Definition of Favourable Conservation Status for Coastal Sand Dunes

Defining Favourable Conservation Status Project

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About the DFCS project

Natural England's Defining Favourable Conservation Status (DFCS) project is defining the minimum threshold at which habitats and species in England can be considered to be thriving. Our FCS definitions are based on ecological evidence and the expertise of specialists.

We are doing this so we can say what good looks like and to set our aspiration for species and habitats in England, which will inform decision making and actions to achieve and sustain thriving wildlife.

We are publishing FCS definitions so that you, our partners and decision-makers can do your bit for nature, better.

As we publish more of our work, the format of our definitions may evolve, however the content will remain largely the same.

This definition has been prepared using current data and evidence. It represents Natural England's view of FCS based on the best available information at the time of production.

Quality of evidence is defined as follows:

- Robust evidence is that which has been reported in peer-reviewed literature, or other reputable literature, from well-designed experiments, surveys or inventories that shows signs of being applicable generally.
- Medium evidence is that reported from well-designed experiments, surveys or inventories but from only one or a small number of sites, with uncertainty over its more general applicability, or is correlational or circumstantial evidence.
- Limited evidence includes 'expert opinion', based on knowledge of ecological factors that plausibly suggest an effect, but there is no circumstantial or direct evidence available.

Confidence levels are assigned as shown in the following matrix (after IPCC 2010):

High agreement Limited evidence	High agreement Medium evidence	High agreement Robust evidence
Medium agreement Limited evidence	Medium agreement Medium evidence	Medium agreement Robust evidence
Low agreement Limited evidence	Low agreement Medium evidence	Low agreement Robust evidence

Introduction

This document sets out Natural England's view on Favourable Conservation Status (FCS) for **coastal sand dunes** in England. FCS is defined in terms of three parameters: natural range and distribution, area, and structure and function attributes.

Section 2 provides the summary definition of FCS in England. Section 3 covers contextual information, Section 4 the metrics used and Section 5 describes the evidence considered when defining FCS for each of the three parameters. Section 6 sets out the conclusions on favourable values for each of the three parameters. Annex 3 lists the references.

This document does not include any action planning, or describe actions, to achieve or maintain FCS. These will be presented separately, for example within strategy documents.

The guidance document Defining Favourable Conservation Status in England describes the Natural England approach to defining FCS

Summary FCS Definition

2. FCS in England

Coastal sand dunes develop where sand is blown inland from beaches and deposited above the high water mark. It is trapped by specialised vegetation and typically builds up into a series of low hillocks or ridges.

Coastal sand dunes have been affected by the development of housing, tourism, golf courses, agricultural land claim, afforestation, military use, sand extraction and hard coastal defences such as rock armour, groynes and artificial sea walls. Some activities have led to direct permanent loss of entire dune systems or indirect permanent loss of some dune habitat elements by impeding dune functioning. England's coastal sand dunes have been reduced by an estimated 50% compared to historical levels. Some human actions, such as afforestation, result in the loss of natural dune vegetation and impact on hydrological processes whilst not affecting the underlying dune morphology. In most cases there is a consistent trend across Europe towards increased vegetation cover and consequent over-stabilisation and a reduction in the area of dynamic and open character habitats, resulting in the loss of specialised species (Howe and others 2010). A key driver of this trend is increased rates of nitrogen deposition leading to eutrophication.

Range: The natural range is favourable when the full variation of successional stages and dune formations that is naturally present within functional coastal sand dune is sustainably represented within each sediment cell.

Area: The Favourable Area for dune habitats is approximately 13,000 ha. This includes the current area (approximately 10,000 ha) of coastal sand dunes together with nearly 2,000 ha of modified vegetation types over blown sand, such as golf courses, plantations and some agriculturally improved land and the restoration of an additional 1,000 ha where there is potential for the habitat. In addition, using the EU Interpretation manual definitions (European Commission 2013), there are 5,635 ha of Annex I dune habitats within the overall dune area. An increase of approximately 7,365 ha across all dune Annex I habitats, or similar, to occupy the whole of the favourable area of sand dune, is needed to achieve FCS. There will be natural fluxes in extent over time for individual dune Annex I habitats as a result of coastal processes or management, but no one habitat type should be lost from any site where it already exists. Use of the 1994 national data set provides a consistent overview of the resource in England but it is recognised that individual sites will change in extent and condition. We therefore have only low confidence in these data.

Structure and function: The size range of individual dune sites is to be maintained, with average patch size not falling below 120 ha. All species associated with the habitat should be Least Concern when assessed using IUCN criteria.

At least 95% of the favourable area (as defined above) of dune Annex I habitats should be in favourable condition as defined by Common Standards Monitoring (JNCC 2004). In addition, the following attributes (not directly included in CSM) need to be covered:

- Natural wind blow and sand processes are allowed to shape the dune topography
- Atmospheric nitrogen deposition at site level is below, or at most close to the lower critical bound site level
- Natural hydrological functioning of the dune system provide the conditions necessary to sustain the features (in particular for H2190 dune slacks)

Parameter	Favourable status	Confidence in the parameter
Natural range and distribution	The full variation that is naturally present is sustainably represented within each sediment cell.	**High**

Area	13,000 ha	**Moderate**
Structure and function	At least 95% of favourable area of dune Annex I habitats in favourable condition and additional attributes favourable.	**Moderate**

Habitat definition and ecosystem context

3.1 Habitat definition

Coastal sand dunes occur in locations where sand blown inland from a beach plain is trapped by vegetation. Several successional stages may be recognised, including strandline vegetation, embryonic dunes, mobile ridges, fixed dune grassland, wet slacks, scrub and dune heath. Humid dune slacks can be created either by accreting sand ridges cutting off low-lying areas from the influence of sea water, or within established dunes by wind blowing out bare sand down to the water table, creating botanically-rich wetland communities.

Dunes are frequently referred to as 'systems' to reflect the fact that they are complexes of habitats influenced by physical and biological processes. 'Dune systems' is a term used in the Geological Conservation Review volume on coastal geomorphology (May and Hansom 2003) and in Pye and others (2007). The term can include the sediment supply processes and the beach plain which sustain the habitats. In this document, the term 'sand dune' is used to describe the element of a dune system, landward of the drift line that supports vegetation, although this may not be a continuous or permanent cover.

Sand dunes include areas of blown sand that retain elements of original surface topography. Current surface vegetation includes a range of semi-natural and modified dune grassland types alongside unfavourable areas of species-poor rank grassland, scrub, plantations, improved grassland, arable land or golf courses. Of the latter, the playing areas are generally subject to intensive treatments and physical modifications that have removed the semi-natural vegetation.

The coastal sand dunes priority habitat, as mapped by the Natural England's 2015 Priority Habitat Inventory (PHI), does not cover the whole sand dune resource, only those areas where the surface vegetation is interpreted as dune habitat. So it excludes, for example, large areas of trees planted on sand dunes, even though the dune topography can still be intact. Also the PHI classes some stands of dune heath as 'lowland heath'.

This definition covers the coastal sand dune priority habitat and its component Annex 1 habitats. The suite of dune Annex I habitats (Table 1) covers the whole range of biodiversity-rich dune habitats. They are defined in the EU Interpretation Manual (European Commission 2013) in conjunction with the corresponding EUNIS categories and the main National Vegetation Classification (NVC) types. Only those coastal dune Annex I habitats occurring in England are shown in the table below (some others are only found in Scotland). The NVC provides a means of understanding and classifying vegetation types, but does not always cover every example of variation. Annex I types are not restricted to the NVC dune communities listed in the Interpretation Manual for the following reasons:

- the final version of coastal NVC descriptions (Rodwell 2000) were not published when the first Interpretation Manual was developed in 1995;
- the analysis of NVC types pre-dated the completion of national dune surveys and new communities are likely to still be described;
- dune slacks have a wide and variable range of environmental gradients reflecting dune hydrology, and only a relatively small dataset was available to generate the NVC classification for this vegetation type (Stratford and others 2014). It should therefore be expected that analysis of vegetation data, especially dune slacks, from individual sites may

not closely correspond with currently published classifications. As these are successional habitats there may be transitional vegetation which has a poor fit to the classification;

- the nature of dune ecology, especially potential for cyclical succession between habitat types, means that there will be overlaps and transitions between different Annex I types. The 2007 Article 17 report audit trails https://webarchive.nationalarchives.gov.uk/20180804090702/http://jncc.defra.gov.uk/page-4064 [Accessed October 2020] attempted to clarify some of the distinctions, and this will benefit from improvements in the interpretation of habitat types, especially H2160 and H2170.

The Annex I habitat H2180 'Wooded dunes of the Atlantic, Continental and Boreal region' is not considered to occur in the UK following scrutiny of phytosociological literature and discussion with specialists in other Member States. Therefore it is not considered further in this statement.

Table 1: Definitions for coastal dune Annex I habitats in England

Code	Annex I name	Summarised Definition based on EU28 Interpretation manual and corresponding NVC types to community level
2110	Embryonic shifting dunes	Formations of the coast representing the first stages of dune construction forming from blown sand constituted by ripples or raised sand surfaces of the upper beach or by a seaward fringe at the foot of a taller dune ridge. Embryonic shifting dune vegetation exists in a highly dynamic state and is dependent on the continued operation of physical processes at the dune/beach interface. It is the first type of vegetation to colonise areas of incipient dune formation at the top of a beach. NVC equivalents: SD4, SD5
2120	Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')	Mobile dunes forming the seaward dune cordon, often as a taller ridge landward of embryo dunes. Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') encompass most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-binding marram *A. arenaria* is always a prominent feature of the vegetation and is usually dominant. It can occur within fixed dunes where surface disturbance occurs, but is not usually persistent NVC equivalent: SD6 (plus some SD5)
2130	Fixed dunes with herbaceous vegetation ('grey dunes')	Fixed dune vegetation ranges from a largely closed cover of grassland to sparse annual grassland on more open sand or dominated by mosses and lichen; the content of calcium carbonate varies, generally diminishing with age and succession inland towards 'brown' dunes (dune heathland H 2150). Acidic forms of dune grassland can intergrade with dune heath. Fixed dune vegetation occurs mainly on the larger dunes, being those that have the width to allow it to develop. H2130 typically occurs inland of the zone dominated by *Ammophila arenaria* on coastal dunes: H2130 represents the vegetation that replaces H2120 as the dune stabilizes and the organic content of the sand increases. Fixed dune grassland is not a stable vegetation surface despite its name, and it includes SD19 which is a dune annual community. The habitat covers the semi-fixed parts of the

		system (SD7) to mature grasslands. It can also include transitions to other habitats especially acid grasslands, heath and wetlands. The NVC descriptions are for open dune grasslands, in SD9 stands of bracken or scrub can be present, but where extensive would be indicative of poor condition. NVC equivalents: SD7, SD8, SD9b, SD10, SD11, SD12, SD19, plus some CG (Calcareous grassland) communities.
2150	Atlantic decalcified fixed dunes (Calluno-Ulicetea)	Atlantic decalcified fixed dunes (Calluno-Ulicetea) occur on mature, stable dunes where the initial calcium carbonate content of the dune sand is low. The surface soil layers lose their remaining calcium carbonate through leaching, and become more acidic, thus able to support heath vegetation. These communities are described in the NVC mires and heaths volume (Rodwell 1991 vol 2). There is a distinctive form of acid dune grassland which intergrades with dune heath, dominated by *Corynephorus canescens*, that is present on the east coast of England, and in some cases this is classed with H2150. NVC equivalents H1, H10, H11
2160	Dunes with *Hippophae rhamnoides*)	Dunes with *Hippophae rhamnoides* comprise scrub vegetation on more-or-less stable sand dunes in which *Hippophae rhamnoides* (sea-buckthorn) is abundant generally on drier ridges. It is only considered native on the east coast of England, elsewhere it has been introduced NVC equivalents SD18
2170	Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*)	*Salix repens* communities (*Salicion arenariae*), found in the older and drier dune slacks with less seasonal flooding but also on slopes. These are more mature slack communities which can develop into mesophilous communities as the *Pyrolo-Salicetum* (with *Pyrola rotundifolia, Viola canina, Monotropa hypopitys)* or, into xerophilous *Salix* communities (with *Carlina vulgaris, Thalictrum minus*) or into *Salix repens* communities with *Mesobromion* elements and few bryophytes. High cover of short shrubby/woody vegetation. Boundaries between H2170 and H2190 are often diffuse and difficult to define on the ground. NVC equivalent: SD16 (not all instances)
2190	Humid dune slacks	Humid dune slacks are low-lying areas within dunes that are seasonally flooded and where nutrient levels are low. Humid depressions of dunal systems. Humid dune-slacks are specialised habitats that are extremely rich in wetland plant species, including bryophytes, and very sensitive to the lowering of water tables. These have less cover of shrubby/woody vegetation NVC equivalents: SD13, SD14, SD15, SD16 (see H2170), SD17

Sources: *European Commission 2013; JNCC 2017; May & Hansom 2003; Rodwell 1991; Rodwell 2000; Stratford and others 2014*

3.2 Ecosystem context

Most of the UK's coastal sand dunes are in Scotland (some 33,000ha). Although the area of dune in England is relatively small, the long coastline, bordering different seas and sediment cells produces variety in geological and morphological conditions and therefore biological diversity. Many sites occur in complexes with other coastal, marine or terrestrial habitats, of great

biodiversity interest. Even small sites can provide an important functional role for other maritime habitats as well as supporting species of conservation value.

Ecological variation between dunes is linked to the morphology of individual sites, exposure, sand type, climatic variation and transitions to other coastal or terrestrial vegetation. The 121 individual locations in England surveyed in the late 1980s (Radley 1994) represent several different types of dune formation:

- Hindshore dunes (13 locations),
- Bay dunes (67 locations),
- Spit dunes (35 locations)
- Ness/cuspate foreland (6),
- Offshore islands (6),
- Climbing dunes (18) and
- Tombolos (2, only on the Isles of Scilly).

England has the most easterly and southerly dune systems in the UK (all east coast dune sites, with Winterton at the extreme east of the range, and the southwest extreme on Isles of Scilly).

Radley (1994) highlights some regional differences in dune habitat types, with a number of geographical factors influencing this variation. For example, dune slacks are concentrated in the north and west; localised occurrences in the north east of some specific communities (SD9 b), and combinations reflecting the types of dune system and underlying shingle bars. Radley (1994) provides an indication of geographical zones for some vegetation types.

The variation in conditions favours a great variety of plant and invertebrate species, many of which are restricted to dune systems.

Bare sand and dune mobility are an essential part of an active dune system, and critical for a range of heat-tolerant or heat-adapted species. For example: over 60% of Section 41 species associated with dunes need early successional habitats (Webb and others 2010). Data from Wales indicates that 41% of 69 species of GB importance found on Welsh dune sites were found to be reliant on pioneer habitats (Howe and others 2012). Annex 2 provides a table of Section 41 species associated with dunes and the niches they require.

Coastal dunes can support these Habitats Directive Annex II/Annex IV species: Great Crested Newt, Petalwort, Sand Lizard, Natterjack Toad, Shore Dock, Early Gentian, and in slacks, the dune form of Fen Orchid.

Birds breeding on dune strandline area include little, Arctic and common terns, oystercatcher and ringed plover. A range of more widespread species, such as meadow pipit, skylark and grasshopper warbler breed within dune habitats. Dunes occur on key migratory pathways and several sites are used as bird observatories.

In the annex below there are 12 coastal geological (GCR) sites in England that represent internationally important examples of dune geomorphology (May & Hansom 2003).Within these sites the active geomorphological processes interact with the biological interest resulting in the distinctive sequence of dune habitats.

Sandy beaches and dunes	Sand spits and tombolos
48 South Haven Peninsula, Dorset	65 East Head, West Sussex
49 Upton and Gwithian Towans, Cornwall	66 Spurn Head, Yorkshire
50 Braunton Burrows, Devon	67 Dawlish Warren, Devon
53 Ainsdale, Lancashire	68 Gibralter Point, Lancashire
55 Sandwood Bay, Sutherland	69 Walney Island, Lancashire
	70 Winterton Ness, Norfolk
	74 Isles of Scilly

Sources: *Howe, Litt & Pye 2012; May & Hansom 2003; Radley 1994; Webb, Drewitt & Measures 2010;*

Metrics and attributes

4.1 Natural range and distribution

Metric: Presence and distribution within sediment cells.

The natural range of coastal sand dunes, and their associated Annex I habitats, is entirely dependent on the availability of deposits of wind-blown sand that can be colonised by vegetation through the different successional stages. Suitable locations are limited by key aspects of coastal morphology. Sediment cells are discrete lengths of coastline within which the natural processes are relatively self-contained and there are distinct inputs (sources), throughputs (sediment transport) and outputs (sinks or stores) of non-cohesive sediment. Sand dunes are therefore connected with the marine processes operating within these sediment cells.

Sediment cells also have similarities with the geographical zones described by Radley in the last column of the table in section 6.1.

Sub-cells are not considered a suitable metric as they can cut across major dune areas, and there is some indication that they may not contain all of the sediment processes.

Sediment cells are defined in the Coastal Geomorphology GCR volume (May & Hansom 2003) and are used for Shoreline Management Planning.

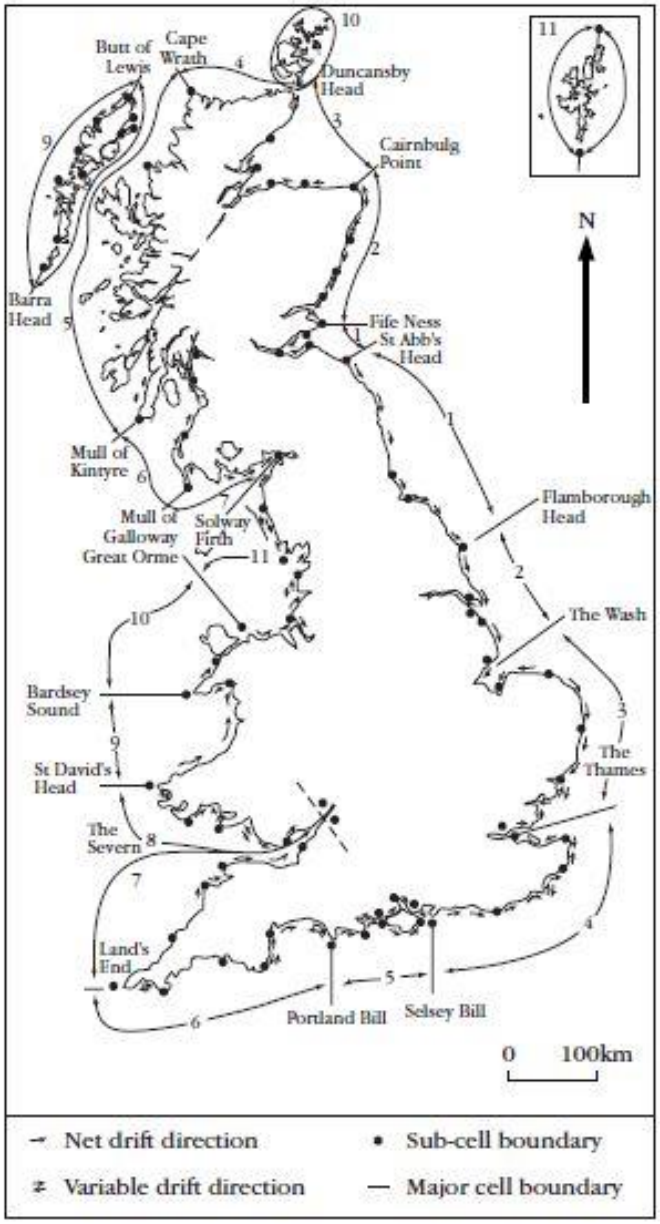


Figure 1: Map of sediment cells. Note that the Scilly Isles are considered as a separate sediment cell, not shown on this map. Source: May & Hansom 2003

4.2 Area

Hectare

4.3 Structural and functional attributes

Structure and function aspects are complex for coastal sand dunes. These are linked to both the physical processes, sediment budgets, hydrology and vegetation across the range of dune features, coupled with positive management measures such as grazing, mowing or restoration measures. The table indicates which attributes are most important for each of the Annex I habitats in order to achieve favourable condition. Those used for monitoring are indicated in the last column.

Structure and function attributes	H2110	H2120	H2130	H2150	H2160	H2170	H2190	Used for CSM
Adaptation and resilience: dune feature, and that of its supporting processes, can adapt or evolve to wider environmental change, either within or external to the site	x	x	x	x			x	N
Aeolian (wind-blow) processes: no constraints to wind-blown sand movement into and within dunes	x	x	x		x	x	x	N
Air quality: levels of pollutants should be at or below Critical Loads for feature	x	x	x	x	x	x	x	N
Conservation measures: (within and/or outside the site boundary) necessary to maintain or restore structure & function and supporting processes are in place and are not being undermined or compromised.	x	x	x	x	x	x	x	N
Dune topography is not artificially modified and natural variations can occur	x	x	x	x		x		N
Functional connectivity with wider coastal sedimentary system to maintain sediment inputs	x	x				x	x	N
Functional connectivity with wider landscape to allow for seed/propagule dispersal	x	x	x	x				N
Hydrology: natural hydrological processes are functioning to sustain the feature within the site	x	x	x	x		x	x	N
Invasive, non-native and/or introduced species are rare or absent.	x	x	x	x	x	x	x	Y
Key structural, influential and distinctive species are present at appropriate levels	x	x	x	x	x	x	x	Y
Presence of unvegetated surfaces at appropriate levels to sustain biological diversity	x	x	x	x		x	x	Y
Soils, substrate and nutrient cycling functioning at appropriate levels and not artificially modified	x	x	x	x	x	x	x	N
Supporting off-site habitat within the local landscape which provide a critical functional connection with the site is maintained		x						N
Vegetation community composition is maintained	x	x	x	x	x	x	x	Y
Vegetation community transitions are maintained	x	x	x	x	x	x	x	Y
Vegetation composition: forb/grass ratio is sustained at appropriate level				x			x	Y
Vegetation composition: trees and scrub do not exceed limits set according to habitat	x	x	x	x	x	x	x	Y
Vegetation structural diversity is maintained at an appropriate level			x	x		x		Y
Vegetation structure: scrub age variation is maintained					x			Y
Vegetation structure: zonation of dune vegetation is present	x	x	x	x	x	x	x	Y

Vegetation: undesirable species are rare or absent	x	x	x	x	x	x	x	Y
Water quality: ensure water quality and quantity meets standards to support the feature	x	x	x	x	x	x	x	N

Sources: *Natural England SAC habitat feature framework; JNCC Sand dune CSM guidance 2004, JNCC Lowland Heath CSM guidance 2009.*

Evidence

5.1 Current situation

Natural range and distribution

Coastal sand dunes

Sand dune is present in all English sediment cells.

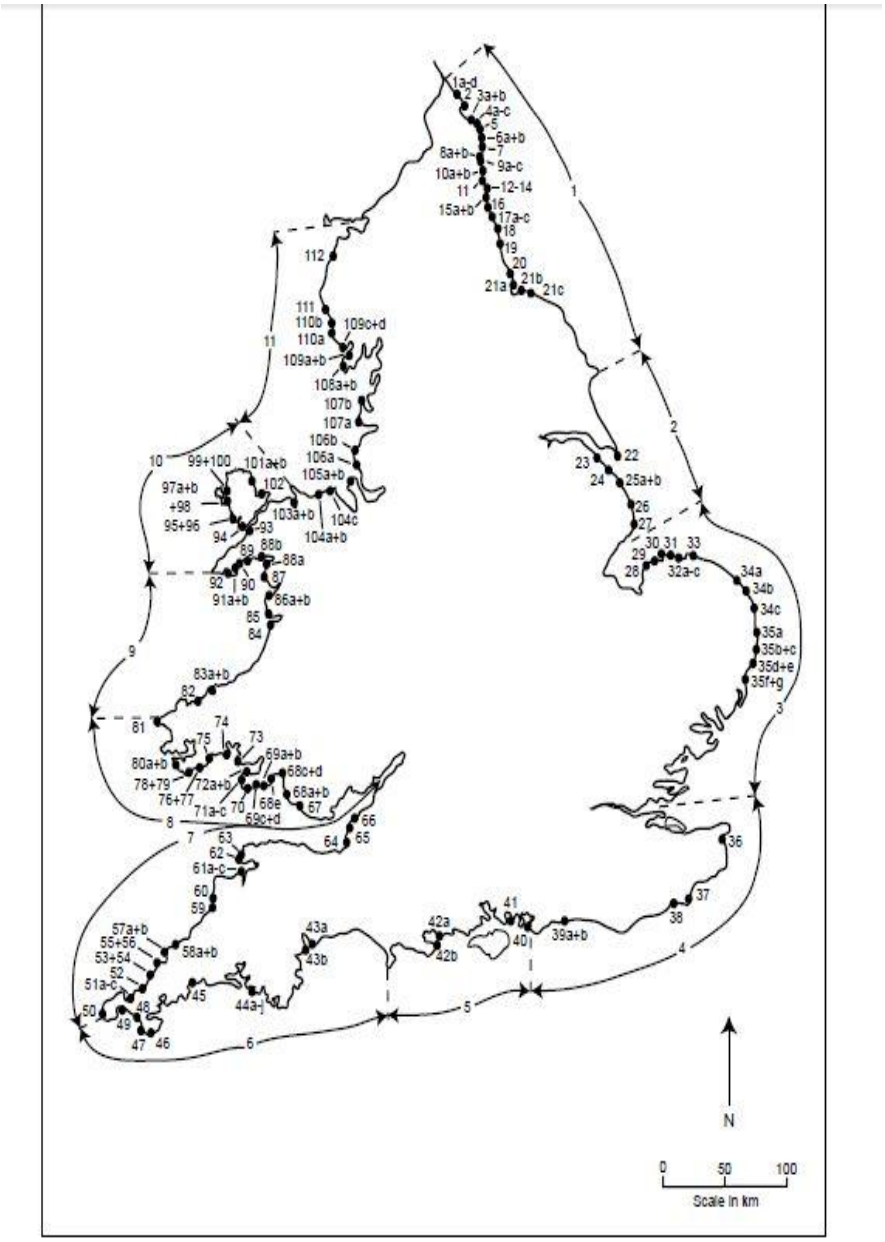


Figure 2: Map of sand dune within sediment cells. Source: Pye, Saye & Blott 2007

Annex I habitats

The current distribution of the Annex I habitats is shown in the maps at Annex 1 of this document https://hub.jncc.gov.uk/assets/a3d9da1e-dedc-4539-a574-84287636c898 [accessed from JNCC website October 2020].

All sediment cells have good representation of most sand dune habitats, with the following exceptions:

- H2150 (dune heath) was not recorded in cells 2, 4 and 7 by Radley (1994). Cells 2 and 4 contain small and narrow sand dunes that probably can't support dune heathland. The capacity for dune heathland to be supported in cell 7 needs further investigation. The absence could be natural and linked to the strong influence of calcareous sand on this coastline.
- For H2160 (dunes with Sea-buckthorn), the current range (likely to be cells 1, 2 and 3) is wider than the natural range, as a result of planting and subsequent expansion.
- H2170 (dunes with *Salix repens*) is not present in cells 2, 5, 6 and Isles of Scilly. This habitat can be hard to distinguish from H2190 (humid dune slacks). It is thought to only occur naturally in large dune systems and can represent a successional form of H2190, most common in the north-west dune sites.
- H2190 (humid dune slacks) is currently not reported from Isles of Scilly. Its natural presence in cell 5 is uncertain and would need to be confirmed based on natural morphology.

Area

Coastal sand dunes

The area of sand dunes in England is estimated at approximately 12,000 ha based on the 1987-1990 Sand dune survey of Great Britain (Radley 1994). This survey identified 121 individual locations and mapped all habitats over sand deposits at the coast to NVC level, together with other semi-natural and modified habitats within the dunes surveyed. Included within the 12,000 ha are 1345 ha of plantations, scrub, improved grassland and other cultivated land plus 375 ha of golf fairways.

The Priority Habitat Inventory (PHI), using a rule-based aerial photography interpretation and Radley's 1994 data to validate results, mapped 9,996.27 ha as coastal sand dune in the 2015 version. The PHI maps surface vegetation only, but as noted above, parts of dunes have been modified and have not been mapped as sand dune habitat in the PHI but they could be considered part of the sand dune system (for example supporting the hydrological functioning).

Annex I habitats

The data from the 1987-1990 survey (Radley 1994), which mapped the area of NVC types that correspond with the Annex I habitats according to the EU Interpretation Manual, has been used to identify area of each type and gives a total extent of 5,635ha. It is recognised that this may not represent an accurate extent in 2020. Approximately 5,582 ha are within SACs (Grade A, B, C). The figures do however provide an indication of the relative area of dune Annex I habitats.

Sand dune vegetation communities that are intermediate between stages, whilst not explicitly included in the definitions, will be intrinsically linked to the Annex I habitats and the open conditions that increase biodiversity and represent good conservation of structure and function. These include SD10 and SD19. Bare sand was mapped in the 1987-1990 survey, with only 253 ha over all the sites surveyed, although this figure will most certainly have changed over time.

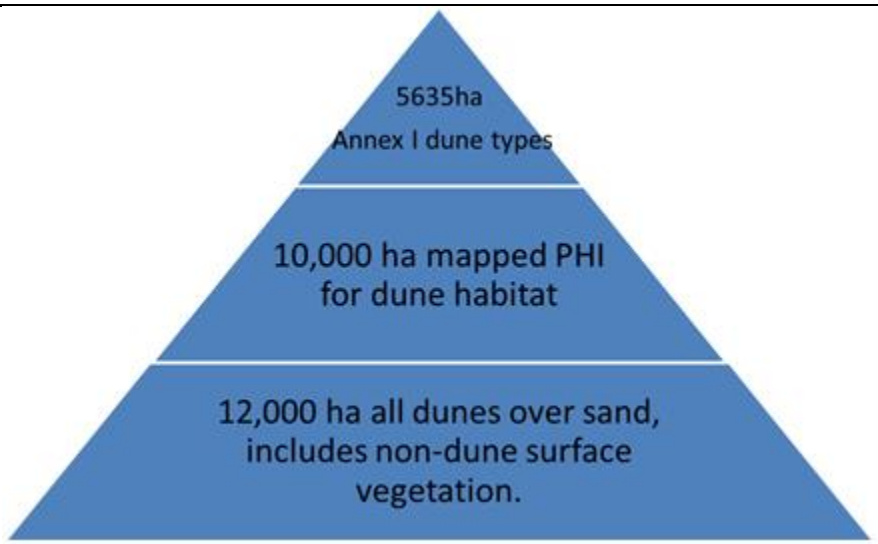


Figure 3: Area of all coastal sand dunes indicating proportion mapped as Priority Habitat and Annex I dune type.

Patch size

Of the sites reported by Radley (1994), continuous extents of dunes range in size from <1 ha to over 1800 ha (the latter is the combined area of the dunes on the Sefton coast, the largest in England). Smaller sites are more common (48 sites < 50 ha). Six sites were reported as 5 ha or less. Only a handful of sites exceed 500 ha.

Table 2: Number of sites as surveyed by Radley (1994) by size classes

Surveyed dune area (ha)	1-50	51-100	101-200	201-300	310-500	510-1000	>1000
Number of dune sites in size range	48	20	14	7	7	2	1 (Sefton coast dunes)

Habitat quality

CSM site assessments do not take full account of the impact of exceeding Critical Loads (CL) for Nitrogen, hence the data shown in Table 3 below doesn't include this risk to quality. Nitrogen CL for calcareous dune sand dunes is 10-15 kg N ha^{-1} $year^{-1}$ but lower for acidic dunes 8-10 kg N ha^{-1} $year^{-1}$. Also, SSSI unit condition may not directly equate to structure and function of Annex I habitats.

Table 3: Proportion of Annex I habitats in favourable conditrion in England as of 2015

Annex I habitat	Total area in England (ha)	Proportion in favourable condition (within SACs, August 2015)	Outside protected sites
H2110	100	94%	No data
H2120	780	87%	No data
H2130	3900	62%	No data
H2150	190	55%	No data
H2160	235	92%	No data
H2170	230	37%	No data
H2190	200	49%	No data

Sources: Natural England SSSI condition data for units with SAC habitats, accessed August 2015; Pye, Saye & Blott 2007; Radley 1994, Air Pollution Information System http://www.apis.ac.uk/node/972

Confidence: Natural range & distribution and Area – Medium; Structure & Function - Low.

5.2 Variation in the above parameters

Coastal sand dunes have been affected by the development of housing, tourism, golf courses, agricultural land claim, afforestation, military use, sand extraction and hard coastal defences such as rock armour, groynes and artificial sea walls (ASC 2013; CEH 2012).

Some activities have led to direct permanent loss of dunes (e.g. development, agricultural land claim, sand extraction) or indirect permanent loss by impeding dune functioning (e.g. hard coastal defences, hydrological changes, changes in sediment processes). Direct losses to housing and development have and are most likely to continue to affect the more mature parts of sand dunes. Coastal defences are more likely to affect the seaward, more mobile elements.

Other activities cause permanent or temporary loss of natural dune vegetation whilst not affecting the area of underlying sand dune (for example military use, golf courses, afforestation). Losses to planting of shelter belts or commercial forestry have been estimated at around 360 ha (Pye & French 1993). Military training on dunes covered many sites in WWII, with a number of locations still being used as training ranges in England, although this is not always incompatible with conservation management.

Threats to coastal dunes in England reflect those affecting northwest Europe. These include loss and fragmentation of habitats, reduction in area of open sand, succession to scrub and woodland, impact of invasive (usually non-native) species and hydrological impacts. Problems are exacerbated in many regions due to nitrogen deposition leading to eutrophication which reduces quality.

For coastal dunes, net coastal erosion (insufficient sand supply partly driven by interference by hard defences alongside other causes) along many coasts and potential impacts of climate change and sea level rise add to concerns. Dune systems with well-functioning sediment processes (that is, adequate sediment supply into the dunes from the beach plain) are expected to be relatively resilient to climate change impacts in terms of area as they can continue to accrete. However sea level rise and changing rainfall patterns in combination with over-stabilised dunes may affect dune hydrology.

The small scale of some individual sites (as little as 1ha, or in the form of narrow spits) makes them vulnerable even to small scale impacts and changes in coastal processes, although in most cases retaining or restoring natural dynamics should be the preferred management approach.

Within coastal sand dunes, a consistent trend towards increased vegetation cover and over-stabilisation has led to a reduction in area of dynamic and open character habitats, resulting in the loss of specialised species (Howe and others 2010). Beach cleaning and recreational activities are another cause of reduced quality or prevent the establishment of foredune habitats particularly on beaches used for tourism (NECR012, 2009).

Natural range and distribution

Coastal sand dunes

No dunes are recorded as being completely lost from English sediment cells. To conserve the full diversity associated with sand dunes the current range and distribution must be maintained.

Annex I habitats

Trends in range data are judged as stable both short term (1980s onwards) and medium term (~1945-1980s). No Annex I habitat types seem to have been lost entirely from the sediment cells that are part of their natural range. For H2150, Coastal Dune heathland, Dargie (1992) reported ongoing declines in the north east (cell 1) and the current state needs to be confirmed by new data. For a natural range to support the biological diversity associated with sand dunes, each sediment cell needs to include the full variation of successional stages that is naturally present within functional sand dunes in that area. This means current sand dune habitat across all types of dune formation within each sediment cell needs to be maintained to ensure the full range of all dune Annex I habitats is maintained and enhanced. For H2160 dunes with Sea-buckthorn, this means within the native range on the east coast of England.

Area

Coastal sand dunes

Although estimates differ depending on survey methodology and scope, it is thought that the UK has lost 30% of its dune area since 1900 (Jones and others 2011). English dunes may have experienced an even higher rate of loss: between 1875 and 1975 the area of sand dune almost halved from just under 20,000 ha to a more stable level from the 1970s onward. Sand dune losses 1945-2010 were from 14,400 ha to 11,800 ha, approximately 18%. The slowing of loss since the 1970s can be attributed to growing awareness of their biodiversity value (Ratcliffe 1977) and greater recognition and changes that strengthened legislation afforded to existing and new protected sites. It is estimated that on the Sefton Coast, one of the largest areas of dune in England, 30% of the dune area has been lost to development since the Victorian era, (Everard and others 2010). Radley (1994) reports industrial development in 16 of the 121 sites surveyed, and notes that past changes are poorly documented.

Whilst expansion would be very desirable to make up for historic losses, there is limited potential to increase the area of sand dune above the current 12,000 ha. There are technical limitations to what is possible because of the need to restore and sustain physical dune processes. The majority of the sand dune area has been lost to large scale built development which forms an immovable constraint to restoration. As a starting point, the overall current area (12,000ha) of coastal sand dune, should be restored to good quality and functioning to support the biodiversity associated with dunes in England. In addition, expert opinion suggests that there may be an additional 1,000 ha that could be restored to functioning coastal sand dune. As this is a scarce and specialised habitat, with a large number of associated threatened species, favourable status requires restoration of the full habitat potential.

Annex I habitat area:

Little is known about the area of Annex I habitat types before the 1980s. Longer-term trends of the dune resource (before 1945) have shown a decline but this is difficult to quantify against individual Annex I types. It is not clear if the historic loss of Annex I dune habitat can be linked to these historic losses of sand dune. Since 1945, many landward sections of dunes have been truncated by a range of human activities with a permanent loss of mature dune vegetation: this could account for the current scarcity of dune heathland. It is rare to find a dune system today with a complete transition to semi-natural terrestrial habitats.

No major losses have been reported since 1994 when compared to Radley (1994) (UK NEA 2011).

Table 4: Annex I dune habitat area trends

Habitat code	Habitat name	Short term (2001-2012) and medium term (1989-2012) trend
H2110	Embryonic shifting dunes	Short term and long term trends stable, (individual locations will have varable extent)
H2120	Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')	Short term trend stable, long term trend decreasing 1% or less per year
H2130	Fixed dunes with herbaceous vegetation ('grey dunes')	Short term trends stable but some long-term losses prior to 1992 indicated
H2150	Atlantic decalcified fixed dunes (Calluno-Ulicetea)	Short and long term trends stable but note that losses reported in one site 1955-1980s*
H2160	Dunes with *Hippophae rhamnoides*	Short term trend stable, long term trend increasing
H2170	Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*)	Short term trend stable, long term trend decreasing
H2190	Humid dune slacks	Short term trend stable, long term trend decreasing

Restoration of more dynamic ecosystem processes will be needed within existing dunes to create more of the rare and/or biodiversity-rich communities through provision of more open vegetation with patches of bare sand. For example, Howe and others (2010) estimate that at a site level, 10% to 30% bare sand is needed across a range of successional stages to support thermophilic invertebrate species. A similar picture appears to be applicable to uncommon vascular plants.

The whole of the favourable area should represent Annex I habitats or their intermediates. However, as part of the shift to more dynamic, naturally functioning dune systems, there will be fluxes in the balance between areas of different elements at a site level.

The degree to which the area of Annex I dune habitat could be increased will need to be assessed on a site-by-site basis. In the absence of detailed measured assessments, the minimum national indicative favourable areas (current area plus potential area) are indicated in the table below.

However, no increase is proposed for H2160 Dunes with *Hippophae rhamnoides* as it is currently found outside its natural range. Also, a very limited increase is proposed for H2170 Dunes with *Salix repens* ssp. *argentea* as this is a very restricted habitat. The proportion of the remaining potential area has been re-distributed to the remaining habitats.

Table 5: Proposed restoration targets for Annex I dune habitats

Habitat code	Habitat name	Area required (as part of dynamic functioning systems) to support biological diversity:
H2110	Embryonic shifting dunes	Increase area locally to ensure regular presence on all sites, with measurable increase of 175 ha nationally to 275 ha
H2120	Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')	Increase area locally to ensure presence on all sites with measurable increase of up to 2,160 ha nationally
H2130*	Fixed dunes with herbaceous vegetation ('grey dunes')	Increase area across key sites with measurable increase of up to 9,000

		ha representing a range of different successional stages
H2150*	Atantic decalcified fixed dunes (Calluno-Ulicetea)	Increase area locally where known losses have occurred up to 525 ha nationally
H2160	Dunes with *Hippophae rhamnoides*	Maintain current area of 235 ha within native range
H2170	Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*)	Increase area proportional to the natural topography and hydrology of systems in key locations for the habitat. An indicative increase of 30 ha nationally is proposed to 260 ha nationally.
H2190	Humid dune slacks	Increase area of early successional stages taking account of different stages of dune slacks (EA 2010) and restoring losses up to 545 ha nationally.

Patch size

The data presented in Radley (1994) has been used to calculate average patch size for coastal sand dunes. An average of the sites surveyed (with the Sefton dunes combined into one site of 1800 ha) is 120 ha. The size range of dune is to be maintained, with the average size not falling below 120 ha.

Habitat quality

With the reduction in bare and open conditions (areas of bare sand reduced by 90% in some places), characteristic rich plant communities of open dynamic dunes have become scarcer and less widespread, also influenced by changed grazing patterns (fewer rabbits or less livestock grazing) and the impacts of air pollution and hydrology. Key species, particularly those only found on dunes or for which dunes provide significant habitat resource, need to have the appropriate conditions through coastal processes and/or management, with full consideration of the importance of open dune communities and bare sand stages.

An increase in the area of functioning sand dune is required to support the reintroduction of dynamism and open vegetation that is needed for favourable structure and function. This should be judged on a site-by-site basis.

Key improvements needed are: restoring degraded areas into Annex I habitat; removing invasive species; turf stripping; managing human activities like beach cleaning or trampling of foredunes to enable natural colonisation.

External factors such as eutrophication or hydrological function require management of activities beyond the site boundary. Sources of airborne nutrients need to be reduced, and the dune water table requires adequate recharge by rainfall across the whole dune surface area. On-site management can ameliorate some impacts of N deposition.

Management of dunes to address climate change impacts is set out in chapter 26 of the Climate Change Adaptation Manual. For dunes it requires the restoration and/or maintenance of habitat in favourable condition and ensure that non-climatic pressures are reduced through a whole system approach (in particular hydrology, recreation, successional stages).

It is judged that Favourable Structure and Function across the whole resource is achieved when at least 95% of the favourable area (as defined below) of Annex I habitats is in favourable condition.

Sources: *Adaptation sub-committee 2013; CEH 2012; Dargie 1992; Everard and others 2010; Howe, Knight & Clee 2010; JNCC 2013; Jones and others 2017; Jones and others 2016; Jones and others 2011; NECR012 2009; Pye & French 1993; Radley 1994; Stevens and others 2013;*

Confidence: Range and distribution – High; Area - Low-medium (very few specific change studies at national level); Structure & Function – Medium

5.3 Potential for restoration

Coastal sand dunes

Dunes are naturally restricted to locations where the coastal sediment processes lead to accumulation of blown sand and subsequent colonisation by dune-building vegetation. It is not possible to artificially create new dune systems in other places, although local restoration of dune types to expand extent and improve quality is possible through reinstating dynamic processes within existing dune systems and addressing causes of unfavourable condition. Well-planned restoration approaches would ensure that specialised dune species will also benefit, but no conflicts are expected with other habitats due to the localised distribution of coastal dune sites and the limited potential for creation outside of the current 12,000 ha dune area.

It may be technically possible to supplement sand supply to the coast by large-scale recharges using dredged sand from offshore sources. This is used as a flood risk management technique on some beaches in England, but not yet developed as a means to extend dunes. There are examples from other European countries (namely the 'sand engine' in the Netherlands) where foreshore recharge might enlarge sand beaches (and potentially vegetated sand dunes) using natural sediment processes. They may only benefit the seaward forms of dune habitat.

The landward parts of dunes have some technical potential for creation, where sandy soils underlie agriculturally reclaimed land (i.e. former dune areas that have been ploughed and flattened. Restoration in such cases would require considerable intervention and need to address how to re-create dune morphology.

Annex I habitats:

There is good potential for restoration to increase the extent and/or quality of Annex I habitats within existing sand dunes. Restoration techniques for some elements of coastal sand dunes have been successfully used in a range of LIFE projects, mainly in other European member states.

Fixed dune/semi-fixed dune habitats can be increased in area through reduction in scrub cover, removal of invasive species and restoration of rank forms of dune grassland. The analysis in section 5.2 above shows that on sand dunes there are areas of dune vegetation cover not currently assigned to a dune Annex I habitat type, yet which might have potential to improve in quality (and therefore increase in area of dune Annex I habitat types). In addition, there were at least 1000 ha of 'other' vegetation indicated in Radley 1994 that could also be targeted for restoration to dune-type grassland (e.g. areas of scrub, afforested area, and non-native species). In addition, clearly targeted management of golf courses on dunes could increase the quality of remaining vegetation.

A critical factor for dune slack habitats is restoration of hydrological function and infiltration capacity of rainfall to recharge the dune water table. Measures to achieve this include opening up vegetation and removing scrub across the wider dune area, which is beneficial to other dune habitats.

Climate change and eutrophication may pose problems for restoration of extent and quality of some habitats, particularly the dune slacks. New evidence in the last five years from a re-survey

of dune wetlands in England suggests that dune slacks are drying out. Overall there has been a 30% loss in the extent of dune slacks at the largest protected sites in England over the period 1990 - 2012. The remaining dune slack habitat has also shown a shift in species composition and in habitat extent from wetter to drier plant communities (Stratford and others 2014). It only takes small shifts in water table levels to result in species changes (Davy and others 2010).

Natural range and distribution

Coastal sand dunes

The range of dunes cannot be expanded as the habitat currently occupies all of its available range as defined by sediment cells.

Annex I habitats

Most Annex I habitats are still represented in the sediment cells that form part of their natural range. Therefore, whilst increases in area are possible within sediment cells, the range cannot be expanded. However, a risk of range reduction has been identified for H2150 Coastal dune heathland (Dargie 1992) in cell 1 which will require restoration if this loss is confirmed. The potential for cell 5 to support H2190 humid dune slacks when functioning naturally needs to be further investigated. Similarly the potential for cell 2 and 7 to support H2150 coastal dune heathland when functioning naturally will need to be further investigated.

Area

Coastal Sand dunes

The historical losses are largely irrecoverable, so it must be judged that the current area (12,000 ha) plus a small increase in the overall current area (to 13,000 ha) of dunes, through removal of individual built structures (car parks for example or derelict buildings with no heritage value) or reversing agricultural improvement, represents the maximum potential for the habitat. When restored to good quality and functioning this area will support the biodiversity associated with dunes in England. There must be no more losses as this is a scarce habitat.

Annex I habitats

There is good potential to increase the extent of all Annex I habitats within existing dune systems through vegetation management and restoration of natural function.

Habitat quality

There is good potential for restoration to increase the quality of Annex I habitats as part of an overall improvement in the existing sand dune sites. Dunes with existing interventions such as military training or golf courses can be integrated into dune management to restore a degree of quality.

Sources: *Curreli and others 2013; Dargie T 1992; Davy and others 2010; Mossman and others 2015; Radley 1994; Rogers and others 2010*

Confidence: Natural range & distribution – High; Area - Low – based on judgement and information from knowledge of beach recharge methods set out in Rogers and others 2010; Structure & function (Patch quality) – Medium – based on published studies and reports on recent restoration projects in UK and Europe

Conclusions

6.1 Favourable range and distribution

The natural range is favourable when the full variation of successional stages that is naturally present within functional dune systems is sustainably represented within each sediment cell.

This means the Annex I habitats are expected to be present in the following sediment cells for a favourable range:

Sediment cell:	1	2	3	4	5	6	7	11	Isles Scilly	Comments (based on Radley 1994)
H2110	x	x	x	x	x	x	x	x	x	Northern & eastern variants (cells 1,2 & 11) with *Leymus arenarius* dominant: elsewhere *Elytrigia juncea* dominant
H2120	x	x	x	x	x	x	x	x	x	Widespread. On narrow dune systems, especially spit and barrier islands of cells 2 & 3, on this may be the predominant dune type
H2130	x	x	x	x	x	x	x	x	x	There is wide variation across this habitat type related to dune maturity, dynamics, management and sand type. More calcareous dunes in west and south-west, (cells 11, 6 & 7). SD9b with *Geranium sanguineum* is one form only present in north east & north west (cells 1 & 11). Isles of Scilly have species-rich variant with bramble & bracken. Different types of transitions to other coastal habitats are represented across the range. South and south-east coasts have dunes over shingle which influences morphology and vegetation
H2150	x	?	x		x	x	?	x	x	The heath communities can intergrade with acidic dune grassland. There is an eastern distribution (cell 3) of the *Corynephorus canescens* acid dune grassland which is classed with H2150. Not naturally present in cell on smaller dunes (cell 4). Isles of Scilly with own variant. Sites may grade into lowland heath (Studland). The capacity for naturally functioning dune systems to

										support H2150 in cells 2 and 7 needs to be investigated.
H2160	x	x	x	x						Natural range in England limited to east coast but extensively planted or established beyond this, as well as within natural range.
H2170	x		x	x			x	x		Form of species-rich drier dune slacks, with more shrubby vegetation types: probably most common in north west but widely distributed. Not naturally present in cells 2,5,6 and Isles of Scilly.
H2190	x	x	x	x	?	x	x	x	?	The range of dune slack & other wetland communities that determine this habitat are widespread overall but good examples of full succession reported in north, west and south-west of the range. Dune slacks not currently reported in cell 5 and on Isles of Scilly (latter have forms of seasonal inundation grassland and swamp). The capacity for naturally functioning dune systems to support H2190 in these cells needs to be investigated.

Monitoring: Site surveys can assess presence, generally using NVC-type survey. In addition, some vegetation can be mapped using a combination of remote sensing and ground-truthing.

6.2 Favourable area

Sand dunes: 13,000 ha

Favourable area needed to support the mapped Priority Habitat extent should be at least the area of sand dunes as mapped in 1987-1990 (12,000 ha), across the existing number of dune sites, plus an increase of approximately 1,000 ha.

Annex I habitats:

In parallel with reaching the 13,000 ha dune extent, an increase in the extent of Annex I habitats, or intermediate types, from degraded habitats to create more of the rare and biodiversity rich communities is required for favourable status. The area should be increased to occupy the whole of the sand dune habitat - indicative favourable area is 13,000 ha overall.

6.3 Favourable structural and functional attributes

Patch size

Average patch size of coastal sand dunes should be maintained at 120 ha, to reflect the range in patch sizes

Habitat quality

For favourable structure and function 95% of the favourable area should meet the defined patch quality.

For the earlier successional habitat types (H2110 embryonic dunes, H2120 shifting dunes the critical structure and function attributes are well covered by CSM and FCTs. For some other habitat types key structure and function attributes such as hydrology and atmospheric nitrogen are not well covered in CSM (in particular for 2190 Humid dune slacks) and favourable condition based on the CSM attributes alone doesn't necessarily represent a favourable structure and functioning for those dune habitats. Vegetation response to hydrological change and nutrient enrichment may show a 'lag' effect after the impact, so these factors may require additional monitoring through use of dip wells or nitrogen deposition recording.

This means for Annex I habitats structure and function is considered favourable if:
H2110: >95% of favourable area in favourable condition
H2120: > 95% of favourable area in favourable condition. Note: there may be places with physical limits to some attributes
H2130: > 95% of favourable area in favourable condition, however, some attributes are not well covered by CSM, therefore the following additional national criteria apply:

- nitrogen deposition (below critical loads);
- wind blow and sand processes are functional at level that sustains topographic variation.

H2150: >95% of favourable area in favourable condition
H2160: >95% of favourable area in favourable condition
H2170: >95% of favourable area in favourable condition
H2190 dune slacks: >95% of favourable area in favourable condition and critical attributes are included:

- nitrogen deposition (below critical loads);
- natural hydrological functioning;
- maintain the number of sites with dune slacks representing the different successional stages from open to well-vegetated.

Threatened species

All species associated with the habitat should be Least Concern, or of equivalent status, when assessed using IUCN criteria.

Monitoring: Various ways of monitoring structure and function may be deployed, including remote sensing for dune topography and proportions of bare sand; dipwells for hydrological functioning; stratified sampling e.g. using dune sites within Natural England's Long Term Monitoring Network.

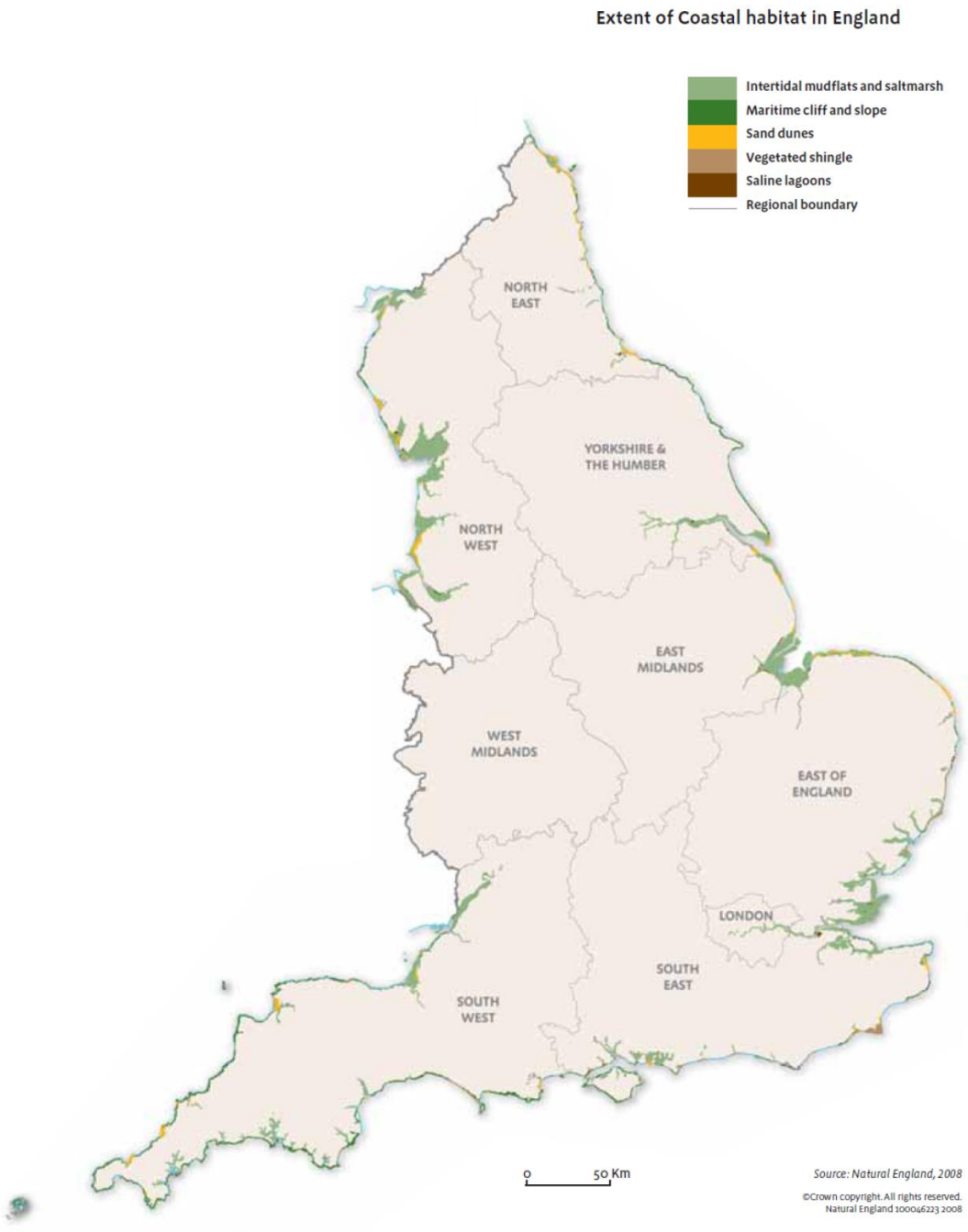
Some of these attributes are evaluated at site level as set out in the CSM guidance http://jncc.defra.gov.uk/pdf/CSM_coastal_sand_dune.pdf and at a site level FCTs and conservation objectives.

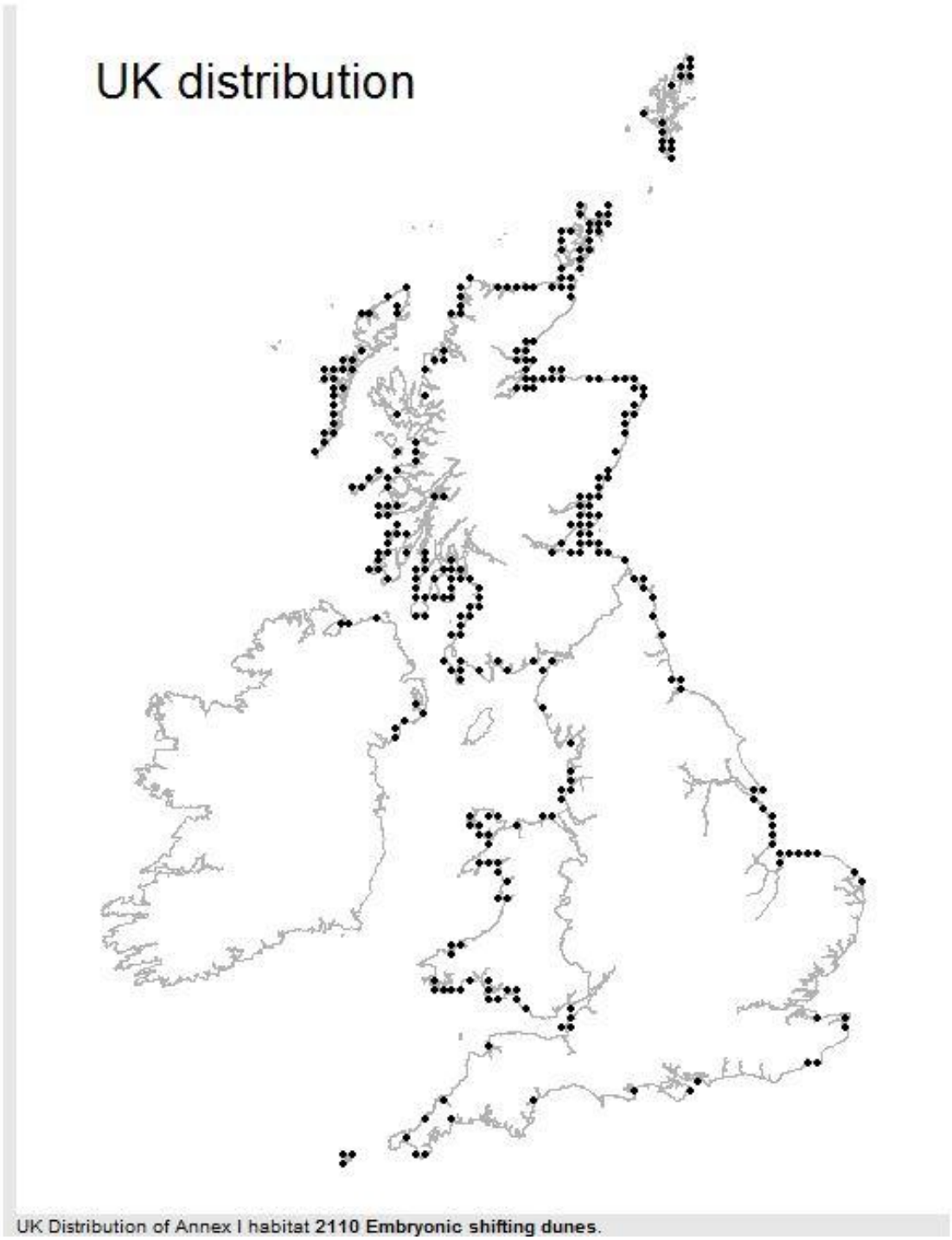
Key attributes not directly included in CSM are:

- Natural wind blow and sand processes are allowed to shape the dune topography
- Atmospheric nitrogen deposition at site level is below, or at most close to the lower critical bound site level (see Jones and others 2016 and Stevens and others 2013)

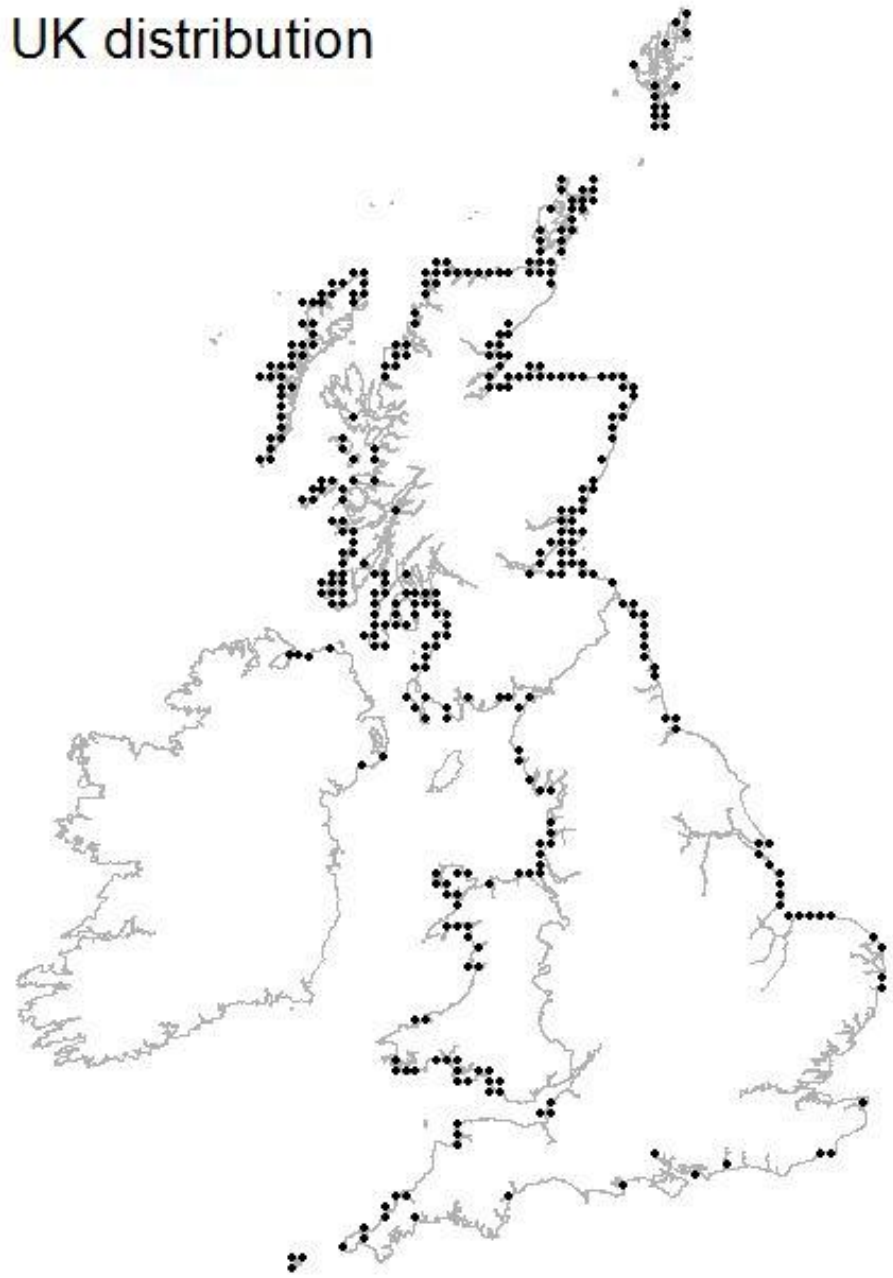
- Natural hydrological functioning of the dune system provide the conditions necessary to sustain the features (in particular for H2190 dune slacks)

Annex 1: Distribution of sand dune habitats (indicative locations – not to scale)



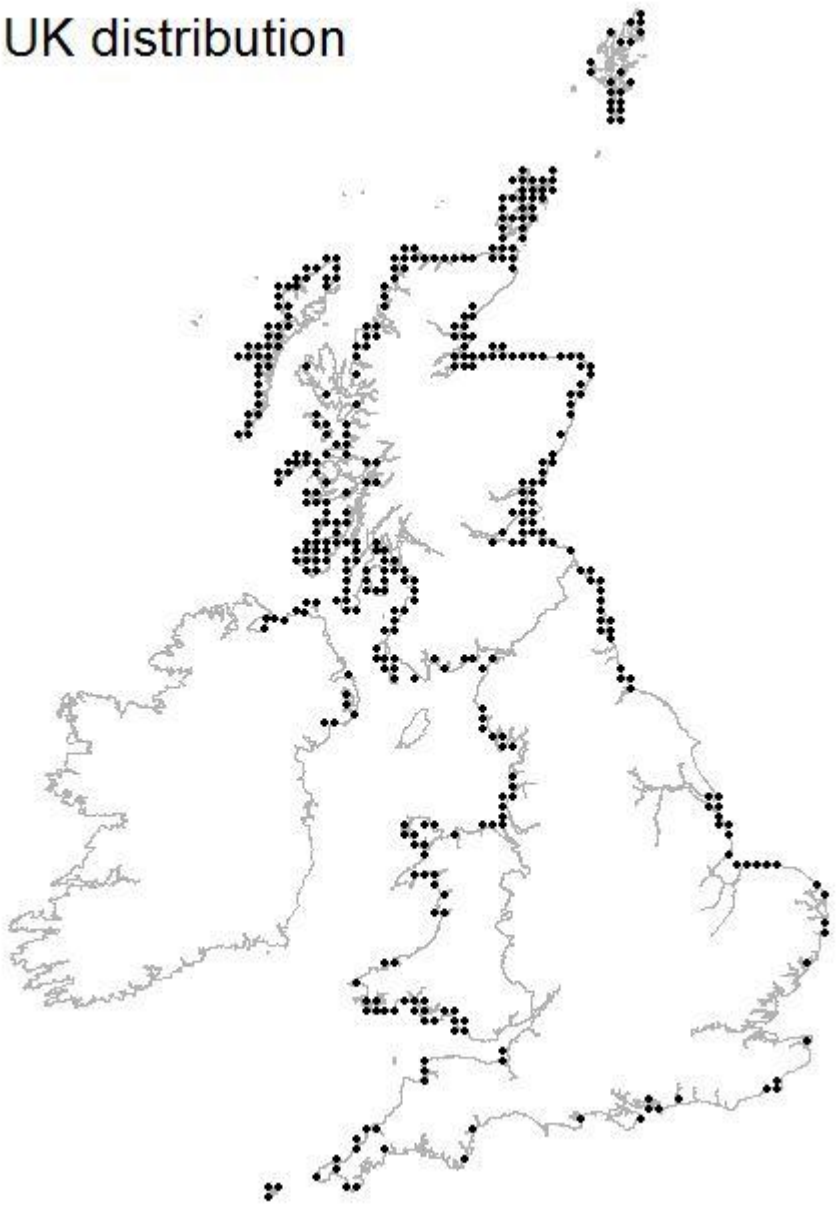


UK Distribution of Annex I habitat **2110 Embryonic shifting dunes**.



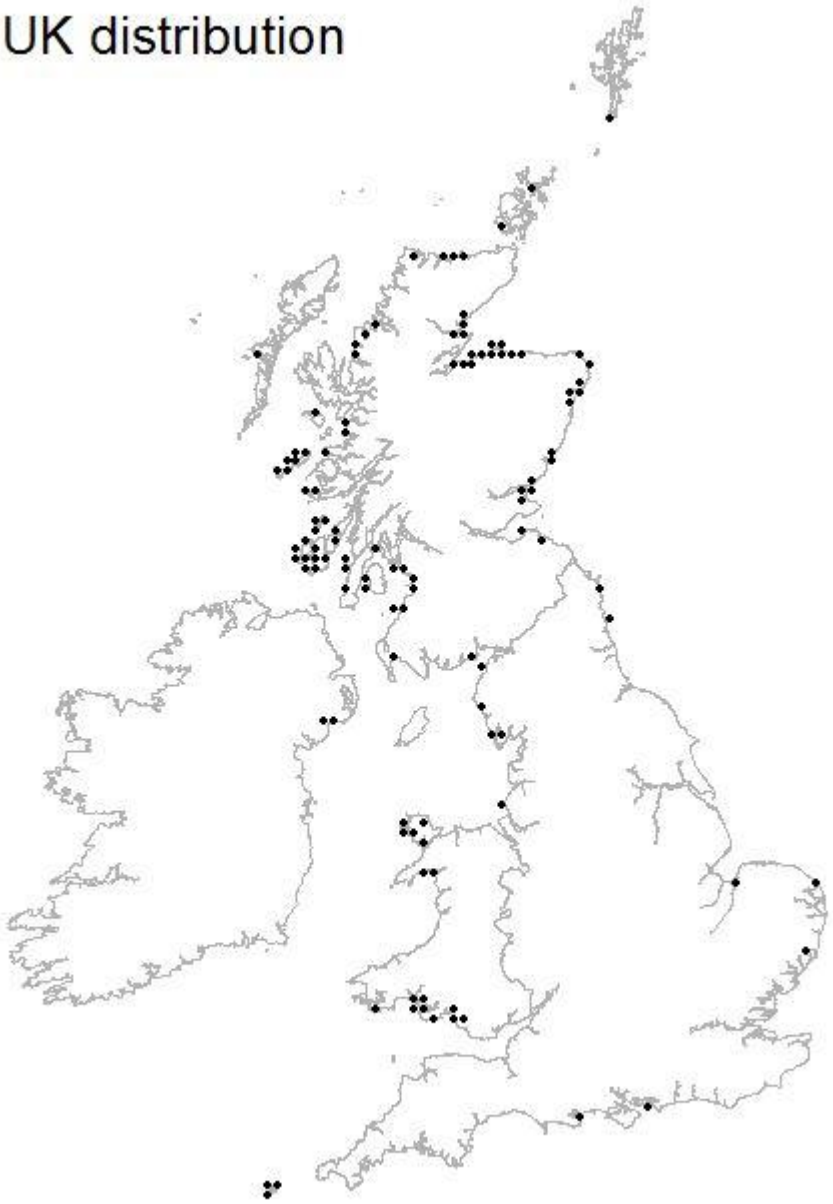
UK Distribution of Annex I habitat **2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').**

UK distribution



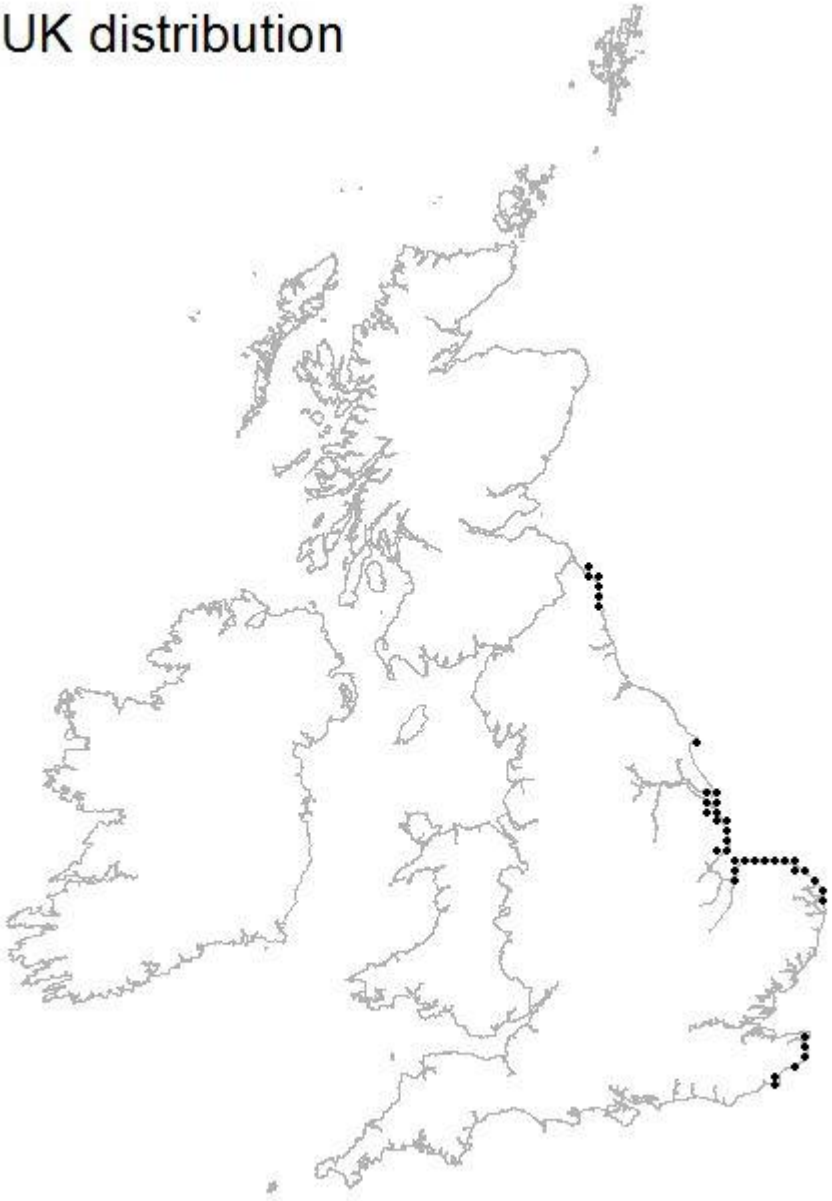
UK Distribution of Annex I habitat **2130 Fixed dunes with herbaceous vegetation ('grey dunes')**.

UK distribution



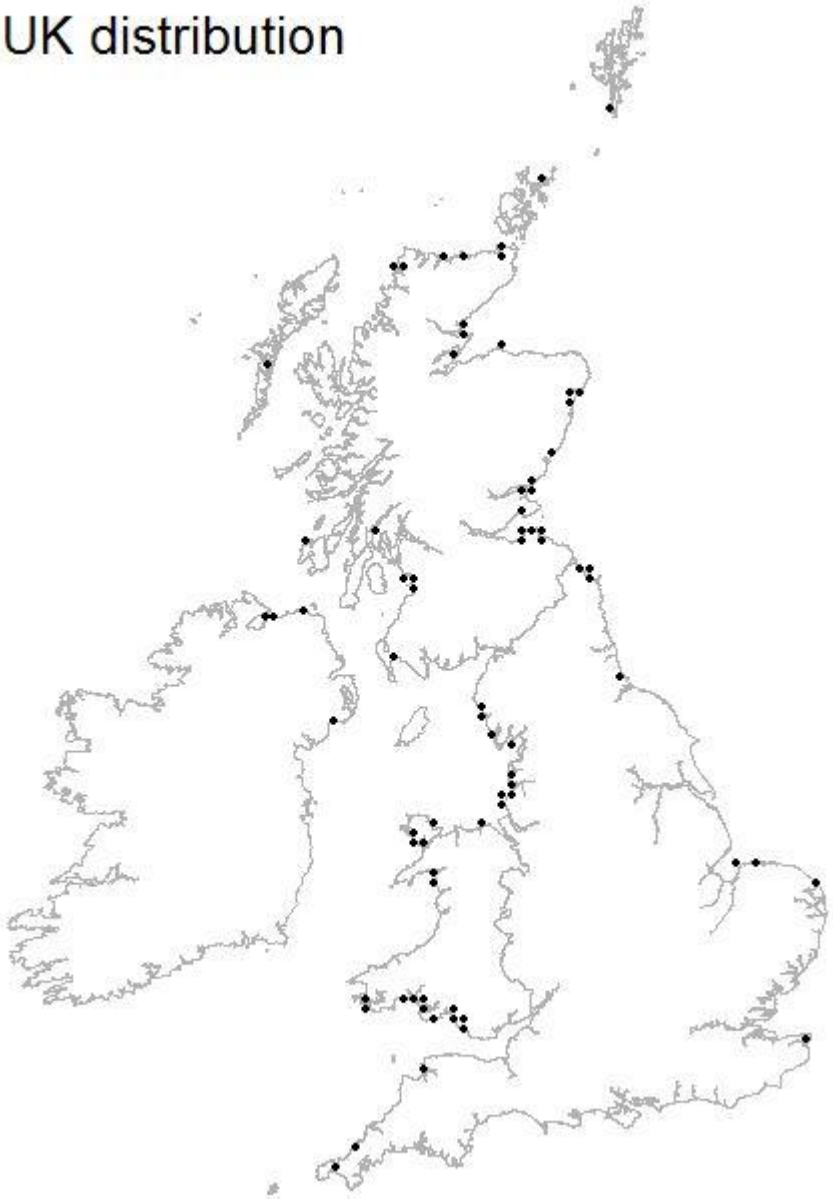
UK Distribution of Annex I habitat **2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)**.

UK distribution

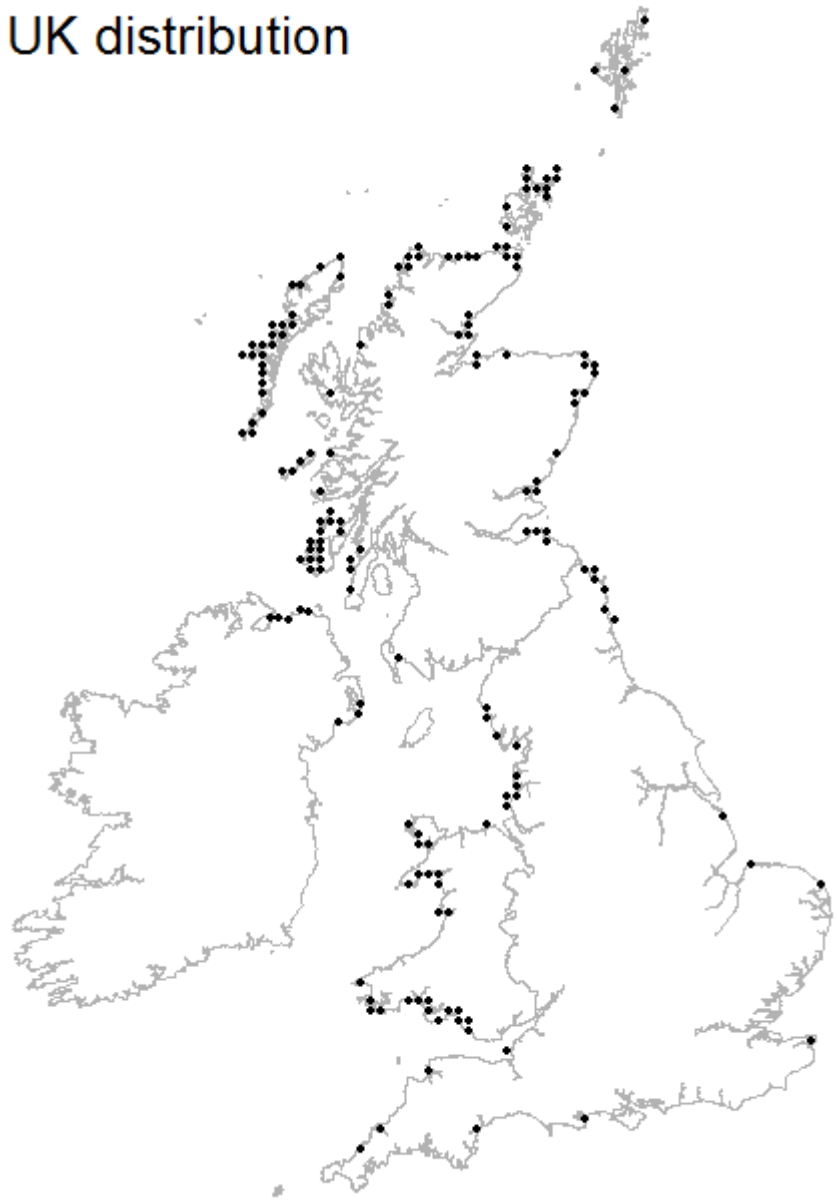


UK Distribution of Annex I habitat **2160 Dunes with *Hippophae rhamnoides***.

UK distribution



UK Distribution of Annex I habitat **2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)**.



UK distribution of Annex I habitat 2190 Humid dune slacks

Annex 2: Habitat niches for Section 41 species in sand dunes

Derived from coastal sites spreadsheet linked to: WEBB, J.R., DREWITT, A.L., & MEASURES, G.H., 2010. Managing for species: Integrating the needs of England's priority species into habitat management. Part 1 Report. Natural England Research Reports, Number 024 http://publications.naturalengland.org.uk/publication/30025?category=129022

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Bufo bufo	Common Toad	Vertebrates	amphibian	Large water body; land habitat of dense ground vegetation/ litter layer/crevices in ground (woodland, scrub and tall grassland)				mosaics		ponds - breeding
Epidalea calamita	Natterjack Toad	Vertebrates	amphibian	Ephemeral / near ephemeral. Bare/low vegetation sparse, no	seasonal water	bare ground				ponds - breeding

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				scrub, shallow and warm. Early succession ; open coastal areas with small-medium ponds						
Triturus cristatus	Great Crested Newt	Vertebrates	amphibian	Open fish-free well-vegetated ponds; high density of ponds in landscape; terrestrial - cover e.g. rough grassland scrub and woodland; (difference between toads and GCN are that toads can				mosaics		ponds - breedin g

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				survive fish and in larger water bodies); extensive terrestrial habitat required						
Alauda arvensis arvensis	Sky Lark	Vertebrates	bird	Mosaic of tall sward and short sward/bare ground; prefer very open areas not enclosed by trees; mosaics of crops, particularly spring sown, utilises bare or sparsely vegetated ground for foraging		bare ground		mosaics		abundant inverts

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Carduelis cannabina autochthona/cannabina	Linnet	Vertebrates	bird	Scrub for nesting; feeding - high density seed resource from suitable habitats (arable, saltmarsh grassland)					scrub - mosaic	abundant seeds
Locustella naevia naevia	Grasshopper Warbler	Vertebrates	bird	Extensive areas of scattered scrub in mosaic with tall herbs					scrub - mosaic	
Motacilla flava flavissima	Yellow Wagtail	Vertebrates	bird	Mosaic of short swards (feeding) and tussocks (nesting); abundant inverts				mosaics		abundant inverts

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Perdix perdix perdix	Grey Partridge	Vertebrates	bird	Mosaic of bare ground (feeding), weedy stubble fields in winter, and long-sward grass (nests); high density of inverts and seeds. Hedgerows and uncultivated margins can provide suitable nesting and feeding conditions		bare ground		mosaics		abundant inverts/ seeds
Lacerta agilis	Sand Lizard	Vertebrates	reptile	Structurally diverse habitat: bare ground,		bare ground	shelter	mosaics		

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				bare sand - dig burrow for eggs. Close to vegetation, edges of bare ground - tight mosaic (50cm) - not too friable. Dense heather or frontal dunes systems						
Vipera berus	Adder	Vertebrates	reptile	Tight mosaic of vegetation; heat; mammals lizards; open habitats (no shading); landscape		bare ground	shelter	mosaics		

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				scale species						
Zootoca vivipara	Common Lizard	Vertebrates	reptile	Tight mosaic of vegetation; heat; inverts; open habitats (no shading)		bare ground	shelter	mosaics		
Asparagus prostratus	Wild Asparagus	Vascular plants	vascular plant	Sea cliff; rocky soils; bare sand in dunes		bare ground				
Astragalus danicus	Purple Milk-vetch	Vascular plants	vascular plant	Short turf; calcareous soils; unimproved						herb-rich short
Carex maritima	Curved Sedge	Vascular plants	vascular plant	Damp dune slacks; freshwater seepages; near streams on the shore	seasonal water					seepages
Chenopodium vulvaria	Stinking Goosefoot	Vascular plants	vascular plant	Nutrient rich, disturbed		bare ground				nutrient-rich,

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				soil; beaches; dung						disturbed
Epipactis sancta	Lindisfarne helleborine	Vascular plants	vascular plant	Fluctuating water; Salix repens (shade?)	seasonal water				scrub - humidity	
Galeopsis angustifolia	Red Hemp-nettle	Vascular plants	vascular plant	Open ground; calcareous substrates; open (unshaded)		bare ground				
Gentianella anglica	Early Gentian	Vascular plants	vascular plant	Base-rich, parched grassland; sparsely vegetated		bare ground				
Gentianella campestris	Field Gentian	Vascular plants	vascular plant	Open grassland; herb rich; unimproved; acidic/neutral soils		bare ground		mosaics		
Gentianella uliginosa	Dune Gentian	Vascular plants	vascular plant	Open ground; short veg		bare ground				herb-rich short

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Liparis loeselii	Fen Orchid	Vascular plants	vascular plant	Infertile soil; seasonally wet water levels; species-rich open fen	seasonal water					infertile soil
Matthiola sinuata	Sea Stock	Vascular plants	vascular plant	Low lying, damp blowouts and? Along driftline (some shelter?)		bare ground	shelter ?			
Melittis melissophyllum	Bastard Balm	Vascular plants	vascular plant	high humid; partial shade					scrub - humidity	
Monotropa hypopitys	Yellow Bird`s-nest	Vascular plants	vascular plant	leaf litter; shade; often on calc substrates or under Salix repens on dune slacks; humidity					scrub - litter	leaf litter; shade

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Monotropa hypopitys subsp. hypophegea	Bird`s-nest	Vascular plants	vascular plant	leaf litter; shade; often on calc substrates or under Salix repens on dune slacks; humidity					scrub - sallow	leaf litter; shade
Monotropa hypopitys subsp. hypopitys	Yellow Bird`s-nest	Vascular plants	vascular plant	leaf litter; shade; often on calc substrates or under Salix repens on dune slacks; humidity					scrub - sallow	leaf litter; shade
Orchis ustulata	Burnt Orchid	Vascular plants	vascular plant	base-rich; open warm aspect; well drained; unimprove d; herb-rich						herb-rich short

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Rumex rupestris	Shore Dock	Vascular plants	vascular plant	supply of freshwater (trickles and seepages); open areas; free draining;						freshwater seepages
Scirpoides holoschoenus	Round-headed Club-rush	Vascular plants	vascular plant	damp dune hollow; seasonal variation; open areas (no scrub);	seasonal water	bare ground				
Silene gallica	Small-flowered Catchfly	Vascular plants	vascular plant	sandy soils; bare ground; drought prone grassland; dry; low nutrient status		bare ground				dry, low nutrient
Teucrium scordium	Water Germander	Vascular plants	vascular plant	damp; seasonal flooding; bare ground and/or	seasonal water	bare ground				

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				very open; dune slacks						
Bombus humilis	Brown-banded Carder-bee	Terrestrial invertebrates	bee	large scale flower-rich resource; with resource present spring-late summer						extensive open forage
Bombus muscorum	Moss Carder-bee	Terrestrial invertebrates	bee	tussocks to nest in; tall sward grassland; large scale flower-rich resource; with resource present spring-late summer						extensive open forage
Bombus subterraneus	Short-haired bumble-bee	Terrestrial invertebrates	bee	large areas of open forage; clovers						extensive open forage
Colletes floralis	The Northern Colletes	Terrestrial invertebrates	bee	flower rich resources and bare	seasonal water	bare ground	shelter		scrub	extensive

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				sand in sheltered locations (uneven topography or within scrub)						open forage
Colletes halophilus	a mining bee	Terrestrial invertebrates	bee	stands of sea aster and bare sand in sheltered locations (uneven topography or within scrub)		bare ground	shelter		scrub	foodplant - sea aster
Cicindela hybrida	Northern dune tiger beetle	Terrestrial invertebrates	beetle	bare friable sand		bare ground	shelter			
Harpalus honestus	St. Bees Seed-eater	Terrestrial invertebrates	beetle	soft rock cliff, bare ground and plentiful seeds		bare ground				seeds (ruderal plants)
Harpalus melancholicus	a seed-eater ground beetle	Terrestrial invertebrates	beetle	maritme cliffs and coastal sand dunes,		bare ground				seeds (ruderal plants)

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				bare ground and seeds						
Melanapion minimum	Dorset to the New Forest, and the Hampshire/Surrey heathlands.	Terrestrial invertebrates	beetle	extensive areas of sallow					scrub - sallow	
Melanotus punctolineatus	a click-beetle	Terrestrial invertebrates	beetle	bare sand		bare ground				
Doratura impudica	a leafhopper	Terrestrial invertebrates	bug	foredune in sparse stands of Calamagrostis epigejos and Elytricia spp.		bare ground				foodplant
Erynnis tages	Dingy Skipper	Terrestrial invertebrates	butterfly	sparse sward; bare ground in mosaic; foodplant - bird's-foot trefoil; (nectar); sheltered locations (uneven		bare ground	shelter		scrub	foodplant

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				topography or within scrub)						
Hipparchia semele	Grayling	Terrestrial invertebrates	butterfly	bare ground, grass, sparse vegetation; sheltered locations (uneven topography or within scrub)		bare ground	shelter		scrub - mosaic	
Plebejus argus	Silver-studded Blue	Terrestrial invertebrates	butterfly	heathers on heathland; or birds-foot trefoil on grassland; tight mosaic of bare ground and sparse veg; sheltered locations (uneven topograph		bare ground	shelter			foodplant

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				y or within scrub)						
Bombylius minor	Heath bee-fly	Terrestrial invertebrates	fly	matrix of heather, bare sand and shelter. Erosion areas and sandy cliff situations and cuttings to be retained on heathland for the host bee, Colletes succinctus to nest in		bare ground	shelter	mosaics		
Salticella fasciata	Dune Snail-killing Fly	Terrestrial invertebrates	fly	snails within dunes; sheltered locations (uneven topograph			shelter			

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				y or within scrub)						
Quickella arenaria	Sandbowl Snail	Terrestrial invertebrates	mollusc	open habitat (unshaded with low vegetation) which remains wet or damp (at or near the water-table)	seasonal water	bare ground				open
Aplasta ononaria	Rest Harrow	Terrestrial invertebrates	moth	foodplant - common restharrow ; calcareous coastal sites; sparsely vegetated sand; possibly also sheltered locations (uneven topograph		bare ground	shelter		scrub	foodplant - common restharrow

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				y or within scrub)						
Idaea ochrata subsp. cantiata	Bright Wave	Terrestrial invertebrates	moth	shingle and dunes; herb-rich areas; 1 site is coastal brownfield (old Hoverport)						herb-rich
Luperina nickerlii subsp. leechi	Sandhill Rustic (Cornish ssp.)	Terrestrial invertebrates	moth	sandbar in Cornwall; foodplant - sand couch Elytrigia juncea; on foredune		bare ground				foodplant - sand couch
Lycia zonaria subsp. britannica	Belted Beauty	Terrestrial invertebrates	moth	sand dunes and machair in scot; n wales; nw england in semi-stabilised dunes, also a sandy			shelter			herb-rich short

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				saltmarsh at one site; foodplant birds-foot trefoil and a range of other low-growing herbs						
Scythris siccella	Least Owlet	Terrestrial invertebrates	moth	foodplant - thyme, birds-foot trefoil, plantain; flower-rich areas- adults frequent flowers. Bare, loose sand required for larval feeding (from within sandy tubes)and pupation		bare ground		mosaics		

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Stigmella zelleriella	Sandhill Pigmy Moth	Terrestrial invertebrates	moth	coastall sandhills; foodplant - larval mine in creeping willow			shelter		scrub - foodplant	foodplant - creeping willow
Dipoena inornata	a comb-footed spider	Terrestrial invertebrates	spider	under low vegetation; heath veg; grass veg; grass heath mix						low vegetation
Haplodrassus dalmatensis	a spider	Terrestrial invertebrates	spider	heathland (after fire); dunes; bare ground		bare ground				
Ozyptila nigrita	a crab spider	Terrestrial invertebrates	spider	bare stoney areas and short grassland; matrix for shelter		bare ground	shelter			
Philodromus fallax	a crab spider	Terrestrial invertebrates	spider	foredunes on sand amongst marram		bare ground				marram
Silometopus incurvatus	a money spider	Terrestrial invertebrates	spider	a species found on sand					scrub - litter	

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				dunes in marram or sea buckthorn litter.						
Sitticus distinguendus	a jumping spider	Terrestrial invertebrates	spider	temp water bodies in dunes	seasonal water	bare ground				
Bryum calophyllum	Matted bryum	Non-vascular plants	bryophyte	dune slacks - temporary water; humid bare open ground in drawdown	seasonal water	bare ground				
Bryum knowltonii	Knowlton`s Thread-moss	Non-vascular plants	bryophyte	open sandy ground; seasonally covered by water	seasonal water	bare ground				
Bryum marratii	Baltic Bryum	Non-vascular plants	bryophyte	dune slacks - temporary water; humid bare open ground in drawdown	seasonal water	bare ground				

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Bryum warneum	Sea bryum	Non-vascular plants	bryophyte	dune slacks - temporary water; humid bare open ground in drawdown	seasonal water	bare ground				
Petalophyllum ralfsii	Petalwort	Non-vascular plants	bryophyte	Dune slacks; paths along sand; requires temp water bodies; compacted bare ground in calcareous places	seasonal water	bare ground				compaction
Chara baltica	Baltic Stonewort	Lower plants and fungi	Stonewort	standing water (can be in deep water); high water quality; aquatic; brackish influence	seasonal water					aquatic - HWQ, brackish

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
Chrysomyxa pirolata	Wintergreen Rust	Fungi (including lichens)	fungus (non lichenised)	dunes, dune slacks. Rust on Pyrola spp.	seasonal water					
Geastrum elegans	Elegant Earthstar	Fungi (including lichens)	fungus (non lichenised)	Dunes, dune grassland (also on sandy soil in gardens, hedges and heaths); short/open ground cover		bare ground		mosaics		
Geastrum minimum	Tiny Earthstar	Fungi (including lichens)	fungus (non lichenised)	dunes, dune grassland on well drained calc soil; short/open ground cover		bare ground		mosaics		
Hohenbuehelia culmicola	Marram Oyster	Fungi (including lichens)	fungus (non lichenised)	on dead and dying stems of						Ammophila arenaria

					Niche/Resource Matrix					
Scientific name	**Common name**	**Classification level 1**	**Classification level 2**	**Habitat require-ments**	**Temporary water**	**Bare ground - ruderal mosaic**	**Shelter**	**Mosaics of grass, scrub and bare ground**	**Scrub**	**Other require-ments**
				Ammophila arenaria						
Hygrocybe spadicea	Date-Coloured Waxcap	Fungi (including lichens)	fungus (non lichenised)	dry, calc or neutral soil in unimproved sward. In dunes in Europe; short/open sward		bare ground		mosaics		
Tulostoma melanocyclum	Scaly Stalkball	Fungi (including lichens)	fungus (non lichenised)	dryish dune slacks on soil with Salix repens and moss (also with Ammophila arenaria?); short/open sward	seasonal water					

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