Ynyslas and Borth Bog

Highlights

A site providing one of the most significant records of sea-level, environmental and vegetational change in the Holocene of Wales. Rock, pollen and radiocarbon evidence has provided a complex dated story of sea-level rise, forest and bog development.

Introduction

Ynyslas and Borth Bog provide a detailed record of coastal and environmental changes during the Holocene. Borth Bog is one of the largest and finest examples of a raised bog occurring near sea-level anywhere in Britain. The pollen biostratigraphy of the site was first studied by Campbell James (Godwin and Newton 1938). The site was also referred to in studies by Godwin (1940a, 1943), and Godwin and Willis (1961, 1964) provided radiocarbon age control. Foraminiferal studies have been carried out at the site by Adams and Haynes (1965) and Haynes and Dobson (1969). Moore (1963, 1966, 1968) studied the pollen biostratigraphy with particular reference to human influences, and the locality has been used in studies of sea-level changes by Churchill (1965), Wilks (1977, 1979) and Heyworth and Kidson (1982). Other accounts are given by Taylor (1973, 1980) and Turner (1977).

Description

Ynyslas and Borth Bog lie on Cardigan Bay just south of the Dyfi Estuary. The site comprises two main parts — the submerged forest and associated beds on the foreshore at Ynyslas [SN 604 927], and Borth Bog [SN 630 910] to the east. The submerged forest lies approximately halfway between high and low tide marks at about –1m OD. It was originally exposed by the building of sea defences at Borth, but these exposures are now largely obscured and the forest is best seen between *c.* [SN 604 924] and [SN 604 933]. The best exposures occur in winter, especially after storms which reveal the stumps and trunks of the forest embedded in a peat which overlies clay. The upper surface of the forest bed is frequently riddled with borings of the common piddock, while the underlying clays contain shells of the burrowing bivalve *Scrobicularia.* The submerged forest beds continue inland, beneath a shingle and sand spit, to underlie the whole of Borth Bog at a level just below OD.

Borth Bog (Cons Fochno) occupies some 800 ha (2000 acres). It is bordered to the west by the River Leri which separates the main bog from the shingle and sand ridge and the submerged forest see (Figure 10). To the south and east of the bog lies high ground; to the north, the bog borders the flats and salt marshes of the Dyfi Estuary (Yapp *et al.* 1916, 1917). Several islands of higher ground also occur on the edges and in the centre of the bog.

The sequence over much of the bog consists of:

5 Fresh *Sphagnum* peat

4 Greasy peat interpreted as a *Grenzhorizont*

3 Highly humified *Sphagnum* — *Calluna* peat

2 Wood peat and submerged forest bed

1 Basal *Scrobicularia* clay

At the northern margin of the bog, the sequence is interrupted by a wedge of sand, clay and salt marsh clay that cuts across beds 1–4 and the lower part of bed 5, and is overlain by the upper part of the fresh *Sphagnum* peat (Godwin 1943) — see (Figure 10).

At Ynyslas, Godwin and Newton (1938) described a sequence of:

5 *Sphagnum* peat

4 Fenwood peat containing a succession of *Alnus — Betula — Pinus* pollen

3 Alder-carr peat

2 *Phragmites* peat

1 Intertidal (*Scrobicularia)* clay

Interpretation

The submerged forest and basal blue-grey clay containing *Scrobicularia* at Ynyslas were first noted by Keeping (1878), and were discussed by Yapp et *al.* (1916, 1917). The first detailed study at the site was by Campbell James (Godwin and Newton 1938). Godwin and Newton suggested that the close correspondence between the sequences at Ynyslas and Borth Bog, indicated a parallel development of the areas from mid Pollen Zone Vila of the Holocene. Godwin (1943) ran a line of borings from north to south across the bog as well as a line extending from east to west, linking the first sections to the beach exposures at Ynyslas foreshore — see (Figure 10). These data confirmed that, over much of the area, the fossil forest and raised bog overlie the *Scrobicularia* clay. He suggested that the *Scrobicularia* clay was evidence for a marine transgression ending in mid Pollen Zone Vila, followed by a long period of woodland and bog development that was unaffected by rising sea-level. He proposed that a second marine transgression, shown by the clay within the upper part of the peat sequence along the northern margin of Borth Bog — see (Figure 10), had occurred within early Pollen Zone VIII.

Godwin and Willis (1961) provided radiocarbon dates from the exposed forest bed near Ynyslas. Birch wood *in situ* near the base of the bed was dated to 6,026 ± 135 BP (Q-380), and a sample from the basal peat yielded a date of 5,898 ± 135 BP (Q382). These dates show that an important change from marine to terrestrial conditions occurred in the area at about 6,000 BP. Subsequently, Godwin and Willis (1964) reported a date of 2,900 ± 110 BP (Q-712) from the base of the clay in the upper part of the peat sequence (bed 5) at the northern margin of the bog. Pollen evidence has shown that this later marine transgression occurred during the sub-Atlantic (Pollen Zone VIII), at the same time as the Romano-British transgression of the East Anglian Fens (Godwin 1943).

Churchill (1965) studied the relative displacement of deposits at sea-level at *c.* 6,500 BP at nine coastal sites in southern Britain, including Ynyslas. He proposed that the Ynyslas coast had been elevated by c. 3m since 6,500 BP by isostatic upwarping, a process which he considers has continued until the present day, except for a single interruption in the late Bronze Age, just before 2,700 BP. This, he suggested was too early to correspond to the marine event of the Romano-British transgression proposed at Borth (Godwin 1943; and subsequently Adams and Haynes 1965).

Adams and Haynes studied the foraminifera in the *Scrobicularia* clay and the later salt marsh clays around Ynyslas and Borth. The assemblages in the basal clay were shown to correspond closely with present day communities in the Dyfi Estuary, and they suggested that the assemblages showed a passage upwards from estuarine deposition through an open tidal flat, salt marsh and freshwater conditions. The *Scrobicularia* clay was believed to be the final deposit of the main Holocene transgression.

Moore (1963, 1966, 1968) studied the pollen stratigraphy of Borth Bog with particular reference to human influences in vegetation development during the Holocene. He showed that the forest peat contained a similar *Alnus–Betula–Pinus* succession to that reported by Godwin and Newton (1938) and Godwin (1943). He demonstrated that Man was a significant factor influencing the development and destruction of vegetation in the area: the times of most severe forest destruction appear to have been the Iron Age-Roman period and that between the fourteenth and eighteenth centuries (Moore 1968).

Recent studies by Wilks (1977, 1979) and Heyworth and Kidson (1982) have elaborated the sequence and the nature of the Holocene evolution of the area. Stratigraphic, microfaunal, pollen and comprehensive radiocarbon dating evidence show that, following glaciation by Late Devensian ice, a large basin in the Borth-Ynyslas-Dyfi area became progressively infilled with marine and estuarine sediments, as the Holocene sea rose. By about 6,500 BP the rate of sea-level rise had slowed, and coastline conditions stabilised, allowing the development of a sand and shingle spit which extended northwards from the cliffs near Borth (Wilks 1979). Estimates show that this spit or bar probably lay about 1 km seaward of the present shoreline. This protective barrier provided more stable and sheltered conditions on its landward side, and there vegetation began to develop. First a reed swamp grew, and, with continued sedimentation and drier conditions, vegetation successions from alder-carr to birch scrub and eventually to pine and oak forest. By about 6,000 BP, an oak and pine forest with alder, hazel and willow was well established.

Important changes in forest type and age have been noted between the southern and northern parts of the submerged forest beds, between Borth and Ynyslas (Wilks 1977, 1979; Campbell and Baxter 1979; Heyworth and Kidson 1982). First, remains of pine trees and reed swamp are prevalent in the northern part of the site, with oak more common in the south. Second, tree ring counts by Heyworth (see Wilks 1979) show the average age of large trunks in the south to range from 150–250 years, with some oaks up to 330 years. In the north, near Ynyslas, the average age of trunks was 80–120 years. Third, radiocarbon dating (76 dates) by Campbell and Baxter (1979) shows that the trees at Ynyslas died at c. 5,400 BP whereas those at the southern end died at *c.* 3,900 BP. These data show that the forest in the south near Borth was more mature, consisting mainly of oak trees, and longer-lived than the forest farther north near present day Ynyslas. In the north there was only sufficient time for the succession to reach the pine forest stage before tree growth was halted.

By about 4,700 BP, much of the forest growth had stopped. One exception was the northern flank of the present day Borth Bog where birch scrub developed (Wilks 1979). As peat developed in the wetter conditions over most of the area, tree stumps and fallen trunks were preserved by anaerobic conditions. Many fallen trunks show an orientation from WSW–ENE, suggesting an exposure to westerly winds (Taylor 1973).

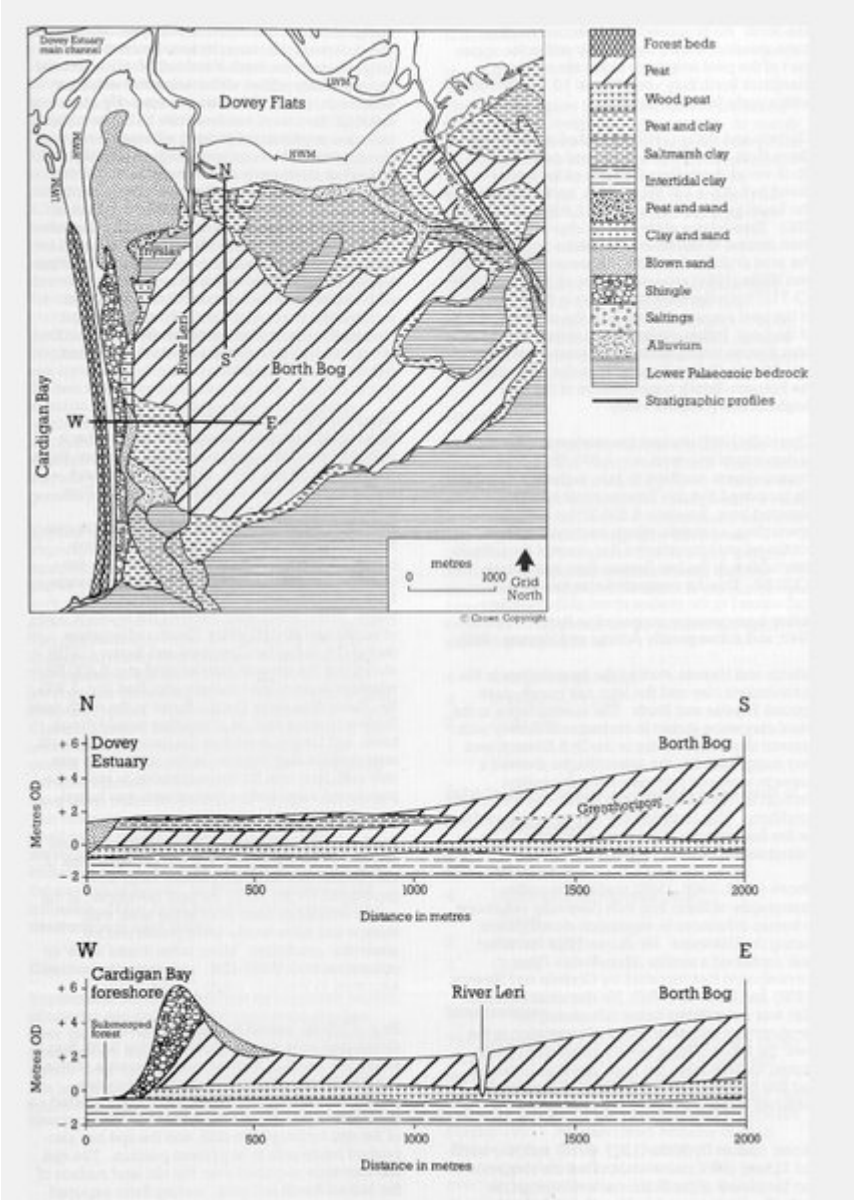
By c. 4,500 BP, raised *Sphagnum* bog had developed over the site of present day Borth Bog, killing the forest as it extended southwards. Since *c.* 4,000 BP, as sea-level has continued to rise slowly, the cliffs south of Borth have been eroded gradually, maintaining the northwards development of the spit by longshore drift, and the spit has also pushed landwards to its present position. The spit has therefore migrated over the old land surface of the buried forest and peat, leaving them exposed on Ynyslas foreshore. Ynyslas and Borth Bog provide a detailed record of coastal environmental changes in Wales during the Holocene. The sequence is especially significant in having been calibrated with a radiocarbon timescale (Godwin and Willis 1961, 1964; Campbell and Baxter 1979). Although the pattern of recorded changes is clear, the underlying causes are not yet fully understood. Stratigraphic, radiocarbon and pollen data provide convincing evidence that a coastal barrier had developed at the site by about 6,500 BP. By c. 6,000 BP, it is also clear that sedimentation was exceeding the rate of sea-level rise, and between c. 6,000–4,700 BP, a vegetation succession culminating in oak and pine forest developed on the prograding land surface behind the coastal barrier. Following this 'regressive overlap' (Shennan 1982, 1983) at about 4,700 BP, the forest was overwhelmed by *Sphagnum* peat bog as the result of a rising water table: a rising sea-level and increased rainfall, or a combination of the two may have been responsible. Any tendency towards impeded drainage and waterlogging would have been amplified by the flat surface of the *Scrobicularia* clay. Wilks (1977) suggested that the regressive overlap at Borth Bog and Ynyslas was, therefore, a consequence of local coastal geomorphological conditions.

Ynyslas and Borth Bog provide one of the most important records of Holocene coastal and environmental changes in Wales. The sequence shows evidence for a period of marine sedimentation followed by a phase in which a succession of terrestrial vegetation can be traced. The destruction of forest and the establishment of *Sphagnum* raised bog indicates wetter conditions. The causes of this are unclear, but a rise in sea-level and/or increased rainfall in the Holocene have been suggested. Whereas the sequence at nearby Clarach shows a balance between the rates of sea-level rise and terrestrial sedimentation, local coastal geomorphological conditions, in particular the development of a coastal barrier, appear to have been controlling factors at Ynyslas and Borth. The contrasting records serve to emphasise the need for a network of sites to trace former shorelines and to reconstruct past sea-levels. The Holocene pollen record from Borth Bog enhances the interest of the site, providing evidence of the influence of Man in vegetational development and destruction in west Wales.

Conclusions

Ynyslas and Borth Bog provide an important record of coastal, sea-level and environmental changes over the past 7,000 years. Part of this evidence is provided by the famous exposure of submerged forest. Such detailed records of sea-level change are important because they can be used to predict future changes.

References



(Figure 10) Quaternary deposits at Ynyslas and Borth Bog (after Godwin 1943)