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# Morfa Harlech, Gwynedd

[SH 574 303]–[SH 550 348]

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## Introduction

Morfa Harlech forms a large triangular area of sandflats, beaches and dunes, and claimed land between an abandoned cliff north of Harlech and the estuary of the Mon Glaslyn and Mon Dwyryd (see (Figure 8.2) for general location and (Figure 8.16)). The present-day beach and dunes form a narrow fringing system in the south of the site, but widen northwards into several sub-parallel ridges. The alignment of a sand beach and dunes at an acute angle to the former cliffs has encouraged extensive sedimentation. Inland there are several recurved zones of former shoreline and dunes. Morfa Harlech is significant for the relationship of the ridges to sediment inputs from local rivers and the seabed. Though progradation is prevalent, there is also some localized erosion, both at the proximal end, near Harlech, and at the distal end of the spit. Morfa Harlech is little-affected by anthro-pogenic intervention into littoral sediment transport, and is part of a suite of beaches that are aligned to Atlantic swell in the Irish Sea. The first description of the site was by Steers (1939b). This was developed further by Steers (1946a) and King (1972b), but much of the description that follows is based on more recent examination of the site both in the field and on aerial photography taken at various dates since the late 1940s.

## Description

The sandy beach at Morfa Harlech extends about 7 km NNW from the coastline at Llanfair towards the estuary of the Mon Glaslyn. The landward edge of Morfa Harlech is formed by a line of former cliffs upon which the 13th century castle at Harlech was built. Between the old cliffline and the beach there is a triangular area of reclaimed marshland, saltmarsh and both geomorphologically active and relict dunes. Within this area there are several rocky outcrops, such as Ynys Llanfihangel-y-traethau, former islands enclosed within the marsh. The main geomorphological interest lies in the beach and dunes that form the seaward part of Morfa Harlech (Figure 8.17) and (Figure 8.18).

Steers (1939b, 1946a) described the development of the Morfa from its earliest days as a small spit of shingle and sand providing some shelter for vessels arriving at the castle water-gate. As the spit grew northwards, sedimentation and the development of saltmarsh was accompanied by land-claim. This was not well documented until the early 19th century when embankments were constructed between the north-east corner of the high ground at Llanfihangel and the coast road at Glyn Cywarch. An Act passed in 1806 allowed embankment, and Steers (1939b) recorded that banks were constructed at both Morfa Harlech and farther up the estuary at Talsarnau soon afterwards. The 1808 embankment from Llanfihangel to Glyn Cywarch finally closed the creeks. Steers considered the relationship of the castle and its port to the growth of the spit and the marshland behind it. He concluded that the spit grew northwards and that small boats were able to reach the castle for several centuries after it was built.

Steers used a number of maps to interpret the historical development of the spit up to 1939. Since the 1950s, maps and aerial photographs have augmented his description of the development of the spit, but there has been little other work on its geomorphology. The beach and dunes fall broadly into three main parts: a southern section, about 3.25 km in length, formed mainly by sub-parallel dune ridges; a central section, formed mainly of recurved vegetated and generally low-lying dunes, and a northern area of mobile sand, also characterized by recurved sandy ridges. There are frequently several curving ridge and runnel forms in the intertidal area at the northern end of the spit. The north-eastern part of the site is formed by saltmarsh (Figure 8.17). These zones are well depicted on the aerial photo-mosaic (Figure 8.18). Although movements of sand along the spit towards its distal end have contributed in part to its extension across the Mon Glaslyn, changes in the position of the river channel have contributed also to the growth and erosion of the spit.

Bird and Schwartz (1985) included Morfa Harlech as one of several important British depositional structures in their review of the world's coastlines, and it is one of several beaches in Cardigan Bay that were reported by King (1972a) as being swash-aligned. It was also noted by Guilcher (1958) as one of the many beaches along this coastline where the larger clasts are mainly slate and shale. As a result its sediments are characteristically platy in form rather than rounded, and this is reflected in the detailed structures of the beach ridges. Steers (1946a) described the southern part of the spit as a dune area bordered by a belt of coarse cobbles. In the 1940s, this was the only shingle visible in the whole area, and Steers estimated that it had moved north about 450 m since 1901. He considered that, prior to the construction of the railway embankment, the erosion of the till cliffs to the south would have provided a source for these cobbles. He also discussed the possibility that the dunes were underlain by shingle or in-situ till, but acknowledged that there was little evidence to resolve the issue. The way in which the sand dunes recurve in the northern part of the spit, decrease in height and fan out, led Steers to believe that they were not underlain by shingle. The northern end of the spit had grown an estimated 200 m in the previous 100 years, and Steers did not expect it to grow much further. In fact, since then the spit has grown much farther to the north-west and then retreated to about its present position. There is now a large area forming the distal end that is made up of a series of curved low ridges. They are over-washed at spring tides or during periods of high wave energy and have not become vegetated. The outer part of the distal area is formed by several ridges and runnels, features that have been discussed elsewhere by Orme and Orme (1988) and may provide a mechanism by which sediment is transferred from the intertidal zone to the beach (Figure 8.19). The changing position of the north-western part of the spit appears to be related to movements in the position of the ebb and flood channels of the Glaslyn estuary. This area has extensive sandy intertidal flats that receive sediment from the rivers of the Vale of Ffestiniog, but sources from Snowdonia via the Mon Glaslyn, north of Porthmadog, were restricted greatly during the 19th century when much of Glaslyn Valley was reclaimed. There are nevertheless extensive intertidal areas that could serve as sources for the spit.

The vegetated dunes are affected by shoreline erosion at their southern end, but this has not been a major problem within the site. There is some damage to the dunes as a result of recreational trampling, and blowthroughs occur along the dunes south of the main public access and at several separate locations farther north, both on the foredunes and on the older inner ridges. Steers (1946a) noted that parts of the inner dunes north of the Cefn mine were affected by blowthroughs, and described the outer seaward line of dunes as wind-eroded. The inner edge of the dunes was migrating at about  $4 \text{ m a}^{-1}$  on to the pasture behind the dunes. Following afforestation of part of the inner dunes, these dunes appear to have stabilized.

## Interpretation

The changes in the area of the spit both during the last 150 years and during the last four decades indicate that Morfa Harlech as a whole is in a state of progradation. The amount of erosion at its southern end is small. The spit appears to be very close to equilibrium with the dominant and prevailing south-west waves, with very little net movement of sediment alongshore. Despite the substantial growth of the distal features, the general line of the southern beach and its position have remained similar for several decades. Its alignment depends to a considerable degree on its relationship to the Glaslyn estuary and the rocky shoreline on the northern side of Cardigan Bay, both of which affect the direction of waves approaching the spit. The source of sand for the spit is probably mainly from the substantial submarine glacial deposits that floor the bay, with some exchange also taking place between the estuarine sands and the distal end of the spit.

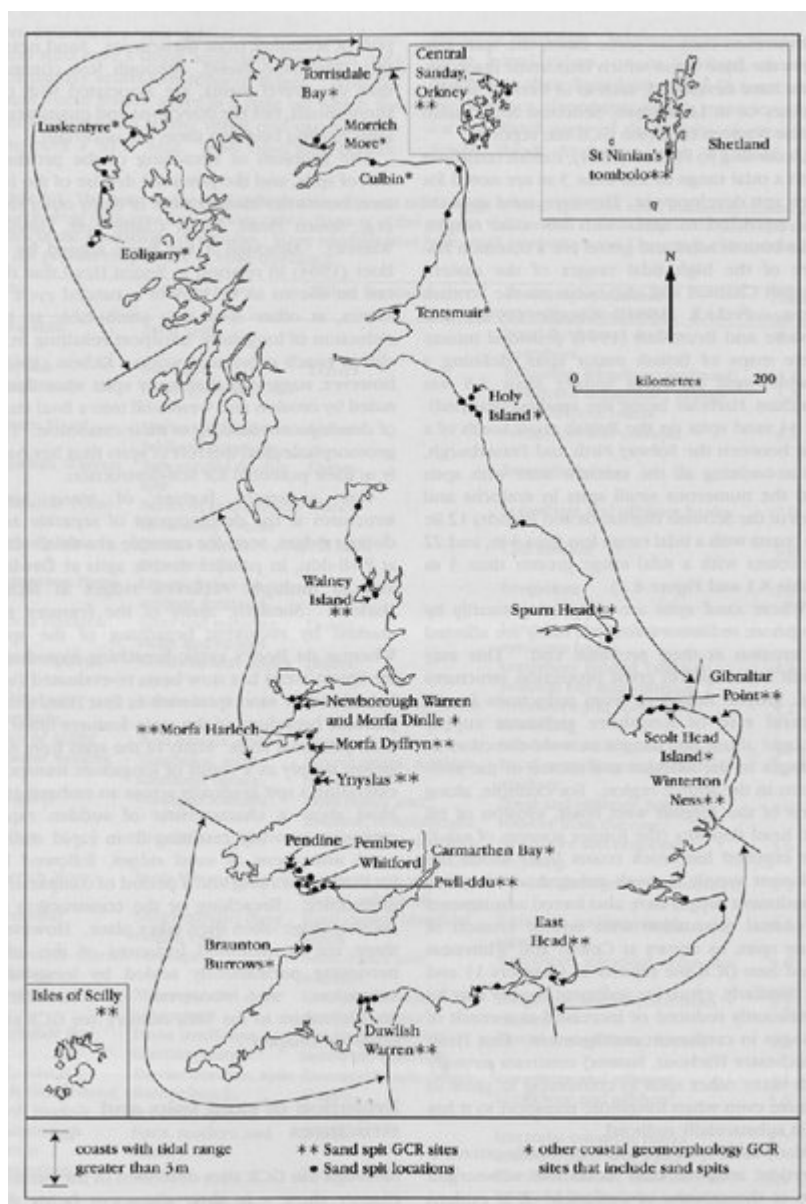
Morfa Harlech is a fine example of a sand spit developing across an infilling estuary. Most of its growth appears to have occurred during the last 700 years, but, unlike many other such forms, it does not appear to have been seriously affected by the worldwide tendency for such features to be affected by erosion (Bird, 1985). This is attributed to a large probable source of seabed sediment in Cardigan Bay and the large quantities of sandy sediment in the Glaslyn estuary that may have increased due to mining inland. The spit has been little affected by coast-protection works, although there is some confined damage resulting from recreational trampling. The processes that are geomorphologically active on Morfa Harlech have not been investigated in detail, but its largely pristine character makes it particularly important as a site for coastal geomorphological studies. There has not been a detailed investigation of the stratigraphy landward of the beach, especially in the Harlech area, which would allow the early history of the beaches to be described. Nevertheless, the historical evidence suggests that most of the beach is a much later development than Ynyslas to the south. It contrasts

also with rock-based dune systems at Newborough Warren.

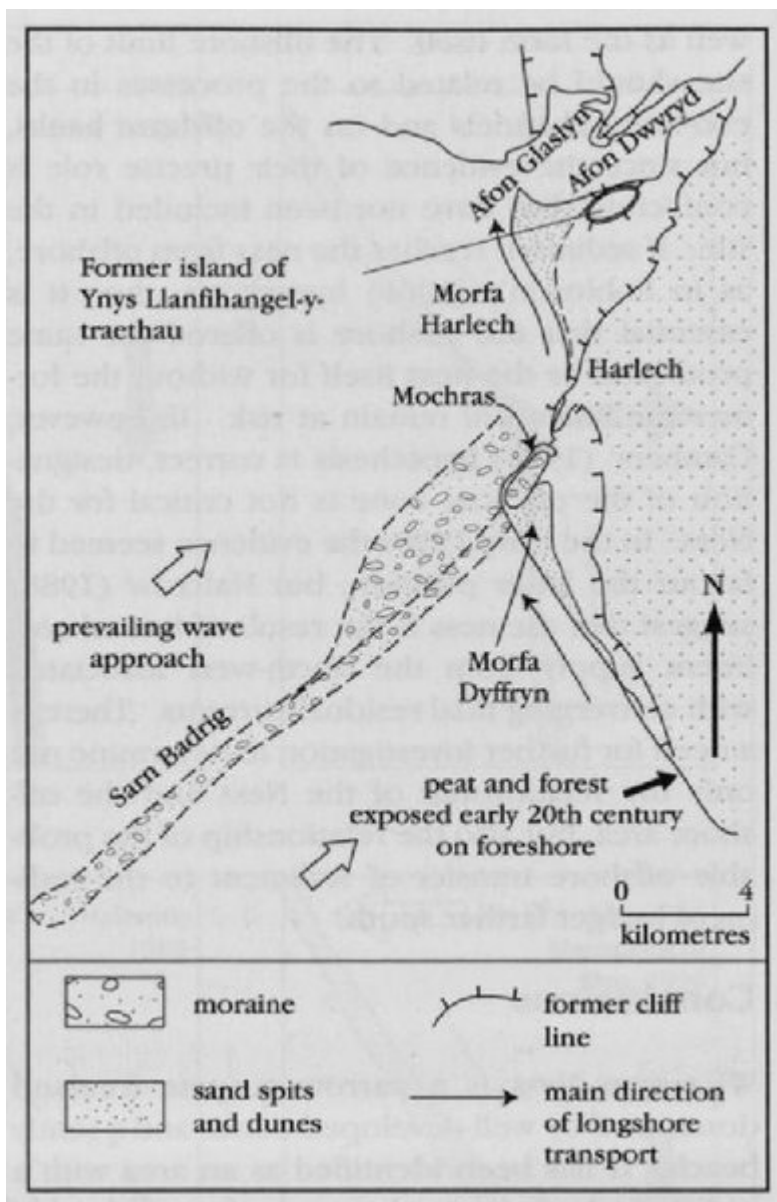
Morfa Harlech is the result of several phases of as yet undated spit growth, and the progressive sedimentation and land-claim of the area between the beach and the former rocky sea cliff upon which Harlech Castle stands. Unlike the other major depositional features of the coastline of Cardigan Bay, it appears to depend upon sediment supplies from the sandy estuary to its north. Morfa Harlech displays several phases of growth, a similar characteristic to several other beach systems (for example Pwll-Ddu, South Haven Peninsula and Gibraltar Point).

## Conclusions

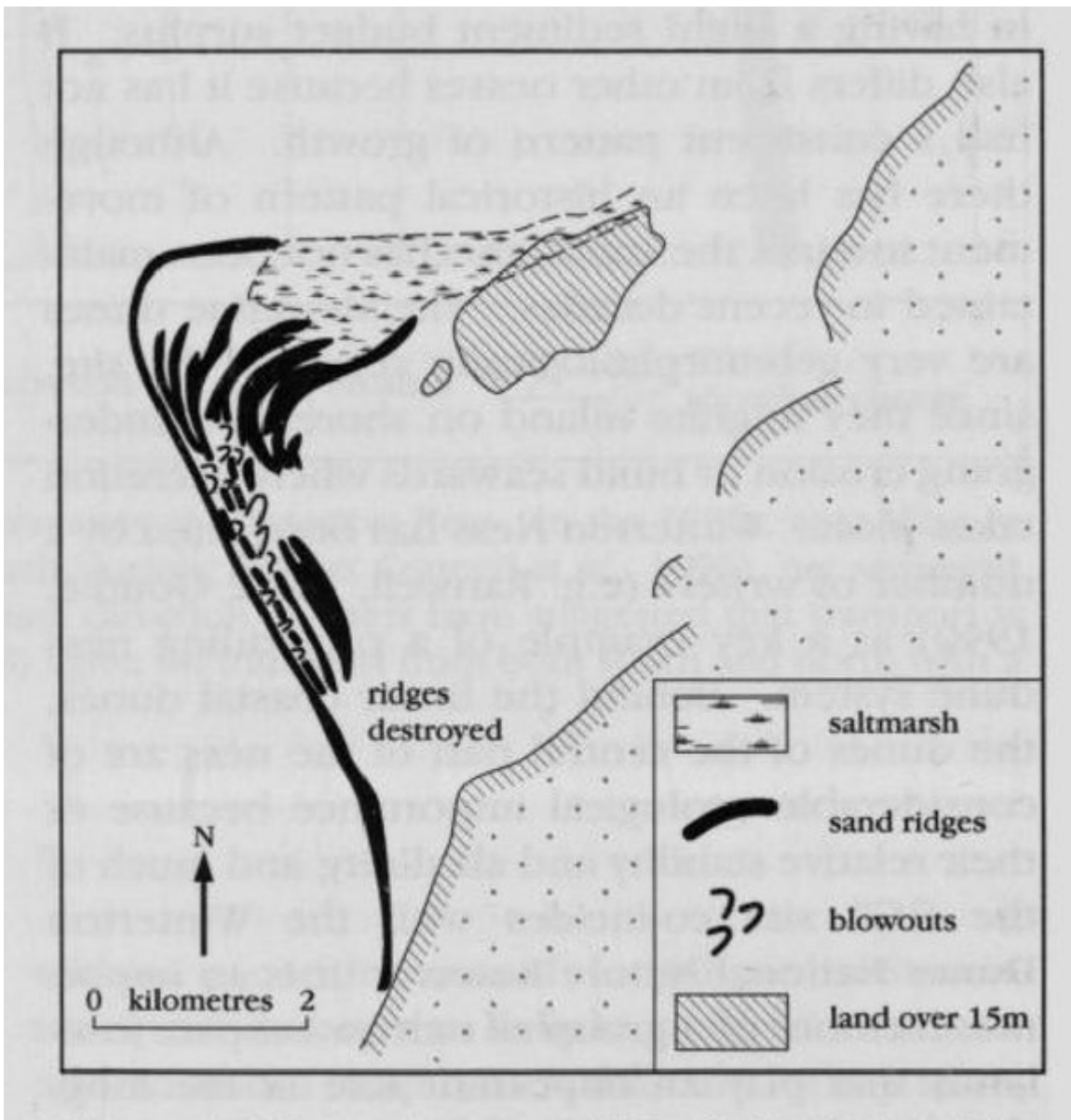
The Morfa Harlech GCR site comprises a well-developed spit across a major estuary whose sediment load may contribute significantly to the coastal sediment budget; it has several distinctive recurved zones that relate to its development during the last 150 years. It is a fine example of a multi-phase, gravel-based, sand spit that has gradually built across a major infilling estuary. Much of its growth has taken place during the last 700 years, and continues to show a positive sediment budget, largely as result of the large quantities of sand available on the shallow sea floor and in the Glaslyn estuary. Its almost totally unspoilt character makes it especially important for coastal studies.



(Figure 8.2) The location of sand spits in Great Britain, also indicating other coastal geomorphology GCR sites that contain sand spits in the assemblage. (Modified after Pethick, 1984).



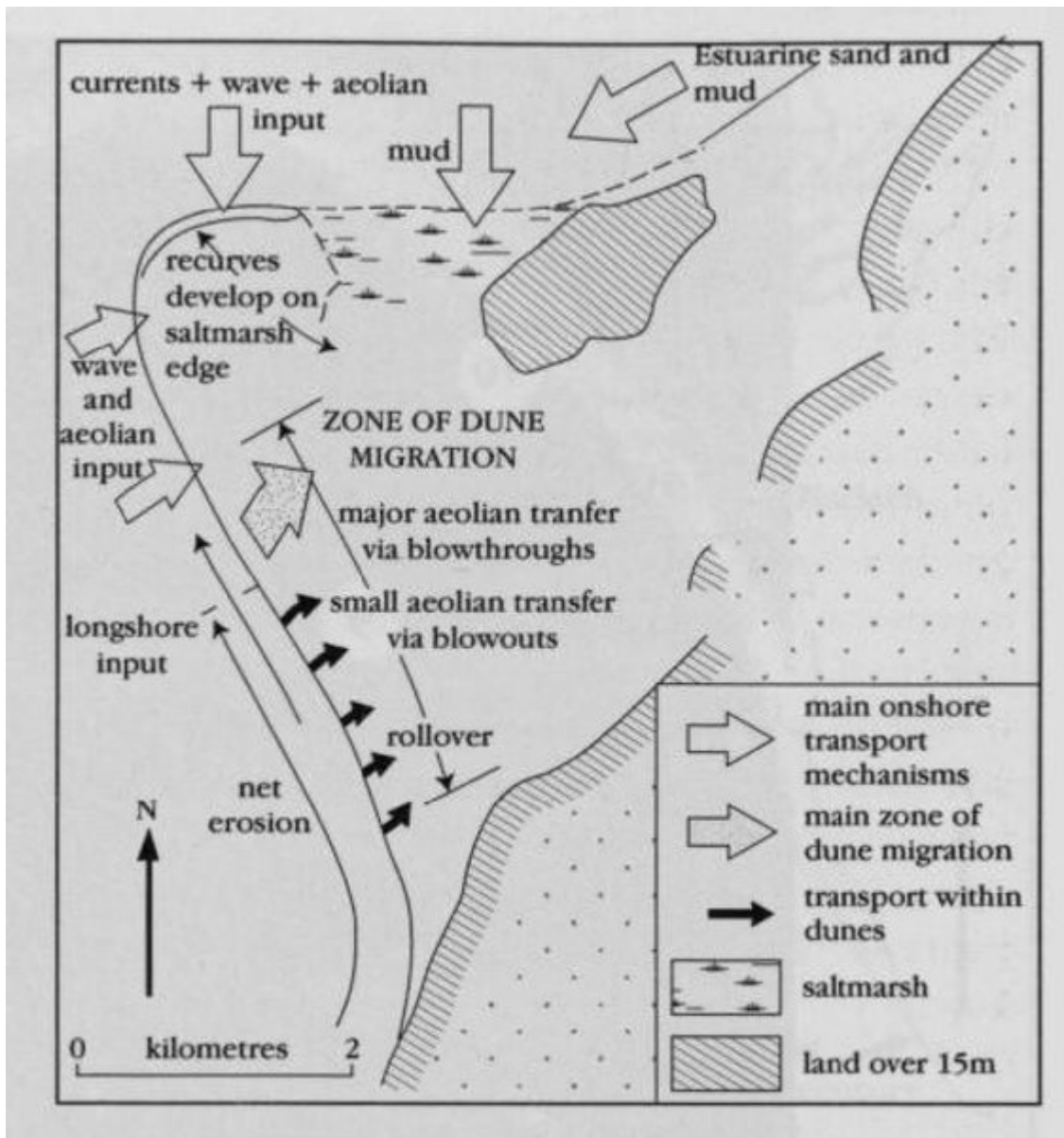
(Figure 8.16) Context of Morfa Harlech and Morfa Dyffryn — key geomorphological features.



(Figure 8.17) Key features of Morfa Harlech. (After Steers, 1946a.)



(Figure 8.18) Aerial photograph of Moth Harlech with the main geomorphological features numbered. 1 = former mainland; 2 = linear stable dunes ('grey dunes'); 3 = active 'yellow' dunes; 4 = zone of active blowthroughs; 5 = relict blowthroughs with SW—NE-aligned linear dunes; 6 = dune and slack topography; 7 = recurved linear dunes; 8 = former distal spits; 9 = 19th century distal features; 10 = modern distal dunes; 11 = intertidal sandflats. (Photo: courtesy Cambridge University Collection of Aerial Photographs, Crown Copyright, Great Scotland Yard.)



(Figure 8.19) The main processes and sediment transfers at Morfa Harlech.