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Shoreline management – conservation, management or restoration?

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Abstract

The estuarine shoreline forms the margin between the land and the sea. It is composed of a wide variety of habitats with attributes and interests associated with both the marine and terrestrial environment. Saltmarshes are dominated by plants tolerant to saltwater. Sand dunes support essentially terrestrial plant and animal communities. In between these extremes there are other habitats and a suite of transitional and successional features of considerable variety. Sand dunes, shingle shores and estuarine habitats are dynamic and show natural and sometimes rapid changes. Their ability to absorb wave energy or move in response to changing sea levels and storms is a significant feature. Too often in the past humankind has failed to recognise these attributes and sought to control this movement. In areas where socio-economic development has taken place the protection of land from erosion and flooding has become a major preoccupation. Where sea level is rising relative to the land or there is a sediment budget deficit or both a 'coastal squeeze' takes place. This not only threatens the existence of many wildlife habitats and associated species, but also the ability of the coast to protect us from the sea (flooding and erosion). This paper raises the question as to whether traditional approaches to nature conservation in coastal areas are sufficient to sustain habitats for wildlife, coastal defence and other economic uses. Lessons learnt from two European studies will be presented in further papers showing some of the possible ways of 'living with the sea'. These are: the LIFE project 'Living with the Sea'; the EURosion study funded by the European Commission.

Keywords: Coastal habitats; Conservation; Management and restoration; Coastal dynamics; Coastal squeeze.

Introduction

Coastal habitats, especially those in estuaries, provide the link between the land and the sea. They are dynamic, combine to form ecosystems of great complexity and are often significant areas for wildlife. Their landscapes are treasured by visitors, painters and musicians. They also provide locations for significant economic activity and are intimately bound up with fisheries, providing food and shelter for the young of some species of commercially exploited fish stocks. The habitats themselves provide a buffer to tides and wave action, which may be particularly important in areas where relative sea level is rising and during storm periods. Managing these assets in the face of continuing pressure from human populations on a sustainable basis is a major task.

The most extensive intertidal habitats normally exist within the confines of estuaries, and embayments with macro to meso tidal ranges. They can also be significant in micro tidal areas, where they help to form sometimes extensive deltas. In all cases the shelter afforded by the configuration of the coast or the presence of enclosing sand dunes or shingle spits facilitate the deposition of sediment and form tidal flats and saltmarshes. The interaction between these habitats helps to sustain the system, which is robust in the face of changing environmental conditions.

Too often in the past the value of these areas has been ignored. Human activities have exploited them, taking large areas from the sea by enclosure regardless of the implications for the habitats or the impact on the functioning of the coastal system. This has led to great loss of natural values and in many cases economic values, though the latter is not always recognised. It is not intended in this paper to chronicle these losses.

A key consideration is that the outcome of all this activity, particularly in the estuary environment, has been to 'squeeze' the shoreline into an ever narrowing zone (Fig. 1).

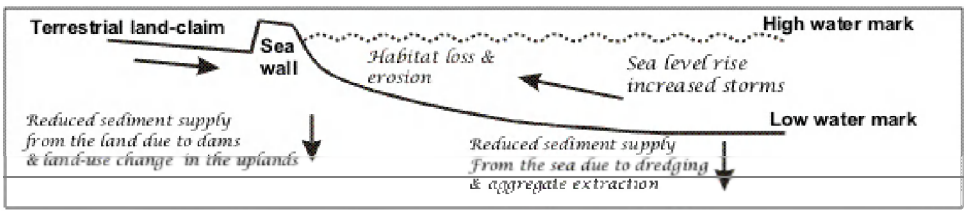

Fig. 1. A simplified picture of 'coastal squeeze'.

In addition to the loss of tidal land, as sediments are removed from functioning coastal systems (for example through nearshore gravel extraction or river damming) the resilience of the remaining habitats is further compromised. This can in turn lead to erosion, which causes further habitat loss and may result in an increased risk of flooding. Where these impacts threaten assets such as industry, housing or high quality agricultural land the response has normally been to erect artificial 'protective' structures.

This exacerbates 'coastal squeeze' and can be especially significant in areas experiencing a relative rise in sea level. The extent to which this results in a loss of economic value and the sustainability of a wide variety of uses, including sea defence and recreational use has only recently been fully appreciated.

This paper will review the role that nature conservation principles have played in conserving nature and the 'natural' environment. It will look beyond these and consider the importance of developing a more sustainable approach, which takes account not only of wildlife, but also coastal defence and other shoreline management issues.

Coastal development

The pressures for economic development and exploitation of biological and non-biological resources for human uses have caused the loss of many coastal areas and the

depletion of some animal populations. For example a review of the situation in Great Britain in the late 1990s showed that in addition to the cumulative loss of some 25% of the natural intertidal areas on 155 estuaries over the previous 100 years or so, in 1989 there were 123 cases of land claim affecting 45 of these sites (Davidson *et al.*, 1991).

Chronicling these losses and their impact elsewhere on the coast of Europe is easy. Papers presented at previous European conferences from 1987 onwards (such as van der Meulen *et al.*, 1989; Doody, 1995) provide examples. It is not intended to give detailed information on these losses here. However, coastal development including land claim (of coastal wetlands) has altered the 'natural' coastline especially in the estuaries and deltas of Europe.

These losses reduce the natural, wide and flexibly barrier, which as well as providing important wildlife habitat can help withstand storms and adjust to changes in sea level. This is replaced by a narrow, inflexible, often costly artificial barrier, increasingly vulnerable to attacks from the sea. The EURosion study (DG Environment 2004) suggests that about 7.5% of Europe's coast is artificially protected in this way (Fig. 2).

This figure only gives an indication of those areas where infrastructure or other 'land claim' has resulted in the need for protection from erosion and flooding. The extent of development on other coasts, which are geologically stable (not prone to erosion) or elevated (not prone to flooding) are not reflected in this figure.

Nature conservation

The conservation of species and habitats has long been a major preoccupation of scientists, naturalists and others interested in nature. This has revolved around two principle approaches:

1. protection of sites and species from damaging developments and over-exploitation;
2. the establishment and management of nature reserves.

Protection

The nature conservation lobby, recognising the potentially harmful and often cumulative effects on wildlife of coastal development, has battled against such activities for several decades. This has proved both time consuming and in many cases fruitless, as the losses of habitats and decline in species populations have continued. Faced with this, those concerned with the conservation of nature have fallen back on the tried and tested approach involving the 'protection' of individual sites from adverse development as an essential part of their conservation.

Fig. 2. The location of artificial protection around the coast of Europe derived from the recent EUrosion study.

Throughout the last century the identification and designation of sites of special interest for plants and/or animals has become one of the mainstays of the nature conservation movement. In Europe the top sites for habitats and species are included within the Natura 2000 network. Each individual country has developed a series of measures not only to protect these top European sites, but also those with a more local value. These range from national statutory legislation to the management of sites owned by national or local voluntary conservation organisations.

For all these sites, boundaries are agreed and drawn on maps. Their protected status does not necessarily mean that all damaging activities are prevented. Proposals for airports, new roads, buildings, housing and ports continue to be put forward and in many instances these threaten the further destruction of habitats and loss of species. When coupled with other activities such as disturbance caused by tourism, pollution from the sea and depletion of coastal sediments, the damage to coastal wildlife continues.

Management

For sites established as nature reserves it is usual for a management plan to be prepared. This is designed to protect the important wildlife features present within the site at the time of designation. Within these 'protected' areas management is normally based on ecological principles and determined through experience (of management elsewhere), knowledge of the specific requirements of individual habitats and/or species and published guidance (*e.g.* Packham and Willis, 1997; Doody, 2001).
This approach has proved successful in many areas. However, even where the resources are available and the policies appropriate, unforeseen influences may cause loss of interest. At the same time the act of drawing site boundaries on maps to establish the limit of a particular nature conservation interest, can reinforce a 'protectionist' philosophy. In this case change may be seen as damaging, especially when 'natural'

processes result in one interest being replaced by another. Three examples will be used to illustrate the issues:

Coastal sand dunes and dune dynamics

For centuries coastal sand dunes have been considered to be fragile systems requiring protection from erosion. Sand drift at many sites throughout Europe prompted the planting of trees, mostly of non-native pine. Examples of this abound throughout Europe where extensive areas have been afforested. A considerable part of the Atlantic coastal dunes are covered with woodland (35%), but only a small part of this (4%) is thought to be natural (see the EUCC Coastal Guide on Dune Management at http://www.coastalguide.org/dune/index.html, implying 31% has been planted with non-native trees.

In Denmark, as early as 1539, a Royal Decree prohibiting the removal of any vegetation on sand dunes was enacted because of the extent of erosion (Skarregaard, 1989). By the turn of the 20th century some 30,000ha out of a total of approximately 80,000ha (c40%) of open dune had been afforested.

In addition to the direct loss of habitat, monitoring of Danish coastal priority habitats in recent years has shown that for the remaining unafforested fixed grey dunes (2130*) and decalcified fixed dunes with *Empetrum nigrum* (2140*) their conservation status has been further threatened. Three reasons have been identified:

1. invasion of non-native species, especially *Pinus mugo* and *Pinus contórta*, planted to help stabilise the dunes;
2. lack of natural dynamic processes (over-stabilisation of dunes) due to reduction and lack of grazing;
3. ammonium deposition / eutrophication.

This resulted in a LIFE project to help restore 'favourable condition' (as defined under the EU Habitats Directive) to the dunes (Ministry of the Environment Danish Forest and Nature Agency, *Restoration of Dune Habitats along the Danish West Coast*, LIFE02/NAT/DK/8584). The restoration methods included the removal of scrub and woodland species and the reintroduction of dune dynamics. This last approach representing a major change in the way dune systems are perceived with a move away from dune protection using sand fences and the like (Fig. 3), which had been practiced at many sites, for many years throughout the world. This change has been accompanied by recognition that a more dynamic approach may fulfil the nature conservation need more readily.

Fig. 3. 'Protected' dunes – gabions and fencing, New Jersey shore, USA.

The need for a change in approach had been highlighted nearly 15 years earlier at a sand dune conference held in Edinburgh. Over-stabilisation of sand dunes, partly due to a reduction in rabbit grazing, was implicated in the loss of open dune vegetation, including sand dune slacks, to invasive scrub. The importance of a more dynamic approach was exemplified by the development of sand dune slacks (Fig. 4). 'It is worth remembering that today's blow-out can be tomorrow's dune slack....' (Doody, 1989).

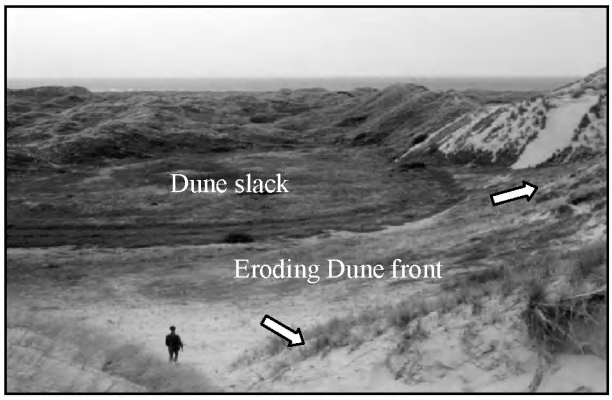

Fig. 4. 'Dynamic' dunes, showing the direction of 'erosion' and the development of a dune slack behind. Braunton Burrows, north Devon, England.

Saltmarsh erosion on the Essex coast

Whilst erosion of sand dunes was recognised as a problem for managers the same was not always true for saltmarshes. If erosion was considered at all, it was more or less seen as an accepted part of the natural processes associated with estuary dynamics. However, in south east England, conservationists became increasingly concerned about the scale of

saltmarsh loss, especially on the Essex coast. These losses became part of what has become known as 'coastal squeeze' (Doody, 2004).

Essex estuaries, protection and re-creation

In Essex much of the low-lying coastal farmland is derived from the enclosure of former tidal land, principally saltmarsh and swamp. In the early 1980s the erosion of saltmarshes and the undermining of some of the earth banks protecting the land had already prompted attempts to re-create the habitat. The method adopted involved building polders outside the sea walls (Fig. 5), an approach borrowed from the southern North Sea coast, particularly in the Wadden Sea.

Fig. 5. Groynes built to form polder-like structures on the foreshore as part of an attempt to 'hold the line', Cudmore Grove, Mersea Island, Essex (at the time the picture was taken in 2003, some 10 years after construction, there were no obvious signs of mudflat accretion or saltmarsh development).

The increasing cost of maintaining the existing line of defence in this part of the UK, especially in areas of limited agricultural value, led to a growing recognition that simply 'holding the line' might not be a cost effective solution. This led to a number of experiments being undertaken in this part of the country to adopt a more flexible approach. Amongst these 'managed realignment' is one of a suite of policies promoted by the UK Department of Environment Food and Rural Affairs (DEFRA) for coastal defence (Fig. 6). The method involves realigning sea defences such that new habitat is created by allowing sea water to flow over former tidal land, which has been enclosed. The result is a redistribution of habitats with a general landward movement of intertidal habitats, notably mudflats and saltmarshes. The approach may include identifying a new line of defence landward of the original protective sea wall. This may or may not involve the construction of new sea wall or other barrier inland of the original one.

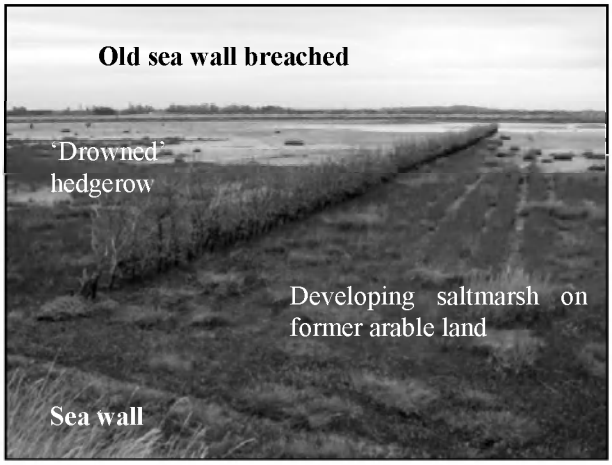

Fig. 6. A managed realignment. Tollesbury, Essex. The outer sea wall was breached in two places in 1995. This picture was taken in 2000, by which time extensive mudflats and some saltmarsh had developed on former agricultural land.

Kessingland shingle shore migration

In areas where there is a net landward movement or longshore drift sand dunes or shingle structures may, over time, move beyond the limits of the original site boundary (Fig. 7). This can result in the nature conservation interest extending beyond the limits of the site as originally designated. This presents a problem for those with the statutory responsibility for 'protecting' the site.

The Kessingland shingle beach was included as part of a larger Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 in 1989. The northern boundary of the site (Fig. 7) was drawn to coincide with the limit of the shingle beach, the identified feature of importance. The positions of the shingle beach and shoreline in 1991 suggest that the limits of the statutory protection already fell short of the full extent of interest when the statutory protection was confirmed in 1989.

The full extent and rapidity of the change is illustrated by Figs 8 and 9 below. A groyne field is clearly visible in the photograph taken looking south along the coast during a site visit in 1984 (Fig. 8). Their location can also be seen on the 1978 aerial photograph (Fig. 7).

By 2004 the groynes shown in the picture above had completely disappeared and in their place an *Ammophila* dominated sandy foreshore had developed (Fig. 9). This change appears to precede the northward movement of the shingle ness as shown above (Fig. 7).

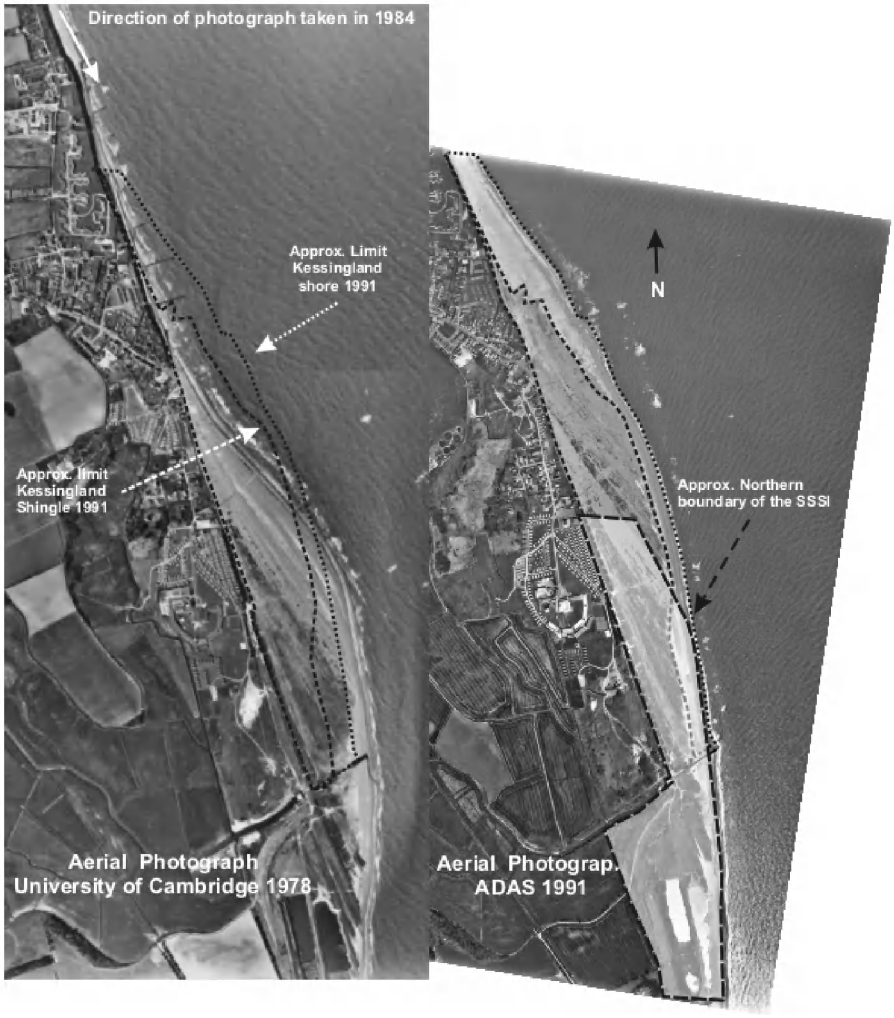

Fig. 7. Aerial photographs of Kessingland Beach, Suffolk, SE England showing the northward migration of the shingle ness and sandy shore between 1978 and 1991.

Fig. 8. Kessingland beach looking south from OS Grid. Ref. NR 536870, June 1984. Notice in the foreground how the groynes are showing signs of being covered by shingle.

Fig. 9. Kessingland beach taken looking south east from approximately the same location as in Fig. 7, August 2004. The upper shingle shore, low sand dunes and sandy foreshore (with Ammophila*) have replaced the narrow shoreline and groyne field.*

Conclusions

This paper effectively poses the question 'can we rely on the traditional approaches to the conservation of habitats and species' centred around site protection and management? In the face of increasing demand for coastal land and other resources for human use, the identification of statutorily designated areas, has aided their protection. This has worked for some sites, but not others. The establishment of nature reserves has provided more secure protection and also allows the management of adverse changes.

However, the three examples described above suggest that relying on habitat protection and/or management are not always enough and different approaches are needed.

Coastal dynamics, 'reintegration' and habitat migration

At the beginning of this paper it was stated that coastal habitats are dynamic and inter-related. Restraining the dynamic can, as the example of sand dunes suggests, result in over-stabilisation and loss of nature conservation interest. By restoring the dune dynamic, which may include initiating rather than controlling erosion, new habitat can be created. This will restore dune slacks and their associated plants and animals (including the uncommon natterjack toad). It will also help ensure the full range of dune types *e.g.* from yellow dune to dune grassland or heath is represented on an individual site. In addition, by creating open dune habitat it will provide suitable sites for a variety of invertebrates, such as bees and wasps nesting in open sand.

Combating 'coastal squeeze' also requires a more proactive approach. Habitat loss may be especially significant in areas where sea level is rising and/or sediment is lost from the coastal system. These losses can also have economic and social consequences, as is the case on the Essex coast where flooding is a key issue. Allowing the sea to flow over land formerly part of the intertidal system provides opportunities for 're-integrating' the land with the sea. This has the combined effect of restoring intertidal habitats and helping to improve sea defences.

The migrating beach at Kessingland may pose problems for those responsible for its protection under national legislation. However, it illustrates another very important aspect of restoration, the ability of natural processes to re-create high quality habitat. In this case, despite intensive recreational pressure the new areas of shingle beach outside the SSSI are as significant as those lost through erosion (Doody 2004). These and other similar issues will be considered more fully in relation to the paper on the EU LIFE project 'Living with the Sea' (Worrall, 2005).

Time and space for coastal processes

In the face of 'coastal squeeze' habitat restoration, re-creation or creation may be as important to the long term sustainability of our coasts as protecting existing habitats. In this context the role of sand and shingle beaches, mudflats, saltmarshes and sand dunes in the functioning of the wider estuarine ecosystem must not be overlooked.

This wider perspective must also include consideration of the value of coastal areas in relation to human activities, and not always in a negative sense. It can be argued that a wider more dynamic zone, in which coastal habitats are a significant element, will help provide a more sustainable future for our low-lying coastal areas and their economic, recreational and environmental values. Nowhere is this more significant than in relation to areas prone to coastal erosion and flooding. In the past the natural, human response has been to erect bigger and 'better' artificial coastal defences. However, the failure of many of these structures, the cost of repair and recognition that they may have exacerbated problems on adjacent coastlines, has led to a reappraisal of their role. At a

European level a study on erosion (EURosion) has resulted in recognition of the need to work within a much wider zone, for example at catchment level (Niesing, 2005). A significant element in this is the importance of allowing time and space for the coast to adjust to external change. This also requires that there is sufficient sediment to allow change to take place without a diminution of the coastal zone.

The above discussion suggests that establishing statutorily designated areas and nature reserves provides only a partial solution to the protection of important habitat and species. Management of these areas can be costly and time-consuming and may not always be optimal. In areas where relative sea level is rising, with or without erosion taking place, 'natural' change may result in habitat loss. In the most dynamic areas coastal habitats will evolve in such a way as to move beyond the limits of 'protected' sites. Taken together, these factors suggest the need for a wider appreciation of the role of natural processes and sediment dynamics in coastal conservation and management. In this context and given the extent of the accumulated losses of coastal habitats Europe-wide, the restoration, re-creation or creation of coastal habitats must be an essential part of any future nature conservation effort.

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