# Eoligarry, Barra, Western Isles

[NF 700 060]

## Introduction

The sand isthmus of Eoligarry connects the rocky northern part of Barra, in the southern Outer Hebrides to the rocks of Ben Eoligarry Mór (see (Figure 9.1) for general location, and (Figure 9.6)). Eoligarry is a wedge-shaped complex of sand dune and machair flanked to the east by an extensive intertidal beach named Tràigh Mhór, and to the west by Tràigh Eais, which faces the Atlantic Ocean. Tràigh Mhór, a vast, creamy-white beach of shell-sand, is well known for its locally harvested cockles, source of shells for building work (although the factory has now closed) and spectacular intertidal landing-strip for the air link between Barra and the Scottish mainland. The geomorphological interest of this beach lies in its size and gradient together with a well-defined series of intertidal bars and mega-ripples. Tràigh Eais, is a narrow, steep, high-energy beach composed of both gravel and sand with a high shell content. Between these beaches, the peninsula of Eoligarry is of scientific interest on account of the vigorous erosional processes at work. Some 20% of the area of Eoligarry above mean high-water springs consists of windblown bare sand, and most of the typical erosional and non-erosional landform features of Hebridean dune and machair landforms occur (Ritchie, 1971, 1979a; Hansom and Comber, 1996). The site has considerable geomorphological, archaeological and botanical interest (Farrow, 1974; Ritchie, 1979; Hansom and Comber, 1996; Gilbertson *et al.,* 1996, 1999)

## Description

The GCR site of Eoligarry extends from MLWS on Tràigh Eais to MLWS on Tràigh Mhór, including all of the machair and dune area between and the hilltop machair of Ben Eoligarry Mór (Figure 9.6). It is noted for its range of classic machair erosional landforms within such a small area. The beach of Tràigh Eais on the exposed Atlantic coast of Eoligarry has a narrow, concave-upwards profile and is composed mainly of sand resting on a basement of gravel. Gravel up to *c.* 10 cm b-axis is evident on the upper profile, particularly in the north and also floors some of the depressions within the backing dunes. The break in slope between the upper and lower beach is indistinct in the south but in the north well-developed cusps occur in the prominent gravel storm ridge. The mean sand size on Tràigh Eais is *c.* 0.8 mm. There is evidence of an offshore bar lying about 80 m offshore from MLWS upon which waves break. Tràigh Eais is backed by a steep and unvegetated scarp eroded into the mature sand dunes. The extensive intertidal beach of Tràigh Mhór on the east coast of the Eoligarry isthmus, is characterized by a 1.3 km-wide platform of sand at low tide, although this narrows to 10 m at high tide (Figure 9.7). On Tràigh Mhór sand of 0.20.3 mm is found with a calcium carbonate shell component of 80% (Hansom and Comber, 1996). The interface between the low-tide platform and the narrow (*c.* 10 m wide) upper beach is marked by a distinct break in slope, with an associated change in colour, reflecting an increase in calcium carbonate content with distance up-beach. Distinctive bars and cusps composed of cockle shells occur on Tràigh Mhór, their genesis having been discussed by Farrow (1974). The mean diameter of the sand grains is 0.3 mm on the upper beach and 0.2 mm on the lower. The beach displays varied topography with an abundance of intertidal mega-ripples and bar-forms, particularly to the north towards the Sound of Orosay. Erosion of the machair edge occurs In the north but the centre and south of the bay supports low embryo dunes at the rear of the beach.

The Eoligarry dunes and machair form a triangular peninsula between Ben Eoligarry in the north (where it is over 1 km wide) and the mainland of Barra to the south (where it narrows to just over 300 m). The dune and machair landforms of Eoligarry can be divided into three main units: the high fringing dunes of Tràigh Eais on the western seaboard; the climbing dunes of Ben Eoligarry; and the various high and low undulating machair surfaces of the main isthmus. The dunes backing Tràigh Eais on the Atlantic coast represent an exceptional series of erosional aeolian landforms with a wave-eroded high dune ridge forming the frontal edge of the system. The dune ridge is lower and more continuous in the north, but reaches up to 20 m in the south where it is spectacularly dissected by several large and 15 m-deep V-shaped blowthroughs. Embryo dune forms are completely absent apart from minor re-deposition within the main blowthroughs. The blowthrough forms of the south represent spectacular examples of the erosional capability of winds crossing the

isthmus from both the prevailing (south-westerly) direction, and also less frequently from the north-western sector (Hansom and Comber, 1996). They form simple SW–NE-trending linear blowthrough chutes through which large quantities of sand pass through the massive, knife-edged dune ridge that backs Tràigh Eais. The blowthroughs are highly dynamic, the volume of sand in transit making natural re-colonization by vegetation difficult and undercutting of the lateral flanks serving to widen the corridors and reduce the intervening dune segment. In several places, most of the original dunes have been removed, leaving vegetation-capped residuals standing alone in the centre of a deflational sand surface (Figure 9.8). To the rear of the seaward dune ridge lies an area of undulating fixed dunes that is widest in the north. Some of these dunes show ridges and depressions that are orientated both west-east and north-south, at odds with the preferred orientation of the large active blowthroughs in the south. These are ridges that were artificially constructed as part of dune rehabilitation works in the 1970s.

The south-facing flanks of Ben Eoligarry Mór are blanketed by sand blown from the beach and dunes below. The presence of such climbing dunes demonstrates the frequency and strength of the prevailing south-westerly winds that have forced the sand up to altitudes of 103 m. Surface instability, due to both high winds and the large rabbit population, has led to the formation of a large, bowl-shaped blowthrough which has recently been re-activated, leaving a scar of bare sand on the hillside (Hansom and Comber, 1996).

Two types of machair surface exist at Eoligarry, both characterized by high calcium carbonate contents and a distinctive calcareous grassland devoid of long dune grasses. The first is a low, almost horizontal, closely vegetated surface dominating the central-southern areas of the Eoligarry isthmus. The second is a higher, more undulating form, distinct from, but frequently grading into, the fixed dune systems to the west. It is also found in isolated zones particularly in the north of the area. Although both types are the result of the deposition of sand at volumes below those of the dunes to the west, they are nevertheless subject to secondary erosion themselves. Numerous large and small blowthroughs, with both westerly and southeasterly orientations, are eroded into the machair surface and serve to distribute sand over adjacent surfaces.

## Interpretation

Eoligarry has been the subject of geomorphological and environmental archaeological research (Ritchie, 1971, 1979a; Hansom and Comber, 1996; Gilbertson *et al.,* 1996, 1999). The interpretation that follows is based on the above work and whereas some details of the evolution and development of the system are necessarily speculative, there is no doubt that the interrelationships of the landform assemblage within this dynamic system are of national importance.

The key to the depositional history of Eoligarry, and its current erosion on the west and deposition on the east, lies in the altitude and geometry of the low-lying former peninsula of Ben Eoligarry and Orosay that once jutted northwards from the Barra mainland. Such low-lying peninsulas have become subject to increasing amounts of marine influence as a result of the rise in sea level that has affected the Hebrides throughout the Holocene Epoch. The depth of the former rock connection between Bcn Eoligarry and the mainland is unknown but it must have been shallow enough to allow gravels, sourced from the nearshore zone, to be driven onshore to build an arcuate, west-facing barrier along the length of Tràigh Eais. In contrast, the connection between Orosay and Ben Eoligarry has become flooded by sea-level rise. The emplacement of one or more gravel ridges as part of a gravel barrier has played an important shaping role in the subsequent evolution of what are now largely sandy beach complexes. Once complete, the gravel barrier adjusted landwards and upwards in the face of ongoing sea-level rise. This is a common feature of the sandy and dune-backed beaches of Scotland where gravel is present on which wave-deposited beach and windblown sands have later accumulated (Hansom, 1988; Hansom and Angus, 2001). Where the source sediment is mixed, gravels are usually the first to arrive and are thrown up at the limit of storm waves, whereas sand arrives in quantity later.

The large influx of these coastal sediments is thought to have occurred around 6500 years BP (Hansom and Angus, 2001). It produced beaches with sufficient excess sand available on the upper profile to be blown into the extensive dune and machair systems that remain active today (Ritchie, 1971; Hansom and Comber, 1996). However, ongoing sea-level rise coupled with a reduction in offshore sand supply has also resulted in chronic erosion of many Hebridean beaches and the frontal undercutting of the sand dune systems that they support, such as occurs at Tràigh Eais. Some areas

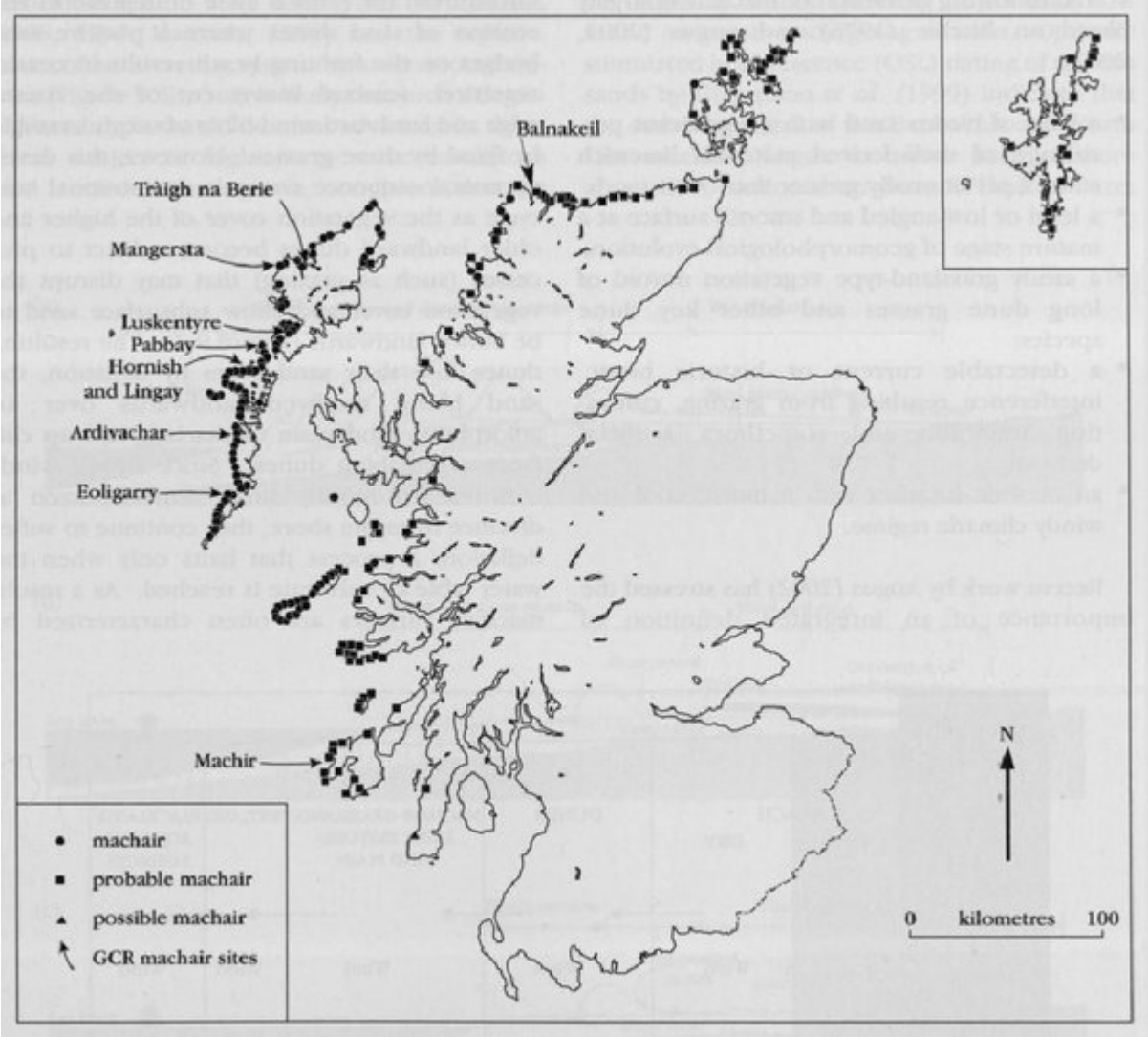
remained sheltered from severe waves and/or by a locally enhanced sediment supply and the effects of chronic frontal erosion have not yet occurred. Tràigh Mhór is such a beach, protected on all sides except the east and sheltered from Atlantic waves. It is a sediment trap within which a wide accretional beach has developed. Farrow (1974) Identified onshore-moving bars composed of cockle shells and sand as a result of both tide and wave-induced onshore transport. Time-series maps and photographs allowed Farrow (1974) to demonstrate onshore movement of the cuspate bars over the period 1948–1965 and 1965–1973.

Optically stimulated luminescence (OSL) dating of aeolian sands (Gilbertson *et al.,* 1999) indicate that the carbonate sand of the Barra machair began to arrive about 6800 years BP However, the arrival of aeolian sand and the initiation of machair development in the Hebrides was almost certainly non-synchronous (Ritchie and Whittington, 1994) and related to local bathymetry and sand supply as the sea level rose over the low-lying and undulating landscape. Thereafter within the Barra dunes and machair various palaeosols dating from Bronze Age to medieval occur together with evidence of periods of instability and sand-blow that extend into modern times. Gilbertson *et al*. (1999) show that the upper surfaces of the Eoligarry machair are only 100 years old. Hansom and Comber (1996) and Gilbertson *et al.* (1999) emphasize that the machair landforms of Eoligarry are continually developing but are probably more stable now than in the past.

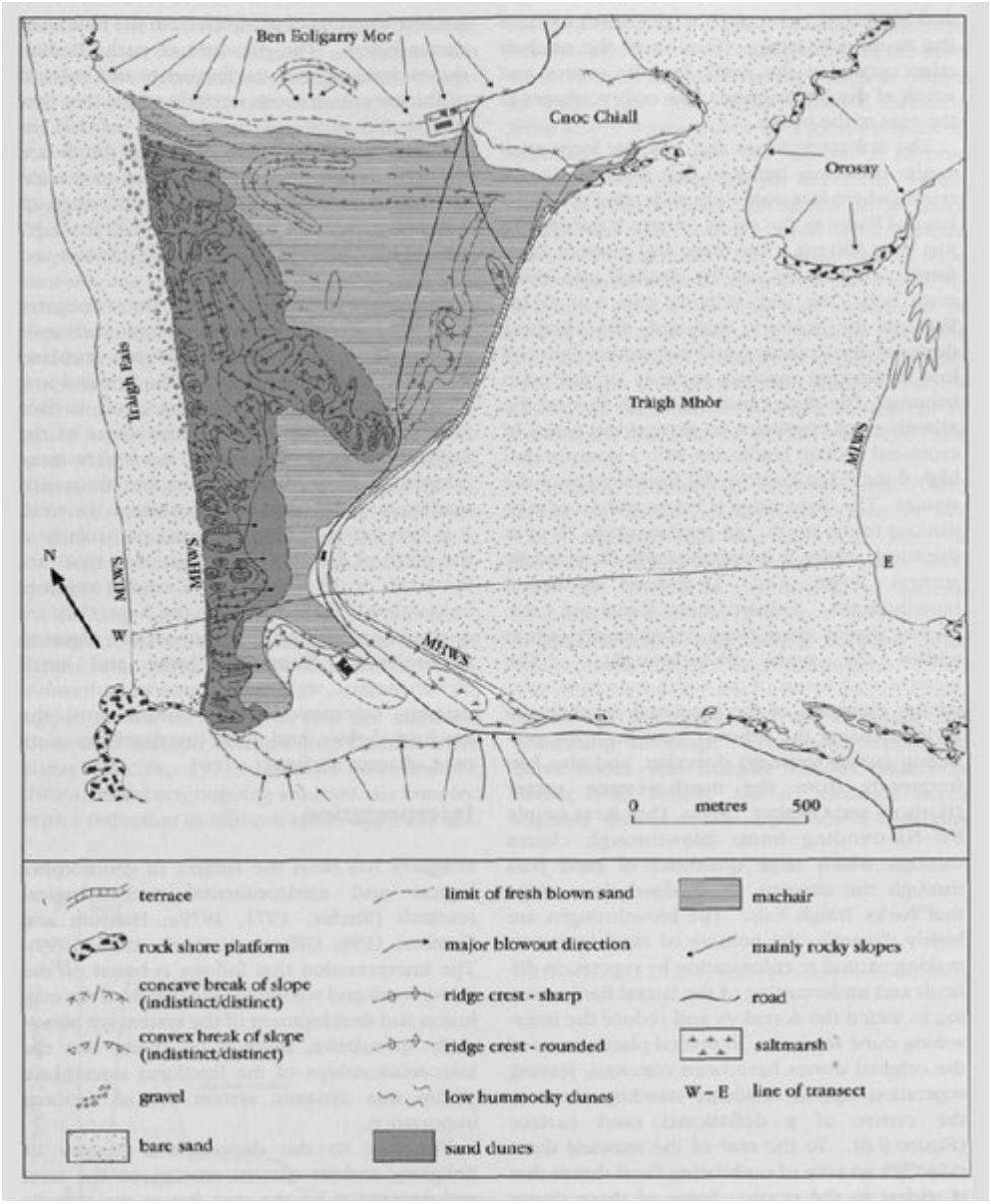
The main factors controlling the geomorphology of the dunes and machair features of Eoligarry are the degree of exposure and the availability of suitably sized sand for aeolian transport. Ritchie (1971) suggested that the high dunes and machair surfaces of Eoligarry are created and nourished by windblown sand from the beaches of Tràigh Eais. The vast extent of Tràigh Mhór derives some of its infill from sand blown across the narrow neck of land from the blowthroughs of the west. Sediment analysis of Tràigh Mhór beach shows that sands of 0.2 mm and 0.3 mm diameter are found on the lower and upper beach respectively whereas the dune sand to the west and rear of the beach is 0.37 mm (Hansom and Comber, 1996). Since the grain size of the dune would be expected to be finer than that of the feeder beach, the present, and probably the past, feeder zones for the dunes at Tràigh Mhór lie to the west. Nevertheless, Hansom and Comber (1996) identify a two-way flow of sand at Eoligarry as a result of easterly or north-easterly winds since, at the western extremity of the large blowthroughs, depositional 'tails' of aeolian sand up to 2 m high are streamlined to the south-west. In addition, along the eastern coastal edge, minor blowthrough features aligned towards the northwest have produced fans of bare sand on the surface inland. Once a blowthrough is initiated, local topography appears to exert an important control over its subsequent evolution.

## Conclusions

The scientific importance of Eoligarry rests largely in the outstanding range of well-developed active erosional features and processes that are unrivalled in any beach–dune–machair system of comparable size in the Hebrides. Most of the typical erosion forms of Hebridean dune and machair morphology are found at Eoligarry within an archaeological context that allows an unrivalled degree of dating precision of phased machair development. Scientific interest is further enhanced by the high- and low-energy flanking beaches of Tràigh Eais and Tràigh Mhór, and the resultant complex sediment interaction which occurs between beaches, dunes and machair plain.




*(Figure 9.1) Distribution of machair in Scotland. Other than Sandwood, Torrisdale and Balta (see Chapter 7), all the sites included in the GCR fulfil both the geomorphological and vegetational definition of machair. Small vegetational differences in the above sites have resulted in the label 'probable machair'. Ongoing work that interprets the geomorphology and botany of machair aims to provide a definitive machair diagnostic test in the future and so the above classification will be subject to slight modification (Angus, 2003, pers. comm.). (After Hansom and Angus, 2001.)*




*(Figure 9.6) Geomorphology of the Eoligarry isthmus. Note the narrow Atlantic beach of Tràigh Eais and the extensive flat beach of Tràigh Mhór between which lie a cordon of high dunes punctuated deeply by blowthroughs. The otherwise extensive machair surfaces are extremely narrow at the southern end of the isthmus. The position of the west-east cross-section of Figure 9.7 is indicated. (After Hansom and Comber, 1996.)*

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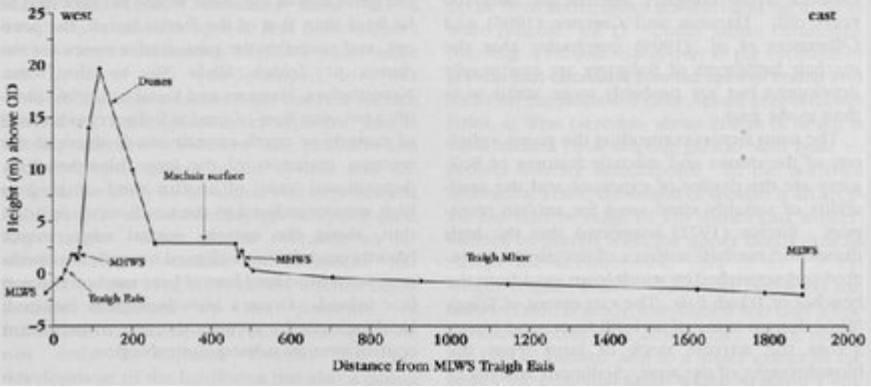


*(Figure 9.7) Representative cross-section levelled west to east over Eoligarry (see Figure 9.6 for line of section). Note the expanse of Tràigh Mhór and the relatively narrow cordon of coastal dunes that are currently undergoing severe wind erosion. (After Hansom and Comber, 1996.)*

*(Figure 9.8) Looking south over the large blowthroughs on the west side of Eoligarry. Some remedial work has been undertaken but deflation is now so extensive that several dunes have been reduced to isolated 'buttes'. Tr-Ai& Eais is to the right. (Photo: J.D. Hansom.)*