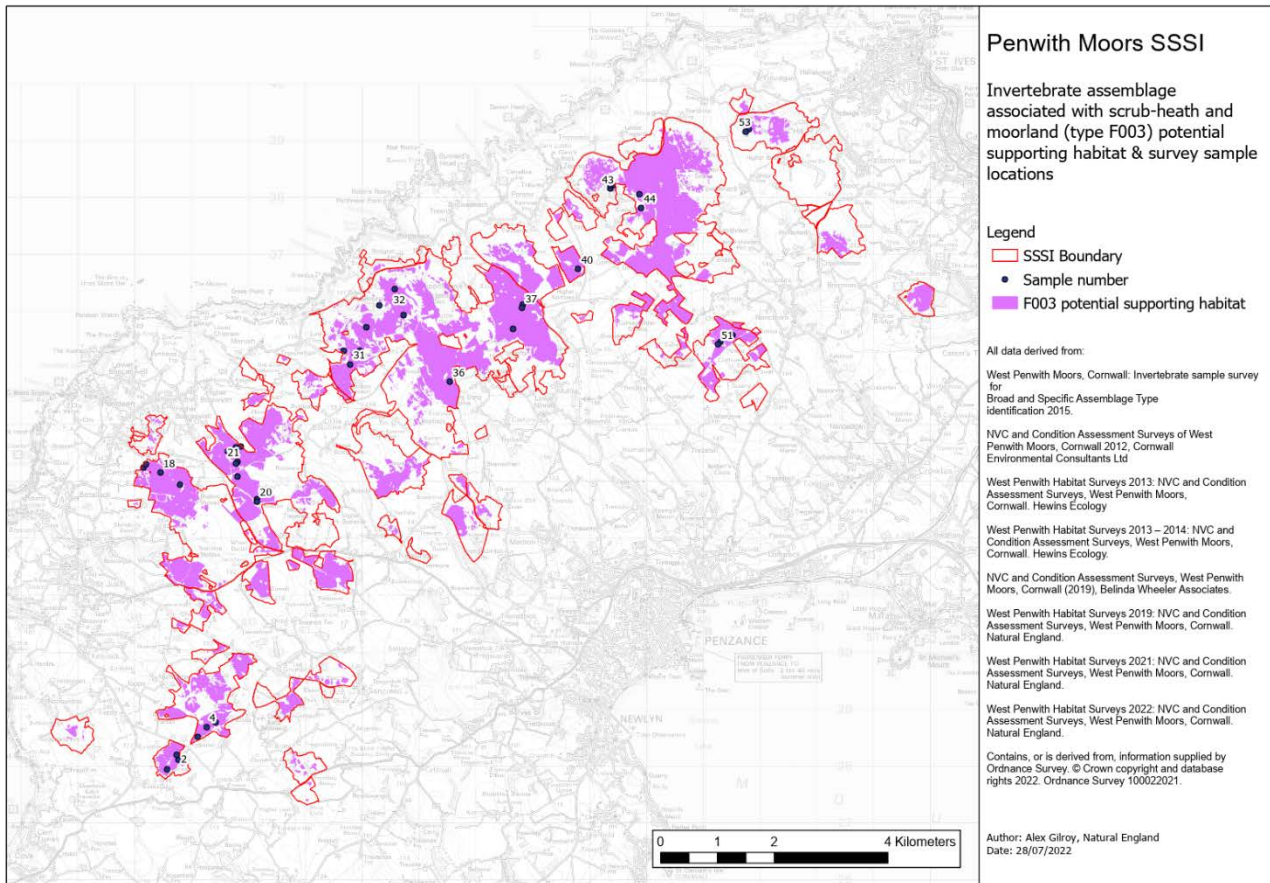
For the sample survey, data was collected from 22 locations ([Map 9](#)) and analysed using Pantheon. Pantheon is a database tool developed by Natural England and the Centre for Ecology & Hydrology. It analyses survey data to align and group species according to the habitat on which they depend, in order to determine the assemblage types present. It also provides information on the conservation status of species and allows a site's value to be determined. The 22 survey locations were chosen to reflect the variation of vegetation types and structures found across Penwith Moors SSSI as summarised below:

- short humid heath with bare ground and where Erica tetralix and/or Molinia caerulea are prominent;
- mires, associated with humid heath and/or ponds;
- ponds;
- short acid grassland forming 'glades' within patchy mature dry heath and/or gorse;



- acid grassland more open than above, may be associated with archaeological features such as drove roads;
- thin 'plateau' communities, usually occurring on hill tops associated with carns and granite outcrops; and
- carns on hill summits.

**Map 9. Sampling points for 2013/14 invertebrate sample survey.**



The Guidelines ([Part 2, Chapter 20, section 3.10, p9](#)) state that:

“All sites that support assemblages which are of either national or international importance should be selected”

and

“Habitat-based assemblages that should be represented in the series are:

- those whose quality is high when compared to similar sites in the same geographical area or AoS. The selected sites will often be associated with large and heterogeneous examples of their supporting habitats”

The sample survey recorded 602 species across Penwith Moors SSSI. Pantheon analysis of these species identified the presence of an invertebrate assemblage associated with scrub-heath and moorland (type F003). This assemblage type is found on nutrient-poor, acid soils where herbaceous or dwarf shrub vegetation is dominant, although trees and taller shrubs can be an important component of the overall habitat. It occurs on both damp and dry soils, but not when they are heavily fertilised. It includes a wide range of invertebrates, but beetles and spiders are particularly important components.

The sample survey recorded 33 species which are included within the F003 assemblage and good representation of beetles, true bugs and spiders. [Table 5](#) summarises the sample survey records for each of the sampling points. Sub samples were taken from some of these sites. Where that is the case, records have been amalgamated. Sample point 21 (Woon Gumpus Common) is not included within the table. Although a few F003 species were recorded around the edges of the sample area it does not support the F003 assemblage.

**Table 5. Invertebrate sample survey records for each sampling point**

Sample number	Sample point name	Total species recorded	F003 species recorded
2	Chapel Carn Brea	141	11
4	Bartinney Downs, Tredinney Common & Numphra Common	38	10
18	Carnyorth Common to Bostraze Bog	109	9
20	Dry Carn & Boswens Common West	95	12
31	Watch Croft, Trevean, White Downs & Bosulow Common	207	17
32	Carn Galva	144	14
36	Nine Maidens Common	52	3
37	Mulfra Hill to Treen Common	113	6
40	North of Higher Kerrowe	81	10
43	Zennor Hill & Rosemorran	115	4
44	Foage Farm to Sperris Croft & Boscubben Croft	63	6
51	Noon Digery, Trenowin Downs Tonkins Downs & Gulval	101	11
53	Rosewall Hill	121	10

[Table 6](#) compares Penwith Moors SSSI with other heathland sites (lowland and upland) within the AoS, Cornwall and south-west England. Not all of the survey data for Goonhilly Downs and Gwendreath has been uploaded to Pantheon. The proportion of uploaded records is 30% and 68% respectively. Figures in [Table 6](#) have been adjusted accordingly and are therefore not definitive. The extent of suitable habitat given for Gwendreath is an estimate.

**Table 6. Comparison of scrub-heath and moorland assemblage sites within the AoS, Cornwall and south-west England.**

Site name	Extent of suitable habitat within site (ha)	AoS	Date of survey	F003 species count
Penwith Moors SSSI	1200	West Penwith NCA	2013-14	33
Goonhilly Downs SSSI <sup>14</sup>	957	The Lizard NCA	1986	29
Gwendreath (part of Kennack to Coverack SSSI) <sup>13</sup>	30	The Lizard NCA	1986	27
A30 Chiverton to Carland Cross corridor heathlands <sup>15</sup>	4	Cornish Killas NCA	2017	18
Exmoor heaths <sup>16</sup>	650	Exmoor NCA	2009	15
Mid Cornwall Moors SSSI <sup>17</sup>	218	Hensbarrow NCA	2008	14
Aire Point to Carrick Du SSSI <sup>18</sup>	111	West Penwith NCA	2016	8

From the available data Table 6 demonstrates that Penwith Moors SSSI supports the highest number of F003 species within the AoS and Cornwall.

The Guidelines ([Part 2, Chapter 20, section 3, p7](#)) also state that:

‘Ideally, site selection for species and assemblages should be based on stable populations that have been resident for at least three years. However, since many threatened species are experiencing severe declines this approach should be used as a guideline only and there may be ample justification for the selection of species and assemblages in unfavourable condition. Advice should be sought from the relevant Country Agency specialist.’

Whilst the survey on which this assessment is based is from 2013/14 and a single year’s data it is considered to be sufficient to determine the invertebrate interest within Penwith Moors SSSI. The F003 assemblage is dependent upon a habitat which, at Penwith Moors SSSI, is subject to slow rates of succession. In addition the 2019 vegetation validation survey did not detect significant change in habitat extent and condition. It is therefore considered that the assemblage will not have changed significantly over the intervening years.

<sup>14</sup> Data from A survey of the invertebrates of the heathland NNRs of the Lizard Peninsula, 1986.

<sup>15</sup> Terrestrial Invertebrate survey of habitat within 100m of the proposed A30 Chiverton to Carland Cross Improvement Scheme. Report by Jon Mellings BSc (hons) MCIEEM and Peter Cranswick for WSP/Parsons Brinckerhoff, 2017.

<sup>16</sup> Boyce, D (2009) Invertebrate Survey of Mire blanket bog sites on the Exmoor Forest.

<sup>17</sup> Goss and Tregoss Moor National Nature Reserve Invertebrate Baseline Monitoring Report, 2008. ECOSA Ltd.

<sup>18</sup> Gibbs, D.J. 2017 Invertebrate assemblage survey at Aire Point to Carrick Du SSSI.

## 1.5.2 Representation of international, nationally threatened, rare, scarce and S41 species.

The guidelines make provision for the selection of SSSIs which support international site features, nationally threatened, nationally rare/scarce and S41 species. The invertebrate sample survey recorded 31 species with a conservation status as shown below in [Table 7](#). It is not considered to be necessary to notify Penwith Moors SSSI for any of these individual species as they either form part of the F003 assemblage or their habitat requirements are catered for within the wider site and notified habitats.

**Table 7. List of invertebrate species with conservation status recorded at Penwith Moors SSSI**

Species	Order	Conservation status
<i>Cercidia prominens</i>	Araneae	Nationally Scarce
<i>Agyneta cauta</i>	Araneae	Nationally Scarce
<i>Walckenaeria alticeps</i>	Araneae	Nationally Scarce
<i>Scotina gracilipes</i>	Araneae	Nationally Scarce
<i>Acalles ptinoides</i>	Coleoptera	Nb <sup>19</sup>
<i>Zyras haworthi</i>	Coleoptera	Na <sup>17</sup>
<i>Aizobius sedi</i>	Coleoptera	Nb
<i>Orthochaetes insignis</i>	Coleoptera	Nb
<i>Agathidium marginatum</i>	Coleoptera	Notable <sup>17</sup>
<i>Meligethes subrugosus</i>	Coleoptera	Notable
<i>Dyschirius thoracicus</i>	Coleoptera	Nationally Scarce
<i>Altica ericeti</i>	Coleoptera	Nationally Scarce
<i>Chaetocnema confusa</i>	Coleoptera	Nationally Scarce
<i>Chaetarthria simillima</i>	Coleoptera	Nationally Scarce
<i>Tachyporus formosus</i>	Coleoptera	Nationally Scarce
<i>Stenus kiesenwetteri</i>	Coleoptera	RDB 2 <sup>20</sup>
<i>Medetera saxatilis</i>	Diptera	DD <sup>21</sup>
<i>Omphiscola glabra</i>	Hygrophila	Nationally Scarce; LC <sup>22</sup> ; S41 Priority Species <sup>23</sup>
<i>Bombus lucorum</i>	Hymenoptera	DD
<i>Nomada integra</i>	Hymenoptera	DD
<i>Andrena rosae</i>	Hymenoptera	DD; Nationally Rare
<i>Nomada roberjeotiana</i>	Hymenoptera	Nationally Rare; RDB 2
<i>Andrena nigriceps</i>	Hymenoptera	Nationally Scarce
<i>Panurgus calcaratus</i>	Hymenoptera	NT <sup>24</sup>
<i>Andrena tarsata</i>	Hymenoptera	S41 Priority Species
<i>Leptoiulus belgicus</i>	Julida	Nationally Scarce

<sup>19</sup> Na, Nb and notable – historic versions of Nationally Scarce.

<sup>20</sup> Red Data Book category 2 (RDB 2) – vulnerable species likely to move into the endangered category in the near future if conditions causing it to be vulnerable persist.

<sup>21</sup> Data Deficient (DD) – IUCN red list category. Inadequate information to make an assessment of the risk of extinction based on distribution and/or population status.

<sup>22</sup> Least Concern (LC) – IUCN red list category. Species does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened status.

<sup>23</sup> S41 Priority Species – species of principal importance for the conservation of biodiversity in England under Section 41 of the Natural Environment and Rural Communities Act (2006).

<sup>24</sup> Nationally Threatened (NT) – IUCN red list category. Species does not qualify for Critically Endangered, Endangered or Vulnerable status now, but is close to qualifying for, or is likely to qualify for a threatened category in the near future.

Species	Order	Conservation status
<i>Hipparchia semele</i>	Lepidoptera	EN <sup>25</sup> ; S41 Priority Species
<i>Lasiommata megera</i>	Lepidoptera	EN; S41 Priority Species
<i>Orgyia antiqua</i>	Lepidoptera	LC
<i>Saturnia pavonia</i>	Lepidoptera	LC
<i>Boloria selene</i>	Lepidoptera	S41 Priority Species; VU <sup>26</sup>

**Photo 5. Perkin's mining bee *Andrena rosae*. Photo courtesy of Patrick Saunders.**



## 1.6 Lichens

### 1.6.1 Lichen assemblage associated with non-montane acid rock

The numerous outcrops of acid granite rock across Penwith Moors SSSI support a nationally important assemblage of lichens. These rocky outcrops are geologically similar to those on Bodmin Moor and Dartmoor, but the lowland maritime setting of Penwith Moors SSSI gives rise to a unique lichen community. Data from the following surveys has been used to determine the lichen interest within Penwith Moors SSSI:

- Survey of Rare Lichens, West Penwith Moors, Cornwall. 2014.
- A Lichen Survey of Penwith Moors. 2019.

<sup>25</sup> Endangered (EN) – IUCN red list category which indicates a taxon is considered to be facing a very high risk of extinction in the wild.

<sup>26</sup> Vulnerable (VU) – IUCN red list category which indicates a taxon is considered to be facing a high risk of extinction in the wild.

The Guidelines ([Part 2, Chapter 13, section 3.1.2, p6](#)) state:

“The evaluation of sites should be based on recent data and taxa should be excluded where there is doubt about their continued presence. In the absence of recent surveys, records from the last 25 years may be included”.

The following assessment is based on recent survey data. Given the nature of the supporting habitat the continued presence of all qualifying species is not in doubt.

The Guidelines ([Part 2, Chapter 13, section 3.4, p8](#)) state:

“Sites holding significant ecologically and/or bio-geographically coherent assemblages<sup>27</sup> are of great scientific interest. Assemblages of lichens have traditionally been evaluated by habitat indices in British lichenology (Rose 1976; Wolseley and James 1991; Rose 1992; Hodgetts 1992; Coppins and Coppins 2002). They are intended to measure lichen diversity in a repeatable way, using species strongly associated with high quality and long continuity of habitat. Selection thresholds are assessed against the total number of index species recorded – i.e. each taxon or species pair/grouping in the relevant index table counts as one. A single site survey is unlikely to record all the indicator species present; it is preferable therefore to pool the results of several recent surveys, although very high totals from single surveys may provide enough evidence for sites to be selected.

Indices have not yet been developed for all key lichen habitats. Where they are lacking, TNTN (Threatened, Near Threatened and Notable Species) assemblage scoring can be used (3.4.7)”.

The guidelines (Appendix 2) describe the non-montane acid rock assemblage as follows:

“Acid and non-calcareous basic rock in the forest zone supports a large proportion of the lichen biodiversity of Britain: 213 taxa are included in the non-montane acid rock assemblage. Assemblages show a high degree of heterogeneity between outcrops and rock types, and typically small numbers of TNTN species will occur on some single outcrops. Full recognition of the diversity of this assemblage can only be attained at a landscape scale”.

The Guidelines ([Part 2, Chapter 13, section 3.4.7, p16](#)) describe the TNTN scoring system. Each species is allocated a score based on its conservation status. The species scores are then summed to calculate the assemblage score which is then compared to a threshold for notification. The Guidelines ([Part 2, Chapter 13, section 3.4.7, p17](#)) state that:

“all sites that attain the threshold should be considered for notification, even where there are many qualifying sites within an Area of Search”.

The guidance in [Appendix 2 of Chapter 13](#) of the guidelines recommends that TNTN records for the non-montane acid rock assemblage are assessed collectively at the landscape scale. The TNTN thresholds for selection are as follows:

- Sites with ecologically coherent assemblages for groups of outcrops<sup>28</sup> scoring **10 or over** should be considered for notification.
- Individual outcrops scoring **6 or over** can be selected as notified features.

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<sup>27</sup> An ecologically coherent assemblage is a habitat-based species assemblage that should be assessed as a single entity across an entire site. However only species of microhabitats/ecological niches that truly belong to the assemblage habitat type should be included within it.

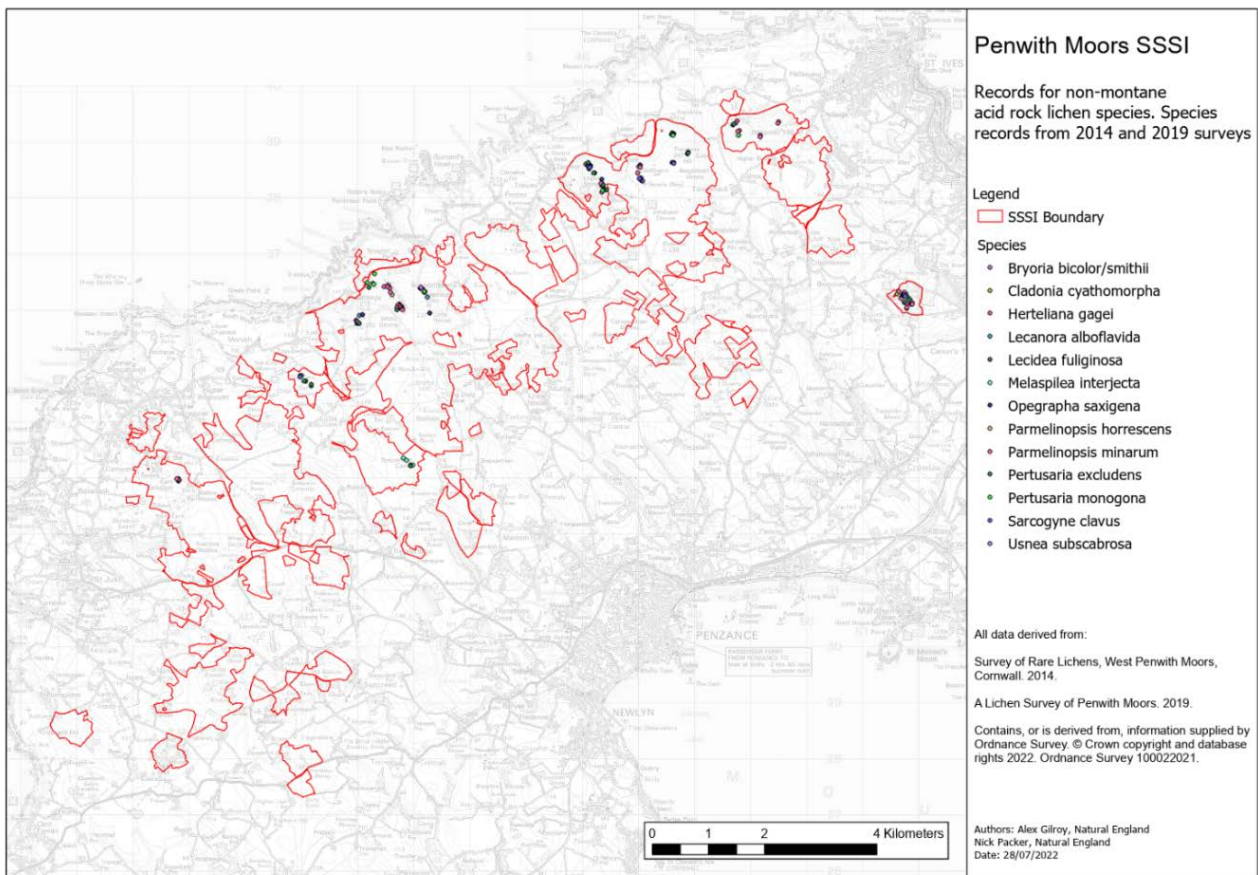
<sup>28</sup> Outcrop is defined as a visible exposure of the bed rock comprising one or more prominent rocks projecting out of the soil in a discrete location, often at the top of a hill. Several outcrops are usually present within a landscape unit.

The 2013 survey assessed four locations known to have historically supported lichens with a conservation status (Carn Galver, Trencorm Hill, Rosewall Hill and Leswidden). No notable lichens were recorded at Leswidden. The 2019 survey revisited Trencorm Hill and widened the survey area to include nine outcrops (Carn Kenidjack, Carn Downs, Watch Croft, Boswarva Carn, Hannibal's Carn, Zennor Hill, Logan Stone, Sperris Quoit and Trendrine Hill). The 2013 and/or 2019 surveys recorded 13 lichen species with a conservation status as summarised in [Table 8](#). [Map 10](#) shows the location of these records.

**Table 8. Lichen species with a conservation status recorded by the 2013 and/or 2019 surveys.**

<b>Species</b>	<b>Status</b>	<b>Comments</b>
<i>Bryoria bicolor/Bryoria smithii</i>	B. bicolor - Notable and Nationally Scarce. B. smithii - Critically endangered and Nationally Rare	Two small colonies recorded at Hannibal's Carn. There is uncertainty over the exact species present, though both are rare and declining.
<i>Cladonia cyathomorpha</i>	Notable and Nationally Scarce	Recorded at 10 of the outcrops.
<i>Herteliana gagei</i>	Notable and Nationally Scarce	Recorded at 7 of the outcrops.
<i>Lecanora alboflavida</i>	Notable and Nationally Scarce	Recorded at all 12 outcrops.
<i>Lecidea fuliginosa</i>	Notable and Nationally Scarce	Recorded at 2 of the outcrops.
<i>Melaspilea interjecta</i>	Notable and Nationally Rare	Penwith Moors SSSI is the only known location for this species in England. Recorded at 7 of the outcrops. GB has an international responsibility for this species.
<i>Opegrapha saxigena</i>	Notable and Nationally Scarce	Recorded at all 12 outcrops. GB has an international responsibility for this species
<i>Parmelinopsis horrescens</i>	Near Threatened and Nationally Scarce	Recorded at 6 of the outcrops. GB has an international responsibility for this species
<i>Parmelinopsis minarum</i>	Notable and Nationally Scarce	Recorded at 10 of the outcrops.
<i>Pertusaria excludens</i>	Notable and Nationally Scarce	Recorded at 11 of the outcrops.
<i>Pertusaria monogona</i>	Notable and Nationally Scarce	Recorded at 4 of the outcrops.
<i>Sarcogyne clavus</i>	Near Threatened and Nationally Scarce	Recorded at 8 of the outcrops.
<i>Usnea subscabrosa</i>	Vulnerable and Nationally Rare	Likely that the only extant populations are at Penwith Moors SSSI and possibly the Lizard. Recorded at 1 outcrop.

## Map 10. Records for non-montane acid rock lichen species.



Combining records from the 2013 and 2019 surveys, a TNTN assemblage score has been calculated for 12 outcrops as summarised in [Table 9](#). Eleven of the outcrops meet or exceed the individual outcrop threshold of 6. The combined TNTN score for the 12 individual outcrops is 18 significantly exceeding the threshold of 10.

Two small colonies of *Bryoria bicolor/smithii* were recorded at Hannibal's Carn in 2019. There is uncertainty over which species is present and molecular work would be required to confirm the species. However both species are rare and declining. For the purposes of assemblage scoring the lowest TNTN score has been used. If *B. smithii* were to be confirmed the combined TNTN score would be 21.



**Table 9. Summary of TNTN scores for individual outcrops and all outcrops combined.**

<b>Species</b>	<b>Carn Kenidjack</b>	<b>Carn Downs</b>	<b>Watch Croft</b>	<b>Carn Galver</b>	<b>Boswarva Carn</b>	<b>Hannibal's Carn</b>	<b>Zennor Hill</b>	<b>Logan Stone</b>	<b>Sperris Quoit</b>	<b>Trendrine Hill</b>	<b>Rosewall Hill</b>	<b>Trencrom Hill</b>	<b>Penwith Moors SSSI</b>
Survey year	2019	2019	2019	2013	2019	2019	2019	2019	2019	2019	2013	2013/19	2013/19
<i>Bryoria bicolor/smithii</i>	-	-	-	-	-	1	-	-	-	-	-	-	1
<i>Cladonia cyathomorpha</i>	1	-	1	1	-	1	1	1	1	1	1	1	1
<i>Herteliana gagei</i>	1	-	1	-	1	1	1	1	-	1	-	-	1
<i>Lecanora alboflavida</i>	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Lecidea fuliginosa</i>	-	-	-	-	-	-	1	1	-	-	-	-	1
<i>Melaspilea interjecta</i>	-	1	-	-	1	-	1	1	1	1	-	1	1
<i>Opegrapha saxigena</i>	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Parmelinopsis horrescens</i>	2	-	-	2	-	2	-	-	-	2	2	2	2
<i>Parmelinopsis minarum</i>	1	-	1	1	1	-	1	1	1	1	1	1	1
<i>Pertusaria excludens</i>	-	1	1	1	1	1	1	1	1	1	1	1	1
<i>Pertusaria monogona</i>	1	-	-	-	-	1	-	1	-	1	-	-	1
<i>Sarcogyne clavus</i>	2	-	-	-	2	2	2	2	2	2	-	2	2
<i>Usnea subscabrosa</i>	-	-	-	-	-	4	-	-	-	-	-	-	4
<b>Assemblage scores</b>	<b>10</b>	<b>4</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>15</b>	<b>10</b>	<b>11</b>	<b>8</b>	<b>12</b>	<b>7</b>	<b>10</b>	<b>18</b>
<b>Selection threshold score for individual outcrops is 6 or over.</b>													
<b>Selection threshold score for groups of outcrops is 10 or over.</b>													

## 1.6.2 Representation of Near Threatened (NT) species for which GB has international responsibility

The guidelines make provision for the selection of individual species which are both Near Threatened and for which Britain has an International Responsibility on the GB IUCN Red List. One of the species recorded at Penwith Moors SSSI, *Parmelinopsis horrescens* meets this criteria. However, it is considered that it is best conserved as part of the non-montane acid rock assemblage and therefore should not be notified as an individual species.

**Photo 6. Carn Kenidjack. Photo courtesy of Alan Orange.**



## 1.7 Dartford warbler

The heathland habitat across Penwith Moors SSSI supports a nationally important population of breeding Dartford warbler *Curruca undata*. Data from the following surveys and sources has been used to assess the importance of Penwith Moors SSSI for this species:

- West Penwith Moors collation of existing bird data from 2006 to 2012.
- West Penwith Moors breeding bird survey 2014.
- West Penwith Moors breeding Dartford Warbler Survey 2015.
- Rare Breeding Bird Panel records 2016-2020.
- Cornwall Bird Watching & Preservation Society records 2016-2021.

The Guidelines ([Part 2, Chapter 17, section 3.2, p4](#)) state that:

“Localities which regularly support 1% or more of the total British breeding population of any native species...will qualify for SSSI selection.”

The total British breeding population of Dartford warbler is estimated to be 2,200 pairs<sup>29</sup>. 1% of the total British breeding population is therefore 22 breeding pairs. A review of Dartford warbler records between 2006 and 2012 confirms that Dartford warbler was a regular breeding bird on Penwith Moors SSSI during that period. Breeding bird surveys were carried out in 2014 and 2015. The surveys were targeted to areas with either suitable habitat or where Dartford warbler had been previously recorded as breeding. [Table 10](#) summarises the results of these surveys.

The Dartford warbler is a scarce breeder present in small numbers on individual heathland fragments. The prerequisite for SSSI site selection is therefore to include all areas of suitable habitat required by the individuals concerned to meet all their ecological needs in a defined 'locality'. Little is known about the Dartford warbler's dispersal and foraging behaviour among heathland fragments. A study of Dartford warbler in Dorset by van den Berg *et al* (2001), however, states that although Dartford warblers are quite sedentary, juveniles seem to disperse readily beyond areas surrounding the natal site colonising areas of suitable habitat. They conclude that it is unlikely that this species forms discrete populations on heathland fragments and that there is only one population in Dorset with some degree of movement between fragments. Given that the Dorset heathlands are more fragmented, comprise a much bigger area spread over a much wider geographical scale it could be concluded that the same applies to the Penwith Moors population. In addition, it is known that Dartford warbler will fly considerable distance over heather to feed in optimal areas of gorse cover (Brown and Grice 2000). The distribution of gorse across the site will therefore be a key determinant of how birds use the site and the distance foraged. There are no 1km squares with breeding territory records from the 2014 or 2015 surveys which are greater than 2km from other occupied squares.

**Table 10. Numbers of breeding pairs of Dartford warbler recorded in the 2014 and 2015 breeding bird surveys.**

Block Number/name	Estimated No of pairs 2014	Estimated No of pairs 2015
4 – Bartinney Downs, Tredinney Common and Numphra Common	2	4
18 – Carnyorth Common to Bostraze Bog	3	3
23 – Higher Downs and Chun Downs	4	3
31 – Watch Croft, Trevean, White Downs and Bosullow Common	4	7
32 – Carn Galver	7	7
35 – Men-an-Tol Croft, Lanyon Croft and Bosilliack	6	4
36 – Nine Maidens Common	3	3
37 – Mulfra Hill to treen Common	1	2
43 – Zennor Hill and Rosemorran	2	3
44 – Foage Farm to Sperris Croft and Boscubben Croft	8	6
45 – Trendrine Hill and Beagletodn Downs	12	8
46 – Amalveor Downs to Noon Billas	1	2
53 – Rosewall Hill	2	3
<b>Total for all blocks</b>	<b>55</b>	<b>55</b>

<sup>29</sup> As published in APEP 4 – Population estimates of birds in Great Britain and the United Kingdom 2020.

The 2014 and 2015 surveys each recorded a total of 55 breeding pairs within Penwith Moors SSSI. This represents 2.5% of the total British breeding population and significantly exceeds the 1% threshold for selection. The survey area did not cover the entire site and it is likely that other areas within Penwith Moors SSSI will also support breeding pairs.

The guidelines ([Part 2, Chapter 17, section 3.11, p7](#)) state:

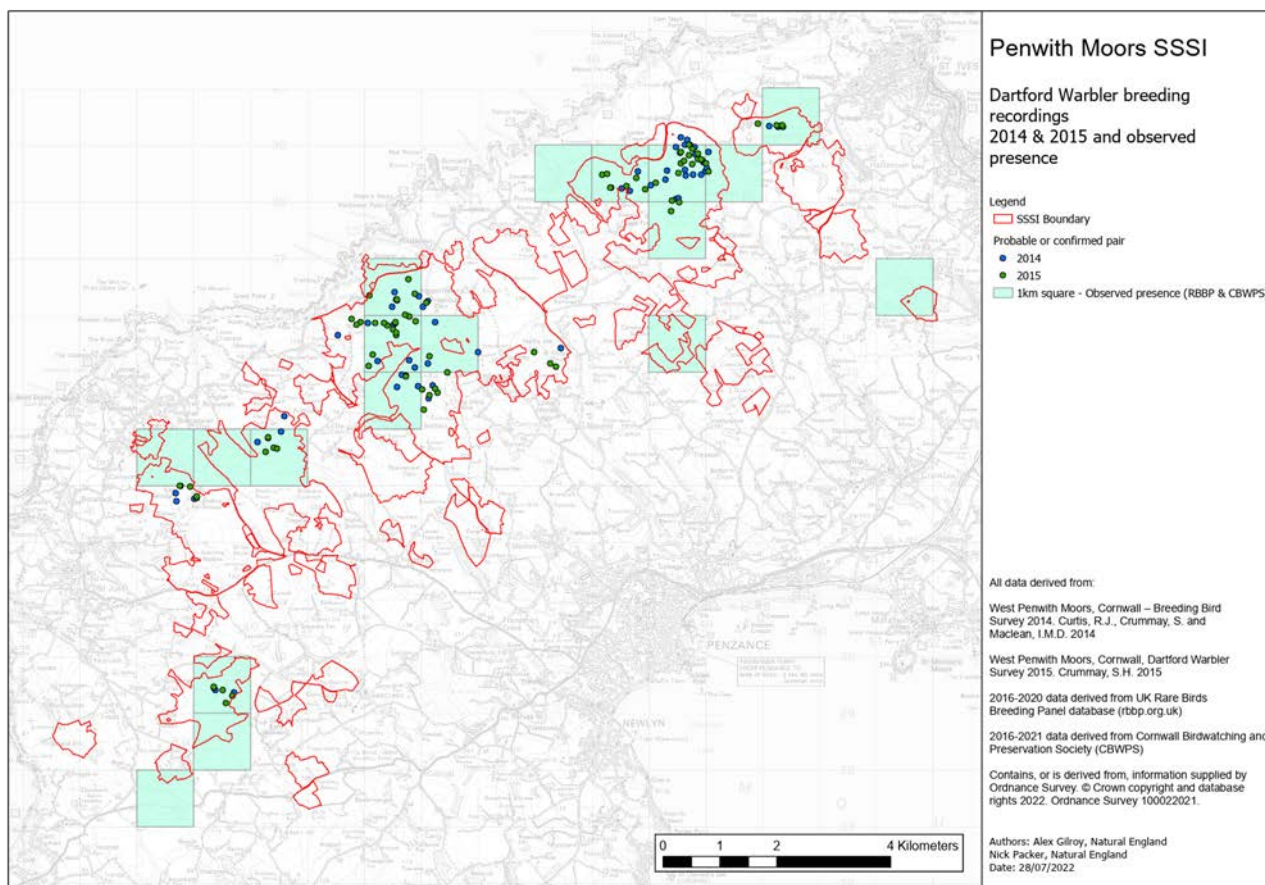
“It is usually important to establish that a site is regularly used by important numbers of birds, except in the cases of severe weather refuges where weather-dependent aggregations of large numbers may be less frequent. It is appropriate to apply the definition of ‘regularly’ used under the Ramsar Convention (see Ramsar 2012), which states that a wetland regularly supports a population of a given size if:

- (a) the requisite number of birds is known to have occurred in two thirds of the seasons for which adequate data are available, the total number of seasons being not less than three.”

Although the 2014/2015 surveys demonstrate that the requisite number of birds were present in two consecutive years i.e. two thirds of the seasons it is recognised that the most recent survey data is now seven years old. However it is considered to remain valid for the following reasons:

- The supporting habitat remains the same in extent and quality and Dartford warbler will persist in use of areas of good quality habitat. Birds show strong site fidelity and are territorial all year round (Bibby 1979).
- A review of available records from the Rare Breeding Bird Panel (RBBP) and Cornwall Bird Watching & Preservation Society demonstrates that Dartford warbler has remained resident and widespread within the SSSI from 2016 to 2021. Of the 19 1km Ordnance Survey grid squares with Dartford warbler records in 2015, 12 had records in at least 1 year from 2016-2021. During the same period (2016-2021) Dartford warbler was recorded in an additional 6 1km squares not surveyed in 2015. The records covering the period 2016-2021 record Dartford warbler in a total of 18 1km squares. Given Dartford warbler’s fidelity to heathland habitat, records in any 1km square should equate to heathland within that square and therefore within the boundary of Penwith Moors SSSI. [Map 11](#) shows the 1 km squares with records from 2016- 2021 together with the 2014/15 survey records.

**Map 11. 1 km squares with Dartford warbler records from 2016- 2021 and 2014/15 breeding bird survey records.**



Although the 1 km square records indicate continued presence of Dartford warbler across the SSSI they do not enable any estimate to be made of numbers of at least probable breeding pairs at the site from 2016 to 2021. Data showing probable or confirmed breeding from 2016-2020, as verified by the RBBP, is available for some of the 1km grid squares within the SSSI. The data is summarised in [Table 11](#) which also provides a comparison with records from the same survey areas in the 2014 and 2015 targeted surveys. The RBBP records are not derived from a targeted, structured survey, but are casual in nature and, as such, will represent a much smaller sample, are limited in extent, and therefore almost certainly underestimate numbers. They do however demonstrate that Dartford warbler has continued to breed within Penwith Moors SSSI since 2015. The number of breeding pairs recorded in 2015 represented 2.5% of the total British breeding population and significantly exceeded the selection threshold. Records from 2016 to 2020 do not indicate a significant decline in the breeding population since 2015.

**Table 11. RBBP verified probable or confirmed records of breeding pairs of Dartford warbler (2016-2020) alongside records from the 2014 and 2015 targeted surveys.**

Survey area	1 km grid ref	Site ref	No pairs 2014 survey	No pairs 2015 survey	2016	2017	2018	2019	2020
Carn Kenidjack	SW3833	18	3	3	1				
Bartinney Downs	SW3929	4	2	4	1	2			1
Chun Castle	SW4033	23	4	3		1			
Men-an-tol	SW4234	35	6	4		1	2	1	
Watch Croft	SW4235	31	4	7		2	2	2	2
Carn Galver	SW4236	32	7	7	2				1
Nine Maidens	SW4335	36	3	3				1	1

Survey area	1 km grid ref	Site ref	No pairs 2014 survey	No pairs 2015 survey	2016	2017	2018	2019	2020
Zennor Hill west	SW4538	43	0	0	1				
Zennor Hill east and Eagle's Nest	SW4638	43	2	3		1		1	
Amalveor Downs	SW4737	46	1	2				2	
Rosewall Hill (Buttermilk Hill)	SW4939	53	2	3	2	2			1

The Dartford warbler is resident in Great Britain and known to be highly susceptible to severe winters. Populations fluctuate, building up during periods with mild winters but falling again after years with heavy snowfall and/or prolonged frost. Due to its extreme south-westerly position in the British Isles, West Penwith has relatively few and then only short-lived frosts and Penwith Moors SSSI could act as a regional 'refuge' when there are episodes of severe winter weather elsewhere in Britain.

**Photo 7. Dartford warbler. Photo courtesy of Natural England/Philip Ray.**



## 1.8 Boundary determination

Part 1 of the guidelines provides general guidance on the determination of site boundaries. [Section 8.2, p34](#) states that:

“SSSI boundaries should be drawn to encompass the special features of the site and all land necessary to ensure the sustainability of those features. Consideration should be given to the inclusion of whole management units, entire ecological units and supporting processes (such as hydrology or sediment supply). Boundaries should take account of dynamic processes (such as active coastal and floodplain geomorphology). Where part of a site does not hold the special features at the time of selection, the guiding principle is that:

- there must be good evidence that this part of the site could support the special features for which other parts of the site are notified.

For example, this could be as a result of natural processes (such as coastal erosion or accretion), predictable rotational management (such as that associated with forestry and agriculture) or the known ecological requirements of a species which uses a series of habitat patches but where not all patches are occupied at one time”.

[Part 1, section 4.9, p12](#) provides the following additional guidance for fragmented habitats and compound sites.

“In many cases SSSIs comprise a single parcel of land and a single habitat. However, some habitats have been particularly prone to fragmentation. For example, there may be a group of individual fields of semi-natural grassland within a matrix of improved farmland within a valley. In such a case it is appropriate to consider these as component parcels of land within one SSSI, which we term a compound site. In Scotland, for example, 33% of SSSIs comprise more than one parcel of land, and in Wales, 31%. Mobile animals are likely to use the components as a single unit, possibly forming a metapopulation, so that the site will therefore help to conserve larger populations of those species. This approach may become increasingly important, given the development of the concept of ecological networks, which are intended to increase the resilience of isolated sites to pressures including climate change and fragmentation. In future, a compound SSSI might include all the key sites of a particular semi-natural habitat in a local area, as well as buffer land, linking land and restoration areas which will help to ensure ecological coherence (see 5.16). This approach is already being adopted for sites to protect species such as the marsh fritillary butterfly (*Euphydryas aurinia*)”.

The habitat and species chapters in Part 2 of the guidelines provide additional guidance on boundaries as follows.

### **1.8.1 Lowland Grasslands**

The guidelines ([Part 2, Chapter 3, section 5.1, p10](#)) state that:

“Consideration should be given to the inclusion of whole management units, entire ecological units and land required for supporting processes, such as hydrology. Thus, for example, this may require the inclusion within a site boundary of areas of land supporting grassland communities of lower botanical interest (section B of Annex 1), or non-grassland vegetation”

The guidelines ([Part 2, Chapter 3, section 5.4, p10](#)) also state:

“Decisions as to what constitutes a ‘site’ where there are non-contiguous fields or units (a compound site) should be guided by one or more of the following criteria applying, with the exception of the first which may not be enough on its own, depending on the distance apart of fields or units:

- the component fields are similar in terms of their vegetation composition (e.g. same NVC community type or broad NVC grouping) and occur on similar soil types/geology within a discrete landscape or occur in similar topographical situations (e.g. disjunct flushes along a valley);
- it is very likely that local habitat fragmentation has caused the current disjunct nature of the habitat(s) and that the elements would formerly have been linked;
- where different vegetation types are present, there is evidence that these once occurred in previously contiguous mosaics and transitions reflecting local changes in soils, hydrology etc, within a similar landscape setting;
- there is a high likelihood that individual sub-components provide an overall habitat resource for certain wide-ranging species”.

### **1.8.2 Lowland Heathland**

The guidelines ([Part 2, Chapter 4, sections 5.1 and 5.2, p6](#)) state that:

- “5.1 Lowland heathlands are often adjacent to other semi-natural habitat types. The most frequent juxtapositions are with valley mires, acidic grassland, upland communities, woodland, developing or mature scrub habitats, and coastal grassland and dunes. It is important to consider not only the selection of habitat combinations, transitions and successional stages, but also how these influence the condition and function of each other as ecological units.
- 5.2 Where lowland heathland and valley mires are contiguous, all of the heathland that contributes to the valley mire catchment area (the hydrological system and supporting habitat) should be included in the area recommended for notification. This applies even if the heathland is in unfavourable condition, as it influences the quality of the mire (see also the Fens SSSI Selection Guidelines). In these cases, an ecohydrological assessment may be required in the process of site selection”.

And that ([Part 2, Chapter 4, section 5.4, p6](#)):

“Compound sites (sometimes called archipelago sites) are those composed of similar habitat parcels geographically separated by a few metres (e.g. by a road) to several kilometres (e.g. by improved grassland or arable land). For lowland heathland, the option of combining non-contiguous units into a compound site is most likely to be justified when:

- inclusion of non-contiguous units enhances habitat connectivity, for example by protecting stepping stones between larger blocks of habitat or providing foci for habitat restoration and expansion within a key network;
- the components are similar in vegetation composition within a discrete landscape or occur in similar topographical situations, e.g. patches of wet heathland separated by arable fields;
- fragmentation has reduced a former stand of a single heathland type, or a former mosaic of different heathland types, into a series of discrete parcels; or
- individual components will provide an overall habitat/resource for wide-ranging species”.

Penwith Moors has a history of habitat fragmentation, starting with enclosure and settlement of ‘rough ground’ in the early medieval period followed by larger-scale agricultural improvement into the 20th century. It is estimated that nearly 900 ha of ‘rough ground’ in West Penwith was lost to agricultural improvement between 1946 and 1980 (Dudley, 2011). This has resulted in an intricate pattern of semi-natural habitats within enclosed, agriculturally improved fields associated with dairy, beef, arable and horticulture.

The SSSI boundary comprises 59 discrete parcels of land in close proximity to one another. Distances which separate these parcels vary from a few metres to a maximum of 1.1 km. All of the parcels support mosaics of similar vegetation communities and lie over the same geology (acid granitic rock) and soil types (gritty, loamy, acid soils with localised peat). They mostly occupy similar topographical situations (hill-tops, slopes and/or valley mires) and have a similar history of land management. Consequently Penwith Moors SSSI is considered to be a single, ecologically coherent compound site.

### **1.8.3 Lowland Fen**

The guidelines ([Part 2, Chapter 7, sections 9.1 and 9.2](#)) state that:

- “9.1 Most fens have a surface catchment contributing water to the fen and a subsurface catchment which influences the ground water table and hydrological inputs from springs and seepage. The subsurface catchment may be particularly extensive when formed by the regional aquifer. The surface catchment or contributing slopes



will vary in their extent, and so the degree of sensitivity of fens to activities taking place within the catchment will also vary.

9.2 Many fens require a buffer zone (see B, 5.4; C.8, 6) of land adjacent to or surrounding the fen proper. This additional area has to be regarded as integral to the special interest of the site, because adverse land-use (e.g. drainage or fertiliser application) within it can profoundly modify and degrade the fen. It may or may not be semi-natural habitat and is included to protect the fen core against potentially damaging operations. The size of the buffer zone should be determined in the field and from soil evidence. Ideally, the site boundary of a fen should encompass the surface catchment and follow an identifiable feature in the field, even if this boundary encompasses 'improved' land. But such an approach is not always practicable, and in such situations the following guidelines apply.

9.2.1 The boundary should include the steepest slopes adjacent to the fen, at least as far as the first break of slope (i.e. where a change in angle of slope occurs).

9.2.2 The boundary should include all peripheral ditches, following the outer edge of such ditches (i.e. the side furthest from the fen).

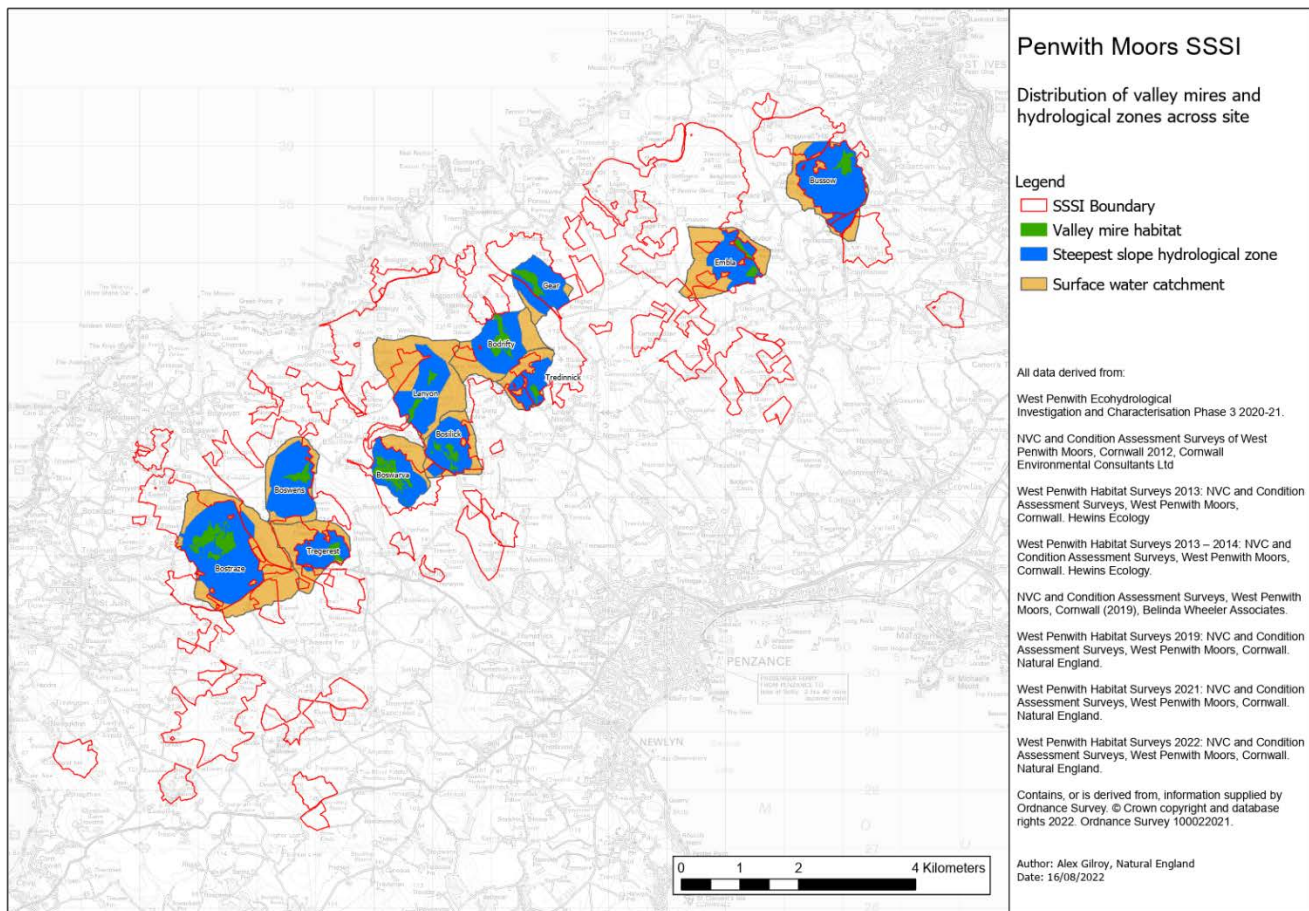
9.2.3 The boundary should encompass all feeding springs and zones of seepage (see 4.2.6).

9.2.4 The boundary should extend part of the way along the outflow stream of the site (see 4.2.6)".

Atkins were commissioned by Natural England to identify the area of land surrounding each of the mires which has a significant influence on their hydrology i.e. the hydrological zone. The hydrological zone of each of the mires was determined using topographical, hydrological and geological information. It was then validated by site visits.

Where hydrological zones coincide with semi-natural habitats selected under other guidelines (e.g. lowland heathland or lowland dry acid grassland), all those parts of the catchments are included within the SSSI boundary. Elsewhere, the boundary includes all land within the hydrological zone as far as the first break of slope. This includes areas of farmland managed for pasture, fodder, arable and horticultural crops. The total extent of such farmland within the boundary is 415 ha, which represents 13% of the total area of Penwith Moors SSSI. [Map 12](#) shows the mires, hydrological zones and boundary to the first break of slope.

**Map 12. Mires, associated hydrological zones and boundary to the first break of slope.**



#### 1.8.4 Vascular plants

The guidelines ([Part 2, Chapter 11, section 5.1, p13](#)) state that:

“The SSSI boundary should include a sufficient area of suitable habitat to enable the longterm maintenance of populations of taxa qualifying either as notified features in their own right or as parts of a species assemblage or Taxonomically Complex Group (sections 4.12 and 4.13). Populations are frequently dynamic, with individuals colonising new patches of suitable habitat whilst others may be lost due to natural change in habitat condition, etc. Therefore, patches of suitable (or potentially suitable) habitat within the same management unit that do not currently support the qualifying taxon should still be included within the SSSI boundary. Areas of suitable habitat nearby should also be considered for inclusion, especially if the habitat is particularly rare or unusual (such as heavy metal contaminated ground and mine spoil), or if the taxon in question is known to be opportunistic or highly mobile, thus allowing appropriate management to be applied across a wider area to provide additional opportunities for the spread of rare or threatened taxa. For some taxa in certain habitats the SSSI boundary may have to include quite large areas which lack the taxon but which are ecologically and functionally part of the same site.

Where taxa are dependent on water supply and/or water quality it is essential that sufficient land is included within the boundary to ensure sustainability of the habitat. This is most obviously important for aquatic taxa inhabiting oligotrophic systems but should also be borne in mind for species of other wet habitats (wet woodland, mires, marshy grassland, flushes, wet heath etc.)”.

The large mosaic of habitats in Penwith Moors SSSI supports populations of coral-necklace, pale dog-violet, pillwort and Cornish moneywort. It also provides good opportunities for new populations to be established.

### 1.8.5 Invertebrates

The guidelines ([Part 2, Chapter 20, section 4.2, p11](#)) provide guidance on the habitat patches which should be considered for inclusion within the boundary of a site, which supports a habitat based assemblage, as follows:

Habitat Type	Habitat patches for consideration of inclusion in SSSI boundaries
Grassland and heathland	Adjoining scrub, woodland, tall ruderal and wetland systems, old sand and marl pits.

The scrub-heath and moorland (F003) assemblage present within Penwith Moors SSSI is found on nutrient-poor, acid soils where herbaceous or dwarf shrub vegetation is dominant. It occurs on both damp and dry soils. The boundary of Penwith Moors SSSI includes areas of heath, scrub, acid grassland and wetland all of which will support this assemblage.

### 1.8.6 Lichens

The guidelines ([Part 2, Chapter 13, sections 5.1 to 5.4. p25](#)) state that:

- “5.1. Generic guidance on boundary setting is provided in [Section 8 of Guidelines for the Selection of Biological SSSIs Part 1 \(Bainbridge et al 2013\)](#). Lichens function on different scales to vascular plants and bryophytes, both spatially and temporally. Some species may be confined to very small areas of fixed habitat such as rock outcrops but depend on qualities of the wider habitat to maintain their populations. In other cases, such as with woodland species, large habitat areas may be required over timescales of centuries to allow for old growth stand succession across sites (Ellis and Coppins 2007).
- 5.2. High ammonia emissions from farming such as intensive stock rearing units, or slurry applications to grassland, can have severe local impacts on lichen populations. For example, woodland boundary trees can support rich lichen assemblages due to higher light levels but this exposure makes them more susceptible to adjacent land use. Habitat buffer strips such as shelter belts have been shown to mitigate the impacts and should also be a key consideration when boundary setting (Dragosits et al 2006; Bealey et al 2015).
- 5.4. Where the interest is fragmented, occurring in a number of discrete hotspots, it may be more appropriate to evaluate the areas collectively and notify them as a single site. However, hotspots need to be ecologically coherent (as a whole) and situated relatively close to one another”.

The guidelines ([Part 2, Chapter 13, Appendix 2](#)) also state:

“Acid and non-calcareous basic rock in the forest zone supports a large proportion of the lichen biodiversity of Britain: 213 taxa are included in the non-montane acid rock assemblage. Assemblages show a high degree of heterogeneity between outcrops and rock types, and typically small numbers of TNTN species will occur on some single outcrops. Full recognition of the diversity of this assemblage can only be attained at a landscape scale”.

All twelve outcrops supporting this assemblage are therefore included within the boundary. The inclusion of surrounding habitat provides a buffer to mitigate potential negative impacts.

### 1.8.7 Implementation of boundary guidance

Taking account of the general and habitat/species boundary guidance the SSSI boundary at Penwith Moors SSSI has therefore been defined to include the following:

- areas of lowland heath, lowland dry acid grassland and/or valley mire (fen) vegetation communities including mosaics of vegetation communities and transitions between them as defined by surveys undertaken in 2012, 2013, 2014, 2019, 2021 and 2022;

- areas of bracken and scrub where they are within management or ecological units which also contain lowland heath, lowland dry acid grassland or valley mire (fen) vegetation communities;
- land within the hydrological zones of lowland fen features as far as the first break of slope.
- any additional parcels of land which support notified vascular plants and/or the non-montane acid rock lichen assemblage.

The boundary follows boundary features which are evident from Ordnance Survey maps and/or in the field, wherever practical to do so. Collectively, these boundary features delineate management units. Generally, they follow ‘Cornish hedges’, traditional field boundaries made of earth and stone. Some of the Cornish hedges used to define the site boundary are in a state of disrepair but still evident on O.S. maps and in the field. Occasionally, other linear features including fences, roads and tracks are used to delineate the site boundary where appropriate.

There are a small number of examples where such boundaries are not used. These occur where large areas of long established agriculturally improved or highly modified land (such as disturbed ground, tips, hardstanding, buildings, enclosed gardens), beyond restoration would have to be included within the SSSI boundary if it was to be extended to the next available ‘field’ boundary. In these few cases the extent of parcels of lowland heathland and/or lowland dry acid grassland is used to define the SSSI boundary which is defined with map coordinates and annotations.

## 2. Condition of features at Penwith Moors SSSI

SSSIs are notified because of special biological or geological features. When these features are being managed so that their special nature conservation interest is being maintained they are said to be in favourable condition. This is a United Kingdom standard and the terminology and definitions are more fully described in ‘A Statement on Common Standards Monitoring (CSM)’, produced by the Joint Nature Conservation Committee in 1998. The condition of features within Penwith Moors SSSI is summarised in [Table 12](#).

**Table 12. Condition of features at Penwith Moors SSSI**

Feature	Condition	Date Assessed
Lowland heathland	Unfavourable	2012-2021
Lowland Fen	Unfavourable	2013- 2019
Lowland dry acid grassland	Unfavourable	2012-2019
Coral-necklace	Favourable	2019
Pale dog-violet	Unfavourable	2019
Pillwort	Favourable	2019
Cornish moneywort	Favourable	2016
F003 invertebrate assemblage	Favourable	2015
Non-montane acid rock lichen assemblage	Favourable	2019
Dartford warbler - breeding	Favourable	2015

### 2.1 Reasons for unfavourable condition

The condition assessments in [Table 12](#) are for the whole site and use common standards attributes and targets which have not been tailored to the conditions found at Penwith Moors SSSI. There is variability in condition across the site. Of the 67 survey areas containing lowland heath habitat, 64 are recorded to be in unfavourable condition and 3 in favourable condition. The majority of unfavourable assessments are attributed to insufficient diversity in physical structure (age class) and in the diversity of associated herbs and graminoids. It is possible that some of the areas recorded as unfavourable would be re-assessed as

favourable when assessed using site tailored attributes and targets. On the whole unfavourable condition is likely to reflect a history of insufficient management. However these survey areas still contain significant characteristic attributes such as heathland flora and fauna and are considered to be recoverable with appropriate management.

In common with the vast majority of mires in England, the valley mires in the Penwith Moors SSSI have been subject to various modifications to their natural state. While they have retained high-value semi-natural vegetation and some rare species, the extent and distribution of particular mire types and species has been altered by human modifications, particularly drainage, nutrient enrichment, burning, historic stock grazing and subsequent abandonment. In some cases, this has led to the condition of these semi-natural mires being assessed as 'Unfavourable', largely on the basis of dense growth of tussocky grasses or rushes and/or low frequency of typical species of the community, although the species are still present within the site.

As long as the key supporting conditions remain favourable, particularly water levels and nutrient status, re-instatement of more regular vegetation management through grazing and cutting will bring these areas into improved and ultimately favourable condition by reducing the dominance of negative species and improving conditions for the 'positive' indicators, which tend to favour open conditions with low competition. Modifications of longer standing, such as drainage, can also be remedied by re-instating natural hydrological regimes, which is largely achieved by removing piped drainage and blocking and in-filling artificial drainage channels. In addition to restoring the integrity of the mire system and associated sub-features such as pools and shallow runnels, this also has benefits for downstream watercourses, and the health of the peat soils.

The condition of lowland dry acid grassland was predominantly unfavourable due to low frequency of positive indicator species, high cover of coarse grass species and in some cases encroachment of bracken and brambles. This is likely to be the result of insufficient management and/or historic agricultural improvement. However these areas still contain significant characteristic attributes and are considered to be recoverable with appropriate management.

Pale dog-violet is considered to be in unfavourable condition as two of the four populations recorded in 2012 were no longer present in 2019 due to habitat succession. However the remaining populations are considered to be sustainable. The lost populations could be recovered given suitable management as seeds within the soil seedbank remain viable for decades.

### **3. Selection of 'operations requiring Natural England's consent'**

To safeguard the special features of Penwith Moors SSSI and achieve positive management owners and occupiers will require consent before undertaking some operations. These operations are known as 'Operations Requiring Natural England Consent' (ORNECs).

When determining the list of operations requiring consent relevant operations are identified from a Natural England master list. Selection is based on the likelihood that the operations may cause damage to the special features that are the reasons for notification of the SSSI. As well as selecting operations from the master list the precise wording of each operation may be tailored to suit the particular circumstances at the site.

It is not possible to predict every possible eventuality that may arise on a site but the aim is to identify all operations where it is reasonably foreseeable that, if carried out at certain times or in a particular manner somewhere within the SSSI, they are likely to damage the special interest features. The table below records at least one reason justifying the inclusion of each operation in the list for Penwith Moors SSSI. It is not intended to be exhaustive and in most cases there will be other ways in which the specified operation is likely to cause damage.

Ref No	Type of operation	At least one reason for listing
1.	Cultivation, including ploughing, rotovating, harrowing and re-seeding.	<p>Heathland, grassland, fen and habitats supporting species could be destroyed. Areas with potential for habitat restoration could be destroyed.</p> <p>Could have an adverse effect upon wetland features as a result of run-off.</p>
2.	Grazing and alterations to the grazing regime (including type of stock, intensity or seasonal pattern of grazing).	<p>Heathland, grassland, fen and habitats supporting species features are sensitive to over or under grazing, which could lead to changes in community composition. Livestock grazing may be a useful tool for restoring and maintaining habitat features in favourable condition but intensity and seasonality must be appropriate.</p>
3.	Stock feeding and alterations to stock feeding practice.	<p>Damage or destruction of designated features from localised nutrient enrichment, livestock trampling and smothering effects.</p> <p>Localised nutrient enrichment or poaching within wetland catchments could have an adverse effect upon wetland features through run-off and/or an increase in nitrogen levels in surface and ground water.</p>
4.	Mowing or cutting vegetation and alterations to the mowing or cutting regime (such as from haymaking to silage).	<p>The notified features are sensitive to cutting or mowing, which could lead to changes in community composition.</p>
5.	Application of manure, slurry, silage liquor, fertilisers and lime.	<p>The notified features are sensitive to nutrient enrichment, which could lead to dominance by competitive species and changes in community composition.</p> <p>Nutrient enrichment within the wetland catchments could have an adverse effect upon wetland features through run-off and/or an increase in nitrogen levels in surface and ground water.</p>
6.	Application of pesticides, including herbicides (weedkillers) whether terrestrial or aquatic, and veterinary products.	<p>Features and associated flora/fauna are sensitive to pesticides, both through direct loss and changes to community composition.</p>
7.	Dumping, spreading or discharging of any materials.	<p>Risk of obscuring/smothering heathland, grassland, fen and rock outcrops and areas with potential for habitat restoration.</p> <p>Risk of altering soil or ground-water pH and increasing nutrient levels within wetland catchments, which could have adverse effect upon wetland features.</p>

Ref No	Type of operation	At least one reason for listing
8.	Burning and alterations to the pattern or frequency of burning.	Heathland, grassland and fen sensitive to burning if undertaken inappropriately, both through direct loss and changes to community composition. Burning may be a useful tool for restoring and maintaining lowland heathland in favourable condition but frequency, extent and seasonality of burning must be appropriate.
9.	Release into the site of any wild, feral, captive-bred or domestic animal, plant, seed or micro-organism (including genetically modified organisms).	Could lead to unforeseen interactions with indigenous species and changes in community composition.
10.	Killing, injuring, taking or removal of any wild animal (including dead animals or parts thereof), or their eggs and nests, including pest control and disturbing them in their places of shelter.	Could lead to unforeseen changes in community composition, for instance if key herbivores, pollinators or predators affected, direct damage to species interests.
11.	Destruction, displacement, removal or cutting of any plant or plant remains, including tree, shrub, herb, hedge, dead or decaying wood, moss, lichen, fungal fruiting body, leaf-mould, turf or peat.	Damage to important habitats/species and risk of incidental damage to other features.
12.	Tree and/or woodland management and alterations to tree and/or woodland management (including planting, felling, pruning and tree surgery, thinning, coppicing, changes in species composition, removal of fallen timber).	Risk of incidental damage to important features.  Tree planting at inappropriate locations may lead to shading of designated habitats and species which require open, sunny conditions.
13a.	Draining (including moor-gripping, the use of mole, tile, tunnel or other artificial drains).	Damage to lowland wetland (fen) features which are sensitive to drainage and risk of incidental damage to other features.
13b.	Modification to the structure of water courses (streams, springs, ditches, dykes and drains) including their banks and beds, as by re-alignment, regrading, damming or dredging.	Drainage within wetland catchments could have an adverse effect upon wetland features by diverting supply of water.

Ref No	Type of operation	At least one reason for listing
13c.	Management of aquatic and bank vegetation for drainage purposes.	Note ref 13b: the term “modification” is interpreted by Natural England to include <u>maintenance</u> of existing drainage systems, natural or man-made.
14.	Alterations to water levels and water tables and water utilisation (including irrigation, storage and abstraction from existing water bodies and through boreholes). Also the modification of current drainage operations, such as through installation of new pumps.	Damage to lowland wetland (fen) features which are sensitive to changes in water levels and water tables.  Alterations to water levels and water tables within wetland catchments could have adverse effect upon wetland features by diverting supply of water.
15.	Infilling or digging of ditches, dykes, drains, ponds, pools, marshes or pits.	Damage to important habitats sensitive to changes in water tables and to drainage.  Loss of supporting habitat for Pillwort.
20.	Extraction of minerals including peat, hard rock, sand and gravel, topsoil, subsoil and spoil.	Direct loss of heathland, grassland, fen, rock outcrops and areas with potential for habitat restoration.  Mineral extraction within wetland catchments could have an adverse effect upon wetland features by lowering water tables.
21.	Destruction, construction, removal, rerouting, or regrading of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, including soil and soft rock exposures or the laying, maintenance or removal of pipelines and cables, above or below ground.	Direct loss of or incidental damage to features.
22.	Storage of materials.	Risk of obscuring/smothering heathland, grassland, fen and rock outcrops.  Depending upon type of material, possible effects of soil contamination which could damage designated features or adversely affect management.  Possible effects of run-off within wetland catchments.
23.	Erection of permanent or temporary structures or the undertaking of engineering works, including drilling.	Direct loss of or incidental damage to features.
24a.	Modification of natural or man-made features and clearance of boulders, large stones, loose rock, scree.	Direct loss of or damage to lichen interest. Risk of incidental damage to other features.



Ref No	Type of operation	At least one reason for listing
26.	Use of vehicles or craft.	Risk of damage to important habitats, such as through compaction. Risk of disturbance to nesting birds.
27.	Recreational or other activities likely to damage or disturb the features of special interest.	Risk of damage to important habitats, trampling effects upon vascular plants and lichens or disturbance to nesting birds.
28a.	Game and waterfowl management and hunting practices and alterations to game and waterfowl management and hunting practice.	Inappropriate location and types could damage habitats through, for example, trampling, nutrient enrichment around feeders or disturbance to nesting birds.

# Annex 1. Information used to support the selection of Penwith Moors SSSI

## General

Dudley, P (2011) Goon, Hal, Cliff and Croft: **The Archaeology and Landscape History of West Cornwall's Rough Ground**. Cornwall Council.

Account of the archaeology and landscape history of rough-ground in west Cornwall. ISBN: 9781903798720.

Bainbridge, I., Brown, A., Burnett, N., Corbett, P., Cork, C., Ferris, R., Howe, M., Maddock, A., Mountford, E. & Pritchard, S. (2013). **Guidelines for the Selection of Biological SSSIs - Part 1: Rationale, Operational Approach and Criteria for Site Selection**, JNCC, Peterborough.

Broad operational approach and criteria for SSSI evaluation and selection. General principles from which the more detailed habitat and species selection criteria have been developed.

Published online: <https://hub.jncc.gov.uk/assets/dc6466a6-1c27-46a0-96c5-b9022774f292>

JNCC (2019). **A Statement on Common Standards for Monitoring Protected Sites**.

Summary of the rationale, need for, and approach behind Common Standards Monitoring.

Published online: <https://hub.jncc.gov.uk/assets/0450edfd-a56b-4f65-aff6-3ef66187dc81>

**Conservation designations for UK Taxa**. JNCC, Peterborough.

Spreadsheet detailing the GB and England status of species. Published online:

<https://hub.jncc.gov.uk/assets/478f7160-967b-4366-acdf-8941fd33850b>.

**All of the Natural England commissioned (NECR) and research (NERR) reports listed below can be accessed via this link:** [Penwith Moors \(nepubprod.appspot.com\)](https://nepubprod.appspot.com).

## Lowland heathland, Lowland dry acid grassland and Lowland fen

Rose, F. (1953). **A survey of the ecology of British lowland bogs**. Proceedings of the Linnnean Society, 164, 186-211.

Description of valley mire systems within heathland ecosystems.

Fuller, R.M. 1987. **The changing extent and conservation interest of lowland grasslands in England and Wales: A review of grassland surveys 1930–1984**. Biological Conservation, Vol. 40, Issue 4.

A study of the changing extent of lowland grassland, in England and Wales. Published online: <https://www.sciencedirect.com/science/article/abs/pii/0006320787901212>.

JNCC (1989). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 7 Fens**. JNCC, Peterborough.

Guidelines for selecting fens for SSSI notification. Published online: [SSSI Guidelines – Chapter 7 Fens | JNCC Resource Hub](#).

Rodwell, J.S. (ed.) (1991). **British Plant Communities. Volume 2: Mires and heaths**. Cambridge University Press.

National Vegetation Classification (NVC) for mires and heaths. ISBN: 9780521627207.

Rodwell, J.S. (ed.) 1992. **British Plant Communities. Volume 3: Grasslands and montane communities.** Cambridge University Press.

National Vegetation Classification (NVC) for acid grassland communities.  
ISBN: 9780521627191.

Farrell, L. (1993). **ENS12 Lowland heathland: the extent of habitat change.** English Nature, Peterborough.

Study of the changing extent of lowland heathland habitat in Great Britain. Published online:  
<http://publications.naturalengland.org.uk/publication/2273530>.

Robertson, H.J. & Jefferson, R.G. (2000). **Monitoring the condition of lowland grassland SSSIs. English Nature Research Report No 315.** English Nature, Peterborough.

Guidelines for monitoring lowland grassland SSSIs in England. Published online:  
<http://publications.naturalengland.org.uk/publication/64033>.

**NECR343 NVC and Condition Assessment Surveys of West Penwith Moors, Cornwall.** Cornwall Environmental Consultants Ltd (2012).

Description and mapping of vegetation communities at Chapel Carn Brea; Bosvenning Common; Chun Downs; Watch Croft; Carn Galver; Bosporthenis; Chykembro; Logan Stone; Zennor Quoit; Trewey Common; Noon Digery; Rosewall Hill and Trevalgan Hill.)

**NECR346 West Penwith Habitat Surveys 2013: NVC and Condition Assessment Surveys, West Penwith Moors, Cornwall.** Hewins Ecology.

Description and mapping of vegetation communities at Tredinney Common; Sancreed Beacon and Grumbla Common; Leswidden; Busvargus and Tregeseal Common; Higher Botrea; Carnyorth Common to Bostraze Bog; Dry Carn and North Road; Dry Carn and Boswens Common; Woon Gumpus Common; Pedn Venton; Boswarva Carn to Great Bosulow; Carn Downs; Men-an-Tol Croft, Lanyon Croft and Bosilliack; Nine Maidens Common; Mulfra Hill to Treen Common; North of Higher Kerrowe; Trewey Hill West; Zennor Hill and Rosemorran (part); Foage Farm to Sperris Croft and Boscubben Croft (part); Eagle's Nest and Wicca Croft (part); Trendrine Hill and Beagletodn Downs; Amalveor Downs to Noon Billas (part); Trewey Common (part); Conquer Downs to Lady Downs; Carnaquidden Downs North; Noon Digery, Trenowin Downs, Tonkins Downs and Gulval Downs (part); Bussow Moor (part); Trink Hill.

**NECR347 West Penwith Habitat Surveys 2013 – 2014: NVC and Condition Assessment Surveys, West Penwith Moors, Cornwall.** Hewins Ecology.

Description and mapping of vegetation communities at Nanquidno Downs; Carn Grean; Bartinney Downs, Tredinney Common and Numphra Common (part); Caer Bran; Botrea; Bosvenning & Roskennals Common, Receven Common and Hewes Common (part); Wheal Buller South; Wheal Buller North; Bostraze Bog to Boslow; Hale Downs and Tor Noon; Higher Downs and Chun Downs; Boswens North; Boswens Common East; Penhale Trewern and Trewern Moor; Boswarva Carn to Great Bosulow; Watch Croft, Trevean, White Downs and Bosulow Common (part); Bosporthenis to Hannibal's Carn (part); Mulfra Hill to Treen Common (part); Chykembro Common, Gear Common and Penance (part); Trewey Hill East; Eagle's Nest and Wicca Croft (part); Amalveor Downs to Noon Billas (part); Carnaquidden Downs to Great Downs; Rosewall Hill (part); Castle Gate.

**NECR339 Definition of the zone of hydrological influence relating to Bostraze Bog, West Penwith, Cornwall.** Rigare Ltd (2018).

Ecohydrological investigation and characterisation of the mire system and its catchment at Bostraze.

Alonso, I., Sullivan, G. & Sherry, J (2018). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 4 Lowland Heathland**. JNCC, Peterborough.

Guidelines for selecting lowland heathland for SSSI notification. Published online: [SSSI Guidelines - Chapter 4 - Lowland Heathland | JNCC Resource Hub](#)

**NECR348 NVC and Condition Assessment Surveys, West Penwith Moors, Cornwall.** Belinda Wheeler Associates (2019).

Description and mapping of vegetation communities at: Nanquidno Downs Fields; Nanquidno Downs (part); South of Sancreed Beacon; Carn Glaze North (part); Dowran Moor; Leswidden SE; Deveral Common; Tregerras Receven and Higher Bodinar Common; Mulfra Hill (part); Gulval Downs (part); Trevalgan Hill East; Bussow West; Carnyorth West; Trengwainton Carn; Trewellard Common; Wheal Bal; Bojewyan; land near Tregaminion; Carrallack and Higher Bosavern Common; Carn Glaze South; Primrose Cottage; Mount Whistle; Rosewall Hill South West; Land West of Trevalgan; Trencrom Hill; Newmill; Millvale; Caer Bran Farm; Trye Farm; Tredinneck; Embla North; Embla South; Tregerest; Boscubban; Nine Maidens Common (part) & Land north of Boskednan; Goldherring and Creeg Tol; Lanroch.

**NERR087 West Penwith Habitat Surveys: Carn Glaze North (part) survey area 8.** Natural England (2019).

Description and mapping of vegetation communities at part of Carn Glaze North.

**NERR088 West Penwith Habitat Surveys: Bosullow survey area 30.** Natural England (2019).

Description and mapping of vegetation communities at Bosullow.

**NERR091 Baseline vegetation validation (site checks) surveys.** Natural England (2019).

Survey to assess habitat change since vegetation surveys undertaken from 2012-2014.

Jefferson, R.G., Smith, S.L.N. & MacKintosh, E.J. (2019). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 3 Lowland Grasslands**. JNCC, Peterborough.

Guidelines for selecting lowland grasslands for SSSI notification. Published online: [Chapter 3 Lowland Grasslands \(jncc.gov.uk\)](#).

**NECR349 Ecohydrological Investigation and Characterisation of three proposed SSSI Units: Boswens North, Bussow Moor and Boswarva North, West Penwith, Cornwall.** Pendleton Hydro Ltd (2019).

Ecohydrological investigation and characterisation of the mire system and its catchment at Boswens North, Bussow Moor and Boswarva North.

**NERR112 West Penwith Habitat Surveys: Chapel Carn Brea (part), survey area 2.** Natural England (2021).

Description and mapping of vegetation communities at Chapel Carn Brea, supplemental to survey in 2012.

**NERR113 West Penwith Habitat Surveys: Bosulow (part), survey area 30.** Natural England (2021).

Description and mapping of vegetation communities at part of Bosulow. Supplemental to survey in 2019.

**NERR106 West Penwith Habitat Surveys: Carn Galver (part), survey area 32.** Natural England (2021).

Description and mapping of vegetation communities at Brook Cottage, supplemental to survey in 2012.

**NERR114 West Penwith Habitat Surveys: Trendrine Hill (part) - survey area 45.** Natural England (2021).

Description and mapping of vegetation communities at Trendrine Hill, supplemental to survey in 2013.

**NERR119 West Penwith Habitat Surveys: Trink Hill (part) - survey area 55.** Natural England (2021).

Description and mapping of vegetation communities at Trink Hill, supplemental to survey in 2013.

**NERR121 West Penwith Habitat Surveys: Busvargus and Tregeseal Common (part) - survey area 11.** Natural England (2021).

Description and mapping of vegetation communities at McLaren Villas, supplemental to survey in 2013.

**NERR120 West Penwith Habitat Surveys: Watch Croft, Trevean, White Downs and Bosulow (part), survey area 31.** Natural England (2021).

Description and mapping of vegetation communities at Higher Bosulow, supplemental to surveys in 2012 & 2013.

**NERR117 West Penwith Habitat Surveys: Conquer Downs to Lady Downs (part), survey area 48.** Natural England (2021).

Description and mapping of vegetation communities at Higher Conquer, supplemental to survey in 2013.

**NERR118 West Penwith Habitat Surveys: Trenowin Downs, Tonkin Downs, Gulval Downs and Noon Diggery (part), survey area 51.** Natural England (2022).

Description and mapping of vegetation communities at Higher Trenowin, Gulval Downs & Baker's Pit, supplemental to surveys in 2012 & 2013.

**NECR399 West Penwith Ecohydrological Investigation and Characterisation Phase 3 2020-21.** Atkins (2021).

Ecohydrological investigation and characterisation of eleven mire systems and their catchments in West Penwith using open data.

**NECR402 West Penwith Ecohydrological Investigation and Characterisation, Phase 3 – Site Visit Report, 2020-21.** Atkins (2021).

Field verification of ecohydrological investigation and characterisation of eleven mire systems and their catchments in West Penwith.

**NERR109 Penwith Moors Ecohydrological catchment land-cover survey, May/June 2021.** Natural England (2021).

Land-cover survey of farmland within 'steepest slope risk zones' of mire (wetland) catchments.

Stephen, K. (2022). **Specialist support for notification of Penwith Moors as a SSSI for lowland acid grassland.**

Support for notifying Penwith Moors for lowland grassland from Natural England's Senior Grassland Specialist.

Diack, I. (2022). **Specialist support for notification of Penwith Moors as a SSSI for lowland fen.**

Support for notifying Penwith Moors for lowland fen from Natural England's Senior Wetland Specialist.

McCullagh, F. (2022). **Specialist support for notification of Penwith Moors as a SSSI for lowland heathland.**

Support for notifying Penwith Moors for lowland heathland from Natural England's Senior Heathland Specialist.

## **Vascular Plants**

Stewart, A., Pearman, D.A., & Preston, C.D. (eds) 1994. **Scarce plants in Britain.** JNCC, Peterborough. ISBN: 9781873701669.

Rare/Scarce status of plants in Great Britain.

Wiggington, M.J. 1999. **British Red Data Books 1. Vascular plants, 3<sup>rd</sup> Edn.** JNCC, Peterborough.

Definition of thresholds for Rare/Scarce status. ISBN 13: 9781861074515.

Cheffings, C.M. & Farrell, L. (eds) 2005. **Species Status No. 7: The Vascular Plant Red Data List for Great Britain.** JNCC, Peterborough.

IUCN status definitions for vascular plants in Great Britain. Published online: <http://jncc.defra.gov.uk/page-3354>.

Pearman, D.A. 2008. **The status of Coral-necklace *Illecebrum verticillatum* L. (Caryophyllaceae) in Great Britain.** *Watsonia* 27: 143-148.

Assessment of the status of coral necklace.

Stroh, P.A., *et. al.* (2014). **A Vascular Plant Red List for England**. Botanical Society of Britain & Ireland.

IUCN assessment of vascular plants in England. Published online: [https://bsbi.org/wp-content/uploads/dlm\\_uploads/England\\_Red\\_List\\_1.pdf](https://bsbi.org/wp-content/uploads/dlm_uploads/England_Red_List_1.pdf).

**NECR342 Assessment of population stability and sustainability of Rare/Scarce vascular plants, West Penwith Moors, Cornwall**. French, C. and Bennallick, I. (2016).

Collation of records and assessment of local conservation status for rare and scarce vascular plants within West Penwith Moors.

**NECR341 Penwith Moors Vascular Plant Survey**. French, C. (2019).

Survey of 5 species of vascular plant within Penwith Moors.

Taylor, I., Leach, S. J., Martin, J. P., Jones, R. A., Woodman, J. and Macdonald, I. (2021). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 11 Vascular Plants**. JNCC, Peterborough.

Guidelines for selecting vascular plants for SSSI notification. Published online: <https://hub.jncc.gov.uk/assets/04b923cd-7658-4b8c-bead-4a65c3af330e>.

Botanical Society of Britain and England (2021) **Distribution Database**.

Database of verified records for vascular plants. Available online following registration: <https://database.bsbi.org/>.

Cornish Biodiversity Network (2021). **ERICA database**.

Biological records database for Cornwall and Isles of Scilly. Available online following registration: [Cornish Biodiversity Network - the leading on-line resource for information about the wildlife of Cornwall and the Isles of Scilly](#).

Prendergast, A. (2022). **Specialist support for notification of Penwith Moors as a SSSI for vascular plants**.

Support for notifying Penwith Moors for vascular plants from Natural England's Senior Vascular Plant Specialist.

## **Invertebrates**

**NECR340 West Penwith Moors, Cornwall: Invertebrate sample survey for Broad and Specific Assemblage Type identification**. Alexander, K.N.A. & Knight, L.R.F.D. (2015).

Description and analysis of invertebrate assemblages based upon a sample survey.

**NECR336 West Penwith Moors targeted rare insect species survey**. Kernow Ecology (2015).

Survey for and evaluation of populations of rare invertebrate species within Penwith Moors.

Webb, J., Heaver, D., Lott, D., Dean, H.J., van Breda, J., Curson, J., Harvey, M.C., Gurney, M., Roy, D.B., van Breda, A., Drake, M., Alexander, K.N.A. and Foster, G. (2018). **Pantheon - database version 3.7.6**. Natural England & Centre for Hydrology & Ecology.

Information on how Pantheon works. Published online: <http://www.brc.ac.uk/pantheon/>.

Curson J., Howe, M, Webb, J., Heaver D. & Tonhasca, A. (2019). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 20 Invertebrates**. JNCC, Peterborough.

Guidelines for selecting invertebrate features for SSSI notification. Published online: [Chapter 20 Terrestrial and Freshwater Invertebrates \(jncc.gov.uk\)](#).

Heaver, D. (2021). **Specialist support for notification of Penwith Moors as a SSSI for invertebrates**.

Support for notifying Penwith Moors for invertebrates from Natural England's Senior Entomology Specialist.

## Lichens

**NECR334 Survey of Rare Lichens, West Penwith Moors, Cornwall**. Neil Sanderson Botanical Survey and Assessment (2014).

Description and evaluation of populations of notable lichen species within 4 survey sites in 2013.

Sanderson, N., Wilkins, T.C., Bosanquet, S., and Genney, D.R. (2018). **Guidelines for the Selection of Biological SSSIs**. Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 13 Lichens and associated microfungi**. JNCC, Peterborough. Published online: [Chapter 13 Lichens and associated microfungi \(jncc.gov.uk\)](#). [Appendix 2 Lichen species list](#).

Guidelines for selecting lichens for SSSI notification.

**NECR332 A Lichen Survey of Penwith Moors**. Orange, A. (2019).

Description and evaluation of populations of notable lichen species within 10 survey sites in 2019.

Wainhouse, M. (2021). **Specialist support for notification of Penwith Moors as a SSSI for lichens**.

Support for notifying Penwith Moors for lichens from Natural England's Senior Fungi and Lichen Specialist.

## Birds

Bibby, C.J. (1979). **Mortality and movements of Dartford warbler in England**. British Birds 72: 10-22.

Research on the movement of Dartford warbler within England.

van den Berg, L.J.L., Bullock, J.M., Clarke, R.T., Langston, R.H.W. and Rose R. J. 2001. **Territory selection by the Dartford warbler (*Sylvia undata*) in Dorset, England: the role of vegetation type, habitat fragmentation and population size**. Biological Conservation 101:217-228.

Study of Dartford warbler in Dorset.

Brown, A. and Grice, P. 2005. **Birds in England**. Poyser, London.

Behaviour of Dartford warbler.



**NECR337 West Penwith Moors, Cornwall Collation of existing bird data.** Crummay, S.H. (2013).

Review and evaluation of records for breeding and wintering birds 2005/06 – 2011/12.

**NECR335 West Penwith Moors, Cornwall – Breeding Bird Survey.** University of Exeter (2014).

Description and evaluation of populations of breeding birds and breeding bird assemblages based upon sample surveys.

**NECR338 West Penwith Moors, Cornwall, Dartford Warbler Survey.** Crummay, S.H. (2015).

Description and evaluation of population of Dartford warbler based upon sample surveys.

Holling, M., and the Rare Breeding Birds Panel. 2019. **Rare Breeding Birds in the UK in 2017.** British Birds 112: 706-758.

Records of Dartford warbler in 2017

Eaton, M., Holling M., and the Rare Breeding Birds Panel (2020). **Rare Breeding Birds in the UK in 2018.** British Birds 113:737–791.

Records of Dartford warbler in 2018.

**Rare Breeding Bird Panel records 2016-2021.**

Bespoke report compiled by the RBBP - verified records from 2016 to 2021 for the Penwith area.

**Cornwall Bird Watching & Preservation Society records 2016-2021.**

<https://cbwps.org.uk/>.

Records of Dartford warbler between 2016 and 2021.

Drewitt, A. L., Whitehead, S. and Cohen, S. (2020). **Guidelines for the Selection of Biological SSSIs.** Part 2: Detailed Guidelines for Habitats and Species Groups. **Chapter 17 Birds** (version 1.1). JNCC, Peterborough.

Guidelines for selecting birds for SSSI notification. Published online: [Chapter 17 Birds - Guidelines for the Selection of biological SSSIs \(jncc.gov.uk\)](#).

Woodward, I., Aebischer, N., Burnell, D., Eaton, M., Frost, T., Hall, C., Stroud, D.A. & Noble, D. (2020). **Population estimates of birds in Great Britain and the United Kingdom.** British Birds 113: 69 -104.

Population estimates of birds to establish critical thresholds for site selection. Summary available online: <https://www.bto.org/our-science/publications/peer-reviewed-papers/apep-4-population-estimates-birds-great-britain-and>.

Anthony, S. (2022). **Specialist support for notification of Penwith Moors as a SSSI for Dartford warbler.**

Support for notifying Penwith Moors for Dartford warbler from Natural England's Senior Ornithology Specialist.

**Annex 2. Map showing location of all notified habitats and species.**