European Community Directive
on the Conservation of Natural Habitats
and of Wild Fauna and Flora
(92/43/EEC)

Second Report by the United Kingdom under Article 17

on the implementation of the Directive from January 2001 to December 2006

Conservation status assessment for :

H2190: Humid dune slacks

Please note that this is a section of the report. For the complete report visit http://www.jncc.gov.uk/article17

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H2190 Humid dune slacks

Audit trail compiled and edited by JNCC and the UK statutory nature conservation agencies Coastal Lead Coordination Network.

This paper and accompanying appendices contain background and data used to complete the standard EC reporting form (Annex D), following the methodology outlined in the document entitled "Assessment, monitoring and reporting under Article 17 of the Habitats Directive, Explanatory Notes & Guidelines, Final Draft 5, October 2006." The superscript numbers below cross-reference to the headings in the corresponding Annex D reporting form. This supporting information should be read in conjunction with the UK approach for habitats (see 'Assessing Conservation Status: UK Approach').

1. National-Biogeographic Level Information

1.1 General description and correspondence with National Vegetation Classification (NVC) and other habitat types

Table 1.1.1 provides a summary description of H2190 and its relations with UK classifications.

Dune slacks are low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. They occur primarily on the larger dune systems in the UK, especially in the west and north, where the wetter climate favours their development when compared with the generally warmer and/or drier dune systems of continental Europe. The range of communities found is considerable and depends on the structure of the dune system, the successional stage of the dune slack, the chemical composition of the dune sand, and the prevailing climatic conditions.

Creeping willow is often found in dune slack vegetation and the boundaries between Humid dune slacks and 2170 Dunes with *Salix repens* ssp. *argentea* are often diffuse and difficult to define on the ground. While Humid dune slacks include creeping willow, the Annex I type excludes those sites where the species is dominant and is associated with Yorkshire-fog *Holcus lanatus* and at times with the bryophytes *Campylium stellatum* and *Calliergon cuspidatum*. A further community is typified by silverweed *Potentilla anserina* and common sedge *Carex nigra*. In the UK the predominant NVC types include:

SD13 *Sagina nodosa – Bryum pseudotriquetrum* dune-slack community
SD14 *Salix repens – Campylium stellatum* dune-slack community
SD15 *Salix repens – Calliergon cuspidatum* dune-slack community
SD17 *Potentilla anserina – Carex nigra* dune-slack community

For the purpose of this reporting, SD16 has been solely associated with H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) in order to separate the two Annex I types H2170 and 2190. SD16 is the dry end of slack vegetation, so reporting on it separately from SD13, 14, 15 and 17 can give results that can be interpreted in a meaningful way.

True dune slacks are fed mainly by rain water and are characterised by a pattern of pronounced annual fluctuation of the water table, related to the landform of the dune system as well as climate and the nature of the underlying sediment – whether porous shingle or impervious clay. Variations in the extent and duration of flooding of the dune surface are very important in determining the vegetation and influence the breeding of aquatic species, including the rare natterjack toad *Bufo calamita*. Humid dune slacks occur on calcareous sand, where the slack vegetation is similar to that of small sedge mires (mires with low-growing sedges), or on acidic dunes where the vegetation may have affinities to wet heath.

A range of other wetland types, especially swamp, mire and tall herb fen communities, occur on some dunes. These communities are not confined to dunes, although they comprise an important part of the

mosaic of vegetation characteristic of dune slack and are dominant at a few dune sites, and can be included in the Annex I type. Some stands of the SD14 *Salix – Campylium* and SD15 *Salix – Calliergon* dune-slack communities are charcterised by the prominence of great fen sedge *Cladium mariscus*, and may be referable to Annex I type H7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*.

Dune slacks are often rich in plant species, particularly rare and local species. Several species, such as the Annex II 1395 Petalwort *Petalophyllum ralfsii*, 1903 Fen orchid *Liparis loeselii*, and round-leaved wintergreen *Pyrola rotundifolia*, are found mainly in this habitat type.

Humid dune slacks are widely but locally distributed throughout the coastal zone of the EU. Mainly owing to the cool wet climate of the UK, Humid dune slacks are a more prominent feature of dunes in the UK than in many other European countries, and the UK has a significant proportion of the EU resource. Dune slacks are widespread but local in the UK and the habitat type exhibits considerable ecological variation.

Table 1.1.1 Summary description of habitat H2190 and its relations with UK vegetation/habitat classifications

Classification	Correspondence with Annex I type	Comments
NVC	In the UK the predominant NVC types are: • SD13 *Sagina nodosa – Bryum pseudotriquetrum* dune-slack community, • SD14 *Salix repens – Campylium stellatum* dune-slack community, • SD15 *Salix repens – Calliergon cuspidatum* dune-slack community, • SD17 *Potentilla anserina – Carex nigra* dune-slack community Additional swamp, fen, mire, tall-herb fen and wet mesotrophic grassland communities including in particular: • M23 *Juncus effusus-Galium palustre* rush pasture • M28 *Iris pseudacorus-Filipendula ulmaria* mire • S4 *Carex riparia* swamp • S7 *Carex acutiformis* swamp	*Salix repens* is frequent and sometimes abundant in SD14 and SD15 communities. However, the associated ground flora indicates that these communities are on average wetter than the SD16 *Salix repens-Holcus lanatus* dune-slack comunity, which is characterised by constant and usually abundant *S. repens*. SD16 is equated with Annex 1 habitat H2170 Dunes with *Salix repens* ssp. a*gentea*. A wide range of swamp, mire, tall-herb fen and wet mesotrophic grassland vegetation also occurs on dunes in the UK, reflecting the range of conditions in which dune wetland is established. They add greatly to the diversity of wetlands within dunes. However, in England and Wales they occupy a smaller area than the SD communities, but in Scotland some sites have large areas of some of these alternative communities.
BAP priority habitat type	Coastal sand dune	Covers a much wider zone than H2170. Coastal sand dunes in the UK comprise the complete sand dune complex, including embryo dunes, grey dunes, dune heath and dune slack communities.

EU Interpretation Manual	Humid depressions of dunal systems. Humid dune-slacks are extremely rich and specialised habitats very threatened by the lowering of water tables. Sub-types : 16.31 - Dune-slack pools (*Charetum tomentosae, Elodeetum canadense, Hippuridetum vulgaris, Hottonietum palustris, Potametum pectinati*): fresh-water aquatic communities (cf. 22.4) of permanent dune-slack water bodies. 16.32 - Dune-slack pioneer swards (*Juncenion bufonii* p.: *Gentiano-Erythraeetum littoralis, Hydrocotylo-Baldellion*): pioneer formations of humid sands and dune pool fringes, on soils with low salinity. 16.33 - Dune-slack fens: calcareous and, occasionally, acidic fen formations (cf. 54.2, 54.4, in particular 54.21, 54.2H, 54.49), often invaded by creeping willow, occupying the wettest parts of dune-slacks. 16.34 - Dune-slack grasslands: humid grasslands and rushbeds (see 37.31, 37.4) of dune-slacks, also often with creeping willows (*Salix rosmarinifolia, S. arenaria*). 16.35 - Dune-slack reedbeds, sedgebeds and canebeds: reedbeds, tall-sedge communities and canebeds (cf. 53.1, 53.2, 53.3) of dune-slacks.	

2. Range [2.3]

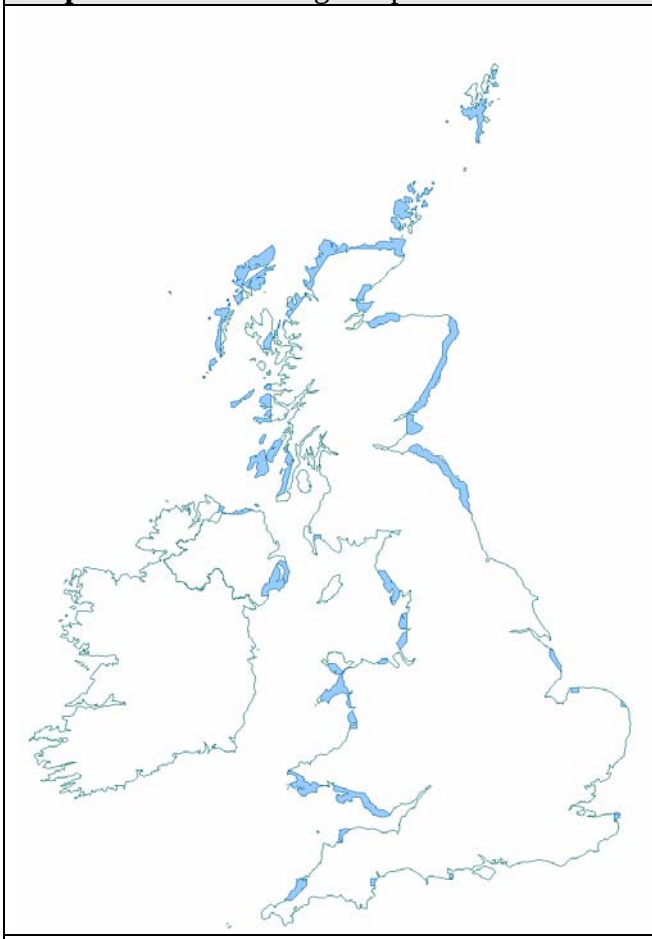
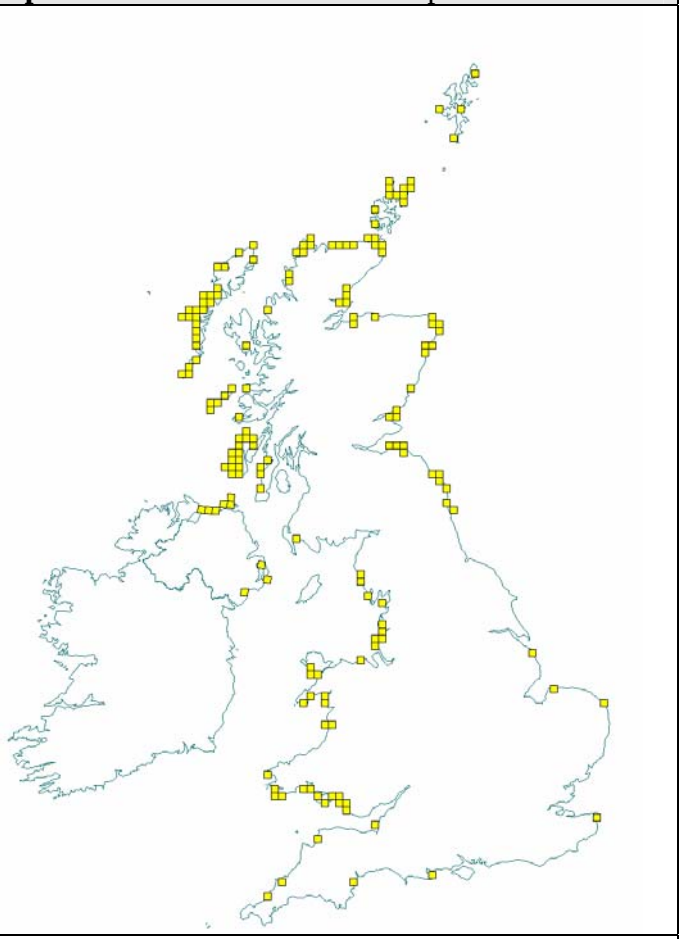
2.1 Current range

Range surface area [2.3.1]: **1,754 km²**
Date calculated [2.3.2]: **May 2007**
Quality of data [2.3.3]: **Moderate**

The surface area estimate was calculated within alpha hull software, using extent of occurrence as a proxy measure for range (see Map 2.1.1). The value of alpha was set at 25 km; the alpha hull software used to calculate the surface area of the range could only be clipped to a 10km strip width along the coast. The geomorphological and physical factors influencing the distribution of the habitats are likely to occur only within a far smaller distance of the coastline (at most 1km) and hence the area value has been reduced by a factor of 10 to give a more realistic value for the surface area of the range for these habitats.

Maps 2.1.1 and 2.1.2 show the range and distribution of H2190 in the UK. The map shows records for NVC communities SD13, SD14, SD15, and SD17, together with Special Areas of Conservation (SACs) supporting this Annex I type. This map does not include NVC community SD16 which in the UK is

equated with Annex I type H2170 Dunes with *Salix repens* ssp. *argentea*. Humid dune slacks and related wetlands are much more frequent up the west coast of Britain than on the south and east coasts: humid dune slacks and related wetlands are genuinely scarce and widely spaced on the east and south coasts of England. This is due to a wetter west coast climate combined with the west coast's larger and more mobile dunes providing more opportunities for dune slacks to form. This contrast is less marked in Scotland. A considerable variety of vegetation communities are included within the H2190 habitat, and some of this variation is regional. In particular, SD17 becomes much more prominent in northern England and Scotland, although it does occur at a few sites in north Wales and in Lincolnshire. Similarly, the 'non-SD dune wetlands' included in the H2190 habitat are much more frequent and extensive in Scotland than in England and Wales. In contrast SD13, SD14 and SD15 are much less frequent in Scotland than in England and Wales. Within England and Wales the location of 'SD dune slacks' and the 'non-SD dune wetlands' do not always coincide, with, for example, 'non-SD dune wetlands' being more prominent along the Norfolk coast where the SD dune slacks are rare.

Map 2.1.1 Habitat range map [1.1] for H2190	**Map 2.1.2** Habitat distribution map [1.2] for H2190
	
Range envelope shown in blue/grey shade in above map is a minimum convex polygon constructed using JNCC Alpha Shapes tool (see Technical note I for details of methodology).	Each yellow square represents a 10x10km square of the National Grid and shows the known and/or predicted occurrence of this habitat. 10-km square count**:** 164

See Section 7.1 for map data sources

2.2 Trend in range since c.1994

Trend in range[2.3.4]: **Stable**
Trend magnitude[2.3.5]: **Not applicable**
Trend period[2.3.6]: **1994-2006**
Reasons for reported trend[2.3.7]: **Not applicable**

Although dune systems are naturally dynamic structures, their general locations have remained mostly stable over the long term. Nevertheless, internal dynamics caused by natural or anthropogenic factors can greatly influence the proportionate representation of constituent habitats, including especially all types of dune wetland. However, although there have been substantial contractions of wetlands within many dune systems, especially in England and Wales (see Section 3), there is no discernible decline in range for H2190 Humid dune slacks either at a UK or regional level. Even on the south and east coasts of England, where humid dune slacks are few and far between, there have not been complete losses at any sites over the last 50 years that could have lead to gaps in the range or in regional representation. The broad range of H2190 has remained stable since 1994.

2.3 Favourable reference range

Favourable reference range[2.5.1]: 1,754 km^2

Section 3.2.1.3 of 'Assessing Conservation Status: UK Approach' sets out how favourable reference range estimates for habitats have been determined in the UK. Based on this approach, the current surface area, 1,754 km^2, has been set as the favourable reference area. Reasons for this are discussed below.

The range of H2190 Humid dune slacks is largely determined by physical and geomorphological processes. Coastal areas that support sand dunes are widely distributed around the UK coast where conditions are suitable – i.e. the presence of sufficient mobile sand to develop into a dune complex. Not all sites that develop dunes will contain humid dune slacks and related wetlands within. An additional requirement is a water table that has the potential to reach the ground surface. Gaps in the Actual Range map largely reflect where suitable natural conditions do not exist.

The humid dune slack communities SD13, SD14 and SD15 are mostly confined to England and Wales, and reliant on base-rich water; whereas SD17 is more widespread throughout the UK on less calcareous sites and is particularly common in Scotland. The 'non-SD dune wetlands' (i.e. swamps, mires etc.) included in the H2190 habitat are also much more extensive in Scotland than elsewhere in the UK. This regional variation reflects differences in soil and substrate conditions combined with wide differences in rainfall.

Despite the scarcity of suitable conditions for H2190 Humid dune slacks to develop, the 1994 range is considered to be sufficiently extensive and with adequate representation of the ecological variation. There is however a concern that the scarcity along the English coast may cause the habitat to be vulnerable to catastrophic events.

2.4 Conclusions on range

Conclusion[2.6.i]: Favourable

The current range of H2190 Humid dune slacks appears to be similar to that from the past although, due to substantial losses of the habitat over time, remaining areas are often smaller than in the past. These losses of area emphasise the need to maintain the current range which is considered to be the favourable reference range. The 1994, and, as the habitat range has been stable since, current range are considered to be viable and with sufficient representation of ecological variation.

3. Area [2.4]

3.1 Current area

Total UK extent [2.4.1]: 18.12km^2
Date of estimation [2.4.2]: May 2007
Method [2.4.3]: 3 = ground based survey
Quality of data [2.4.4]: Moderate

Table 3.1.1 provides information on the area of H2190 in the UK. Comprehensive extent data are available from the Sand Dune Survey of Great Britain (1987-1990) and the subsequent Sand Dune Vegetation Survey of Scotland. The Sand Dune Database and other survey reports provide information on NVC communities SD13, SD14, SD15, and SD17. Figures for the extent of SD16 have not been included because in the UK the SD16 community is equated with H2170 Dunes with *Salix repens* ssp. *argentea*. Much of the resource is concentrated on a small number of sites – Sefton Coast (74 ha) in England, Kenfig Dunes (129 ha) in Wales, and Morrich More (208 ha) in Scotland. Elsewhere, particularly in England and Wales, there are usually only small areas within each dune system – this is especially the case with SD13, SD14 and SD15. As such, the H2190 habitat is highly vulnerable in England and Wales.

Table 3.1.1 Area of H2190 in the UK

	Area (ha)	**Method** [2.4.3]	**Quality of data** [2.4.4]
England	200	3	Moderate
Scotland	1200	3	Moderate
Wales	390	3	Moderate
Northern Ireland	22	3	Moderate
Total UK extent [2.4.1]	1812	3	Moderate

Method used to estimate the habitat surface area: 1 = only or mostly based on expert opinion; 2 = based on remote sensing data; 3 = ground based survey. Only the most relevant class is given if more than one applies.
Quality of habitat surface area data: 'Good' e.g. based on extensive surveys; 'Moderate' e.g. based on partial data with some extrapolation; 'Poor' e.g. based on very incomplete data or on expert judgement.

3.2 Trend in area since c.1994

Trend in area[2.4.5]**:** **Decreasing**
Trend magnitude[2.4.6]**:** **Unknown**
Trend period[2.4.7]**:** **1994-2006**
Reasons for reported trend[2.4.8]**:** **3 – Direct human influence**
4 – Indirect anthropogenic or zoogenic influence
5 – Natural processes

Losses have occurred from the lowering of the water table even where dunes survive. Trends in climate change have resulted in some losses. For example, at Braunton Burrows a decline of 5% in effective rainfall since 1966 has resulted in a decline of about 0.5 m in the groundwater level (Robins 2007). In addition, conifer plantations, surface drainage (on or adjacent to the dunes), and groundwater abstraction have all resulted in a lowering of the water table and less surface flooding at many sites – although the scale of these impacts in comparison to trends (or cycles) in climate is still controversial. Furthermore, in part due to these impacts, most dunes have become substantially more stable over the last 50 years.

Where these adverse impacts on the water table are still occurring, H2190 Humid dune slacks habitat has given way to mesotrophic grassland or scrub woodland. As a consequence trend in area has been a decline which is still occurring.

Taken together, all these trends have led to further losses of dune slack habitat. Early succession humid dune slacks (SD13 and SD14) have disproportionately suffered from these processes, resulting in critically small remaining areas in some dune systems.

3.3 Favourable reference area [2.5.2]

Favourable reference area: **at least 20 km^2**

Section 3.2.2.3 of 'Assessing Conservation Status: UK Approach' sets out how favourable reference area estimates have been determined in the UK. Based on this approach, the favourable reference area has been identified as greater than the current extent, but not by a factor of more than 10%. Reasons for this are discussed below.

The area of H2190 Humid dune slacks is largely determined by physical and geomorphological processes. Coastal sites that support sand dunes are widely distributed around the UK coast where conditions are suitable – i.e. the presence of sufficient mobile sand to develop into a dune complex. Not all sites that develop dunes will contain humid dune slacks and related wetlands within. An additional requirement is a water table that has the potential to reach the ground surface. Gaps in the current range largely reflect where suitable natural conditions do not exist. As described in Section 2.3, there is significant regional variation in community types, with this variation reflecting differences in soil and substrate conditions combined with wide differences in rainfall.

Hydrology is critical to the functioning of all these communities. Specific information for British dune slacks tends still to be anecdotal, but a provisional summary has been published in Davy *et al*. (2006) and is reproduced here.

Table 3.3.1 Water requirements for H2170 NVC types

Annex 1 habitat code	NVC	NVC Name	Approximate winter water table depth (cm)*	Approximate summer water table depth (cm)
H2190	SD13	*Sagina nodosa-Bryum pseudotriquetrum* community	+2	-60 to -160
	SD14	*Salix repens-Campylium stellatum* community	+10 to +50	-10 to -60
	SD15	*Salix repens-Calliergon cuspidatum* community	+5	-40
	SD17	*Potentilla anserina-Carex nigra* community	+50	Unknown
H2170	SD16	*Salix repens-Holcus lanatus* community	0	-50 to -200

* Positive values indicate water tables above the soil surface i.e. flooding.

Within dunes where there is potential for humid dune slacks, currently a range of human activities have reduced the potential area that these slacks could cover. These include drainage, abstraction, forestry plantations, erosion control measures, removal or reduction of grazing. These activities have a further adverse affect on humid dune slacks by increasing dune stabilisation and therefore greatly reducing any opportunities for new humid dune slack formation. Early succession humid dune slacks (SD13 and SD14) have disproportionately suffered from these processes, resulting in critically small remaining areas in some dune systems. Furthermore this can lead to a loss of ecological variation and a lessened capacity for the habitat to colonise or recover from adverse impacts. This is a concern in terms of habitat viability.

The habitat only covers 1812 ha, which is rather scarce, especially as it is found all around the British coast. This scarcity is not a natural phenomenon but the consequence of a decline due to past reclamation and development. For example, about 40% of the original Sefton coast dune area has been lost to development, mostly since the mid-1800s (Smith 1999). It is reasonable to assume that there were H2190 Humid dune slacks in these lost areas.

Much of the resource is concentrated on a small number of sites – Sefton Coast (74 ha) in England, Kenfig Dunes (129 ha) in Wales, and Morrich More (208 ha) in Scotland. Elsewhere, particularly in England and Wales, there are usually only small areas within each dune system – this is especially the case with SD13, SD14 and SD15. As such, the H2190 habitat is highly vulnerable in England and Wales.

The scarcity of suitable conditions for H2190 Humid dune slacks to develop and the critically small areas of H2190 Humid dune slacks currently in some dune systems are also of grave concern. Not only is the habitat made of isolated patches within its range, but these can be so small as to induce doubt regarding

their viability. This could lead to total losses in area in some sites. This vulnerability is compounded by the fact that restoration requires modifying the water table and allowing remobilisation of the whole dune system on which these communities depend.

The current range of H2190 is therefore considered to be less than that necessary to ensure viability of the habitat. It is however judged that an increase of no more than 10% above the current area is necessary to remedy this situation. Thus, the favourable reference range is taken as not more than 10% above the current range of 1,812 ha.

3.4 Conclusions on area covered by habitat

Conclusion[2.6.ii]: Unfavourable – Inadequate and deteriorating

H2190 Humid dune slacks is a rare and vulnerable habitat, much of which is concentrated on a small number of sites with only very small areas on most other dune systems. There have also been substantial losses in the past, and currently losses are still occurring. The early successional communities are disproportionately affected which affects the ecological variation. The range is considered to be unviable although assessing if it is more than 10% below the favourable reference range has not been possible.

4. Specific Structures and Functions **(including typical species)**

4.1 Main pressures [2.4.10]

The H2190 Humid dune slacks habitat is critically dependent on continuity of appropriate dune hydrology – maintaining both an adequate groundwater level and annual fluctuations. A new typology of dune slacks has been proposed (Davy *et al.* 2006) based on hydrological functioning: more work still needs to done to relate these dune slack hydrological types to the occurrence of H2190 Humid dune slacks. However, in their review of dune slack habitats, Davey *et al.* concluded that all 'SD' dune slack vegetation is highly sensitive to changes in hydrological regime. Although equally dependant on appropriate groundwater conditions, 'non-SD dune wetlands' are probably less sensitive to small changes in hydrology. Similarly, humid dune slacks are likely to be at least partially buffered from human-induced changes to the water table in the high rainfall areas of the north and west of the UK.

Both human activities and changes in climate can rapidly affect humid dune slacks. And, in practice, this community is under great pressure from falling water tables, combined with increasing stabilisation of dunes, under-grazing and lack of remedial action (scrub/tree clearance).

The factors affecting coastal sand dunes are covered in the *Habitat Action Plan for Coastal sand dunes* (UKBAP website). The main pressures affecting dunes with *Salix repens* are listed below. The related EC codes are shown in brackets.

- Falling water tables (**853 Management of water levels, 920 Drying out**)

Dune slacks support characteristic communities dependent on a seasonally high water table, including the formation of temporary or even permanent ponds. There may be considerable variation in the behaviour of the water table from year to year, resulting in a stressed ecosystem where only specialised species can survive. However, in some dune systems with important slacks, a long term fall in the water table has led to loss of the specialist slack flora and invasion by coarse vegetation and scrub. While unusually dry summers may have contributed to this problem, the long-term causes are believed to be local extraction of water and/or drainage of adjacent land used for agriculture or housing. The H2190 Humid dune slacks habitat is critically dependent on continuity of appropriate dune hydrology – maintaining both an adequate groundwater level and annual fluctuations. A new typology of dune slacks has been proposed (Davy *et al.* 2006) based on hydrological functioning: more work still needs to done to relate these dune slack hydrological types to the occurrence of H2190 Humid dune slacks. However, in their review of dune slack habitats, Davy *et al.* concluded that all 'SD' dune slack vegetation is highly sensitive to

changes in hydrological regime. Although equally dependant on appropriate groundwater conditions, 'non-SD dune wetlands' are probably less sensitive to small changes in hydrology. Similarly, humid dune slacks are likely to be at least partially buffered from human-induced changes to the water table in the high rainfall areas of the north and west of the UK.

Causes of falling water tables include drainage, water abstraction, and forestry plantations. These activities all have a further adverse affect on humid dune slacks by increasing dune stabilisation and therefore greatly reducing any opportunities for new humid dune slack formation. Early succession humid dune slacks (SD13 and SD14) have disproportionately suffered from these processes.

- Grazing (**140 Grazing**)

In the absence of human interference, most stable dunes, with the exception of those experiencing severe exposure, would develop into scrub and woodland. The preponderance of grassland and heath vegetation on British dunes is due to a long history of grazing by livestock. Continued grazing is normally necessary to maintain the typical fixed dune communities, but over-grazing, particularly when combined with the provision of imported feedstuffs, can have damaging effects. A more widespread problem is under-grazing, leading to invasion by coarse grasses and scrub, though rabbits are locally effective in maintaining a short turf. Parts of some stabilised dune systems have been entirely converted to agricultural use, resulting in almost total loss of the conservation interest. Undergrazing and lack of remedial action (scrub/tree clearance) reinforce the adverse impacts of falling water tables and increasing dune stabilisation but, in practice, they are subsidiary pressures.

- Forestry (**162 Artificial planting**)

Afforestation of dunes is not as prevalent in Britain as it is in parts of continental Europe, but in a few locations it has had a major effect on large areas of dune landscape. Some sites hold large conifer plantations which have the effect of suppressing the dune vegetation communities and lowering the water table. However, both routine fellings and permanent removal of conifers have shown that vegetation close to the original can be restored in a relatively short time.

- Recreation (**622 walking, horse riding and non-motorised vehicles, 623 motorised vehicles**)

Recreation is a major land use on sand dunes. Many dune systems are used extensively by holiday-makers, mostly on foot but also for parking cars and in some cases for driving four-wheel-drive vehicles or motorcycles. Moderate pressure by pedestrians may cause little damage, and may even help to counteract the effects of abandonment of grazing. However, excessive pedestrian use, as on routes between car parks and beaches, and vehicular use in particular, have caused unacceptable erosion on many dune sites. Many dune systems also support one or more golf courses. Here much of the original vegetation may be retained in the rough, but the communities of the fairways, and particularly the greens and tees, are often severely modified by mowing, fertilising and re-seeding. Fragmentation of dune systems by golf courses makes grazing management much more difficult.

- Sea defences and stabilisation (**871 sea defence or coast protection works**)

Many dune systems are affected by sea defence works or artificial stabilisation measures such as sand fencing and marram planting. These practices are particularly prevalent on the more developed coastlines where drifting sand may be perceived as a threat to urban or holiday developments. While carefully applied dune management measures can help to counteract severe erosion which may threaten the existence of a dune, engineered defence systems usually reduce the biodiversity inherent in the natural dynamism of dune systems, and may cause sediment starvation down-drift. UK dunes as a whole suffer from over-stabilisation and poor representation of the mobile phases.

- Beach management (**302 removal of beach material, 622 walking, horse riding and non-motorised vehicles, 623 motorised vehicles**)

The seaward accretion of dune systems takes place through the accumulation of wind-blown sand caught by plants or debris along the driftline; the initial accumulations are colonised by pioneer plant species and form embryo dunes. On some heavily used beaches this process is inhibited by pressure of pedestrian or vehicular traffic, or by beach cleaning using mechanical methods, where the organic nuclei for sand deposition may be removed. These factors may remove the minor obstacles which would catch the sand initially, or destroy the embryo dunes at an early stage in their formation. In either case a dune system in a location where the physical conditions exist for accretion may actually be static or eroding.

- Erosion and progradation (**900 erosion**)

Unless artificially constrained, the seaward edges of sand dunes can be a highly mobile feature, though there is a natural trend to greater stability further inland. Very few dune systems are in overall equilibrium, and a majority of those in the UK demonstrate net erosion rather than net progradation; insufficient sand supply is frequently the underlying cause. There is no particular geographical distribution of either trend, both normally being present along any one stretch of coastline, and often within individual sites. Changes may be cyclical, both seasonally and over longer periods of time. Landward movement of mobile dunes often entails loss of fixed dune and dune heath habitat, as the latter are usually stable, or retreat may be impeded by development; in a few cases dune systems may move inland where not artificially constrained. The net loss of dune habitat in England to erosion has been estimated as not more than 2% of the resource over the next 20 years.

- Other human influences (**302 removal of beach material, 400 Urbanised areas, human habitation, 410 Industrial or commercial areas, 422 disposal of industrial waste, 421 disposal of household waste**)

Sand dunes have also been affected in the past by housing developments, industrial development, waste tips on or adjacent to them, fly tipping and sand extraction. Indirect effects on dunes include atmospheric nutrient deposition, and coastal squeeze due to rising sea levels and increased storminess. The potential for dredging and marine aggregate extraction, through the disruption of coastal processes, to have cumulative and long-term effects on sand dunes is an area for further investigation.

- Air pollution (**702 air pollution**)

Nutrient deposition also needs to be considered. It is suspected that nutrient deposition on many sand dunes is already above their critical threshold for impacts on vegetation (Jones *et al.* 2002, 2004, 2005). There is no certainty that there will be a decline in the foreseeable future. The consequence of this for H2190 Humid dune slacks is the tendency to a speeded up succession away from dune slack vegetation.

4.2 Current condition

4.2.1 Common Standards Monitoring (CSM) condition assessments

Condition assessments based on CSM (see http://www.jncc.gov.uk/page-2199) provide a means to assess the structure and functioning of H2190 in the UK. The following attributes were examined for all CSM assessments relevant to the habitat:

- Extent.
- Structure and natural processes.
- Regeneration potential.
- Composition (trees and shrubs).
- Indicators of local distinctiveness.
- Habitat extent.
- Physical structure: functionality and sediment supply (strandline, embryo and mobile dune, machair).
- Vegetation structure: range of zones of vegetation,
- Vegetation structure,

- Vegetation composition:
    - typical species,
    - grass: forbs ratio,
- Other negative indicators (negative indicator species and signs of disturbance).

SAC condition assessments

Table 4.2.1 and Map 4.2.1 summarise the CSM condition assessments for UK SACs supporting habitat H2190. These data were collated in January 2007. The maps give an impression of the overall spread of where Unfavourable and Favourable sites exist (summary statistics for the map are given in Section 7.2). The combined assessments show that of the SACs assessed:

- 73% of the area and 70% of the number of assessments was Unfavourable; and
- at least 47% of the total UK habitat area was in Unfavourable condition.

Site of Special Scientific Interest (SSSI)/Area of Special Scientific Interest (ASSI) condition assessments

Table 4.2.2 and Maps 4.2.2 and 4.2.3 summarise the CSM condition assessments that were judged to be either strongly or weakly indicative of the condition of the Annex I habitat on SSSI/ASSIs (see Technical note II for details of methodology behind this). These data were collated in January 2007. The maps give an impression of the overall spread of where Unfavourable and Favourable sites exist (summary statistics for the maps are given in Section 7.2). The combined condition assessments show that of the SSSI/ASSI assessments considered:

- 52% weakly indicative assessments were Unfavourable.

Table 4.2.1 CSM condition assessment results for UK SACs supporting H2190. See notes below table for details. Information on the coverage of these results is given in Section 7.2

Condition	Condition sub-categories	Area (ha)	Number of site features
Unfavourable	Declining	509	6
	No change	22	3
	Unclassified	21	1
	Recovering	297	6
	Total	849	16
	% of all assessments	***73%***	***70%***
	% of total UK resource	***47%***	***unknown***
Favourable	Maintained	287	4
	Recovered		
	Unclassified	28	3
	Total	315	7
	% of all assessments	***27%***	***30%***
	% of total UK resource	***17%***	***unknown***

Notes

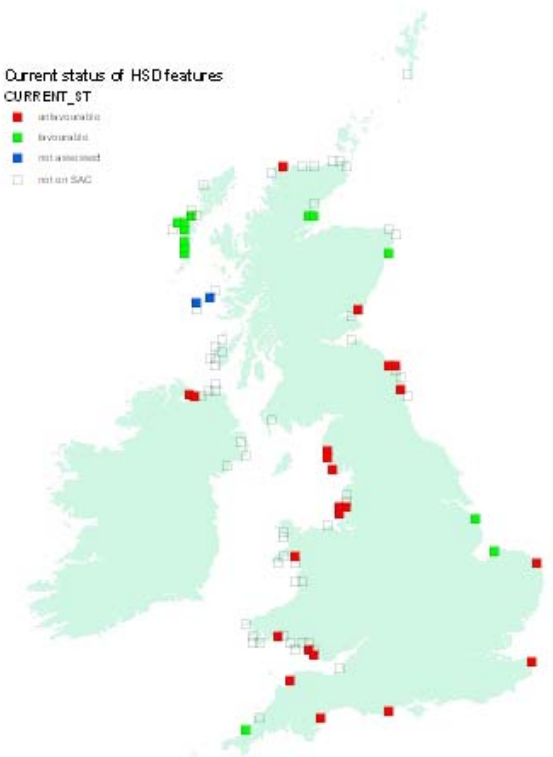
1. Data on features that have been partly-destroyed have been excluded from this table because they are not relevant to the consideration of present condition.
2. The data included are from CSM assessments carried out between April 1998 and December 2006. NB: these include additional and some up-date data from those used in the six year report produced by JNCC. (Williams, J.M., ed. 2006. *Common Standards Monitoring for Designated Sites: First Six Year Report*. Peterborough, JNCC).
3. Only assessments made for qualifying interest features on SAC have been included in this analysis.
4. Area figures for CSM assessments have been calculated using the data presented on the standard Natura 2000 data forms submitted to the EU.

Table 4.2.2 CSM condition assessment results for UK SSSI/ASSIs that were judged to be either strongly or weakly indicative of the condition of H2190 on SSSI/ASSIs. See notes below table and Technical note II for further details

Condition	Condition sub-categories	Number of assessments	
		Strongly indicative assessments (Category 1)	Weakly indicative assessments (Category 2)
Unfavourable	Declining		21
	No change		19
	Unclassified		5
	Recovering		24
	Total		69
	% of all assessments	***%***	***52%***
Favourable	Maintained		17
	Recovered		
	Unclassified		46
	Total		63
	% of all assessments	***%***	***48%***

Notes

1. Data on features that have been partly-destroyed have been excluded from this table because they are not relevant to the consideration of present condition.
2. The data included are from CSM assessments carried out between April 1998 and March 2005, as used for the JNCC Common Standards Monitoring Report 2006.

<table>
<tr><th colspan="3">Current Condition of H2190 based on Common Standard Monitoring condition assessments (See Sections 4.2 and 7.2 for further information)</th></tr>
<tr><td>Map 4.2.1 SAC assessments</td><td>Map 4.2.2 Assessments strongly indicative of the condition on SSSI/ASSIs</td><td>Map 4.2.3 Assessments weakly indicative of the condition on SSSI/ASSIs</td></tr>
<tr><td> 
</td><td>Not applicable</td><td> 
</td></tr>
<tr><td>Key
Red = Unfavourable, i.e. the square contains at least one SAC where this habitat feature is present and has been judged to be Unfavourable
Green = Favourable, i.e. the square contains at least one SAC where this habitat feature is present and has been assessed as Favourable but there are no Unfavourable SAC features
Blue = SAC not assessed, i.e. the square contains at least one SAC supporting this habitat feature but no assessment has been reported
Transparent = SAC feature not present, i.e. the square does not contain any SAC features of this habitat type</td><td colspan="2">Key*
Green – 80 – 100% of assessed features on 10km square are Favourable
Yellow - 50 – 80% of assessed features on 10km square are Favourable
Orange - 20 – 50% of assessed features on 10km square are Favourable
Red - 0 – 20% of assessed features on 10km square are Favourable
*This is the same key as was used for JNCC CSM Report 2006</td></tr>
</table>

4.3 Typical species

Typical species[2.5.3]: ***Sagina nodosa, Centaurium pulchellum, Senecio erucifolius, Rubus caesius, Trifolium fragiferum***

Typical species assessment[2.5.4]: **Change in 10 km square occupancy across UK over last 25 years**

Several species show a medium degree of faithfulness to this habitat or at least to the four main related sand dune community types (SD13, SD14, SD15 and SD17) within the NVC. Trends in the occurrence of these species across the UK during the last 25 years are set out in the table below. All but one showed significant increases, mostly of less than 25%. These data suggest that at least some species associated with H2190 have increased in occurrence, though not necessarily within this sand dune type.

Table 4.3.1 Trends and faithfulness of selected typical species for H2190

Typical species	Faithfulness to habitat H2190 (based on analysis of NVC synoptic tables)	Trend over last 25 years from BSBI atlas – based on change in 10 km square occupancy across UK (see http://www.jncc.gov.uk/page-3254)
Sagina nodosa	Medium	Significant increase, but <25% in 25 years
Centaurium pulchellum	Medium	Significant increase, but <25% in 25 years
Senecio erucifolius	Medium	Significant increase, but <25% in 25 years
Rubus caesius	Medium	Significant decline, but <25% in 25 years
Trifolium fragiferum	Medium	Significant increase, but <25% in 25 years

4.4 Conclusions on specific structures and functions (including typical species)

Conclusion[2.6.iii]: **Unfavourable – Bad and deteriorating**

The EC Guidance states that where "more than 25% of the area of the habitat is unfavourable as regards its specific structures and functions", the conclusion should be Unfavourable – Bad. In the UK this was generally taken to mean that more than 25% of the habitat area in Unfavourable condition.

H2190 is a rare and vulnerable habitat, much of which is concentrated on a small number of sites with only very small areas on most other dune systems. There have also been substantial losses in the past, and currently losses are still occurring due to falling water tables, dune stabilisation, under-grazing and scrub encroachment. Early successional communities are disproportionately affected. 73% of SAC condition assessments for H2190 are classed as Unfavourable, which represents 47% of the total UK resource. About 60% of the area assessed, and thus 28% of the overall resource, is classed as declining.

5. Future Prospects

5.1 Main factors affecting the habitat

5.1.1 Conservation measures

- Protection within designated sites

Around 64% of the resource of H2190 lies within SACs with management measures specifically aimed at maintaining and enhancing the features for which they are designated, and to address some of the pressures listed within Section 4.1 and the future threats listed in Section 5.1.2. A significant proportion of the resource of this habitat also lies within the SSSI/ASSI series where similar management measures are in place.

- UK Biodiversity Action Plan (BAP)

The habitat is covered by the *Coastal sand dunes action plan* under the UK BAP (see http://www.ukbap.org.uk), as well as under country and local biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource.

Where loss of the H2190 Humid dune slacks community has been caused by drying out of the slack and/or progression to wet woodland, the area can be increased directly by reversing the fall in water tables (if anthropogenic) and/or the removal of trees and scrub combined with follow-up grazing management. It is also possible to "chase the water table down" by excavation or scraping to an appropriate depth within areas that have dried out. This work is expensive and is likely to remain dependent on agri-environment funding for the foreseeable future. However, if the current trend of falling water tables is maintained (and not reversed by changes in climate), appropriate scrub clearance and grazing restoration and maintenance management will not be sufficient to reverse the trend of declining extent and quality of the 'Humid dune slacks' community.

Where loss of dune wetlands has been part of a wider loss of whole areas of dune systems, their re-creation is intricately bound up with the re-creation of the wider dune system. Scope for this is probably greatest in situations where agricultural improvements have been made on the landward side of a number of dune systems. In addition, where plantations have been planted in the past directly on dune slacks (a significant impact on a number of key dune systems), often following drainage, removal of the trees combined with rehabilitation of the integrity of the hydrology would make a substantial contribution to increasing the area of this scarce and vulnerable H2190 Humid dune slacks community.

In the longer term, remobilisation of dune systems would allow a readjustment of ground levels to lower water tables and hence the establishment of new dune slack successions – if the current trend of falling water tables is maintained. However, few dune systems are now unconstrained by infrastructure and other land uses (e.g. golf courses and woodlands), either within the dune system or along the landward fringe. There would be strong objections to the need for relocation if dunes were to be remobilised, as has already been found where plantation felling has been proposed (e.g. Sefton coast and Newborough Warren).

There are, therefore, enormous challenges to maintaining the very small resource of ecologically functioning H2190 Humid dune slacks through the current period of continuing dune stability. A management model is being developed for H2190 (European Commission, in preparation), providing guidelines to address threats and pressures and drawing on experience from other European countries (the Netherlands, Denmark, Germany…) for a better conservation of British dune slacks.

5.1.2 Main future threats[2.4.11]

The most obvious major future threats to H2190 are listed below, several of which are referred to in Section 4.1.

- Climate change (**900 erosion, 920 Drying out, 930 submersion**)

Based on the literature review (Technical note IV) climate change is considered a major threat to the future condition of this habitat especially in the long term. Climate change and its impacts on dune hydrology are probably critical to the future of H2190 Humid dune slacks. Climate is predicted to get drier, with rainfall more concentrated in the winter with longer droughts in the summer. These trends are potentially severe but difficult to predict given our current lack of sufficient knowledge of the hydrological functioning of even the key dune systems for H2190 Humid dune slacks – as well as the range of predictions for future climate. Modelling work on the Ainsdale Dunes National Nature Reserve part of the Sefton coast suggests that there will be a significant decline in water tables under all future climate predictions (Clarke and Sanitwong-Na-Ayutthaya 2006) – increasing the already severe pressures on dune slacks. [The more extreme predictions, though, would lead to sufficient summer drought to kill dune vegetation allowing dunes to remobilise.] However, work at Newborough Warren is more equivocal (Hollinghham 2006). Some of this difference seems to be explained in part by different predictions of the future pattern of local rainfall and its impact on water tables. It is becoming clear that reduced rainfall in recent years is having a significant effect on dune water tables and hence having an adverse impact on

H2190 Humid dune slacks. For example, at Braunton Burrows a decline of 5% in effective rainfall since 1966 has resulted in a decline of at least 0.5 m in the groundwater level (Robins 2007).

However, there is a high degree of uncertainty in defining future climate threats on habitats and species due to uncertainty in: future greenhouse gas emissions; the consequential changes in climatic features (for instance temperature, precipitation CO_2 concentrations); the responses of habitats and species to these changes (for instance location, phenology, community structure) and the role of other socio-economic drivers of environmental change. The scale of change in habitats and species as a result of climate change will vary across ecosystems. Small changes in the climate are more likely to have a substantial impact on habitats and species which exist within a narrow range of environmental conditions. The future impacts of climate change on UK biodiversity will be exacerbated when coupled with other drivers of environmental change.

- Falling water tables (**920 Drying out**)

It therefore becomes critical to address other reasons for falling water tables. More work is required to better understand the hydrological regimes of all sand dune systems in the UK, but any artificial drainage within and adjacent to dune systems is highly likely to be having a negative effect on dune hydrology and hence on dune slacks. The evidence is less clear-cut for the impact of plantations on dune water tables. Even if scientific agreement can be reached over the degree of water table impact exerted by plantations, there will still continue to be significant public opposition to plantation clearance. In addition, abstractions into dune groundwater will intensify this draw-down, even if only in localised areas. Future drier summers are likely to increase the demand for irrigation of golf courses and other human developments and, depending on how they source this water, there may be increased demand for abstraction.

- Dune stabilisation (**990 Other natural processes, 950 Biocenotic evolution**)

Over the longer term, the functioning of dune slacks is probably dependent on periodic remobilisation of significant portions of dune systems. Evidence of buried soil horizons at Newborough Warren suggests a major remobilisation there about every 200 years. At many other dune systems, we are currently observing a process of maturing and stabilisation following major remobilisation during the 1940s as a consequence of military training.

- Air pollution (**702 air pollution**)

Nutrient deposition also needs to be considered. It is suspected that nutrient deposition on many sand dunes is already above their critical threshold for impacts on vegetation (Jones *et al* 2002, 2004, 2005). There is no certainty that there will be a decline in the foreseeable future. The consequence of this for H2190 Humid dune slacks is the tendency to a speeded up succession away from dune slack vegetation.

- Undergrazing and scrub encroachment (**140 Grazing**)

Lack of appropriate grazing regimes and the subsequent development of scrubs contribute to the stabilisation of the dune system, which is not Favourable to H2190.

- Habitat fragmentation (**990 Other natural processes**)

The fragmented nature of the remaining resource and the frequently small size of habitat patches mean that localised extinctions become more likely on some sites.

5.2 Future condition **(as regards range, area covered and specific structures and functions)**

5.2.1 CSM condition assessments

The CSM condition assessments reported in Sections 4.2.1-2 provide a basis to predict the potential future condition of H2190 in the UK. This involved treating all assessments currently identified as either Favourable or Unfavourable recovering as future-Favourable: remaining categories were treated as future-

Unfavourable – see Table 5.2.1. There are a number of caveats to this approach, which are set out beneath this table.

SAC condition assessments

Table 5.2.1 and Map 5.2.1 summarise the predicted potential future condition of H2190 on UK SACs. This is based on the approach described above. The maps give an impression of the overall spread of where future-Unfavourable and future-Favourable sites are predicted to occur (summary statistics for the map are given in Section 7.2). The combined assessments show that of the SACs assessed:

- 53% of the area and 57% of the number of assessments fall within the future-Favourable category; and
- at least 34% of the total UK habitat area falls within the future-Favourable category.

Table 5.2.1 Predicted future condition of UK SACs supporting H2190 based on current CSM condition assessments. See notes below table for details. Information on the coverage of these results is given in Section 7.2

Future condition	Present condition	Area (ha)	Number of site features
Future-Unfavourable	Unfavourable declining	509	6
	Unfavourable no change	22	3
	Unfavourable unclassified	21	1
	Total	552	10
	% of assessments	***47%***	***43%***
	% of total UK extent	***30%***	***Unknown***
Future-Favourable	Favourable maintained	287	4
	Favourable recovered		
	Unfavourable recovering	297	6
	Favourable unclassified	28	3
	Total	612	13
	% of assessments	***53%***	***57%***
	% of total extent	***34%***	***Unknown***

Note that the scenario presented above is based on the same information as used to construct the Table in section 4.1. It is based on the following premises:

(i) the Unfavourable-recovering condition assessments will at some point in the future become Favourable.

(ii) all Unfavourable-unclassified sites will remain Unfavourable, which is probably overly pessimistic;

(iii) sympathetic management will be sustained on sites already classified as Favourable and these will not be seriously damaged by any unforeseen events.

IMPORTANT NOTE: we do not have information on the timescale of the predicted recovery, which may be influenced by many past, natural and human related factors. A sustained, sympathetic management regime is more likely to result in 'Favourable' condition being attained.

Table 5.2.2 Predicted future condition of H2190 on SSSI/ASSIs based on CSM assessments that were judged to be either strongly or weakly indicative of the condition. See notes below table and Technical note II for further details

Future condition	Present condition	Number of assessments	
		Strongly indicative assessments (Category 1)	**Weakly indicative assessments (Category 2)**
Future-Unfavourable	Unfavourable declining		21
	Unfavourable no change		19
	Unfavourable unclassified		5
	Total		***45***
	% of assessments	***%***	***34%***
Future-Favourable	Favourable maintained		17
	Favourable recovered		
	Unfavourable recovering		24
	Favourable unclassified		46
	Total		87
	% of assessments	***%***	***66%***

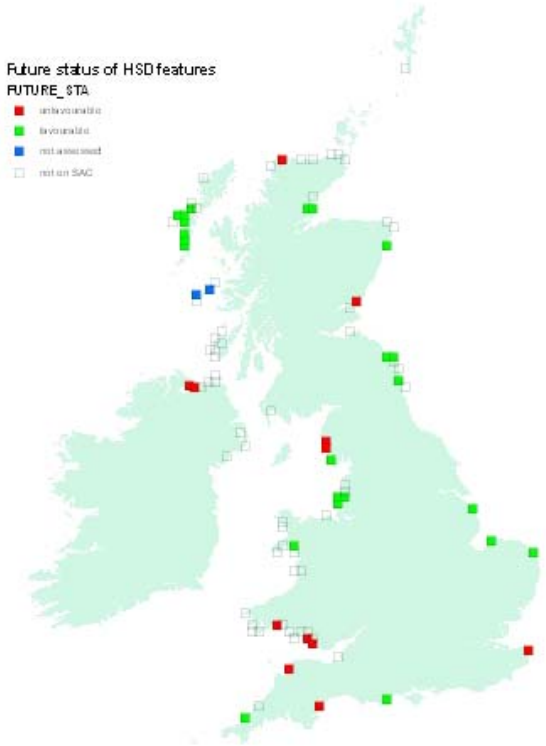
Note that the scenario presented above is based on the same information as used to construct the Table in section 4.1. It is based on the following premises:
(i) the Unfavourable-recovering condition assessments will at some point in the future become Favourable.
(ii) all Unfavourable-unclassified sites will remain Unfavourable, which is probably overly pessimistic;
(iii) sympathetic management will be sustained on sites already classified as Favourable and these will not be seriously damaged by any unforeseen events.
IMPORTANT NOTE: We do not have information on the timescale of the predicted recovery, which may be influenced by many past, natural and human related factors. A sustained, sympathetic management regime is more likely to result in Favourable condition being attained.

SSSI/ASSI condition assessments

Table 5.2.2 and Maps 5.2.2 and 5.2.3 summarise the predicted potential future condition of H2190 on UK SSSI/ASSIs. This is based on the approach described above and utilises condition assessments that were judged to be either strongly or weakly indicative of the condition of the Annex I habitat on SSSI/ASSIs (see Technical note II for details of methodology behind this). The maps give an impression of the overall spread of where Unfavourable and Favourable sites exist (summary statistics for the maps are given in Section 7.2.). The combined condition assessments show that of the SSSI/ASSI assessments considered:

- 66% weakly indicative assessments fall within the future-Favourable category.

Predicted Future Condition of H2190 based on Common Standard Monitoring condition assessments (See Sections 5.2 and 7.2 for further information on these maps)

Map 5.2.1 SAC assessments	**Map 5.2.2** Assessments strongly indicative of the condition on SSSI/ASSIs	**Map 5.2.3** Assessments weakly indicative of the condition on SSSI/ASSIs
		
Key Red = future-Unfavourable, i.e. the square contains one or more SACs where this habitat feature is present and has been predicted to be future-Unfavourable Green = future-Favourable, i.e. the square contains at least one SAC where this habitat feature is present and has been predicted to be future-Favourable Blue = SAC not assessed, i.e. the square contains at least one SAC supporting this habitat feature but no assessment has been reported Transparent = SAC feature not present, i.e. the square does not contain any SAC features of this habitat type	Key* Green – 80 – 100% of assessed features on 10km square are Favourable Yellow - 50 – 80% of assessed features on 10km square are Favourable Orange - 20 – 50% of assessed features on 10km square are Favourable Red - 0 – 20% of assessed features on 10km square are Favourable *This is the same key as was used for JNCC CSM Report 2006	

5.3 Conclusions on future prospects (as regards range, area covered and specific structures and functions)

Conclusion[2.6.iv]: Unfavourable – Bad and deteriorating

Based on the UK approach (see 'Assessing Conservation Status: UK Approach' section 3.2.4.3), where less than 75% of the total UK habitat area is likely to be Favourable in 12-15 years, the judgement for Future Prospects should be Unfavourable – Bad.

The key adverse pressures that have reduced H2190 Humid dune slacks to their current fragmented and vulnerable state – falling water tables and increasing dune stability – are likely to continue to threaten this habitat into the future. Scrub clearance and more effective grazing may ameliorate, but not reverse, these trends. This is reflected in assessment of future predicted condition of SACs supporting H2190 habitat, where 47% of the resource is predicted to remain Unfavourable, nearly all of it declining. The UK BAP, working towards enhancing future viability, has targets to bring the dune systems into Favourable or recovering condition by 2010 while maintaining the current extent. Despite progress already made and some additional recovery once further conservation measures are put into place, the expectation is that more than 25% of the habitat will be in Unfavourable condition in the next 10-15 years.

6. Overall Conclusions and Judgements on Conservation Status

Conclusion[2.6]: Unfavourable – Bad and deteriorating

On the basis of the Structure and Function and Future Prospects assessments, the overall conclusion for this habitat feature is Unfavourable – Bad.

Table 6.1 Summary of overall conclusions and judgements

Parameter	Judgement	Grounds for Judgement	Confidence in judgement*
Range	Favourable	Current range is stable and not less than the favourable reference range.	1
Area covered by habitat type within range	Unfavourable – Inadequate and deteriorating	Current extent is below the favourable reference area, but not by more than 10%.	1
Specific structures and functions (including typical species)	Unfavourable – Bad and deteriorating	More than 25% of the habitat area is considered to be Unfavourable as regards its specific structures and functions. Significantly more of the resource in Unfavourable condition is declining than improving.	1
Future prospects (as regards range, area covered and specific structures and functions)	Unfavourable – Bad and deteriorating	Habitat prospects over next 12-15 years considered to be bad, with severe impact from threats expected and long term viability not assured. Further measures are required to address threats to future extent and structure and function for the overall UK resource.	1
Overall assessment of conservation status	Unfavourable – Bad and deteriorating	On the basis of the Structure and Function and Future Prospects assessments, the overall conclusion for this habitat feature is Unfavourable – Bad.	1

Key to confidence in judgement: 1 = High; 2 = Medium; 3 = Low

7. Annexed Material (including information sources used 2.2)

7.1 References

AIR POLLUTION INFORMATION SYSTEM. 2004. www.apis.ceh.ac.uk

CLARKE, D. (Viewed 23/1/07). Climate change and the Water Balance in coastal aquifers, School of Civil Engineering and the Environment University of Southampton. http://www.civil.soton.ac.uk/research/researchcents.asp?ResearchCentreID=3&ResearchGrantID=617

DARGIE, T. 1993. *Sand dune vegetation survey of Great Britain. Part 3 – Wales*. Joint Nature Conservation Committee, Peterborough.

DARGIE, T. 1994. *Sand dune vegetation survey of Great Britain. Part 2 – Scotland*. Joint Nature Conservation Committee, Peterborough.

DARGIE, T. 2002. *Ecological assessment of Hippophae rhamnoides*. A report to English Nature (East Midlands Team). EN contract 12.5.2-2.

DARGIE, T. 2002. *Sand dune vegetation survey of Scotland: National report*. SNH Research, Survey and Monitoring Report series. Scottish Natural Heritage, Battleby.

DAVY, A.J *et al.* 2006 Development of eco-hydrological guidelines for dune habitats – phase 1 *English Nature Research Report 696* Peterborough.

EUROPEAN COMMISSION. In preparation. *Management models for habitats in* Natura 2000 *sites. 2190 Humid dune slacks*.

HAINES-YOUNG, R.H. *et al.* 2000 *Accounting for nature: assessing habitats in the UK countryside.* DETR, Rotherham.

HOLLINGHAM, M. 2005. Presentation on the Hydrology of the Warren for the Habitats and Species Group Meeting of the Newborough Warren Liaison Partnership. http://www.bangor.ac.uk/~azs808/NewbroLPpresent.htm

HOLLINGHAM, M. 2007. *Comments on the CEH Preliminary Hydrological Review for the Newborough Liaison Partnership & Hydrological monitoring report for Newborough June-December 2006* m.hollingham@gmail.com

JACKSON, D.L. & MCLEOD, C.R. (eds.) 2002. Handbook on the UK status of EC Habitats Directive interest features: provisional data on the UK distribution and extent of Annex I habitats and the UK distribution and population size of Annex II species. *JNCC Report* No. 312. Version 2. www.jncc.gov.uk/page-2447

JOINT NATURE CONSERVATION COMMITTEE. 2005. *Common Standards Monitoring (CSM)*. Joint Nature Conservation Committee, Peterborough. www.jncc.gov.uk/page-2217

JONES, M.L.M. *et al.* 2002. *Changing nutrient budget of sand dunes: consequences for the nature conservation interest and dune management* CEH, Bangor.

JONES, M.L.M. *et al*. 2004. Changes in vegetation and soil characteristics in coastal sand dunes along a gradient of atmospheric nitrogen deposition *Plant Biology* **6**, 598-605.

JONES, M.L.M. *et al*. 2005. *Determining a nitrogen budget for Merthyr Mawr sand dune system: final report* CEH, Bangor.
MCLEOD, C.R., YEO, M., BROWN, A.E., BURN, A.J., HOPKINS, J.J. & WAY, S.F. (eds.) 2008. *The Habitats Directive: selection of Special Areas of Conservation in the UK*. 2nd edn. Joint Nature Conservation Committee, Peterborough. www.jncc.gov.uk/SACselection

RADLEY, G.P. 1994. *Sand dune vegetation survey of Great Britain. Part 1-England*. Joint Nature Conservation Committee, Peterborough.

RANWELL, D.S. 1959. Newborough Warren Anglesey. I. The dune system and dune slack habitat. *Journal of Ecology*, **47**, 571-601.

RANWELL, D.S. 1960. Newborough Warren Anglesey. II. Plant associes and succession cycles of the sand dune and dune slack vegetation. *Journal of Ecology*, **48**, 117-141.

ROBINS, N. 2007. *Conceptual flow model and changes with time at Braunton Burrows coastal dunes [Draft]*. Report to Natural England. British Geological Survey, Wallingford.

RODWELL, J.S. (ed.) 2000. *British Plant Communities. Volume 5 Maritime communities and vegetation of open habitats*. Cambridge University Press.

SMITH, P. 1992. *The sands of time.* National Museums and Galleries on Mersyside in association with Sefton Metropolitan Borough Council.

STRATFORD, C., HUGHES, A., ROBERTS, J. & ROBINS, N. 2006. *Review of Hydrological Reports for Newborough Warren NNR, Anglesey*. CEH, Wallingford.

Map data sources

British Plant Communities.1995. Volumes 1-5. Cambridge University Press, Cambridge.

Coastal vegetation survey of Northern Ireland. 1992. University of Lancaster, Unit of Vegetation Science.

Inter-agency Coastal Specialist Working Group. 1999.

JNCC International Designations Database. Joint Nature Conservation Committee.

Pete Jones (*pers. comm.*) Countryside Council for Wales.

Sand Dune Database. 1995. Joint Nature Conservation Committee.

Sand dune vegetation survey of Scotland. Scottish Natural Heritage.

7.2 Further information on CSM data as presented in Sections 4.2 and 5.2

Table 7.2.1 Summary of the coverage of the data shown in Tables 4.2.1 and 5.2.1

Data	Value
Number of SACs supporting feature (a)	25
Number of SACs with CSM assessments (b)	23
% of SACs assessed (b/a)	92
Extent of feature in the UK – hectares (c)	1,812
Extent of feature on SACs – hectares (d)	1,254
Extent of features assessed – hectares (e)	1,164
% of total UK hectarage on SACs (d/c)	69
% of SAC total hectarage that has been assessed (e/d)	93
% of total UK hectarage that has been assessed (e/c)	64

Notes

1. Extent of features on SACs (d) includes only those features that have been submitted on the official Natura 2000 data form as qualifying features. This figure is based on the habitat extent figures presented on standard Natura 2000 data forms.
2. The data included are from CSM assessments carried out between April 1998 and December 2006. NB: these include additional and some up-date data form those used in the six year report produced by JNCC (Williams, J.M., ed. 2006. *Common Standards Monitoring for Designated Sites: First Six Year Report*. Peterborough, JNCC).

Table 7.2.2 Summary of grid square map data shown in Maps 4.2.1-3 and 5.2.1-3

Status	Number of squares	Proportion of all squares
Current – Unfavourable (red)	22	23%
Current – Favourable (green)	13	14%
On SAC but not assessed (blue)	2	2%
Not on SAC (transparent)	57	61%
Total Number of 10km squares (any colour)	94	100%
Future – Unfavourable (red)	12	13%
Future – Favourable (green)	23	24%