Upton and Gwithian Towans, Cornwall

[SW 575 406]

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Introduction

Much of the shoreline of St Ives Bay is formed by dunes, known as the 'Hayle, Upton and Gwithian Towans', banked against and covering bedrock to heights of over 60 m (see (Figure 7.1) for general location). Blown sand also covers parts of the western side of Godrevy Point at the northern end of St Ives Bay. Documentary evidence indicates that the dunes spread inland covering small houses from the 12th century onwards (Steers, 1946a). Dunes in the southern part of the site are gradually replaced northwards by rock cliffs, caves, stacks and arches overlain by blown sand and dunes. These features have been exposed as the covering dunes have been eroded and the shoreline has retreated. Remnants of former dunes are still preserved on the stacks, but are gradually being removed by subaerial processes. There has been only limited research on this site (Steers, 1946a; Balchin, 1954; Hosking and Ong, 1963); nevertheless the site is important as an example of a relict cliff coastline. It also allows examination of the interface between the dunes and the sub-dune surface.

Description

The site lies at the northern end of St Ives Bay. It is formed at its southern end [SW 572 393] by active climbing dunes which reach over 25 m in height and at its northern end [SW 580 416] by a series of cliffs, stacks, caves and rocky platforms known as 'Strap Rocks'. Between these two contrasting forms, the dunes undergoing erosion are gradually replaced at the shoreline by a small rock cliff upon which they rest. This cliff reaches about 20 m in height south of Peter's Point before declining towards 15 m around Strap Rocks. Between Peter's Point and the northern boundary of the site [SW 530 417], the cliff is broken by small coves, stacks and caves associated with lines of weakness in the Lower Devonian rocks. The stacks appear to have developed as marine action has attacked joints and other weaknesses (Figure 7.7) and (Figure 7.8).

Steers (1946a) described the area as a 'mass of high and well-developed dunes', and makes no reference to the erosional forms that now characterize the northern part of the site. Indeed, the dunes have suffered considerable erosion not only since the 1940s but also over a much longer period, for there appear to have been dunes well to seaward of the present shoreline in the early 19th century. Even allowing for the inadequacies of topographical maps as evidence for coastal change (Carr, 1962) both the Ordnance Survey and the Geological Survey maps point to considerable retreat of the shoreline.

Erosion of the rocky coast is slow when compared with the inferred rate of retreat of the dune shoreline. No dating of the interface between the dunes and the surface beneath them has been attempted. Many west coast dunes lie upon a rocky base and often owe their height to their rocky foundations; similar sub-dune rocky cliffs have been observed in Brittany, though without the intricate forms of Strap Rocks.

The dune sands are carbonate-rich (Table 7.3). The beach sands contain both tin and other heavy metals which have presumably been carried to the beach down the streams both to north and south (Hosking and Ong, 1963). The potential fluvial sediment supply to the beach has not been quantified, but may have been significant in the past. De la Beche (1830) indicates that up to 100 000 tonnes a^{-1} was removed from the Camel estuary in the 1820s, and extraction from this area may have removed comparable volumes.

Interpretation

This site is unusual in that it contains both active dunes and intricate erosional forms, the latter exhumed from beneath a retreating sandy shoreline. The relatively rapid changes in this site's cuffed coastline today contrast with the much slower changes farther north at Tintagel. It is the exhumed cliffline that makes this site particularly important for coastal geomorphology. There are several other locations where there is clear evidence of exhumation (Hallsands and Redend Point (South Haven Peninsula) in England, and Tarbat Ness and the Bullers of Buchan in Scotland — see GCR site reports). The dune-rock interface is poorly preserved at Redend Point, whereas in this site it is well exposed. At the Bullers of Buchan (Walton, 1959), stacks and geos are cloaked and infilled by till, indicating that they are at least older than the last glaciation.

Taken as a whole the site demonstrates a sequence from sandy dune shoreline through progressively dominant erosional rock forms to stacks with residual dune deposits atop them. As such, it is a good example of the cyclic nature of the processes affecting the British coastline. Erosional processes were replaced by depositional marine or periglacial processes, the resultant forms then being eroded and the earlier erosional forms exhumed. Even on a shorter time-scale of less than 100 years, much of this coastline is marked by oscillation between erosion and deposition.

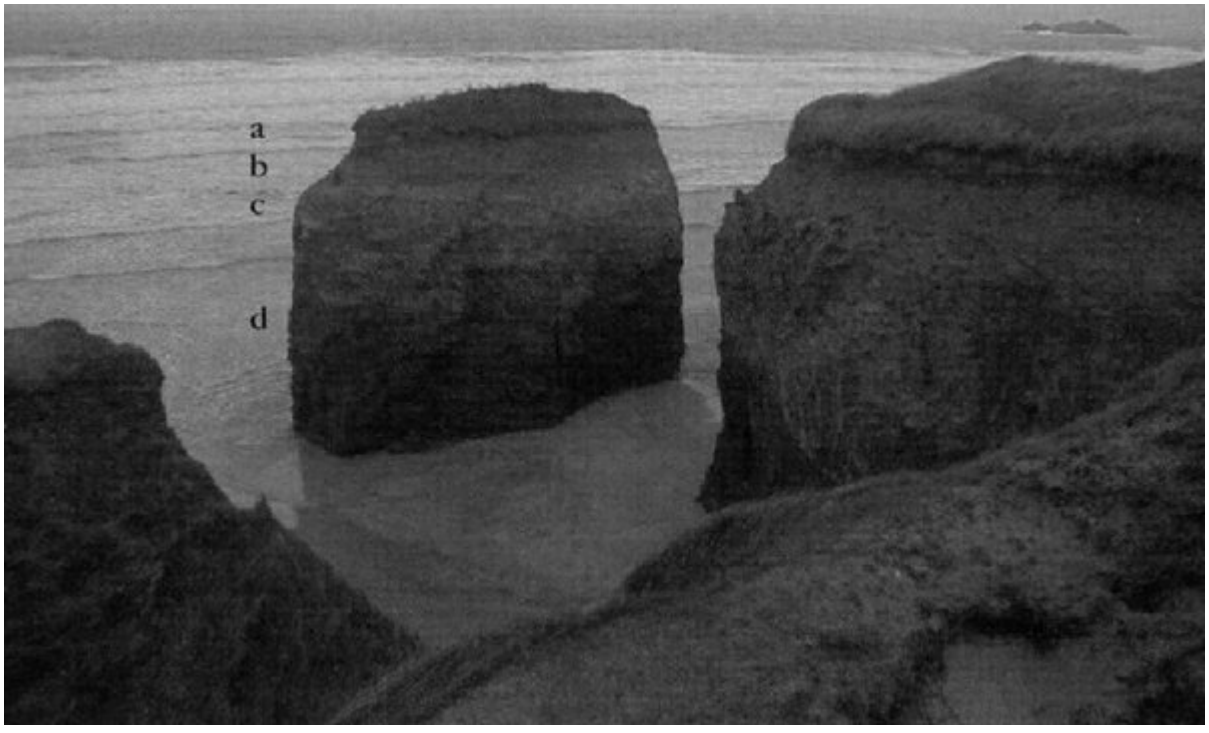
The age of the exhumed cliffs is not known. It is possible that they merely pre-date the dune growth and migration recorded along much of the Cornish coast during medieval times. Steers (1946a) notes for example the spread of the dunes in Perran Bay that engulfed St Piran's Chapel. Balchin (1954) suggests that St Piran's Chapel was buried before the 12th century. Leland (1535–1543) described St Ives in the 16th century as 'sore oppressed or over covered with sander...'. Steers (1946a) also refers to 'the east side of St Ives Bay where the dunes have buried St Gothian's Chapel and by 1907 had banked themselves around the walls of Millook churchyard'.

In the absence of a firm date, the contemporary origin of the cliffs must be considered. Assuming that the erosion of the dunes was sufficiently rapid during the late 1940s to bring the sea to the foot of the sub-dune rocky topography, all of the features now in existence at Strap Rocks could have formed since the 1950s. However, although erosion is undoubtedly taking place there is no evidence that the cliffs are eroding at a sufficiently rapid rate to produce the forms during this time. The presence of a layer of regolith and small angular dasts (possibly head) beneath the dunes that is continued on to the top of the stacks suggests that this was laid down before they were isolated. This suggests a substantial period of cold conditions followed by warmer conditions after the cliffs were formed, and so the cliffs could be pre-glacial and have been re-occupied in the Holocene Epoch. Subsequent erosion has removed the surface between the stack and the mainland. On balance it is likely that the forms substantially pre-date the dunes, have been exhumed and are being reworked at present.

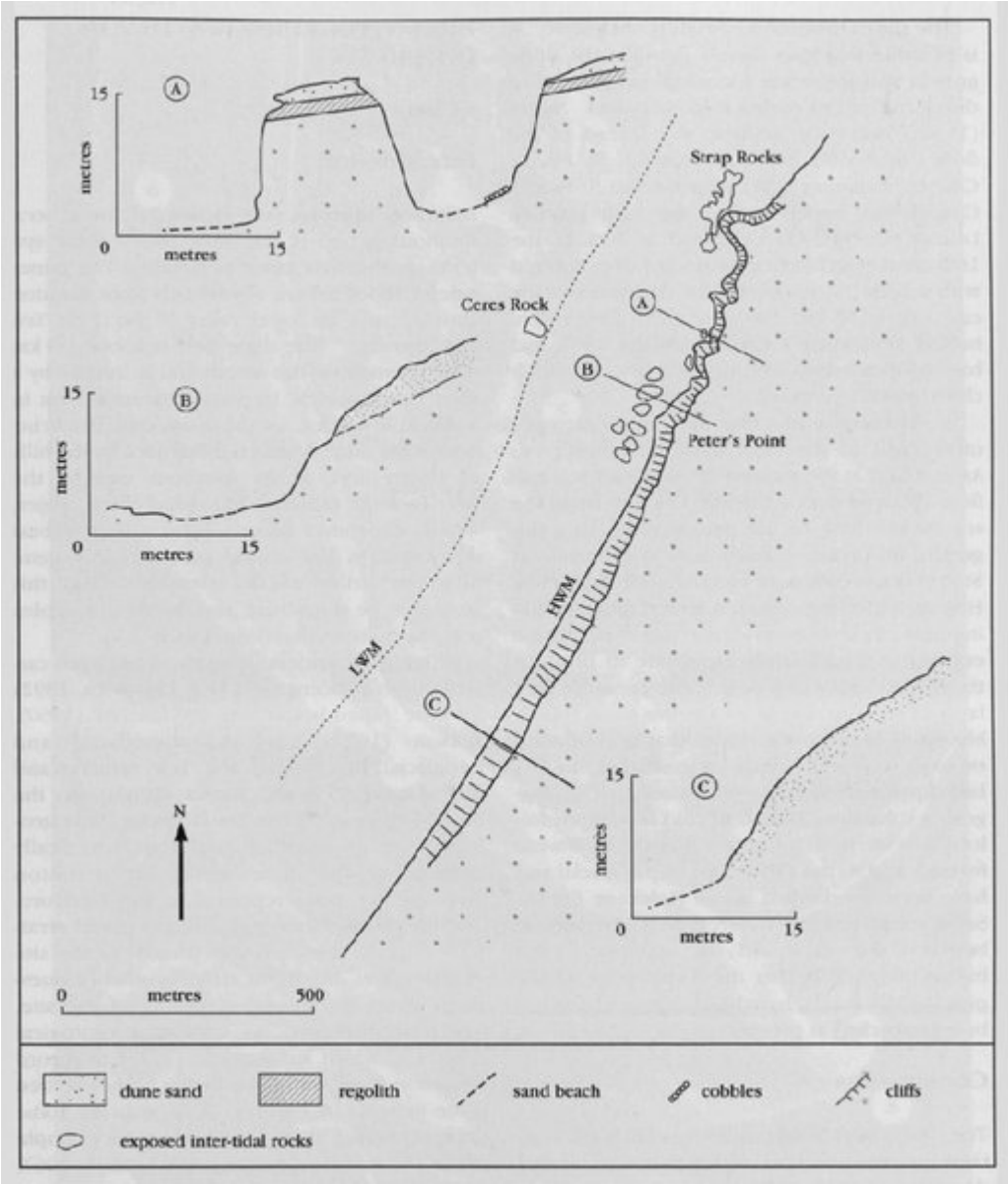
Conclusions

The Upton and Gwithian Towans GCR site contains an unusual set of forms that warrant further investigation. Cliff-forms and erosional features are being exhumed at this site from beneath a formerly more extensive dune system. They are unusual within Great Britain because there are few sites where erosional forms are being exposed by the removal of dunes at present. As dunes to the south have been eroded they have exposed former cliffs, caves and stacks.

(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.



(Figure 7.7) Upton and Gwithian Towans GCR site. Both on the mainland and on the stack the sequence a–d is as follows: (a) dune grasses on blown sand; (b) thin sandy soil on weathered clay and angular intermittent gravel-sized clasts; (c) weathered bedrock; (d) bedrock. (Photo: V.J. May)



(Figure 7.8) Relationships between dunes and cliffs at Peter's Point. Profiles through section A, B and C are shown.

Table 7.3 Calcium carbonate content of upper beach/foredune in selected coastal geomorphology GCR sites. Sites described in the present chapter are in **bold** typeface. (Based in part on Goudie, 1990, and various sources cited by Ritchie and Mather, 1984.)

Dune location	$CaCO_3$ (%)	Median grain size (phi)
Culbin	0.0	2.0
South Haven Peninsula	0.015	?
Lossiemouth	0.26	2.0
Tentsmuir	0.4	2.5
Luce Sands	0.5	2.4
Foevie	0.55	1.9
Buckton Ness (**Barry Links**)	1.0	2.0
Walney Island	1.51	2.21
Morfa Dyffryn	3.34	2.31
Ainsdale	3.57	2.13
Invernaver	3.8	1.9
Morfa Harlech	3.96	2.13
Newborough Warren	4.56	2.50
Youlas	4.98	2.29
Strathbeg	7.86	2.0
Rattray (Strathbeg site)	9.10	1.9
Laugharne (Pendine)*	11.15	2.00
Morrich More	12.0	2.4
Pembrey*	12.04	2.53
Oxwich Bay	12.45	1.93
Tywyn Aberffraw	13.20	2.47
Llangennith*	15.65	1.63
Braunton Burrows	19.59	2.13
Dunnet Bay	20.4	1.7
Dunbar	20.4	1.5
Westward Ho!	21.79	2.65
Machir, Islay	33.6	2.2
Mangersta, Lewis	38	1.4
Luskentyre, Harris	44	2.0
Traigh na Beric, Lewis	47	2.4
St. Ninian's Tombolo, Shetland	47.5	2.0
Balnakiel	52.0	1.8
Hayle (Upton and Gwithian Towans)	56.80	1.56
Loch Gruinart, Islay	59.0	2.1
Rodgarry, Barra	80.0	2.0
Ardivachar, South Uist	84.0	1.7
Balta Island, Shetland	95.5	1.8

* Carmarthen Bay

millennia, especially from the evidence of preserved peat associated with dune slacks and larger wetlands that developed shorewards of the coastal beaches. In contrast, other dunes are more recent, for example at South Haven Peninsula the dunes have formed since the 16th century. Some dunes, for example at Culbin, Moray, Newborough Warren on the Isle of Angelsey, and Hayle and Upton and Gwithian Towans, Cornwall, have migrated inland covering buildings and farmland. British dunes tend to be located:

1. in areas of high tidal range,
2. where prevailing winds provide the main means of landward aeolian transport, and
3. in association with estuary mouths dominated by large sandy sediment loads or at the heads of inlets and bays,
4. on north-eastern coasts, where strong winds from the north and east provide the means for landward aeolian transport e.g. the coasts between Aberdeen and Fraserburgh and Northumberland.

Narrow, linear-dune systems occur along eastern coasts that are associated with sandy estuaries or high tidal ranges, but the size of the dunes is generally much less than those of the exposed and windy western coasts, even though the intertidal sandy area may be very extensive.

There are few significant dunes on the eastern coast of England, apart from the dunes around Holy Island, Northumberland, and along the Lincolnshire and north Norfolk coasts. Between the Tees and the Tamar there are 24 dune sites (c. 8%) and between the Tamar and the Mull of Galloway 67 dune sites (c. 23%). The remaining 204 (c. 69%) sites lie along the coast of Scotland and the English coast north of the Tees. The largest area of dunes is in north-west Scotland, particularly in the Outer Hebrides where machair predominates (Ritchie and Mather, 1984; Dargie, 2000; see Chapter 9). Of 43

Table 7.4 Variations in calcium carbonate content and pH in foredunes and main dunes. (Based on Salisbury, 1952; and Willis, 1985)

Location	Calcium carbonate content of dunes		pH	
	Foredunes	Main dunes	Foredunes	Main dunes
South Haven Peninsula	0.015	0.01	7.0	5.6
Southport (near Ainsdale)	6.0	0.2	8.2	5.5
Braunton Burrows	20.0	8.5	9.05	8.2
Blakeney Point, North Norfolk Coast	0.6	0.02	7.3	4.2

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