

## IMPACTS ON BEACH AND CLIFF STABILITY ASSOCIATED WITH EXTRACTION OF SEDIMENTS FROM BEACHES AND OFFSHORE: UNDERSTANDING THE COMMUNITIES' RESPONSES TO PERCEIVED RISK

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### INTRODUCTION

One hundred years ago, the British Government set up a Royal Commission on Coast Erosion "...to reach some conclusion with regard to the amount of land which has been lost in recent years by the encroachment of the sea on the coasts of the United Kingdom...". The Minutes (1908, 1909) and the Final Report (1911) expressed concern that removal of sand and gravel from beaches caused or accelerated coastal land loss. The same issues exist today. Why? Hasn't our knowledge improved? Or are we no better at communicating it?

### ROYAL COMMISSION ON COAST EROSION (RCCE)

The British Association for the Advancement of Science established a Committee in 1883 "for the purpose of inquiring into the rate of erosion of the Sea-Coasts of England and Wales, and the influence of the artificial abstraction of shingle and other materials in that action": a strong indication of public and scientific concern. It reported (in 1885) that shingle extraction was causing loss of land and property. Extensive landsliding and shore retreat accompanying the 1897 North Sea storm surge increased public pressure for action. Local communities could not afford to pay for adequate defences and pressure grew on the Government to provide central funding for coast protection. There were also bitter arguments about the effects of extraction and how Government and the dredging contractors responded to fears of land and property losses. The Government responded by setting up the RCCE, following the practice that Royal Commissions are established to inquire publicly about very important, often controversial, issues of national concern.

The RCCE started work in 1907, presenting its Final Report in 1911. It was required to inquire and report: "a. As to the encroachment of the sea on various parts of the Coast of the United Kingdom and the damage which has been or is likely to be caused thereby; and what measures are desirable for the prevention of such damage". It also considered what powers were needed for protection and if changes to the law were needed. Its Final Report (1911 p.158) said "The removal of materials from many parts of the shores of the Kingdom and the dredging of material from below low water mark, have resulted in much erosion on neighbouring parts of the coast, .... "Removal of sediments from the shore should be illegal (Para. 7(a) p.160). It recommended "systematic observations" (of) change below low water, deep water sediment travel and sandbanks movements for which "information at present is scanty and vague". Little subsequent action was taken.

The Final Report (RCCE 1911, Part II) said that on the basis of foreshore losses “the gradient of the foreshore must be becoming steeper.” (p.45). There was no recognition by the authorities of the implications. More recently, Taylor *et al* (2004) report that 61% of the coastline was steepening and 33% had flattened. This is critical to the debate about coastal changes, especially in discussion of sand-mining impacts, as it indicates a progressive exposure of beaches to serious damage. Despite extensive damage to the English North Sea Coast in 1953, the Waverley Committee on Coastal Flooding (1954) did not comment on this, but noted an increasing frequency of severe storms and stressed that research into the movements of beach material, offshore sand banks and related coastal problems was urgent (Summary of Recommendations Para. 114 –(3), p.28).

Analysis of the RCCE Minutes of Evidence reveals the causes of coast erosion reported by engineers and geologists, the professional groups commonly advising the coast protection authorities, as wave action and the removal of beach material for road-making and construction. Directly affected groups such as Parish Councils and individual landowners added a third cause: the effects of engineering works, such as groynes and jetties reducing longshore sediment transport. Although extraction in some locations directly affected beach-loss, the links with offshore extraction were poorly described.

By the 1960s extraction of sand and gravel from beaches had been stopped but offshore extraction of aggregates increased. Although extraction from beaches for commercial reasons is not now allowed, in practice removal does occur when downdrift beaches are used as sources for rebuilding updrift beaches (Thorn 1960; May and Hansom 2003).

#### THE PRESENT SITUATION

There are conflicting views on the effects of aggregate dredging. The UK Government argues consistently that there is no evidence that offshore dredging causes coastal erosion (Department of the Environment 1995), a view strongly supported by the Aggregates Industry. Extraction is not permitted if there is a risk that coastal erosion would result (Department of the Environment and Welsh Office 1993, Section 5.3.4) and beach monitoring may be required if there is uncertainty about the effects of dredging, even if adverse effects are not expected (Marine Minerals Guidance Notes 2002, Para. 42). Ministers also emphasise that “extraction is also an enormous benefit because of the use of such material for beach nourishment schemes and for the protection of beaches from erosion.” (Hansard 14 June 2002).

Recent major research projects in the North Sea have concluded that current marine aggregate extraction is not influencing coastal erosion (Gubbay 2005). In contrast, a Europe-wide investigation of coastal erosion reported that because dredging starves parts of the seabed of sediment this may be compensated by (re)activation of shoreline erosion processes. “This has proved to be the case in a significant number of cases including ...North Norfolk (UK).” (EuroSION 2004). Press reports (e.g. Eastern Daily Press, 19 February 2004) described it as a pioneering report by European experts and emphasised its high-profile. In the opinion of interest groups, it conflicted directly with the UK Government's position. Furthermore, in a report on European Integrated Coastal Zone Management, Rupprecht-Consult (2006) state that “sand and gravel mining are of great

concern and may impact fisheries and tourism” (p.127). The Government responded by saying that it would review the Euroasion claims, but doubted that they were based on new research. Causes of erosion and levels of extraction impact are still uncertain.

## **EROSION-AFFECTED COMMUNITIES**

Coastal communities have reacted strongly to offshore aggregate removal. A typical response in coastal communities affected by land loss to increases in offshore dredging volumes perceives them as the cause of increased coastal erosion. For example, the villagers of Hallsands on the Devon coast argued for over 40 years that extraction threatened their homes. In 1917, the village was destroyed by a combination of gravel extraction, focused wave energy and high wave and tide conditions caused the disaster (Hails 1975). The community attributed it directly to the effects of gravel extraction. The question of compensation was very important, with the Government of the day accused of suppressing official reports and bowing to commercial pressures (Melia 2004).

Today, objections come from both individuals and interest groups such as Marinet (<http://www.marinet.org.uk/mad/objection.html>) and CCAG ([www.happisburgh.org.uk](http://www.happisburgh.org.uk)). The former publishes, in full, correspondence relating to marine aggregate dredging proposals. Despite the consistent official position that there are no demonstrable links, these groups argue strongly that the official bodies are not pursuing their avowed policy of the precautionary approach. In their view, the increased erosion of the East Anglian coast, for example, is associated with the increased offshore dredging activities. Their websites include statements that rates of beach and cliff retreat have increased following the start or extension of offshore dredging. Detailed listings of the land loss and the quantities of materials dredged and needed for replenishment schemes. They regard the official line as influenced by the commercial interests of the aggregate companies and Government and Crown Estate. They doubt the independence of the consultants, often funded by applicants for dredging licenses.

In order to establish if progress has been made in way in which erosion-affected communities respond, these and all other UK sites have been analysed. Several common themes emerge: the official view is wrong, erosion accelerated when dredging started, beaches are increasingly damaged, funding has been reduced, increased research evidence that ecological recovery is not confirmed. The Royal Commission on Environmental Pollution says the Crown Estate has a “potential conflict of interest” because they must maintain and enhance the estate’s income and have “due regard to its good management” (Report 13, Para. 9.62). The communities and interest groups raise the question of compensation for loss of land, but the Government rejects such claims.

## **COMPLEXITY, UNCERTAINTY AND PUBLIC UNDERSTANDING**

Considerable doubt often remains as to the level of impact. However, a typical response in coastal communities affected by land loss to increases in offshore dredging volumes perceives them as the cause of increased coastal erosion. Communities both in the past and now have comparable responses and doubts. Debate remains confrontational. Although beach loss has occurred at the same time as extraction, this need not mean that the offshore extraction is the only (or even a contributory) cause of the land loss. Indeed

large-scale studies during the last decade have consistently argued that there is no link between offshore aggregate extraction and coastal erosion. Even if the rate of retreat has accelerated at the same time as extraction has occurred, this does not confirm a causal link. Even if there were a causal link, the time-lags and response-times in these complex sea bed systems can produce a sometimes lengthy lag between sea bed extraction and the reaction of the beach-cliff system. Other factors may accelerate erosion, in particular, beach steepening, changed longshore transport, increased frequency of storms. In combination, as at Hallsands, they can be disastrous if the beach has gradually been reduced in volume. Beaches seen as previously stable often have recovery times than the interval between storms. However, increased storm frequency and a tendency to clustered events mean that beaches do not recover and begin to demonstrate progressive decline.

The complexity of the linkages and the lack of long-term monitoring of sea bed change typically militate against sufficient levels of proof to withstand the legal process. Coastal inhabitants affected by land loss mistrust official statements and research results, demonstrating aspects of Kamphuis' (2006) views about the difficulties for coastal engineers in dealing with complex coastal situations. As a result, when applications are made for offshore extraction, it may be difficult to confirm or refute the presumption that there are definite linkages between offshore sites and beaches.

Underpinning much of the debate about sand-mining in the UK over more than a century, there are several consistent themes: the perceived onset of erosion associated with the start of extraction, the view that beaches were previously stable, lag-times between the cessation of dredging and the final disaster, failure to provide convincing evidence of the causes of the erosion, the strong views of local people of the risks to their homes, institutional reluctance to grant compensation and dismissal of scientific evidence, and inadequate long-term monitoring of sea-bed change.

These themes are compounded, first, by the uncertainty and incompleteness of the scientific information. Inadequate data was identified by the RCCE and the Waverley Committee and remains an issue. Second, the causes of the accelerated erosion have often not been explained. Third, public understanding of risk remains poor. Fourth, communities are increasingly sceptical about the accuracy and honesty of statements made by government and experts (Heeps and May 1997). Fifth, application of the precautionary principle by coastal authorities is seen to be ignored when government allows dredging. Finally, communication between scientists and the wider public is often poor or left to the vagaries of the media. This is a wider issue as Overton (2007) expresses exactly the same view with regard to climate change.

## CONCLUSIONS

The consistency of response over the past century poses two questions. Hasn't our knowledge improved? Or are we no better at communicating it? In brief, despite much more research, the complexities of the linkages between offshore and beach sediments remain uncertain. At the same time, the causes of the accelerated erosion of many beaches adjacent to sea bed extraction are not adequately explained and may be due to combined, cumulative and lagged effects. The same arguments between commercial

interests, government and the affected public exist. Coastal decision-making has become more complex. Decisions and counter-arguments must robust enough to be tested in the courts. Relationships often tend to be confrontational, not surprising if compensation is involved. Coastal decision-making today involves many stakeholders, but those who might be most affected feel excluded largely because there has been little attempt to assess exactly what, if extraction is not involved, is causing the accelerated erosion.

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