



European Site Conservation Objectives: Supplementary advice on conserving and restoring site features

**Winterton – Horsey Dunes Special Area of Conservation (SAC)
Site Code: UK0013043**



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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to Winterton – Horsey Dunes SAC. This advice should therefore be read together with the SAC Conservation Objectives available [here](#).

Where this site overlaps with other European Sites, you should also refer to the separate European Site Conservation Objectives and Supplementary Advice (where available) provided for those sites.

You should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England when developing, proposing or assessing an activity, plan or project that may affect this site'

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute.

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email

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About this site

European Site information

Name of European Site	Winterton – Horsey Dunes Special Area of Conservation (SAC)
Location	Norfolk
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1 April 2005
Qualifying Features	See section below
Designation Area	425.94 ha
Designation Changes	N/A
Feature Condition Status	Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	Winterton-Horsey Dunes SSSI
Relationship with other European or International Site designations	The SSSI and SAC boundaries are coincident but the Great Yarmouth North Denes SPA is restricted to the beach area which forms a narrow strip running along the entire length of the SSSI. Conservation Objectives for Great Yarmouth North Denes SPA can be found here .

Site background and geography

The SAC is situated on the east Norfolk coast and largely lies within The Broads National Character Area ([NCA Profile 80](#)). This site consists of an extensive dune system supporting acidic plant communities. It contains well-developed areas of dune heath, slacks and dune grassland merging into grazing marsh and downy birch *Betula pubescens* woodland.

The site is unusual in the British context in that it is more similar to the dune systems in the Baltic, which support acidic plant communities, than the calcareous dune sands of the North Norfolk Coast (Stratford et al. 2014). On the continent, there is marked difference between the dunes north of Bergen op Zoom in the Netherlands (near Antwerp), which are deficient in lime content, and those south of Bergen which are calcareous or partly calcareous.

The seaward edge of the dunes is well vegetated with marram *Ammophila arenaria* and lyme-grass *Leymus arenarius*. The older, grey dunes support a more diverse flora with frequent sand sedge *Carex arenaria*, sheep's-fescue *Festuca ovina*, common polypody *Polypodium vulgare* and narrow buckler-fern *Dryopteris carthusiana*. Three rare grasses are present in abundance; grey hair-grass *Corynephorus canescens*, rush-leaved fescue *Festuca juncifolia* and purple marram *X Calammophila baltica*. A notable assemblage of bryophytes and lichens occurs on these acidic dunes.

Dune heath has developed on the landward side with heather *Calluna vulgaris*, bell heather *Erica cinerea*, cross-leaved heath *Erica tetralix* and bog-moss *Sphagnum spp* in the damper hollows. Because of their acidic soils, the dune slacks support swamp and mire communities with notable species including royal fern *Osmunda regalis*. In addition to small areas of typical dune slack vegetation characterised by creeping willow *Salix repens ssp. argentea* with the moss *Calliergon cuspidatum* and Yorkshire-fog *Holcus lanatus*.

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying habitats:

The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- **H2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) (coastal dune heathland).***

Winterton – Horsey Dunes is the only significant area of dune heath on the east coast of England and also includes areas of acidic dune grassland as an associated acidic habitat. The contrast with the nearby calcareous and species-rich dunes of north Norfolk is marked. The Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) vegetation is characteristic of dune heath in an eastern locality with low rainfall. The drought-resistant grey hair-grass *Corynephorus canescens* is a characteristic species of the open dry dune soils.

- **H2110 Embryonic shifting dunes.**

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. On a prograding dune system this vegetation may be the precursor to the main dune-building vegetation dominated by marram *Ammophila arenaria*. In most cases Embryonic shifting dunes are transient and will either be displaced by marram-dominated vegetation as the dunes develop (H2120 Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")) or will be washed away by storms. The continued supply of new sand from the beach plain into the dune system is therefore vital to the continued existence of this community, even if this sand is derived from within the same system. The habitat type is of exceptional importance as an indicator of the general structural and functional 'health' of a dune system. Creation of new dune habitat, and indeed the long-term survival of the dune system at which it occurs, is often dependent upon the survival of this habitat type.

- **H2190 Humid dune slacks.**

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. It is variously associated with Yorkshire-fog *Holcus lanatus* and the bryophytes *Campylium stellatum* and *Calliergon cuspidatum*. A further community is typified by silverweed *Potentilla anserina* and common sedge *Carex nigra*.

- **H2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (shifting dunes with marram).**

Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") encompasses most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-

binding marram *Ammophila arenaria* is always a prominent feature of the vegetation and is usually dominant. In the UK the majority of such vegetation falls within NVC type SD6 *Ammophila arenaria* mobile dune community. This is a dynamic vegetation type maintained only by change. It can occur on both accreting and eroding dunes, but will rapidly change and disappear if stability is imposed. It rarely occurs in isolation because of its dynamic nature and because it is successional related to other dune habitats. The habitat type excludes the low, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram and where plants of the strandline mingle with salt-tolerant, sand-binding grasses; such vegetation is referable to Annex I type H2110 Embryonic shifting dunes.

Annex I priority habitats are denoted by an asterisk (*).

References

Rodwell, J.S. (Ed). 2000. *British plant communities. Maritime communities and vegetation of open habitats*. Cambridge University Press.

Rodwell, J.S. 2006. *National Vegetation Classification: Users' handbook*, JNCC.

Stratford, C., Jones, L., Robins, N., Mountford, O., Amy, S., Peyton, J., Hulmes, L. Hulmes S., Jones, F., Redhead, J., Dean, H. 2013. *Hydro-Ecological survey and analysis of vegetation change in English dune slack habitats*. Report to Natural England, August 2013.

Table 1: Supplementary Advice for Qualifying Features: H2110. Embryonic shifting dunes

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	Extent of the feature within the site	Restore the total extent of the feature to 1.71 hectares.	<p>There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information.</p> <p>The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis.</p> <p>This is the most dynamic, naturally changing, zone of the dune system. Its extent may vary seasonally and through the years. This natural functioning is critically dependent on no interruption of sand movement to and from the foredunes and the beach. Where beaches are narrow or prevailing winds not onshore, this Annex 1 habitat may be limited in extent. Evidence of natural changes to extent should not justify further loss to development.</p> <p>Embryonic shifting dunes are restricted in the area they can occupy on the Winterton-Horsey beach as they are dependent on actively prograding conditions. The main area of accretion is strongly associated with Ness development, which also broadly corresponds to the location of the tern enclosure where human trampling is minimised. Notwithstanding, embryonic dunes are also developing elsewhere at the foot of the frontal dune, though these may be transient features as the constituent</p>	<p>European Environmental Agency. 2015. <i>Winterton - Horsey Dunes – Quick Facts</i>. Available https://eunis.eea.europa.eu/sites/UK0013043</p> <p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from the Norwich Office, Natural England.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>species occupy rather than initiate sand accumulations from bank slippage and their survival may not withstand storm events.</p> <p>OHES (2018) complements the Access and Nature Conservation Guidance Note which sets out Natural England's agreed process for undertaking an Access and Nature Conservation Assessment for access related plans or projects. It is to be used for the consideration of likely significant effect on Natura 2000 sites or impacts on sensitive habitats and species based on anticipated changes to access levels and patterns arising from the implementation of access proposals.</p>	
Extent and distribution of the feature	Spatial distribution of the feature within the site	Restore the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	<p>A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. This zone of shifting dunes occurs between the beach plane and the usually more stable and fully vegetated older dunes. Communities may be dynamic in their distribution and are linked the sedimentary processes operating at the site.</p> <p>The strandline and embryonic dunes are transitory and resilient; they often occur in areas away from the heaviest pressure from people; there is likely to be some localised erosion directly out from Beach Road access and immediately to the north and south of this access point.</p>	
Extent and distribution of the feature	Future extent of habitat within the site and ability to respond to seasonal changes	Restore the ability to absorb seasonal and periodic fluctuations in the extent of the habitat.	<p>This recognises the need to allow for natural fluctuations in the extent and the distribution of this habitat feature, often during particular seasons and usually as a result of natural coastal processes. This ability depends on a continuing linkage between the beach and this Annex 1 habitat, together with the ability of dune building grasses to respond in periods of net sand input.</p> <p>The most obvious impact on the beach and young dune</p>	<p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Unpublished report for Natural England</p> <p>OHES. 2018. <i>An investigation into the vegetation communities</i></p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>vegetation caused by coastal processes is the loss of mobile dunes and foredunes in front of the sea wall which, in creating a 'hard defence' along a high energy section of the coast, is now located seaward of the natural aeolian accretion zone at the head of the beach. Fragments of mobile and foredune may develop at the foot of a naturally eroding frontal dune, albeit as typically ephemeral features, likely to be removed during storm events.'</p> <p>Aerial photography, the remote sensing analysis, the coastal access maps showing areas of erosion, the research by OHES (2016) has been used to determine the current levels of erosion in the foredune feature.</p>	<p>of <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from the Norwich Office, Natural England.</p>
Structure and function (including its typical species)	Dune topography	Restore a natural dune topography, and allow natural change that is wind driven (some change may be necessary to maintain the continuity of slacks).	<p>Dune topography in this zone can change seasonally and through the years due to wind and tidal events. Accumulations of driftline organic material are important for trapping sand and initiating dune formation. See also 'Functional connectivity with wider coastal sedimentary system' and 'Within-site sedimentary processes' component.</p> <p>The re-establishment of strandline, foredune and young mobile dune communities is vigorous in the lee of Winterton Ness where sand accretion around the vegetation is protected by fencing. It is considered unlikely that similar vegetation is currently able to establish on the upper beach along the sections of eroding coast except in fragmentary, ephemeral forms. Notwithstanding, visitor pressure appears to act to obliterate any vegetative growth near Winterton carpark.</p>	OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i> . Available from Natural England
Structure and function (including its typical species)	Presence of unvegetated surfaces	Restore an extent of bare sand of varying sizes in a mosaic with the vegetation (up to 50% of the feature extent).	<p>In these developing, dynamic zones, bare sand should be expected. Lack of bare sand would suggest an artificially stabilised system. Blow-throughs are a natural element of this zone. If extent of sand is towards the upper end of the range, it will become important to assess whether recreational pressures are over-riding natural dynamics.</p> <p>Both foredune and strandline communities are severely damaged or eradicated everywhere where public access is prevalent. This is particularly marked in the vicinity of the</p>	<p>Natural England. 2014. Winterton Access and Nature Conservation Assessment</p> <p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>Winterton car-park.</p> <p>In marked contrast, the tern fencing appears to be respected and both suites of vegetation are in much better condition with the fencing.</p>	
Structure and function (including its typical species)	Vegetation community composition	<p>Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types</p> <p>SD2 <i>Honkenya peploides</i> – <i>Cakile maritima</i> strandline community.</p> <p>SD4 <i>Elymus farctus ssp.boreali-atlanticus</i> foredune community;</p>	<p>This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC).</p> <p>Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e. the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations).</p>	<p>JNCC. 2004. Common Standards Monitoring <i>Guidance for Sand dune</i>. Available: Habitats http://jncc.defra.gov.uk/pdf/CSM_coastal_sand_dune.pdf</p> <p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England.</p>
Structure and function (including its typical species)	Vegetation structure: zonation of dune vegetation	<p>Maintain the cover of this feature at or to 95% of the wider dune frontage.</p>	<p>The coastal sand dune ecosystem has a characteristic range of natural features, representing different stages of natural succession. The full representation of these stages should be maintained or where appropriate restored. On some sites there may be specific natural factors that limit continuous coverage, related to broader scale sediment budgets. Where <i>Leymus arenarius</i> is present, there can be a continuous floristic transition to marram dominated mobile dunes (Shifting dunes along the shoreline with <i>Ammophila arenaria</i>).</p> <p>Embryonic shifting dunes are restricted in the area they can occupy on the Winterton-Horsey beach as they are dependent on actively prograding conditions. The main area of accretion is strongly associated with Ness development, which also broadly corresponds to the location of the tern enclosure where human trampling is minimised. Notwithstanding, embryonic dunes are also developing elsewhere at the foot of the frontal dune, though these may be transient features as the constituent species occupy rather than initiate sand accumulations from</p>	<p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England</p> <p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>bank slippage and their survival may not withstand storm events.</p> <p>At Winterton, the area of erosion under this criteria is likely to approach 5% (as there are only a small number of persistent blowouts and main trackways showing no recolonization, and limited areas where strandline and foredune vegetation is permanently destroyed) and therefore the units would currently pass overall, providing the tern enclosure was retained.</p>	
Structure and function (including its typical species)	Vegetation composition: trees and scrub	Ensure scrub and tree cover is absent or rare, except where sea buckthorn is native (where <10% cover is acceptable).	<p>Dense cover of trees and shrubs can smother and shade out smaller and more characteristic vegetation of this habitat feature, and interrupt naturally occurring dune processes. Usually active management is required to reduce or contain its cover across this habitat feature. Apart from sea buckthorn (where it is native), other trees and shrubs would usually indicate an artificially stabilised system.</p> <p>There is no scrub cover on this feature at Winterton.</p>	
Structure and function (including its typical species)	Vegetation: undesirable species	Maintain the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread.	<p>Two types of negative species can occur: invasive non-natives, or species indicative of poor condition (e.g. nettle or creeping thistle). For known or likely invasive, there should be zero tolerance.</p> <p>Ragwort <i>Senecio jacobaea</i> and False oat-grass <i>Arrhenatherum elatius</i> present but less than 5%.</p>	OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> shed report for Natural England
Structure and function (including its typical species)	Soils, substrate and nutrient cycling	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat.	<p>Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature.</p> <p>This Annex 1 habitat has essentially raw soils with little humus and low nutrient status.</p> <p>No further anthropogenic increase in factors leading to the</p>	OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>decrease of natural mobility of the system. The natural circulation of sand and organic matter should be retained.</p> <p>The natural beach sediment budget is likely to be disrupted by the presence of sea defences. Further movement of the Ness northwards may be restricted by the presence of groynes, though insufficient information makes this speculative.</p> <p>Accumulation of driftline organic material (seaweed etc.) is essential for trapping sand and initiating dune formation. Although present, current dune formation is occurring higher up the beach than the driftline.</p>	
Structure and function (including its typical species)	Key structural, influential and/or distinctive species	<p>Maintain the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat;</p> <ul style="list-style-type: none"> • Constant and preferential plant species of SD2 and SD 4 dune NVC communities which are the main component of the H2110 feature within the SAC • Breeding populations of Little Tern <i>Sternula albifrons</i> and Ringed Plover <i>Charadrius hiaticula</i> • Breeding colony of Grey Seal <i>Halichoerus grypus</i> 	<p>Some plant or animal species (or related groups of such species) make a particularly important contribution to the necessary structure, function and/or quality of an Annex I habitat feature at a particular site. These species will include;</p> <ul style="list-style-type: none"> • Influential species which are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of soil/sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat) • Site-distinctive species which are considered to be a particularly special and distinguishing component of an Annex I habitat on a particular SAC. <p>There may be natural fluctuations in the frequency and cover of each of these species. The relative contribution made by them to the overall ecological integrity of a site may vary, and Natural England will provide bespoke advice on this as necessary.</p> <p>The list of species given here for this Annex I habitat feature at this SAC is not necessarily exhaustive. The list may evolve, and species may be added or deleted, as new information about this site becomes available.</p>	<p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	Adaptation and resilience	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	<p>This recognises the increasing likelihood of natural habitat features to absorb or adapt to wider environmental changes. Resilience may be described as the ability of an ecological system to cope with, and adapt to environmental stress and change whilst retaining the same basic structure and ways of functioning. Such environmental changes may include changes in sea levels, precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of a feature within a site. The vulnerability and response of features to such changes will vary.</p> <p>Using best available information, any necessary or likely adaptation or adjustment by the feature and its management in response to actual or expected climatic change should be allowed for, as far as practicable, in order to ensure the feature's long-term viability.</p> <p>The overall vulnerability of this SAC to climate change has been assessed by Natural England (2015) as being high taking into account the sensitivity, fragmentation, topography and management of its habitats. This means that this site is considered to be the most vulnerable sites overall and are likely to require the most adaptation action, most urgently. A site based assessment should be carried out as a priority.</p> <p>This means that action to address specific issues is likely, such as reducing habitat fragmentation, creating more habitat to buffer the site or expand the habitat into more varied landscapes and addressing particular management and condition issues. Individual species may be more or less vulnerable than their habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable.</p>	<p>Natural England. 2014. <i>Winterton_Access_and_Nature_Conservation_Assessment_v 9_8.9.14</i></p> <p>Natural England, 2015. <i>Climate Change Theme Plan and supporting National Biodiversity Climate Change Vulnerability assessments ('NBCCVAs') for SACs and SPAs in England</i> [Available at http://publications.naturalengland.org.uk/publication/4954594591375360].</p>
Supporting processes (on which the feature relies)	Functional connectivity with wider coastal sedimentary	Maintain adequate movement of sediment from all key sediment sources (directly from the beach, indirectly from offshore, eroding cliffs etc.).	This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features outside of the designated site boundary which are either important for the	OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
	system		<p>continuous supply of sediment (such as soft eroding cliffs, dunes, offshore sand banks) or for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site.</p> <p>These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial.</p> <p>Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis. This Annex 1 habitat is an integral element of the 'coastal foredune' (the beach-dune sand-sharing system). However, it is also important that sediment transport that feeds the beach from offshore is also not interrupted. In some cases sand may come from marram-dominated dunes landward (Shifting dunes along the shore with <i>Ammophila arenaria</i>).</p> <p>The scientific integrity of Winterton Ness is dependent upon a constant flow of sediment from the north. Although this flow has been reduced by coastal protection works the supply is sufficient to keep the ness mobile.</p> <p>The sea wall on the frontage of much of the site essentially fixes the embryonic and mobile dune system, and hence interrupts the ability of these features to shift and change in response to changing sediment supply.</p>	Available from Natural England
Supporting processes (on which the feature relies)	Aeolian (wind-blow) processes	Maintain the natural movement of sand within the site, resulting from wind blow-outs and blow-throughs.	<p>Allowing natural wind-blow (or 'aeolian') processes to operate and to allow active movement of dry sand is important. Blow-throughs are a natural element of the dynamics of this zone. However, excessive recreational pressure can inhibit vegetation growth in sand building phases.</p> <p>This target would take into account that some mobility of sand and low level disturbance is required for some species and only becomes an issue when re-colonisation is prevented by</p>	OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i> . Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>excessive disturbance. Thus excavation of holes by dogs, for example, would not be considered detrimental unless the vegetation were prevented from recolonizing by repeat disturbance.</p> <p>Management options to combat trampling erosion are fairly limited at these sites, namely consisting of either re-routing pathways, constructing artificial surfaces or using temporary fencing to rest areas.</p>	
Supporting processes (on which the feature relies)	Hydrology	At a site, unit and/or catchment level (as necessary) maintain natural hydrological processes to provide the conditions necessary to sustain the feature within the site.	<p>Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present.</p> <p>This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. On a few sites, the development of new Embryonic shifting dunes can lead to new primary dune slacks forming.</p>	
Supporting processes (on which the feature relies)	Air quality	Maintain the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	<p>This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it.</p> <p>Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH₃), oxides of nitrogen (NO_x) and sulphur dioxide (SO₂), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a</p>	<p>More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).</p> <p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England</p> <p>Willis. A.J. 1965. The Influence of Mineral Nutrients on the Growth</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>case-by-case basis.</p> <p>Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales.</p> <p>In recent decades, increased atmospheric nitrogen pollution has altered the physiognomy and floristic composition of coastal acidic dune systems in northwest Europe. Many authors have undertaken extensive surveys (e.g. Stevens <i>et al.</i> 2011) or experimented in a range of oligotrophic sandy habitats in order to understand the likely impacts of N-deposition on sensitive vegetation. For example, Willis (1965) observed an increase of grasses in a dry dune pasture after adding a general fertilizer, while Boorman & Fuller (1982) noticed a decline of annuals, mosses, and lichens in coastal grey dune vegetation after adding Nitrogen.</p> <p>However, vegetation responses to N-deposition have been varied, with key variables including the amount of Nitrogen being added, the stage of successions (including the amount of organic matter in the topsoil), the degree of leaching effected in humus-poor soils or by the possibility that phosphorus becomes limiting.</p>	<p>of <i>Ammophila Arenaria</i> <i>Journal of Ecology</i> Vol. 53, No. 3 (Nov., 1965), pp. 735-745</p> <p>Boorman. L.A and Fuller. R. M. 1982. Effects of Added Nutrients on Dune Swards Grazed by Rabbits. <i>Journal of Ecology</i> Vol. 70, No. 1 (Mar., 1982), pp. 345-355</p>
Supporting processes (on which the feature relies)	Conservation measures	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the feature.	<p>Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England.</p> <p>This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.</p>	OHES. 2018. An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification. Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>For this feature, direct habitat and species management is not expected to take place in this zone. However, excessive recreational activity can be damaging and may well need to be managed.</p> <p>On the seaward side of the frontal dune where Winterton Ness is developing, tern fencing has done much to protect the fore- and mobile dune communities.</p>	
<p>Version Control Advice last updated: N/A</p>				
<p>Variations from national feature-framework of integrity-guidance: Supporting processes (on which the feature relies) – water quality attribute has been removed as not relevant to these embryonic dunes.</p>				

Table 2: Supplementary Advice for Qualifying Features: H2120. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Shifting dunes with marram

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	Extent of the feature within the site	Restore the total extent of the feature to at least 4.09 hectares.	<p>There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information.</p> <p>The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations.</p> <p>Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis.</p>	<p>European Environmental Agency. 2015. Winterton - Horsey Dunes – Quick Facts. Available https://eunis.eea.europa.eu/sites/UK0013043</p> <p>Natural England. 2014. Winterton_Access_and_Nature_Conservation_Assessment_v9_8.9.14</p>
Extent and distribution of the feature	Spatial distribution of the feature within the site	Restore the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	<p>A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes.</p> <p>This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat. Smaller fragments of habitat can typically support smaller and more isolated populations which are more vulnerable to extinction. These fragments also</p>	<p>OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England</p> <p>Doarks, C., Woolven, S.C., Radley, G.P., and Hedley, S.M. 1989. <i>Sand dune survey of Great Britain. Site Report no. 74. Winterton to Horsey Dunes, Norfolk 1989.</i> JNCC Report No. 124. Peterborough: Joint Nature</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature.</p> <p>For this feature, this strongly relates to the coastal processes (sand deposition by wind, tideline debris to initiate sand trapping and lack of disturbance during growing season) as well as seed/propagule supply that determine the presence of the habitat. Distribution of habitat relates to the availability of blown sand from the beach plain, as well as seed/propagule supply that determine the presence of the habitat. <i>Ammophila arenaria</i> (Marram grass) plants also have a mycorrhizal association.</p> <p>At Winterton, the mobile dune habitat is situated on the top and seaward flank of the frontal dune south of Unit 3 (where it is absent), and may extend landwards where sand has recently been disturbed, or seawards in front of Unit 13, where immature mobile dunes have formed in the lea of the developing Ness. Where it is present, mobile dunes may be fronted by foredunes, though this is only well-developed within the tern enclosure.</p> <p>The extent of this feature is probably about the same now as it was in 1989 but the locations have altered along both the eroding and accreting sections of the coastline. Where the Ness is developing north of Winterton Beach Café, sand accretion has promoted the formation of quite vigorous mobile dune stands, protected by the tern fencing. Elsewhere, however, erosion and trampling are largely preventing vegetation establishment. The supply of sediment is likely to be affected by the hard sea defences.</p>	Conservation Committee.
Structure and function (including its typical	Vegetation community composition	Ensure the component vegetation communities of the feature are referable to and characterised by the following	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring the presence,	OHES. 2018. <i>An investigation into the vegetation communities of Winterton-Horsey Dunes SSSI: Assessment of current condition</i>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
species)		National Vegetation Classification types SD6 (<i>Ammophila arenaria</i> mobile dune community) SD7 (<i>Ammophila arenaria</i> - <i>Festuca rubra</i> semi-fixed dune community)	variety and composition of these vegetation types at this site will help to conserve the typical species composition of the SAC feature at this site at appropriate levels (recognising natural fluctuations). There are a number of sub-communities and there will be natural fluxes in the transition between the mobile dunes and fixed dunes seaward as sand deposition changes.	<i>and change since notification.</i> Available from Natural England
Structure and function (including its typical species)	Vegetation: undesirable species	Maintain the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread	Undesirable non-woody and woody vascular plants species may require active management to avert an unwanted succession to a different and less desirable state. Often they may be indicative of a negative trend relating to another aspect of a site's structure and function. These species will vary depending on the nature of the particular feature, and in some cases these species may be natural/acceptable components or even dominants.	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England
Structure and function (including its typical species)	Vegetation community transitions	Maintain and restore where practicable the full natural range of vegetation zones and the transitions between them.	Zonations are seen as indicative of good conservation of structure and function. It is essential that the relationship between this habitat and other elements of the sand dune system are recognised. As much of the dune frontage as possible should have intact zonation to the next stage in succession (generally fixed dunes). This target needs to be determined at a site level, as there may be specific factors that naturally limit continuous coverage. This transition of the mobile dune vegetation across the face of three types of fixed dune appears to follow the retreat of the frontal dune through coastal erosion, though its floristic composition retains little of the species-richness associated with the more developed forms of fixed dune vegetation. The stand is dominated by dense marram tussocks and <i>Carex arenaria</i> is restricted to a constant but subordinate role in a relatively stable form of this sub-community with little sand movement.	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification.</i> Available from Natural England
Structure and function	Dune topography	Restore a natural topography to the shifting dune feature.	Dune topography may be influenced by the operation of geomorphological processes, which should be allowed to	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of</i>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
(including its typical species)			<p>continue in order to maintain the dune system in its naturally dynamic form. Maintaining this zone in a natural form, and as part of the wider dune zonation, will provide optimal conditions for the full range of characteristic flora and fauna. The low shifting dunes on the foreshore provide a vital structural element to any dune system: the varied natural topography provides important means of dune-building and progradation seawards. Key dune-building plants such as <i>Ammophila arenaria</i> (Marram grass) is sensitive to salinities over 1.5% so only persists on higher dune ridges.</p> <p>Coastal erosion and the fixing of the mobile dune system by the sea wall has clearly truncated the typical <i>Ammophila</i> mobile dune phase along some sections of the frontal dune which would typically have extended seawards. It is absent from Unit 3 and further south this is a remnant and diminishing vegetation over a sand surface that is not accreting. South of the sea wall, the seaward face of the frontal dune is typically a steep, eroding slope with patches of vegetation which have obviously slipped from above as the base of the slope is ripped away by the sea. Behind the protection of the Ness, however, shifting dune vegetation has become well-established in front of this formerly eroding edge of the frontal dune.</p> <p>As previously described, the capacity for dune re-creation is affected both by the sea wall and groynes, which reduce the beach's natural supply of sand during storms used for Ness extension and dune accretion, and by repeated trampling pressure, which prevent the establishment of mobile dune communities.</p> <p>The sea wall on the frontage of much of the site essentially fixes the embryonic and mobile dune system, and hence interrupts the ability of these features to shift and change in response to changing sediment supply.</p>	<p>current condition and change since notification. Available from Natural England</p>
Structure and function (including its	Presence of unvegetated surfaces	Maintain the extent of bare sand which typically covers up to 50% of the feature extent, of varying	In these developing, dynamic zones, bare sand should be expected. Lack of bare sand would suggest an artificially stabilised system. Blow-outs are a natural element of this zone.	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change</i>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
typical species)		<p>sizes, in a mosaic with the vegetation.</p> <p>Surface erosion due to human disturbance (such as informal bare sand paths through mobile dune communities) or blowouts should not exceed 5% of the mobile/foredune total area.</p> <p>N.B. "Erosion" in this case should not include areas where vegetation is actively recolonizing, but only those areas which are persistently bare sand.</p>	<p>If extent of sand is towards the upper end of the range, it will become important to assess whether recreational pressures are over-riding natural dynamics.</p> <p>This target would take into account the ability of mobile dune communities to comfortably contain a significant proportion of bare sand, but to highlight those areas where trampling or wind erosion is at sufficient levels that vegetation cannot naturally recover. These areas would need temporarily fencing to alleviate some of the disturbance.</p>	<p><i>since notification</i>. Available from Natural England</p>
Structure and function (including its typical species)	Key structural, influential and distinctive species	<p>Maintain the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat;</p> <ul style="list-style-type: none"> Constant and preferential plant species of SD6 and SD7 dune NVC communities which are the main component of the H2120 feature within the SAC 	<p>See generic text for this attribute in Table 1</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p>
Structure and function (including its typical species)	Supporting off-site habitat	<p>Maintain the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature, within the constraints of natural coastal processes</p>	<p>Include only where applicable. The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to</p>	<p>OHES. 2015. Other survey of non-designated land</p> <p>Natural England. Aerial surveys of Winterton-Horsey Dunes</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			prevent/reduce/absorb damaging impacts from adjacent land uses e.g. pesticide drift, nutrient enrichment.	
Structure and function (including its typical species)	Functional connectivity with wider landscape	Maintain the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site	<p>This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site.</p> <p>These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis.</p> <p>It is very likely that a network of routeways over the dunes has been perpetuated throughout human occupation of the coastal landscape, and may be associated with access to the shore as well as to the uses to which the dunefield has been put.</p>	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England
Structure and function (including its typical species)	Adaptation and resilience	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	See generic text for this attribute in Table 1.	
Structure and function (including its typical species)	Soils, substrate and nutrient cycling	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the	Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		habitat.	soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature. This Annex 1 habitat has essentially raw soils with little humus and low nutrient status.	
Supporting processes (on which the feature relies)	Conservation measures	Restore the management measures within and outside the site boundary, which are necessary to restore the structure, functions and supporting processes associated with the feature.	<p>Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England.</p> <p>This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.</p> <p>Management should consider the structures on and functions of the site as a whole. Management measures specifically aimed at maintaining and enhancing the features for which they are designated and to address some of the pressures and future threats.</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England</p>
Supporting processes (on which the feature relies)	Air quality	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	<p>This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it.</p> <p>Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH₃), oxides of nitrogen (NO_x) and sulphur dioxide (SO₂), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis.</p>	<p>More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).</p> <p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales.</p> <p>In recent decades, increased atmospheric nitrogen pollution has altered the physiognomy and floristic composition of coastal acidic dune systems in northwest Europe. Many authors have undertaken extensive surveys (e.g. Stevens <i>et al.</i> 2011) or experimented in a range of oligotrophic sandy habitats in order to understand the likely impacts of N-deposition on sensitive vegetation.</p> <p>For example, Willis (1963) observed an increase of grasses in a dry dune pasture after adding a general fertilizer, while Boorman & Fuller (1982) noticed a decline of annuals, mosses, and lichens in coastal grey dune vegetation after adding Nitrogen. However, vegetation responses to N-deposition have been varied, with key variables including the amount of Nitrogen being added, the stage of successions (including the amount of organic matter in the topsoil), the degree of leaching effected in humus-poor soils or by the possibility that phosphorus becomes limiting.</p>	
Supporting processes (on which the feature relies)	Aeolian (wind-blow) processes	Maintain the ability of wind-blow processes to transport sand from the beach plain to the foredune.	Allowing natural wind-blow (or 'aeolian') processes to shape the topography of this habitat feature is important to its long-term conservation. The beach plain needs to be dry to allow sand to be transported into the dune system.	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: N/A				
Supporting processes (on which the feature relies) – Water Quality and Hydrology attributes deleted as not relevant to H2120. Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes"); Shifting dunes with marram.				

Table 3: Supplementary Advice for Qualifying Features: H2150. Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) *

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	Extent of the feature within the site	Maintain the total extent of the feature to approximately 28.18 hectares	<p>There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys.</p> <p>Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information.</p> <p>The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis.</p> <p>The bulk of the approximately 200ha of this habitat in England is found on only 5 sites, all of which are SACs. Due to the very limited extent and the absence of knowledge about reinstatement, any reduction in extent to development, even of a small part of one site would be considered an adverse impact.</p> <p>This feature is extremely rare nationally and highly sensitive to erosion; it is currently considered at the limit of acceptable levels of anthropogenic erosion.</p>	<p>European Environmental Agency. 2015. Winterton - Horsey Dunes – Quick Facts. Available https://eunis.eea.europa.eu/sites/UK0013043</p> <p>Natural England. 2014. Winterton_Access_and_Nature_Conservation_Assessment_v 9_8.9.14</p>
Extent and distribution of the feature	Spatial distribution of the feature within the site	Maintain the distribution of the dune heath Annex I habitat across the site, and transitions with and between other dune or terrestrial habitats, including fixed	A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		dune grassland, acid dune grassland and lowland heath.	<p>future environmental changes. This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat. Smaller fragments of habitat can typically support smaller and more isolated populations which are more vulnerable to extinction. These fragments also have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature.</p> <p>In general, blocks of <i>Calluna</i>-dominated heath remain a feature of the central part of the SSSI – largely within Unit 13. However, many scattered fragments are present in a grassy mosaic around their boundaries and are distinguished as a form of 'grass-heath'. It is not clear whether the sub-shrub is colonising the dune grassland or now forms a relic of a previously more extensive area of dune heath.</p>	
Structure and function (including its typical species)	Vegetation community composition	<p>Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types</p> <p>H11c <i>Calluna vulgaris</i>-<i>Carex arenaria</i> heath, Species-poor sub-community.</p>	<p>This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC).</p> <p>Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e. the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations).</p> <p>On the Winterton-Horsey Dunes, heather stands are a frequent habitat type of the fixed dunes. They are a particular feature of</p>	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>Unit 13, creeping into small areas of Units 12 and 15. The species composition of the heather stands is so similar to related vegetation that a note of caution is required in their description.</p> <p>Much of the heather is in a mosaic with fixed dune grasslands of very similar species composition. Two distinct forms of this vegetation type were distinguished, largely on the basis of the relative abundance of ground lichens. These were the <i>Festuca ovina</i> sub-community of the SD11 <i>Carex-Cornicularia</i> grassland and the <i>Anthoxanthum odoratum</i> sub-community of the SD12 <i>Carex-Festuca-Agrostis</i> grassland.</p> <p>The <i>Carex-Cornicularia</i> grassland tends to be a thin sward with very scattered clumps of heathers, and was retained as a distinct stand. Some areas of the <i>Carex-Festuca-Agrostis</i> grassland, however, such as in the vicinity of NGR 648561 321700, are best viewed as forming an intimate mosaic with the <i>Erica cinerea</i> or Species-poor sub-communities of H11 <i>Calluna-Carex</i> heath.</p>	
Structure and function (including its typical species)	Vegetation: undesirable species	<p>Restore the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread.</p> <p>These can include Bracken <i>Pteridium aquilinum</i>, Bukhara fleecflower <i>Fallopia baldschuanica</i> and Rhododendron <i>Rhododendron ponticum</i>.</p> <p>Broom forkmoss <i>Dicranum scoparium</i> and occasionally Heath Star moss <i>Campylopus</i></p>	<p>Undesirable non-woody and woody vascular plants species may require active management to avert an unwanted succession to a different and less desirable state. Often they may be indicative of a negative trend relating to another aspect of a site's structure and function. These species will vary depending on the nature of the particular feature, and in some cases these species may be natural/acceptable components or even dominants.</p> <p>For this feature, two types of negative species can occur: invasive non-natives, or species indicative of poor or declining condition. For known or likely invasive species there should be zero tolerance. Invasive non-native species may be an issue, the presence of non-natives and other undesirable species could be an indication of increased stability. Some species are potentially more invasive into areas of bare sand and will require specific management on site.</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>Natural England. 2014. IPENS Site Improvement Plan - Great Yarmouth Winterton Horsey</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		<i>introflexus</i> are present throughout	There is a need to undertake control of Russian vine in the Great Valley at Winterton.	
Structure and function (including its typical species)	Vegetation community transitions (range and zones)	<p>Maintain the typical patterns of zonations/transitions between the feature and landward to other dune habitats or terrestrial and wetland habitats.</p> <p>SD11 <i>Carex arenaria</i> - <i>Cornicularia aculeata</i> dune community</p> <p>SD12 <i>Carex arenaria</i> - <i>Festuca ovina</i> - <i>Agrostis capillaris</i> dune grassland</p>	<p>Transitions/zonations between adjacent but different vegetation communities are usually related to naturally-occurring changes in soil, aspect or slope. Such 'ecotones' retain characteristics of each bordering community and can add value in often containing species not found in the adjacent communities. Retaining such transitions can provide further diversity to the habitat feature, and support additional flora and fauna. For this habitat, fluctuations in the extent of grasses to dwarf shrubs can occur over time, but there should be evidence on re-colonisation by dwarf shrubs.</p> <p>This feature generally occurs in a diverse mosaic of fixed dune vegetation types, particularly SD11 and SD12. These are critical in supporting the dune heath community and its transitions.</p>	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England.
Structure and function (including its typical species)	Functional connectivity with wider landscape	Maintain the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site.	<p>This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site.</p> <p>These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis.</p> <p>The wide range of associates may indicate the role of this form</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>OHES. 2015. <i>Covering non-designated land</i>. Available From Natural England.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			of coastal heath as both a later successional stage for ungrazed fixed grasslands, where bramble bushes and birch saplings are establishing, but may also represent a transitional zone between the parched habitats of the slightly raised sand plain and relict dunes, and the moister soils that support damp heath and the <i>Molinia</i> mire. The rather less parched soils of the shaded slopes of the dunefield, and on the more developed soils of the older sand plain, may favour <i>Calluna</i> germination and regeneration and provide more amenable conditions for the development of coastal heath.	
Structure and function (including its typical species)	Adaptation and resilience	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	<p>See generic text for this attribute in Table 1.</p> <p>Although it is recognised that this form of dune heath may naturally lie closer to the physiognomy of grass-heaths found, for example, in Breckland, even quite moderate visitor pressure caused by trampling and ground compaction may be progressively compounding existing damage to these stands. A dense network of small tracks criss-cross much of this vegetation and may represent decades of quite moderate disturbance.</p> <p>While this process is likely to be the result of habitat sensitivity over a prolonged period, infrequent but widespread trampling appears to be exacerbating the poor recovery ability of the heather stands, particularly in drier areas, allowing successful establishment of an undesirable bryophyte flora. This community and its transitions to other fixed dune communities is rich in <i>Cladonia</i> lichens, which are very sensitive to trampling pressure.</p>	
Structure and function (including its typical species)	Key structural, influential and distinctive species	<ul style="list-style-type: none"> Maintain the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat Constant and preferential plant species of SD11, SD12 	See generic text for this attribute in Table 1.	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>Natural England. 2014. <i>Winterton_Access_and_Nature_</i></p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		<p>and H11 NVC communities which are the main component of the H2150 feature within the SAC</p> <ul style="list-style-type: none"> Breeding population of Nightjar <i>Caprimulgus europaeus</i> 		Conservation_Assessment_v 9_8.9.14
Structure and function (including its typical species)	Soils, substrate and nutrient cycling	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat.	<p>Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter.</p> <p>Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature this habitat depends on acidic surface layers which overlie acidic sand or sand deposits that have been subject to long-term leaching.</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>OHES. 2016. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England</p> <p>Natural England. 2014. <i>Winterton_Access_and_Nature_Conservation_Assessment_v 9_8.9.14</i></p>
Supporting processes (on which the feature relies)	Conservation measures	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to restore the structure, functions and supporting processes associated with the feature.	<p>Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England.</p> <p>This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.</p> <p>Dune heath specifically requires stable sand with no inputs of</p>	Natural England. 2014. IPENS Site Improvement Plan - Great Yarmouth Winterton Horsey

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>calcareous sand, surface layers should not be disturbed as these have been leached over long time periods.</p> <p>Eradication of Rhododendron, and control of native scrub encroachment within the dune grassland / heath is an issue that requires ongoing management.</p>	
Supporting processes (on which the feature relies)	Air quality	Maintain the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	<p>See generic text for this attribute in Table 1</p> <p>In recent decades, increased atmospheric nitrogen pollution has altered the physiognomy and floristic composition of coastal acidic dune systems in northwest Europe. Many authors have undertaken extensive surveys (e.g. Stevens et al. 2011) or experimented in a range of oligotrophic sandy habitats in order to understand the likely impacts of N-deposition on sensitive vegetation.</p> <p>For example, Willis (1965) observed an increase of grasses in a dry dune pasture after adding a general fertilizer, while Boorman and Fuller (1982) noticed a decline of annuals, mosses, and lichens in coastal grey dune vegetation after adding Nitrogen. However, vegetation responses to N-deposition have been varied, with key variables including the amount of Nitrogen being added, the stage of successions (including the amount of organic matter in the topsoil), the degree of leaching effected in humus-poor soils or by the possibility that phosphorus becomes limiting.</p>	<p>More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).</p> <p>Willis. A.J. 1965. The Influence of Mineral Nutrients on the Growth of <i>Ammophila Arenaria</i> <i>Journal of Ecology</i> Vol. 53, No. 3 (Nov., 1965), pp. 735-745</p> <p>Boorman. L.A and Fuller. R. M. 1982. Effects of Added Nutrients on Dune Swards Grazed by Rabbits. <i>Journal of Ecology</i> Vol. 70, No. 1 (Mar., 1982), pp. 345-355</p> <p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion Results and Future Monitoring Protocols</i>. Available from Natural England</p>
Supporting processes (on which the feature relies)	Water quality	Where the feature is dependent on surface water and/or groundwater, restore water quality and quantity to a standard	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and	Stratford, C. <i>et al.</i> 2012. Survey and analysis of vegetation and hydrological change in English dune slack habitats . Report by

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		which provides the necessary conditions to support the feature.	<p>inadequate quantities of water can adversely affect the structure and function of this habitat type.</p> <p>Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.</p> <p>Given the sensitive nature of the hydrological system and its role in the hydro-ecological conditions at the site, it would be worthwhile installing and operating a groundwater monitoring network, to provide better understanding of both water level and water quality. This could incorporate the dipwells previously installed but would ideally extend north and, in particular, south of this area.</p>	CEH (NECR153)
Supporting processes (on which the feature relies)	Hydrology	At a site, unit and/or catchment level as necessary, restore natural hydrological processes to provide the conditions necessary to sustain the feature within the site.	<p>Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts.</p> <p>The hydrological system in the northern part of this site is strongly influenced by the sea wall. The regime is therefore different to that observed at the other sites in this study. This, in combination with the differences in soil and groundwater chemistry, create contrasting hydro-ecological conditions and these are reflected by the unusual (for the UK) dune wetland vegetation at the site.</p>	Stratford, C. <i>et al.</i> 2012. Survey and analysis of vegetation and hydrological change in English dune slack habitats . Report by CEH (NECR153)
Version Control: Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: N/A				

Table 4: Supplementary Advice for Qualifying Features: H2190. Humid dune slacks

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	Extent of the feature within the site	Maintain the total extent of the feature to 3.9 hectares	<p>There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information. The extent of dune slack and associated wetland communities was measured at 3.9ha in 1989 (Doarks <i>et al.</i>, 1989) and 5.7ha in 2012 (CEH, 2014), although this probably reflects interpretation rather than change in extent.</p> <p>The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis.</p> <p>For this feature if loss (or gain) of area is from natural physical dynamism this is not a decline in condition, but any significant loss due to human interference (e.g., sand extraction, visitor impacts, ploughing or conversion to improved grassland) is to be regarded as unfavourable. In a naturally functioning dune system some dune slacks will, over time, dry out but new ones will be created by sand blow (secondary slacks) or by beach development (primary slacks).</p> <p>Humid dune slacks represents the wetter and early succession elements of dune wetlands. All elements of the wet-dry and early-late succession spectrums should be represented on the site. Evidence of natural changes to extent should not justify further loss to development. H2170 - Dunes with creeping willow <i>Salix repens</i> are characteristic of older, drier dune</p>	<p>European Environmental Agency. 2015. Winterton - Horsey Dunes – Quick Facts. Available https://eunis.eea.europa.eu/sites/UK0013043</p> <p>Natural England. 2014. Winterton_Access_and_Nature_Conservation_Assessment_v 9_8.9.14</p> <p>Doarks, C., Woolven, S.C., Radley, G.P., and Hedley, S.M. 1989. <i>Sand dune survey of Great Britain. Site Report no. 74. Winterton to Horsey Dunes, Norfolk 1989.</i> JNCC Report No. 124. Peterborough: Joint Nature Conservation Committee.</p> <p>CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats.</i> Annex 7 - Site report for Winterton, Report by CEH (NECR153)</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			slacks, therefore, this Annex 1 habitat needs to be assessed in combination with it.	
Extent and distribution of the feature	Dune topography	Maintain a natural dune topography, but allow natural change that is wind driven (some change may be necessary to maintain the continuity of slacks).	It is possible that on some sites there are over-riding constraints that will not allow natural dune dynamics to proceed. On these sites it may be necessary to artificially lower ground surface levels in slacks to extend their lives. See also 'Within-site sedimentary processes' component.	Natural England. 2014. <i>Winterton_Access_and_Nature_Conservation_Assessment_v 9_8.9.14</i>
Extent and distribution of the feature	Spatial distribution of the feature within the site	Maintain the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	<p>A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat.</p> <p>Smaller fragments of habitat can typically support smaller and more isolated populations which are more vulnerable to extinction. These fragments also have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature. In the short term, dune wetland features are fixed in space determined by dune topography and hydrology. However, in a naturally functioning dune system topography can change leading to localised losses and gains in dune wetlands, including Humid dune slacks.</p> <p>It is quite likely that the sea wall and its foundations are largely responsible for this, preventing groundwater discharge to the east (beach) in the northern area, whilst outflow is unrestricted in the southern area. The contrasting elevation inland is also likely to influence conditions in the dunes. There are various 'ponds' in the northern part of the site, which are smaller and</p>	CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>more deeply incised than the dune slacks seen at other sites.</p> <p>The hydro-ecological conditions in these ponds have been noted as suitable habitat for natterjack toads however a decline in the numbers of natterjack toads recorded in the ponds has been a source of concern over the past 5 to 10 years largely associated with changes in water quality.</p> <p>The extent to which the sea wall acts to maintain a raised water table and the extent to which this might influence the impact of possible future changes in temperature (and related evapotranspiration) and rainfall has not been quantified.</p>	
Extent and distribution of the feature	Future extent of habitat within the site and ability to respond to seasonal changes	Maintain the ability to absorb seasonal and periodic fluctuations in the extent of the habitat.	<p>This recognises the need to allow for natural fluctuations in the extent and the distribution of this habitat feature, often during particular seasons and usually as a result of natural coastal processes. Humid dune slacks are buffered from short term natural variations in hydrology including dry seasons. However, artificial drainage or a longer series of dry years with lowered water table will lead to early succession away to non-dune wetland habitat. In the medium term, a degree of dune dynamics is required to create new dune slacks.</p> <p>Whilst evapotranspiration is broadly similar across many of the UK sites, rainfall varies considerably, and Winterton is one of the sites receiving the lowest average amounts of rainfall. The long term (1961 to 2012) average annual rainfall for this area (area defined as the 40km x 40km grid square calculated using the Meteorological Office Rainfall and Evapotranspiration Calculation System (MORECS)) is 622 mm, and the long term (1961 to 2012) average annual net (rainfall – actual evaporation) is 92 mm. This means that there is very little water available to drive or support a rising water table, and that relatively small changes in the timing and amount of rainfall could bring about a recharge deficit.</p>	CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)
Structure and function (including its	Presence of unvegetated surfaces	Maintain an extent of bare ground or sand which is no more than 20% of the total dune slack	Patches of bare sand are essential for a wide range of dune invertebrates and colonisation by some bryophytes.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
typical species)		area.		
Structure and function (including its typical species)	Vegetation community composition	<p>Maintain the component vegetation communities and associated transitions, allowing for successional changes in response to natural processes.</p> <p>M16 <i>Erica tetralix</i> – <i>Sphagnum compactum</i> wet heath</p> <p>M23 <i>Juncus effusus/acutiflorus-Galium palustre</i> rush-pasture</p> <p>M25 <i>Molinia caerulea-Potentilla erecta</i> mire</p> <p>H11 <i>Calluna vulgaris-Carex arenaria</i> heath</p> <p>S4 <i>Phragmites australis</i> swamp</p> <p>W4 <i>Betula pubescens-Molinia caerulea</i> woodland</p>	<p>This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC).</p> <p>Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e. the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations).</p> <p>For this feature it is unlikely that all slack communities will be represented in a single slack. It is more usual for individual slacks to be at different stages in vegetation succession, and to have slightly different hydrological regimes. The target relates to the humid dune slack resource across the whole site.</p> <p>As a result of the underlying soil type, the dune-slack communities more attributable to Mire (M) and Heath (H) communities of the National Vegetation Classification than those traditionally associated with dune-slacks (SD13-17); particularly unusual on the East coast. M16 <i>Erica tetralix-Sphagnum compactum</i> wet heath and H11 <i>Calluna vulgaris-Carex arenaria</i> heath are the most common communities, occurring individually in comparable measure, and occasionally as mosaics, in depressions of varying size across the site. The Lichen-rich mixed Ericaceous heath is dominated by <i>Calluna vulgaris</i> with <i>Carex arenaria</i>, <i>Agrostis stolonifera</i> and rare <i>Erica tetralix</i>. Where the <i>E. tetralix</i> dominates in the M16 mire, it is accompanied by <i>Osmunda regalis</i> and other ferns, <i>Molinia caerulea</i>, <i>Carex nigra</i>, <i>Juncus conglomeratus</i>. In the wetter part of the site, and towards the seaward edge of the dunes, W4 <i>Betula pubescens-Molinia caerulea</i> woodland occurs with</p>	<p>OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i>. Available from Natural England</p> <p>CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i>. Annex 7 - Site report for Winterton, Report by CEH (NECR153)</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<i>Salix</i> spp., grading into the wet heath/bog to the West, and with some transition to M23 <i>Juncus effusus/acutiflorus-Galium palustre</i> rush-pasture and S4 <i>Phragmites australis</i> swamp and reed-beds. Some small (seasonal) pools of S4 are present with species including <i>Hydrocotyle vulgaris</i> , <i>Typha angustifolia</i> , <i>Eleocharis palustris</i> and <i>Potamogeton polygonifolius</i> . Some of the smaller depressions, particularly in the South of the site also support M23, with areas of M25 <i>Molinia caerulea-Potentilla erecta</i> mire where <i>M. caerulea</i> is more predominant.	
Structure and function (including its typical species)	Vegetation structure: zonation of dune vegetation	Maintain succession of dune slack stages (early, middle and later). All humid slack communities should be present – from embryonic dune slacks with a high % of bare ground to those with more closed vegetation and up to 33% cover of creeping willow <i>Salix repens</i> . Early dune slack successional stages at least occasional.	The coastal sand dune ecosystem has a characteristic range of natural features, representing different stages of natural succession. The full representation of these stages should be maintained or where appropriate restored. The target relates to the humid dune slack resource across the whole site. Not all slack communities will be represented in a single slack. It is more usual for individual slacks to be at different stages in vegetation succession, and to have slightly different hydrological regimes. A mosaic of other wetland vegetation communities are frequently present within dunes (swamp/mire/tall herb fen). These are all important elements of the dune system and may have hydrological connectivity with the dune slack habitats.	CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)
Structure and function (including its typical species)	Vegetation composition: trees and scrub	Maintain scrub and tree cover of locally native species to between 5% and 10%, scattered and in small groups. Cover of creeping thistle <i>Salix repens</i> not more than 33%.	Dense cover of trees and shrubs can smother and shade out smaller and more characteristic vegetation of this habitat feature, and interrupt naturally occurring dune processes. Usually active management is required to reduce or contain its cover across this habitat feature. Apart from sea buckthorn (where it is native), other trees and shrubs would usually indicate an artificially stabilised system. The 'humid dune slack' community requires soil to be wet enough and not too dominated by creeping willow (<i>Salix repens</i>) for a diverse range of forbs and some grasses to be also present. The target relates to the humid dune slack resource across the whole site.	CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)
Structure and	Vegetation	Maintain a typically low	Maintain low swards required by some dune slack species.	CEH. 2014. <i>Survey and analysis</i>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
function (including its typical species)	composition: forb/grass ratio	vegetation sward with >30% cover of forbs and <50% cover of grasses, and occasional bryophytes e.g. <i>Calliargon cuspidatum</i> , <i>Campylium stellatum</i>	Drying and eutrophication of the slack can be indicated by increase in 'grassiness'.	<i>of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)
Structure and function (including its typical species)	Vegetation: undesirable species	Restore the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread;	<p>Undesirable non-woody and woody vascular plants species may require active management to avert an unwanted succession to a different and less desirable state. Often they may be indicative of a negative trend relating to another aspect of a site's structure and function. These species will vary depending on the nature of the particular feature, and in some cases these species may be natural/acceptable components or even dominants.</p> <p>Undesirable species include: rose <i>Rosa spp.</i>, Creeping thistle <i>Cirsium arvense</i>, Spear thistle <i>Cirsium vulgare</i>, Common stinging nettle <i>Urtica dioica</i>, Perennial ryegrass <i>Lolium perenne</i>, False oat-grass <i>Arrhenatherum elatius</i>, Bracken <i>Pteridium aquilinum</i>, Bramble <i>Rubus fruticosus</i>, Rosebay willow-herb <i>Chamaenerion angustifolium</i>, Crested dog's tail <i>Cynosurus cristatus</i>, large docks <i>Rumex sp.</i>, Ragwort <i>Senecio jacobaea</i>,</p> <p>Species such as Common stinging nettle <i>Urtica dioica</i>, Creeping thistle <i>Cirsium arvense</i> and <i>C. vulgare</i> species are indicative of poor condition because of enrichment. Ragwort <i>Senecio jacobaea</i> is a natural constituent of dune vegetation and should only to be included as a negative indicator where extensive dense stands of robust plants are present.</p>	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England
Structure and function (including its typical species)	Key structural, influential and distinctive species	<p>Maintain the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat;</p> <ul style="list-style-type: none"> Constant and preferential plant species of M16, M23, 	See relevant text for this feature in Table 1.	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		<p>M25, H11, S4 and W4 NVC communities which are the main component of the H2190 feature within the SAC</p> <ul style="list-style-type: none"> Natterjack Toad <i>Epidalea calamita</i> 		
Structure and function (including its typical species)	Soils, substrate and nutrient cycling	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat.	<p>Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature.</p> <p>As dune slack vegetation succession progresses, soils develop in structure and nutrient status. The soils under Humid dune slacks represent less to moderately develop natural soils to be found on dunes.</p>	
Supporting processes (on which the feature relies)	Functional connectivity with wider coastal sedimentary system, including seed/ propagule dispersal.	Maintain adequate movement of sediment from all key sediment sources (directly from the beach, indirectly from offshore, eroding cliffs etc.).	<p>Although Humid dune slacks do not depend in the short term on continued inputs of sand, its medium/long term survival does. Primary slacks can occur on the beach plane with sufficient input of sand.</p> <p>Targets to be set to maintain distinctive elements at current extent/levels and/or in current locations, e.g. (to maintain transitions between habitats), or to maintain existing populations of notable species.</p>	OHES. 2018. <i>Winterton-Horsey Dunes SSSI: Assessment of current condition and change since notification</i> . Available from Natural England
Supporting processes (on which the feature relies)	Aeolian (wind-blow) processes	Maintain the natural movement of sand within the site, resulting from wind blow-outs and blow-throughs.	<p>Allowing natural wind-blow (or 'aeolian') processes to operate and to allow active movement of dry sand is important. Current dune topography, including hollows reaching damp sand where slacks occur, has resulted from past within-site dune movement.</p> <p>Although Humid dune slacks does not depend in the short</p>	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			term on new dune mobility, its medium/long term survival does. Secondary slacks are created where overlying sand is blown away down to the water table/wet sand.	
Supporting processes (on which the feature relies)	Hydrology	At a site, unit and/or catchment level as necessary, restore natural hydrological processes, where possible, to provide the conditions necessary to sustain the feature within the site	<p>Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present.</p> <p>All dune wetland vegetation communities are influenced by the water table. Each community reflects a particular past and current hydrological regime. Water table monitoring should be present on all sites with dune wetlands. Humid dune-slacks are extremely rich and specialised habitats which are very threatened by the lowering of water tables (Interpretation Manual - EUR28).</p> <p>They require a period of wetting, with inundation to shallow depth in winter and dry in summer. Permanent pools will sometimes occur in association with dune slacks, and can be hydrologically linked to the humid dune slack feature. There will be a suite of dune slacks within a site, all at different stages in vegetation succession, and although all linked to the same dune aquifer, may have slightly different hydrological regimes due to variations in age, elevation and management.</p> <p>The hydrology of the site appears to differ between the northern and southern ends of the site, with the southern end drier, and the northern end wetter. It is quite likely that the sea wall and its foundations are largely responsible for this, preventing groundwater discharge to the east (beach) in the northern area, whilst outflow is unrestricted in the southern area.</p> <p>The contrasting elevation inland is also likely to influence conditions in the dunes. There are various 'ponds' in the northern part of the site, which are smaller and more deeply</p>	CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i> . Annex 7 - Site report for Winterton, Report by CEH (NECR153)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>incised than the dune slacks seen at other sites. The hydro-ecological conditions in these ponds have been noted as suitable habitat for natterjack toads however a decline in the numbers of natterjack toads recorded in the ponds has been a source of concern over the past 5 to 10 years.</p>	
Supporting processes (on which the feature relies)	Water quality	<p>Where the feature is dependent on surface water and/or groundwater, restore water quality and quantity to a standard which provides the necessary conditions to support the feature</p>	<p>For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type.</p> <p>Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.</p> <p>Given the sensitive nature of the hydrological system and its role in the hydro-ecological conditions at the site, it would be worthwhile installing and operating a groundwater monitoring network, to provide better understanding of for both water level and water quality. This could incorporate the dipwells previously installed but would ideally extend north and, in particular, south of this area.</p>	<p>CEH. 2014. <i>Survey and analysis of vegetation and hydrological change in English dune slack habitats</i>. Annex 7 - Site report for Winterton, Report by CEH (NECR153)</p>
Supporting processes (on which the feature relies)	Air quality	<p>Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).</p>	<p>See generic text for this attribute in Table 1.</p> <p>In recent decades, increased atmospheric nitrogen pollution has altered the physiognomy and floristic composition of coastal acidic dune systems in northwest Europe. Many authors have undertaken extensive surveys (e.g. Stevens et al. 2011) or experimented in a range of oligotrophic sandy habitats in order to understand the likely impacts of N-deposition on sensitive vegetation.</p>	<p>More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).</p> <p>OHES. 2016. <i>Winterton-Horseley Dunes SSSI and Great Yarmouth North Denes SSSI: Erosion</i></p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>For example, Willis (1965) observed an increase of grasses in a dry dune pasture after adding a general fertilizer, while Boorman & Fuller (1982) noticed a decline of annuals, mosses, and lichens in coastal grey dune vegetation after adding Nitrogen. However, vegetation responses to N-deposition have been varied, with key variables including the amount of Nitrogen being added, the stage of successions (including the amount of organic matter in the topsoil), the degree of leaching effected in humus-poor soils or by the possibility that phosphorus becomes limiting.</p>	<p><i>Results and Future Monitoring Protocols</i>. Available from Natural England</p> <p>Willis. A.J. 1965. The Influence of Mineral Nutrients on the Growth of <i>Ammophila Arenaria</i> <i>Journal of Ecology</i> Vol. 53, No. 3 (Nov., 1965), pp. 735-745</p> <p>Boorman. L.A and Fuller. R. M. 1982. Effects of Added Nutrients on Dune Swards Grazed by Rabbits. <i>Journal of Ecology</i> Vol. 70, No. 1 (Mar., 1982), pp. 345-355</p>
Supporting processes (on which the feature relies)	Conservation measures	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to Maintain the structure, functions and supporting processes associated with the feature.	<p>Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England.</p> <p>This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.</p> <p>Although 'natural processes' are given a high priority in sustaining site and feature integrity in dunes, active management (including livestock grazing) is sometimes required. Management includes scrub cutting, mowing, grazing, turf-stripping and re-wetting. Mowing can prolong the younger species-rich stage of slack succession but cannot reverse the process. Reverse the fall in water tables (if anthropogenic) and/or removal of trees and scrub combined with follow-up grazing management. Management should focus on creating new successional cycles to provide habitat for early</p>	<p>Stratford, C. <i>et al.</i> 2012. Survey and analysis of vegetation and hydrological change in English dune slack habitats. Report by CEH (NECR153)</p> <p>Plassman, K. 2009. Changing nutrient budget of sand dunes: consequences for the nature conservation interest & dune management. Available from Natural England.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>successional species and replace that lost by accelerated succession. Stimulation of germination from the seed bank through management may contribute to the conservation of both characteristic and threatened species typical of dune slacks. (Plassmann <i>et al.</i>, 2009). Management practices that remove nutrients (N) from the system can mitigate the effects of N inputs but may damage fragile components. A range of invertebrates and plants require bare sand, usually naturally created by wind blow, but sometimes where it is infrequently disturbed by vehicles or feet.</p>	
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