# Appendix D – Coastal habitats

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## D1. Habitat variation

Coastal habitats dominated by vascular plants occur in both the supralittoral and littoral zones. In the former, dune, shingle and cliff habitats occur above the tidal limit, exposed to the splash/spray of sea water and maritime climate, but only infrequently covered in sea water during storm events. Coastal change is inevitable: even without sea level rise (which has secondary effects by increasing wave and tidal energy), because it is continually shaped by wind, wave and tidal energy and responds through the combined processes of erosion and accretion. In so doing cliffs erode, beaches build and sand, gravel and fine sediments are moved along the coast.

In some areas these changes are slow and perhaps less appreciated; in other areas changes are rapid and have a profound influence on both the natural environment and the way we use and manage the coast. By way of example the 60km of the Holderness coast in East Yorkshire has a documented history of erosion stretching back hundreds of years; the southern parts of this coast are still eroding at more than 2 metres per year.

The resulting sediment is vital for the development of beaches and intertidal areas, notably the Humber, the Wash and the estuaries of Essex, north Kent and Suffolk. This sediment is also important to other southern North Sea nations as it circulates towards a sink in the Waddenzee coast of Holland and north-west Germany. These processes of change have been underway since at least the last glaciation, and have led to a varied suite of habitats at the coast. The biological interest depends largely on the ongoing processes and the properties of the sediments that have been or are being laid down or eroded by the sea. This aspect of near-naturalness is an important aspect for selection of protected sites (Bainbridge et al. 2013)

In their natural state, coastal habitats straddle marine and terrestrial systems, both providing influences on the form and condition of coastal environments. The habitats are described in a number of publications[1] such as Boorman (2003), Houston (2008a and 2008b), Doody (2008a, 2008b), Doody and Randall (2003), Packham and Willis (1997) and Jones *et al*. (2011). The following is a relatively short summary of key factors.

It is important to recognise that coastal systems can be mosaics of functionally interdependent habitats: for instance, saltmarsh may form in a sheltered intertidal area behind a barrier island or shingle ridge that itself may also support dune or shingle vegetation; estuaries include a range of habitats that ultimately depend on sediment supply from the catchment and the mixing of fresh and saline waters.

A range of evidence can be used to date the initiation and evolution of individual sites, how sediment processes operate and the main sources and sinks of sediment. Coastal systems will adjust following natural or human perturbation and may be affected by activities some distance away, for example when sediment transport processes are interrupted. Coastal processes generally function to achieve a form of ‘equilibrium’, but even where this occurs there are regular fluxes around a long-term ‘steady state’ that need to be understood when making decisions about management and restoration. Information about coastal processes is generally available from Shoreline Management Plan baseline studies as well as other sources such as the Geological Conservation Review (May and Hansom 2003).

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[1] For example for most coastal Annex I habitats see the Natural England document: **General descriptions for Special Area of Conservation features and Special Protection Area supporting habitats**https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/520290/SAC-feature-descriptions.pdf

Timescales for development of vegetation and progress through successional stages will vary between habitat types and location. Some elements of the habitats can be apparently stable over long periods of time, or shift slowly from one state to another, whereas others go through frequent phases of colonisation and disturbance linked to tidal inundation or storm events. Ephemeral driftline vegetation occurs at the boundary of littoral and supralittoral zones, generally dominated by a limited number of vascular plants and other species able to colonise and survive in these extreme conditions.

The four main coastal habitat types covered by this appendix are:

- Coastal vegetated shingle
- Maritime cliff and slopes
- Coastal saltmarshes
- Coastal sand dunes

These habitats do not occur in isolation and each can be very varied. There are also specialised forms of other habitat found close to the sea, especially grassland and heath, which are strongly influenced by maritime influence[2]. For example, those associated with cliff slopes such as the 'waved heath' on the exposed Cornish coastline, or on cliff tops above the zone of specialised ledge communities and beyond the most exposed spray-splashed zone. Other forms of coastal grassland or wetland occur on low-lying coasts as transitions from upper saltmarsh where there is some brackish influence but regular tidal inundation is infrequent. Grazing can influence habitat species composition, but maritime exposure and instability are factors restricting the rate of scrub development in terrestrial habitats. In most cases, however, the coastal flood plain has been embanked

There can also be important freshwater elements of coastal habitats, from the river flows into estuaries at a large scale, to smaller elements of the habitat mosaic such as freshwater seepages onto cliff slopes. The hydrology of coastal systems can be complex: larger sand dune systems typically have a domed water table that reflects dune topography. The porosity of the sand influences the level of the water table, and water chemistry is linked to the pH of the sediment and amount of organic matter, which can change over time.

Instances of natural transitions between coastal habitats and with other terrestrial habitats provide additional variation. Of the latter, many have been truncated by building of sea defences or agricultural improvement, so these are valuable where they occur.

### D1.1 Coastal Vegetated Shingle (approximately 4,100ha in England)

Shingle consists of sediment with particle sizes in the range of 2–200 mm. There are two main elements of the habitat – the drift line just above the active beach zone, and the more established vegetation out of the reach of waves. Storm events move shingle up the beach and plant communities can develop from the tideline landwards. Vegetation of drift lines occurs on deposits of shingle lying at or above mean high-water spring tides, when seeds dispersed by the sea germinate in organic strandline deposits. The distinctive vegetation, which may form only sparse cover, is ephemeral and composed of annual or short-lived perennial vascular plants. This type of habitat is widespread but very limited in extent, often only a few metres wide just above the tideline, and can be composed of similar species found on sandy beaches.

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[2] Maritime influence is described in Ratcliffe (1977) as: **Maritime**: strong and direct influence of sea with markedly saline soils. **Sub-maritime**: less direct effect of sea with soils still more saline than those inland. **Para-maritime**: zone in which special climatic conditions of sea coast are influential but soils not saline and halophytes not present (NB this can relate to the influence of the underlying sediment such as shingle, sand or silt, and the microclimatic conditions of the coast).

Landward of the fringing shingle beach conditions are more stable and perennial plant communities can develop on shingle previously deposited by the sea. Typically, the seaward edge harbours species adapted to wind and exposure to sea spray – such as sea kale *Crambe maritima.* The vegetation present will depend on site-level factors such as hydrology and sediment size range and shows distinctive patterns reflecting the depositional history of a site. Shingle habitats and the associated sediment habitat can be extensive, such as at Dungeness in Kent, or may be found in smaller systems, sometimes with sandy habitats. Shingle beaches and structures are important for some breeding birds such as oystercatchers and terns, as well as other waders and some gull species. England holds a significant part of the European resource of this habitat.

The vegetation types found on shingle are not fully described by the NVC, but comparable studies have developed a corresponding classification (Sneddon and Randall 1993 and Ferry *et al.*1990 for Dungeness). There is a typical succession on larger systems, which can include lichen heath, acid grassland, wetlands and unique scrub communities. Few of the individual plant communities are extensive and should be considered as part of a mosaic of vegetation and naturally bare shingle which may still support a range of encrusting lichens.

Open water can occur on shingle structures following past gravel extraction. While these are artificial they provide an additional element of conservation interest.

For more information on coastal vegetated shingle see Doody and Randall (2003) and information on the JNCC website.

### D1.2 Maritime cliff and slope (approximately 14,100ha in England)

The different geology at the coast influences the type of cliff habitat that can occur. Rocks resistant to erosion forming near-vertical profiles are described as 'hard' cliffs characteristic of igneous, metamorphic and sedimentary rocks.

The vegetation on cliff ledges and cliff tops includes species adapted to the exposed maritime conditions, but also reflecting the geology and nutrient status of seabird colonies. Hard cliff vegetation is well-described by the NVC, with 12 different communities, some of which are maintained by extremes of temperature and drought.

Soft cliffs support a wide diversity of vegetation types with variable maritime influence. The UK holds a significant proportion of soft cliff in north-western Europe (Whitehouse, 2007). England and Wales are estimated to have lengths of 255 km and 101 km respectively. Shorter lengths of soft rock cliffs occur in Scotland and Northern Ireland. England has the largest proportion of the UK resource with only 255 km of unprotected soft rock cliffs representing just 2.4% of the total coastal length. Of the 255 km 80% of this is found in the seven counties Devon, Dorset Humberside, Norfolk, Suffolk, Isle of Wight , and Yorkshire (Howe, 2003). Soft cliffs have a sloping or slumped profile, often with a distinct undercliff; they occur on a range of soft rocks, or on hard rocks interspersed with softer deposits. The more mobile soft cliffs occur where there are unstable soft deposits such as mudstones or glacial drift deposits. They may be subject to mudslides or landslips, which create complexes of pioneer and more mature vegetation. Chalk, although a soft rock, forms vertical cliffs but also experiences mass movement.

Soft cliff habitats include bare ground and a range of different plant communities from open pioneer vegetation, grassland and wetland through to woodland, reflecting the frequency of landslides, hydrology and sediment type. As cliff habitats, these are not well-described by the NVC, but equivalents to other habitat types such as grassland and wetlands can be used to describe the range of variation (Hill *et al*. 2002). Vegetation communities are generally in a mosaic and benefit from semi-natural habitats on cliff tops providing a supply of plant material to colonise after landslips.

Approximately 4000 km of the UK coastline has been classified as cliff, with an estimated 1100 km in England.

For more information on maritime cliff and slope habitat see Hill *et al*. (2002).

**D1.3 Coastal saltmarsh (approximately 33,290ha in England)**

Saltmarsh occurs in the littoral zone approximately between mean high water neap tides and mean high water spring tides, this means some parts are flooded 600 times a year and others only around 24 times. Soft sediment intertidal saltmarsh habitats are naturally dynamic, influenced by a combination of factors including wave action, local hydrodynamics, wind direction and sediment transportation. The composition of saltmarsh flora and fauna is determined by complex interactions between frequency of tidal inundation, salinity, suspended sediment content and particle size, slope, and herbivory. In general, total species richness increases with elevation leading to a characteristic zonation of the vegetation.

Saltmarsh habitats are naturally variable because of tidal influence. A pre-marsh stage stabilises the sediment surface film of diatoms or microalgae (Underwood 2000). Pioneer saltmarsh colonises intertidal mud and sandflats in areas protected from strong wave action. Found on the lower parts of saltmarshes, and also colonising open creek sides, depressions or pans within saltmarshes, it is an important precursor to the development of more stable saltmarsh vegetation. Pioneer species colonise as the first stage in recovery following disturbance to upper saltmarsh. The vegetation (mainly pioneer *Salicornia* species and *Spartina anglica*) is frequently flooded by the tide, at least daily, so plant communities are composed of salt tolerant species

Upper saltmarsh develops when fine-grained intertidal sediment accretes as the tide recedes, building a gentle slope upwards towards the land. This changes the amount of tidal inundation: flooding still occurs but with decreasing frequency and duration compared to lower areas in the saltmarsh. The vegetation varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock and wildfowl or other wild herbivores can be significant in determining the structure and species composition of saltmarsh and in determining its relative value for plants, invertebrates and wintering or breeding waterfowl. The patterns of creeks and small pools (or ‘pans’) across the marsh add further variation. Creek formation is linked not just to drainage but the delivery of sediment over the marsh, which aids accretion.

There are over 20 different NVC communities found on saltmarsh, some of which are scarce or restricted such as *Spartina maritima* stands or *Sueada vera* high marsh scrub, plus saline reedbeds and other vegetation reliant on freshwater seepages.

Transitional saltmarsh occurs where there is a transition from saltmarsh to dunes or shingle. These communities are not well-covered by the NVC

For more information on salt marsh habitats see: Boorman (2003), Adnitt *et al*. (2007) and Doody (2008b).

**Table D1. Overview of saltmarsh zonation in relation to tidal inundations.**

| Zone | Main species | Tidal coverage | Number of annual submergences | Vegetation cover | Typical NVC types |
|---|---|---|---|---|---|
| Pioneer Open communities | *Spartina* spp., annual *Salicornia* spp., *Aster tripolium* | covered by all tides except the lowest neap tides | 290-c.600 | Transitional with intertidal mudflats, fluxes in the boundary between unvegetated and vegetated mud vary with degree of sediment deposition and season, as *Salicornia* species are annuals. 50-85% cover | SM 6<br>SM 7<br>SM 8<br>SM 9<br>SM10 |
| Low marsh | *Puccinellia maritima* and *Atriplex portulacoides* as well as pioneer species | covered by most tides | 350-400 submergences | 50-100% cover | SM 13<br>SM 14 |
| Middle marsh | *Limonium* spp. and/or *Plantago*, as well as low marsh species. | covered only by spring tides | 150 to 220 submergences | 70-100% cover | SM13<br>SM15<br>SM16 |
| High marsh | one or more of the following – *Festuca rubra*, *Armeria maritima*, *Elytrigia* spp., as well as the middle marsh species | covered only by highest spring tides | Minimum 25 submergences, maximum 150 submergences | 70-100% cover | SM17<br>SM18 |
| Transition zone | Species of high marsh and adjoining non-halophytic areas | covered only occasionally by tidal surges during extreme storm events | | 50-100% cover. | SM 21<br>SM 24<br>S4 |

### D1.4 Coastal sand dunes (approximately 10,000ha in England)

As with saltmarsh, coastal dunes display natural variation and zonation. Typically, phases of mobility driven by coastal dynamics result in a dune system with a sequence of dune ridges, usually more active towards the sea, although the amount of active succession is quite rare, with only a few sites prograding seawards. Wind speed, sand mobility and salt-spray impacts have less influence as distance from the sea increases. When the beach sediment budget is positive, blown sand is trapped by tidal debris and allows salt tolerant plants to colonise from seed brought in by the tide. As more sand is trapped, other plants including dune-building grasses colonise. Although winter storms can interrupt the process, higher foredunes gradually develop, with frequent active sand movement. Embryo dunes are colonised by plants like Lyme grass *Leymus arenarius* which gives way to marram grass *Ammophila arenaria* as more sand is deposited. The latter species stems trap sand very effectively and new shoots are stimulated to grow from dense rhizome system as sand accumulates. As marram becomes more dominant, foredunes increase in height into a frontal dune ridge, providing shelter to sand that has already been deposited, leading to succession with more diverse vegetation on a series of increasingly stable ridges of varying height and form. They are influenced by wind-blown sand and other coastal processes as well as hydrological factors, with a dune water table developing under the series of dune ridges.

The free-draining and naturally nutrient-poor dune soils support specialised and often diverse forms of vegetation. Within dune systems, wind can scour bare sand down to the water table; the exposed damp sand is colonised by a characteristic plant assemblage including wetland species, creating low-lying dune slacks. These are seasonal wetlands, flooded in winter and often with high botanical diversity. Slacks can also occur where a new dune ridge forms to seaward, trapping a low-lying area that is initially brackish but which eventually is only influenced by freshwater. Key factors are a seasonally fluctuating water table, driven by rainfall. Water levels usually reach a maximum in winter and spring, when surface water is visible, but dropping below the sand surface in summer. The range of plant communities found is considerable and depends not just on the water levels but 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. Dune slacks are important features for species like the Natterjack toad *Epidalea calamita* as well as many scarce invertebrates and plants.

On the drier ridges dune grassland predominates, with dune heath on a few acidic sites. Mature native dune woodlands, one potential outcome of this succession, rarely occur in Britain (Radley 1994), and paleao-ecological investigations into past presence of dune woodland in the UK are limited (Provoost *et al*. 2011). Development of woodland cover may have been limited by sand dynamics during geomorphologically active phases (May and Hansom 2003). Scrub vegetation on more-or-less stable sand dunes support a range of species, with sea buckthorn *Hippophaë rhamnoides* often abundant as a result of planting outside of its native range on the east coast. Sea buckthorn may either form dense thickets, with sparse nitrophilous associates such as common nettle *Urtica dioica*, or occur as more scattered bushes interspersed with various grasses, typically marram *Ammophila arenaria* and red fescue *Festuca rubra*, and associated herbs of dune grassland. This form of dune vegetation is mainly found on Atlantic coasts in the EU. In the UK, the native distribution of *Hippophaë* is considered to be ranging patchily from Dunbar on the east coast of Scotland down to Dungeness/Camber in Sussex, being widely planted elsewhere.

Generally however it is the diverse mix of open sand dune habitats that underpin most of the biological interest, with some of the more open plant communities comprising just a few species adapted to colonising bare sand, such as sand sedge, *Carex arenaria*. Vegetation varies between sites and within sites due to differences in successional age, soil pH, local disturbance, management history, topography, groundwater chemistry and the dune slack hydrological regime (Everard *et al*. 2010, Stratford *et al.* 2013).

For more information on coastal sand dune habitat see Houston (2008a, b) and Davy *et al*. (2006). Pye *et al*. (2007) and other documents on the [Defra publications page](#).

## D2. Factors affecting ecological position in the landscape

Nearly a third of our most important protected areas for wildlife occur in the coastal zone (sites with an international designation). A high proportion is inter-tidal, but coastal grazing marsh and coastal wetlands are also significant. Almost 20% of all SSSIs with geological features are at the coast. Over half of all Areas of Outstanding Natural Beauty have a coastal element; 6 out of 9 current or proposed national parks in England have a coastline. Because of this importance for wildlife, landscape and earth science, it is vital that there is better understanding of how coastal habitats are underpinned by physical processes to ensure that management can seek to work with the processes and not against them. The supply and movement of sediment by both marine and Aeolian processes as well as other processes including cycles of vegetation succession and re-colonisation are all factors that influence ecological development of coastal habitats, many of which cannot be managed. This is recognised by the National Trust, which is developing a dynamic approach to the management of coastal change on its properties through the ‘Shifting Shores’ project. The following section sets out some relevant information to help indicate where better understanding is needed.

Geology and coastal geomorphology form the building blocks for the development of coastal habitats and are considered as scientifically important in their own right (May and Hansom 2003).The coastal environment arises from a complex interaction between dynamic physical processes, maritime exposure, tidal inundation, sediment movement and species. The sedimentary habitats are the result of deposition of largely marine-transported shingle and sand, some of which is derived from cliff erosion. Ongoing influence from wind, waves or tides drives regular change in the seaward parts of all systems. To landward, deposition has resulted in sediments left beyond the reach of waves under normal circumstances, but can still be affected by wind and maritime exposure. Shingle systems have a strong influence on microclimate. These environments are very dry, with no significant development of soils due to the freely-draining substrate, so plants need to be adapted to extreme conditions. The mechanisms of water supply at the surface are linked to the ratio of small and larger particles reducing infiltration, and pebble surfaces are thought to promote moist air to condense.

Coasts should be seen as naturally dynamic systems which exhibit episodic or gradual morphological and vegetation change depending on the availability and movement of sediment. For example, deposits of wind-blown sand can be reactivated by storm conditions, creating greater diversity as they introduce early successional stages into the system. Maritime cliffs are influenced by marine erosion, and in the case of boulder clay, groundwater drives rates of cliff recession.

Coastal habitats are linked to the marine environment through coastal processes and maritime influence. They are shaped by waves (size and direction), tides, nearshore currents, wind, fronting beach width, sediment availability, extreme events, exposure, rainfall, groundwater and air temperature. Changes in sea level relative to the land and other climate change impacts will affect coastal evolution. Past or current human activities such as grazing, agriculture, coastal defence or industry are also factors that shape the present configuration and ongoing evolution of the coastal margins, often preventing change.

The present-day coast and its evolution is still strongly influenced by the effects of the last glaciation, through the distribution of sediment by glaciation and its subsequent constant re-working over the last 10,000 years. Isostatic rebound is also causing both lowering and raising of land levels relative to the sea. The continuation of sea-level rise can either transport sediment towards the land or ‘strand’ the sediment offshore, making it unavailable to the coast through natural processes.

The interactions of the active physical processes of sediment movement by wind, waves and tides (accretion and erosion) and geological, biological, chemical and human influences give the coastal margins of the UK a unique and varied character, as a result of geology, climate, exposure and land-use history (May and Hansom, 2003). The importance of sediment transport by marine and aeolian processes is essential for shaping supralittoral coastal habitats and driving coastal change (Pye *et al.* 2007). Low-lying coastal margin habitats will experience infrequent tidal inundation during storm events as well as salt spray and wave splash. Maritime exposure influences species composition of vegetation, with some communities only found in coastal environments. Saline intrusion through beach sediments can also occur, particularly shingle, as a result of increased water pressure during high tides, or as a result of sustained sea-level rise. In contrast, many coastal margin habitats have groundwater or surface systems that are sustained by rainfall or groundwater movement. These can be above a saline water table, with some mixing between them. Freshwater aquifers may be subject to saline intrusion, especially in shingle (Burnham and Cook 2001).

The degree of human management, past and present, will vary by site and habitat type. This influences the type and pattern of vegetation and processes. Past interventions still influence the evolution of the coast and the habitats present.

## D3. Ecological function and relationships

The main forms of abiotic processes influencing the biological elements of coastal habitats are indicated in the habitat variation section above. Factors such as sediment size, water currents and wave energy influence the methods for transport in and out of individual locations, which can also bring in nutrients and seeds to enable colonisation. Other important factors influencing vegetation succession are time, leaching of nutrients, frequency/intensity of natural (or non-natural) disturbance, hydrology and water relations.

A series of micro-habitats can develop within coastal habitats, influenced by topography, aspect, exposure, geographic location and hydrology. In sand dunes, the water regime of a slack is determined by the hydrology of the dune system and its location within it. Variations in the level of water tables mean that the sand surface of some slacks may be dry in summer whereas others are permanently flooded. This is a major determinant of their plant and animal communities but hydrochemistry is also important: calcareous dune systems and groundwater support different communities from acidic ones, salinity may be an influence near the sea, and nutrient enrichment (particularly with nitrogen and phosphorus) has major consequences for community development. Sea-level rise affects the position and condition of water tables through increased hydrostatic pressure. However, research to date based on analysis of dipwell and rainfall data demonstrates that the main factor influencing water tables in dune systems is effective rainfall (Jones *et al.* 2006) although vegetation type also affects infiltration: planted non-native pine trees evaporated 214 mm/year more than open dune vegetation, resulting in the water table being 0.5–1.0 m lower under the trees than under the open dunes (Clarke and Sanitwong Na Ayutthaya 2010). Soil development is influenced by climatic factors interacting with nutrient deposition (Jones *et al*. 2008). Long-term leaching of sandy soils can lead to acidic surface layers suitable for dune heath development.

The vegetation of maritime cliff and slopes varies according the extent of exposure to wind and salt spray, the chemistry of the underlying rock, the water content and stability of the substrate and, on soft cliffs, the time elapsed since the last movement event.

## D4. Current levels of natural function

Almost all habitats in the UK and Europe, including those with high ecological, cultural and aesthetic value, are human-modified to at least some extent (Rouquette *et al*. 2014). Coastal environments in England have been directly or indirectly modified over many decades, at different scales and intensity. In 2009, it was reported[3] that about half of England' coastline is currently protected by hard defences such as sea walls and groynes, many of which have interrupted natural coastal processes resulting in the removal of protective sediment from the coastal zone and foreshore lowering/toe scour in front of defences. Construction of defences does not stop coastal processes, which continue to operate but in a modified form, sometimes transferring the impacts to a different location or starting a sequence of change that may have unexpected consequences.

Increasingly these impacts are better understood and although recently the approach to risk management is moving towards greater working with natural processes, (McInnes 2008) there is a huge legacy of historic intervention that constrains natural function. Such interventions usually have a limited lifespan, and maintenance and replacement are carried out where there is an economic justification. Whilst coastal habitats can be considered some of the most natural habitats in England, it could be said that coastal processes are no longer 'natural' even on coasts without engineered defences. Some of the most important English locations for coastal habitats including Dungeness, Orfordness, Sefton coast, Braunton Burrows, The Wash and the Essex Estuaries have had a history of intervention ranging from construction of sea defences, military activity, aggregate extraction, introduction of non-native species or sediment removal. Their current conservation value is still high, despite the legacy of these activities, and processes are altered but still functioning. Longer-term changes such as relative sea level rise (on some areas accelerated by anthropogenic climate change), reduction in sediment supply and nutrient enrichment are of concern when considering the ability to manage habitats and restore function. It is important to understand this when considering risks to the coastal environment and potential for restoration.

Few systems have had full studies of all abiotic and biotic elements of habitat function, so there is a need to apply expert judgement. In developing the European Red List of Habitats, the risk of 'habitat collapse' was used in evaluating the degree of threat for habitats. When the assessments were completed (Jansen *et al*. 2016) coastal habitats were amongst some of the most threatened types in Europe.

The five elements of habitat function are strongly inter-related, so it's not always possible to attribute declines in quality to one specific factor. In the context of this evaluation they have been considered in relation to coastal habitats in the following ways:

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[3] Parliamentary Office of Science and technology POST note 342 October 2009
http://www.parliament.uk/documents/post/postpn342.pdf

- ***Hydrology***: This has been taken as covering the largely rainwater-fed groundwater of dune and shingle systems and often discrete from a wider terrestrial catchment. Groundwater levels in dunes have seasonal fluctuations but can also be affected by changes in sea levels as well as abstraction. Maritime cliffs, especially soft cliffs, have important freshwater seepages fed from a wider catchment, feeding important elements of the biological interest. Freshwater seepages into the upper saltmarsh are determined by geology. Where these occur, upper marsh vegetation can be dominated by non-halophytic species. Within the water bodies, estuaries have a gradient of decreasing salinity up stream, however saltmarshes may have hypersaline pans resulting from evaporation at low tides. Saltmarshes also have an underlying water table with a vertical salinity gradient that influences the vegetation. Fresh groundwater and saline groundwater are found in adjacent zones at the coast, with freshwater often discharging into the tidal or sub-tidal areas. Because sea water is slightly heavier than fresh water, it intrudes into aquifers in coastal areas forming a saline wedge below the fresh water. The interface, between them is in a state of dynamic equilibrium, moving with the seasonal variations of the water table and daily tidal fluctuations, resulting in a transition zone of mixed salinity.
- ***Nutrient Status.*** There are a number of pathways for nutrients to enter coastal habitats, through both natural and anthropogenic processes. The sea is a natural source and sink of nutrients, with estuaries receiving inputs from the wider catchment. Intertidal habitats and those on the foreshore exposed to wave splash are more productive than supralittoral dune and shingle habitats which normally have limited soil development.
- ***Soil/sediment processes***. Geology drives the primary structure within which the processes of coastal evolution and habitat development operate. Because of the dynamics of these systems, soils do not develop in the same way as the terrestrial environment, and are often strongly influenced by the nature of the underlying sediment. Soils and underlying geological deposits may even be completely removed by the processes of erosion, especially cliffs. The eroded sediment however is transported to depositional environments by coastal processes. There has been a break in the process of sediment transfer for many coastal habitats though decades of shoreline management activities, although increasingly consideration is given to using sediment recharge for risk management rather than hard defences alone. Extraction of sand and shingle or removal of saltmarsh sediment from ‘borrow pits’ to build sea walls has also occurred, leading to impacts on processes and surface sediments, with secondary colonisation occurring in some cases, but on a different trajectory to the more natural direction. Land reclamation, whether recent of historic, has an impact on overall sediment processes, especially in estuaries, causing shifts in the natural balance of accretion and erosion.
- ***Vegetation controls.*** Some coastal habitats do not need management in the same way that for example lowland heathland or grassland do to sustain the plant species composition. There are some natural grazing controls such as wildfowl grazing on saltmarshes. Saltmarsh vegetation structure can be changed by livestock grazing, with impacts greater from increased animal numbers and prolonged periods across different seasons, or conversely by the abandonment of grazing. Some saltmarsh plant species are removed by selective grazing. On other habitats, dunes have a similar response to grazing as lowland grasslands, and have had long histories of managed rabbit grazing and low-intensity livestock use, although much of this has now declined through disease and changes in agricultural policy. On shingle and cliffs, grazing is less important, with the physical factors such as erosion, drought and coastal change limiting vegetation succession.
- ***Species composition.*** This mainly covers the potentially negative effects of non-native invasive species, whether deliberately or accidentally introduced, as well as other species not typical of coastal environments but which have been introduced or colonised and been able to persist due to other changes in function that have occurred as a result of other changes. Examples on sand dunes might be *Hippophae rhamnoides* planted into sand dunes beyond its native range, non-native invasives encroaching aggressively like *Rosa rugosa*, or the increased nutrient enrichment enabling competitive grass species to dominate dune grasslands.

Tables D2 -5 below set out an attempt, using expert judgement, on the state of naturalness of the four main coastal habitats, based on the above. Whilst these reflect the wider state of reporting on the habitats, the judgements may not apply in the same way everywhere and need to be read with consideration of the wide variation between and within coastal habitats.

**Table D2. Prevalence of state ('natural function') within the habitat resource: vegetated shingle.** (Judgements relate to the most prevalent state of naturalness out of the three categories used)

| | Hydrology | Nutrients | Soil/sediment | Vegetation control | (Invasives) Species composition |
|---|---|---|---|---|---|
| **State of naturalness: High/Moderate/Low** | Moderate | Moderate | Low | Moderate | Moderate |
| ***Confidence*** | *Moderate* | *Moderate* | *Moderate* | *Moderate* | *Moderate* |
| ***Comments*** | *Shingle hydrology can be affected by removal of sediment, abstraction and pollution* | *Shingle systems are naturally nutrient poor due to the free-draining sediment and lack of soil* | *A range of factors affect different parts of the shingle system, from interrupted longshore drift affecting seaward areas to extraction and damage of landward deposits.* | *Few shingle systems depend on vegetation management, larger sites may benefit from some management but this can be damaging to shingle surface structure* | *Invasive species, both native and non-native, are an increasing problem across many shingle sites* |

**Table D3. Prevalence of state ('natural function') within the habitat resource: maritime cliff and slope.** (Judgements relate to the most prevalent state of naturalness out of the three categories used)

| | Hydrology | Nutrients | Soil/sediment | Vegetation control | (Invasives) Species composition |
|---|---|---|---|---|---|
| **State of naturalness: High/Moderate/Low** | Moderate | Moderate | Moderate | Moderate | Moderate |
| ***Confidence*** | *Moderate* | *Low* | *Moderate* | *Moderate* | *Moderate* |
| ***Comments*** | *Hydrology is a key process particularly for soft cliffs with a wider catchment* | *Point nutrient pollution and atmospheric N deposition. There limited information on the impacts of nutrient inputs on cliff habitats* | *Only a limited length of soft rock cliff coast retains more or less natural function. Hard cliffs tend to have less impact of erosion risk management* | *Cliff vegetation rarely requires vegetation control due to limits on species ability to grow – main issue is those areas where cliffs have been stabilised and undergo succession* | *Invasive species, both native and non-native, are an increasing problem across many cliff sites* |

**Table D4. Prevalence of state ('natural function') within the habitat resource: coastal saltmarsh.** (Judgements relate to the most prevalent state of naturalness out of the three categories used)

| | Hydrology | Nutrients | Soil/sediment | Vegetation control | (Invasives) Species composition |
|---|---|---|---|---|---|
| **State of naturalness: High/Moderate/Low** | Moderate | Moderate | Low | Moderate | Moderate |
| ***Confidence*** | *Moderate* | *Moderate* | *Moderate* | *Moderate* | *Moderate* |
| ***Comments*** | *Hydrological controls on vegetation include the saline inundation and freshwater inputs from seepages and through estuarine processes. Sea walls and other barriers can compromise these* | *Saltmarshses are naturally nutrient rich but can be affected directly and indirectly by nutrient enrichment, including dense growth of algal mats swamping saltmarsh vegetation* | *Many saltmarshes have a range of sediment processes compromised by hard structures, dredging and legacy of development, leading to potential imbalance of accretion and erosion* | *In general, saltmarshes don't need management as tidal inundation prevents succession to scrub, however changes in grazing levels can result in shifts in dominance of species, so existing grazed marshes may benefit from appropriate grazing levels* | *The intertidal natures of saltmarsh makes it more vulnerable to invasion by non-native species. Whilst now considered an endemic species there is a legacy of change driven by spread of Spartina anglica* |

**Table D5. Prevalence of state ('natural function') within the habitat resource: Coastal sand dunes.** (Judgements relate to the most prevalent state of naturalness out of the three categories used)

| | Hydrology | Nutrients | Soil/sediment | Vegetation control | (Invasives) Species composition |
|---|---|---|---|---|---|
| **State of naturalness: High/Moderate/Low** | Moderate | Low | Low | Low | Moderate |
| ***Confidence*** | *Moderate* | *Moderate* | *Moderate* | *Moderate* | *Moderate* |
| ***Comments*** | *Hydrology is a key process but many sites show signs of changes in dune hydrology* | *Point nutrient pollution and atmospheric N deposition. There is relatively good information on the impacts of nutrient inputs on dune habitats* | *Would expect naturally low nutrient status on dune systems with active sediment processes able to function, creating a micro- and macro-scale mosaic of vegetation and open sand.* | *A balance of natural limitations on vegetation growth and vegetation management would be needed to achieve favourable condition: many sites are now dominated by rank vegetation and increasing amounts of scrub* | *Invasive species, both native and non-native, are an increasing problem across many dune sites* |

## D5. Scope for restoration of natural function

Coastal processes are driven by a tendency to develop into a form of stable equilibrium, not static but dynamic. Swash- aligned coasts are more stable than those dominated by longshore drift, however these will still 'roll back' as sea level rises. Sediment supply drives these shifts, which often comes from outside a site. Essentially this means restoring natural function is limited by external factors, and restoring function will influence the trajectory of ongoing change. Trying to 'fix' the coast can only be temporary and there are implications for future changes, as the coast tries to respond to a new state – long periods of artificial constraint can result in major changes in a short period of time. It is important to understand and expect such changes and seek to work with natural processes to achieve long-term benefits for biodiversity and ecosystem services.

Coastal habitats can only be recreated or restored at the interface of land and sea and where there are appropriate sediment types present. This limits potential locations and can lead to conflicts with other habitats present behind sea defences or on cliff tops. The main aim would be to seek to restore the appropriate biotic processes, allowing colonisation from adjacent areas of habitats. In some cases, such as Maritime Cliff and Slope, the only options might be to remove hard coastal defences (Lee *et al*. 2001), and/or encourage the development of a range of cliff top vegetation within the zone of maritime influence. For sand dunes and shingle, options would be limited to restoring the landward areas formerly converted to agricultural land. The degree of infrastructure development at the coast makes habitat re-creation a complex option, and for the majority of coastal habitats the emphasis is on restoration of functionality at different scales where habitats are degraded and unfavourable. These could benefit from provision of adaptation space, for example to allow shingle ridges to roll back over the flood plain, or for sand blow to occur beyond the current position of sand dunes.

The main success in the last two decades has been the increasing amount and scale of managed realignment to create intertidal habitats. From small pilot areas in 1991 of less than 1 ha, to larger schemes of up to 400ha in 2014, totalling well over 1000ha, there is an increasing body of scientific and practical knowledge, including the important of linking habitat creation with operational flood risk management. Lessons from these projects highlight that there can be shifts in habitat type over time and that there can be differences in saltmarsh sediment properties between reference marshes and restored marshes. Of particular importance is the relationship between water retention and drainage: in natural saltmarshes there is less waterlogging than in realignment sites, indicating that there will be differences in the vegetation that can establish, at least in the short term (Davy *et al.* 2011).

Table D6 indicates some broad principles relevant to the restoration of 'natural function' to coastal habitats.

**Table D6. Restoration of 'natural function': coastal habitats.**

| | Hydrology | Nutrients | Soil/sediment | Vegetation control | (Non-native) Species composition |
|---|---|---|---|---|---|
| **Desirability** | Yes | Yes | Yes | Yes and No | Yes |
| **Comments** | Hydrology is a significant issue for some elements of coastal habitats and should be restored or negative impacts reduced/removed | Reduce or eliminate excess nutrients (both from atmospheric and other sources) to below critical loads | Sediment processes are vital for effective restoration of coastal habitats. | Depending on the habitat type grazing by natural or domestic animals can be beneifical, but timing and intensity must be appropriate. Cliffs and shingle less likely to benefit from grazing or cutting however | Management and control measures are needed to reduce the cover and impact of non-native species and facilitate the establishment of semi-natural species assemblages. |
| **Conservation constraints** | Would need to ensure mitigation of any potential impacts on species | None – such measures may happen beyond site boundaries and should benefit many habitats | Concerns may be raised if perturbation is proposed to maintain early successional elements of the habitat | Removal of trees and scrub can be controversial if these provide niches for important habitats – not all of these rea restricted to coastal habitats | None |

## D6. Provision of habitat for particular species

### D6.1 General

Coastal habitat types are very variable. Mosaics occur between habitat types together with transitions between other maritime, terrestrial and freshwater systems. This wide variation can provide important niches for species or uncommon plant associations. The analysis presented in Webb *et al*. (2010) indicates that it is these niches which support the Priority species found on coastal habitats.

A total of 168 UK BAP species are associated with coastal priority habitats. The extent and distribution of these habitats varies considerably and the more extensive saltmarsh habitats support relatively fewer priority species.

**Table D7. Numbers of priority species associated with different coastal habitats (derived from Webb *et al*. 2010)**.

| Priority habitat | No. of associated priority species |
|---|---|
| Sand Dunes | 68 |
| Maritime Cliffs and Slopes | 58 |
| Saltmarsh | 27 |
| Coastal Vegetated Shingle | 15 |

Mosaics within habitats, largely driven by natural processes were considered important in an analysis for development of agri-environment scheme options highlighted the following habitat elements, many of which are related to natural abiotic function:

- Natural disturbance such as tidal action or wind blow

- Bare substrates including those created by animal activity (rabbit burrowing)
- Transitions and ecotones between habitats
- Natural deposits of litter ( e.g. strandlines)
- Early successional habitats with high degree of openness
- Topography/shelter ( i.e. microclimatic variation
- Freshwater seepages
- Permanent and seasonal water bodies
- Naturally sorted sediment
- Flower-rich vegetation
- Vegetation structure

**D6.2 Higher plants**

Coastal habitats are predominantly defined by the presence of vascular plants, although non-vascular plants are important elements of some types and free-living fucoids can be present in some saltmarshes. The extent of vegetation will vary, with large patches of naturally bare rock, boulder clay or sediment surfaces occurring, sometimes seasonally, as part of a mosaic. These are often linked to the sediment processes which support coastal habitats, and NVC or equivalent descriptions (Rodwell 2000, Sneddon and Randall 1993) will indicate where there is a more open plant community. Coastal vegetation may not always be species-rich, and vegetation can sometimes be sparse or ephemeral, but the coast provides the only suitable locations for many plants and plant communities (Webb *et al*. 2010, Rodwell 2000).

Many of the vascular plant species found in saltmarsh, dune, shingle and cliff habitats are adapted to maritime environments, with the ability to tolerate conditions of salinity, tidal inundation, exposure, nutrient stress and drought. A key aspect of all coastal environments is the variable topography, from gently sloping intertidal areas, to low-lying dune slacks and shingle ridge patterns to steep cliff faces or more gentle slopes. In all cases, there is a change in elevation from landward to seaward. There are functional relationships between different elements of the habitat, reflected in mobile species making use of different niches at different times or as the habitats evolve over time. This is illustrated by vegetation succession in sand dunes, described as the ‘psammosere’ (Packham and Willis 1997). This is a sequence of vegetation types from seasonal foredunes to more established grassland. The foredune stages are kept open by coastal processes, and support only a few specialised plants: on the more landward fixed dunes, swards can have the appearance of unimproved grassland sometimes with high species diversity, but may at times revert back to early successional stages if there is disturbance. Transitions to other habitats such as saline lagoons, intertidal mudflats, freshwater wetlands and grassland or heathland habitats can all occur, providing niches for several species.

**D6.3 Lower plants**

The coast is an important habitat for many bryophytes, including some of our rarest species. Many coastal bryophytes are tolerant of dessication, and some are able to tolerate sea spray, saline soils and even occasional immersion in salt water. Bryophytes occurring in the differing coastal habitats are highlighted below

Soft cliffs and undercliffs provide open ground habitats suitable for ephemeral bryophytes that are intolerant of competition. *Didymodon tophaceus* is often frequent, particularly near seepages of calcium-rich water, and the delicate *Epipterygium tozeri* may occur on open soil. The rare moss *Philonotis rigida* occurs on wet clays on undercliffs, for example at the Land’s End peninsula in Cornwall.

The bryophytes that occur on sunny coastal cliff-tops have to tolerate both salt spray and dessication, and such species include *Tortella atrovirens, Trichostomum brachydontium* and the Section 41 moss *Tortula wilsonii*. A number of uncommon South-coast bryophytes have Mediterranean affinities, and in Britain are at the northerly limit of their distributions. These include the Section 41 mosses *Acaulon triquetrum* and *Tortula cuneifolia*, and the Section 41 liverworts *Cephaloziella baumgartneri* and *Southbya nigrella*. The Lizard peninsula in Cornwall is a particulary important site for such bryophytes as its climate has Mediterranean affinities, with frequent summer droughting and infrequent frosts. Approximately 270 moss species and 95 liverworts have been recorded here (Porley and Hodgetts 2005), and rarities include five Section 41 liverworts, namely *Cephaloziella calyculata, C. dentata, Lejeunea mandonii, Riccia bifurca* and *R. nigrella*.

Coastal sand dunes are a challenging environment for bryophytes, but despite this many bryophytes are well-adapted to the conditions, including several rare species. A characteristic species is *Syntrichia ruralis ssp. ruraliformis*, a patch-forming moss that is very tolerant of dessication, can survive being buried in sand, makes effective use of small amounts of water, and can regenerate from vegetative fragments. Such bryophytes play an important role in the ecology of sand dunes, including by binding loose sand and providing a habitat for invertebrates. Three Section 41 mosses of the genus Bryum occur in coastal sand dunes, *Bryum calophyllum, B. knowltonii,* and *Bryum warneum.* These mosses occur in dunes with sparse open vegetation such as foredune slacks or beside shallow pools. A sand dune bryophyte of particular conservation significance is the Section 41 Petalwort *Petalophyllum ralfsii*, a tiny but attractive liverwort that resembles a miniature lettuce. This diminutive species is an Annex II and Schedule 8 species, and is also included in Appendix I of the Bern Convention. It grows in calcareous damp dune slacks that are moist or wet in winter, but can tolerate summer dessication. Other sand dune bryophytes of conservation significance include three species that occur in calcareous dune slacks, namely *Pseudocalliergon lycopodioides,* a Nationally Scarce moss that occurs in seasonally flooded slacks, and the Nationally Rare liverworts *Southbya tophacea* and *Fossombronia maritima.*

Relatively few bryophytes are able to tolerate living in the highly saline conditions of saltmarshes. A characteristic species is the small acrocarpous moss *Hennediella heimii* that occurs in upper saltmarsh and may be regularly inundated by the higher tides. Other mosses here include two Section 41 species, namely *Bryum marratii* which may occur at transitions between saltmarsh and sand dunes, and *B. salinum.*

A further challenging habitat for bryophytes is coastal shingle, due its instability, salinity and frequent droughting. In places where the shingle becomes semi-stabilised and mixed with sand and organic detritus species such as *Tortula atrovirens* and *H. heimii* may occur, whilst scrub on shingle may support epiphytes such as species of *Ulota, Orthotrichum* and *Zygodon*.

Hard rock coasts, for example those occurring around Cornwall, provide a habitat for the most distinctly maritime bryophyte in Britain, Seaside Grimmia *Schistidium maritimum*, which grows on boulders from just above the high water mark and tolerates regular soakings from salt spray. Further away from the waves hard rock coasts support species such as *Ulota phyllantha, Tortella flavovirens* and the liverwort *Frullania teneriffae*.

Sea caves may provide valuable habitats for bryophytes due to their humidity and equable temperature, particularly if freshwater percolating into them counteracts the effects of salinity. The most well-known species occurring in such caves is the Section 41 Bright Green Cave Moss *Cyclodictyon laetevirens*, an attractive species that was nearly wiped out by collectors in Victorian times. Other bryophytes that frequently occur in sea caves include the liverworts *Conocephalum conicum* and *Riccardia chamedryfolia*, and the mosses *Palustriella commutata* and *Pseudotaxiphyllum elegans*.

The restoration of natural processes in coastal habitats is in many cases likely to be beneficial for bryophytes, for example by restoring low nutrients status where practicable, keeping the vegetation structure open by grazing, creating suitable microhabitats, and preventing bryophytes from being overwhelmed by the build-up of litter and taller vegetation. The restoration of partially vegetated open habitats, including slacks in dune systems, is valuable to those specialised bryophytes that occur here. However in the case of the rarer species, in particular those listed within Section 41, care will need to be taken within individual sites to ensure that large-scale management actions do not have a negative effect on species that may be restricted to very small areas of habitat. An example where such an issue could occur is that of managed retreat schemes near dune systems, where an unwelcome side-effect of the removal of long-established artificial sea defences might be the flooding by salt water of dune slacks important for Section 41 species such as Petalwort. Decisions in such cases are likely to need to be carefully made on a site-by-site basis.

### D6.4 Birds

Priority species at the coast and their habitat preferences are shown in Table D8. In broad terms all of these species require extensive open areas, abundant food (invertebrate prey, vegetation), and little or no human disturbance.

**Table D8. Priority bird species using coastal habitats. (B= Breeding, NB = non-breeding)**

| Species | Habitats | Breeding status |
|---|---|---|
| Skylark | Dunes | B and NB |
| European White-fronted Goose | Grazing marsh | NB |
| Bittern | Reedbeds | B and NB |
| Dark-bellied Brent Goose | Intertidal mud (algae, zostera), saltmarsh, grazing marsh | NB |
| Linnet | Strand line, saltmarsh, dunes | B and NB |
| Twite | Saltmarsh | NB |
| Herring Gull | Intertidal mud, saltmarsh, shingle beaches, grazing marsh | B and NB |
| Black-tailed Godwit | Intertidal, grazing marsh | NB |
| Grasshopper Warbler | Dunes | B |
| Yellow Wagtail | Grazing marsh | B |
| Curlew | Intertidal, grazing marsh | B and NB |
| Grey Partridge | Dunes | B and NB |
| Roseate Tern | Shingle beaches | B |
| Lapwing | Grazing marsh | NB |
| Skylark | Dunes | B and NB |

Seabirds nesting on coastal shingle require open or sparse vegetation, conditions which occur naturally through wave action. Coastal processes which result in the formation of spits, barrier islands and extensive forelands of shingle will favour these species although recreational disturbance and predation often limit habitat availability. Herring gulls also use hard and soft rock cliffs for nesting.

Dark bellied Brent goose, black-tailed godwit and curlew (and to a lesser degree herring gull) are dependent on intertidal mudflats for foraging. Coastal saltmarsh and associated creeks are used for foraging and also for roosting at high tide.

Twite and linnet feed on saltmarsh plant seeds, exclusively so in the case of the former. Herring gulls also nest on upper saltmarsh in some locations (e.g. Ribble Estuary).Coastal squeeze reduces the extent of these habitats, particularly saltmarsh, so removing flood defences to allow landward migration of intertidal habitats will benefit these species, although any associated loss of grazing marsh might reduce this benefit (e.g. loss of high tide foraging and roosting areas). Loss of reedbeds to tidal inundation will displace breeding and non-breeding bitterns, and so this species is less likely to be adversely affected by the restoration of natural coastal processes.

Skylarks prefer open dune habitats with short vegetation and bare ground but all other dune species (linnet, grasshopper warbler, grey partridge) require some scrub for nesting. Natural succession and structural diversity of vegetation will favour a range of bird species although some scrub management may be required to maintain open habitats.

Most bird species require large scale mosaics of habitat, particularly a combination of intertidal habitats and upper shore freshwater habitats, which are often protected by sea defences. Coastal process which favour a wide range of habitats including extensive mudflats, saltmarsh with both lower and upper saltmarsh vegetation, and shingle and sand-dune habitats will support a high diversity of breeding and non-breeding species, including several priority species.

Very often, areas of freshwater habitat, usually protected by sea defences, provide additional functional habitat, more or less important to different species (foraging, nesting, roosting). Although these habitats are not restricted to the coast, there proximity to true coastal habitats is valuable.

Restoration of natural processes at the coast tends to generate large increases in intertidal habitats, especially saltmarsh. The biggest habitat losses relate to grazing marsh that has been artificially created behind sea defences. Grazing marsh is important for breeding birds (skylark, lapwing, curlew, yellow wagtail) and non-breeding birds (geese, waders). Any associated freshwater reedbeds are important for breeding and non-breeding bittern.

Restoration of natural coastal process which create new areas of extensive, unvegetated shingle would benefit nesting seabirds but only if recreational activities are managed.

Careful targeting of realignments to avoid loss of important freshwater wetlands, or alternatively, creating compensatory freshwater habitats (preferably naturally functioning) as part of realignment proposals, should help provide more intertidal habitat but needs to avoid  other important bird habitats.

### D6.5 Fish

Fish will make use of saltmarsh when flooded at high tide as well as water remaining in creeks and pans when the tide falls. Adult and juvenile fish utilise salt marshes for food and shelter at high tide, moving into adjacent sublittoral regions during low tide. Studies have shown that for some common coastal fish species, high levels of site fidelity result in individual salt marshes operating as discrete habitats for fish assemblages (Green *et al.* 2012). .For managed realignment sites, studies have shown a positive relationship between the degree of fish utilisation, particularly juveniles, and habitat heterogeneity was ascertained using species richness, abundance and behavioural observations. (Colclough *et al.* 2005).

### D6.6 Amphibians and reptiles

Sand dunes support a range of species including the natterjack toad, which requires early-stage dune slacks and foraging areas, and the sand lizard, which requires open bare areas for basking and bare sand for digging breeding burrows.

## D7. Key messages

- The coastline changes continually because of the action of coastal processes. It receives incoming wave, wind and tidal energy and responds through the combined processes of erosion and accretion. Sea-level rise adds a further dimension because it is accompanied by increased levels of wave and tidal energy. The normal response of an unmanaged soft coast to sea-level rise is landward movement of the shoreline. The many distinctive habitats and geological exposures of the coast are the result of this highly dynamic environment and most depend on the continual process of erosion and accretion for their existence. For example, to persist, mudflats rely on a regular supply of fine sediment eroded from other parts of the coast.
- Coastal habitats have a long history of human intervention in the processes that support them. However the processes continue to operate and as a result sea defences can be degraded or undermined and outflanked, as well as foreshores lowering and loss of habitats.
- The role of human management to maintain certain stages of coastal vegetation is not necessarily essential unlike open terrestrial habitats. Maritime exposure, salinity, flooding and sediment processes limit development of climax vegetation. Coastal habitats

therefore comprise a range of successional and transitional stages, sometimes with ephemeral vegetation, and which may go through repeated cycles of change driven by environmental conditions. Habitat management can mimic these to some degree and reduce levels of scrub on the more terrestrial systems.

- The variation in coastal habitats provides important niches for species, in some cases their needs can be fully met through the action of natural processes, in others a degree of management may be required, as long as this does not aim to fix those dynamic elements essential to habitat function.
- Coastal habitats are not fixed in time and space. Storm events such as those in 2013 demonstrated the degree of resilience of a range of habitats: greater natural function before and after such disruptions can help recovery over varying timescales.
- Management of the English coastline should focus upon the development of a dynamic environment resilient to the action of coastal processes and sea level rise and there is a need to conserve, manage and sustain sediment supplies that feed coastal systems and the landscapes and habitats they support.
- Shortfalls in sediment supply are rapidly developing to be a key issue. These problems are exacerbated because much of the sediment on our coastline comes from re-worked glacial material and in many cases that has now been exhausted. For example, supplies of shingle feeding the Orfordness foreland in Suffolk are largely exhausted, and supplies feeding Dungeness have been significantly depleted.
- Large scale beach recharge with sand or shingle is one way of feeding coastal systems with additional sediment. Generally this needs to come from off-shore sources although these are also exploited as a source of aggregate by the construction industry. Careful assessment of all applications for marine aggregate extraction ensures that any permissions do not themselves lead to an increase in erosion or flood risk. There is arguably a need to allocate strategic reserves of off-shore sediment to provide a current and future resource for beach ‘recharge’ schemes in vulnerable areas.
- Many coastlines with a legacy of risk management structures and operations will not be restorable to fully natural processes, but we must learn to work more closely with them and move towards more resilient coasts and management in future.

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