

SANDWOOD

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OS Grid Reference: NC220650

Introduction

The beach–dune complex of Sandwood Bay, north-western Sutherland (see Figure 7.1 for general location), is among the most dynamic in Britain. The high level of activity of the beach and dune landforms, in a situation where human interference is limited, is of great geomorphological interest. Sandwood Bay is enclosed by cliffed headlands to the north and south and contains a diverse assemblage of spectacular soft coastal landforms. To the landward side of the wide sandy beach, a gravel-cored bar capped with highly dynamic sand dunes impounds the freshwater of Sandwood Loch. Other features of interest include extremely mobile sand dunes with large blowthroughs and climbing dunes that reach altitudes of over 100 m OD on adjacent hilltops (Ritchie and Mather, 1969).



Figure 7.1: Great Britain sandy beaches and coastal dunes, also indicating the location of GCR machair-dune sites (see chapter 9) and other coastal geomorphology GCR sites that contain dunes in the assemblage.

Description

Sandwood Bay GCR site, western Sutherland, encompasses the seaward end of the glacially modified valley of Strath Shinary, and lies seawards of the north-western limit of Sandwood Loch (Figure 7.22). The beach and dune machair complex of Sandwood Bay separates the

flooded lower part of this depression (Sandwood Loch) from the sea. The GCR site represents only the western part of the much larger Southern Parghe SSSI. The south-east to north-west orientation of Sandwood Bay corresponds to a structural depression along the junction of the near-vertical cliffs of Torridonian sandstones to the south and the bold convex cliffs cut in Lewisian gneisses to the north (Figure 7.23). The steep sandstone cliffs, which form the south-west limit of the bay, rise to over 90 m and are variously subject to block failure and granular disintegration, giving rise to talus cones in places. As a result, a wide textural range of sediments is contributed to the inshore zone from the crumbling cliffs (Ritchie and Mather, 1969). The gneiss rocks of the north are more massive and resistant and provide little detrital material. Exposures of bedrock crop out in several places within the beach and dune complex (e.g. the low rock skerries at mean low-water springs). In the hinterland the bedrock supports a thin and discontinuous cover of gravelly till. Erosion scars in stream sections within the gneiss reveal the presence of a thin veneer of gritty red till and Torridonian erratics on top of the gneiss testify to ice movement towards the north and north-west.

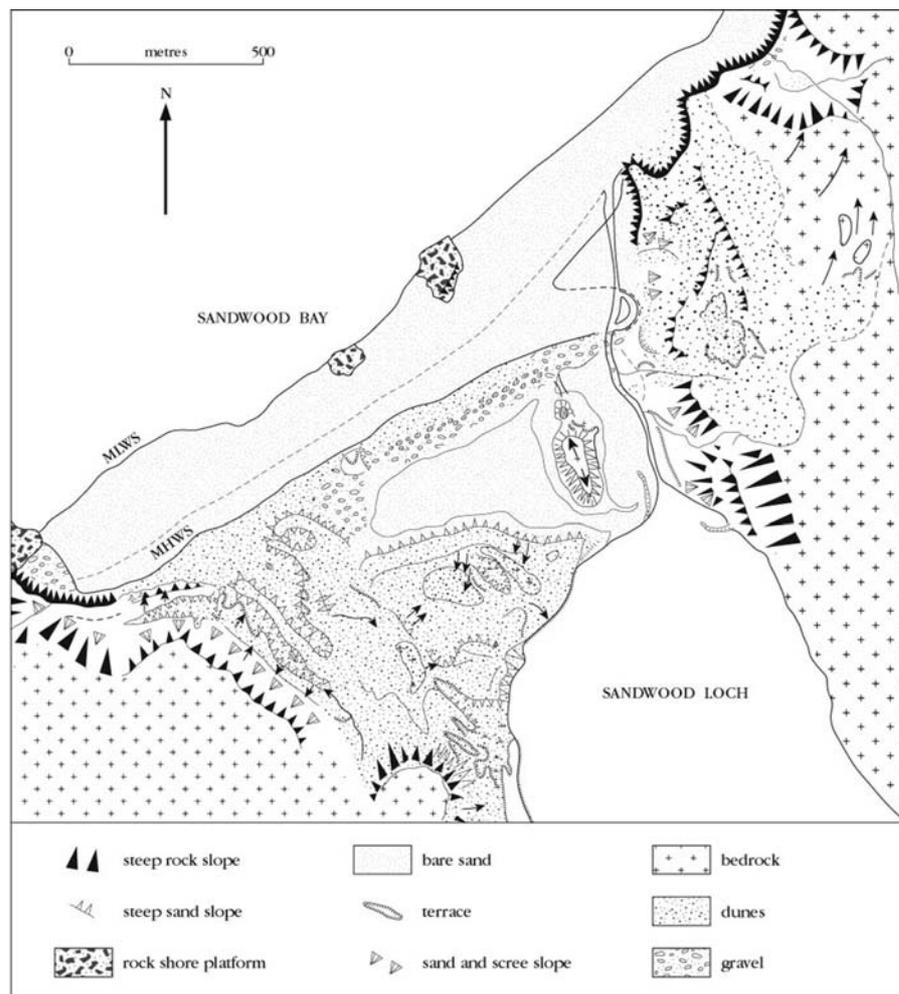


Figure 7.22: Sandwood Bay, Sutherland, is dominated by a large and highly dynamic area of blown sand and machair that lies between the sea and the freshwater Sandwood Loch. Arrows show slope direction. (After Ritchie and Mather, 1969.)



Figure 7.23: This view of the broad sweep of Sandwood Bay from the south shows the large areas of bare sand that indicate a high degree of dynamism at the beach-dune edge and within the dune-complex. Note the development of low tombolos linking the skerries to the beach crest (arrowed). Depending on the state of the tide these can be quite prominent features. (Photo: J.D. Hansom.)

A wide sandy beach, with an average intertidal width of c. 250 m, has developed in this natural structural embayment (Figure 7.23). This exposed Atlantic beach is among the most dynamic in Britain and is characterized by ephemeral bars that develop and erode depending on prevailing wind and wave conditions (MacTaggart, 1996). There is some development of rip currents in the nearshore zone, possibly controlled by the partially submerged rock skerries. The lower beach has a relatively steep slope and the upper beach has a convex-up profile with a well-developed summer beach berm (MacTaggart, 1996). The reddish-coloured, medium-grained sand has median diameter of 0.46 mm within the dunes, but although the shell content is unknown it is likely to be about 40–50%, similar to most other west coast beaches of Sutherland.

Landwards of the beach a distinctive dune-capped gravel bar impounds the freshwater Sandwood Loch (Figures 7.22 and 7.23). In the centre of the bay, the dunes have an interesting and peculiar form, consisting of a series of upstanding vegetated dune pillars standing on a sand and gravel base. The dune pillars are likely to represent the erosional remnants of a more extensive dune system that previously covered the gravel bar. In July 1996, low embryo dunes were accreting seawards of the dune pillars (MacTaggart, 1996) (Figure 7.24). Gravel is periodically exposed in several other locations in Sandwood Bay, suggesting the gravel bar is laterally extensive and connects the cliffs in the south of the bay to the cliffs in the north (MacTaggart, 1996). The gravels of the bar are largely composed of Torridonian sandstones (Ritchie and Mather, 1969) seen best where the stream outlet of Loch Sandwood traverses the beach at its northern extremity. Between 1969 and 1996, this channel moved frequently and is now constrained by outcrops of gneiss in the north. During the high loch levels of late winter and early spring, several ephemeral streams develop and drain through the dune-capped gravel bar (Ritchie and Mather, 1969; MacTaggart, 1996).



Figure 7.24: Looking south from the dune-capped gravel bar of Sandwood Bay towards the stack of Am Buachaille ('the Herdsman') in the distance. The low embryo dunes in the foreground lie adjacent to dune pillars, the eroded remnants of a more extensive dune cordon. (Photo: Lorne Gill/SNH.)

In the lee of the dune-capped gravel bar there is an ephemerally flooded flat surface of bare sand (Figure 7.22). The flooding of this area is mainly due to the freshwater outlet from Sandwood Loch being impounded by the tide, but marine incursions may also flood this area (Ritchie and Mather, 1969). The low sand-bar that separates the ephemerally flooded tidal sand from the main body of Sandwood Loch, is best seen in summer when drainage of this area occurs. The accumulation of aeolian landforms at Sandwood Bay has been favoured by a location exposed to an open part of the Minch and Atlantic Ocean. An extensive sand-dune system has developed in the south-west of the bay as windblown sand is piled up against the Torridonian cliff escarpments and scree. Almost continuous sand recycling has produced exceptionally dynamic sand dunes in this part of the bay and several large elongate blowthroughs trending north-west–south-east are extremely active. Large areas of bare sand characterize this area; in the summer of 1996 there was evidence of considerable sand accretion and sand recycling within the system. The gravel or bedrock deflation bases of the main blowthroughs were covered with drifting sand and large sand aprons extended seawards onto the beach face (MacTaggart, 1996). The immaturity of the dune vegetation gives an indication of the dynamism of the dune system. The main dune area is characterized by abundant and vigorous marram *Ammophila arenaria* that stretches inland for 500–900 m (Dargie, 1994), and only locally do patches of more mature dune vegetation survive. In the south, marram-dominated dunes are piled up against the Torridonian cliff and blown sand colonized by marram extends inland and south-east onto the blocky scree and talus slopes.

Strong winds from the west and north-west have resulted in the extension of dune and aeolian activity inland, not only to develop dune surfaces high onto the Lewisian ridge to the north of the bay, but also to infill the northern part of Sandwood Loch. The lower parts of the northern Lewisian gneiss ridge consist of an assemblage of scree, glacially abraded and smoothed rock surfaces and climbing dunes. An active blowthrough has developed in the climbing dunes. At over 100 m OD, the upper slopes and ridge crest are covered by a well-developed climbing dune that supports a heath-type vegetation. Numerous erosion scars and terracettes characterize the surface as a result of sheep and rabbit grazing and scraping. Subsequent re-deposition of exposed sand has created localized accretion and embryonic dune forms within the dissected dune topography (MacTaggart, 1996). On the northern and western shores of the loch the dunes are cliffed and eroded as a result of wave action within the loch (Ritchie and Mather, 1969).

Interpretation

Sandwood Bay is perhaps the best example on the mainland of Britain of a naturally unstable and dynamic beach–dune system. Its relative remoteness has resulted in a system that is now largely unmodified by direct interference by humans and offers the rare opportunity to study natural rates of change in this high-energy and dynamic coastal system. Steers (1973) highlighted the fact that the site requires further investigation; however, perhaps as a result of the relative inaccessibility of the site, no detailed geomorphological work has been carried out to date other than the descriptions by Ritchie and Mather (1969) and MacTaggart (1996). In spite of this it is possible to interpret the landforms of Sandwood Bay in a systematic context.

Sandwood Bay has been glaciated several times in the past, the most recent Devensian ice passing northwards from Torridonian to Lewisian rocks leaving behind a legacy of polished and plucked valley sides and floor, a discontinuous till cover dominated by sandstone material and widespread occurrence of perched sandstone erratics on both the high and low ground (Ritchie and Mather, 1969). The exposures of bedrock on the foreshore and at the base of the dune complex suggest the existence of a discontinuous sill of rock, running transverse to the main structural corridor of Strath Shinary, and forming the foundation of the coastal and aeolian landforms that separate Sandwood Loch from the sea (Ritchie and Mather, 1969).

In common with beaches elsewhere in the Highlands and Islands of Scotland, Sandwood Bay was probably first closed by the development of a gravel barrier beach whose sediments were derived from adjacent rocky coasts and from glaciogenic deposits on the seabed (Ritchie and Mather, 1969). At Sandwood Bay, since the passage of ice was south to north, the local provenance of this glaciogenic material was Torridonian sandstone. The gravel was deposited on and between the various outcrops of bedrock that now underlie the beach and dune system. Since sea-level rise began to slow down in mid-Holocene times, it is likely that the gravel ridges date from this time and were overwhelmed by large amounts of sand that began to arrive from offshore to develop a wide beach and large dune system behind (Hansom and Angus, 2001).

Open to the north-west, and in a wind and wave environment dominated by westerly and north-westerly activity, Sandwood Bay is effectively a sediment trap for both onshore-moving sediments within the bay and for longshore-moving sediment from the cliffs to the south. However, frequent storm wave activity from the north-west is likely to result in a foreshore characterized by periodic reversals in onshore–offshore sediment exchange. Ritchie and Mather (1969) suggest that the Torridonian sandstone has been and remains a continual source of sediment for the coastal landforms of Sandwood Bay. The underlying gravel bar is composed predominantly of Torridonian clasts and the relatively coarse, reddish-coloured, quartzose fractions of the dune sand are derived from the subaerially weathered Torridonian cliffs to the south. The process continues today and in July 1996, angular and freshly weathered granules of Torridonian sandstone, blown and fallen from the cliffs behind, covered much of the adjacent beach surface (MacTaggart, 1996). Sand is probably still delivered to Sandwood from offshore, but since shell content is unknown it is difficult to estimate the offshore contribution, other than to suggest that it is now likely to be declining. Other sources of contemporary beach and dune sand come from the cliffs to the south and from sand recycled through the dune system by streams.

The exposed Atlantic location of the bay has also favoured the accumulation of aeolian landforms, and the natural structural embayment to landward has channelled windblown sand inland and uphill to cover the scree and high rock slopes to the north and south of the bay. The highly dynamic nature of the sand dunes and blowthroughs also suggest that there is continual sediment recycling within the system (MacTaggart, 1996).

Where the dissection is greatest within the dune system, distinctive upstanding dune pillars (Figure 7.24) are likely to be the result of erosion either by ephemeral streams that drain over the bar during high loch levels or by wave action during storms and extreme high spring tides (MacTaggart, 1996). Several changes have occurred since Sandwood was mapped by Ritchie and Mather in 1969, particularly in the south. The elongate multiple blowthrough system of 1969 has been modified into three large coalesced blowthroughs that have an amphitheatre-like form. Vertical accretion is widespread and, in 1996, 4–5 m thick aprons of sand had accumulated seawards and to the north of the main faces. Since the main axis of the blowthroughs in 1969 was north-west–south-east, the main direction of advance of the sand

removal is assumed to be landwards to feed the dunes behind. However, it is also clear that substantial amounts of sand are also returned to the beach during winds from the south and south-east, and this is also the direction of advance of a high-altitude blowthrough on the northern side of the bay (MacTaggart, 1996).

Conclusions

Sandwood Bay, western Sutherland, contains a spectacular assemblage of soft coastal landforms that have accumulated at the head of Strath Shinary impounding the freshwater Sandwood Loch. The principal geomorphological interest of the site rests in the very high levels of geomorphological activity in the beach and dune landforms, in a situation where human interference is limited, and thus offers a rare opportunity to study natural rates of coastal change. Individual features of interest include the dune-capped gravel bar, highly dynamic and mobile sand dunes, large blowthroughs and climbing dunes that reach hilltop altitudes of over 100 m OD (Ritchie and Mather, 1969). The cliffs that enclose Sandwood Bay are integrally linked to the past and current evolution of the geomorphological system, the sandstone cliffs that are undergoing erosion to the south providing an important sediment source.

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