

# Coastal Habitat Action Plan

---

Hampshire Biodiversity Partnership  
March 2003



# COASTAL HABITAT ACTION PLAN

---

## CONTENTS

<b>COASTAL</b>	<b>1</b>
Introduction	1
Current status	1
Current Generic Factors affecting the habitats	3
Current Generic Actions	8
Plan Objectives	14
Proposed Generic Actions	16
<b>MARITIME CLIFFS</b>	<b>22</b>
Introduction	22
Current status	22
Current Factors affecting the habitat	23
Current Actions	24
Proposed Actions	26
<b>SHINGLE AND SAND DUNES</b>	<b>28</b>
Introduction	28
Current status	29
Current Factors affecting the habitat	30
Current Actions	31
Proposed Actions	33
<b>SALTMARSH</b>	<b>37</b>
Introduction	37
Current status	37
Current Factors affecting the habitat	39
Current Actions	40
Proposed Actions	43
<b>COASTAL WET GRASSLAND</b>	<b>46</b>
Introduction	46
Current status	46
Current Factors affecting the habitat	47
Current Actions	48
Proposed Actions	50
<b>MUDFLATS AND EELGRASS BEDS</b>	<b>51</b>
Introduction	51
Current status	51
Current Factors affecting the habitat	52
Current Actions	53
Proposed Actions	55
<b>SALINE LAGOONS</b>	<b>58</b>
Introduction	58
Current status	58
Current Factors affecting the habitat	59
Current Actions	59
Proposed Actions	62

<b>APPENDIX 1</b>	<b>65</b>
Table 1 – Hampshire priority species found primarily in coastal habitats	66
Table 2 – Priority species, thought to be extinct in Hampshire which are primarily associated with coastal habitats	74
Table 3 – Priority species found primarily in other habitats, but which occur in coastal habitats	76
<b>APPENDIX 2</b>	<b>78</b>
<b>REFERENCES</b>	<b>78</b>

## 1 INTRODUCTION

The Hampshire coast is notable for its unusual oceanographic, geological and biogeographic characteristics and the very large numbers and exceptionally wide range of regionally, nationally and internationally important habitats, communities and species populations that it supports<sup>1,2</sup>.

This diversity of coastal habitats and species arises partly because Hampshire lies on the transition between the warm 'Lusitanian' waters of the western Channel and the cold 'Boreal' waters of the Eastern Channel. This results in the presence of marine flora and fauna characteristic of both provinces, with several species at the edge of their British geographical distribution. Hampshire's southern location in Britain also means that many maritime species characteristic of warmer regions of Europe can maintain a foothold in Hampshire's coastal zone, alongside species more characteristic of northerly climes. Its climate and position close to the centre of the European flyway for many waterbirds and wildfowl encourages internationally important bird populations to make use of its estuaries while on migration and during the winter months. Additionally, the complex nature of Hampshire's coastal zone makes the county of particular importance to birds which utilise a range of coastal habitats at different times of the tidal cycle, day and year, and for different parts of their life cycle. Finally, the unusual double tides of the Solent area contribute to its special characters.

This Coastal Biodiversity Action Plan covers the most important estuarine, coastal and intertidal habitats in Hampshire. Each of these habitats contributes essential components to a single, highly interdependent, ecological system, comprising a network of estuaries, harbours and the Solent itself. This coastal system does not, of course, lie wholly within Hampshire's county boundaries (Chichester Harbour falls within two counties). It is, therefore, essential to consider adjacent counties (especially the Isle of Wight and West Sussex) when planning for biodiversity on the Hampshire coast.

Separate Habitat Action Plans are provided in the following pages for maritime cliff, shingle and sand dune, saltmarsh, coastal wet grassland, saline lagoon and intertidal mud and sand flats habitats with eelgrass

(*Zostera*) beds. The often-intimate relationship between these coastal habitats and the presence of natural transitions between them (some of which are rare in England) means that their individual management can not be considered in isolation. For example, tackling coastal habitat loss in the face of relative sea level rise through managed realignment may, in many cases, involve loss of coastal, brackish and freshwater habitats in order to enable intertidal areas to become re-established. Some of these lost habitats may be within designated sites, and sites that were purchased to secure the long-term protection of these habitats.

Biodiversity Action Plans must, therefore, be central to any coastal conservation initiatives and must make appropriate provision for compensatory habitat creation and consider the importance of natural transitions between different coastal and estuarine habitats.

## 2 CURRENT STATUS

### 2.1 Description of Habitats

Most of the 145 km of Hampshire's coast is relatively sheltered and enclosed within the Solent and its estuaries. Although marine, estuarine and maritime habitats have been lost in some areas through coastal urbanisation, industrial use, reclamation or dredging activity, coastal habitats of high geomorphological<sup>3</sup> and biodiversity<sup>1</sup> value still occur all along the coast, even in the most industrialised estuary, Portsmouth Harbour. This site still supports important populations of wintering and migratory birds, which rely on its mudflats and tidal creeks.

Enclosed estuarine habitats dominate the Hampshire coast<sup>4</sup>, and are a very important feature of the county's biodiversity<sup>5</sup>. Estuaries do not, however, receive attention within the context of a single Habitat Action Plan, except in this chapter. Rather, the range of habitats which they encompass are dealt with separately in the following pages.

Most of the County's estuaries are intertidal harbours that are partially closed by sand and shingle spits at their mouths. They are characterised by low freshwater inflow, large areas of saltmarsh and extensive sand and mud tidal flats with eelgrass beds exposed in the intertidal zone at low tide. Extensive areas of coastal wet grassland, reclaimed

from saltmarsh and intertidal hundreds of years ago, still occur in many areas behind sea walls. Some estuaries (e.g. Beaulieu) still support natural transitions to terrestrial habitats, now an unusual feature in southern Britain. Not only is each site individually of great value as a functioning estuarine ecosystem, but they are collectively of high biodiversity value because of the variation of estuarine types and large number present and the way in which they form a single inter-dependent ecological unit.

Hampshire's estuaries are also of national and international importance for the large wading bird and waterfowl populations which breed, feed and migrate through the area at different times of year, utilising many coastal and estuarine habitats at some stage of their life history. Chichester (which lies partly within Sussex), Langstone and Portsmouth Harbours, Southampton Water and the north-west Solent are individually and collectively of international importance for their wintering and migratory waterfowl populations, and for numbers of breeding seabirds. The Beaulieu Estuary is, when considered in isolation, of national importance for bird populations, but of international importance as an essential part of the complex Solent Maritime European marine site. Waterfowl move between all of these areas during the winter, and the whole system supports a total consolidated mean peak winter population of 150,000 waterfowl. Their sheltered intertidal flats, with extensive beds of eelgrass or seagrass, *Zostera* species, provide vital feeding areas for these internationally important bird populations, particularly during migration and in winter when other European estuaries may be frozen. Chichester and Langstone Harbours and Southampton Water are also nationally important for offshore wintering sea ducks<sup>6</sup>.

Internationally important sites for breeding birds are Langstone Harbour (little tern and Mediterranean gull) and Beaulieu Estuary (including Needs Ore Point, for black-headed gull). The latter site and the Solent Marshes, west of Needs Ore, are also of national importance for Sandwich, common and little terns, and black-headed gull, common and little terns, respectively<sup>6</sup>.

Separate chapters describe shingle (and some sand dune), saltmarsh and coastal lagoon habitats, with these including among the most important examples of their type in the UK and Europe. Coastal wet grassland habitat, much of it formed by the enclosure of saltmarsh, has now mostly been converted to agricultural, urban, recreational or industrial use, but Hampshire still holds some of the largest remaining areas of this habitat on the south coast. The maritime cliffs fringing parts of the more open coast

are of importance both for their geological features, invertebrate communities and vegetation. Intertidal and eelgrass habitats are also described in more detail in the following sections.

The coastal habitats described in this plan are each part of a complex and dynamic natural coastal system. These habitats are individually important for biodiversity conservation. The intimate mixture of these habitats and the transitions between them and adjacent terrestrial habitats are also of particular importance for many species. Maintaining these transitions between habitats and, where possible, reinstating them is a high priority. Maintaining the capability of the coastal system to respond to dynamic changes is also an important objective. Changes may lead to an increase in the extent of one habitat and a resultant decrease in the extent of an adjacent habitat. Such changes should only be accepted where they are the result of natural processes and so long as site integrity and function are not adversely impacted.

## 2.2 Distribution and Extent

Low crumbling maritime cliffs fringe mainly the westernmost section of coast and parts of Southampton Water. Moving into the Solent, sheltered by the Isle of Wight and the large shingle structure of Hurst Spit, much of the coast is fringed at high water mark by shingle and a small amount of sand dune habitat, with particularly important examples at Hurst Spit, Browndown and Hayling Island.

The saltmarshes to seaward and adjacent coastal wet grassland to landward on the Lymington-Keyhaven coast, inside the Lymington River and Beaulieu Estuary, and in Langstone and Chichester Harbours are among the largest not only on the south coast, but in the UK. The *Spartina* marshes between Hythe and Calshot are of international importance as a genetic resource for this genus, with Hythe marsh the site of origin of *Spartina anglica*.

Extensive sand and mudflats on the mid to lower shore support eelgrass communities and provide feeding grounds for huge numbers of waders and wildfowl.

Coastal saline lagoons occur along most of the coast, protected behind shingle and seawalls, but are most abundant in the west.

The Hampshire County Council's Phase 1 coastal survey and Hampshire Biodiversity Action Plan (Volume 1) have identified the following areas of coastal habitat:

Lagoons (brackish)	95 ha
Coastal wet grassland	750 ha
Intertidal mud & sand inc. algal beds	4,000 ha
Saltmarsh	2,660 ha
Shingle	250 ha
Sand dune and dune scrub	110 ha
Shoreline cliff	7 ha
Engineered coastal features	39 ha

### 2.3 Legislation and Site Designation

Most coastal and estuarine habitats of biodiversity importance are covered by Site of Special Scientific Interest (SSSI) designation down to the mean low water mark. Remaining fragments of the key coastal habitats mentioned above are designated as Sites of Importance for Nature Conservation (SINC) and receive protection from development. Exceptions are noted in specific Habitat Action Plans in the following chapters.

International biodiversity designations also cover large areas of the Hampshire coast. Special Protection Areas (SPA) have been designated under the European Wild Birds Directive within Chichester and Langstone Harbours, and Portsmouth Harbour. In winter, these sites regularly support an average of over 25,000 wintering wildfowl and 77,000 wintering waders, including several migratory species of waterfowl which are present in internationally or nationally important numbers. The Solent and Southampton Water SPA (which includes a complex of sites in Hampshire and the Isle of Wight) is of European and national importance for breeding gulls and terns and wintering waterfowl (supporting a mean of over 20,000 wildfowl and nearly 30,000 waders). All of these areas are also Ramsar sites, as 'Wetlands of International Importance Especially as Waterfowl Habitat'.

Finally, extensive areas of the Hampshire coast fall within the Solent Maritime and Solent Lagoons candidate Special Areas of Conservation (SAC) under the EC Habitats and Species Directive. The candidate Solent Maritime SAC is proposed for the following habitats of European importance: Atlantic salt meadows (perennial saltmarsh vegetation, for which this is one of the best areas in the United Kingdom); Cord Grass (*Spartina*) swards (one of only two outstanding UK localities, and more than 40% of the UK resource); Estuarine habitats (one of the best areas in the UK); Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; Sandbanks which are slightly covered by seawater all the time; and Annual vegetation of drift lines. The Lagoons SAC includes most of the saline lagoons on the Hampshire coast (some are in the Maritime

site) and areas of brackish ditches with lagoonal communities inside coastal wet grassland.

## 3 CURRENT GENERIC FACTORS AFFECTING THE HABITATS

### Rising sea level, Climate change and Coastal squeeze

Two unrelated factors which combine to cause a rise in relative sea level on the Hampshire coast pose a serious threat to coastal and estuarine habitats. Firstly, the land itself is sinking as a result of the isostatic movements that have been taking place across the British Isles since the last glaciation. It has been suggested that this movement is at its most rapid on the Channel coast from the Solent eastwards, where values in the region of 2-8mm/year have been reported (higher in the east, lower in the west Solent)<sup>7,8</sup>. Secondly, a possible combination of climate change and natural processes (whose effects are presently difficult to distinguish) are currently causing global sea level to rise at an estimated 2 mm/year, while recent estimates suggest that this rate of change is accelerating and may reach 6.5 mm/year over the next fifty years<sup>9</sup>. The in-progress SCOPAC study suggests a rise of mean sea level of 54 cm and a rise of extreme sea level (incorporating a 1:50 year surge) of 84 cm by the 2080s<sup>10</sup>. A trend towards increased storm frequency is also anticipated.

Although the scale of these trends is still uncertain, the overall result of this relative sea level rise is the landward movement of both low water and high water marks. The former is causing an increase in width of low water channels in the harbours and estuaries, loss of intertidal sediment flats, erosion of saltmarshes and the realignment of shingle spits. Additionally, die-back of *Spartina* saltmarshes (which may be at least partly unrelated to sea level rise) is taking place at a rate of 4-5m per year at the seaward edge of marshes in the Lymington Estuary<sup>8</sup>. The drying mark is also migrating landward as accretion continues at the upper levels of the shore and saltmarshes, but this movement occurs at a slower rate, with the overall effect being a steepening in profile and reduction in area of the intertidal zone.

Coastal squeeze describes the process by which intertidal habitats or fringing natural maritime habitats are reduced to seaward by the landward movement of the low water and/or high water marks described above, but are unable to move inland to compensate. This may occur when coastal works at the high water mark prevent intertidal habitats such as saltmarsh and

mudflats from extending inland, or urban developments, cultivated land, or other maritime land uses limit the inland development of coastal habitats above the high watermark. Cliff top habitats may be squeezed when erosion physically removes the semi-natural fringe of cliff top vegetation restricted to a narrow zone between the cliff and adjacent agricultural or developed land.

The net effect in Hampshire has been a significant rise in relative sea level and loss of intertidal area since the 1860s, with particularly dramatic losses since the 1950s and in the western arm of the Solent. It has been calculated there had been a 30% loss in width of intertidal in the shelter of Hurst Spit, 65% off Pennington Marshes sea wall, and 90% in the Beaulieu Estuary, most of this since 1910<sup>7,8</sup>. Sediment levels at the toe of seawalls have lowered by 1-1.5 m since these structures were constructed. In the 1980s-1990s, the drying line (low water mark) has been moving landward at some 20-40 m/year<sup>8</sup>.

On a natural coastline, in the absence of sea walls, it would be possible for the whole of the intertidal area to move inland, providing opportunities for the growth of saltmarshes higher on the coast and the development of a broader and more stable intertidal area. Very little of the Hampshire coast, however, is natural at the high water mark. Long stretches of artificial coastal defences and flood protection protect urban, industrial, recreational, agricultural and nature conservation areas and prevent this landward movement. Sea walls are now threatened in some areas by undermining and overtopping as seaward saltmarsh and sediment habitats are eroded and steepened. Similarly, natural 'soft' defences provided by shingle and sand dune features are affected by developments on their landward side, which prevent their dynamic movement towards a more stable state.

Habitats of nature conservation importance which are most badly affected by sea level rise and coastal squeeze include intertidal mudflats, saltmarshes, coastal wet grassland and coastal lagoons. Additionally, cliff erosion results in the loss of narrow fringes of maritime vegetation between the cliff edge and adjacent land managed for agriculture or under urban development. Under natural conditions, cliff erosion proceeds in steps at different rates and locations along the coast, thus ensuring that a full range of cliff face and cliff top communities are represented. If cliff face erosion is stopped or slowed by the construction of coastal defences, it ceases to renew suitable habitat for cliff plants and invertebrates, resulting in loss of successional stages, while too much erosion prevents development of cliff face and cliff

top communities; both result in loss of biodiversity.

#### Disruption of natural coastal sediment processes

The Hampshire coast is a dynamic system which has not reached a state of natural equilibrium. As noted above, many of man's activities on the coast have been aimed at stopping or reversing natural processes on the shoreline through construction of coastal defence works. Additionally, subtidal features and sedimentary processes have been altered by dredging and land claim. These activities all affect biodiversity, although not necessarily detrimentally.

Much of Hampshire's 145 km of coastline has been affected to some extent by sea defence or coastal protection works, whether in the form of continuous sea walls at the high water mark or set back behind shingle banks or saltmarshes, or other structures such as beach groynes which slow both erosion rates and the long-shore drift of sediment originating from elsewhere on the coast. Details are recorded in the (former) Ministry of Agriculture Coast Protection Survey of England database and in Shoreline Management Plans. The Hampshire County Council Phase One coastal survey recorded 39.3 ha of engineered coastal features.

The construction of artificial coastal works along many sections of coast has stabilised cliffs and prevented flooding and erosion of low-lying land above the high water mark. Some of these activities have reduced the supply of sediments from the land which would feed other parts of the coastal system, particularly saltmarshes and intertidal mudflats, and prevent their erosion and loss of biodiversity. Erosion control and sea defence works at Browndown and Hurst Spit have affected shingle vegetation and invertebrate biodiversity over large areas in recent years (as has natural wave action, particularly at Hurst Spit). Lagoon habitats are particularly susceptible to disruption of natural coastal processes on soft dynamic coastlines and natural lagoons are now scarce in the area (most remaining lagoons are maintained by sea defences).

Continued sea level rise will increase the need for erosion control and the upgrading of coastal works, potentially with consequent loss of coastal biodiversity. On the other hand, some important lagoonal and coastal wet grassland habitats are protected from erosion behind seawalls, and might otherwise be lost.

Capital and maintenance dredging of shipping channels and marine aggregate dredging can also disrupt natural coastal

sediment processes, including the movement of sediment between intertidal and subtidal areas. This disruption of natural processes is exacerbated when capital and maintenance dredgings are dumped outside the Solent and unable to return to feed coastal processes there. This removed sediment may also be implicated in the loss of width of intertidal habitat described in the previous section. Dredgings have also frequently been dumped on coastal land, affecting maritime habitats, or used for land claim. There are, however, ways of using dredged material beneficially for habitat recreation, and such use is now often included under the terms of dredging licenses, although it is yet to be proved effective in the Solent.

Intertidal land claim in harbours has changed the current regimes which formerly swept inlets clear of sediments.

#### Water quality and pollution

Like many other areas, the Hampshire coastline and estuaries have been affected by human society. Dense human populations and numerous industries along the coast and estuaries result in the input of many substances into the aquatic environment. Pollution from agricultural and urban runoff, anti-fouling chemicals, and sewage and industrial discharges (historic and present) has affected water and habitat quality and populations of some species, particularly within enclosed areas. Marine litter, lost fishing gear and sewage debris are also potentially damaging marine pollutants. Dredging of contaminated sediments and dumping of spoil can also affect biodiversity.

In the past, much water pollution (particularly organic inputs) originated from point sources, such as waste water treatment plants (industrial and sewage outfalls). Significant progress has been made in recent years in improving the quality of these discharges, and non-point sources (from atmosphere and agriculture) are now considered to be a more significant source of pollution than point sources, even though Hampshire has been one of the fastest growing areas of the UK in the 1980s and 1990s<sup>11</sup>.

At 92%, the proportion of Designated Bathing Waters judged to comply with EC Directive requirements is extremely high in the Solent area when compared to the National figure of 82.5% for 1994. The trend appears to be towards sustained improvement. The steady improvement in storm sewage outfall screening is beginning to show a reduction in debris and nuisance pollution of the Solent shoreline. The point will hopefully be reached when visible pollution of beaches from the sewerage

infrastructure will have virtually ceased to exist. The driving force for further investment in sewage infrastructure in the foreseeable future is the Urban Waste Water Directive. Regardless of whichever options are finally selected, the associated schemes must be complete by the end of 2000 or 2005, dependent upon Directive requirements.

A further problem within the Solent Area is the high nutrient level indicated by monitoring. Nutrient inputs can originate from both point and non-point sources. Although the water quality of the rivers and estuaries around industrial areas is mainly Class 1, some upper reaches and the southern shore of Southampton Water, and the north of Langstone Harbour are of poorer quality. Parts of the Solent coast may potentially be sensitive to eutrophication (caused by increased levels of nutrients), for example possibly the Western Solent, western Southampton Water and Eastern Solent, tidal areas of the Itchen and Test, and certainly Langstone, Chichester and Portsmouth Harbours.

Excessive plant growth (anoxic events and blooms of nuisance algae) can be a consequence of nutrient enrichment. Green algae are important primary producers in estuaries but in conditions of high nutrient levels they can form dense, smothering mats on mudflats which can lead to highly anaerobic conditions in the underlying mud and to changes in the biomass and composition of the benthic fauna. Potentially this has implications for the fish and birds which feed on the benthic animals. Ironically, however, reduced productivity and increased infaunal biodiversity resulting from cleaning up effluents (particularly sewage discharges) may potentially have detrimental effects on other aspects of coastal biodiversity; some bird populations thrive on the high biomass, low-biodiversity invertebrate communities characteristic of moderate organic pollution.

Some pollution problems are the legacy of past discharges from large industrial complexes, particularly along Southampton Water where there are some areas of heavily polluted sediments and saltmarsh contaminated with heavy metals<sup>12</sup>, toxic chemicals and oil. This is likely to be the reason for the low diversity of some benthic communities in Southampton Water. Spills of oil or chemicals could still affect areas around industrial installations or adjacent to shipping lanes and bird populations at sea or feeding on the shore. Dredging of shipping channels, shellfish dredging or bait digging may also cause a deterioration in water quality by releasing heavy metals bound up in undisturbed sediments.

The whole English Channel is an important route for tankers and other vessels, and

there is a major oil-refinery in Southampton Water. Spills can also occur from non-tanker shipping movements, and the Solent is an extremely busy area for shipping, which makes it a high risk area for potential accidents. Contingency plans (including SOLSPILL) are in place to help authorities to cope with such events.

Despite receiving large volumes of sewage effluent, industrial residues, herbicides, pesticides and fertilisers, the levels of a wide range of the most toxic and undesirable substances remain well below the standards set or proposed under European legislation. One exception to this is organic tin. Levels of this substance are well above acceptable levels, with recovery unlikely within the foreseeable future. The use of tributyltin (TBT) antifouling paint on shipping caused the disappearance of dogwhelk populations from most of the Solent and suppressed clam recruitment in the 1980s. Despite a ban on its use on small craft, the very long half life of TBT in sediments and its continued use on larger vessels in Southampton Water appears to be responsible for the continued high levels of this chemical in the environment, particularly in the Test<sup>12</sup>. The continuing use of this material for protection of large vessels must be a subject for future debate given the UK requirement for sustainable development.

A Plymouth Marine Laboratory project is assessing the impacts of antifouling agents in the coastal environment<sup>13</sup>. The new antifoulants being developed could also have detrimental effects on biodiversity<sup>14,15</sup>.

#### Fisheries and bait collection

The major impact of the economically important commercial fisheries on the biodiversity of the Hampshire coast arises from dredging, primarily for oysters, clams and other shellfish, in most of the larger harbours and throughout the Solent area. Some lagoonal and intertidal areas have been used for shellfish culture. The traditional oyster dredging and trawling carried out by small, low powered vessels offshore is apparently sustainable and unlikely to cause much damage to the coastal biodiversity on which these fisheries rely. In contrast, modified oyster dredges and hydraulic dredges designed to dig deeply into the sediment to remove clams have been extremely damaging to sediment structure, habitats and benthic communities, including invertebrates, algae and eelgrass (*Zostera* spp.) beds<sup>16</sup>; their use is now prohibited in the coastal areas covered by this Biodiversity Action Plan.

Trawls and dredges move, damage or remove surface layers of sediment, shell,

pebbles and cobbles and their associated flora and fauna. Dredging also increases water turbidity, thus restricting algal photosynthesis even at shallow depths and potentially clogging or smothering other species as fine material settles back to the seabed. The more sheltered and low energy the habitat affected, the longer it takes to recover and the greater the potential problems are for the release of heavy metals from anaerobic muds into the environment.

A study on the effects of intensive dredging for *Mercenaria* clams on benthic community structure in Southampton Water<sup>17</sup> concluded that it resulted in significant changes to the benthos of subtidal areas, with a decline in biodiversity and species abundance. Similar effects on the benthos and reduction in the gravel fraction of dredged muddy gravel were identified during an experimental study<sup>18</sup>. Hydraulic dredging and use of modified oyster dredges with long tines in much softer sediments inside the harbours completely disrupted intertidal sediments, bringing anoxic sediments and underlying clay bedrock to the surface and shattering or removing bivalves<sup>19</sup>. Clam dredging activity may also affect water quality by mobilising polluted sediments from sheltered areas and disrupt bird feeding activity by physically destroying intertidal infauna, habitats and eelgrass beds.

In contrast to commercial fishing operations, which are generally not widespread on the foreshore, bait digging activity occurs almost anywhere that anglers or commercial collectors can gain access to the foreshore. Controls on access and bait collection activity result in the rapid redirection of activity to other accessible sites. This much more widespread activity can have similar effects to dredging on intertidal biodiversity, although sandy shores recover more quickly than mixed muddy sediment shores, where habitats and sediment infauna (particularly long-lived mollusca) may take a long time to recover from damage and pebble epifauna can readily be destroyed. Eelgrass beds can be particularly badly damaged by bait digging<sup>16</sup>. Where exploitation of saltmarsh habitats (pans and creeks) occurs, the damage caused is long-lasting.

Intertidal dredging and bait digging both pose a potential threat to wintering bird populations, which depend upon a high biomass sediment infauna and healthy eelgrass beds for their survival, and which may suffer from disturbance caused by activity taking place on the shore while they are foraging there.

Disturbance and loss of biodiversity on cobble and boulder shores may be caused by trampling and boulder-turning undertaken

by bait collectors, field study groups and casual holiday-makers<sup>16</sup>.

#### Dredging and dumping

Dredging of seabed sediments takes place in harbour channels and marinas to maintain navigational depths, with capital dredging in Southampton Water having enabled access to the port for larger vessels. Capital dredging of shipping channels can cause draw-down of adjacent sediment areas; this may already have affected the intertidal in Southampton Water. Maintenance dredging continually removes accreting sediment from the system. When dumping of dredged spoil takes place in designated sites well offshore outside the Solent, this also contributes to coastal erosion. Disposal of dredged sediments may be undertaken with beneficial effects, such as for beach recharge. On the other hand, depending on the methods involved, disposal of sediments inshore or in the intertidal may cause smothering, increased turbidity and the mobilisation of contaminants from estuarine sediments, potentially damaging coastal biodiversity, and obscuring important geological or geomorphological features<sup>20</sup>.

Former aggregate dredging from near-shore gravel beds within the Solent may have reduced the supply of sediments to the shore and hence increased the force of wave action on the shore.

#### Changing land use and management

Changes in land use have altered and frequently considerably reduced the biodiversity of many coastal habitats in Hampshire. The development of coastal wet grassland and salterns hundreds of years ago has sometimes produced coastal habitats which are now of considerable biodiversity importance. More recently, arable intensification, recreational, urban, port and industrial developments have resulted in large-scale habitat loss. Only Chichester Harbour and the Beaulieu Estuary still have a predominantly rural hinterland with largely natural shoreline transitions. Now that coastal developments are controlled under planning legislation, changes in the intensity of land management are likely to be of greater significance for coastal biodiversity. Examples include maintenance of grazing and water levels on grasslands, which affect the growth of rare and scarce plants and associated invertebrates, and disturbance to fragile habitats (e.g. by trampling) by changing levels of access or use of bird feeding, breeding or roosting sites.

#### Recreation

The Hampshire coast is used extremely heavily for a wide variety of leisure and recreational activities, particularly water-based recreation. The Solent is an internationally important centre for yachting, dinghy sailing and power-boating (which utilise some 21,500 moorings and about 9,000 marina berths on the Hampshire coast). It is also of national importance for canoeing, wind-surfing and water-skiing. There is also extensive use of maritime habitats by land-based recreational activities, and pressure is likely to rise. Detailed information on recreational use is provided in the Coastal Recreation Strategy of the Southern Council for Sport and Recreation.

These high levels of recreational pressure may affect coastal and marine biodiversity through physical damage from trampling, to disturbance from proximity of leisure and recreational activities. These activities could affect bird biodiversity by indirectly denying them access to roost sites or feeding areas (the latter is particularly serious in cold winters when maintaining adequate food intake is essential for migrating or wintering wildfowl to be able to survive<sup>21</sup>), or by disturbing breeding and roosting sites.

Aquatic mammals (e.g. cetaceans and otters) may also be affected by the noise, visual and physical disturbance associated with recreation in the Solent and its harbours.

Hampshire County Council's Strategy for the Coast<sup>22</sup> states: "The County Council considers that the existing character of the Solent cannot survive continued development, or the growth of water recreation, at the scale and pace experienced in recent years... It also believes that the capacity of the Solent to accommodate additional water recreation has almost been reached. Policies should not encourage further growth of such activities."

#### Land claim and development

Large areas of Hampshire's intertidal and maritime habitat have been lost as a result of land claim and development. In the past, land claim was primarily for agricultural purposes and salt production and resulted in the formation of extensive areas of coastal wet grassland and lagoons (now themselves of high biodiversity value) from saltmarsh, particularly in Langstone Harbour, Beaulieu Estuary and Lymington River. Some 3,655 ha of saltmarshes and mudflats within the Solent (including the north coast of the Isle of Wight and Pagham Harbour, outside Hampshire) is estimated to have been

embanked, 90% of this between 1600 and 1900<sup>6</sup>.

More recently, land claim has been primarily for industrial and port developments (including the naval docks and installations of Portsmouth Harbour and the oil refinery and power station developments of Southampton Water), rubbish and spoil disposal, transport, housing and marinas.

For example, 80 ha (4.6%) of Langstone Harbour has been reclaimed by refuse tipping. Portsmouth Harbour lost 240 ha of its intertidal area for refuse disposal and the construction of the M27 motorway in the 1960s, contributing significantly to the 425 ha or 26% loss of its intertidal area between 1720 and 1964<sup>8</sup>.

Southampton Water has lost a substantial area of natural habitat to industrial and port developments since land claim began in 1840 for the development of the 'Old Docks'. Southampton Docks now occupy almost 400 ha of former coastal habitat, while associated reclamation in Dibden Bay occupies 176 ha. Additional areas were infilled in the 1960s for the construction of refinery at Calshot and Fawley Power station<sup>23</sup>. Total habitat loss in Southampton Water is an estimated as 690 ha or 40% of the intertidal<sup>8</sup>.

There is sand and gravel extraction and associated land fill at Efford, adjacent to and affecting coastal wet grassland and lagoons at Keyhaven and Pennington Marshes. The planning consent for mineral workings has been reviewed because of the adverse effect on these coastal habitats and mitigation measures are currently being implemented.

#### Non-native and introduced species

The Solent area has been the site of many introductions of non-native species. Many have been accidentally introduced, for example as a result of shipping movements<sup>24,25</sup>. Discharge of ballast water is implicated in many introductions, but the Jap weed *Sargassum muticum* may have been transported to the Solent entangled on anchors or anchor lines<sup>26</sup>. The other major source of introductions is through the deliberate translocation of species for mariculture. Notable examples in Hampshire include commercially-harvested species such as the American clam *Mercenaria mercenaria* and Pacific oyster *Crassostrea gigas*, while species which may have been unintentionally introduced with some of the above are the soft clam *Mya arenaria*, slipper limpet *Crepidula fornicata*, and Japanese or Korean seasquirt *Styela clava*, all of which now dominate some native benthic communities on the Hampshire coast. There is also a very large number of non-native

species of algae now established on the Hampshire and adjacent coasts<sup>27</sup>.

Deliberate introductions of non-native species are in violation of the Wildlife and Countryside Act, if undertaken without a license, because of the damage that introductions may cause to native flora, fauna and habitats. Non-native species may have such fast growth rates, resilience to disease and to local predators that they have the potential to out-compete local species (fast-growing Jap weed, for example, could potentially shade out *Zostera* beds and displace native algae). If hybridisation occurs between introduced and native species, this may also lead to the loss of the latter if the hybrid is invasive.

## 4 CURRENT GENERIC ACTION

### 4.1 Site Protection

Most of the Hampshire coast is covered by Site of Special Scientific Interest (SSSI) designation with SINC designation covering any remaining undeveloped coastline. Much of it, particularly estuarine, saltmarsh and lagoonal habitats and those areas of importance for bird populations, is also under existing or proposed international designation as Special Protection Area, Ramsar Site or Special Area of Conservation. Large areas of these designated sites and the species that they support receive additional protection through their ownership and/or management as nature reserves by Hampshire County Council, English Nature, the Hampshire Wildlife Trust, and RSPB. Finally, the proposed New Forest National Park may well include significant areas of the western Hampshire coastline.

### 4.2 Habitat Management and Programmes of Action

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast. These range from biodiversity management plans for internationally important sites (SEMS and CHaMPs – see below) and English Nature's Natural Areas Profiles and conservation objectives<sup>28,29,30</sup>, to the Hampshire County Structure Plan Coastal Policies, regional Shoreline Management Plans (which cut across County boundaries), and Local Plans, policies or management schemes which only cover parts of the County. The latter include District Council Coastal Management Plans, Estuary Management Plans, Local Area Environment Agency Plans (LEAPs, formerly Catchment Management Plans) and Water

Level Management Plans, Nature Reserve management plans and English Nature Site Management Schemes.

Co-ordination and integration of this wide range of overlapping initiatives, within the south coast region as well as within the county, is an essential part of biodiversity planning in Hampshire. The Standing Committee on Problems Associated with the Coastline (SCOPAC), comprising the coastal local authorities of West Sussex, Hampshire, the Isle of Wight and Dorset, goes some way to achieving this at county planning level, while the Solent Forum has brought together all national and local statutory bodies, user groups, academia, industry and the main voluntary organisations (over 60 organisations) in order to develop a common strategy (through consensus) for the management and conservation of the Solent.

Overall, planning authority policies in Hampshire are highly protective of coastal habitats and generally opposed to the continued development or expansion either of recreational or commercial coastal activities.

#### Solent European Marine Sites (SEMS) Management Scheme

The European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (generally known as the Habitats Directive) requires the maintenance or restoration of natural habitats and species of European interest at favourable conservation status. The identification and management of a network of sites of European importance (SACs and SPAs), known as Natura 2000 sites, is one of the main vehicles for achieving this. The Directive includes special provisions for European Marine Sites (SACs and SPAs which include areas of sea), particularly the production of a management scheme.

The Solent European Marine Site (SEMS) includes the Solent Maritime candidate SAC, the Solent and Southampton Water SPA, Portsmouth Harbour SPA, and Chichester and Langstone Harbours SPA. A Management Group of Relevant Authorities is currently preparing a management scheme for the Site. This will outline measures required to achieve the favourable conservation status of the Site by considering the impacts of current activities and their management. Plans and projects that require a license or permission from a competent authority will be assessed on a case-by-case basis through Habitats Regulations 48-50 and the requirement for appropriate assessments.

The management scheme will build on English Nature's Regulation 33 Advice<sup>6</sup> (on conservation objectives and operations

which may cause deterioration and disturbance to habitats and species) and will identify issues that need to be addressed by the Relevant Authorities to ensure the conservation status of the SEMS is maintained.

The statutory SEMS Management Scheme will link into other current initiatives in the area including the Coastal BAP; for example where issues are identified through the management scheme process, existing actions from other initiatives may be highlighted as possible control mechanisms.

#### Coastal Habitat Management Plans (CHaMPs)

CHaMPs, launched in April 2000, are intended to 'resolve situations where predictable changes to the coastline make it impractical or unsuitable to maintain all the components of a European or other international site in situ, and to meet their conservation objective, such as dynamic coasts where habitats are no longer able to respond to sea level rise<sup>31</sup>. The CHaMPs guidelines aim to develop a strategic approach to the holistic management of flood risk and internationally important wildlife sites. They may be applied to coastal sites of international nature conservation importance (SPAs and SACs) threatened by rising sea levels and coastal squeeze or to areas immediately adjacent to European or international sites.

The Project will seek opportunities for mitigation of net losses that are likely due to coastal defence actions. The aim is to maintain or protect in situ in the first instance and only to mitigate elsewhere where losses still persist or are otherwise likely. Habitats included are vegetated shingle, sand dune, saltmarsh, coastal grazing marsh, mudflat and saline lagoons.

Low-lying coastal sites in West Sussex and Hampshire are among the first six priority areas for which CHaMPs have been produced by English Nature and the Environment Agency, in close consultation with DEFRA and DETR, and with funding from the EU LIFE Project 'Living with the Sea' and DEFRA. The Solent CHaMP covers the area from Hurst Spit to Pagham. It aims to provide for losses over the next 30-100 years incurred through coastal defence schemes to maintain the overall integrity of the international sites in the Solent.

#### Countryside Stewardship

Countryside Stewardship is a DEFRA grant scheme which is available throughout Hampshire, but specifically targets named habitats, including coastal areas such as cliff tops, coastal wet grassland, managed sand dunes, coastal heaths and intertidal habitats

such as saltmarshes and shingle ridges. This agri-environment scheme offers payments to farmers and other land managers to conserve and enhance the landscape and its associated wildlife and cultural history and to help people to enjoy the countryside. The scheme offers ten year management agreements with annual management payments and a wide range of accompanying capital grants for re-creating intertidal habitats on agricultural land and managing coastal habitats traditionally (particularly by grazing). In the case of creating intertidal habitats, a detailed creation and management plan will need to be prepared and this can be funded by the Countryside Stewardship under a separate one year agreement, with any subsequent agreement dependent on the outcome of the plan.

#### Shoreline Management Plans (SMP)

Shoreline Management Plans cover natural coastal sediment circulation cells. There are two main SMPs in Hampshire; for the Western Solent and Southampton Water, and for the East Solent. The adjoining Poole and Christchurch Bay SMP in the west partly overlaps the Western Solent and Southampton Water SMP.

#### Coastal and Harbour Management Plans

A large number of smaller areas of the Hampshire coast are covered by District Coastal, Estuary or Harbour Management Plans. These include Management Plans for the New Forest Coast, Portsmouth Harbour (reviewed 2000), Langstone Harbour and Chichester Harbour, and the River Hamble.

The Chichester Harbour Conservancy bases its management on the principles of sustainable stewardship of the AONB, aiming to ensure that management of the various uses and pressures is carried out in such a way as to ensure the undiminished continuity and replenishment of the whole. A specific nature conservation objective is to maintain and increase priority habitats, as defined by the Habitats Directive and the UK Biodiversity Action Plan, and to provide for local diversity. The importance of undertaking or commissioning scientific research as the basis for sound environmental management is recognised.

#### Local Area Environment Agency Plans

Local Environment Agency Plans set out the programme of work that the Environment Agency (EA) plans to undertake over the next five years to protect and enhance the local environment. They address environmental issues and concerns which can be tackled locally, identify opportunities for partnership (e.g. with Local Authorities, representatives of local communities,

regulated organisations and other bodies with similar environmental objectives and responsibilities), and highlight the need for a proactive role in the land use planning process.

LEAPs enable the EA to identify and develop partnerships with other organisations and to co-ordinate their joint local aims, objectives and actions so as to make the most effective use of limited resources. LEAPs also provide a practical source of data and guidance for all those who wish to become involved in local environmental management and improvement.

LEAPs take a long term view of local environments and set out a five year plan of action for solving local issues. Actions are prioritised, taking account of costs and benefits, and identify time scales and partner organisations. Progress against actions is monitored and reported annually. Reviews after five years (or sooner if necessary) result in new LEAP consultation drafts reflecting progress and further changes needed to improve the local environment.

The following LEAP documents are relevant to the Hampshire coastline:

Arun & Western Streams LEAP July 2000 (Sussex Area, Southern Region)

East Hampshire LEAP August 2000 (Hampshire & IOW Area, Southern Region)

Test & Itchen LEAP August 2000 (Hampshire & IOW Area, Southern Region)

New Forest LEAP March 1999 (Hampshire & IOW Area, Southern Region)

#### Water Level Management Plans (WLMPs)

WLMPs provide a means by which the water level requirements for a range of activities in a particular area, including agriculture, flood defence, nature conservation, water resources, and amenity, can be taken into account, balanced and integrated. They are a reference document providing continuity and stability in site management which, by identifying opportunities, can help fulfil the duty of an operating authority to further the conservation and enhancement of wildlife and the enhancement of natural beauty.

Although primarily aimed at sites of conservation interest, it is likely that WLMPs would be beneficial for most areas where water levels can be controlled. The history of these areas, most of which are low-lying, has been one of increasing use; over the centuries they have been embanked and drained primarily to create conditions suitable for agriculture or settlement.

A WLMP is a written statement, produced by an operating authority, which outlines the objectives for the area and the means by

which those objectives may be achieved. Its production should involve all those interests that may be affected by water management within the area covered by the plan. The existence of the plan will ensure that the agreed management regime is recorded for future reference, even if there is a change in personnel. For SSSIs, such agreements should be between the operating authority and English Nature, and will seek to ensure that the nature conservation interest for which the site is designated is not damaged. An operating authority is an administrative body, with responsibility for flood defence, land drainage or coastal defence. This is normally the Environment Agency, Independent Drainage Board, or Local Authorities.

Once a WLMP has been produced it should be treated as a working document, which is reviewed on a regular basis and updated or revised if the objectives are not being met or if circumstances change. The purpose of a plan, in summary, is to:

- Establish the aims of the various interests;
- Describe the water level management objectives for the area;
- Prescribe a target water regime and the range of acceptable tolerance for each water management structure, and specify seasonal requirements;
- Describe contingency measures for exceptional circumstances;
- Prescribe the timing and nature of maintenance activities that may affect water levels;
- Define an implementation programme of monitoring to ensure the objectives are being met;
- Describe funding and operating responsibilities;
- Outline a review procedure.

Ideally WLMPs should be prepared for all areas that have a conservation interest where control of water levels is important to the maintenance or rehabilitation of that interest. The highest priority should be given to production of plans for sites of international importance such as SACs, SPAs, Ramsar site and World Heritage sites. These should be followed by plans for nationally, and then regionally and locally important sites (including archaeological sites), and other as appropriate.

The Water Level Management Plans relevant to the Hampshire Coast and their status (as of March 2003) are as follows:

- Farlington Marshes – written, awaiting approval
- Hurst, Lymington, Keyhaven and Pennington – Interim report written and approved
- Lymington River & Reedbeds – written and approved
- Titchfield – written, awaiting approval
- Eling Tide Mill – Plan being considered.

#### Site Management Plans

Nature Reserves on the Hampshire Coast are managed to maintain their importance for biodiversity, with Management Plans generally being updated regularly. Documents called Site Management Statements are produced for landowners by English Nature to guide management of SSSIs and other sites.

#### Habitat and Species Management Plans

National Coastal Habitat and Species Biodiversity Action Plans (BAPs) have been published by the UK Biodiversity Group<sup>32</sup>. In addition, a number of Natural Area BAPs have been prepared by English Nature which take the national targets set out in the UK Biodiversity Action Plan and break them down into specific targets for each Natural Area<sup>33</sup>. The Hampshire coast is covered by three Natural Areas: the New Forest, the South Coast Plain and Hampshire Lowlands, and the Solent and Poole Bay Natural Area maritime BAP. Habitats referred to in these Natural Area BAP include Coastal and Floodplain Grazing Marsh, Saline Lagoons and Seagrass beds.

More information on National and Natural Areas Biodiversity Action Plan targets are given in the appropriate habitat sections which follow.

#### 4.3 Action for Species

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily in coastal habitats. Action proposed in this Plan will be the principle means of conserving most of these species, although certain species will have their own Species Action Plans (SAPs). Details of these are given in each of the following habitat sections. In some cases additional action plans and programmes will also contribute to conserving priority species: for example UK Species Action Plans (UK SAP), Butterfly Conservation Regional Action Plans (BC RAP) and the English Nature Species Recovery Programme (EN SRP).

Table 2 (Appendix 1) lists those priority species, thought to be extinct in Hampshire,

which are primarily associated with coastal habitats.

Table 3 (Appendix 1) lists those Hampshire priority species that occur in coastal habitats but whose main habitat is not on the coast. Although actions in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation.

As noted above, a number of coastal species are covered by UK and Natural Area Biodiversity Action Plans (BAPs). English Nature is responsible for delivering the Biodiversity Action Plan for the Native Oyster (*Ostrea edulis*) and the Environment Agency is preparing an Action Plan for the Atlantic Salmon (*Salmo salar*). County species BAPs have also been prepared, some for single species, others for groups of species (e.g. the Lepidoptera Species Action Plan covers a number of butterflies, including coastal species). Coastal BAP species of importance in Hampshire include coastal birds, the Water Vole, European Otter, Natterjack Toad (see section on shingle and sand dunes), Starlet Sea Anemone and Ivell's Sea Anemone (the latter two are saline lagoon species).

#### Water Vole

Hampshire contains one of the most important populations of the Water Vole *Arvicola terrestris* in England, with the River Itchen a key site<sup>34</sup>. This species is tolerant of brackish conditions and occurs in ditches in coastal wet grassland and some coastal lagoons, particularly where reeds are present and the water edge is not trampled by grazing animals. The Natural Areas BAP target for Water Voles is to maintain their current distribution and abundance and to ensure their presence throughout their 1970s range by 2010, considering habitat management and possible translocation of populations to areas from where they have been lost. The Species Action Plan for the Water Vole in Hampshire<sup>34</sup> identifies key actions for this species in the county.

#### European Otter

Hampshire lies on the edge of naturally expanding otter populations from the west and northwest and the species appears to be colonising western coastal habitats, including estuaries and coastal wet grassland. The Natural Areas BAP targets are to maintain and expand existing populations and, by 2010, to restore breeding otters to all catchments and coastal areas where they have been recorded since 1960. The Species Action Plan for the European Otter *Lutra lutra* in Hampshire<sup>35</sup> identifies key actions for this species in the county.

#### Butterflies and moths

The Species Action Plan for the Lepidoptera of Hampshire covers several important species of coastal habitats<sup>36</sup>.

#### Coastal birds

The Dark-bellied Brent Goose Strategy has been prepared by a partnership of Hampshire County Council, District Councils, Hampshire Wildlife Trust, English Nature and others<sup>37</sup>. It is intended to be adopted as Supplementary Planning Guidance by the relevant authorities.

A Joint Species Action Plan has been prepared for Shorebirds<sup>38</sup>. This takes into account the very similar needs of those species for which Hampshire coastal habitats are an important feeding ground in winter or during migration, and those coastal breeding birds which rely on coastal habitats during the summer months. Species covered include little egret, Mediterranean gull, little tern, roseate tern, turnstone, dark-bellied brent goose, sanderling, dunlin, knot, bar-tailed godwit, black-tailed godwit, grey plover and redshank. Similarly, the Species Action Plan for the birds of wet meadows covers white fronted goose and Bewick's swan.

#### 4.4 Survey, Research and Monitoring

As a result of the long history of scientific research in the region, the Hampshire coast and adjacent marine areas are generally very well-studied and relatively well understood. A recent Solent Science Conference has summarised the current extent of science in the area<sup>39</sup> and used plenary sessions to identify information gaps and future needs<sup>40</sup>. Three main areas of activity were identified with regards to a future research agenda: monitoring and measuring (of natural and man-made processes and impacts); improving understanding of processes and ecosystems within an interdisciplinary framework; and management, training and promotion of existing knowledge.

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary.

For example, monitoring of cliff habitat and erosion processes occurs within the frameworks of the Shoreline Management Plans and the New Forest Coastal Management Plan, while the strategic CHaMPs guidelines rely heavily on research and monitoring. The status of coastal SSSIs are monitored by English Nature and the status of SINCs by Hampshire County Council.

DEFRA's High Level Targets require operating authorities to report annually to the Environment Authority on all habitat losses

and gains covered by BAPs as a result of their coastal defence operations.

## 5 PLAN OBJECTIVES

The overall aim of this Plan is to protect and enhance the biodiversity of coasts in Hampshire. This broad aim translates into the objectives set out below. Where feasible, objectives have been allocated targets against which progress can be measured; for example total areas to be restored or dates for completion. The 'Proposed Action' table in section 6 (pages 16-20) identifies the generic action to be taken to meet the objectives.

	OBJECTIVE	PROPOSED ACTIONS							
		COASTAL (GENERAL)	MARITIME CLIFFS	SHINGLE AND SAND DUNES	SALTMARSH	COASTAL WET GRASSLAND	MUDFLATS AND EELGRASS BEDS	SALINE LAGOONS	
A	Ensure that site designation and management reflect coastal and estuarine habitat site quality, and that all designated coastal sites are maintained in favourable condition	1, 5-10, 13, 22-23, 28	5	1, 2, 9-11	1	1, 2, 7, 15	1, 2	1, 6, 7, 16	
B	Maintain and enhance, where possible and desirable, the present extent of all coastal habitats. Accept natural changes in their distribution as a result of management strategies (such as coastal setback) which enable the recreation or natural development of such habitats.	2-7, 9-14, 24, 28	3, 5, 6	2, 4-11	2, 4, 5	11	2, 5, 8	2, 6	
C	Minimise, so far as possible, further net loss of coastal and estuarine habitats as a result of anthropogenic causes.	2-5, 9-11, 14, 15	1-4, 6	2-4, 7-9			2, 3, 5, 8	2, 5	
D	Seek opportunities for further coastal and estuarine habitat creation. Increase, where possible and desirable, the overall extent of coastal and estuarine habitats by implementing coastal setback and other management strategies enabling the recreation or natural development of such habitats. Where habitat losses occur as the result of relative sea level rise, opportunities for mitigation/compensation should be sought within the Greater Solent to maintain the integrity of the coastal system.	2-7, 9-15, 23-25, 27, 33, 36-37	2, 5, 6	5-8	2-6, 14	3, 5, 6, 8, 11	7, 8	2, 3, 8, 15, 18	
E	Use appropriate management strategies and techniques to maintain, restore or improve coastal and estuarine habitat quality and biodiversity, including important examples of natural transitions between habitats	2-6, 8-13, 22-25, 27, 28, 36-37	1-6	4-11, 15, 18, 19, 24	2, 4-7, 14, 16	2-5, 7, 8, 11, 14	2, 4, 5, 7, 8	2-4, 6-7, 10, 15, 16, 18	

**Coastal**

F	Maintain, wherever possible, the free functioning of physical processes influencing coastal and estuarine habitats, including the recycling of dredged sediments within the coastal cell of origin	3, 4, 9, 11-12, 15, 24-27 37, 35	1, 3, 4, 6	2-7,10, 11, 21, 22, 24	3, 6, 14		3, 8	5
G	Ensure the full integration of BAP management: policy targets, survey, research and monitoring activities with similar actions for other coastal management plans (e.g. SEMs, SMPs, CHaMPS and the landuse planning system)	3, 5, 9-10,13, 23, 26-30, 34, 36-38	1,2	4, 6, 21, 22, 24	5, 6, 14-16	8, 12, 14, 15	3, 9, 10	4 6, 7
H	Improve knowledge of coastal and estuarine habitats and species in Hampshire through survey, research and monitoring	16-30, 37	7, 8	14, 16-22	7-15	9-15	6, 9-11	4, 9, 11-19
I	Confirm and map the extent of coastal habitats in Hampshire, the processes influencing them and the potential for retaining and/or augmenting these resources, particularly in the face of projected sea level rise	2, 4, 15, 23-29, 37-38	6	5, 6, 8	2, 7, 12-15	3, 6, 8, 11, 13	6-11	2, 8, 15, 16, 17
J	Assess the quality of coastal and estuarine habitats and the communities that they support, identifying the most important examples of each	16-23, 28, 30	7, 8	14	12, 13	12	6, 9	1, 9, 16, 18
K	Assess the status of all Hampshire Biodiversity Action Plan Priority Species associated with coastal and estuarine habitats, ensure that their requirements are met and their populations maintained and where possible augmented through appropriate management	8, 16-22, 30, 38	7, 8	12-19	8-11	9-10	4, 9	6, 9-15, 19
L	Communicate with and provide information to statutory and voluntary organisations, coastal industries and user groups, landowners, community groups and the public, including publication of losses/gains to promote awareness and sympathy for coastal habitats.	2, 4, 5, 8-10, 13, 32-37, 39	5-7, 9, 23, 24	5-9, 23, 24	3, 17, 18	3, 5	11-13	16

**6 PROPOSED ACTION**

The following table lists the generic actions required to achieve the objectives set out in this Plan (actions specific to particular habitats are listed in the individual coastal habitat chapters). Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

Key to symbols in Action Table:

- ◆ To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆→ Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ◆→ To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- Work that has already begun and is ongoing.

ACTION	DELIVERY BY	YEAR					MEETS OBJ.		
		2003	2004	2005	2006	2007		2010	
<i>Habitat Protection</i>									
1	Identify any mismatch between areas of high quality coastal and estuarine habitat and conservation designations, then apply conservation designations (SPA, SAC, National Nature Reserve and/or SSSI status) to all remaining areas that meet national and international criteria for site selection and SINC designation to other areas of county importance.	EN, HCC	Others	◆					A
2	Develop a strategy for maintaining (where possible) the extent and balance of all coastal habitats, particularly the Natura 2000 series and SSSI series, in the face of projected sea level rise and coastal squeeze	EA, EN	LAs, HWT LAS, HCC, SCOPAC	◆→					B, C, D, E, I, L
3	Review recommendations within strategic flood defence plans, shoreline management plans and the Solent CHaMP to determine what could be achieved sustainably in terms of coastal habitat rehabilitation and	EA, DEFRA,	LAs, EN, HCC, SCOPAC	◆→					B, C, D, E, F, G



**Coastal**

12	Implement managed realignment on appropriate coastal sites to maintain the range of intertidal habitats and species and natural coastal processes, and to deliver mitigation priorities identified by the Solent CHaMP.	EA, LAs	HCC, EN, HWT, RSPB		◆↔	↔	↔	↔	↔	↔	↔	↔	B, D, E, F
13	Develop effective co-ordination and integration between coastal BAP and SAP management actions and activities with those of other local and regional plans	HBP	HOS	↔	↔	↔	↔	↔	↔	↔	↔	↔	A, B, D, E, G, L
14	Take into consideration the projected loss and requirements for maintenance/recreation of coastal habitats in Hampshire (e.g. saline lagoons and coastal wet grassland), and make appropriate provision for habitat creation in areas of other coastal habitat or adjacent coastal areas, if considered appropriate	HCC, LAs, EN, HWT	Other landowners	↔	↔	↔	↔	↔	↔	↔	↔	↔	B, C, D
15	Review the impact of current marine and coastal aggregate extraction licenses and coastal defence systems on coastal processes and habitats	EA, DEFRA, EN	HCC, SCOPAC	↔	◆								C, D, F, I
<b>Species Action</b>													
16	Monitor the status of priority species, other species of national concern, and priority species in Hampshire. Determine management requirements for stabilising populations and reversing declines	HBP	Universities, BC		◆↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
17	Implement the SAP for the European Otter <i>Lutra lutra</i> , within coastal and estuarine habitats (particularly management and survey in estuaries and coastal wet grassland habitats)	HBP, SEORP,		↔	↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
18	Implement the SAP for Water Vole <i>Arvicola terrestris</i> , within coastal habitats, including survey and monitoring of coastal populations (particularly in upper estuaries, coastal wet grassland ditches and coastal lagoon habitats).	EA, SCH, HWT	LAs	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
19	Implement the Foreshore Birds SAP.	HOS, RSPB, HWT,	EN, HCC, LAs		↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
20	Implement the Lepidoptera SAP.	BC, HWT,	EN, HCC, LAs		↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
21	Implement the Dark-bellied Brent Goose Strategy	LAs	HCC, Landowners, EN, HWT	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
22	Monitor and take action where possible against invasive non-native species	Landowners		↔	↔	↔	↔	↔	↔	↔	↔	↔	A, E, H, J, K

**Coastal**

Survey, Research and Monitoring									
23	Complete coastal and estuarine habitat surveys, including SSSI condition monitoring and SINC survey and monitoring, and update maps of habitat distribution and quality, in liaison with the Solent CHaMP. Monitor the success of habitat management and restoration initiatives and ensure that all relevant data on coastal habitat is incorporated into the Hampshire Biodiversity Information Centre databases and fed into the National Biodiversity Network.	HBIC	HCC, EA, HWT, EN & LAs, BC, Universities, RSPB, SSSP, HOS	◆↕	↕	◆			A, D, E, G, H, I, J
24	Research the processes influencing the distribution of coastal habitats in Hampshire, and the potential for retaining these resources in the face of projected sea level rise and climate change.	EN, HWT, LAs, EA, SCOPAC	Universities	◆↕	↕	◆			B, D, E, F, H, I
25	Promote research into the causes of recent coastal changes (natural and anthropogenic), determine future trends, and assess the potential for the amelioration of such changes (e.g. by removal of groynes).	EN, EA, SCOPAC, DEFRA	Universities	◆↕	↕	↕	↕	↕	D, E, F, H, I
26	Review existing research investigating the links between offshore aggregate dredging and coastal sediment supply, and determine whether additional work is needed.	DEFRA, SCOPAC	LAs, EN, Universities	↕	↕	◆			F, G, H, I
27	Collate and review research on estuary dynamics, including the effects of sediment removal in relation to its impact on coastal habitats. Develop and implement a range of innovative techniques (including intertidal recharge) for 'recycling' and strategic disposal of waste dredged sediments within the estuarine system with the aim of restoring and enhancing coastal accretion and the natural coast and flood protection functions and biodiversity of coastal and estuarine habitats. Examine the economics, suitability and environmental impact of recycling marina dredged 'waste' sediments for promoting coastal accretion.	NFDC, Harbour Authorities, EA, SCOPAC	EN, HCC, DEFRA, Universities	◆↕	↕	◆			D, E, F, G, H, I
28	Develop and operate programmes to monitor the extent and quality of coastal habitats, taking into account CHaMP recommendations.	EN,	SCOPAC, HCC, EA, Universities	↕	↕	◆	↕	↕	A, B, E, G, H, I, J
29	Continue research into the use of remote sensing (e.g. LIDAR, CASI) for monitoring the extent and rate of change in soft coast habitats, initially at two year intervals	EA, EN	SCOPAC, LAs, Universities	↕	↕	↕	↕	↕	G, H, I
30	Establish an agreed monitoring programme for coastal biodiversity (in particular bird numbers) to use as an	RSPB, HCC, SSSG,	EA, LAs, HBIC	↕	↕	◆			G, H, J, K

**Coastal**

	indicator of the 'health' of coastal systems.	HWT, EN	HWT																
31	Investigate the extent of natural transitions between coastal and terrestrial habitats and initiate a restoration programme to increase the extent of such transitions.	EN		↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕
<i>Communication and Publicity</i>																			
32	Promote, disseminate and implement established codes of conduct for recreational and commercial users of the Hampshire coast	HCC, Harbour Authorities	LAs, SF, RYA, BMF	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	L
33	Communicate the need for managed realignment (for biodiversity and to fulfil requirements of EU legislation) to landowners	EA, EN, RSPB	DEFRA, CLA, LAs, NFU	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	D, L
34	Promote awareness of the implications of the policies outlined in this plan among coastal Local Authorities and ensure that these are integrated with other relevant management plans and policies	HCC, EN, HWT	LAs	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	G, L
35	Raise public awareness of the essential mobility of soft coasts and the value of maintaining unrestricted coastal processes	EN, LAs, SCOPAC, landowners	SF	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	F, L
36	Participate in national programmes for developing demonstration sites for the management and rehabilitation of coastal habitats and disseminating best practice	EN, SF, landowners	HWT, RSPB, Universities	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	D, E, G, L
37	Collate and disseminate information relating to the relationship between coastal habitats, nature conservation and flood defence/coast protection	SCOPAC, SF		↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	D, E, G, H, I, L
38	Promote the use of on-site interpretation, where appropriate, of the existence, importance and sensitivity of coastal species and habitats and the need for their management.	EN, RSPB, HWT, HCC, Landowners	SF	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	G, K, I
39	Raise public awareness by increasing links between schools, colleges and universities and local coastal sites by providing educational resources and training on the interpretation of habitats	LAs, EN, HCC		↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	L

**KEY TO ORGANISATIONS**

BC	Butterfly Conservation	HWT	Hampshire Wildlife Trust
CHC	Chichester Harbour Conservancy	LAs	Local Authorities (District, City and Parish Councils)
CLA	Country Landowners Association	NFDC	New Forest District Council
DEFRA	Department for Environment, Food and Rural Affairs	NFU	National Farmers Union
EA	Environment Agency	RSPB	Royal Society for the Protection of Birds
EN	English Nature (EN <sup>N</sup> denotes national office)	SCH	Sparsholt College Hampshire
HA	Harbour Authorities	SCOPAC	Standing Committee on Problems Associated with the Coastline
HBP	Hampshire Biodiversity Partnership	SEORP	South East Otters Rivers Project
HCC	Hampshire County Council	SF	Solent Forum
HCCMS	Hampshire County Council Museums Service	SFC	Southern Sea Fisheries Committee
HBIC	Hampshire Biodiversity Information Centre	SSSG	Solent Shorebirds Study Group
HOS	Hampshire Ornithological Society		

# MARITIME CLIFFS

*Hampshire Biodiversity Partnership*

## 1 INTRODUCTION

Maritime cliffs are formed between the land and the sea where a break in slope is formed by slippage and/or erosion by the sea. Seacliffs are a key habitat within the National Biodiversity Action Plan. They are of nature conservation importance as a result of the unique combination of environmental factors that influence the habitats and vegetation present. In order of significance, these are the maritime influence of the sea, geology and soils, (which affect slope morphology and the degree of disturbance arising from erosion and landslides), climate and cliff aspect, the presence or absence of grazing, and seabird activity (the latter is not significant in Hampshire).

The 7 km of high maritime soft rock cliff on the western-most section of Hampshire coast represent 2.7% of the UK resource of this habitat<sup>47</sup>. However, there are also several other lengths of cliff-like habitat on the coast, albeit less high and steeply sloping, which are included in this Biodiversity Action Plan.

Hampshire's cliffs are soft and erodable, making them liable to cliff falls and slumping. They are of national importance for plant, vertebrate and invertebrate fossil faunas.

The extant invertebrate fauna is also of national importance (Hampshire's cliffs are notable breeding sites for nationally rare bees and wasps). Additionally, maritime vegetation (particularly grassland) on cliffs and cliff tops is of particular concern in Hampshire. Sediments released by cliff erosion are of great importance in feeding beaches and other coastal features downdrift.

## 2 CURRENT STATUS

### *2.1 Description of Habitat*

Hampshire's coastal cliffs are characterised by their soft rock geology, including the underlying clays, sands, the capping gravel and top soils, only found on the coast in a few locations in Britain<sup>41,42,43,44</sup>. The Eocene geology found in these cliffs was deposited between 35 and 45 million years ago and are often rich in fossils and of national or international geological importance<sup>45,46</sup>. Occasionally, previously unrecorded fossils are found in the cliffs and on the foreshores

of Hampshire; these sites therefore become the type localities for these newly described species.

These cliffs are generally rather low (from about 34 m to only a few metres in height) and, where unprotected, erode constantly under the influence of the sea and the effects of water seepage from the land. In doing so, these cliffs provide an important source of sediment to the coast that contributes to the maintenance of tourist beaches and slows erosion further along the coast. Erosion also acts to continually renew geological exposures (including fossil beds).

Maritime influence is an important factor affecting the biodiversity of cliff vegetation. Because the Isle of Wight and Purbeck shelter the Hampshire coast from the open Channel, this influence does not extend very far inland in Hampshire. Former cliff lines that are now isolated even a relatively short distance inland are, therefore, excluded from this Action Plan.

The geological and maritime conditions of Hampshire's cliffs give rise to a characteristic complex of habitats, with their associated plant and animal communities. Erosion of the soft cliffs produces crumbling surfaces and landslips that provide suitable conditions for invertebrates (particularly burrowing bees and wasps and the Glanville fritillary butterfly) and ephemeral maritime plants. The latter include pioneer cliff plants, while more stable areas support longer-established grassland, herb, heath and scrub communities. Thin turfs on the cliff tops include a range of bryophytes, lichens and higher plants, still characteristic of a southern maritime location. Their south-facing aspect produces a particularly warm micro-climate in summer, enabling a southern flora and fauna to become established, including species at the edge of their range. Where grazing of cliff top grassland still occurs, this also affects the biodiversity of the habitat.

### *2.2 Distribution and Extent*

Hampshire contains 7 km of coastal cliff in the west of the county (the section of Hordle Cliffs between Barton and Milford), representing 2.7% of the UK extent of this habitat<sup>47</sup>. These undeveloped western sandy and clay cliffs with steep slopes and ravine habitats are relatively extensive, although the

cliff top is heavily built-up in many areas. Barton and Hordle Cliffs are of international importance for their unique geological exposures, which contain fossil plants and molluscs<sup>48</sup>, preserved with the fossil teeth and bones of numerous species of reptiles<sup>49</sup>, mammals<sup>50,51,52</sup>, birds<sup>53</sup> and fish<sup>54,55</sup>. Of particular importance is the association of animal and plant remains, which makes this a critical site for the study of Tertiary palaeobotany and palaeoecology and one of the most important locations for fossils in the UK (GCR publications). In addition to their huge importance for earth science, the cliffs are also of regional importance for their habitats and living biodiversity. Runnels and pools on the slopes of the cliffs are partly colonised by plants and a range of invertebrates (particularly beetles) strongly associated with this type of eroding, south-facing soft rock cliff.

Smaller, lower areas of cliff (or steep coastal slopes) on the western Solent coast are also of importance for their habitats, species (including those at the northern edge of their range on the Hampshire coast) and geology. Significant sites include those at Lepe (~1.5 km), Stanswood Bay (1 km), Netley Cliff (<1 km), Solent Breezes, Hill Head (~2 km), Lee-on-the-Solent and Browndown (1.2 km). There are low cliffs on the western shore of Hayling Island. The low cliff habitat at Browndown is now somewhat isolated from maritime influence by the extensive shingle structure which has formed to seaward, as is the remnant of coastal cliff behind Gilkicker Point.

Hampshire County Council has recorded 43.1 ha of shoreline cliff in its coastal Phase One survey.

### 2.3 Legislation and Site Designation

The nationally and internationally important geological exposures of the Eocene, Barton and Solent Groups between Barton and Milford Cliffs in the west of the county are notified as Site of Special Scientific Interest (SSSI)<sup>56</sup>. The low cliffs and upper foreshore between Solent Breezes and Lee-on-the-Solent (5.5 km) are also a geological SSSI<sup>57</sup>. Within this SSSI an important geological excavation was made into the Bracklesham Group at Crofton Cliff, Hill Head<sup>58</sup>. The internationally important geological SSSI of Lee-on-the-Solent<sup>59,60</sup> (2.3 km) remains buried by the shingle provided for the recent coastal protection work<sup>61,62</sup>, while the cliffs have been regraded and are largely vegetated or concealed by the esplanade.

These notifications also confer protection on the regionally-important cliff communities of plants and invertebrates at these sites. All of the other, smaller and less important areas of coastal cliff in Hampshire also fall within

coastal SSSIs, although the cliff habitats and species form a secondary interest in most of these sites.

## **3 CURRENT FACTORS AFFECTING THE HABITAT**

### Erosion

Erosion is an essential natural process that continually exposes new unstable surfaces on the cliff face, including geological strata that would otherwise be covered by vegetation on stable sites<sup>63</sup>. In the absence of coastal protection, cliffs in the west of the county recede at an average of about 1 m/year. More sheltered low cliffs within the Solent recede at about 0.5 m/year. There is a delicate balance between natural succession and disturbance by erosion, but because natural coasts erode irregularly, all stages of succession and erosion are usually present in sites that have not been subject to coastal engineering or cliff top development.

South-facing cliff slumps form warm microclimates, enabling pioneering plants and southern species at the edge of their range to become established. The surfaces exposed by erosion are used by burrowing bees and wasps and colonised by specialist pioneer cliff vegetation, some of which are important food plants for rare invertebrates. (*Plantago lanceolata*, the food plant of the rare Glanville fritillary butterfly only occurs in recent cliff slumps.) Erosion is also the major source of the sediments that maintain beaches and accreting habitats further down the coast. Where maritime grassland is restricted to a narrow band along the cliff edge, backed by cultivated land or cliff top settlements, erosion unfortunately removes this semi-natural fringe, which is often unable to move landward in Hampshire to replace other land uses.

### Coastal defences

Coastal protection works slow or stop the natural erosion processes that supply sediment to the coastal system. They may also isolate upper shore or splash zone communities on the cliff face from the intertidal zone. Cessation or reduction in cliff face erosion obscures important geological structures formerly freshly exposed in the cliff face for research and educational use<sup>63,63</sup> and encourages overgrowth of stabilised slopes by scrub. A certain amount of instability is required to maintain the open habitats which are important for rare invertebrates, particularly those associated with freshwater seepage, their food plants, and other colonising vegetation. Cessation of erosion prevents colonisation of bare soil

plants and invertebrates and reduces biodiversity.

#### Coastal squeeze

Coastal squeeze describes the process by which natural habitats are reduced to seaward by the landward movement of the low water and/or high water marks, but are unable to move inland to compensate (see section 3 in the introductory chapter). Cliff top habitats can be squeezed when erosion physically removes the semi-natural fringe of cliff top vegetation restricted to a narrow zone between the cliff and adjacent agricultural or developed land, and urban development or other land uses limit the inland movement of this vegetation. Much of Hampshire's important sea cliff habitats border areas of urban development at Barton on Sea and Milford on Sea.

#### Recreational use

Excessive cliff top recreation, including trampling and erosion by footpath users, may damage maritime vegetation. Path and road construction and grounds maintenance at the holiday village at Naish Farm, Highcliffe, affects cliff top vegetation. Holiday chalets are gradually relocated landwards as the cliff edge erodes. The open space used for informal recreation between the chalets and the adjacent cliff top golf course between Barton and Milford on Sea is intensively mown, apart from a strip along the cliff edge (where erosion is prevented by coast protection works). The narrow strip of cliff top vegetation fringing the golf course is trampled by walkers and transient as a result of cliff erosion.

#### Drainage works

Drainage of cliff top land results in alterations to cliff face hydrology, leading to the stabilisation of soft rock cliffs, and changes the nature of the plant and animal communities present.

## 4 CURRENT ACTION

### 4.1 Site and Species Protection

Virtually all important coastal cliff habitats in Hampshire fall within coastal SSSI, either for their geological importance or as part of other complex coastal sites.

Two maritime cliff species are listed on Schedule 5 of the Wildlife and Countryside Act and strictly protected: the Glanville fritillary *Melitaea cinxia* (immigrants from the Isle of Wight have now established a continuously breeding population on a

### **Maritime Cliffs**

Hampshire cliff site) and the fiery clearwing moth *Bembecia chrysidiformis* (now probably extinct, but which used to occur at Southsea and Hayling Island).

### 4.2 Habitat Management and Programmes of Action

A large number of habitat management plans and programmes of action (e.g. the Solent CHaMP) promote biodiversity management on the Hampshire coast. The following are of particular relevance for coastal cliff habitats.

#### Shoreline Management Plans (SMP)

Three Shoreline Management Plans cover the Hampshire coast: the Poole and Christchurch Bays SMP in the west, which partly overlaps the Western Solent and Southampton Water SMP on the central section of coast, and the East Solent SMP in the east. The sections of cliff habitat described above are mainly covered within the first two of these Plans.

#### Coastal Management Plans

The New Forest District Coastal Management Plan includes some low sections of cliff habitat.

#### Site Management Plans

Nature Reserves on the Hampshire Coast are managed to maintain their importance for biodiversity, with Management Plans generally being updated regularly. Documents called Site Management Statements are produced for landowners by English Nature to guide management of SSSIs and other sites.

#### Habitat and Species Management Plans

National Coastal Habitat and Species Biodiversity Action Plans have been published by the UK Biodiversity Group<sup>32</sup>. Poole Bay and Solent Natural Area BAPs have also been prepared by English Nature.

#### Restoring biodiversity to soft cliffs

A recent English Nature study<sup>64</sup> concluded that a national 'no net loss' policy for maritime cliff slopes in England is unlikely to succeed. Future demand for new coast protection works (particularly on the east coast) is predicted to exceed the availability of potential 'free up' sites where defences may be removed or abandoned, enabling renewed cliff recession and habitat restoration. The report recommends increasing the likelihood of delivery of potential 'free-up' sites under a partnership approach, and reducing the demand for new coast protection structures.

#### 4.3 Action for Species

---

Table 1(Appendix 1) gives details of priority species in Hampshire found primarily in maritime cliff habitat.

Table 2(Appendix 1) lists those priority species, thought to be extinct in Hampshire, which are primarily associated with maritime cliff habitat.

Table 3(Appendix 1) lists those Hampshire priority species that occur in maritime cliffs but are primarily found in other habitats. Although action in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation.

There are UK Species Action Plans for four Hampshire priority species of maritime cliffs, most of which no longer occur in Hampshire (see Appendices): the mason bee *Osmia xanthomelana*, tiger beetle *Cincadela germanica*, beefly *Bombylus discolor*, and fiery clearwing moth *Bembecia*

#### **Maritime Cliffs**

*chrysidiformis*, and a Species Statement for the ground beetle *Tachys micros*.

#### 4.4 Survey, Research and Monitoring

---

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary. For example, some monitoring of cliff habitat and erosion processes occurs within the frameworks of the Shoreline Management Plans and the New Forest Coastal Management Plan (see 4.2). The status of maritime cliff Sites of Special Scientific Interest is also monitored by English Nature.

The Joint Nature Conservation Committee has provided advice on the ecological principles relating to sea cliff vegetation management, primarily in the context of current and historic agricultural use of cliff top land<sup>65</sup>.

**6 PROPOSED ACTION**

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 14-15). The table below excludes generic actions, which are included in section 6 on page 16. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

Key to symbols in Action Table:

- ◆ To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇄ Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ◆➔ To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- ⇄ Work that has already begun and is ongoing.

ACTION	DELIVERY BY	YEAR					MEETS OBJ.
		2003	2004	2005	2006	2007	
	Key Partner	Others					
<i>Habitat Protection</i>							
1	LAs	DEFRA, EN, NGOs, SCOPAC	⇄	⇄	⇄	⇄	C, E, F, G
2	LAs		◆⇄	⇄	⇄	⇄	C, D, E, G, L
3	LAs	Landowners, DEFRA, SCOPAC	⇄	⇄	⇄	⇄	B, C, E, F
<i>Habitat Management, Incentive Schemes and Other Resources</i>							
4	LAs, EA, landowners		⇄	⇄	⇄	⇄	C, E, F

**Maritime Cliffs**

5	Promote and implement improved management and quality of maritime cliff, cliff top grassland and heath habitats by scrub control and grazing, where appropriate, by encouraging landowners of coastal sites to enter land into the Countryside Stewardship Scheme for the restoration and management of cliff top and maritime grassland, or undertaking less intensive management of cliff top habitats used for recreation (e.g. on Barton-Milford cliffs)	EN, HWT, DEFRA, New Forest District Council	LAs and landowners	↔	↔	↔	↔	↔	↔	↔	↔	↔	A, B, D, E, G
6	Discourage further stabilisation and protection of cliffs and allow some existing coastal works to fall into disuse in order to maintain and, where possible, increase the proportion of the maritime cliff and slope resource unaffected by coastal defence and engineering works. Identify, within ten years, the potential for freeing up lengths of protected cliff over the next 20 years.	LA, EA, DEFRA, EN		↔	↔	↔	↔	↔	↔	↔	↔	↔	B, C, D, E, F, I
<b>Species Action</b>													
7	<i>Osria xanthomelana</i> : Habitat restoration &/or reintroduction at former site(s) under UK BAP	EN		◆↔	↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
8	<i>Cicindela germanica</i> : (extinct in Hampshire) Habitat restoration &/or reintroduction at former site(s) under UK BAP.	EN		◆↔	↔	↔	↔	↔	↔	↔	↔	↔	H, J, K
<b>Survey, Research and Monitoring</b>													
<b>Communication and Publicity</b>													
9	Raise public awareness of the mobile nature of soft cliffs and the ecological and economic value of maintaining unrestricted coastal processes	EN, SF, HWT, LAs, DEFRA, SCOPAC	BC	↔	↔	↔	↔	↔	↔	↔	↔	↔	L
10	Prepare and disseminate guidance material that encourages the adoption of policies and practices in the management of maritime cliff and slope habitats that are sympathetic to their biodiversity interest	LAs, HWT, DEFRA, EN, SF, SCOPAC	landowners	◆↔	↔	↔	↔	↔	↔	↔	↔	↔	L

**KEY TO ORGANISATIONS**

BC	Butterfly Conservation	HWT	Hampshire Wildlife Trust
DEFRA	Department for Environment, Food and Rural Affairs	LAs	Local Authorities (District, City and Parish Councils)
EA	Environment Agency	SCOPAC	Standing Committee on Problems Associated with the Coastline
EN	English Nature (EN <sup>N</sup> denotes national office)	SF	Solent Forum
HCC	Hampshire County Council		

# SHINGLE AND SAND DUNES

Hampshire Biodiversity Partnership

## 1 INTRODUCTION

Maritime vegetated shingle structures<sup>66</sup> and sand dunes are rare and specialised habitats supporting internationally important vegetation types, several types of which are listed as priority habitats in Annex I of the EU Habitats Directive. As such, they are key habitats within the National Biodiversity Action Plan. These two coastal habitats are often found in such an intimate matrix or continuum in Hampshire, subject to the same environmental factors and constraints, that the majority of issues requiring attention under the Biodiversity Action Plan are very similar, if not identical. They are therefore considered together in this Plan.

Shingle and sand beaches, often formed from a mobile or stable mixture of shingle with silt and sand, and transitions between these mixtures and coastal vegetated shingle structures and sand dune habitats are common on Hampshire's coast. They extend from habitats near the high water mark, which support relatively impoverished communities of annuals and specialist sand or shingle pioneer plants, to much more complex communities of plants and associated invertebrates in the adjacent coastal fringe. These not only include classic vegetation of sand or shingle, but much more complex and permanent grassland, heath and scrub communities on fixed shingle, dune or dune slack habitats, where a maritime influence is predominant. (Inland shingle habitats are not included here.)

## 2 CURRENT STATUS

### 2.1 Description of Habitat

Most coastal shingle and sand (in Hampshire, as in the whole of the UK,) is too mobile to support plant communities. Only a small proportion of these habitats are sufficiently stable for fixed vegetation to become established, further stabilising the habitat and providing opportunities for a more biodiverse community structure to develop<sup>66</sup>. Rose<sup>67</sup> refers to the sites and plant species characteristic of the more important coastal sand dune and shingle habitats in the county.

Vegetated shingle (colonised by a very restricted range of specialist flowering plants able to survive these nutrient-poor, often disturbed and arid conditions) is a rare coastal community. Several Hampshire shingle sites are of national importance for their representative southern vegetation communities. Pioneer assemblages on undisturbed pure shingle contain sea kale *Crambe maritima* (declining in Britain) and yellow horned-poppy *Glaucium flavum*. Rarities on pure shingle include the nationally rare sea pea *Lathyrus japonicus* and the scarce Portland spurge *Euphorbia portlandica*. Little robin *Geranium purpureum* subsp. *forsteri* is limited to south and west coast sites and has some of its best development on open shingle at Browdown and Hurst Spit, although recorded in several other locations, particularly at the entrance to Southampton Water and in Langstone Harbour.

Hampshire's shingle habitats include transitions from mobile to stable shingle, to sand dunes, saltmarsh and lagoons, and incorporate a wide representation of shingle vegetation communities. Many of the major harbours are protected from the open sea by multiple ridge sand/shingle spit systems, and shingle islets. Some are unstable and largely unvegetated (for example Chichester). The smaller estuaries have small shingle spits, often with transition to marsh. A few of these former promontories are now isolated inland, as at Keyhaven. The long shingle beach at Hurst Spit, somewhat damaged by breaches and repairs, plays a vital role in sheltering the Solent from south-westerly storms. Inland transitions from shingle can be to a species rich grassland and then acid grass heath and scrub<sup>68</sup>. Important fauna includes breeding colonies of tern (often on shingle islands on the face of saltmarsh or in harbours), ringed plover, Mediterranean gull, and nationally rare invertebrates.

Sand dunes are windblown sand formations associated with dune slacks, grassland and scrub. Small areas of sand dune occur on the Hampshire coast at several scattered locations, but most of these are very small and virtually unvegetated, with a low biodiversity. The larger areas are associated with shingle habitats, particularly shingle spits, with the most important sites in the county on the South coast of Hayling Island presenting a rich mosaic of sand dune and shingle habitats and associated species.

Hayling Island has a good range of foredune, mobile dune and fixed dune types (all acidic), dune slacks, sandy and fixed shingle beaches, and rich dune and shingle acid heath, including important moss and lichen communities. Transitions between sand dune, shingle and saltmarsh occur. These habitats are of particularly high biodiversity for their parched coastal grasslands, which may take many decades, even centuries to develop. They are, along with a site on the Isle of Wight and one in Pagham Harbour, among the botanically richest in Britain<sup>69,70</sup>.

### 2.2 Distribution and Extent

Shingle and sand dune habitats are most widespread at the mouths of harbours, but shingle beaches fringe most of Hampshire's coast. These are largely unstable, unvegetated, and of limited biodiversity importance.

The single most important vegetated shingle site in the county is the 64.3 ha multiple ridge system at Browdown, which is of national geomorphological importance, and the ninth most important shingle structure in Britain<sup>71</sup>. This extensive shingle cusped foreland structure is made up largely by pure shingle ridges, with no blown sand, backed by a low cliff line. Although some areas have been disturbed by military use and are bare shingle, it still contains very important vegetation communities of high biodiversity importance<sup>72</sup> and supports nationally rare invertebrate populations.

Hurst Spit is a dynamic 2.5 km long shingle spit with terminal recurved ridges which is moving slowly into the Solent over the saltmarsh that it shelters. Although affected by breaches and repairs, it is still of national importance for its geomorphology, shingle vegetation and nationally rare invertebrate communities, and plays a vital role in protecting the western Solent coast from storms.

The smaller more stable shingle spit at Needs Ore Point is also of national biodiversity importance. This double vegetated shingle and sand spit system shelters the saltmarsh of the Beaulieu Estuary and adjoins a sandy beach with miniature dunes. It extends inland in a series of stabilised storm ridges forming a 'gravelly marsh', which supports transitions from pioneer species of shingle habitats to heathland and gorse scrub to mixed oak and hawthorn scrub. The sand and shingle spit supports important colonies of breeding birds, including Dartford warbler, and Roesel's bush-cricket occurs here in gorse and bramble.

Stabilised shingle beaches occur in Stanswood Bay and at Calshot Spit and within Southampton Water at Weston Shore, Woolston (owned by Southampton City Council and outside the current SSSI), and Hook Spit, at the southern side of the entrance to the Hamble River (within the SSSI). The latter shingle spit is unprotected and vulnerable to breaching if coastal drift is reduced or the beach drawn down during storms. Cockle ridges (cheniers) in Southampton Water can have similar vegetation to that of shingle.

Further east, Gilkicker saline lagoon is protected by shingle habitat to the west of Gilkicker Point. Unspoilt shingle beach vegetation communities also occur within the HWT Reserve at Pewit Island in Portsmouth Harbour and RSPB Reserve at Binness Islands in Langstone Harbour, the latter with internationally important nesting bird populations and a typical shingle flora. The shingle site at Fort Cumberland, Eastney, is less important than formerly, as a result of disturbance. It still contains a good beach flora, but appears to have lost one of its most important species: the rare childing pink *Petrorhagia nanteuillii*.

The importance of Hampshire's 250 ha of coastal vegetated shingle is put into context by the national data for this habitat: there are only six sites of over 100 ha in area in the whole of Britain. England's coast has a total of about 5000 ha of vegetated shingle, but over 2000 ha of this occurs at one site, Dungeness. There are just 700 ha of vegetated shingle in Scotland and 100 ha in Wales.

In contrast, vegetated sand habitats, including sand dunes, slacks and associated features are relatively scarce in Hampshire (about 68 ha of sand dune and 27 ha of dune scrub recorded in the HCC Phase One coastal survey database), absent further east on the Channel coast and in the Thames Estuary, but relatively abundant on most other areas of the British coast. Data from national sand dune surveys indicate that some 11,897 ha of dunes have been recorded in England, 8,101 ha in Wales, and perhaps as much as 40,000 ha of dunes in Scotland.

The most important areas of vegetated dune and coastal sandy shingle in Hampshire are a complex of remnants of the former dominant coastal habitats on the south coast of Hayling Island, which is now mostly built up. Two fragmented sites: Sinah Common and adjacent Beachlands in the west, and Eastoke-Sandy Point-Black Point in the east represent the remnants of the natural coastal sand dune and fixed shingle habitats that made up the south coast of Hayling Island. This area of about 110 ha is of regional

significance because of the rarity of sand dune habitat in the area<sup>73,74</sup>, and is considered to be nationally important as a matrix of coastal sand and gravel habitat supporting some of the most unusual and botanically richest parched grassland and associated invertebrates in Britain<sup>69,70</sup>.

Important habitats include a good range of foredune, mobile dune and fixed dune types (all acidic). Transitions to saltmarsh and shingle occur, with several examples of fine vegetated shingle beach. A rich fixed-dune flora, supporting unusual grasses and clovers, occurs alongside mobile sand dunes that also support many species local to Hampshire. Elsewhere, a transition occurs from mobile sand dunes and stable shingle ridges through to low-lying wet dune slacks and extensive dune heath. Large sandy areas support carpets of heather and lichens, with many nationally rare plants and invertebrates.

Sinah Common has a rich flora of fixed-dune species and its dune grasses are particularly diverse. It contains the largest and best developed of Hampshire's sand dunes at Gunner Point, supporting many local species of plants for Hampshire, and a broad shingle beach with diverse communities characteristic of this habitat. Sandy Point is even richer. Here low dunes, dune slacks, sandy beach and dune heath habitats grade into species-rich fixed shingle in many locations, with rich acid heath, moss and lichen communities. Sandy shingle adjacent to one of the sand dune areas has extensive spreads of the declining Ray's knotgrass *Polygonum oxyspermum* and sea knotgrass *P. maritimum*. Part of this site is grazed. There is also shingle around the Kench and on the western side of Hayling Island.

This complex site, together with the sand dunes across the harbour entrance at East Head, West Sussex, represents some of the eastern-most sand dunes in the English Channel. There are also very small areas of miniature dunes at the top of the beach at Needs Ore Point, and dunes near Lepe.

### 2.3 Legislation and Site Designation

All of the important shingle and sand dune sites in Hampshire are designated as Site of Special Scientific Interest (SSSI) with the remainder of vegetated shingle sites being designated as Sites of Importance for Nature Conservation (SINCs). Several also lie within Local, RSPB or National Nature Reserves, SPAs, Ramsar site, SAC, or have other conservation designations. Annual vegetated drift lines (on shingle) is one of the features of the Solent European Marine Site.

## 3 CURRENT FACTORS AFFECTING THE HABITAT

### Sediment supply

The health and ongoing development of coastal sediment features depend on a continuing supply of new sediment, usually from eroding coastlines and river sources further up the coast. (There is usually little direct exchange between offshore and intertidal deposits.) Very few sand dune systems are in overall equilibrium, the majority in the UK are eroding as a result of insufficient sand supply. Changes may be cyclical, both seasonally and over longer periods of time. Replenishment of shingle may occur sporadically as a response to storm events rather than continuously. Several of man's activities may prevent natural replenishment: coast defence structures and offshore aggregate extraction may interrupt coastal processes, material may be redistributed artificially within the site, or offshore shingle supplies may no longer exist for very ancient 'fossil' sites. Mechanical re-profiling which does not address the need to supply new material is likely to fail in the long run. Beach recharge may be successful, and may even be used to re-circulate material sustainably within a dynamic coastal cell.

### Natural mobility: erosion and progradation

Unless artificially constrained, the seaward edges of sand dunes and shingle features can be highly mobile and are rarely stable in the long term. Many shingle structures exhibit continuous longshore drift, and ridges lying parallel to the shoreline tend to be rolled over towards the land by wave action in storm events. This movement has a knock-on effect on low-lying habitats behind the shingle. Movement is likely to be accelerated by climate change resulting in sea level rise and increased storminess. Landward movement of mobile dunes often entails loss of fixed dune and dune heath habitat, as the latter are usually stable, or retreat may be impeded by development; in a few cases dune systems may move inland where not artificially constrained. The net loss of dune habitat in England to erosion has been estimated as not more than 2% of the resource over 20 years<sup>74</sup>.

### Sea defence and stabilisation

Sea defence works or artificial stabilisation measures (such as sand fencing and marram planting) may be used to prevent sand movement within dune systems and protect urban or holiday developments. Carefully applied dune management measures can help to counteract severe erosion, but

engineered defence systems usually reduce the natural dynamism and biodiversity of dune systems and may cause sediment starvation down-drift. UK dunes as a whole suffer from over-stabilisation and poor representation of the mobile phases. Erosion control has affected shingle vegetation at Browdown and Hurst Spit. Much of the latter has been disturbed during sea defence works in recent years. Sea defences are present adjacent to Hampshire's sand dune systems, and coastal erosion is still occurring at the seaward edge.

### Exploitation

---

Shingle structures and sand dunes have been regarded as a convenient source of aggregates, and have been subject to varying degrees of extraction. Fossil shingle resources a short distance inland are subject to permission for gravel extraction and waste disposal (shingle recycling still continues at Hurst Spit, and sand extraction at Hayling Island). Effects range from severe alteration of morphology and vegetation, to total destruction of the feature. Construction of industrial plant, defence infrastructure and housing on shingle structures destroys vegetation and ridge morphology. Where groundwater abstraction takes place, drought stress on the vegetation may result, but it is difficult to distinguish these effects from those of gravel extraction.

### Grazing

---

Shingle and sand dune habitats were traditionally grazed by agricultural livestock in most locations. This form of management has now mostly ceased, leading to habitat deterioration. It continues in the North Solent NNR and has recently been reintroduced to the Nature Reserve at Sandy Point. Locally, grazing by rabbits has maintained a short turf and the interest of stabilised dunes at South Hayling Beachlands.

### Access, recreation and other uses

---

Shingle and sand dune vegetation is fragile and easily damaged by wear and tear caused by access on foot, and particularly by vehicles. Problems encountered in Hampshire include military use, vehicle access to beaches, and recreational use. Moderate pressure by pedestrians may cause little damage, and may even help to counteract the effects of abandonment of grazing, but excessive pedestrian use, such as on routes between car parks and beaches, and vehicular use cause unacceptable dune erosion.

Recreation is a major land use on sand dunes, and to a lesser extent shingle habitat (e.g. at Calshot and Hurst Spit). There is leisure development adjacent to the sand dunes on Hayling Island, which probably experience some of the highest dune visitor numbers in Britain and are suffering from local severe erosion due to trampling. Vehicles have caused severe local damage to dune grassland and a golf course and car park occupy part of the site. Here much of the original vegetation may be retained in the roughs, but the communities of the fairways, and particularly the greens and tees, are severely modified by mowing, fertilising and re-seeding.

During the Second World War the majority of dune systems were used for the construction of defensive installations, for military training or both. The resultant widespread erosion had a severe effect on dune vegetation, since been reversed by protective measures and natural recovery. Browdown is still used for military training and has been affected in the past by clearance of vegetation, excavation, structural change and vehicular access.

Sand dunes and shingle structures have been affected by housing and industrial developments, waste disposal onsite or nearby, and fly tipping. Indirect effects on coastal dunes and shingle structures include atmospheric nutrient deposition, coastal squeeze due to rising sea level and increased storminess, and disruption of coastal processes by marine aggregate extraction.

## 4 CURRENT ACTION

### 4.1 Site and Species Protection

---

All of the important shingle and sand dune structures on the Hampshire coast are protected as SSSI. Shingle forms a very important breeding habitat for strictly protected and scarce species of tern which breed in Hampshire: the little tern *Sterna albifrons* and roseate tern *S. dougalli*, and for colony nesting gulls.

### 4.2 Habitat Management and Programmes of Action

---

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast (see Chapter 1).

Co-ordination of this wide range of overlapping initiatives is an essential part of biodiversity planning in Hampshire.

Coastal Habitat Management Plans (CHaMPs)

Low-lying coastal sites, including shingle habitats, in West Sussex and Hampshire are among the first six priority areas for which CHaMPs are being drawn up by English Nature and the Environment Agency, in close consultation with DEFRA and DETR, and with funding from the EU LIFE Project 'Living with the Sea' and DEFRA.

Habitat and Species Management Plans

Annual vegetated drift lines (on shingle) is one of the features of the Solent European Marine Site and will be considered in the Management Scheme for this site.

National Coastal Habitat and Species Biodiversity Action Plans (HAPs and SAPs) have been published by the UK Biodiversity Group<sup>32</sup>. Poole Bay and Solent Natural Area BAPs have been prepared by English Nature.

National HAP objectives for vegetated shingle include: to prevent further net loss of existing vegetation shingle structures; to prevent further exploitation of or damage to sites through human activities; to maintain the quality of existing plant and invertebrate communities which are optimal in condition; and to achieve the restoration, where possible, of degraded or damaged shingle structures, including landward transitions.

4.3 Action for Species

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily in coastal shingle and sand dune habitats. Action proposed in this Plan will be the principle means of conserving most of these species, although some species, such as the rare chiding pink *Petrohagia nanteuilli*, will have their own species Action Plans (SAPs), and others are covered by national SAPs.

Table 2 (Appendix 1) lists those priority species, thought to be extinct in Hampshire, which are primarily associated with coastal shingle and sand dune habitats.

Table 3(Appendix 1) lists those Hampshire priority species that occur in coastal shingle and sand dune habitats but are primarily found in other habitats. Although action in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation.

The chiding pink *Petrohagia nanteuilli* which occurs in shingle habitat in Hampshire at one of only two UK sites, is the subject of a Hampshire Species Action Plan (SAP). The terns *Sterna albifrons* and *S. dougalli* are covered by UK SAPs, as is the bright wave moth *Idea ochrata cantiata* (although the latter was last recorded in Hampshire in 1900), while the ground beetle *Lionychus quadrillum* (no extant colony of which is known) is the subject of a UK Grouped SAP. The white spot moth *Hadena albimacula* and the Gilkicker weevil *Pachytychius haematocephalus* are both covered by UK Species Statements.

Natural Areas Species Actions include: assessing sites with a view to re-introducing the natterjack toad *Bufo calamita* to one coastal site along the Solent by 2010. This species is also the subject of a Hants SAP.

4.4 Survey, Research and Monitoring

The Sand Dune Survey of Great Britain, initiated in 1987, provides information on the vegetation and management of all significant dune systems in England<sup>75</sup>, and a similar study describes surveys of coastal vegetated shingle structures<sup>76,77</sup>.

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary. For example, monitoring of beach profiles and shingle structures (where undertaken) is co-ordinated within Shoreline Habitat Management Plans. The Environment Agency's Annual Beach Monitoring Survey of the south coast of England provides a photogrammetric record of beach profiles along the Hampshire Coast. This is supplemented along the New Forest District Council's coastline by more detailed coastal surveys, including quarterly surveys of Hurst Spit and Milford.

Hampshire Wildlife Trust's recent habitat survey for Gosport Borough Council<sup>78</sup> has covered Browdown South and Gilkicker Point.

HBIC's recent survey of Sinah Beachlands helped determine the recent SSSI and SINC in the area.

**6 PROPOSED ACTION**

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 14-15). The table below excludes generic actions, which are included in section 6 on page 16. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

Key to symbols in Action Table:

- ◆ To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇄ Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ◆⇄ To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- ⇄ Work that has already begun and is ongoing.

ACTION	DELIVERY BY	YEAR					MEETS OBJ.
		2003	2004	2005	2006	2007	
	Key Partner	Others					
<i>Habitat Protection</i>							
1	EN, LAs, HCC	HWT	⇄	◆			A
2	LAs, EN,	DEFRA	⇄	⇄	⇄	⇄	A, B, C, F
3	Crown Estate	DEFRA	⇄	⇄	⇄	⇄	C, F

## Shingle and Sand Dunes

4	Support beach management strategies that encourage the protection of the seaward fronts of dune systems from unsustainable pressure by pedestrian or vehicular traffic, and discourage the use of mechanical beach cleaning close to dune fronts	LAs,	DEFRA, EN, landowners	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	B, C, E, F, G	
<i>Habitat Management, Incentive Schemes and Other Resources</i>																			
5	Promote agri-environment and Countryside Stewardship schemes that will encourage restoration and sustainable management of dune and shingle vegetation (particularly extensive grazing management, preferably as part of larger grazing units), accretion of new dunes and movement of dune habitat inland. Target degraded sites, coastal systems used for arable farming, or agriculturally improved grassland, including South Haying, in order to increase the area of natural vegetated sand dune and shingle habitat over 10 years.	EN, DEFRA, Havant BC	Landowners, LAs	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	B, D, E, F, I, L
6	Promote incentives (for example through planning conditions and agreements) to encourage the management and restoration of landward transitional dune habitats and where appropriate to allow landward movement of dunes used primarily for recreation	EN, LAs		⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	B, D, E, F, G, I, L
7	Resist unnecessary stabilisation of dunes and shingle structures and encourage beach management strategies that allow natural sediment movement and development of dynamic foreshores	LAs, landowners	DEFRA, EN	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	B, C, D, E, F, L
8	Seek opportunities to restore sand dune and shingle habitat impacted or lost as a result of general 'wear and tear' from recreational activity, trampling and erosion, conversion to recreational or housing development, agriculture, and natural succession to scrub & woodland	EN	HCC, LAs																B, C, D, E, I
9	Encourage golf course management policies and practices that are sympathetic to the flora and fauna of sand dune and shingle systems	EN, LAs, landowners		⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	⇄	A, B, C, E, L
10	Restore where possible those parts of shingle structures at Browdown whose geomorphology and vegetation have been damaged or destroyed, including landward transitions.	MOD	HCC, LAs																A, B, E, F
11	Restore where possible those areas of Hurst Spit whose geomorphology and vegetation have been damaged or destroyed during former management and small-scale recharge	HCC	LA																A, B, E, F

## Shingle and Sand Dunes

Species Action											
12	Protect tern <i>Sterna albifrons</i> and <i>S. dougalii</i> coastal breeding sites	EN, HCC	HWT, RSPB, HOS	↔	↔	↔	↔	↔	↔	↔	K
13	Introduce the natterjack toad <i>Bufo calamita</i> to one coastal sand dune site	HWT	HARG, HS	↔	↔	↔	↔	↔	↔	↔	K
14	Implement Hampshire SAP for the chiding pink <i>Petrohagia nanteuilli</i>	HWT	HFG	↔	↔	↔	↔	↔	↔	◆	H, J, K
15	Introduce scrub management to maintain <i>Petrorhagia nanteuilli</i> and <i>Silene nutans</i> colonies on shingle and <i>Vulpia fasciculata</i> on sand dunes	EN, Havant BC	HWT	↔	↔	↔	↔	↔	↔	◆	E, K
16	Monitor <i>Hadena albimacula</i> . Ensure existing Browndown population is maintained (see UK BAP statement). Implement Gosport Borough Council action plan	Gosport BC, HWT	BC	↔	↔	↔	↔	↔	↔	◆	H, K
17	Introduce monitoring of <i>Oncocera genistella</i>	HWT	HWT	↔	↔	↔	↔	↔	↔	◆	H, K
18	Establish viable network of populations of <i>Lasiocampa trifolii</i> in core areas and encourage suitable habitat management throughout its former range.	Havant BC	HWT	↔	↔	↔	↔	↔	↔	◆	E, H, K
19	Implement the Species Action Plan for Gilkicker weevil <i>Pachytychius haematocephalus</i> , including survey, monitoring and habitat management.	HWT		↔	↔	↔	↔	↔	↔	◆	E, H, K
20	Establish a monitoring programme for shingle nesting seabirds to inform the strategy for future management of the coast in light of sea level rise.	RSPB, HWT, EN	HOS, BTO, HCC	↔	↔	↔	↔	↔	↔	↔	H
<b>Survey, Research and Monitoring</b>											
21	Continue regular monitoring of offshore shingle bank following extraction to renourish Hurst Spit	NFDC	EA, SCOPAC	↔	↔	↔	↔	↔	↔	↔	F, G, H
22	Continue beach profile monitoring at Hayling Island	HBC, EN, HBIC	EA	↔	↔	↔	↔	↔	↔	↔	F, G, H
<b>Communication and Publicity</b>											
23	Increase public awareness of the value and fragility of vegetated shingle and sand dune systems through appropriate interpretation	EN, LAs, SF, HWT, landowners		↔	↔	↔	↔	↔	↔	↔	L
24	Promote awareness of the importance of shingle and sand dune structures and offshore shingle resources in flood and coastal defence strategies and, where appropriate, encourage such strategies to contribute to the objectives and targets of this plan	DEFRA, EA, EN, LAs, SCOPAC		↔	↔	↔	↔	↔	↔	↔	E, F, G, L

**KEY TO ORGANISATIONS**

BTO	British Trust for Ornithology	HBC	Haying Borough Council
DEFRA	Department for Environment, Food and Rural Affairs (formerly DETR and MAFF)	HBIC	Hampshire Biodiversity Partnership
EA	Environment Agency	HS	Herpetological Society
EN	English Nature (EN <sup>N</sup> denotes national office)	HWT	Hampshire Wildlife Trust
HARG	Hampshire Amphibians and Reptiles Group	LAs	Local Authorities (District, City and Parish Councils)
HCC	Hampshire County Council	NFDC	New Forest District Council
HFG	Hampshire Flora Group	RSPB	Royal Society for the Protection of Birds
HOS	Hampshire Ornithological Society	SCOPAC	Standing Committee on Problems Associated with the Coastline
		SF	Solent Forum

# SALTMARSH

Hampshire Biodiversity Partnership

## 1 INTRODUCTION

Coastal saltmarshes occur in sheltered areas on the upper to mid shore where fine coastal sediment can accrete. They have a characteristic, highly specialised vegetation consisting of a limited number of annual and perennial halophytic (salt tolerant) species, adapted to regular immersion by the tides, and able to colonise areas between the mean high water of neap tides and the high water mark of spring tides. This means that they are regularly inundated by the sea, but not covered by seawater at low tide. In addition to their botanical diversity, saltmarsh habitats support a diverse range of invertebrates and algae, and are of particular importance as feeding, roosting and breeding grounds for nationally and internationally important populations of wildfowl and waders<sup>79</sup>. Some forms of saltmarsh are listed as priority habitats in Annex I of the EU Habitats Directive, and are key habitats within the National Biodiversity Action Plan.

Saltmarshes have a vitally important coastal protection role, accreting sediments to stabilise the intertidal and keep pace with sea level rise, and protecting seawalls and other coastal habitat from wave attack. Recent research led by the Environment Agency has shown that saltmarshes reduce the wave energy reaching sea walls and have an important role to play in flood defence. It may even be cost-effective in the long term, when seawalls are at the end of their useful life, to set back lines of coastal defence and promote saltmarsh development to seaward.

Saltmarshes are also of great importance as the source of organic material to adjacent marine and estuarine communities, although the scale of their contribution in the Solent area is unknown. Finally, they provide a cleaning function by absorbing nutrients, heavy metals and oil from the estuarine system, and act as sheltered nursery sites for several fish species.

Many saltmarshes have, since medieval times, gradually been reduced in extent by land claim. The land enclosed by sea walls was originally converted to coastal wet grassland with brackish ditches, but much was subsequently agriculturally improved to grow arable crops or converted to industrial use. As a consequence, the upper and

transitional zones of saltmarshes have become comparatively scarce in England, where sites still displaying a full range of zonation are particularly valuable for nature conservation.

Rising sea level poses a new threat to saltmarshes, whose distribution is becoming increasingly 'squeezed' as static coastal and flood defence works prevent landward movement to compensate for seaward erosion and dieback. The result will be very substantial loss of saltmarsh (and other intertidal habitats), unless a strategy is developed to enable these habitats to move inland through managed retreat. Options for managed retreat are restricted by the large amount of coastal land that has been developed for industry or housing and is of too high an economic value to be abandoned. Decision-makers and landowners must decide which of the valuable semi-natural habitats (particularly coastal wet grassland and saline lagoon) located behind seawalls should be sacrificed, if it proves impossible to move all coastal and transitional habitats inland.

The often-intimate relationship between saltmarsh vegetation and other coastal habitats, such as shingle structures, sand dunes and intertidal mudflats, means that the management of saltmarshes can rarely be considered in isolation. Managed realignment of flood defences and saltmarsh habitat creation where existing defences are not sustainable in the long-term will, in some places, involve loss of freshwater habitats (e.g. coastal wet grassland and reed beds) behind sea walls. Some of these habitats may be designated sites. Biodiversity Action Plans must make appropriate provision for compensatory habitat creation.

## 2 CURRENT STATUS

### 2.1 Description of Habitat

Saltmarsh develops along sheltered coasts and estuaries. Its vegetation (flowering plants and algae) exhibits a range of zonation from low level marshes, dominated by pioneer species (e.g. glassworts *Salicornia* spp. and cordgrass *Spartina anglica*) which are able to withstand regular coverage by seawater, to longer-established and more

botanically-diverse high level upper saltmarsh. The most species-rich communities at the highest levels of the upper marsh include transitional species of plants that can only withstand occasional inundation during high spring tides.

Over half of Hampshire's saltmarsh is of relatively recent origin (less than 120 years old) and is dominated by the hybrid cord-grass *Spartina anglica*. There is relatively little upper and mid shore saltmarsh habitat compared with other regions. The *Spartina* marshes of Southampton Water are of international importance as the original site for the introduction of the cord grass *Spartina alterniflora* by ship from America. Development of the infertile hybrid *Spartina townsendii* between this species and the native *Spartina maritima* in the area was followed by the establishment of the aggressive polyploid hybrid *Spartina anglica*. The Southampton Water saltmarshes retain a wide range of genetic material of considerable scientific importance, particularly for the non-*anglica* species; this is the only area in the world where all these species occur together and they are the subject of continuing scientific studies<sup>80, 81, 82</sup>. Rapid expansion of *S. anglica* by deliberate introduction and natural spread led to it becoming dominant throughout the area. It has since been exported all over the world to promote growth of saltmarshes. The rapid expansion of *Spartina* marsh in the Solent area has since been followed by die-back over large areas.

Other saltmarshes in Hampshire are more typical mixed communities that support species such as glasswort *Salicornia* spp., sea aster *Aster tripolium*, sea purslane *Halimione portulacoides*, sea lavenders *Limonium* spp. and a variety of saltmarsh grasses. Although the range of saltmarsh species present depends primarily on the duration and frequency of flooding with seawater, other factors, such as grazing intensity, are also important. Traditionally grazed upper saltmarsh is shorter, dominated by grasses, and an exceptionally rich habitat; there are important examples in Hampshire.

In natural conditions, true saltmarsh communities are replaced at the upper limits of tidal water penetration by driftline, freshwater wet grassland, shingle, heath, scrub or oak woodland habitats. These transitional habitats are very valuable for invertebrates, particularly where there is high structural and plant diversity and where freshwater seepages provide a gradation from fresh to brackish conditions. Hampshire contains particularly important examples of these natural transitions, which are absent from most other regions in the UK either because of heavy grazing, as in the north, or

because of enclosure, as in many areas of England and Wales.

Saltmarsh habitats in Hampshire are also of great importance as feeding grounds for internationally important populations of wildfowl and waders. They act as high tide refuges or roosts for birds (particularly waders) feeding on adjacent mudflats, as breeding sites for waders and for nationally-important breeding colonies of black-headed gulls and terns, and as a source of food for passerine birds in autumn and winter. In winter, grazed saltmarshes are used as feeding grounds by large flocks of wild ducks and geese.

## 2.2 Distribution and Extent

---

Coastal saltmarshes occur in sheltered areas on the upper to mid shore where fine coastal sediment can accrete. In Hampshire these conditions occur in harbours, estuaries and inlets, including the Solent and Southampton Water, and behind shingle spits. Saltmarsh habitat also occurs on the landward sides of certain coastal defences, where some saltwater influence is able to penetrate behind seawalls to areas of semi-natural habitat. In these locations saltmarsh may grade into coastal wet grassland (see separate chapter).

The Hampshire coast supports extensive areas of saltmarsh; close to 2,000 ha, which is roughly 4% of the UK total and of national importance as the largest aggregation on the south coast of England<sup>83</sup>. The Solent as a whole has the second largest aggregation of Atlantic salt meadows in south and southwestern England, representing 33% of the marsh in this area. This habitat is particularly extensive from inside Hurst Spit to Lymington and Keyhaven, inside the Beaulieu River, on the west shore of Southampton Water, in the Hamble River, and inside Portsmouth, Langstone and Chichester Harbours. The most important areas of *Spartina* marsh are on Bury March in the Test, Hythe in Southampton Water and Northney, Hayling Island. These sites are among the very few locations in the UK where the rare native species *Spartina maritima*, naturalised species *S. alterniflora*, and their hybrid *S. townsendii* still occur.

## 2.3 Legislation and Site Designation

---

Almost all of Hampshire's saltmarsh habitat is designated as Site of Special Scientific Interest (SSSI), in recognition of the range of saltmarsh communities and transitional communities present, the origin of *Spartina* saltmarshes in the area, the history of scientific study here, and the nationally

important extent of saltmarsh in the county. The remainder is covered by SINCs and protected from development in local plans.

International biodiversity designations also cover large areas of saltmarsh, which is included in the Special Protection Areas (SPAs) designated under the European Wild Birds Directive within Chichester, Langstone, and Portsmouth Harbours, the Solent and Southampton Water (the latter including a complex of sites in Hampshire and the Isle of Wight) because they support feeding and roosting birds throughout the year. All of these areas are also Ramsar sites, as 'Wetlands of International Importance Especially as Waterfowl Habitat'.

Finally, extensive areas of saltmarsh habitat considered to be of European importance are included in the Solent Maritime candidate Special Area of Conservation (SAC). This SAC is proposed under the EC Habitats and Species Directive for sub-features including Atlantic salt meadows (low-mid-upper saltmarsh and transitions within the marsh and into adjacent habitats), for which this is one of the best areas in the United Kingdom); Cord Grass (*Spartina*) swards (one of only two outstanding UK localities, selected specifically for the diversity of *Spartina anglica*, *S. maritima* and *S. townsendii* present, and more than 40% of the UK resource); *Salicornia* and other annuals colonising mud and sand; and estuarine habitats (one of the best areas in the UK). These habitats will be considered in the SEMS Management Scheme.

### 3 CURRENT FACTORS AFFECTING THE HABITAT

#### *Rising sea level and 'coastal squeeze'*

Hampshire is experiencing the highest rate of relative sea level rise in the UK, recently at 1-5 mm/year<sup>9</sup>, but increasing<sup>10</sup>, as a result both of climate change and isostatic sinking of the land surface. As noted in the introductory chapter of this Coastal Biodiversity Action Plan, this is a major concern for coastal biodiversity conservation in Hampshire.

While sea level rise causes the low water mark to move inland, coastal and flood defences at the high water mark prevent the landward movement of saltmarsh to compensate for this seaward erosion. 'Coastal squeeze' then occurs, with intertidal shore profiles steepening, mudflats being lost, saltmarsh plant colonisation slowing or ceasing, and erosion rates increasing. Coastal squeeze is most pronounced in south east England (for example, it is

estimated that 20% of the saltmarsh resource in Kent and Essex was lost between 1973 and 1988). There are no figures available at a national level, but the best available information suggests that saltmarshes are being lost to erosion at a rate of 100 ha a year throughout Britain, with effects most pronounced in the south.

In Hampshire, the seaward edges of saltmarshes are now eroding at rates of 0.5 m to 5 m per year<sup>8</sup>. These erosion rates are likely to continue to increase, partly as a result of the large-scale die-back of *Spartina* (see below) and reduced sediment supplies for saltmarsh accretion, and possibly also because of increased storm frequencies (also a result of climate change). A 30% loss of Hampshire's saltmarsh is now anticipated over the next 20 years.

Sea water incursion inland will also change the extent and character of transitional zones between saltmarsh, coastal wet grassland and other semi-natural habitats, particularly in areas where there is no opportunity for all these habitats to move inland or up river valleys.

Unless a programme of managed retreat or coastal realignment is implemented, much of the county's saltmarsh resource will be lost over the next few decades. Options for managed retreat are, however, restricted by the large amount of coastal land that has been developed for industry or housing and is of too high an economic value to be abandoned. Decision-makers and landowners must decide which of the valuable semi-natural habitats (particularly coastal wet grassland and saline lagoon) located behind seawalls should be sacrificed for the re-establishment of saltmarsh, when it proves impossible to move all coastal and transitional habitats inland.

#### *Sediment dynamics*

The balance between erosion and accretion of saltmarsh is determined primarily by the local sediment budget, and only secondarily by vegetative processes such as the spread of pioneer species - where of course sea level rise and coastal squeeze permit the latter. This sediment budget may be affected by coast protection works, or by changes in estuary morphology caused by land claim, dredging of shipping channels and flood defence works. Such changes may occur over tens or 100s of years following the activities that originally caused them.

#### *Cord grass (*Spartina*) dieback*

*Spartina anglica* is a very efficient pioneer species that has invaded previously unvegetated mudflats during the past 100

years since originating in Southampton Water. The rapid development of these pioneer marshes to the seaward side of higher level saltmarsh has protected the latter from erosion. *Spartina* is, however, now undergoing a phase of die-back in places. The cause is unclear, though increased storminess, possibly due to climatic change or changing prevailing wind direction, may be implicated (*Spartina* is sensitive to wave action). In some places other saltmarsh communities are succeeding it, but the main effect has been to expose higher level more biodiverse areas of saltmarsh to accelerated erosion at their seaward edges.

#### Grazing and hay cutting

Grazing has a marked effect on the structure and composition of saltmarsh vegetation; it reduces the height of the vegetation and, in moderation, increased the diversity of plant and invertebrate species, whilst creating a sward attractive to wintering and passage wildfowl and waders. Less intense grazing produces a tussocky structure that favours breeding waders. Over-grazing, which can detrimentally affect saltmarsh biodiversity, is only a very local problem in Hampshire.

In recent decades, some grazed saltmarshes have been abandoned, leading to domination of the mid- to upper marsh by rank grasses. In the early 1960s domestic animals grazed the vast majority of intertidal marshes as part of the New Forest common grazings<sup>84</sup>. Grazing of saltmarsh in Hampshire now only occurs between Pitts Deep and the Lymington River, at Eling Great Marsh, Bury Marsh, and Hacketts Marsh. The biodiversity of middle and upper saltmarsh would be considerably improved if extensive or light grazing were restored to other areas.

There is some hay cutting on the very rich upper saltmarsh and coastal wet grassland at Farlington and in the Lower Test Valley.

#### Land claim and development

There have been extensive losses of saltmarsh in Hampshire through land claim for urban, harbour, transport, industrial or recreational infrastructure, waste disposal and agriculture. Large scale saltmarsh land claim schemes for agriculture are now rare. Piecemeal smaller scale land claim for industry, port facilities, transport infrastructure and waste disposal is still comparatively common, and marina development occurs occasionally on saltmarsh. Such developments usually affect the more botanically diverse upper marsh and landward transition zones. Upper

saltmarsh transitions are also most likely to be affected by upgrades of coastal defences.

Land claim and coastal defence work can also interrupt movement of sediments along the coast, slow accretion rates and lead to erosion of saltmarsh elsewhere on the coast.

#### Other human influences

Agricultural improvement (re-seeding and draining) has affected the upper edge and transition zones of some saltmarshes in the past and may still occur on a small scale. Eutrophication due to sewage effluent and agricultural fertiliser run-off has caused local problems of algal growth on saltmarshes. Oil pollution can potentially destroy saltmarsh vegetation and, whilst this can usually recover, sediment may be lost during the period of die-back unless bound together by the oil. Any subsequent re-erosion may release oil that had been retained by the marsh. The effects of recreational pressure, including habitat trampling and bird disturbance as a result of recreational uses (e.g. wildfowling and dog-walking) and some commercial activities (e.g. blackheaded gull egg collection), are not well understood but may be locally significant. Erosion of the seaward edges of saltmarsh may also be accelerated by wakes from ship and boat movements.

## 4 CURRENT ACTION

### 4.1 Site and Species Protection

Most significant areas of saltmarsh on the Hampshire coast are designated as Sites of Special Scientific Interest (SSSI) and many are also Special Protection Area (SPA). The most important areas have been included within the candidate Solent Maritime Special Area of Conservation (SAC) under the Habitats Directive. Outstanding gaps in SSSI coverage have been identified for future action.

The Mediterranean gull *Larus melanocephalus* is an Annex I species within the Birds Directive and protected under Schedule 1 of the Wildlife and Countryside Act. This scarce but increasing visitor and breeding species in Hampshire uses saltmarsh for breeding, feeding and nesting.

### 4.2 Habitat Management and Programmes of Action

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast (see Chapter 1).

Shoreline Management Plans (SMP), SEMS, CHaMPs, Estuary Management Plans and Harbour Plans, in particular, identify the importance of saltmarsh habitats on the Hampshire coast and make recommendations for their management. A key recommendation of the West Solent and Southampton Water SMP is the development of a Saltmarsh Management Strategy for the SCOPAC Region.

Co-ordination of this wide range of overlapping initiatives is an essential part of biodiversity planning in Hampshire.

#### Solent European Marine Sites Management Scheme (SEMS)

Much of the Hampshire coast falls within the Solent Maritime SAC (notified for its Atlantic salt meadows, *Spartina* sward habitats and Estuaries). A single Solent European Marine Sites (SEMS) Management Scheme will implement the Habitats Directive on the Hampshire coast. In relation to Atlantic salt meadows and cordgrass swards, the Management Scheme will consider activities which may cause deterioration or damage to these features and outline appropriate actions where necessary to ensure their conservation status.

#### Coastal Habitat Management Plans (CHaMPs)

Low-lying coastal sites in West Sussex and Hampshire, including saltmarsh habitats, are among the first six priority areas for which CHaMPs have been produced by English Nature and the Environment Agency, in close consultation with DEFRA and DETR, and with funding from the EU LIFE Project 'Living with the Sea' and DEFRA.

Publications by the National Rivers Authority<sup>85</sup> (now Environment Agency) and English Nature<sup>86</sup> provide important information on the management and recreation of saltmarsh. Initial results are now available from the managed retreat experiments at Tollesbury, Essex<sup>87</sup> (one of the sites within the CHaMPs initiative), at Thornham Point in Chichester Harbour, and DEFRA (formerly MAFF) funded monitoring of the Saltmarsh Creation option of the old Habitat Scheme at four coastal sites.

#### Habitat and Species Management Plans

National Coastal Habitat and Species Biodiversity Action Plans have been published by the UK Biodiversity Group<sup>32</sup>. Poole Bay and Solent Natural Area BAPs have been prepared by English Nature<sup>33</sup>.

The UK BAP objectives for saltmarsh include maintaining the existing extent of saltmarsh habitat and restoring the area to 1993 levels by offsetting current national losses due to coastal squeeze and erosion.

Saltmarsh is an important summer breeding and winter roosting habitat for several species of coastal bird. Joint Species Action Plans are to be developed for wintering and breeding birds, which will be of relevance to this Habitat BAP.

#### Saltmarsh Demonstration Project

Hampshire and Isle of Wight County Councils, New Forest District Council, Chichester Harbour Conservancy and English Nature are developing proposals for a Demonstration Project for the management of saltmarsh in the Solent area. The objective is to test and develop the innovative saltmarsh management techniques required to implement the management strategies being developed via Shoreline Management Plans and CHaMPs. These management techniques will balance environmentally sensitive technology against the economic needs of recreational and commercial users and conservation status. The proposal is to focus, in particular, on opportunities to recycle dredged material from marinas to provide sustainable restoration and enhancement of saltmarsh and mudflat systems, and to provide widely applicable practical guidance for implementation of strategic management programmes required by EC legislation.

#### Other initiatives

DEFRA's Countryside Stewardship Scheme includes a saltmarsh re-creation and management option for agricultural land behind sea walls. Locally, two contrasting schemes in Chichester Harbour provide examples of different methodologies being employed for saltmarsh creation. The Hampshire County Council is considering undertaking a review on the impacts of grazing on saltmarsh in the county and the potential for increased levels of grazing.

#### 4.3 Action for Species

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily in saltmarsh habitat. Action proposed in this Plan will be the principle means of conserving most of these species.

Table 2 (Appendix 1) lists those priority species, thought to be extinct in Hampshire, which are primarily associated with saltmarshes.

Table 3 (Appendix1) lists those Hampshire priority species that occur in saltmarshes but are primarily found in other habitats. Although action in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation

Some former Hampshire saltmarsh species are covered by a national Species Action Plan (the ground beetle *Anisodactylus poeciloides*, possibly extinct in Hampshire) or Species Statements (the ground beetle *Dyschirius angustatus* and the capsid bug *Orthotyplus rubidus* – neither of which are known to be extant in Hampshire).

#### 4.4 Survey, Research and Monitoring

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary.

English Nature has completed an audit of intertidal habitats in Hampshire, including

saltmarsh, through Phase 1 survey and remote sensing. Data are available on a Geographical Information System.

The Saltmarsh Demonstration Project will, in particular, include examination of natural processes of sedimentation and re-vegetation, research into the recycling of dredged 'waste' sediments for saltmarsh recharge, and examination of the effectiveness of monitoring the coastal environment as a management tool. Monitoring techniques and methods identified for this project include airborne remote sensing (e.g. LIDAR – Light and Distance Ranging and CASI – Compact Airborne Spectral Imager – see appendix 2) and aerial photogrammetry) and field-based instrumentation.

**6 PROPOSED ACTION**

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 13-14). The table below excludes generic actions, which are included in section 6 on page 15. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

**Key to symbols in Action Table:**

- ◆ = To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇄ = Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ➡ = To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- ⇄ = Work that has already begun and is ongoing.

	ACTION	DELIVERY BY		YEAR					MEETS OBJ.		
		Key Partner	Others	2003	2004	2005	2006	2007		2010	
<b>Habitat Protection</b>											
1	Apply conservation designations to all remaining areas of saltmarsh which meet international criteria for site selection, including areas in the Hamble River and Chichester Harbour	EN	LAs HCC, HWT	⇄	◆						A
2	Develop a regional, rather than county, strategy for saltmarsh management and recreation, recognising that mitigation for inevitable losses in Hampshire may have to take place elsewhere on the south coast	SCOPAC	CHaMP partners/ project team	➡	⇄	◆					B, D, E, I
3	Consider the non-use value of saltmarsh created as part of a flood defence scheme in cost/benefit analyses for flood defence schemes that contribute to the objectives of this plan	LAs, DEFRA	landowners	◆⇄	⇄	⇄	⇄	⇄	⇄		D, F, L
<b>Habitat Management, Incentive Schemes and Other Resources</b>											
4	Identify potential areas for managed realignment and creation of new areas of saltmarsh, and enable some of these to develop the full range of saltmarsh zonation (including natural transitions at estuary margins), taking into account the needs of other coastal habitats	EA, EN, LAs, CHC	Landowners, HWT, CHaMP partners	◆⇄	⇄	⇄	⇄	⇄	⇄		B, D, E,

**Saltmarsh**

5	Encourage uptake of DEFRA's Countryside Stewardship Inter-tidal Habitats Scheme, to recreate saltmarsh on agricultural land behind sea walls and meet the targets of this BAP	DEFRA, EN, EA, LAS	Landowners, farmers	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	B, D, E, G
6	Use the Saltmarsh Demonstration Project to improve habitat management, particularly within Chichester Harbour and the Keyhaven-Lymington saltmarsh system	NFDC, CHC	EN, EA, HCC	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	D, E, F, G
7	Undertake a review of saltmarshes historically and currently grazed in the Solent area, with a view to restoring extensive or light grazing to larger areas of middle and upper saltmarsh habitat.	HCC, EN, HWT,	Landowners, farmers, HGP	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	E, H, I
<b>Species Action</b>																	
8	Protect and monitor breeding sites for Mediterranean gull <i>Larus melanocephalus</i> and other species of biodiversity importance	EN	RSPB, HOS	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	K, H
9	<i>Anisodactylus poeciloides</i> (UK SAP). Resurvey former locations, including Browdown, to determine status	HWT	MOD, EN	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, K
10	<i>Dyschirius angustatus</i> (UK Species Statement). Resurvey former sites of colonies to determine status.			↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, K
11	<i>Orthotylus rubidus</i> (UK Species Statement). Resurvey former sites to determine status.			↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, K
<b>Survey, Research and Monitoring</b>																	
12	Clarify the classification and extent of Solent saltmarsh behind seawalls	EN, HWT		↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, I, J
13	Carry out research and survey to determine key areas suffering from erosion and any accreting sites, then determine the potential for retaining and/or augmenting the saltmarsh resource in Hampshire	EN, HWT, EA, HCC, Harbour Authorities	Universities	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	H, I, J
14	Develop a range of measurement techniques to monitor and analyse the performance of saltmarsh systems and inter-tidal recharge techniques. Consider and assess the environmental impact and feasibility of a pilot project utilising material from Southampton Water capital dredging and marina maintenance dredging at Hythe/Fawley or Lymington marsh.	ABP, EN	NFDC, HWT, Universities	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	D, E, F, G, H, I
15	Collate the results of research into the factors (including grazing, natural sedimentation and re-vegetation) influencing the establishment and development of saltmarsh vegetation in Hampshire	DEFRA, EA	EN, Universities	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	G, H, I
16	Examine the socio-economic implications of practical saltmarsh management techniques	LAS	EN, Universities	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	E, G

Communication and Publicity										
17	Ensure that the scale of the problems of saltmarsh loss and conservation is widely understood by landowners	EN, EA, DEFRA, LAS		↔	↔	↔	↔	↔	↔	L
18	Promote the economic value of saltmarsh for flood defence	EA, DEFRA, SCOPAC	EN, HCC	↔	↔	↔	↔	↔	↔	L

**KEY TO ORGANISATIONS**

ABP	Associated British Ports	HCC	Hampshire County Council
CHC	Chichester Harbour Commissioners	HGP	Hampshire Grazing Project
CHaMP	Coastal Habitat Management Plan	HOS	Hampshire Ornithological Society
DEFRA	Department for Environment, Food and Rural Affairs (formerly MAFF)	HWT	Hampshire Wildlife Trust
EA	Environment Agency	LAs	Local Authorities (District, City and Parish Councils)
EN	English Nature (EN <sup>N</sup> denotes national office)	NFDC	New Forest District Council
FWAG	Farming and Wildlife Advisory Group	RSPB	Royal Society for the Protection of Birds
		SCOPAC	Standing Committee on Problems Associated with the Coastline

# COASTAL WET GRASSLAND

Hampshire Biodiversity Partnership

## 1 INTRODUCTION

Most areas of coastal wet grassland in Hampshire and elsewhere in England were created by the enclosure of estuarine saltmarshes, mainly between 1600 and 1900. Some are of natural origin. All coastal wet grassland has been under increasing pressures during the past few decades through improved drainage and conversion to arable or intensive grassland management, or loss to recreational, industrial and urban development. Overall, an estimated 64% of this habitat has been lost in the Greater Thames area, 48% in Romney Marsh, and 37% in Broadlands.

Although much of Hampshire's coastal wet grassland has also been converted to intensive agriculture or urban and industrial use, extensive areas still remain, representing some of the largest remaining areas of this habitat on the south coast. They are of national nature conservation importance because of their plant and invertebrate biodiversity and internationally important populations of wintering and breeding birds, especially dark-bellied brent geese and waders.

There are some very important areas of wet grassland in some of Hampshire's river valleys (e.g. the Hampshire Avon) which are not currently affected by coastal influences. Coastal realignment and landward movement of coastal habitats into the lower reaches of river valleys as a result of rising sea level may, however, result in increased coastal influences on these riverine wet grasslands.

## 2 CURRENT STATUS

### 2.1 Description of Habitat

Coastal wet grassland is relatively flat, low-lying, periodically flooded grassland, pasture or meadow drained by a network of drainage ditches. These ditches, which maintain the water levels, contain standing water ranging from brackish (near seawalls) to freshwater. Seasonally-flooded hollows or permanent ponds may also occur, sometimes with emergent swamp communities or with lagoonal communities. Coastal wet grassland may grade into saltmarsh to seaward and, to landward, into other habitats

of nature conservation importance, such as lowland wet grassland (along river valleys), reedbed, freshwater marshes, fen meadows, wet ditches and transitions to mires and ancient woodland. These natural transitions, both within drainage ditches and the grassland, are of particularly high biodiversity value.

Where traditionally managed by extensive grazing, without the application of herbicides or fertiliser, an unusual mix of grassland and saltmarsh vegetation types can arise. These are characterised by several nationally rare and scarce plant species such as sea clover *Trifolium squamosum*, divided sedge and a number of species of saltmarsh-grass. Nation-wide, about 500 species of vascular plants have been recorded from UK coastal wet grasslands and inland marshes, while their drainage channels support some 130 of Britain's 170 species of brackish and freshwater vascular plants<sup>88</sup>.

Hampshire's coastal wet grassland habitat is particularly species-rich (compared with other southern sites), with many unusual species present. Farlington Marshes, for example, is a particularly diverse Hampshire coastal wet grassland created about 230 years ago. It contains a range of types of calcareous grassland, over 50 grass species, and the nationally scarce slender hare's-ear *Bupleurum tenuissimum* and sea clover<sup>67</sup>.

Nationally important species such as the short and long-winged coneheads (grasshoppers) *Conocephalus dorsalis* and *C. discolor* (once among Britain's scarcest invertebrates, but now expanding their range northwards) are also recorded in these marshes. The wet grasslands associated with coastal areas are often important for breeding birds, particularly waders (e.g. redshank and lapwing, species that are under threat nationally), and the nationally-declining yellow wagtail. In winter, these grasslands provide important feeding and roosting grounds for a number of coastal bird species, some of them in internationally significant numbers. The grasses, sedges and other plants tolerant of high water tables and winter flooding provide ideal feeding for grazing species such as wigeon and brent geese. Ten species of birds are totally dependent on lowland wet grassland habitat<sup>89</sup>.

Drainage ditches in coastal wet grassland often receive saltwater from seepage through sea walls and embankments or overtopping during high spring tides. The range of ditch habitats from brackish to freshwater may support brackish plants and large numbers of rare and endangered invertebrates, some of which are characteristic coastal lagoon species (see separate Action Plan for this habitat) and others, including water-beetles, which are virtually confined to this habitat.

### *2.2 Distribution and Extent*

The total UK extent of the habitat is unknown, but there may be a total of 300,000 ha, 200,000 ha of which is in England. Only a small proportion of this is semi-natural, supporting a high diversity of native plant species (5,000 ha in England, an estimated 10,000 ha in the UK).

Hampshire County Council's Phase One coastal survey and Hampshire Biodiversity Action Plan (Volume 1) indicates that there are some 750 ha of coastal wet grassland in Hampshire, but a comprehensive habitat survey has not yet been completed. The coastal wet grassland of Langstone and Chichester Harbours (particularly on the eastern side of Hayling Island and Farlington Marshes), Beaulieu Estuary, Keyhaven-Pennington Marshes and the Lower Test Valley are some of the largest remaining areas of this habitat on the south coast.

Hampshire Wildlife Trust has mapped the massive loss of coastal wet grassland in the north of Langstone Harbour<sup>90</sup>.

### *2.3 Legislation and Site Designation*

Large areas of species-rich coastal wet grassland and areas of greatest importance for their bird populations have been designated as Sites of Special Scientific Interest (SSSI), much also as Special Protection Area (SPA) and Ramsar site. Some designated areas of coastal wet grassland have been purchased or are managed under agreement as National Nature Reserve or Local Nature Reserves. The candidate Solent and Isle of Wight Lagoon Special Area of Conservation (SAC) includes some large areas of coastal wet grassland with brackish ditches and ponds which support lagoonal communities (see separate Action Plan for lagoonal habitats).

## **3 CURRENT FACTORS AFFECTING THE HABITAT**

### *Sea level rise and managed retreat*

As noted in the introductory chapter of this Coastal Biodiversity Action Plan, the high rate of relative sea level rise on the Hampshire coast is a major concern for coastal biodiversity conservation because of the rate at which it is causing the low water mark to move landward, shore profiles to steepen, and 'squeezing' intertidal habitats.

Sea level rise is also causing erosion of sediment at the toe of sea defences, increasing the likelihood that defences will be overtopped during high tide storm events, and resulting in increased penetration of saltwater along drainage ditches and through seawalls. This is causing salination of former freshwater marshes and ditches (some of which may develop important brackish lagoon communities – see separate Biodiversity Action Plan for lagoonal habitats), and reversion to saltmarsh. Sea water incursion inland will also change the extent and character of transitional zones between saltmarsh, coastal wet grassland and other semi-natural habitats, particularly in areas where there is no opportunity for all these habitats to move inland or up river valleys.

It is apparent from these trends that a programme of managed retreat or coastal realignment to counter sea level rise and intertidal and saltmarsh habitat loss is becoming urgent. There is a need to recreate freshwater habitat in advance of losses to sea level rise as part of holistic coastal realignment projects. Options for managed retreat are, however, restricted by the large amount of coastal land that has been developed for industry or housing and is of too high an economic value to be abandoned. Unfortunately, agricultural land and coastal wet grassland are the obvious candidates for recreation of saltmarsh and mudflat behind former seawalls, requiring the creation of equivalent areas of coastal wet grassland elsewhere. It may not, however, prove to be as easy in the short term to move coastal wet grassland habitat (which has developed much of its species richness over one or two hundred years) inland, as it will be to recreate saltmarsh and mudflat habitat on the sites of former coastal wet grassland. Arable reversion schemes in North Kent, however, have demonstrated that relatively rapid establishment of biodiverse grassland and breeding bird populations is possible in these situations.

Whether managed retreat is introduced or not, rising sea level will result in an increased demand for the improvement or

construction of flood defence works. This may result in loss of coastal wet grassland through the excavation of borrow pits to provide material for new or wider and higher sea walls.

#### Agricultural intensification or neglect

Agricultural improvement includes the increased use of fertilisers, herbicides and pesticides, reseeded, ploughing, improved drainage of coastal wet grassland, and even spray drift from nearby agricultural land onto traditionally managed coastal wet grassland. These influences lead to a reduction in the biodiversity of coastal wet grassland and ditch vegetation and the invertebrates, birds and mammals associated with these habitats. They may completely destroy most of these coastal wet grassland features, even if sites remain important for some of their roosting or grazing bird populations.

Conversely, agricultural neglect, in the form of a decline in traditional management (particularly grazing) of coastal wet grassland results in the growth of coarser grasses and scrub, and loss of biodiversity. Neglected coastal wet grassland also tends to be used for dumping, storage of various agricultural and industrial materials, and generally mismanaged.

#### Pollution and eutrophication

Pollution of coastal wet grassland may arise as a result of agricultural intensification, by incursion of water-borne pollutants (e.g. oil) from the sea, or through pollution of ground or surface water. Eutrophication (pollution by excess nutrients) causes deterioration of habitat quality in grassland and adjacent drainage ditches on coastal wet grassland. It usually occurs as a result of the runoff from fertilised agricultural land, or when sewage discharges to nearshore waters penetrate drainage ditches from the sea. Pollution of ground or surface water commonly occurs as a result of routine industrial or highway runoff or through accidental spills.

#### Development

There are considerable pressures for the development of coastal wet grassland, whether for recreational use, industrial or urban development, transport infrastructure (mainly new roads), waste disposal, or excavation and development for port and marina use. Major development proposals for areas of coastal wet grassland still arise from time to time, most recently for port developments at Dibden Bay, Southampton Water.

#### Groundwater and aggregate abstraction

Groundwater abstraction inland can result in reduced freshwater input to coastal wet grassland, and consequently increased penetration of saltwater to this habitat. Aggregates may be abstracted for local construction purposes, or for the improvement of existing seawalls.

The detrimental effects of mineral extraction and associated land fill on land adjoining coastal wet grassland has been demonstrated at Keyhaven-Pennington marshes since 1996.

### **CURRENT ACTION**

#### 4.1 Site and Species Protection

Significant areas of coastal wet grasslands are notified as SSSI, with some small areas being designated as Sites of Importance for Nature Conservation (SINC). Much of this is also protected through international designations such as Special Protection Area and/or Ramsar Wetlands of International Importance. The Hampshire Biodiversity Information Centre (HBIC) database records the area, distribution and management status of this habitat for known sites in Hampshire, but is incomplete. Large areas are managed as Nature Reserves by English Nature (North Solent), Hampshire County Council (Lymington marshes and Titchfield Haven) and the Hampshire Wildlife Trust (Farlington Marshes). The proposed Solent Maritime and Solent Lagoon Special Areas of Conservation also includes areas of wet grassland bordering the lagoons and ditches comprising this site.

#### 4.2 Habitat Management and Programmes of Action

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast (see Chapter 1).

Co-ordination of this wide range of overlapping initiatives, within the south coast region as well as within the county, is an essential part of biodiversity planning in Hampshire.

#### Coastal Habitat Management Plans (CHaMPs)

Coastal sites of international nature conservation importance (SPAs and SACs) threatened by rising sea levels and coastal squeeze are covered by the CHaMPs guidelines, launched in April 2000. These guidelines aim to develop a strategic approach to the holistic management of flood

risk and internationally important wildlife sites. Low-lying coastal sites in West Sussex and Hampshire are among the first six priority areas for which CHaMPs are being drawn up by English Nature and the Environment Agency, in close consultation with DEFRA and DETR, and with funding from the EU LIFE Project 'Living with the Sea' and DEFRA.

#### Site Management Plans

The Environment Agency is currently preparing Water Level Management Plans for all wetland SSSIs in order to prevent damage to these sites through excessive drainage and/or over abstraction of water.

Environmentally Sensitive Areas (ESA) include prescriptions encouraging the management of coastal wet grassland, which could be applied along the Lower Test in the Test Valley ESA.

#### Habitat and Species Management Plans

National Coastal Habitat and Species Biodiversity Action Plans have been published by the UK Biodiversity Group<sup>32</sup>. The Hampshire coast is also covered by three Natural Area BAPs (two terrestrial and one maritime) prepared by English Nature. These take the national targets set out in the UK Biodiversity Action Plan and break them down into specific targets for each Natural Area<sup>91</sup>. Coastal wet grassland is combined in these Natural Area targets with floodplain wet grassland (there is a natural gradation between the two forms of this habitat as coastal influences diminish inland). This makes it difficult to relate overall Natural Area BAP targets to coastal marsh. The New Forest Natural Area BAP target is to commence creating 450 ha of new coastal wet grassland from arable land or other land uses in the Avon Valley (this is unlikely to include much coastal wet grassland). The Coastal Plan and Hampshire Lowlands Natural Area BAP is simply to rehabilitate existing coastal wet grassland which is in an unfavourable condition.

Coastal wet grassland is an important summer breeding and winter roosting habitat for several species of coastal bird. Joint Species Action Plans are being developed for wintering and breeding birds. The Wet Grasslands Birds SAP (covering white fronted goose and Bewick's swan) and the Foreshore Birds SAP will be of relevance to this Habitat BAP. There is also a Hampshire Strategy for the dark-bellied brent goose *Branta bernicla bernicla*, which over-winters in internationally important numbers and for which coastal wet grassland is an important habitat.

#### 4.3 Action for Species

There are several additional initiatives relevant to coastal wet grassland species in Hampshire. The weevil *Pachytychius haematocephalus*, found at Gosport (Gilkicker) is the subject of UK and Hampshire Species Action Plans. Rush-leaved fescue *Festuca arenaria* is a priority species in Hampshire; very rare and found on reclaimed land at Dibden Bay. Sea barley *Hordeum marinum* and several other species of herbs and grasses will benefit from the reintroduction of grazing to this habitat.

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily in coastal wet grassland habitat. Action proposed in this Plan (particularly the reintroduction of grazing) will be the principle means of conserving most of these species, although some also have their own species Action Plans (SAPs).

Table 3 (Appendix 1) lists those Hampshire priority species that occur in coastal wet grassland habitat but primarily occur in other habitats. Although action in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation.

#### 4.4 Survey, Research and Monitoring

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary.

DEFRA (formerly MAFF) is currently funding a research project on grazing marshes, birds and livestock systems, 'Grazing marsh for birds and livestock: development of management guidelines' which is due for completion in September 2001. This follows up an initial three year project 'The management of coastal grazing marsh for livestock rearing and wildlife conservation' which was completed in March 1999. Final reports are available from DEFRA and details of other research is given on the DEFRA website.

English Nature undertakes regular breeding bird surveys on the grazing marshes of the North Solent NNR.

**6 PROPOSED ACTION**

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 14-15). The table below excludes generic actions, which are included in section 6 on page 16. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

**Key to symbols in Action Table:**

- ◆ = To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇄ = Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ➡ = To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new impetus to existing work.
- ⇄ = Work that has already begun and is ongoing.

	ACTION	DELIVERY BY		YEAR						MEETS OBJ.	
		Key Partner	Others	2003	2004	2005	2006	2007	2010		
<b>Habitat Protection</b>											
1	Continue to notify important wet grassland sites as SINC, SSSI, SAC and SPA.	EN, HCC	LAs, HWT,	⇄	⇄	⇄	⇄	⇄	⇄	⇄	A
<b>Habitat Management, Incentive Schemes and Other Resources</b>											
2	Implement existing programme of water level management plans for coastal wet grassland SSSIs.	EA, EN, RSPB		➡	⇄	⇄	⇄	⇄	⇄	⇄	A, E
3	Ensure a presumption against development that would prevent plans for the inland movement of wet grassland on flood plains	LAs, HCC		⇄	⇄	⇄	⇄	⇄	⇄	⇄	D, E, I, L
4	Ensure that the important transition zone between fresh and brackish water (e.g. for the biodiversity of invertebrates in ditches) is maintained	LAs, EN, EA, HCC, ChaMIP, SMP	Landowners	⇄	⇄	⇄	⇄	⇄	⇄	⇄	E
5	Encourage uptake of wet grassland into ESA and CSS agreements (e.g. along the Lower Test, Test Valley ESA)	DEFRA, HMAP, FWAG	HCC, HWT,	⇄	⇄	⇄	⇄	⇄	⇄	⇄	D, E, L
6	Identify opportunities for creating new areas of coastal wet grassland from arable in targeted areas, in addition to that which will be achieved by existing agri-environment schemes	HWT, ChaMP partners, landowners, SMP groups	LAs, HGP, FWAG, HMAP	➡	⇄	⇄	⇄	⇄	⇄	⇄	D, I



# MUDFLATS AND EELGRASS BEDS

Hampshire Biodiversity Partnership

## 1 INTRODUCTION

Mudflats occur in areas where fine coastal sediment accrete. These sediment flat habitats are regularly inundated by the sea, but not covered by seawater at low tide. They include a range of sediment types from very fine organic muds in extremely sheltered harbour inlets, to muddy sandflats in more exposed conditions in the Solent. Mudflats support a diverse range of invertebrates and algae and, in some locations, communities of eelgrass (*Zostera* species) with associated communities of algae and animals. In addition to their value for marine species biodiversity, these habitats are also of particular importance as feeding grounds for wildfowl and waders.

All of the two or three British eelgrass or seagrass species (the taxonomy of this group is still under debate) are present on intertidal and shallow subtidal sediment areas of the Hampshire coast. Although these species are considered nationally scarce in the UK (occurring in only 16-100 ten km<sup>2</sup> squares), they occur on the western Solent shore and in very extensive beds in the eastern harbours. The Solent is recognised as one of the most important areas in Britain for this habitat which has been the subject of considerable study on the Hampshire coast<sup>92, 93</sup>.

These habitats are in significant decline, both as a result of relative sea level rise and intertidal squeeze (which process is likely to accelerate) and eelgrass wasting disease (which may be a cyclical phenomenon). A strategy is required to address the former and enable mudflat and eelgrass habitat to move inland through managed retreat.

## 2 CURRENT STATUS

### 2.1 Description of Habitat

Tidal flats range from soft muds in the most sheltered inner areas of harbours and estuaries, to firm sands in more wave and current-exposed areas. The habitat represents a transition from subtidal sediment areas that are continually covered by the sea, through areas completely inundated by most tides. In shelter, mudflats usually grade into saltmarsh communities

(see separate Biodiversity Action Plan for this habitat).

Tidal flats support very little vegetation other than green algal blooms and large beds of eelgrass in some harbours and inlets. They are mainly characterised by the range of infaunal and epifaunal invertebrates present. Some of these invertebrate communities are of integral importance for the biodiversity of marine species present, typically supporting a diverse burrowing infauna of molluscs, crustaceans and worms, and providing an important nursery and feeding ground for many fish species<sup>94</sup>. These and more impoverished estuarine sediment communities in the sheltered harbours and estuaries of the Solent also provide a valuable food source for internationally important populations of wintering waders, waterfowl and other coastal birds.

The root systems of eelgrass species stabilise and encourage accretion of the sediment on which they grow. These plants are an important source of organic matter, and provide shelter and attachment sites for other plants and animals, allowing interesting marine communities to develop. Infaunal communities within eelgrass beds include some species not found in adjacent areas, with a number of sedentary species of plant and animal typically found attached to the leaves and free-living species occurring within the beds. Eelgrass beds also support a large number of burrowing invertebrates, provide an important nursery and feeding ground for many fish species and a valuable food source for internationally important populations of waterfowl (particularly brent geese and wigeon).

### 2.2 Distribution and Extent

Most of the Hampshire coastline is bordered by sediment flats at the low water mark (there is very little rocky intertidal). There is a total of about 3,800-4,000 ha of mud and sandflat resource in the County<sup>95, 83</sup>. Most of this occurs within the eastern Harbours, with sizeable areas also in the Western Solent (sheltered by Hurst Spit) and rivers, and in Southampton Water.

Eelgrass *Zostera marina* generally occurs on the more open Solent shores on shallow subtidal sand and gravel and is uncovered only during extreme low water spring tides.

This species (or form) is rare on the Hampshire coast, occurring in small quantities at only a few sites, mainly along the western Solent shore.

Narrow-leaved eelgrass *Z. marina* var. *angustifolia* is simply an intertidal form of the *Zostera marina*. It is found on firm mud from the lower to mid shore, often in association with the much finer and smaller 'dwarf eelgrass' *Z. noltii*. The latter species grows on firm mud and sand from low water neap tide level to the upper shore in sheltered harbours, sometimes penetrating high into saltmarsh creeks and hollows in degenerating *Spartina* marsh. Around the Solent shore, however, it is found on firm sand from low water neap level down to the bottom of the shore<sup>8</sup>. Intertidal eelgrass communities may occur as isolated patches or extensive beds.

*Z. marina* var. *angustifolia* and *Z. noltii* are locally very abundant in suitable habitats, particularly in the eastern harbours where extensive areas of intertidal sandy mud and mud are colonised by these two species growing in association with each other. In 1979, eelgrass meadows were estimated to cover some 280 ha of intertidal mudflat in Langstone Harbour alone<sup>96</sup>, rising to 340 ha in 1987. There were also extensive areas in Chichester Harbour (220 ha in 1988) and, perhaps the same extent, in Portsmouth Harbour<sup>8</sup>. Eelgrass wasting disease became re-established in the late 1980s and areas may have decreased significantly since then.

Langstone Harbour is (or was) the single most important site in Hampshire for extensive eelgrass beds, particularly for *Zostera noltii* and *Z. marina* var. *angustifolia*, followed by Chichester and Portsmouth Harbours. Patches of *Z. marina* have mainly been recorded on the western Solent shore at Calshot Spit, Stanswood Bay and off Sowley shore.

English Nature plans to map the distribution of *Zostera* beds within the Solent European Marine Site.

### 2.3 Legislation and Site Designation

Most, but not all, intertidal mud and sand flats are covered by SSSI and SPA designation (exceptions are some of the mudflats in Southampton Water). Additionally, all important colonies of the intertidal species, narrow-leaved eelgrass *Z. marina* var. *angustifolia* and dwarf eelgrass *Z. noltii* fall within SSSI boundaries, with their importance to feeding waterfowl populations in these sites being widely recognised. The distribution of the subtidal *Z. marina*, however, generally lies outside SSSIs, although some populations fall within

the boundary of the candidate Solent European Marine Site, which incorporates 'mud and sand banks not covered by seawater at low tide' as one of its features of interest.

## **3 CURRENT FACTORS AFFECTING THE HABITAT**

### Rising sea level and coastal squeeze

Rising sea level in Hampshire is causing the landward movement of the low water mark, steepening of shore profiles and 'squeezing' intertidal habitats into smaller areas. Sea defences prevent compensatory landward movement.

Evidence from maps of the Solent shore demonstrate that the intertidal area outside the main harbours has reduced by some 50-80% since the end of the 19<sup>th</sup> Century<sup>8</sup>. Current and projected levels of relative sea level rise in Hampshire will continue this trend, possibly resulting in another 30% loss of intertidal habitat, including sand and mudflats and eelgrass beds over the next 20 years<sup>8</sup>.

### Coastal developments

At least 1,000 ha of mudflats have been lost to development on the Hampshire coast since 1930, reducing the biological capacity of the Solent to support fisheries and wildlife (including eelgrass beds). Losses to development have now slowed – the majority of the mudflats are designated as SSSI and SPA, Ramsar site and/or candidate SAC. There are still some major development proposals for areas of mudflat, for example at Dibden Bay.

### Sediment dynamics

Coastal defence or land claim, maintenance dredging of navigational channels or marinas and marine aggregate dredging can interrupt sediment movement along the coast and prevent or slow accretion elsewhere, leading to erosion of mudflats. In cases where these activities do not directly cause habitat loss, they may result in changes in sediment and hydrological regimes that subsequently result in loss of mudflat or eelgrass habitat. Such changes may occur over tens or 100s of years following the activities that originally caused them.

### Wasting Disease

Very large areas of eelgrass beds were lost in the 1930s to a 'wasting disease' apparently responsible for the dieback of

large areas of eelgrass in the UK. Although some have recovered, many eelgrass beds on the south coast are still not as extensive as they were formerly. The factors that enabled this disease to become established so widely are still debated, but stress from a number of other natural and man-made environmental and anthropogenic sources may have contributed to the stresses possibly partly responsible for (or at least associated with) this apparently cyclical phenomenon. The fungus and slime mould that colonised weakened eelgrass and have been linked with this dieback reappeared in south coast eelgrass beds in the 1980s, but without leading to such damaging effects.

#### Natural cycles

Climatic and oceanographic factors (exceptionally cold or warm sea or air temperature, air exposure, low levels of sunlight, influxes of freshwater and storms) can cause changes in the extent and health of eelgrass beds from year to year or over longer time scales. In exceptional cases, these factors could lead to sufficient stress to cause dieback. Seasonal grazing by waterfowl may cause shorter-term changes, reducing leaf cover by over 60% during periods of heavy feeding at some UK sites. The establishment of new species, such as *Spartina anglica* and *Sargassum muticum*, in eelgrass habitat may result in competition, with the establishment of the former possibly having resulted in a reduction in the overall area of intertidal eelgrass beds on the Hampshire coast. Recent die-back of *Spartina anglica* may be providing opportunities for eelgrass recolonisation.

#### Pollution and nutrient enrichment

Pollution of mudflats and eelgrass beds may arise from land or marine sources. Mudflats and their associated species are particularly vulnerable to pollution incidents such as oil spills, to sewage and industrial discharges, and to the use of tributyl tin antifouling paints (which continues on large vessels). The long history of such activities have left a legacy of heavily polluted sediments. These have affected estuarine invertebrate populations and are likely to be the reason for the low biodiversity found in some areas. Eelgrasses are also known to accumulate tributyl tin and possibly other metals and organic pollutants and may pass these on to grazers such as brent geese. These and other substances may reduce nitrogen fixation and affect the viability of these plants<sup>15</sup>. The Chichester Harbour Conservancy plans to commission studies into these effects.

Low levels of nutrient enrichment may increase production in eelgrass (the spread of eelgrass meadows in the eastern harbours from the 1960s to the 1980s apparently

coincided with increasing levels of effluent discharges), but high nitrate concentrations have been implicated in the decline of mature *Z. marina*. Phytoplankton blooms make seawater turbid, affecting photosynthesis, and may reduce eelgrass biomass and depth penetration. Eutrophication results in a shift to phytoplankton, epiphyte or macroalgal dominance. This has been the subject of a study in Langstone Harbour, where green algae cover large areas of the shore and may competitively exclude the eelgrasses.

#### Physical disturbance

A number of recreational and fisheries activities may cause physical disturbance of mudflats and eelgrass habitat. Trampling (for example by wind-surfers), bivalve dredging, the use of mobile fishing gear and other fisheries activities in shallow water, bait digging and shoreline species collection and anchoring have all been reported to cause habitat damage.

## **4 CURRENT ACTION**

### 4.1 Site and Species Protection

In addition to the existing SSSI, SPA and Ramsar site designation of most sediment flats and intertidal eelgrass beds in Hampshire, large areas of these habitats, including some below the mean low water mark, will be included within the proposed Solent Maritime Special Area of Conservation (SAC). Outstanding gaps in SSSI coverage (e.g. some of the mudflats in Southampton Water) have been identified for future action.

Mudflats and eelgrass beds are used by large numbers of protected species of birds, many of which occur in nationally or internationally-important numbers. These habitats are probably better feeding grounds than *Spartina* beds. The dwarf spike-rush *Eleocharis parvula*, which occurs in short swards on some areas of estuarine sand or mudflat, is protected under Schedule 8 of the Wildlife and Countryside Act.

### 4.2 Habitat Management and Programmes of Action

The Countryside Stewardship Intertidal Habitat Creation option, managed by DEFRA covers the creation of mudflats.

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast (see Chapter 1), recognising the

importance of intertidal sediment flats and the communities which they support.

Co-ordination of this wide range of overlapping initiatives, within the south coast region as well as within the county, is an essential part of biodiversity planning in Hampshire.

#### Habitat and Species Management Plans

The Management Scheme for the Solent European Marine Site will cover activities damaging to its features of interest, including 'mud and sand banks not covered by seawater at low tide' and *Zostera* beds as a sub-feature of low estuarine habitats.

National Coastal Habitat and Species Biodiversity Action Plans have been published by the UK Biodiversity Group<sup>32</sup>. Poole Bay and Solent Natural Area BAPs have also been prepared by English Nature<sup>33</sup>.

Natural Areas Biodiversity Action Plan targets for the Hampshire coast note that restoration of eelgrass beds in the region is not appropriate. Rather, their extent and distribution should be maintained.

Mudflats and eelgrass beds provide essential feeding habitat for many species of coastal birds, some as summer breeding species and others as passage migrants or winter visitors. Joint Species Action Plans for Hampshire are to be developed for both wintering and breeding birds, which will be of relevance to this Habitat BAP.

#### 4.3 Action for Species

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily on sediment flats and in eelgrass beds. Action proposed in this Plan for the conservation of these habitats and the maintenance of habitat quality will be the principle means of conserving most of these species.

Table 3 (Appendix 1) lists those Hampshire priority species that occur in mudflats and Eelgrass habitats but primarily occur in other habitats. Although action in this Coastal HAP may contribute to the conservation of these species, other HAPs have key responsibility for their conservation.

#### 4.4 Survey, Research and Monitoring

English Nature has been undertaking an audit and remote sensing of intertidal habitats in Hampshire, including mudflats and eelgrass beds. This will include preparation of maps and data entry to a Geographical Information System. More detailed surveys of *Zostera angustifolia* and *Z. noltii* are planned by English Nature for the Solent European Marine Site.

Research in other areas of the UK has examined the utilisation of eelgrass by wildfowl and methods of controlling encroachment of *Spartina* onto eelgrass beds (both in Strangford Lough, Northern Ireland).

A major review of the key conservation, management and monitoring requirements for the genus *Zostera* in the UK has been undertaken as a contribution to the UK Marine SACs LIFE Project<sup>97</sup>. A two year project on the biology and conservation of eelgrass seeds has been completed by the Royal Botanic Gardens, Kew.

A 'beneficial use' study undertaken by the CEFAS Burnham Laboratory to be published shortly is reviewing the potential for recharge of intertidal areas using dredged sediments, and will contain information which may be used to inform decisions on the use and disposal of such material.

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary.

6 PROPOSED ACTION

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 14-15). The table below excludes generic actions, which are included in section 6 on page 16. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

Key to symbols in Action Table:

- ◆ To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇄ Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ◆⇄ To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- ⇄ Work that has already begun and is ongoing.

ACTION	DELIVERY BY		YEAR				MEETS OBJ.		
	Key Partner	Others	2003	2004	2005	2006		2007	2010
<b>Habitat Protection</b>									
1	EN	HWT, HCC, LAs	⇄	⇄	◆				A
2	SFC, Port and harbour authorities	DEFRA, CEFAS	◆	⇄	⇄	⇄	⇄	⇄	A, B, C, E
3	EN, SFC, LAs, Port and harbour authorities	DEFRA, CEFAS	⇄	⇄	⇄	⇄	⇄	⇄	C, F, G
4	EN, SEMS management group		⇄	◆					E, K
<b>Habitat Management, Incentive Schemes and Other Resources</b>									
5	EA	Water Companies	⇄	⇄	⇄	⇄	⇄	⇄	B, C, E
<b>Species Action</b>									
6	EN	HWT	⇄	⇄	◆				H, I, J

**Mudflats and Eelgrass Beds**

<b>Survey, Research and Monitoring</b>									
7	Identify potential sites for restoration of eelgrass beds and draw up a strategy to implement restoration.	EN, HWT, Universities,	RSPB	↔	↔	◆	↔	↔	D, E, I
8	Investigate the beneficial use of fine dredged materials to promote intertidal flat accretion. Initiate an environmental assessment for a potential pilot project.	EA, DEFRA, EN, CEFAS	Universities	↔	↔	↔	↔	↔	B, C, D, E, F, I
9	Develop and use standardised procedure for long-term monitoring of eelgrass beds in Hampshire (extent, health, associated communities), building on the CHaMPs baseline and existing monitoring programmes (e.g. <sup>98</sup> ) as part of a UK-wide network of eelgrass monitoring sites. Maintain up to date information regarding the extent, quality and distribution of eelgrass beds in Hampshire and feed into HBIC.	EN, Universities,	RSPB, LRC, CHaMPs partners, HBIC	➔	↔	↔	↔	↔	G, H, I, J, K
10	Research the natural and anthropogenic factors which influence the recruitment, establishment, persistence and loss of eelgrasses.	EN	Universities	➔	↔	↔	↔	↔	G, H, I
<b>Communication and Publicity</b>									
11	Provide advice on minimising the impacts of developments, bait digging, and other activities on eelgrass beds and sediment flats	EN, SEMS management group		↔	↔	↔	↔	↔	H, I, L
12	Promote awareness among coastal users of the importance of eelgrass beds and how to avoid damage to these habitats	EN, HWT,	RSPB	➔	↔	↔	↔	↔	L
13	Ensure that the scale of the problems of sediment flat loss and conservation is widely understood by landowners and the public	EN, EA, DEFRA, LAS	SF	➔	↔	↔	↔	↔	L

**KEY TO ORGANISATIONS**

CEFAS	Centre for Environmental and Fisheries Advisory Services	HWT	Hampshire Wildlife Trust
CHaMPs	Coastal Habitat Management Plans	LAs	Local Authorities (District, City and Parish Councils)
DEFRA	Department for Environment, Food and Rural Affairs	LRC	Local Records Centre
EA	Environment Agency	RSPB	Royal Society for the Protection of Birds
EN	English Nature (EN <sup>N</sup> denotes national office)	SF	Solent Forum
HBIC	Hampshire Biodiversity Information Centre	SFC	Sea Fisheries Committee

# SALINE LAGOONS

Hampshire Biodiversity Partnership

## 1 INTRODUCTION

Saline lagoons are considered a priority habitat type under Annex 1 of the EC Habitats and Species Directive because of their high nature conservation importance, and the Solent coast is one of the most important areas for lagoons in the UK<sup>99, 100</sup>. The Hampshire coast is therefore of international importance for the large number of saline lagoon sites and complexes which it contains, and the high proportion of these which are individually of international, national or regional importance. The most important of Hampshire's lagoons and brackish ditches lie within the Solent and Isle of Wight Lagoons Special Area of Conservation proposed under this Directive.

Many of the twelve UK lagoonal species protected under the Wildlife and Countryside Act are found in Hampshire. There are particularly important populations here of the nationally-rare and protected foxtail stonewort *Lamprothamnium papulosum*, starlet sea anemone *Nematostella vectensis* and lagoon shrimp *Gammarus insensibilis*, while, prior to its decline and disappearance, the lagoon sandworm *Armandia cirrhosa*, was very abundant in Eight Acre Pond<sup>101</sup>.

## 2 CURRENT STATUS

### 2.1 Description of Habitat

Saline lagoons are pond- or lake-like, virtually tideless, shallow brackish or saline bodies of water separated or partly separated from the sea by a beach, spit or seawall which allows only limited influx of seawater. Natural lagoons are very rare; most of Hampshire's lagoons are formed from sluiced ponds or inlets. Despite their highly modified nature or artificial origins, these saline lagoons still provide a similar habitat to that of natural lagoons, with a comparable range of specialised species.

The county also contains extensive areas of brackish ditches within coastal wet grassland habitats (see separate Biodiversity Action Plan for this habitat) which support species characteristic of lagoons. Because of the rarity and importance of lagoonal habitat, these brackish ditches and their lagoonal communities are also of high biodiversity importance.

Lagoonal habitats are characterised by brackish water and fluctuating salinity, providing a very challenging environment for a restricted range of highly specialised flora and invertebrate fauna. The species composition of lagoons therefore shows little regional variation, even within Europe<sup>102</sup>.

Despite the apparent isolation of each saline lagoon, they are interdependent and have the potential to act as sources of recruitment of lagoonal species for neighbouring lagoon habitats through percolation, overtopping or sluice connection with the sea<sup>102, 103</sup>. A number of lagoons in the area have six or more lagoonal specialist species in their communities, with ten lagoonal specialist species having been recorded at Eight Acre Pond, four of them scheduled (legally protected under the Wildlife and Countryside Act 1981).

Most of the British lagoonal sites for the starlet sea anemone *Nematostella vectensis* and for the lagoon sand shrimp *Gammarus insensibilis* occur in sites on or close to the Hampshire coast<sup>104</sup>. Hampshire contains one of only two sites for the lagoonal sandworm *Armandia cirrosa* (albeit not recently recorded here and possibly now extinct in Hampshire). The tentacled lagoon worm *Alkmaria romijnii* also occurs in Hampshire lagoons (but more commonly in estuaries). Lagoons and lagoon-like habitats in the area have recently been reviewed<sup>105, 106, 107</sup> and historic data collated for some sites<sup>108</sup>, consequently the distributions of species restricted to these habitats are probably comparatively better understood. Some important lagoonal species may also occur in brackish drainage ditches, which have not been subjected to adequate survey<sup>109</sup>.

### 2.2 Distribution and Extent

The Hampshire coast and adjacent areas has among the greatest concentration of saline lagoons in Britain. Some 33 lagoons (95 ha) are found in Hampshire, 7.3% of the total of 1,300 ha in England and Wales. About 12 of Hampshire's lagoons (some 35 ha) are of national or international importance for their communities of specialised plants and invertebrates, while others have potential for improvement through appropriate management.

Particularly important concentrations of lagoonal habitats occur in the west, from

Keyhaven to Lymington, and along the shores of the eastern Harbours. New lagoons and lagoonal systems have recently been created in several areas.

### 2.3 Legislation and Site Designation

The most important lagoonal sites in Hampshire are all designated as SSSI, some are also designated as SINCS. Most are also included within the proposed Solent and Isle of Wight Lagoon Special Area of Conservation (SACs). Other lagoonal sites that are benefiting from improved management may warrant site designation in future. Some specialist lagoonal species are also legally protected under the Wildlife and Countryside Act 1981.

## **3 CURRENT FACTORS AFFECTING THE HABITAT**

The most significant threats currently facing saline lagoons are natural succession (including changes in salinity, sedimentation and vegetation changes), sea-level rise (which can result in flooding by the sea, for example following breaches in seawalls, or by percolation and infiltration), and changes arising from man's activities and patterns of land use: pollution (particularly nutrient enrichment), inappropriate artificial control of water levels and salinity, and habitat loss through infilling, landclaim, or the construction of coastal defence works. Use of lagoonal habitat by breeding or feeding birds may also be threatened by changes to the habitat or by human disturbance.

### Natural processes

Lagoons are often relatively short-lived as a result of natural coastal dynamic changes and man's activities. In a completely natural system some will progress naturally through brackish conditions to become completely overgrown by *Phragmites* marsh or fully freshwater. Others may return to fully saline or estuarine conditions as their barriers are eroded and lost. Many former lagoonal features on the Hampshire coast are now freshwater or fully marine or estuarine as a result. However, in natural conditions, new lagoons would continually become established and a range of lagoonal habitats would usually be present, holding species characteristic of each successional stage in their development. The widespread influence of man on the Hampshire coast, particularly through the construction of coastal works, has not only infilled or completely changed the form of natural lagoons (e.g. by adding concrete linings or sluices to regulate water exchange), but has prevented natural processes from continually creating new

## **Saline Lagoons**

lagoons. As a result, natural lagoonal habitats are now scarce in the area. Sea level rise and coastal squeeze will cause further pressures on existing and potential lagoonal habitats, by reducing the area of the low-lying coastal fringe habitats that are suitable for their establishment and increasing pressures for reinforcement of seawalls or managed retreat at the expense of existing lagoonal sites.

### Changing land use patterns

Lagoonal habitats are fragile and susceptible to changes in salinity and pollution (particularly nutrient enrichment, which can lead to blooms of phytoplankton or blanket algae, followed by decay and deoxygenation, and run-off or deliberate application of herbicides), but have some ability to buffer themselves from such changes. Alterations to their retaining barriers and water connections with the sea, such as those brought about by coastal defence works or a rise in sea level, are a particular threat. The potentially detrimental effects of land-based mineral extraction and associated landfill on land adjoining coastal lagoons has been demonstrated at Keyhaven and Pennington Marshes since 1996.

Man's activities on the coast have compensated for the losses of natural lagoons by creating numerous semi-natural lagoonal habitats during the construction of seawalls, saltings, shellfish ponds, recreational facilities and even nature reserves (as bird scrapes). Changing land use patterns have caused many of these structures to fall into disuse, with a deterioration of their lagoonal characteristics, and several sites have been lost or reduced in size through infilling or by changes to their salinity control regimes. Without action to reverse these trends, coastal lagoons will continue to deteriorate in quality and be lost. Coastal setback in response to sea level rise, however, may provide important opportunities for the creation of new lagoonal habitats, and the Solent CHaMPs project should identify these.

## **4 CURRENT ACTION**

### 4.1 Site and Species Protection

All of the most important lagoonal sites on the Hampshire coast are protected by SSSI designation and lie within the Solent and Isle of Wight candidate Special Area of Conservation (SAC or European Site). Some are also within Local or National Nature Reserves. Because additional sites may increase in habitat quality and species diversity through good management, regular reviews of lagoons in the region have been

carried out and SSSI designation undertaken as necessary.

Twelve species of invertebrates and plants associated with saline lagoons are protected in Great Britain under the Wildlife and Countryside Act 1981. All but two of the most important lagoonal species occur in the Solent region<sup>107</sup>.

#### 4.2 Habitat Management and Programmes of Action

A large number of habitat management plans and programmes of action promote biodiversity management on the Hampshire coast (see Chapter 1). These include regional Shoreline Management Plans, County and District Coastal Management Plans and Policies, Nature Reserve Management Plans and English Nature Site Management Schemes. Several of the latter two categories target saline lagoon habitats. National Biodiversity Action Plans also present actions for the conservation of lagoonal habitats and species. Some of the more important of these are described below.

The Countryside Stewardship Intertidal Habitat Creation option, managed by DEFRA covers the creation of saline lagoons.

The Environment Agency is currently preparing Water Level Management Plans for all wetland SSSIs in order to prevent damage to these sites through excessive drainage and/or over abstraction of water.

Co-ordination of this wide range of overlapping initiatives, within the south coast region as well as within the county, is an essential part of biodiversity planning in Hampshire.

##### Shoreline Management Plans (SMPs)

SMPs for the Hampshire coast set out strategies for coastal defence taking into account natural processes, human and other environmental influences and needs. They consider sand dune, saltmarsh and mudflat management, but generally do not mention coastal lagoons, set back behind (although wholly dependent on) the barriers between the sea and coastal land and dynamic coastal processes that are the focus of SMPs.

##### Solent and Isle of Wight Special Area of Conservation

The most important examples of lagoonal habitats on the Hampshire coast lie within the candidate SAC for the Solent and Isle of Wight Lagoons. Some of these lagoons (the Lymington to Keyhaven Nature Reserve lagoons complex and the newly created Langstone Oyster Beds saline lagoon) are targeted by a LIFE Nature project in

### **Saline Lagoons**

partnership between RSPB, Havant Borough Council and Hampshire County Council. This project aims to maintain and enhance the conservation of saline lagoons and their birds on ten Natura 2000 sites in England through positive management, monitoring and community involvement.

#### Habitat and Species Management Plans

National Coastal Habitat and Species Biodiversity Action Plans have been published by the UK Biodiversity Group<sup>32</sup>. This document includes BAPs for two lagoonal species (see section 4.3), a Saline Lagoons Habitat Action Plan, and an Annex to the latter containing eight additional lagoonal species statements. The objectives of the national saline lagoon BAP include maintaining and enhancing the current number, area and distribution of coastal lagoons, and creating, by the year 2001, sufficient habitat to offset losses over the past 50 years (a target of at least 120 ha).

Poole Bay and Solent Natural Area BAPs have also been prepared by English Nature<sup>33</sup>, covering the Hampshire coast. These support national BAPs. They include targets for maintaining and enhancing existing lagoons and considering opportunities for creating new sites. Targets of four to five (2.3 ha) new lagoons are proposed for each of the western and eastern sections of the Hampshire coast (the New Forest Natural Area and the South Coast Plain and Hampshire Lowlands Natural Area). These contribute towards an overall target of 10 ha of new lagoons in the Solent and Poole Bay (Natural Area 108).

The high potential value of poor-quality coastal ponds and inlets for lagoon creation and restoration arises from the correlation between high numbers of lagoonal species found at any site and the density of other examples of this habitat nearby (within 15 km)<sup>110</sup>. High quality lagoon habitats may therefore be quite easy to restore from existing low value coastal ponds or inlets or to create *de novo* during coastal engineering projects (e.g. Normandy Farm, Pennington, and Calshot Pond, Fawley)<sup>111</sup>.

English Nature have produced a Best Practice Guide for lagoon creation and re-creation<sup>112</sup>.

#### LIFE project

The Saline lagoons LIFE project is a partnership between the RSPB, Hampshire County Council and Havant Borough Council which aims to maintain and enhance the conservation of saline lagoons and their birds on 10 Natura 2000 sites in England. Two of the sites are in Hampshire, Langstone Oysterbeds and Lymington-Keyhaven.

#### 4.3 Action for Species

---

Table 1 (Appendix I) gives details of priority species in Hampshire found primarily in lagoonal habitats. Action proposed in this Plan will be the principle means of conserving most of these species.

Table 2 (Appendix 1) lists those priority species, thought to be extinct in Hampshire, which are primarily associated with saline lagoon habitats.

As noted above, a number of saline lagoon species are covered by UK BAP statements annexed to the Saline Lagoon Habitat BAP<sup>32</sup>, on the assumption that implementation of the habitat BAP will benefit these and other lagoon flora and fauna. These include the Lagoon Sandworm *Armandia cirrhosa* (formerly very abundant in Eight Acre Pond but possibly now extinct in Hampshire) which is also included in the English Nature Species Recovery Programme<sup>113</sup>.

Two separate UK Species Action Plans (SAPs) have been produced for the Starlet Sea Anemone and Ivell's Sea Anemone<sup>32</sup>. These species are also covered by the Natural Areas BAPs, whose targets include:

- assessing the status of *Nematostella vectensis* in all suitable brackish ponds and ditches by the year 2005, and maintaining current populations by appropriate management of host lagoons; and
- establishing whether Ivell's sea anemone *Edwardsia ivelli* (known only from one site in Sussex) survives,

#### Saline Lagoons

restoring its habitat, and considering introduction to other sites. (This BAP is only relevant in Hampshire if the species is rediscovered and introductions to Hampshire lagoons considered.)

#### 4.4 Survey, Research and Monitoring

---

Lagoons in the area have received a great deal of attention and survey work both as a result of projects undertaken by local Universities, Societies and Laboratories, and the national survey commissioned by the former Nature Conservancy Council<sup>102, 107</sup>.

Most of the management schemes and plans described in section 4.2 include elements of research, survey and monitoring. These are carried out in order that the success of these plans and policies may be assessed and policies amended as necessary. For example, there is a significant element of monitoring included in the LIFE project and within the management programme for the Lagoon SAC. Hampshire Wildlife Trust has also undertaken a survey of non-SAC lagoons in the county<sup>107</sup>.

Key issues for future research and monitoring should include the physical stability of lagoons (particularly within the context of future climate change and shoreline management initiatives) and the tolerance of lagoon ecology to changes in physical parameters.

6 PROPOSED ACTION

The following table lists the actions required to achieve the objectives set out in this Plan (see section 5 'Plan Objectives' on pages 14-15). The table below excludes generic actions, which are included in section 6 on page 16. Each action has been assigned to one or more 'Key Partners'. Key Partners are those organisations that are expected to take responsibility for the delivery of the actions assigned to them, according to the targets set in this Plan. Other organisations may also be involved in the delivery of an action, and they have been indicated in the 'Others' column of the table.

Key to symbols in Action Table:

- ◆ To be completed by the indicated year. Work can commence at any time before the due date, at the discretion of the Key Partner.
- ◆⇆ Design or production of a plan/strategy to be completed by this year and then followed by its implementation.
- ◆⇆ To start by the indicated year and usually followed by ongoing work. A start arrow in year 2003 can indicate a new action or a new impetus to existing work.
- ⇆ Work that has already begun and is ongoing.

ACTION	DELIVERY BY		YEAR				MEETS OBJ.	
	Key Partner	Others	2003	2004	2005	2006		2007
<b>Habitat Protection</b>								
1	EN, HCC	HWT, LAS	⇆	⇆	⇆	⇆	⇆	A, J
2	EN	HCC, HBC, RSPB	⇆	⇆	◆			B, C, D, E, I
<b>Habitat Management, Incentive Schemes and Other Resources</b>								
3	DEFRA	Landowners	⇆	⇆	⇆	⇆	⇆	D, E
4	EN, EA	HCC, HBC, RSPB	⇆	⇆	⇆	⇆	⇆	E, G, H
5	EA	Landowners	⇆	⇆	⇆	⇆	⇆	C, F
6	EN	HCC, HBC, RSPB	◆	⇆	◆			A, B, E, G, K



**Saline Lagoons**

19	Carry out research into the environmental requirements and other elements of the ecology and genetic viability of populations of key lagoonal species (e.g. <i>Armandia</i> ), to provide a sound basis for management	Universities, EN	HWT	↔	↔	↔	↔	↔	↔	↔	↔	H, K
<b>Communication and Publicity</b>												

**KEY TO ORGANISATIONS**

- CHaMP Coastal Habitat Management Plan
- CS Conchological Society
- DEFRA Department for Environment, Food and Rural Affairs (formerly MAFF)
- EA Environment Agency
- EN English Nature (EN<sup>N</sup> denotes national office)
- HBC Havant Borough Council\*
- HBIC Hampshire Biodiversity Information Centre
- HCC Hampshire County Council\*
- HWT Hampshire Wildlife Trust
- LAs Local Authorities (District, City and Parish Councils)
- RSPB Royal Society for the Protection of Birds\*

\*HCC, HBC & RSPB are all partners in a current LIFE project targeting lagoonal habitats]

## APPENDIX 1

Key to abbreviations in Tables 1, 2 and 3 – see columns ‘Action in addition to HAP’ and ‘Status/Protection’

Abbreviation	Definition
<b>ACTION IN ADDITION TO HAP (Other Plans Relevant to Priority Species)</b>	
UK SAP	Species Action Plan prepared under UK Biodiversity programme
UK Grouped SAP	Species catered for by a grouped Species Action Plan prepared under UK Biodiversity programme
UK Species Statement	Conservation of species generally achieved through HAPs. Statement prepared under UK Biodiversity programme to link the relevant Plans.
No Plan	Species removed from revised UK priority list. No Action Plan / Species Statement produced
BC RAP	Butterfly Conservation Regional Action Plan
BC NAP	Butterfly Conservation National Action Plan
<b>PROTECTION: European (EC Habitats Directive)</b>	
Annex II	Designation of protected areas for animals and plants listed
Annex IV	Special protection for animals and plants listed
Annex V	Control of exploitation of animals and plants listed
<b>PROTECTION: British (Wildlife and Countryside Act 1981)</b>	
Sch. 1	Special protection for birds listed
Sch. 5	Special protection for animals listed
Sch. 5 (sale)	Protection against sale for animals listed (Schedule 5 section 9 (5))
Sch. 8	Special protection for plants listed
<b>STATUS: International (International Union for the Conservation of Nature)</b>	
IUCN VU	Vulnerable – Species facing high risk of extinction
IUCN LR/cd	Lower Risk / conservation dependent species – Species that do not satisfy the criteria for ‘Critically Endangered’, ‘Endangered’ or ‘Vulnerable’. They are ‘conservation dependent’ if they are the focus of specific conservation programmes, which if stopped, would result in the taxon qualifying for one of the threatened categories within a period of five years.
IUCN LR/nt	Lower Risk / near threatened species – Species that do not qualify for ‘conservation dependent’ but are close to ‘Vulnerable’ status
IUCN DD	Data Deficient – Insufficient data to make a direct or indirect assessment of a species status, based on its distribution and/or population status.
<b>STATUS: British – Mammals (Red Data Book)</b>	
RDB	Mammal species listed in the British Red Data Book
<b>STATUS: British – Plant and Fungi (Red Data Book and associated)</b>	
RDB Cr	Critically Endangered – Extremely high risk of extinction in the near future
RDB En	Endangered – Very high risk of extinction in the near future
RDB V	Vulnerable – High risk of extinction in the medium-term future
RDB K	Insufficient data to assess status
NS	Nationally Scarce – Plants not on red list but occurring in 16 to 100 10x10 km squares
NT	Near Threatened – Plants not on red list but occurring in 15 or fewer 10x10 km squares
<b>STATUS: British – Invertebrates (Red Data Book and associated)</b>	
RDB En	Endangered – In danger of extinction
RDB V	Vulnerable – Declining or occurring in a vulnerable habitat. Usually occurs in less than 16 10x10 km squares
RDB R	Rare – Not declining but occurring in less than 16 10x10 km squares
RDB K	Insufficiently known – Suspected, but not definitely, Endangered, Vulnerable or Rare
NS (a)	Nationally Scarce – Occurring in 16 to 30 10x10 km squares (for well recorded species)
NS (b)	Nationally Scarce – Occurring in 31 to 100 10x10 km squares (for well recorded species)
<b>STATUS: Royal Society for the Protection of Birds (Birds of Conservation Concern)</b>	
Red List	Various criteria, including a 50% decline in breeding population or range over last 25 years
Amber List	Various criteria, including a 25-49% decline in breeding population or range over last 25 years

## APPENDIX 1

Table 1 – Hampshire priority species found primarily in coastal habitats

Scientific name	Common name	Group	Protection/Status	Habitat/Ecology	Hants Distribution	Specific management requirements	Action in addition to HAP	Hants SAP?
<b>Maritime Cliffs</b>								
<i>Nomada sexfasciata</i>	a cuckoo bee	Bees	RDB En	Coastal soft-rock cliffs, landslips, perhaps also heathland	Only old records from S Hampshire; likely extinct		no	no
<i>Osmia xanthomelana</i>	a mason bee	Bees	RDB En	Coastal landslips, eroding clay cliffs, nest in sunny light soils	Pre-1930 in Hampshire now IOW only		UK SAP	no
<i>Cicindela germanica</i>	a tiger beetle	Beetles	RDB R	Damp clay/sandy/silty areas devoid of vegetation sandy undercliffs; larvae burrow in damp sand	Old records (Barton-on-sea), probably extinct		UK SAP	no
<i>Tachys micros</i>	a ground beetle	Beetles	NS (a)	Coastal, undercliffs, landslips, seashore, damp sand; predatory	Last record 1964		UK Species Statement	no
<i>Melitaea cinxia</i>	Glanville fritillary	Butterflies	Sch. 5 (sale), RDB R	Soft-rock cliffs, landslips	Occasional short-lived colonies on coast, Compton Bay, thought to be immigrants from IOW. 1 colony known in 1999		no	no
<i>Bombylius discolor</i>	a beefly	Flies	NS	Woodland rides, sandy areas, coastal landslips, bare soil; larvae develop in cells of solitary bees ( <i>Andrena</i> sp)	Probably only one site in Hampshire	Bare ground and nectar sources for host bee	UK SAP	no
<i>Bembecia chrysidiformis</i>	fiery clearwing	Moths	Sch. 5, RDB En	Associated with dock and sorrel	Probably extinct		UK SAP	yes
<i>Idaea degeneraria</i>	Portland ribbon wave	Moths	RDB R	Open grassy/bushy areas on limestone by the coast. Undercliffs, hollows and quarries. Warm sites in sunshine	Records from Totton, Brockenhurst, New Forest, and Sandown, but not thought to be breeding in Hants		no	yes

Shingle							
<i>Ceutorhynchus verrucatus</i>	a weevil	Beetles	RDB R	Coastal shingle with Yellow Horned Poppey	Only pre-1970 records	no	no
<i>Lionychus quadrillum</i>	a ground beetle	Beetles	RDB R	River shingle/sand, coasts above high tide, saltmarshes; predatory	No extant colony known	UK Grouped SAP	no
<i>Sterna albifrons</i>	little tern	Birds	Sch. 1, RSPB Amber List	Coastal shingle and saltmarsh	Scarce summer visitor, breeds in Langstone Harbour, Beaulieu Estuary and Pitts Deep/Hurst SSSI.	UK SAP	yes
<i>Sterna dougallii</i>	roseate tern	Birds	Sch. 1, RSPB Red List	Coastal shingle and saltmarsh	Recent breeding at 3 protected sites. Breeds in Langstone Harbour	UK SAP	yes
<i>Euphorbia portlandica</i>	portland spurge	Flw Plants	NS	On coastal shingle beaches	Lost from some sites, new records from Fareham and Stanswood Bay	no	no
<i>Geranium purpureum</i> spp. <i>forsteri</i>	little robin	Flw Plants	NS	Coastal shingle; On both stabilized and mobile areas of shingle beaches, and on rubble and concrete buildings close to the sea.	Coastal sites including Hurst Castle, Sinah Common, Gunner Point	no	no
<i>Lathyrus japonicus</i>	sea pea	Flw Plants	NS	Coastal shingle	Very rare, Hurst Castle only	no	no
<i>Paropholis incurva</i>	curved hard grass	Flw Plants	NS	Firm clay below cliffs, sandy shingle spits, bare gravelly ground, dry mud, top of sea walls	Scarce at Farlington, Calshot, Hayling Island, Milford	no	no
<i>Petrorhagia nanteuillii</i>	Childing pink	Flw Plants	Sch. 8, RDB En	Coastal shingle	One of only two known UK sites, Hayling Island	no	yes
<i>Poa bulbosa</i>	bulbous meadow grass	Flw Plants	NS	Coastal sand and shingle dunes	Very rare, Sinah common, Eastney, Hengisbury, Hurst Castle, Portsdown Hill	no	no

**Coastal**

<i>Silene nutans</i>	Nottingham catchfly	Flw Plants	NS	Coastal fixed shingle or sand dunes	National stronghold, sundry sites around Portsmouth and Gosport.	no	no
<i>Trifolium suffocatum</i>	suffocated clover	Flw Plants	NS	In turf on shingle beaches, or bare ground, near the coast	Very rare but locally plentiful, mainly around Hayling Island	no	no
<i>Calophasia lunula</i>	toadflax brocade moth	Moths	RDB R	Coastal shingle, wasteland, railway embankments, gardens, waste ground	3 Hants records, last in Gosport	UK Species Statement	yes
<i>Hadena albimacula</i>	white spot moth	Moths	RDB V	Coastal shingle with Nottingham catchfly.	Stable at its one site in Hants (Browdown shingle).	UK Species Statement	yes
<i>Idaea ochrata cantiata</i>	bright wave	Moths	RDB V	Sandy/shingle beaches and sandhills. Low herbage and small bushes.	Last recorded 1900	UK SAP	yes
<i>Oncocera genistella</i>	a pyralid moth	Moths	NS (a)	Mostly near the coast, larvae on gorse	Local along coast	no	yes
<i>Thalera fimbrialis</i>	Sussex emerald	Moths	Sch. 5, RDB En	Open shingle w. low plants/scattered bushes	old records only (1946)	no	yes
<b>Sand Dune</b>							
<i>Vulpia fasciculata</i>	dune fescue	Flw Plants	NS	Dunes, beaches of sand and shingle	Confined to SE coast	no	no
<i>Lasiocampa trifolii</i>	grass eggar	Moths	NS (a)	Ecological requirements imperfectly understood. Assoc. w. mainly coastal areas and inland heaths.	One remaining site in Hants is stable (SW Hayling)	no	yes
<b>Saltmarsh</b>							
<i>Anisodactylus poeciloides</i>	a ground beetle	Beetles	RDB R	Saltmarshes, salt pans, brackish ditches at margins of grazing levels, adults phytophagus	Old record for Browdown, possibly extinct in Hants	UK SAP	no
<i>Dyschirius angustatus</i>	a ground beetle	Beetles	RDB R	Bare sand near ponds/rivers - often estuarine; predatory, burrows in sand	No extant colony known	UK Species Statement	no

**Coastal**

<i>Larus melanocephalus</i>	Mediterranean gull	Birds	Sch. 1, RSPB Amber List	Coastal mudflats and shingle	2-3 coastal sites, particularly the Beaulieu Estuary, breeds in Langstone Harbour	no	yes
<i>Atylotus latistriatus</i>	a horsefly	Flies	RDB R	Saltmarsh and sheltered lagoons; predatory/blood suckers and sea lavender	National stronghold, South Hants Coast	no	no
<i>Hybomitra expollicata</i>	a horse fly	Flies	RDB V	Brackish coastal levels with ditches, saltmarsh	Farlington Marshes is only Hants site	no	no
<i>Stratiomys longicornis</i>	a soldier fly	Flies	RDB V	Coastal saltmarshes & strongly brackish pools/ditches on coastal levels; larvae aquatic	A few records from coastal sites, including Farlington Marshes and the Hythe Spartina Marshes	no	no
<i>Althaea officinalis</i>	marsh-mallow	Flw Plants	NS	Along the drift line and in upper tidal marshes; rarely in brackish pastures.	Strongholds around Hamble and Beaulieu River	no	no
<i>Inula crithmoides</i>	golden samphire	Flw Plants	NS	Upper parts of gravelly, muddy salt marshes	Almost confined to shores of Portsmouth, Langstone & Chichester Harbours	no	no
<i>Puccinellia fasciculata</i>	borrer's saltmarsh grass	Flw Plants	NS	Saltmarsh	A number of sites scattered along the coast, including Farlington Marshes	no	no
<i>Puccinellia rupestris</i>	stiff saltmarsh grass	Flw Plants	NS	Saltmarsh	A number of sites scattered along the coast, including Farlington Marshes	no	no
<i>Salicornia pusilla</i>	one-flowered glasswort	Flw Plants	NS	Upper zones of salt marshes, on firm mud or nearby sand.	Few records	no	no
<i>Sonchus palustris</i>	marsh sow thistle	Flw Plants	NS	Wooded margins of estuaries above high-water mark on clay	Only one location, Exbury	no	no

**Coastal**

<i>Cuculia asteris</i>	starwort	Moths	NS (b)	Cleared woodland inland w. goldenrod; salt-marshes w. sea aster and occ. sea wormwood. V. occasionally in gardens w. michaelmas and China aster	Widespread along coast where foodplant is	no	yes
<i>Mythimna favicolor</i>	Matthew's wainscot	Moths	NS (a)	Saltmarsh	Locally common coastally, N.Hayling island, 4-8 sites.	no	yes
<i>Orthotylus rubidus</i>	a capsid bug	True Bugs	RDB R	Landward edge of saline habitats; assoc. with <i>Salicornia</i> sp.	No recent records, but may be overlooked	UK Species Statement	no
<b>Coastal Grazing Marsh</b>							
<i>Branta bernicla bernicla</i>	dark-bellied brent goose	Birds	RSPB Amber List	Saltmarsh, mudflats and eelgrass beds, coastal grazing marsh, amenity grasslands	Internationally important numbers overwinter. Increasing.	no	yes
<i>Motacilla flava</i>	yellow wagtail	Birds	-	Favours water meadows, damp cattle-grazed pastures and marshes. Mainly coastal	Farlington Marshes (only regular Hants site) Extinct in river valleys.	no	no
<i>Atylotus rusticus</i>	a horsefly	Flies	RDB En	Coastal grazing marsh	National stronghold, Farlington Marshes	no	no
<i>Haematopota grandis</i>	a horsefly	Flies	RDB R	Coastal marshes, sometimes inland along tidal rivers; predatory on others in damp soil	Coastal sites (Hacketts Marsh, Farlington Marshes, Lower Test, Keyhaven)	no	no
<i>Paragus albifrons</i>	a hoverfly	Flies	RDB V	Grasslands near shingle and sea wall embankments. Not exclusively coastal nationally	Infrequent and declining. Hythe 1984	no	no
<i>Alopecurus bulbosus</i>	bulbous foxtail	Flw Plants	NS	Maritime grasslands: In wet, brackish pastures, usually subject to tidal flooding.	Large extant populations, Lower Test and Keyhaven	no	no

**Coastal**

<i>Bupleurum tenuissimum</i>	slender hare's ear	Flw Plants	NS	Dry banks, especially inside sea-walls and upper margins of short-turf salt-marshes, often beside tidal drains.	Frequent around Langstone Harbour and Hayling Island, rare elsewhere.	no	no
<i>Carex divisa</i>	divided sedge	Flw Plants	NS	Maritime saltmarsh; In brackish pastures, especially along drains, grassy salt-marshes and inner sea-walls. Always near the sea or in estuaries	Locally frequent around Langstone Harbour and other coastal sites.	no	no
<i>Carex punctata</i>	dotted sedge	Flw Plants	NS	Damp, open sandy or shingly depressions in brackish grassland, behind sea walls	Rare, coast and New Forest	no	no
<i>Festuca arenaria</i>	rush-leaved fescue	Flw Plants	NS	Coastal sand-dunes or sandy shingle.	Very rare on coastal sites, Dibden reclaimed land	no	no
<i>Hordeum marinum</i>	sea barley	Flw Plants	NS	Coastal grazing marsh; disturbed saline soils	Eastern harbours & Southampton Water; Farlington Marshes, Dibden Bay	no	no
<i>Polypogon monspeliensis</i>	annual beard grass	Flw Plants	NS	In wet brackish hollows on coastal marshes	Handful of sites around Southampton Water, Langstone Harbour	no	no
<i>Trifolium squamosum</i>	sea clover	Flw Plants	NS	On earthen sea-walls	All records clustered around Portsmouth, incl. Farlington Marshes	no	no
<b>Mudflats and Eelgrass beds</b>							
<i>Arenaria interpres</i>	Turnstone	Birds	RSPB Amber List	Coastal mudflats and saltmarsh	Moderately common winter visitor and passage migrant.	no	no
<i>Calidris alba</i>	Sanderling	Birds	-	Coastal mudflats and saltmarsh	Moderately common passage migrant and winter visitor. Concentrations in the eastern harbours.	no	no

**Coastal**

<i>Calidris alpina</i>	dunlin	Birds	RSPB Amber List	Coastal mudflats and grazing marsh	Internationally important numbers overwinter.	no	yes
<i>Calidris canutus</i>	knot	Birds	RSPB Amber List	Coastal mudflats and saltmarsh	Concentrations in the eastern harbours	no	no
<i>Limosa lapponica</i>	bar-tailed godwit	Birds	RSPB Amber List	Coastal mudflats and saltmarsh	Overwinters in internationally significant numbers. Particularly Chichester and Langstone harbours.	no	no
<i>Limosa limosa</i>	black-tailed godwit	Birds	RSPB Red List	Coastal mudflats, grazing marsh and saltmarsh	Internationally important numbers overwinter. May have bred.	no	yes
<i>Pluvialis squatarola</i>	grey plover	Birds	RSPB Amber List	Coastal mudflats and saltmarsh	Around the eastern harbours and to a lesser extent in the west Solent	no	yes
<i>Eleocharis parvula</i>	dwarf spike-rush	Flw Plants	Sch. 8, RDB V	Forming short swards on estuarine sand or mud that is regularly submerged in brackish water.	Beaulieu, tidal millpond, Stanpit Marsh	no	no
<i>Zostera angustifolia</i>	narrow leaved eelgrass	Flw Plants	NS	On soft to relatively firm mud, in estuaries an shallow water, from half to low tide-mark.	Eastern harbours, Portsmouth, Langstone, Chichester.	no	no
<i>Zostera marina</i>	eelgrass	Flw Plants	NS	Relatively exposed shores, firm sands sometimes mixed with flint and gravel, below low-tide.	Declined, scattered sites along coast.	no	no
<i>Zostera noltii</i>	dwarf eelgrass	Flw Plants	NS	In firm mud or sand, from low-water, spring-tide to low-water, neap-tide levels	Eastern Harbours	no	no
<b>Saline Lagoons</b>							
<i>Lamprothamnium papulosum</i>	foxtail stonewort	Algae	Sch. 8, RDB V	Sandy or silty substrates in coastal lagoons.	National stronghold; rare at 3 sites only (Fort Gilkicker Moat)	UK Species Statement	no
<i>Alkmaria romijni</i>	tentacled lagoon-worm	Annelids	Sch. 5	Saline Lagoons	National stronghold; rare. Found at 3 sites only	no	no
<i>Corophium lacustre</i>	a brackish water crustacean	Crustaceans	RDB R	Brackish pools	One site only coast Little Anglesey	no	no

**Coastal**

<i>Gammarus insensibilis</i>	lagoon sand shrimp	Crustaceans	Sch. 5, RDB R	Saline lagoons	National stronghold at 15 sites	UK Species Statement	no
<i>Ruppia cirrhosa</i>	spiral tasselweed	Flw Plants	NS	In brackish ponds and drains on the coast	S Hayling island	no	no
<i>Heleobia stagnorum</i>	a marine snail	Molluscs		Saline lagoons	Only known to have lived at one UK locality at Farlington Marshes	no	no
<i>Hydrobia ventrosa</i>	spire snail	Molluscs	-	Saline lagoons	Occurs all round south east Coast, Keyhaven Marshes	no	no
<i>Truncatella subcylindrica</i>	looping snail	Molluscs	RDB R	Among rotting vegetation or shingle at high water mark, lagoons and estuaries with high salinity	3 sites coast Southampton Water, Langstone Harbour	no	no
<i>Nematostella vectensis</i>	starlet sea-anemone	Sea-anemones	IUCN VU, Sch. 5, RDB R	Saline lagoons	National stronghold, 14 sites	UK SAP	no

## APPENDIX 1

Table 2 – Priority species, thought to be extinct in Hampshire, which are primarily associated with coastal habitats

Scientific name	Common name	Group	Protection/Status	Habitat/Ecology	Hants Distribution	Specific management requirements	Action in addition to HAP	Hants SAP?
<b>Maritime Cliffs</b>								
<i>Bembecia chrysidiformis</i>	fiery clearwing	Moths	Sch. 5, RDB En	Associated with dock and sorrel	Probably extinct		UK SAP	yes
<i>Nomada sexfasciata</i>	a cuckoo bee	Bees	RDB En	Coastal soft-rock cliffs, landslips, perhaps also heathland	Only old records from S Hampshire; likely extinct		0	no
<i>Cicindela germanica</i>	a tiger beetle	Beetles	RDB R	Damp clay/sandy/silty areas devoid of vegetation sandy undercliffs; larvae burrow in damp sand	Old records (Barton-on-sea), probably extinct		UK SAP	no
<b>Shingle</b>								
<i>Idaea ochrata cantata</i>	bright wave	Moths	RDB V	Sandy/shingle beaches and sandhills. Low herbage and small bushes.	Last recorded 1900		UK SAP	yes
<i>Lionychus quadrillum</i>	a ground beetle	Beetles	RDB R	River shingle/sand, coasts above high tide, saltmarshes; predatory	No extant colony known		UK Grouped SAP	no
<i>Thalera fimbrialis</i>	Sussex emerald	Moths	Sch. 5, RDB En	Open shingle w. low plants/scattered bushes	old records only (1946)		no	yes
<b>Saltmarsh</b>								
<i>Dyschirius angustatus</i>	a ground beetle	Beetles	RDB R	Bare sand near ponds/rivers - often estuarine; predatory, burrows in sand	No extant colony known		UK Species Statement	no
<i>Anisodactylus poeciloides</i>	a ground beetle	Beetles	RDB R	Saltmarshes, salt pans, brackish ditches at margins of grazing levels, adults phytophagous	Old record for Browdown, possibly extinct in Hants		UK SAP	no
<b>Coastal Grazing Marsh</b>								
None								
<b>Mudflats and Eelgrass Beds</b>								
None								
<b>Saline Lagoons</b>								
<i>Chara baltica</i>	Baltic stonewort	Algae	RDB V	A variety of habitats adjacent to the sea, including lakes, lagoons, quarry pools and pools in	No extant colonies		UK Species Statement	no

**Coastal**

				sand dunes				
<i>Nitellopsis obtusa</i>	starry stonewort	Algae	RDB En	Deep lakes and slow running water at low-altitudes	Previous records, no extant populations		UK SAP	no
<i>Armandia cirrhosa</i>	lagoon sandworm	Annelids	Sch. 5	Saline Lagoons	Restricted to Hants; rare. May be extinct at Eight Acre Pond, Lymington		UK Species Statement	no
<i>Allomelita pellucida</i>	a brackish water crustacean	Crustaceans		Brackish water in harbours or ditches	One site only, on coast		no	no
<i>Poecilobothrus ducalis</i>	a fly	Flies	RDB R	Larvae in mud beside saline pools and ditches	Only old records		no	no

## APPENDIX 1

Table 3 – Priority species found primarily in other habitats, but which occur in coastal habitats

Scientific name	Common name	Group	Primary HAP	Hants SAP?
<b>Maritime Cliffs</b>				
<i>Anthophora retusa</i>	potter flower bee		Heathland, acid grassland, bog	no
<i>Melecta luctosa</i>	a solitary bee		Heathland, acid grassland, bog	no
<i>Harpalus parallelus</i>	a ground beetle		Chalk grassland	no
<i>Hadena albimacula</i>	white spot moth		Shingle	yes
<i>Heliophobus reticulata</i>	bordered gothic		Chalk grassland	yes
<i>Cerceris quinquefasciata</i>	a ruby-tailed wasp		Heathland, acid grassland, bog	no
<b>Shingle</b>				
<i>Larus melanocephalus</i>	Mediterranean gull	Birds	Saltmarsh	no
<i>Paragus albifrons</i>	a hoverfly	Flies	Coastal Grazing Marsh	no
<i>Crassula tillaea</i>	mossy stonecrop	Flw Plants	Heathland, Acid Grassland & Bog	no
<i>Inula crithmoides</i>	golden samphire	Flw Plants	Saltmarsh	no
<i>Vulpia fasciculata</i>	dune fescue	Flw Plants	Sand Dunes	no
<b>Sand Dunes</b>				
<i>Poa bulbosa</i>	bulbous meadow grass	Flw Plants	Shingle	no
<i>Silene nutans</i>	Nottingham catchfly	Flw Plants	Shingle	no
<i>Vulpia ciliata ssp.ambigua</i>	bearded fescue	Flw Plants	Heathland, Acid grassland & bog	no
<i>Idaea ochrata cantiata</i>	bright wave	Moths	Shingle	yes
<b>Saltmarsh</b>				
<i>Lionychus quadrillum</i>	a ground beetle	Beetles	Shingle	no
<i>Arenaria interpres</i>	turnstone	Birds	Mudflats & eelgrass beds	no
<i>Calidris alba</i>	sanderling	Birds	Mudflats & eelgrass beds	no
<i>Calidris canutus</i>	knot	Birds	Mudflats & eelgrass beds	no
<i>Limosa lapponica</i>	bar-tailed godwit	Birds	Mudflats & eelgrass beds	no
<i>Pluvialis squatarola</i>	grey plover	Birds	Mudflats & eelgrass beds	no
<i>Sterna albifrons</i>	little tern	Birds	Shingle	no
<i>Sterna dougallii</i>	roseate tern	Birds	Shingle	no
<i>Haematopota grandis</i>	a horsefly	Flies	Coastal grazing marsh	no
<b>Coastal Grazing Marsh</b>				
<i>Anisodactylus poeciloides</i>	a ground beetle	Beetles	Saltmarsh	no
<i>Acrocephalus paludicola</i>	aquatic warbler	Birds	Fen, Carr, Marsh, Swamp, reedbeds	no
<i>Calidris alpina</i>	dunlin	Birds	Mudflats & eelgrass beds	no
<i>Gammarus insensibilis</i>	lagoon sand shrimp	Crustaceans	Saline Lagoons	no
<i>Atylotus latistriatus</i>	a horsefly	Flies	Saltmarsh	no
<i>Hybomitra expollicata</i>	a horse fly	Flies	Saltmarsh	no
<i>Poecilobothrus ducalis</i>	a fly	Flies	Saline Lagoons	no
<i>Stratiomys longicornis</i>	a soldier fly	Flies	Saltmarsh	no

<b>Mudflats and Eelgrass Beds</b>				
<i>Anthophora retusa</i>	potter flower bee		Heathland, acid grassland, bog	no
<i>Melecta luctosa</i>	a solitary bee		Heathland, acid grassland, bog	no
<i>Harpalus parallelus</i>	a ground beetle		Chalk grassland	no
<i>Hadena albimacula</i>	white spot moth		Shingle	Yes
<i>Heliophobus reticulata</i>	bordered gothic		Chalk grassland	Yes
<i>Cerceris quinquefasciata</i>	a ruby-tailed wasp		Heathland, acid grassland, bog	no
<b>Saline Lagoons</b>				
None				

### **A survey of intertidal vegetation and other coastal habitats using Compact Airborne Spectral Imager (CASI) survey techniques<sup>114</sup>**

The CASI is a passive sensor which detects visible and near-infrared spectra. Deployed from an aircraft, it can characterise alternative intertidal cover types, including saltmarsh, green macro-algal cover and bare mud, sand/shingle or water. CASI classifications may be improved when combined with data on elevation above sea level obtained simultaneously from Light Detection and Ranging (LIDAR) systems.

A single baseline survey of the coastal habitat resource within the Solent area is required on which to base the future monitoring requirements of the Habitats and Species Directive for the Solent Maritime Special Area of Conservation, proposed for its Annex I estuarine, Atlantic saltmeadow and *Spartina* sward habitats. No single comprehensive overview of coastal habitats exists. In 1999, therefore, English Nature commissioned ABP Research, the Environment Agency and GeoData Institute to conduct a survey using CASI techniques.

The objectives of the 1999 survey were to establish a baseline set of survey data identifying the spatial distribution and area of the coastal vegetation types and intertidal habitats present around the Solent and to establish a methodology which is readily repeatable at regular intervals for monitoring change over time and distribution of these coastal features over time.

## **REFERENCES**

- 1 Coastal habitats of the Solent, S. Fowler, in **Solent Science: a review**. 231-245. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 2 **Coasts and Seas of the United Kingdom. Region 9: Southern England. Hayling Island to Lyme Regis**, J.H. Barne, C.F. Robson, S.S. Kaznowska, J.P. Doody, & N.C. Davidson (Editors). Joint Nature Conservation Committee. Peterborough, UK. 1996.
- 3 **Coastal Geomorphology of Great Britain**. Geological Conservation Review. Joint Nature Conservation Committee, Peterborough, UK, In preparation.
- 4 **Nature conservation and estuaries in Great Britain**, N.C. Davidson, D. Laffoley, J.P. Doody, L.S. Way, J. Gordon, R. Key, C.M. Drake, M.W. Pienkowski, R.M. Mitchell, & K.L. Duff, Nature Conservancy Council, Peterborough, UK. 1991.
- 5 **Directory of the North Sea Coastal Margin**, J.P. Doody, C. Johnston, and B. Smith, Joint Nature Conservation Committee, Peterborough. 1993.
- 6 **Solent Maritime European marine site**, English Nature's draft advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994, Draft version September 2000.
- 7 Sea level change and estuaries, C.R. Tubbs, in **British Wildlife**, 6, 168-176. 1995.
- 8 **The Ecology, Conservation and History of the Solent**, C.R. Tubbs, Packard Publishing, Chichester. 1999.
- 9 Sea-Level Rise in the Solent Region, M.J. Bray, J.M. Hooke, and D.J. Carter, in **Solent Science: a review**, 101-102. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 10 **Preparing for the Impacts of Climate Change**, Halcrow interim report to SCOPAC, 93pp + 5 appendices, 2001.
- 11 Nutrients in the Solent, D. Hydes, in **Solent Science: a review**, 135-148. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 12 Trace metals in waters, sediments and biota of the Solent system: a synopsis of existing information, P.J. Statham, in **Solent Science: a review**. 149-161. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 13 **Assessing the impacts of Antifouling agents in the Coastal Environment (ACE)**. Plymouth Marine Laboratory website [www.pml.ac.uk/ace](http://www.pml.ac.uk/ace)

- 14 Coastal water contamination from a triaxine herbicide used in antifouling paints, J.W. Readman *et al.*, in *Environ. Sci. Technol.*, 27: 1940-1942. 1993.
- 15 Risk posed by the antifouling agent Iragol 1051 to the seagrass *Zostera marina*, A. Scarlett *et al.*, in *Aquatic Toxicology*, 45, 159-170. 1999.
- 16 **Guidelines for managing the collection of bait and other shoreline animals within UK European Sites**, S.L. Fowler, English Nature (UK Marine SACs Project). 132 pp. 1999.
- 17 The effect of intensive dredging on benthic community structure: a report to the Nature Conservancy Council, M. Shearer, **NCC CSD Report No. 679**. 1986.
- 18 An experimental study on the impact of clam dredging on soft sediment macroinvertebrates. Report no. 92/2/291 to English Nature. Southern Science, Otterbourne, Hampshire. 1992.
- 19 Dredging for the American hardshell clam: the implications for nature conservation, J. Cox in *Ecos*, 12 (2), 50-54. 1991.
- 20 Recent coastal protection and associated temporary exposures to the Middle Eocene coastal sections at Lee-on-the-Solent, Gosport, D.J. Kemp, **Hampshire Museum Papers: no. 20**. 1999.
- 21 Disturbance to waterfowl on estuaries: the conservation and coastal management implications of current knowledge, N.C. Davidson & P.I. Rothwell, **Wader Study Group Bulletin**, 68: 97-105. 1993.
- 22 **Strategy for the Coast**, Hampshire County Council, Winchester. 1991.
- 23 Coastal Habitat Change – an historical review of man's impact on the coastline of Great Britain, J.P. Doody, unpublished Joint Nature Conservation Committee report, Peterborough.
- 24 Non-native marine species in British waters: effects and controls, N.C. Eno, in **Aquatic Conservation: Marine and Freshwater Ecosystems**, 6 (4), 215-228, 1996.
- 25 **Non-native marine species in British waters: a review and directory**, N.C. Eno, R.A. Clare and W.G. Sanderson (eds), JNCC, Peterborough, UK, 1997.
- 26 An account of the attempted control of an introduced marine alga, *Sargassum muticum*, in southern England, A.T. Critchley, W.F. Farnham and S L Morrell, in **Biological Conservation**, 35, 313-332, 1986.
- 27 Studies on aliens in the marine flora of Southern England, W.F. Farnham, in **The Shore Environment, Volume 2, Ecosystems (Systematics Association Volume no. 17(b))**, ed. By J.H. Price, D.E.G. Irvine and W.F. Farham, London, Academic Press. 1980.
- 28 **South Coast Plain and Hampshire Lowlands: Natural Area profile**, English Nature, Lyndhurst, UK. 36pp. 1998.
- 29 **New Forest: Natural Area profile**, English Nature, Lyndhurst, UK. 2000.
- 30 **Solent and Poole Bay: Natural Area profile**, English Nature, in preparation.
- 31 **Coastal Habitat Management Plans: An Interim Guide to Content and Structure**, English Nature, 2000. ([www.english-nature.org.uk/livingwiththesea/](http://www.english-nature.org.uk/livingwiththesea/))
- 32 **Tranche 2 Action Plans. Volume V – maritime species and habitats**, UK Biodiversity Group, 1999.
- 33 **Natural Areas: nature conservation in context**, English Nature, (compact disc). 1998.
- 34 Water Vole *Arvicola terrestris* Species Action Plan, Hampshire Biodiversity Partnership, in **Biodiversity Action Plan for Hampshire: Volume 2**. July 2000.
- 35 European Otter *Lutra lutra* Species Action Plan, Hampshire Biodiversity Partnership, in **Biodiversity Action Plan for Hampshire: Volume 2**. July 2000.
- 36 Lepidoptera Species Action Plan, Hampshire Biodiversity Partnership, in **Biodiversity Action Plan for Hampshire: Volume 2**. March 2003.

- 37 **Brent Goose Strategy - South East Hampshire Coast**, Consultation Draft, D. Wicks *et al.* 2000, Hampshire Brent Goose Strategy Working Group, published by Hampshire & Isle of Wight Wildlife Trust.
- 38 Draft Shorebirds Species Action Plan, Hampshire Biodiversity Partnership, in **Biodiversity Action Plan for Hampshire: Volume 2**. December 2002.
- 39 **Solent Science: a review. Proceedings in Marine Science, 1**. Eds. Collins, M. and Ansell, K. Elsevier Science. 2000.
- 40 Developing a research agenda for the future, I. Townend, in **Solent Science: a review**, 101-102. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 41 **British Tertiary Stratigraphy, Geological Conservation Review Series No. 15**. Daley, B. and Balson, P. Joint Nature Conservation Committee, Peterborough, UK. 1999.
- 42 **Quaternary of southern England, Geological Conservation Review Series**, Joint Nature Conservation Committee, Peterborough, UK, in preparation.
- 43 **Fossil Mammals and Birds of Great Britain**. Geological Conservation Review. Joint Nature Conservation Committee, Peterborough, UK, in press (2001).
- 44 **Fossil Reptiles of Great Britain**. Geological Conservation Review. Joint Nature Conservation Committee, Peterborough, UK, 1995.
- 45 **Fossil Fishes of Great Britain**. Geological Conservation Review. Joint Nature Conservation Committee, Peterborough, UK, 1999.
- 46 **Mesozoic-Tertiary Palaeobotany of Great Britain**. Geological Conservation Review. Joint Nature Conservation Committee, Peterborough, UK, 2001.
- 47 **Priorities for habitat conservation in England. English Nature Research Report No. 97**. A.M. Moffat, (ed.,) Peterborough. 46pp. 1994.
- 48 **Systematic list of the Frederick E. Edwards Collection of British Oligocene and Eocene Mollusca in the British Museum (Natural History)**, R.B. Newton, 365, London. 1891.
- 49 **Catalogues of fossil Reptilia and Amphibia in the British Museum (Natural History)**, R. Lydekker, 1:309, 3:239. London. 1888 & 1889.
- 50 **Catalogue of fossil Mammalia in the British Museum (Natural History)**, R. Lydekker, 1:268, 2:324, 3:186, 5:345. London. 1885 – 1887.
- 51 Marsupialia, Insectivora, Primates, Creodonts and Carnivora from the Headon Beds (upper Eocene) of Southern England, P.E. Cray, in **Bulletin of the British Museum (Natural History): Geology**. 23(1): 1-102. London. 1973.
- 52 Mammals from the Bartonian (middle/late Eocene) of the Hampshire Basin, southern England, J.J. Hooker, in **Bulletin of the British Museum (Natural History): Geology**. 39(4): 19-478. London. 1986.
- 53 **Catalogue of fossil Birds in the British Museum (Natural History)**, R. Lydekker, 368. London. 1891.
- 54 **Catalogue of fossil Fishes in the British Museum (Natural History)**, A.S. Woodward, 1:474, 2:567, 3:544, 4:636. London. 1889 – 1901.
- 55 The Stratigraphy and vertebrate faunas of the Barton Clay Formation (Paleogene): new information from recent exposures at Barton Cliff, Hampshire, D.J. Kemp, in **Report of Activities no. 14: Portsmouth Polytechnic, Department of Geology, UK**. 1991.
- 56 Highcliffe to Milford Cliff (Dorset/Hampshire) Site of Special Scientific Interest. English Nature. 1991.
- 57 Lee-on-the-Solent to Itchen Estuary (Hampshire) Site of Special Scientific Interest. English Nature. 1992.
- 58 Account of excavations into the Campanile Bed (Eocene, Selsey Formation) at Stubbington, Hants., D.J. Kemp, in **Tertiary Research** 1(2): 41-45. 1976.
- 59 Stratigraphy and Biota of the Elmore Formation (Huntingbridge Division, Bracklesham Group) Lee-on-the-Solent, Hampshire, D.J. Kemp *et al.*, in **Tertiary Research** 2(2): 93-103. 1979.

- 60 The Selsey Division (Bracklesham Group) at Lee-on-the-Solent, Gosport (Hants), D.J. Kemp, in ***Tertiary Research*** 7(2): 35-44. 1985.
- 61 Recent coastal protection and associated temporary exposures to the Middle Eocene coastal sections at Lee-on-the-Solent, Gosport, Hampshire, D.J. Kemp, in ***Hampshire Museum Papers*** No. 20. 1999.
- 62 Lee-on-the-Solent Coast Protection Scheme, L. Banyard and R. Fowler, in ***Solent Science: a review***. 115-118. Eds. M. Collins and K. Ansell. Elsevier Science. 2000.
- 63 ***Coastal Defence and Earth Science Conservation***, J. Hooke, Geological Society. 1998.
- 64 ***Restoring biodiversity to soft cliffs, English Nature Research Report*** no. 398, English Nature, Peterborough. 2001.
- 65 ***Sea Cliff Management Handbook for Great Britain***, J. Mitchley and A.J.C. Malloch, Joint Nature Conservation Committee, 1991.
- 66 ***Ecology and Geomorphology of Coastal Shingle***, J.R. Packham, R.E. Randall, R.S.K. Barnes and A. Neal, Westbury Publishing, UK. 2001.
- 67 ***The Habitats and Vegetation of present-day Hampshire. I. Coastal Habitats***, F. Rose, in ***The Flora of Hampshire***, A. Brewis, P. Bowman and F. Rose, Harley Books, Colchester, England. 1996.
- 68 ***Vegetated Shingle Structures and Shorelines***, R.E. Randall, in ***British Coasts and Seas. Region 9: Southern England. Hayling Island to Lyme Regis***. Ed. by Barne, J. & Robson, C. Peterborough. Joint Nature Conservation Committee. 1995.
- 69 ***Vegetation survey of Sandy Point, Hampshire, 1997***, N.A. Sanderson, A Botanical Survey and Assessment Report to Hampshire County Council, 1998.
- 70 A review of the extent, conservation interest and management of lowland acid grassland, Volume 1: Overview, N.A. Sanderson, ***English Nature Research Reports No. 259***, 1998.
- 71 ***Variations in Shingle vegetation around the British coastline***. Sneddon, P. PhD Thesis (unpubl) Univ. Cambridge. 1992.
- 72 Plant communities of Browndown South Training Area, R. Randall, P. Sneddon and J. Aitcheson, in ***MOD Sanctuary magazine***, MOD. 1996.
- 73 ***Sand dunes***, T.C.D. Dargie, in ***British Coasts and Seas. Region 9: Southern England. Hayling Island to Lyme Regis***. Ed. by J. Barne & C. Robson, Peterborough. Joint Nature Conservation Committee. 1995.
- 74 ***Targets for coastal habitat recreation***. K. Pye, & French, P.W. Report to English Nature from Cambridge Environmental Research Consultants Ltd. 1992.
- 75 ***Sand dune vegetation survey of Great Britain. Part 1 - England***. Radley, G.P. Peterborough, Joint Nature Conservation Committee. 1994.
- 76 ***Coastal Vegetated shingle structures of Great Britain***. Sneddon P & Randall R.E. JNCC, Peterborough. 1993.
- 77 ***Coastal Vegetated shingle structures of Great Britain: Appendix 3 England***. Sneddon P & Randall R.E., JNCC, Peterborough. 1994.
- 78 Gosport Habitat Survey. Rowe, J. and C. Lycett, Hampshire Wildlife Trust report to Gosport Borough Council (unpublished). 1996.
- 79 ***British Saltmarshes***, B.R. Sherwood, B.G. Gardiner and T. Harris (Eds), Linnean Society of London. 2001.
- 80 *Spartina anglica* in Great Britain, J.P. Doody, in ***Focus on nature conservation, 5***, Nature Conservancy Council, Attingham Park. 72 pp. 1984.
- 81 Introduction to the Region, J.P. Doody, in ***British Coasts and Seas. Region 9: Southern England. Hayling Island to Lyme Regis***. Eds. Barne, J. *et al.* Joint Nature Conservation Committee, Peterborough, UK. 1996.
- 82 ***Spartina anglica - a research review***, A.J. Gray and P.E.M. Benham, (Eds), Institute of Terrestrial Ecology, HMSO, London. 79pp. 1990.

- 83 The saltmarsh survey of Great Britain: an inventory of British saltmarshes, F. Burd, Nature Conservancy Council **Research and Survey in Nature Conservation No. 17**. Peterborough. 1989.
- 84 **Loss of Commonable Grazing Land in the New Forest**, J. Cox and R. Reeves, Report to NFA, CDA and HWT, 2000.
- 85 **A Guide to the understanding and Management of Saltmarshes**. National Rivers Authority. 1995.
- 86 **Managed retreat - a practical guide**. English Nature, Peterborough, UK. 1995.
- 87 **Large Scale Experimental Managed Re-alignment**, L.A. Boorman, R.A. Garbutt, D. Barratt, and P. Rothery, ITE Final Report to MAFF, Vols. 1-3, 1997.
- 88 **The Wet Grassland Guide: managing floodplain and coastal wet grasslands for wildlife**, RSPB, EN and ITE, RSPB, Sandy, 1997.
- 89 **Birds of Conservation Concern**, RSPB, 1996.
- 90 Public Inquiry into proposed development at Farlington, Portsmouth. Proof of evidence to be given by Colin R Tubbs. English Nature, Hampshire & Isle of Wight Wildlife Trust and RSPB. (Annex 4: Loss of Coastal Grazing Marshes in North Langstone Harbour)
- 91 **Natural Areas: nature conservation in context**. Compact disc. English Nature 1998.
- 92 Waders and shelduck feeding distribution in Langstone Harbour, Hampshire, C.R. Tubbs and J.M. Tubbs, in **Bird Study**, 27: 239-248. 1980.
- 93 The Solent: an estuarine system in flux, C.R. Tubbs, in **Wader Study Group Bulletin**, 60: 21-23. 1990. Tubbs 1995.
- 94 Review of nature conservation features and information within the Solent and Isle of Wight Sensitive Marine Area, S.L. Fowler, **Report to the Solent Forum**, Nature Conservation Bureau, Newbury, Berkshire. 1995.
- 95 **Phase One survey database**, Hampshire County Council, 2000.
- 96 **The Flora of Hampshire**. Brewis, A., Bowman, P., and Rose, F. Harley Books, Colchester, England. 1996.
- 97 **Zostera Biotopes: an overview of dynamics and sensitivity characteristics for conservation management of marine SACs**, D.M. Davidson and D.J. Hughes, Scottish Association for Marine Science (UK Marine SACs Project), 1998.
- 98 Changes in the infauna of a sandy beach, R.N. Bamber, in **Journal of Experimental Marine Biology and Ecology**, 172: 93-107, 1993.
- 99 Saline lagoons and lagoon-like saline ponds in England, A.J. Downie, in **English Nature Science** No. 29. English Nature, Peterborough. 1996.
- 100 The coastal saline ponds of England and Wales: an overview, M. Sheader and A. Sheader, **Report to the Nature Conservancy Council** No. 1009. 1989.
- 101 Report for the Species Recovery Programme: on the lagoon sandworm (*Armandia cirrhosa*), S. L. Fowler and M. Sheader, Report to English Nature from the Nature Conservation Bureau, 1993.
- 102 Coastal Lagoons, R.N. Bamber and R.S.K. Barnes, in **British Coasts and Seas. Region 9: Southern England. Hayling Island to Lyme Regis**. Ed. by Barne, J. & Robson, C. Peterborough. Joint Nature Conservation Committee. 1996.
- 103 The coastal lagoons of Britain: an overview and conservation appraisal, R.S.K. Barnes, in **Biological Conservation**, 49: 295-313. 1989.
- 104 The distribution of the lagoonal amphipod *Gammarus insensibilis* Stock in England, M. Sheader and A. Sheader, in **Porcupine Newsletter**, 3: 220-223. 1987.
- 105 **A directory of saline lagoons and lagoon like habitats in England**, B.P. Smith and D. Laffoley, English Nature, Peterborough. 1992.
- 106 **Assessment of saline lagoons within Special Areas of Conservation. English Nature Research Report No. 235**, R.N. Bamber, English Nature, Peterborough. 1997.

- 107 Assessment of the Solent Saline Lagoon Resource, *R.N. Bamber, M. Sheader, A. Sheader and R. Somes*, Report to Hampshire and Isle of Wight Wildlife Trust. Fawley Aquatic Research Laboratories Ltd. 1997.
- 108 Collation of historic data for the Keyhaven to Lymington saline lagoon system. Bamber, R.N. Natural History Museum report for Hampshire County Council. 2000.
- 109 The faunas of land-locked lagoons: chance differences and the problems of dispersal, R.S.K. Barnes, in *Estuarine, Coastal and Shelf Science*, 26, 309-318. 1988.
- 110 On the ecology of brackish water lagoons in Great Britain, R.N. Bamber, S.D. Batten, and N.D. Bridgwater, in *Aquatic Conservation: Marine and Freshwater Ecosystems*, 2: 65-94. 1992a.
- 111 On a coastal brackish pond at Calshot, Hampshire, R.N. Bamber, N.D. Bridgwater and S.D. Batten, *National Power Research Report* TEC/L/0544/R91. 1992b.
- 112 **Saline lagoons: a guide to their management and creation (interim version)**. R.N. Bamber, P.M. Gilliland, and M.E.A. Shardlow, English Nature, Peterborough. 2001.
- 113 Report for the Species Recovery Programme: on the lagoon sandworm (*Armandia cirrhosa*), S. L. Fowler and M. Sheader, Report to English Nature from the Nature Conservation Bureau, 1993.
- 114 **A survey of intertidal vegetation and other coastal habitats in Beaulieu, Southampton Water and Upper Test using CASI survey techniques**. Report no. R856. ABP Research and Consultancy Ltd. Southampton. March 2000.

This Plan is one of many Habitat, Species and Topic Action Plans being prepared by the Hampshire Biodiversity Partnership. It will be monitored by the Partnership and fully reviewed and updated.

This habitat action plan has been prepared by Sarah Fowler and the Coastal HAP Working Group on behalf of the Hampshire Biodiversity Partnership.

For further information contact: Alan Inder, Hampshire County Council, Tel: 01962 846759  
Email: Alan.Inder@hants.gov.uk