NORTH WALES INTERTIDAL PEAT SURVEY 2001-2002 (G1679)

Report No. 450

Prepared for
Cadw: Welsh Historic Monuments
March 2002

Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

Cover Photograph: Nigel Bannerman and Terry Williams examining
lower peat bed at Llandudno North Shore 28th February 2002.
1m scale

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1. INTRODUCTION

The existence of submerged land surfaces and 'forests' around the coast of Wales and England has been recognised for several centuries, the earliest recorded evidence being that of Gerald of Wales, who records the exposure of a submerged forest at Newgale, South Wales, in 1172. Occasional records were made in the 18th and 19th century but until recent years the main research in this area was that of geographers, looking for evidence of changing sea-levels during the post-glacial period. In Wales there have long been folk traditions of 'drowned lands' off Cardigan, Meirionnydd and Caernarfonshire and these have encouraged interest in the subject, for instance in the work of Ashton (1920). Extensive research programmes began with the work of the geographers Kidson, Heyworth and Tooley in the 1970's, studying evidence for sea-level changes around the British coast. Archaeological work began in earnest with the work of Wilkinson and Murphy (1984 and 1986) in the Hullbridge estuary of Essex, which demonstrated for the first time the wealth of archaeological and environmental evidence waiting to be recorded. Subsequently, several major projects have produced important results, particularly those of the Severn Estuary Levels Research Committee, the Northumberland Coastal Survey, the Langstone Harbour project and the Wooton-Quarr research project in the Solent. Other work on terrestial coastal archaeological sites had already focussed interest on the potential of the coastal area, such as the work at Gwithian, Cornwall, the Scilly Isles, Hengistbury Head, Dorset, Brean Down, Somerset and Stackpole Warren, Dyfed. At the same time policies were being developed to facilitate management of the coast for planning purposes because of the prospect of rising sea-levels and erosion as a result of global warming. Subsequently the Coastal Forum was set up as a discussion group to include all interested bodies in regional meetings (DoE 1993). Cadw initiated the Coastal Erosion survey of Wales in 1993, which concentrated on the archaeology of the terrestrial edge and its erosion, rather than the intertidal zone. In England a review of coastal archaeology and research was carried out for English Heritage, which produced a desk-top summary of the geomorphological and environmental background, of survey techniques and of the extent of archaeological knowledge including the terrestial and intertidal zone with some reference to the sub-tidal zone (Fulford *et al* 1997). This was a management-led study with a remit to characterise the resource, assess the threats, synthesise the evidence for sea-level change in the past and the future, look at management and at survey priorities (*ibid.* 17-18). This produced some general principles, of which the most important for the present study were - that intertidal and sub-tidal archaeology should be regarded as just as important, and managed by the same principles, as terrestrial archaeology and that management should be applied, where possible, according to the same principle of preservation and incorporated in wider coastal zone management schemes. It also made some detailed recommendations for research of which that most relevant to present work was research on 'palaeo-environments and the creation of the coastal landscape (including the distribution and condition of submerged land surfaces: cultural and environmental evidence present in the remains of submerged forests and peats and their relationship with contemporary coastlines; sea-level change, shoreline evolution, and their chronology)' (*ibid.* 19).

It has also been pointed out that the threat of rising sea-level as a result of global warming, and the potential huge cost to the economy, not only threatens the archaeology, as identified by the pan-Wales coastal survey, but that the intensive historic record and understanding of the coast edge and changes to it are a subject for which archaeology provides essential information. This should form an integral part of the interface between purely scientific geological studies such as stratigraphic borehole evidence and sediment movement analysis and the requirements of everyday land use for roads, housing and industry.

Despite the substantial discoveries from various parts of Britain mentioned above, work focussed on local or regional issues and the Fulford report recommended that more general assessment should be a priority. It suggested this should take the form of desk-based assessment, aerial photographic work and field visits. The present study was designed to be such a general assessment. Its aims were to identify areas of intertidal preserved peat land surfaces, to assess their extent, nature and potential and to assess the threats to them, both specifically and in relation to possible changes in the coastline as a whole. In the latter it should tie in with the previous coastal erosion surveys of Gwynedd. These identified areas that were vulnerable to rising sea-level, those below 5m OD, which were probably flooded at the maximum of the post-glacial transgression and which are directly relevant to the study of the intertidal peats (Whittow 1965). As a result further work has been carried out on coastal sites, including the Tide Mills survey (Davidson 1998), evaluation excavations at the Bishop's Palace, Gogarth, Llandudno (Davidson 1999b) and at Tywyn y Capel medieval cemetery, Trearddur Bay, Anglesey (Davidson (1999a) and the Fish Weirs survey (Hopewell 2000).

Intertidal areas are best known for their prehistoric remains, which include the numerous submerged forests of broadly Neolithic date and the many timber features of Bronze Age and later date known from the Severn Estuary. However, the intertidal zone may preserve other valuable remains, even where peat is not present, particularly remains of industries or activities exploiting the tidal margins such as fish traps, trackways, jetties, breakwaters and boats. The Fulford report specifically identified a weakness in the present record with regard to medieval and post-medieval remains. In north-west Wales a major part of the economy was once concerned with the construction and sailing of small coastal vessels and their use as transport, particularly of stone and slate, as well as in fishing. There is also some evidence related to 'historic' engineering works, such as the building of the Britannia and Menai Bridges, Victorian piers and WWII Mulberry harbours, defences and training camps as well as harbour works, wrecks and abandoned vessels. The Gwynedd coastal surveys listed many features relating to these industries and more detailed research and recording is needed.

2. THE BACKGROUND TO COASTAL STUDIES

The most extensive work in the intertidal zone in Britain is that carried out since about 1990 in the Severn Estuary. However, the development of interest in wetland archaeology generally, began in Britain in the late 19th century in the Somerset Levels at the Iron Age settlements of Meare and Glastonbury (Bulleid and Gray 1911, 1917 and Coles 1987) and later, in Yorkshire, at the Mesolithic settlement of Star Carr (Clark 1954). The gradual development of environmental studies and the particular value of organic survival in wetland deposits was brought to fruition by the work of John Coles in the Somerset Levels, paralleling work on the Continent in Switzerland, Denmark and Poland. After demonstration of the potential, surveys have been carried out in the Fens, North-West England, Humberside and Scotland. Smaller, more focussed projects have produced significant results at Wooton-Quarr on the Isle of Wight, in Langstone harbour, Hampshire, the River Blackwater, Essex, Westward Ho! Devon and in the Scilly Isles. In Wales the work has all been in the Severn estuary, carried out by the Severn Estuary Levels Research Committee, producing outstanding results, which include the Later Mesolithic settlement at Goldcliff, Gwent, associated with rich organic remains, round houses of the Middle Bronze Age at Rumney Great Wharf, Chapel Tump and Collister Pill, rectangular structures of the Middle Bronze Age at Redwick and of the later 1st millennium BC at Goldcliff (Bell *et al* 2000) as well as many more finds, including parts of trackways and fishing structures. This was combined with good dating evidence (sometimes with the added precision of dendrochronology), geomorphological studies of processes and environmental evidence. The survival of organic artefactual evidence from this type of work has helped to demonstrate how sparse the archaeological evidence is from dry land sites of these periods, where only objects of inorganic material survive, often with no accompanying economic or environmental evidence.

The success of all these projects provoked a strategic review of the whole resource in England, commissioned by English Heritage and the RCAHME (Fulford *et al* 1997), mentioned above. The survey identified several major points and showed how important the intertidal submerged peats were, particularly for their organic and environmental evidence around the west of Britain where bone rarely survives on terrestrial sites. It also pointed out that projected future rises in sea-levels could result in breaching of coastal barriers and subsequent erosion and so further work was desirable, stating 'At the outset there is much to commend a national base-line survey of the peats and 'submerged forests' of England' (*ibid.* 216).

In all the work in the intertidal zone it is increasingly apparent that there are features inland and on the coast edge and even possibly in the sub-tidal zone that may be part of a related socio-economic pattern. This view has been pursued successfully in the Wooton-Quarr project where intertidal survey together with detailed planning of features has been supported by study of the onshore environment as well as by trawling of the deeper sea bed to provide samples of artefacts (Tomalin 2000, 86). It is important therefore not to be too focussed on one environmental zone. Fish-traps and related structures for instance are part of a local economy. How does a stray find of a stone axe relate to similar finds in inland contexts? The Isle of Wight sub-tidal survey suggested that artefacts accumulated around mooring areas while on open coasts others might derive from shipwrecks. The English Heritage survey pointed out that most surveys have some bias towards a particular approach, a particular period or monument type. In the Severn Estuary research has been carried out over a long period and with a variety of approaches. In north-west Wales there has been quite comprehensive survey of terrestial archaeology and previous study of the coast edge itself. The intertidal zone in Gwynedd therefore presents itself as an area needing a 'base-line survey' and the present survey aimed to fulfil this requirement.

3. ARCHAEOLOGICAL AND ENVIRONMENTAL BACKGROUND

The background to sea-level changes since the last glaciation in north-west Wales has been reviewed by Whittow (1965). The main evidence is provided by the intertidal peat or submerged tree remains, including ten reported locations around Anglesey, three on the Llyn peninsula and six on the north Caernarfon coast (Fig. 1). There have been further identifications in recent years as a result of the observations of local historians Margaret Griffith, Cecil Jones (University of Wales, Dept. of Ocean Sciences, Bangor), Nigel Bannerman and Terry Williams. Some of these intertidal deposits have been visible only at extreme low tide while others are visible relatively high on the beach. The present dating evidence suggests that the last inundation occurred several thousand years ago. The nearest detailed studies of sea-level changes are those carried out in north-west England (Tooley 1974, 1978 and 1985) and in mid-Wales (Heyworth and Kidson 1982). The latter suggest a rapid rise in sea-level to about 5m below the present by about 5500BC followed by a gradual increase to the present. Tooley's work in the north of England shows where the land had been covered by an ice sheet the sea encroached further inland than the present day levels. This is because isostatic uplift of the land, after removal of the ice, meant that the shore line was also uplifted, giving the appearance that sea-levels had retreated. Moreover, actual sea-levels rose and fell within the general sequence and this scenario would fit a situation where a number of peat levels and silt levels would accumulate over time. This latter pattern of a period of oscillating sea levels and of a period of apparent transgression above present levels is one that should also fit north Wales, which was also affected by an ice sheet cover. Heyworth and Kidson suggested a sea-level curve for north Wales, based on the two dates then available (from Rhyl and Llandudno) with sea-levels between about 7500-4000 radiocarbon years BP being about 2m above those of south Wales and southern England (*ibid.* 110, fig. 5) although they rule out Whittow's idea that there were post-glacial raised beaches in north Wales. However, the main observation still stands, that the main, rapid inundation was completed some time at or before the Early Neolithic period. Areas of preserved land surfaces seem to be fairly uniformly areas of coastal regression: low-lying level areas of silts deposited as sea-levels rise, that then become colonised by marsh or even wet woodland, which is then lost as sea-level rises again.

The archaeological background would suggest that these areas of marshy foreshore would be areas of special, perhaps seasonal activities, such as hunting and fishing, Thus at Lydstep Haven, Pembrokeshire two microliths, probably from an arrow or spear, were found in close association with a pig skeleton in intertidal peat (Jacobi 1980, 171-5). However, there may have been seasonal settlement on the marshes, as shown by the lightly built rectangular buildings of the second and first millennia BC found at Redwick and Goldcliff in the Severn Estuary. In other cases the associated settlement might be just nearby, overlooking or easily accessible to these productive hunting and fishing areas. Around the coast of Gwynedd evidence of flint working on several coastal or estuarine promontories provides possible evidence of such settlement of Early Mesolithic date at Trwyn Du, Aberffraw, Anglesey and Pencilan Head, Llyn, of Later Mesolithic date at several locations around the coast of south Llyn, of Early Neolithic date at Bryn Glas, Penrhos Bay, Holyhead, Anglesey and of the Beaker period at Bryn Llwyd, Newborough, Anglesey. All of these are close to known intertidal deposits and there is potential for associated evidence to be found there.

The prehistoric inundations may have been the most significant but there must also have been periods of more recent fluctuations. Sand blows occurred in prehistory and may have been the result of falling sea-levels, leaving beach sediments exposed to erosion. Similar sand-blows also occurred in historic times. Baillie (2001) has identified a severe growth reduction in tree rings for 540 AD across Europe, matching other evidence from around the world and has claimed that a natural disaster, apart from many other effects, may have created tidal waves that would have affected the form of the coast edge. A severe deterioration of climate in the 14th century AD (Parry 1985) not only affected agriculture generally but was also accompanied by widespread sand-blows at Newborough on Anglesey. Intertidal remains should therefore be seen as just part of a complex of coastal features, which might be inter-related.

The earliest references to submergence in our area, apart from the factual observations of Gerald of Wales, are those contained in folklore in the story of the Cantref y Gwaelod (the Lowland Hundred) in a manuscript supposed to be by Sir John Wynn of Gwydir, Conwy, written, 'before 1627', recording the history of 'Helig ap Glannog, great grandson of Cadog, called by the Saxons Cadog the Strong ... afterwards king of North Wales, who had many great conflictes with the Romanes (sic)...This Helig ap Glannog was Lord of Abergele, Rhos, Arllechwedd, Llyn, Cantred Gwaylod and Earl of Hereford. In his time happened the great inundacion which surrounded Cantred Gwaylod … from Bangor to Gogarth (Great Orme) ... and to the point of Flintshire that came up from Ruthlan to Priestholme (Puffin Island or Ynys Seiriol)' (Williams 2001). Lewis Morris in the

eighteenth century also mentioned that farmers who dug in Dulas Bay, Anglesey for organic material to improve their land 'find in digging about a foot deep, an Inumerable quantity of Nut shells, and I have seen fir trees dugg up there …' (Morris 1725).

More exact understanding derives from the discovery of datable artefacts on the intertidal peat beds in north-east Wales around Rhyl and Abergele, including flints, animal bones, two axes of Graig Lwyd stone and a bronze armlet (Glenn 1935). Two separate levels of peat were recognised there, the upper lying over a 'blue estuary clay' containing fresh water mollusca. This clay overlay a lower forest bed with peat which also lay over another layer of estuary clay and this overlay an 'old land surface' meaning clay and gravel glacial till. It was also noted that in some places at Rhyl a 'dense growth of scrub' grew in the surface of the till (*ibid.* 207). This may actually have been the lower root system of trees penetrating from higher surfaces. Over 70 casual finds of prehistoric artefacts have now been recorded from the beach at Rhyl (Manley 1988, 185) including several Bronze Age finds and two Roman coins (Jones 1997, 30-1). Of most interest was a Mesolithic antler mattock from Splash Point, Rhyl, dated to *c*. 6560 BP (Bonsall and Smith 1990).

The existence of two levels of peats at Rhyl and Abergele was an important observation. It showed that sea level rise was not simply a gradual process but may have had distinct stages that might be correlated with similar evidence elsewhere. The range of dates of material recovered from the peat beds also demonstrated that because of the nature of the environment of deposition, artefacts are not necessarily well stratified because objects can sink into the mud or peat and so be detached from their contemporary surface horizon.

The next nearest extensive exposure to north-west Wales, which has been the subject of study is that at Borth and Ynyslas, Cardiganshire, close to the south of Meirionnydd. There, intertidal peats are exposed for some 5km along the shore. They appear as outcrops on the beach from beneath the adjoining Borth raised bog, under which they must extend, and consist of fen, alder carr and forest beds overlying salt marsh clay (Heyworth and Kidson 1982, 102). Radiocarbon dates give a date of *c*. 6000 BP for the underlying salt marsh and dates of *c*. 5400 BP to 3900 BP, at its lowest for the forest bed (*ibid.*). A number of casual archaeological finds have been made from these peats including a Mesolithic flint pick, flint flakes, an antler tool and a hearth which produced a date of *c*. 4000 BP from the surrounding peat (Sambrook and Williams 1996, 26) as well as bones of red deer and *bos primigenius*. A series of radiocarbon dates were used to reconstruct a sea-level curve for Cardigan Bay, which was found to be not significantly different to curves from the Bristol Channel, Somerset Levels and English Channel (Heyworth and Kidson 1982, 110). As discussed above, an attempt to construct a curve for the north Wales coast indicated that sea level was once about 2m higher, possibly because the coast itself had risen because of isostatic recovery. Fortunately, as a long-term gradual event, isostatic recovery might affect the absolute levels of individual coastal events but should not affect the overall stratigraphic sequence. However, the types of deposits could vary somewhat depending on local geomorphology. For instance a stabilising coast in north Wales might be equivalent in time to one still flooding further south.

Since Heyworth and Kidson's work there have been no more published synthetic studies of North Wales but there have been two more radiocarbon dates, both from mature tree stumps on the intertidal peat (Williams 1996). The first was of oak, from Llanddwyn, Newborough, Anglesey, of 6925 BP +/- 90 (SRR-5265). The other was of alder from Llandudno, North Shore, of 6985 BP +/- 45 (SRR-5266). Other work has been carried out on deposits recovered as part of a watching brief on the construction of a waste-water pipeline, in the valley of the Afon Ganol, Conwy, between the Little Orme and Rhos-on-Sea (Dorning 1999). The valley is a low-lying area that was a tidal inlet until the early 19th century, at which time it was drained and protected by a sea-wall. The results are important for overall interpretation because intertidal peats occur just beyond the valley mouth in Penrhyn Bay, part of the present project (Fieldwork results, PRN 16581, below). The environmental investigations at the Afon Ganol consisted of observation of bore-holes and digging of trial sections. Two main sections were analysed, C in the middle and F close to the coast edge. These revealed, in places, three levels of buried peat. The results are summarised in Table 1. The lowest was woody peat with abundant pollen of *Alnus* and *Pinus* and lay directly over the boulder clay and solifluction deposits, like the lower peat at Rhyl, with which it was assumed to be equivalent in age although it was not dated. The Middle peat produced dates within the range of *c*. 5200-4900 BC and the Upper peat of *c*. 3950-3650 BC. Another section near the present coast edge only revealed one peat horizon but with a date and palynology that indicated it was equivalent to the Middle peat. The variations between the borehole sections was deduced to result from deposition within a restricted estuary, where levels and deposits would be affected by local slopes and landforms.

It was unfortunate that no date was achieved for the lower peat but all other evidence suggested that a complete

sequence was present from late glacial times to the present. Both the Middle and Upper peat were woody below with more fibrous material above and all three levels were succeeded in turn by deposition of fine estuarine mud with salt marsh closer to the coast edge. These provide a model for the post-glacial coastal environment sequence with, typically, carr woodland developing over estuarine clay, followed by flooding and development of more open marshland conditions, succeeded by more estuarine mud. This sequence, in turn, provides a suitable reference when looking at the intertidal peats elsewhere, because in most cases these occur over similar muds and in some cases are woody and in others fibrous.

Description	***Depth, m***	***Interpretation***	***Date range, cal BC***	***Main species***
Grey-brown silty clay	0.00-0.80	Estuarine mud flats. Cereal cultivation locally		*Alnus*, *Quercus*, Poaceae, *Plantago* (pollen).
Upper peat, fibrous to woody below	0.80-1.00	Alder carr with sedges, later flooded and treeless with sedges and grasses	3950-3650	Upper: herbaceous (pollen and macrobot. frags) Lower: *Alnus*, *Quercus*, Cyperaceae (pollen).
Grey, soft silty clay	1.00-1.80	Brackish estuarine mud with salt marsh nearer to the coast		*Pinus*, *Quercus* and *Alnus*. Significant numbers of Chenopodiaceae (pollen)
Middle peat, fibrous above to woody below	1.80-2.25	Alder carr inland, peat on coast. Charcoal present. Woody below, with freshwater flooding above	5200-4900	Below, mainly *Alnus* with less *Quercus* and Cyperaceae (pollen). Increasing grasses above.
Grey soft clay	2.25-2.40	Slow accumulation of estuarine mud derived from boulder clay		
Lower peat, woody	2.40-2.50			*Alnus*, *Pinus* (pollen)
Silty clay with mudstone pebbles	2.50-2.70	Late Devensian/early Holocene solifluction		*Pinus*, *Betula* (pollen)

Table 1 Afon Ganol, Conwy, Section C, summary of environmental evidence (after Dorning 1999)

Although the Afon Ganol study provides good environmental information for our area there have been few significant finds of archaeological material equivalent to those from Rhyl and Borth. Nevertheless there have been some finds. A bronze palstave and spear have been found by metal detectorists on the peat surface at Llandudno North Shore and a stone axe of Graig Lwyd stone was trawled up by a fisherman from the Lavan Sands, Bangor (Williams 1996). Flint flakes and human skulls were reported to have been found in association with peat at Penrhos Bay, Holyhead but closer study suggests that the flints came from a cliff edge exposure, while the human bones were almost certainly a more recent intrusion (Williams 1950).

A single flint flake was found beneath a tree trunk on the intertidal peat at Porth Neigwl, Llyn (Griffith 1981), but this may have just been a fire-cracked flake as some burnt flint and quartz was found there during the present survey.

At Shell Island, Mochras, Meirionnydd flints have been recorded as well as an antler hammer (Guilbert 1981) but this is a coastal site, not an intertidal site and no peat has yet been recorded there. The flints are most likely to have been found eroding out of the cliff edge. The antler hammer is more interesting because it would be unlikely to survive except in a waterlogged context. It was reported to have been found in a dry land context but it can be suggested that it may originally have been in buried peat, which probably exists in the lagoon there, and was recently brought to the surface, perhaps during drainage ditching.

Slightly further south at Llanaber, Barmouth, animal bones have been found in the clay underlying the intertidal peat there, including shed red deer antlers, mature and immature, as well as red deer and bovid bones (Kelly 1982). Nearby a portion of timber trackway preserved in a linear hollow in the peat was excavated and this produced radiocarbon dates in the 12th to 14th centuries AD. A nearby tree stump, however, produced a date within the Roman period (Musson *et al* 1989). South of the Mawddach estuary, at Tywyn, there are extensive intertidal peat exposures, comparable to those at Borth, on the south side of the Dyfi Estuary in Cardiganshire, but there are no records of any artefacts being found there, despite being easily accessible and having been dug into on a large scale for post-medieval peat cutting.

4. PROJECT OBJECTIVES AND METHODS

The first stage of the project was a desk-top collection of data and references to ensure that the present record of past exposures was complete. This comprised a search of the SMR and reference to primary sources, secondary sources and maps with relevant maps and information copied for use during the field visits. All relevant references are included here, whether specifically referred to or not.

The project was made known to Dr James Scourse of the Department of Ocean Sciences, University of Wales, Bangor and discussed with a research associate there, Michael Roberts, conducting research into the sedimentological history of the northern end of the Menai Straits. This research aims to take new deep cores of the sea bed for analysis and dating, with the aim of elucidating the post-glacial history of sea-levels. The results will be an important addition to knowledge of coastal change in our area.

The aims of the project were also discussed with Paul Brazier of the Countryside Council for Wales, manager of the current Marine Intertidal Habitat Survey. That project is carrying out a survey of the whole of the Welsh coast and producing digitised plots of habitats overlaid onto OS maps using a combination of aerial photographs and field visits. The resulting database records the geological substrates of the shore. Print-outs of those records appertaining to peat or clay were produced for the use of the GAT intertidal survey but these did not produce any new submerged peat identifications. However, study of the CCW aerial photographic cover did show a number of man-made structures. Those man-made features that were determined to be significant are discussed and illustrated below. Not all these features were visited as some were already known but had not been recorded on plan. They comprise mainly fish weirs and other types of features associated with coastal exploitation in the post-medieval period.

Fieldwork was then undertaken to visit each of the identified sites. Some of the references were observations from earlier this century, chiefly by Greenly (1919) and their exact locations were not certain. Some were known to be only visible at extreme low tides, while others were known to be regularly visible on the middle or upper beach so would be exposed between most tides. Attempts were made, however, to visit all locations during spring low tides, when most of the intertidal area would be visible. Around Anglesey and the north coast the tide times meant that these tides occur around 5 to 7 in the morning and evening and so, in winter, were only exposed during the hours of darkness. Although only one visit to each site had been allowed for, the variable nature of the exposures with changing profiles of the beaches meant that repeated visits might be needed.

Intertidal peat exposures varied from areas of just a few square metres to areas of over 1km in length. Two sites proved to have particularly extensive exposures, those at Conwy and Tywyn. Both these are also complex in terms of stratigraphy and features and deserve accurate planning although this was not possible within the remit of the present survey.

Astrid Caseldine visited four sites of known exposures for assessment for environmental potential and samples were taken. Samples of wood were also collected from other exposures for possible radiocarbon dating. Two sites, at Tywyn and Conwy have also been sampled by Nigel Nayling for possible dendrochronological dating. Preliminary work has not been able to provide a date by matching these with existing curves elsewhere and it is thought that it probably be necessary to construct a new independent curve for north-west Wales (Nayling, pers. comm.).

Field visits were recorded on a standard form. This recorded the nature of the coast, description of any peat exposure and provided an assessment of threats (Appendix 1). Threats were assessed in a similar way to those

on dry land sites, recording threat type, threat class (severity) and threat time (the time period in which the threat was expected to become significant.

The position of exposures was sketch plotted onto OS 1:10,000 scale maps. Field visit and sample records have been entered onto a database and the visits also produced a photographic archive. Hand augering was not attempted after it became obvious that previous identifications of location were so vague that only very extensive augering along beaches might help to locate buried peat horizons. A motorised auger also proved to be difficult when employed on sandy beaches by Mike Roberts for his research project at the Department of Ocean Studies, University of Wales, Bangor, mentioned above. Test pitting was also tried and also proved unproductive in the sand because the high water table caused the sand to collapse and did not allow cutting deeper than about 0.5m. In some places, however, there were naturally exposed eroded sections of which the stratigraphy could be easily investigated, or horizontal layers that could be pursued some way beneath covering sand to indicate their continuity. The methods and other possible approaches will be discussed along with recommendations for future work at the end of the report.

Some external work will follow on from the survey, before any final recommendations can be made. This will include environmental assessment of pollen and macrobotanical remains, as well as radiocarbon and dendrochronological dating.

5 RESULTS

5.1 OVERVIEW

Prior to this study the SMR listed 13 locations relevant to intertidal finds. Of these, seven were parts of one location, that around Llanaber, Meirionnydd and others are duplicate records of finds from the same locations. The project has created 31 new records and there are now 32 individual, separate records of intertidal peats. Features plotted from aerial photographs and records of visits to the intertidal locations are described separately. The locations are shown on Fig. 1 and they are described and discussed in order of their occurrence on the coast from south to north

5.2 AERIAL PHOTOGRAPHIC STUDY

The aerial photographic collection in the Countryside Council for Wales, Penrhos Road, Bangor, consists of a complete cover of north-west Wales as colour vertical shots at 1:10000 scale, commercially produced and of high quality. Most of the cover was flown in east-west strips before commencement of the Marine Intertidal Habitat Survey and so without regard for the state of the tide, The cover for Meirionnydd was unfortunately carried out mostly around high tide and so is not very useful for our purposes. That around Llyn is of variable use. However, for Anglesey a separate coastal cover was produced by flying along the coast at low tide, rather than in east-west runs, without regard for the tide, and this is very useful. All the photographs also provide excellent cover of the land and deserve study. Not all features plotted are reproduced here. Some turned out to be to be well-known features, already on plan, others were just ill-defined features, possible areas of silt, pebble banks or rock exposure.

Llwyngwril, Meirionnydd, PRN 16607 (Fig. 2)

This is a straight-sided feature with one part of two parallel lines, perpendicular to the shore about 100m long and a shorter arm at least 50m long offset to the north. The straightness of the feature means it could be modern, such as a drain outfall. However, it has the characteristic hooked shape of a ‘type 5 ‘ fish weir with the hook on the uptide side and no outfall is marked on the OS 1:10000 map of 1972 although the feature lies in line with a land drain. If it is a fish weir then it is the first to be recorded in Meirionnydd.

Carreg y Defaid, Llanbedrog, Gwynedd, PRN 16609 (Fig. 3)

This feature is a curving arc, about 150m across, with a central gap. It is quite high up on the beach because the shore shelves out for quite a distance here at lowest tides. Intertidal peats and clays are also recorded from here and the beach was visited as part of the intertidal survey. Neither this AP feature or any peat or clay were seen because the beach was well covered with sand. In appearance it is very similar to that at Porth y Pistyll (PRN5605, Fig. 5, below) and is also possibly a breakwater or cleared area for boat launching and beaching.

Llanbedrog, Gwynedd, PRN 14598 (Fig. 3)

Gorad Llanbedrog was first recorded by Jones and Bannerman (1999) and noted on oblique photographs taken for the Coastal Erosion survey (Gwyn and Dutton 1997). It was visited as part of the Fish Weirs survey but nothing could be found, probably because of sand cover. The feature shows convincingly here as a 'hook' shaped fish-trap, with a main part at least 100m long and a shorter return piece on the up-tide side. The main part has a double line, possibly evidence of repair or rebuild (see also PRN 7204, below).

Llanbedrog, Gwynedd, PRN 16608 (Fig. 3)

This feature lies near to the previous (14598) but close against the rocky shore. It consists of two sides of a probable sub-rectangular structure about 70m long, lying parallel to the shore. It is closely similar to the features from Ynys y Charcarorion, Dulas, Anglesey (PRN 16606), possibly a fairly recent oyster bed. Its position close to the probably earlier fish trap is because both are situated where rather deeper water is accessible around the rocky edge of the bay.

Porth Dinllaen, Gwynedd, PRN 16610 (Fig. 4)

A straight, double linear feature over 100m long lying parallel to the shore at around the mean low water mark in the bay. There was a large fishing and boat-building industry here, and there are boat sheds on the nearby promontory and a former customs house. The parallel track nature of this feature suggests it might have been a slipway but on the other hand it does not run into deeper water and seems to be too far out to connect to the land. Possibly it could have been some kind of mooring device.

Porth y Pistyll, Nefyn, PRN 5605 (Fig. 5)

This curvilinear feature has been previously identified by GAT and described as part of the Fish Weirs survey. It is a half circle of boulder bank, about 120m across, with a possibly deliberate gap at its seaward side, set close up against the rocky shore. Within it are the remains of a jetty and the terminal of a tram incline from a granite sett-making factory on top of the cliffs just above. This was supplied with stone from quarries further up the hill. The boulder bank was almost certainly therefore not a fish-trap, but created either to clear a boat beaching area, or to create breakwaters. Presumably by coincidence, a well-preserved Late Bronze Age gold bracelet was found here on the shore, perhaps deriving from a wreck.

Cored Gwyrfai, Llanfaglan, Caernarfon, PRN 14601 (Fig. 6)

This is a fish-trap that was probably one of three in the Caernarfon area mentioned in early records. Two, near the Afon Seiont, seem to have been destroyed by harbour constructions. This one was identified on the ground for the first time by the Fish Weirs survey (Hopewell 2000, Survey no. 14). It is overlaid by a rubble jetty, marked on recent OS maps and on the 25 inch map of 1918, but the fish-trap itself has not yet been put on plan. It is a complete and well-preserved rectilinear trap consisting of a main arm about 140m long, almost perpendicular to the shore. It has a return arm parallel to the shore, 150m long and a third, hook arm 80m long. The Fish Weirs survey recorded it as consisting of a stone bank with wooden stakes. Some of the latter were identified, including Douglas fir, spruce/larch and beech, indicating that the trap was used in relatively recent times.

Beddmanarch Bay, Penrhos, Holyhead, Anglesey, PRN 7171 and 7172 (Fig. 7)

These two features were first identified during the Coastal Erosion survey (Jones and Davidson 1996) as probable class 5, rectilinear fish traps. 7172 is marked on the 1st edition OS 1:2500, XI.7 1900, making use of a rock outcrop on the beach but 7171 has never been put on plan. Both were visited as part of the Fish Weirs survey (Hopewell 2000) but 7171 was a vague stony bank and was only tentatively identified as a fish-trap. The AP evidence is more convincing because it shows two 'arms' at an angle, each over 200m long and in a very similar orientation to 7172.

Ynys y Carcharorion, Dulas Bay, Anglesey, PRN 16606 (Fig. 8)

Two adjoining subrectangular features, each about 50m long and about 100m from the rocky cliffs. Not visited because there is no public access to the beach near to Ynys y Carcharorion and the difficulty of alternative access along the beach from Dulas Bay. The features lie just above mean low water and beyond the rocky foreshore. They are seen as three-sided from the air but this is probably because they shelve into the beach and are partly hidden by sand. They seem likely to be oyster beds by comparison with those at Gorad y Gyt, Bangor (PRN 1725, see below) and therefore relatively recent.

Traeth Bychan, Benllech, Anglesey, PRN 16611 (Fig. 9)

A possible fish-trap of class B, curvilinear type, lying just below mean low water. It is about 100m long, hooked in towards the inside of the bay. It is very similar in appearance and local topographic position to traps at Lligwy Bay and Red Wharf Bay, Anglesey, but could be a natural erosion feature.

Traeth Bychan, Benllech, Anglesey, PRN 16612 (Fig. 9)

A straight linear feature on the middle beach running at an angle from the shore with a slight hook at the seaward end turned downtide, the wrong way for a fish-trap. Nothing is marked on the beach here on the recent OS 1:10000 or the 1889 25 inch maps although the latter shows a small quarry on the cliff edge just here. The feature may be the remains of a jetty associated with the quarry or a recent outfall pipe.

Red Wharf Bay, Anglesey, PRN 16613 (Fig. 10)

Four groups of probable upright posts, forming part of some associated pattern. Three are almost in a line, set parallel to the coast edge while the last, at the east, turns southwards, following the inlet of the bay. The posts are about 20m apart and this indicates that they are part of the same system as others recorded during fieldwork further to the east in the bay, on the other side of the Afon Nodwydd (see Fig. 28). It has been suggested that these might be WWII features, possibly set up to deter gliders, as the huge flat expanse of the bay at low tide would make a good landing area. However, the posts are in the wrong position for this, leaving most of the beach unobstructed and those of 16613 certainly must have some other function. They seem most likely to be associated with the extensive 19th century quarrying on Trwyn Dwlban but it is difficult to see how they could have formed breakwaters because at 20m apart they couldn't have been planked between.

Red Wharf Bay, Anglesey, PRN 16614 (Fig. 10)

Four slightly curving linear features, each about 130m long lying perpendicular to the shore on the seaward side of Trwyn Dwlban. These are marked as stony banks on the 1900 edition of the OS 1:2500 map. They are positioned exactly alongside a small cliff edge quarry shown on that map and are almost certainly breakwaters associated with loading of boats on the beach. The two larger ones, at the west, probably form a pair, enclosing a loading area, and it is probably relevant that one of the groups of post-lines of 16613 had a seaward offset at just this point.

Red Wharf Bay, Anglesey, PRN 7204 (Not illus.)

This is a well-known fish-trap of type D – a linear extended V, and has already been planned, being marked on the 1919 OS 25 inch map (Anglesey XIV.4). However, the AP shows a new detail of the structure, showing that it has a double line, either the way it was constructed or evidence of a rebuild or separate phase.

Penmon Point, Anglesey, PRN 1724 (Fig. 11)

The features here have already been identified on oblique aerial photographs but not yet put on plan. A possible fish-trap has also been recorded here as 'Irregular walls, not uncovered at low tide.' (Hopewell 2000, Survey no. 50). The photograph shows that there are probably two phases of structures. One is a long curving 'arm' about 140m long, which has a slightly everted end, turned in a down-tide direction. The other phase consists of parts of possibly two small subrectangular structures. These two phases may represent a curvilinear fish-trap overlaid by two later oyster tanks. The position and size of the curvilinear feature is correct for a fish-trap but not the down-tide everted end, although this could be a result of natural erosion. Its function as a fish-trap would be aided by the presence of a long offshore bar just here which would funnel water into the small bay from which the 'trap' extends. An old lifeboat slipway also crosses the beach just here, in use at the time of the 1919 OS 25 inch map (Anglesey XV.3), which does not mark any of the other features.

Aberlleiniog East, Beaumaris, Anglesey, PRN 1722, 1723 and 16615 (Fig. 12)

Two fish-traps of type D are already known here. One of them, Gorad Tre Castell (PRN 1723) has a multi-phase structure, is marked on OS maps and has been planned in detail as part of the Fish Weirs survey (Hopewell 2000, Survey No. 45, Fig. 8). The other, Lleiniog 2 (PRN 1722) does not appear on OS maps and has not yet been put on plan. North-east of 1722 are traces of one or possibly two further fish-traps (PRN 16615). One is a V, the other two arms at a more oblique angle.

Aberlleiniog West, Beaumaris, Anglesey, PRN 892 and 14606 (Fig. 13)

Just south of the fish-trap of Tre Castell is another well-known trap, Gorad Bach (PRN 892) which is marked on the modern OS 1:10000 map. Further to the south another possible trap (PRN 14606, Survey No. 48) was recorded by the Fish Weirs survey, identified with historical records of one called Fisherman Warth (sic) in use from the early 14th century AD, hereabouts. This, previously recorded as a 'rectilinear stone bank' (*ibid.*), has not been put on plan before. It was also noted that there were oyster beds in this area at the end of the 19th century but only possible traces of these were seen. This aerial plot shows the oyster beds quite clearly as a series of rectangular walled structures. The bank of the possible fish-trap is also seen. Between Fisherman's Warth and Gorad Bach is a long slipway with adjoining breakwater, belonging to the Harland Wolf factory at Llanfaes, an important site for its use in WWII, which included bringing on-shore Catalania flying boats for servicing. Just off-shore from the end of this jetty is a small length of a straight linear feature, lying parallel to the shore. This is at the right distance from the shore and at the right angle to be a fragment of another fish-trap, similar to Gorad Bach.

Garth Pier, Bangor, PRN 1719 (Fig. 14)

A possible fish-trap has previously been recorded here, consisting of a very long, almost straight line lying at a steep angle to the shore (PRN 1719). It is not marked on the modern OS 1:10000 map but is marked on the OS 1:2500 map of 1914 as a stony bank about 500m long (Caernarvonshire XIX.8). Its great length and proximity to the pier, which is of similar length, hints that it might be associated with the construction of the pier or used as a jetty for the ferry, which was an important historical crossing, before the construction of the pier. However, its different angle to the pier sets it apart and the AP shows a slight 'hook' turning uptide at the end of the bank, which would be correct for a fish-trap. A fish-trap to the south, at Gorad y Gyt (PRN 1725), is already well known and on plan. It was overlaid by oyster tanks and the aerial photograph provides a good record of these.

5.3 FIELD VISIT RESULTS

Tywyn, Meirionnydd, PRN 16601 (Fig. 15)

The intertidal peat deposits here were recorded as part of the Coastal Erosion survey (Gwyn and Dutton 1997). The one feature noted about them was the presence of 19th century peat-cutting beds. The deposits begin close to the south end of the concrete promenade immediately south of the minor road that runs from Tywyn to the beach at Glan-y-Don and continue southward for about a kilometre. From the north end to the drain outfall the peat deposits are at first very eroded and in isolated blocks but include some large timbers and one very large tree stump which erosion has left upstanding and isolated about mid-beach. South of the outfall there is a fairly continuous stretch of peat which is deeper with fewer wood pieces or stumps. This stretch has been heavily cut into for post-medieval peat cutting - in the form of rectangular trenches (Fig. 16). The peat cutting has occasionally exposed fallen timbers within the peat (Fig. 17), some of them have been chopped during the peat cutting but mostly were left *in situ* - the largest is about 8m long and 0.3-0.4m in diameter. In two places there is a second, upper, thinner layer of peat *c.* 0.15m thick and separated from the main layer of peat by a layer of clayey silt about 0.2m deep. The main layer of peat has quite a smooth level surface where best preserved, and without stumps. At the north side of the drain outfall the peat, perhaps eroded away (?), is only *c*. 0.1m deep, overlying grey clay. The main layer of peat south of the outfall runs back under the shingle of the storm bank and is probably quite close to the level of the inland marshy, drained area, behind the storm bank. The surviving stumps are quite high suggesting that some depth of peat has been eroded from its surface. Overall, the most striking feature is the difference between the deeper, generally wood-free peat to the south and the thinner peat at the north full of fallen timbers, large and small. This could be a reflection of the local environment at the time of deposition but it is also possible that these are quite different peat deposits - that at the north is close to low water while that at the south is higher up the beach.

Summary of condition and deterioration.
In the area of woody peat to the north, the surfaces are well eroded and the peat exists in isolated blocks, undergoing serious erosion. The area to the south is quite well preserved, possibly because it is buried under sand much of the time.

Summary of potential and recommendations.
Archaeological: There are no records of archaeological finds in the past, despite extensive peat-cutting. There are some areas of well-preserved surface to the south and very many sections in the side of peat-cuts. Further visits are needed to study these in detail and these might identify archaeological evidence. A full measured survey is needed to record the peat extent and the absolute levels of horizons. The peat-cutting remains are themselves of interest and deserve recording.

Environmental and dating: The deposits have considerable potential for pollen analysis and dendrochronological work. Surveying is required to map the extent, the position of the major timbers and stumps and to record the absolute levels. Excavation or auguring is also required to find the depth and underlying deposits of the main peat bed. Trial samples were taken by Astrid Caseldine for pollen assessment from the two peat areas - ie that with many timbers and wood remains and that fairly wood-free. See 5.4 Preliminary Environmental Assessment, below. This assessment suggested woodland giving way to reed swamp with evidence of Alder carr. Samples have also been taken for dendrochronological dating by Nigel Nayling.

Llanaber, Meirionnydd, PRN 16590 (Fig. 18)

A widespread area of peat in raised blocks, as eroded by the sea, is exposed for some 500m or more along the upper part of the foreshore. The peat appears to be a direct continuation of the inland land surface but divided off from it by a pebble storm beach. In several places the peat follows curvilinear narrow bands which are probably relict palaeo-channels while all the surrounding, slightly higher peat has been eroded away (Fig. 19). This interpretation is supported by the fact that the peat surface in these bands can be seen to be concave or 'dished'. However, the channels seem to form a rather odd meandering network, not a simple downslope channel. The channels have previously been interpreted as either old field boundaries or trackways. The areas could be easily planned from an aerial photograph. Unfortunately the aerial photographs of this area in CCW

were taken at a time of high water. There have been several separate finds of red deer antlers and bones (Kelly 1981) but not dated and no human artefacts. The best known bone and antler finds, made by Maurice Giffin, Llanaber, came from the clay below the peat, possibly as a result of animals becoming trapped in the mud of the lagoon (Fig. 20). These deposits are lower down the beach than the presently exposed peat and were not uncovered during the first visit. Arrangements were made to re-visit when Mr Giffin identified suitable exposures but these have not yet occurred.

Summary of condition and deterioration. The remains are quite extensive but have suffered from considerable erosion. The peat beds are an extension of inland buried peat beds so the best preserved areas are those closest to the land edge, which includes the area with the medieval trackway (Musson *et al* 1989). This was preserved in a hollow channel. The contemporary surface itself has been truncated by sea-erosion. Further downslope the peat has eroded more extensively and only peat-filled palaeo-channels survive. However, the underlying clay must survive well, but hidden under sand most of the time.

Summary of potential and recommendations.

Archaeological: The location has produced a medieval trackway from above the peat and red deer antler and bones and a possible *bos primigenius* bone from the underlying clay. A single radiocarbon date indicates that the peat surface itself might date from the Roman period. The peat beds themselves are extensions of inland buried peat beds. Development in the marsh area should be monitored for any exposures of buried peat. The area excavated in 1974 was an inland site until recently as the 1905 OS map shows the shingle bank of the shore edge 150m further to the west. The 1974 excavations did not plot the peat exposures, only the immediate area of the features and a measured survey of the whole area is therefore needed.

Environmental and dating: The animal bones from the clay are probably a natural deposit but are of interest in their own right and their date and context of deposition may reveal something about human activity. In two cases elsewhere, animal carcasses have been found in peat interpreted as resulting from Mesolithic hunting episodes. A radiocarbon date for a red deer bone would therefore be of great interest and provide a context for the clay layer. Planning of the palaeo-channels would help in understanding the local environment.

Mochras, Shell Island, Meirionnydd, PRN 16600 (Not illus.)

Mochras, Shell Island is connected to the mainland by a causeway across muddy marshland. The island was almost certainly once a true island but the intervening channel has gradually been infilled by sand movement along the coast, by silting and by the development of marshland. The island itself is low and undulating with low eroding cliffs of glacial till to the north and extensive sand dunes to the south. Similarly, the foreshore is of boulders, cobbles and gravel to the north and of sand to the south. The finds from here, of flints and of a perforated antler hammer - are from an unknown location but probably eroded out of the cliffs. It would be typical to find flints on a coastal promontory but the antler hammer was said by the finder to have been 'buried in sand at an unspecified point near the western shore of Mochras, or Shell Island' (Guilbert 1981, 106). Survival of such an organic object, probably several millennia old, seems unlikely if not in a 'wetland' context - so possibly came from peat preserved on the landward side of the dunes and was redeposited. The area is now a camp site and adjoins a military airfield so was probably heavily used during WWII and there may have been much local interference. The beach itself has much sand deposited at the south end and the dunes have covered much old land surface, presumably marsh but there are no exposures. However, a series of eight upright posts in pairs, set at an angle to the beach were noted at just below lowest tide point - probably for setting up trap nets, each pair about 20-25m apart. The posts were of whole small trunks of softwood so must be relatively recent. However, the spacing of the posts is similar to that of other post-lines recorded in Red Wharf Bay, Anglesey (see below) and soft wood was used in a (19th C) fish trap at Llanfaglan, Caernarfon (see above). Inland, the marsh area from Shell Island to the mainland is quite extensive and no obvious exposures were seen. The drift cliff edge is eroded and exposed towards the north of the island on the seaward side and all of it, where accessible, was searched for possible flint scatters but without result.

Summary of condition and deterioration.
Any coastal peat that may be present is inaccessible. Inland peat is stable.

Summary of potential and recommendations.

Archaeological: There have been significant chance finds here, but the exact locations of their find spots are unknown. Sand movement and deposition at the south side of the island means that there may well be buried peats off shore but these are unlikely ever to be exposed. However, there are likely to be large areas of inland coastal peats and this general area has particular potential because it must have provided a sheltered inlet in the prehistoric period as indicated by the presence of a standing stone at Llanaber, close to a silted-up channel, and thought to be at the end of a prehistoric trackway, the Fonllech Hir. Areas here can be expected to have extensive evidence of prehistoric activity. In the future, any development works that involve excavation in the inland marsh should be monitored.

Environmental and dating: The extensive inland marsh and silted up palaeo-channels are of potential interest and an understanding of their date and formative processes is directly relevant to archaeological finds from the area.

Criccieth, Gwynedd, PRN 16589 (Not illus.)

No peat visible. Known only from a single brief reference (Whittow 1965, Fig. 24). Although visited at low water the tide was still at 1m above extreme spring low. The grid reference given is below mean low water as marked on the OS 1:10000 map so it must be assumed to be only visible at extreme low tides. The lower foreshore is cobbles and boulders and must represent the eroded base of the glacial till. The peat must therefore be above this, even if lower down the beach.

Summary of condition and deterioration.
Not applicable although the absence of exposure means that deposits must be buried and not deteriorating.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Afon Wen, Llanystumdwy, Gwynedd, PRN 16588 (Not illus.)

No peat visible. Known only from a single brief reference (Whittow 1965, Fig. 24). The grid reference given is slightly below mean low water so it may be that peat is only visible at extreme low tides - at this visit it was only a little below mean low water. The coast edge is a fairly level spread of till over cobble dump. The upper foreshore is gravel and sand - a storm beach. The middle and lower foreshore is of cobbles set in a hard matrix so it is difficult to believe that this could overlie peat. A couple of low reefs could be seen off shore so it is evident that a large area might be exposed at extreme low water. A possible curving stony bank was seen at the west side of the bay, just north of Porth Fechan. However, the fact that this adjoins the holiday camp, which was previously a WWII naval training base means the feature could be a jetty or breakwater.

Summary of condition and deterioration.
Not applicable although the absence of exposure means that deposits may be buried and not deteriorating.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Carreg y Defaid, Gwynedd, PRN 16599 (Not illus.)

The beach was walked over the area where a peat exposure had previously been identified and around to the centre of Llanbedrog beach. The tide was an extreme low and a long offshore sandy bar was exposed which was not shown as exposed at mean low water on the OS 1:10000 map. No peat or timbers visible although the identification of peat and timbers here is confirmed by Margaret Griffith (1981) and a photograph taken by her showing tree stumps and horizontal timbers. Gullying on the beach shows that there is at least 0.5m of coarse sand and gravel thrown up on the upper beach.

Summary of condition and deterioration.
Not applicable although the absence of exposure means that deposits must be buried and not deteriorating.

Summary of potential and recommendations.
Archaeological: The previous photograph (*ibid.*) shows that there is potential for further work here so the site needs monitoring for possible exposure.
Environmental and dating: Some potential but needs further investigation.

Porth Neigwl, Gwynedd, PRN 16587 (Fig. 21)

The beach was walked from the footpath by the car park to the south-eastern end. Approximately at the position recorded for the previous peat exposure, about 90m from the coast-edge fence, was a roughly triangular area of small and large cobbles, exposed by scouring by some cross-current here. As this seemed to be the right location and there was no sign of any peat or tree stumps this might mean that they have all been eroded away.

However, the beach was revisited after a phone call to GAT from the niece of Lily Chitty who lives nearby and reported that there was peat exposed on the beach. Sand had been moved off beach by north-westerly storms exposing a large area of cobbles and small boulders and, directly in front of the beach access path, at the position previously recorded by Griffith (1981) was a large block of peat *c*. 40m by 40m with a smaller outlying block further to seaward (Fig. 22). The surface of the peat was smooth with slight furrows caused by water erosion; large blocks were collapsing off its edge as it is exposed all around. The surface of the peat slopes gently seaward. The peat is of variable depth and formed over gravelly grey silt in the part further up the beach slope and over fine grey clay to seaward - the junction of the two can be seen in section at the south-east side of the eroding block and appear to be interdigitated. Where the peat lies over clay there is another layer of peat beneath the clay and this lower layer then also lies over gravel on silty clay (Fig. 23). There are 4 surviving tree trunks or rather boles but little survives of any upstanding timber as these are fallen trees and some of the trunks can be seen as fallen, still *in situ* (Fig. 24). The direction of tree-throw is variable. There are also several trees indicated just by groups of roots. The trees seem to have been fairly mature and fairly evenly spaced, at about 5m apart. There are various pieces of horizontal timbers, both larger trunks and small twigs/branches. A reasonable sized horizontal timber was seen in the lower peat layer and a sample taken. All the timber appears similar, with little grain texture so possibly alder rather than oak. The surface of the peat has eroded somewhat and in it can be seen occasional stones including occasional fragments of possible fire shattered flint and quartz. Samples for identification and dating were taken from *in situ* trunks and horizontal timbers and a peat sample for pollen assessment. Further to the south-east along the beach a broad stretch of grey clay is exposed (not gravelly), running back under the upper beach shingle, possibly the same as the clay underlying the upper peat but with the peat eroded away. The peat block itself also continues under the upper beach shingle and may continue inland where there a belt of low-lying land (below 5m OD), which is interpreted as an area flooded during the maximum of the post-glacial transgression (Whittow 1965, Fig. 24) and where, therefore there may be more buried peat of the same age as that on the beach. The peat on the beach is about 2 to 3m below the land edge surface. The position of the peat block, just where the ancient channel approaches the sea, suggests that it may be a remnant of this channel rather than a chance survival (Fig. 21).

Summary of condition and deterioration.
This is an isolated block, quite a limited survival and is eroding quite rapidly while exposed. The surface of the peat is somewhat depleted but still in relatively good condition. This is a very exposed beach, facing the prevailing winds, and if the peat does not get covered again soon it could quickly be destroyed. However, its survival thus far suggests that the prevailing winds will quickly dump sand back onto the beach and over the peat, hiding it from view again.

Summary of potential and recommendations.

Archaeological: No definite evidence of human activity was seen and as it was quite small exposure it was quite thoroughly walked over. The presence of possibly fire-cracked stones, including flint, is interesting and ties in with the previous find of a flint flake from here (Griffith 1981).

Environmental and dating: The presence of two layers of peat is unusual, as is the variation in the underlying

clay layers. None of the stumps or timbers look to be good enough for dendrochronology but samples were taken for radiocarbon dating and a date from the upper and the lower peats would be useful. Depending on these results pollen sampling would be desirable.

Trefor, Gwynedd, PRN 15951 (Not illus.)

No peat visible. The inside of the bay is a boulder plain with occasional linear trains, some of which create intertidal pools that could make natural fish-traps. To the north the boulders give way to sand which probably overlies more boulders. The boulders must be a residue of eroded glacial till and cannot overlie peat. Just emerging at lowest low water are the erect stems of deeper water sea-weed - and possibly the exposure of these were what was called the 'Gardd Fawr' of early descriptions, rather than submerged tree trunks. At the south-eastern part of the bay are the timber stumps of a quay or jetty belonging with the former granite quarry tramway. The boulders have been partly cleared from this area as well.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: Not applicable.
Environmental and dating: Not applicable.

Dinas Dinlle, Gwynedd, PRN 15949/Caer Arianrhod, PRN 15950 (Fig. 25)

No peat was visible on the first visit although it had been seen by GAT staff in recent years when it was seen as thin separate blocks, with occasional roots and therefore must be quite eroded. The lower beach consists of either just sand or beds of cobbles and small boulders lying relatively level with overlying drifts of sand.

It was revisited at an exceptionally low tide, close to nightfall, when a small area of peat was seen but could not be studied or photographed. It was some way above lowest tide level where the more level lower beach meets the steeper shingle of the upper beach. At this particularly low tide the off-shore reef of Caer Arianrhod was well exposed.

The site was re-visited again and the previously identified peat was relocated, with difficulty. The topography of the beach had changed dramatically, presumably after storms, which had exposed quite large areas of boulders on the mid to lower part of what is normally a fairly smooth pebbly or sandy beach. The peat was a very limited exposure of a few metres square although more extensive exposures have been seen in the past. It was quite smooth surfaced with no evident woody remains. The peat was about 0.25m deep and overlying grey clayey silt. The western, sea-ward edge was exposed and eroded but the land-ward side could be seen to run back beneath the sand higher up the beach so more of the peat must survive elsewhere. Some of this was exposed by digging off the sand cover and this revealed a piece of horizontal round-wood about 10cm dia., probably a root. This was sampled for identification and possible dating. Samples were also taken of the peat and the underlying clay. The peat lay directly in front of the outer rampart and ditch of the adjoining Iron Age hillfort and approximately 180m from the base of the cliff. This places it at slightly below Mean Low Water. An interesting point about this location is that it helps to define the maximum sea-ward extent of the promontory on which the Iron Age fort stands, prior to its erosion, which has been documented (Smith 1993). A radiocarbon date from this peat would therefore be of particular interest.

Summary of condition and deterioration.
The peat has clearly been buried for most of the time and it has not been subject to much erosion although it is an isolated block with eroding edges of peat and clay and the its surface of the peat is depleted.

Summary of potential and recommendations.

Archaeological: This is such a small and eroded exposure that archaeological evidence is rather unlikely. However, previous records show that the peat is much more extensive and its proximity to the hill fort (which

has also produced a Neolithic axe) gives it particular interest for the possibility of environmental evidence.
Environmental and dating: See above.

Llanddwyn, Anglesey, PRN 6396 (Not illus.)

The peat deposits here, which have been reliably described as having upstanding tree stumps (Williams, pers. comm.) were not exposed at the time of the visit. However, one small detached block of peat (0.80m x 0.45m x 0.1m) was seen and sampled. It was lying on the foreshore at the lowest point of the tide at about the point where submerged peat and tree remains have been reported. It must be presumed that these are still buried beneath the sand, and perhaps more might be visible at an extreme low when tide which would be about 2m below that when visited. An offshore sand bar was exposed suggesting that with a lower tide a considerable area of beach might be exposed.

Summary of condition and deterioration.

Not applicable, although the absence of exposure suggests that deposits may be buried and not deteriorating. However, the finding of a detached block shows that it must be eroding.

Summary of potential and recommendations.

Archaeological: Not applicable. However, the proximity to finds of flints and Beaker pottery at Bryn Llwyd, Newborough Forest and of shell middens in Newborough Warren makes the deposits here of interest. A re-visit is needed when exposed and careful scrutiny for archaeological evidence.
Environmental and dating: One radiocarbon date has already been acquired. This was 6925 +/- 90 BP (SRR-5265) (Williams 1996).

Porth Cwyfan, Anglesey, PRN 16584 (Not illus.)

No definite peat levels were identified during the visit but black sand overlying rock may be the remains of former eroded peat levels. The land edge is formed of eroding glacial till about 2m high. Erosion is active but no obvious archaeology is visible. A medieval church of the 12th century stands on what was formerly a headland, but is now a small island reached only at low tide, showing that there has been major erosion here. This may, in fact, not be an area of intertidal peat. Whittow (1965) does not list it as such although he shows a 'post glacial deposit of peat and peaty clay' exposed at about high water mark at the base of the low glacial cliffs (*ibid.* Fig 26d).

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Traeth Llydan, Anglesey, PRN 16578 (Not illus.)

No peat was visible between Rhosneigr and Porth Nobla during the visit. However, much more of the lower beach would be exposed at a spring low tide, which would be some 3m below that seen during this visit. Possibly a misleading location. It is listed by Whittow (1965, 114) as 'Peaty clay' (after Greenly 1919, 767).

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Cymyran Bay, Llanfair yn Neubyll, Anglesey, PRN 16603 (Not illus.)

No peat visible. A considerable amount of sand is accumulated on the beach. A few rock outcrops protrude in the lower intertidal area at the west end of the beach and a small ridge of cobbles (ballast?), turning to a rocky shore at the east edge. If there is peat here, and it could be expected because of the nearby inland peat deposits around Valley airfield, it must lie buried under the sand or be only visible at extreme low water.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Borth Wen, Rhoscolyn, Anglesey, PRN 16583 (Not illus.)

No peat visible. This is a deep, sandy bay framed by rock promontories but with low marshy land on the inner north side, which must be the reason for the formation of the bay. A steep cobble storm beach has piled up at the inside of the bay. There is likely to be peat within the marshy valley behind the bay and so probably earlier peats extend into the bay, covered by sand. As the bay is sheltered from northerly winds any intertidal peat is unlikely to be uncovered. There are some low eroded cliffs of glacial till at the east side of the bay and part of the west side is protected by a concrete sea wall.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Carreg Llwyd, Holyhead, Anglesey, PRN 16576 (Not illus.)

No peat seen. The majority of the shore here is rock. The cove consists of two ‘arms’ eroded into valley-like areas, possibly channels eroded by the ice sheet. At the eastern of these two areas is a low eroded cliff, at the very upper edge of the tidal range. This seems to be what Whittow recorded, with the peat at the base of the cliff dated to pollen zone VIIa-VIIb, the Atlantic to Sub-boreal periods, Later Mesolithic to Early Neolithic (Whittow 1975, Fig. 26, 103-4, 114). The upper part is a series of fairly horizontal layers of alternating sand and rocky fragments, which Whittow regarded as raised post-glacial beach, although the existence of such a raised beach has since been disputed by Heyworth and Kidson (1982). At its base is a thin dark humic layer, the layer that Whittow recorded as peat, which in turn overlies glacial till. The cliff face is actively eroding.

Summary of condition and deterioration.
The deposit is actively eroding but is extensive and it existence is not threatened.

Summary of potential and recommendations.
Archaeological: Not applicable – exposed only in cliff section.
Environmental and dating: Already dated but just in terms of pollen zones (Hopley 1963).

Trearddur Bay, Anglesey, PRN 16572 (Fig. 26)

A well known exposure on a popular beach. First recorded as ‘Peat with stools and trunks’ by Greenly (1919, 767) and ‘the only Anglesey site where a (freshwater) *Scrobicularia*-clay has been recognised beneath the peat’ (Whittow 1965, 114). Reports from earlier accounts suggest that much of the beach is underlain by peat,

however the section visible when visited was 200m long by *c*. 20m wide on the north side of the bay. It is a raised area of peat overlying grey clay. Several tree stumps and fallen trees are visible. Its thickness varies from 100mm to over 300mm, though the former is more typical. The peat was sampled by Astrid Caseldine.

Summary of condition and deterioration.
Active erosion of the peat surface is taking place because it is often exposed, caused largely by vehicles taking boats on to the beach.

Summary of potential and recommendations.
Archaeological: Although there are no recorded archaeological finds, the intensity of prehistoric activity on Holy Island, with several standing stones and two chambered tombs, makes these deposits of interest and further study, survey and dating is needed. Their extent is also of interest because of the fragmentary remains of an Early Medieval cemetery at the edge of the beach. The peat may help define the limits of the land edge here or may prove to continue beneath the medieval site, built on blown sand.
Environmental and dating: See 5.2 Preliminary Environmental Assessment, below. This suggested 'a wooded environment with reed. *Sphagnum* moss was increasingly important in the upper samples.'

Penrhos Bay, Holyhead, Anglesey, PRN 16604 (Fig. 27)

In 1949 flints, peat and human bones were discovered at Penrhos Bay. 'A substratum of peaty prehistoric forest runs across the bay and under the cliffs of clayey alluvium striped with ancient mixed pebble floors and crowned by a deep layer of fine grass-covered, old sand...' (Williams 1950, 95). The exact location cannot be identified but is assumed to correspond to the reference given by Greenly (1919, 767) to 'Peat' at *c*. SH265817 (Whittow 1965, 114), on the east side of the bay. The present visit however, identified peat more centrally on the beach, about mid-way between high and low water. More may exist elsewhere, hidden beneath the sand. The peat is in thin and eroded discontinuous patches and there are two upright tree stumps, both quite small. A second visit recorded a higher layer of peat, only about 50mm thick, smooth and non-woody, protruding from the base of the steeper slope of the upper beach. The peat overlies light grey clay. This was mainly visible at the west side of the beach but could be seen to extend to the east and is probably present right across the beach, although hidden by sand. Fig. 27 plots marshland shown on the 1900 OS 25 inch map, indicating a possible former inlet leading towards Trefignath chambered tomb. Peat in this area may be the same as that exposed on the upper beach.

Summary of condition and deterioration.
The peat is in poor condition with a partly eroded profile as shown by the exposure of the base of the tree boles. Ongoing erosion appears to be quite gentle as this is a fairly well inset bay and faces away from the prevailing winds.

Summary of potential and recommendations.

Archaeological: There is no archaeological evidence although the finding of Neolithic flints on the adjoining headland of Bryn Glas (PRN 7895) and the presence of the Neolithic chambered tomb of Trefignath about 1km to the south makes these peat deposits of interest and they may be related to the valley peat deposits sampled for pollen as part of the Trefignath excavation (Smith and Lynch 1987).
Environmental and dating: The potential for environmental information that may be related to Neolithic activity in the area means that a radiocarbon date would be worthwhile as a first step. The peat has been sampled by Astrid Caseldine. See Preliminary Environmental Assessment, below. This indicated freshwater reed swamp with carr woodland in the area. Charcoal indicated burning and possibly human activity.

Bodlasan, Anglesey, PRN 16573 (Not illus.)

An uncertain location, listed by Whittow (1965, 114) as 'Peaty clay' after Greenly (1919, 767). Visited in near dark at dawn so no photos were taken. This is a broad sandy beach with very little slope so the sea retreats quite a long way. All could be seen to be sand apart from rock outcrops at the north end. Although the tide was not at its lowest there was no sign of scouring. It lies in the lea of Holy Island with respect to the south-western prevailing winds go and appears to be a beach of aggradation and so shallow that much sediment removal seems unlikely, only in exceptional storm conditions, perhaps with a wind from the north-west. It is a long beach and to

have more chance of results a visit during daylight and at extreme low tide would be best.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable.
Environmental and dating: Not applicable.

Llanrhwydrys, Anglesey, PRN 16575 (Not illus.)

This is an uncertain location. Whittow's description (1965, 114) from Greenly (1919, 767) is 'Peat with twigs'. The grid ref. he gives is in the slight bay north of Tyn Llan farmhouse, and on the land edge, perhaps suggesting a peat under the glacial till cliffs.

The beach was walked from Cemlyn Bay round to the north of Tyn Llan. The beach is mainly solid rock, except for some storm shingle on the upper beach so peat in the intertidal area seems very unlikely. The low cliffs are of eroding glacial till, which has some interesting stratigraphy but no peat was visible.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: Not applicable.
Environmental and dating: Not applicable.

Traeth Dulas, Anglesey, PRN 16577 (Not illus.)

Traeth Dulas consists of two parts, an inner estuary that opens out, beyond a broad sand bar, into an open bay. The inner part is quite deeply cut by the meandering channel of the Afon Goch. It consists largely of silty sand but towards the mouth are spreads of cobbles and boulders into which the river channel is incised. The outer bay is predominantly of boulders with a good growth of seaweed. The sand must overlie the cobble/boulder beds and so there seems little likelihood of a preserved peat horizon there unless at a lower tide level than that seen - about an hour after a not very low tide - so the lowest would be at least 1m lower. The area of cliff sections around Morfa Dulas would be worth further study, as well as the rest of the estuary and river channel. These deposits were first recorded by Lewis Morris in the eighteenth century (Morris 1725). The grid reference that Whittow (1965, 114) gives, derived from Greenly (1929), is slightly inland at the head of the estuary and is described rather oddly as 'Gravel with trunks', perhaps indicating detached timbers within a fluvial deposit. Discussion with Terry Williams indicates that the deposits seen were exposed in the side of the river bed near the top of the estuary. This would be understandable if the peat is an extension of buried deposits within the valley floor.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: Not applicable but the estuary is a place that might have had great attraction in prehistory as a sheltered inlet and close to the copper deposits at Mynydd Parys, and so has archaeological potential.
Environmental and dating: Not applicable.

Lligwy Bay, Anglesey, PRN 16585 (Not illus.)

No peat visible. Visited at a very low tide, but in the dark although visibility was good in the moonlight and the dawn. The only reference to this location is that of Greenly (1928) listed by Whittow (1965, 114). The grid

reference that Whittow gives is actually within the sandy covered centre of the beach. The description there is 'Peat with trunks'. The majority of the beach is sand with some areas of pebbles in the centre upper part of the beach. Near the centre top of the beach a temporary lagoon had formed where the Afon Lligwy enters the bay. The lagoon shows the sand must have banked up about 1.5m high at least and may therefore hide peat deposits, although the sand is unlikely to be so deep everywhere on the beach because the fish trap at the south-east side is exposed to the base of its boulders, although this is partly caused by local erosion around the stones. It seems that augering would be the only chance of locating peat as the amount of sand cover would only be moved under exceptional circumstances of wind and tide and generally the beach seems to be accreting. The bay is quite deep and sheltered with a low scrubby valley at its head and higher rocky cliffs at either side of its mouth. The bay is therefore formed in a partly flooded small valley and so underlying buried and submerged remains could be expected. The presence of the curving, boulder-built fish-trap, PRN 7228, at the south-east side of the bay shows that there has been no significant changes in sea-levels since it was built. The trap may well be medieval in date; it was shown on Lewis Morris' 1748 coastal maps.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: Not applicable.
Environmental and dating: Not applicable.

Red Wharf Bay, Anglesey, PRN 16574 (Fig. 28)

No peat seen. Walked from Red Wharf Bay car park to low water mark and back across the centre of the beach. This is a very broad, shallow, sand-filled bay with little chance of sediment removal. The only reference to deposits here is that of Greenly (1928) listed as 'Peats with oak and birch stumps and trunks' (Whittow 1965, 114). The grid reference given (543802) is on the east side of the bay not far below the high water mark so perhaps the remains were relatively recently inundated.

The sand forms low banks parallel to the sea-edge close to the low water mark but even in the troughs only sand is visible. At low water close to the Afon Nodwydd dark worm casts can be seen on the light coloured sand, indicating underlying organic deposits. A test pit 40cm deep still only reached sand. The black worm casts may just derive from organic-rich silt from the river channel. Occasional low stumps of posts - probably oak, are visible close to low water, at the east side of the Afon Nodwydd. They lie in 5 main groups of lines. The stumps are about 0.10-0.30m high and 0.10-0.15m diameter. They all lie in approximate lines SW-NE, fairly regularly spaced about 20m apart (Fig. 29). The post lines were sketched onto the map. They seem too far apart to be for any kind of fishing, even as stands for gill nets. Their spacing is similar to others recorded near to the west edge of the bay at Trwyn Dwlban (see AP report above), interpreted as associated with beach-loading of quarried stone. There are more posts at the far east side of the bay, near to Llanddona and it has been reported by a local that they were put up during WWII, probably to deter troop transport gliders and cut down later (Hopewell, pers. comm.). A small cairn was also recorded close to the low water mark, possibly a ballast dump, and a 20th century wooden boat hulk - see below.

A. Cairn. An approximately circular low heap of sub-angular stones about 0.30 high and 5m diameter, surrounded by an erosion gully and just NE of an extensive sand bank. Interpretation uncertain. The appearance of the stones and its well-defined shape make it look more like a prehistoric cairn than a dump of ballast.

B. Wooden boat hulk. Complete and so probably abandoned rather than a wreck. Approximately at centre of beach on a sand bank, 200-300m from low water. A post-stump line lies just to its NW with two posts returning towards the wreck position. Carvel plank built. Possibly a sailing barge? The rudder and pintle survive, some planking, 2 iron deck support beams (probably later repair work?) and the prow is visible. About 22m long with a 5m beam.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: The various post lines here are most likely to be post-medieval but a measured survey of them would be useful for future reference.
Environmental and dating: Not applicable.

Aber Ogwen, Bangor, Gwynedd, PRN 16602 (Not illus.)

No peat visible. There are probably some dozens of tree stumps here, spread over quite a wide area, as well as overturned stump boles. Several have been sawn off as low as possible to the bole, suggesting deliberate felling. Several are almost eroded out and are left perched on root buttresses. Although they lie on the higher part of the shore they are still a metre or more below mean high water. They may have been growing in a wet valley bottom but are probably post-medieval as previously suggested. The coast behind, part of Penrhyn Castle Park has certainly eroded - the park wall is fragmentary, standing on the foreshore. Early OS or estate maps may show if the area of stumps was dry land within historic times.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.

Archaeological: Not applicable.
Environmental and dating: Not applicable.

Glan y Mor, Gwynedd, PRN 16586 (Not illus.)

The only record is made by Whittow himself (1965, 114) of 'Tree stumps *in situ*'. A circuit of Glan y Mor Elias Bay did not locate any peat. There are silty sand flats from the shore line to sea edge at low tide and the sea retreats for about a mile here, actually an extension of the Lavan Sands. The sand flats must be redeposited and must cover other levels but were no exposures at the time of the visit. Only exceptional storms or augering could investigate further. In one place a probably fossil bog log was seen but on top of the sand. In another the two truncated limbs of a tree stump protruded from the sand at about the right location listed by Whittow. However, it is unlikely that a trunk would survive to such an extent and may be recent driftwood although it looked like ancient wood and it would be odd to find a driftwood stump in an upright position.

Summary of condition and deterioration.
Not applicable.

Summary of potential and recommendations.
Archaeological: Not applicable. Further visits are needed during varying beach conditions.
Environmental and dating: Not applicable.

Morfa Conwy, Conwy, PRN 16582 (Fig. 30)

This is a well-known exposure although no recording or dating has been carried out and there are no records of archaeological finds. Extensive areas of peat are exposed as well as of the underlying clay from which, presumably, the peat has all eroded. The beach has been visited several times but the area involved is so large it would have to be walked systematically and a measured survey produced to properly identify features and look for archaeological evidence. As well as tree stumps, there are occasional large roots and fallen timbers embedded in the peat. The peat survives almost up to the modern coast edge so probably extends beneath the Morfa, which is a level, low-lying area, now, mainly a golf course. Watching briefs on the excavation of the Conwy marina would have been useful. It is notable that the peat exposures are not in a level bed but undulating. It would be useful to know if this is the contour of the original land surface and what it says about the environment at the time, for example there may have been pools and braided channels within the marsh. There are no

obvious palaeo-channels and it seems possible that the broad shallow depressions in the surface are the result of compaction of underlying peat layers. Nigel Bannerman believes that there may have been a series of glacial drumlins, which formed small islands across the mouth of the Conwy estuary and that these determined the form of the beach and are now identifiable only as stony areas. This is a possibility but there is no obvious evidence of it in the landscape now. What was noticed, at one point fairly far out, towards the estuary mouth was a small area of rock outcrop.

A large area of peat and clay surfaces is regularly exposed around the north and north-west parts of the Morfa beach in separate areas, i.e. partly eroded. A number of low tree stumps were seen, exposed to their roots - showing that part of their contemporary land surface has eroded away (Figs 31-2). There are also several fallen timbers including one quite long trunk - about 6m long, still with stumps of side branches. This lies at the edge of a 'pool' or broad concavity or depression in the peat, towards the west part of the exposure. The exposure is mainly towards the top end of the beach - apparently revealed by erosion at around high water mark against the artificial boulder sea wall. At the far west end this has eroded the peat and partly the clay leaving a good elevated section (Fig. 30, b). This shows that a thin layer of peat developed on top of about a 350mm deep layer of grey sandy silt that includes small pebbles at all angles and some pockets of pure clay. This seems to abruptly overlie the lower clay surface. The peat here at the western end of the exposure tips gently down northwards and it appears that it must continue under the sand there, so there may be large areas of well preserved buried surface. Towards the centre of the exposure the peat can be seen to dip into a broad, gentle concavity mentioned above. In one place peat seems to fill an oval pit-like depression, about 2m x 1.5m. Where the peat has been eroded away at the west end of the exposure, the exposed clay is also fissured and eroded and partly overlaid with cobbles. The clay shows various linear and circular features - probably ghost features depending on what overlay the clay and helped protect it - like tree stumps for instance. At the west end and partly elsewhere the surface of the clay is distinctly red-brown whereas to the east it is grey. The redness seems to be just a result of silting. In places roots can be seen penetrating the clay from vegetation on the peat above. Also, in the clay, in places can be seen a fairly even scatter of small preserved vegetal fragments, possibly of rushes etc. rather than woody. Also occasionally can be seen bivalve shells, presumably *Scrobicularia* - although they are rotted *in situ* and too soft to collect. Nowhere has erosion revealed what lies under the clay, and so, also, how deep the clay is, but it exceeds 0.5m. It remains to pursue the peat and clay surfaces lower down the beach to see if they run on under the cobble mussel beds. Also it seems likely that the peat and clay beds continue inland, below the Morfa. In the central part of the beach, close to its upper edge was an irregular oval curvilinear feature (Fig. 30, a), quite close to the sea wall but consisting of cobbles and small boulders in a linear depression in the clay surface - possibly infilling an old meander channel? Further east are some smaller lines of stone, aligned up and down the slope, apparently filling linear hollows - erosion channels (?) in the top of the clay. These also contain linear concentrations of *Scrobicularia* shells - possibly redeposited. Slightly lower down the beach are the raised 'mussel beds' some of these overlie blocks of clay and some have a peat layer as well but this is very thin as if compressed or desiccated and detaching. At the lower part of the beach are mussel beds on redeposited clayey silt and spreads of cobbles with occasional erratic boulders. It seems unlikely that any peat or even clay survives here.

Summary of condition and deterioration.
The *in situ* tree stumps are few, exposed and deteriorating and there are some large fallen timbers that are exposed and at risk. Most of the peat is fairly stable but the isolated block at the west is now being eroded quite rapidly as seen between two visits only weeks apart.

Summary of potential and recommendations.

Archaeological: In summary, the areas of peat are fairly discrete, mainly surviving in 3 or 4 shallow, bowl-shaped depressions, the higher parts already eroded away. The area is very varied and provides good potential because of the area of exposure, even though no evidence of human activity has yet been identified. A measured survey is a first requirement followed by a careful search for archaeological evidence and record of the main timbers, peat and clay exposures.

Environmental and dating: There are several timbers suitable for dendrochronological dating. Astrid Caseldine has taken peat samples for assessment. See 5.2 Preliminary Environmental Assessment, below. This suggested reed peat and woodland. Charcoal indicated burning and possibly human activity. Nigel Nayling has taken samples for possible dendrochronological dating.

Llandudno West Shore, PRN 16580 (Not illus.)

No peat seen. The beach is covered by a sand bank, probably about a metre deep. A few mussel beds on cobbles show through in the upper part of the beach. N. Bannerman reports this peat to be a continuation of the Morfa Conwy peat and so presumably also on the upper beach where it would be visible at most tides if not buried. This east side of the estuary seems to be aggrading, while the west side (Morfa Conwy) is being depleted.

Summary of condition and deterioration.
Not applicable but probably stable under sand cover.

Summary of potential and recommendations.
Archaeological: Not applicable. Further visits are needed during varying beach conditions.
Environmental and dating: Not applicable.

Llandudno North Shore, PRN 6470 (Fig. 33)

This was visited at one of the lowest tides of the year. The remains previously were only just exposed at the very lowest of the tide. A thin layer of dark peat overlying grey clay was seen at the very lowest point of the tide, approximately in the centre of the beach. Numerous small roots could be seen in groups indicating the position of former stumps. This shows that a considerable depth of peat had been eroded away. The peat surface appeared to slope gently back into the beach, but was probably just level, the slope an illusion because of the general slope of the beach. However, it shows that more peat could survive beneath the sand. The exposure was fairly limited in extent, about 30m long. In some places there appeared to be red clay like that at Morfa Conwy, instead of grey clay, but scraping it suggested that it was the same deposit but with a surface colour alteration - perhaps through biological action or oxidation. Higher up the beach, directly behind but slightly to the west of the first deposit was found another exposure of peat, almost certainly a different, higher horizon, a metre or more above the level of the original exposure. This one had not previously been recorded. It was relatively free of roots but included a few larger fallen timbers. One piece was quite thin, consisting of the outer rings of a section of trunk, evidently all that remained after erosion of the peat and timber to a fairly flat plane. Further away was a larger timber, more completely preserved, embedded deeper in the peat. The peat surface in this area dipped gently to the north, following the general slope of the beach although this could be simply an erosion surface. The lower peat with timbers has had one stump identified as Alder and radiocarbon dated to 6985 BP +/-45 (SRR - 5266) (Williams 1996, 281). The visit was with Terry Williams who (privately) obtained the radiocarbon date and with Nigel Bannerman who lives locally and has devoted much time to study of the local coast. He observed that this was as good an exposure as ever seen before.

Summary of condition and deterioration.
The exposure is thin and eroding but as it is rarely exposed is not open to interference and may be under sand most of the time.

Summary of potential and recommendations.

Archaeological: More must survive beneath the sand and shingle but on present evidence there is not a great deal of potential. Its interest lies in its proximity to the Great Orme copper mines and the finding of two bronzes on the peat surface, a palstave and a spear.

Environmental and dating: There is not much potential for pollen sampling - because the peat levels are thin and eroded, or for dendrochronological work - because of the small numbers of timbers. Excavation or auguring to identify the depth of the grey clay, the possible stratigraphic relationship of the two peat deposits and their extent would be worthwhile, together with surveying to record their positions and absolute levels.

Penrhyn Bay, Conwy, PRN 16581 (Fig. 34)

This is an isolated raised ‘island’ of peat about 200mm deep over light grey clay. The exposure is situated at about mid-beach towards its eastern, Rhos-on -Sea end and is about 500m east of the reference (830815) given

by Whittow (1965, 114). This described it as 'Upper peat with oak and pine stools (surface of peat *c*. 3ft. OD)'. Clay could be seen continuing beneath the pebbles and cobbles to the west, apparently with no peat surviving. The peat is thin and contains quite a few horizontal fallen timbers, some fairly complete, others remaining just as thin traces. Both peat and timbers are in very poor condition, riddled with pyddoke holes. No tree stumps or root boles can be identified but the peat surface has been badly eroded. Although the clay beneath the peat is light grey the clay visible slightly higher up the beach is quite red and it is not possible to tell if it is the same as the grey clay but a different colour, or a different layer altogether. The surface of the peat slopes slightly to the north (seaward), following the slope of the beach. The horizontal timbers are all of quite small diameter - ie they appear to be branches rather than trunks but interestingly are nearly all quite straight - perhaps indicative of the type of tree they derive from, perhaps pine (Fig. 34). Samples of wood, peat and clay were taken. The peat block is about 30m wide and lies about 200 north of the sea wall directly opposite the north end of Abbey Road, Rhos-on-Sea.

Summary of condition and deterioration.
In poor condition, eroded on the surface and at the edges as well as riddled with pyddoke holes. However, previous observations suggest that the peat deposits extend further to the west around the beach, buried by sand.

Summary of potential and recommendations.

Archaeological: Such a small and poorly preserved exposure that there is little potential for archaeological remains.
Environmental and dating: The proximity to the well-studied remains in the Afon Ganol Valley means that any work here would just duplicate the work there.

5.4 PRELIMINARY ENVIRONMENTAL ASSESSMENT OF PEAT DEPOSITS

By Astrid Caseldine and Catherine Griffiths

Spot samples from peat deposits at several sites visited as part of the Coastal Peat Survey have been examined. The samples were sieved and scanned rapidly, primarily for plant macrofossil remains. The results are as follows:

Trearddur Bay
The peat was c 40 cm in depth. Samples were taken from towards the top of a small pit and a clay sample from an exposed section. The samples were 25 ml in size apart from 10 cm, which was c. 5ml.

Surface sample
The sample contained a mixture of Sphagnum moss leaves, Phragmites australis (common reed) remains, wood fragments and fungal sclerotia.

6-7 cm
Phragmites remains, Sphagnum moss leaves, wood fragments and fungal sclerotia were present.

10cm
The sample included wood fragments, a leaf bud and bud scale, Phragmites remains and Sphagnum moss leaves.

Bulk sample
Phragmites remains, Sphagnum moss leaves and wood fragments occurred.

Clay sample
The sample included monocot. (Phragmites) remains, wood fragments and fungal sclerotia.

The samples examined contained a similar assemblage, suggesting a wooded environment with reed. Sphagnum moss was increasingly important in the upper samples. Preservation was relatively good

Penrhos Beach
Two samples were taken from a small pit. Sample 1 was from the surface and sample 2 from immediately below. The peat was at least 25 cm in depth. The size of samples examined was 25 ml.

Sample 1
The sample contained Phragmites remains, Potamogeton sp. (pondweed) Potentilla anserina (silverweed), Lycopus europaeus (gypsywort), Mentha sp. (mints), Betula sp. (birch), Ranunculus sp. (buttercups/ spearworts), and caddis fly larvae cases.

Sample 2
The sample contained Phragmites remains, Potamogeton sp., cf. Carex sp. (sedge), Ranunculus sp., Potentilla anserina, Betula sp. seeds, Alnus sp. (alder) cone-scale, wood fragments and charcoal fragments.

Both samples were dominated by monocotyledonous remains and the assemblages were typical of freshwater reed swamp. The presence of wood fragments, birch seeds and alder cone-scales indicated carr woodland in the area. Charcoal indicated burning. Preservation was good.

Conwy
Wood and peat spot samples were taken from small exposed sections and surfaces.

Sample 1
Wood sample identified as Pinus sylvestris (pine).

Sample 2
A thin organic layer above sandy clay. 25 ml from each unit examined.

Sample 2A: organic layer
Monocot. remains including Phragmites. Charcoal present and sandy minerogenic material. Fungal sclerotia occurred.

Sample 2B: sandy clay layer
Sandy mineralogenic material and monocot. remains including Phragmites. Charcoal present.

Sample 3
Organic layer above sandy clay. 25 ml from each unit examined.

Sample 3A: organic layer
Monocot. remains including Phragmites. Sandy minerogenic material present.

Sample 3B: sandy clay layer
Sandy minerogenic material and monocot. remains including Phragmites. Charcoal present.

Sample 4
Red clay sample - not further examined.

Sample 5
Wood sample associated with red clay. Probable Corylus avellana (hazel) root wood.

Sample 6
Wood sample identified as Quercus sp. (oak) rootwood.

Sample 7
Organic layer above clay. Not examined. Same as sample 8.

Sample 8

Organic layer above clay 25 ml sample from each unit examined.

Sample 8A: organic layer
Wood fragments frequent with leaf buds and bud scales. Phragmites and seeds of Juncus sp. (rushes) and Solanum dulcamara (bittersweet) present.

Sample 8B: sandy clay layer
Wood fragments and Phragmites remains with sandy minerogenic material. Charcoal present including one large fragment (partial round wood).

The organic layers were thin and tended to be hard and dried out. However, macrofossil remains were preserved, indicating the presence of reed peat and woodland. Charcoal indicated burning.

Tywyn
A sequence of samples at 20cm intervals was taken down an exposed face in one of the peat cuts. 50 ml samples were examined. A spot sample (250 ml) from a woody basal peat from an area where a number of tree stumps and tree trunks were present was also examined.

0-5 cm
The sample contained frequent monocot. remains, a few charcoal fragments and the occasional wood fragment. Seeds of Betula sp., Potentilla sp. (cinquefoils), Carex sp. and Ranunculus sp. were also present.

20-25 cm
Monocot remains were frequent. Charcoal was rare. Ranunculus spp., Hydrocotyle vulgaris (marsh pennywort) Apium sp. (marshworts) and Lycopus europaeus seeds occurred.

40-45 cm
The sample was dominated by monocot. remains, including Phragmites. Wood fragments were rare but charcoal fragments were frequent. Ranunculus sp. and Hydrocotyle vulgaris occurred.

60-65 cm
Wood fragments were relatively frequent and monocot remains, including Phragmites, were occasional. Bud scales and leaf scars were also present. Betula sp. and Carex sp. seeds occurred. A few very small charcoal fragments were present.

Woody peat
Wood fragments were abundant and monocot. remains occasional. A leaf bud and bud scales were also present as well as minerogenic material and moss. Rubus fruticosus (bramble) seeds occurred. Two pieces of wood were identified as Alnus.

The evidence from the sequence suggests woodland giving way to reed swamp. Further evidence for woodland is provided by the separate sample, which indicates the presence of alder carr. Preservation was good

Conclusions
Preservation tends to be poorest where the peats are thin, e.g. Conwy, and have tended to dry out and become hard. However, all the sites offer some potential for further work. Of note is the occurrence of charcoal (wood or monocot.) in a number of the samples which may be simply due to 'natural' fires or could possibly indicate anthropogenic activity in the area and some deliberate attempt at management or manipulation of the environment. Alternatively, the presence of wood charcoal could perhaps indicate occupation not too far away e.g.. Conwy Sample 8b. This requires further investigation.

6. DISCUSSION

6.1 EVALUATION OF THE RESOURCE

Of the 32 recorded occurrences of coastal peat around north-west Wales the survey has located and evaluated nine. Of the remainder six have had recent identification but have not been exposed in recent months. That at Holyhead Harbour is sub-tidal while that in the Lavan Sands, Bangor is too deeply buried to be ever exposed. It will, however, be sampled and possibly dated as part of a marine sediment project in progress at the Department of Ocean Studies, University of Wales, Bangor. Some other occurrences are early references by Greenly and not all are very secure, some may be coast-edge peats.

The direct archaeological evidence of prehistoric activity has been limited to surface finds from Llandudno and the Lavan Sands apart from cut wood from Llanaber, Meirionnydd, probably associated with a medieval trackway, and evidence of 19th century peat-cutting at Tywyn. There are, however, a considerable number of fish-traps around the shores, none related to peat exposures but at least demonstrating the exploitation of the coast. The traps vary in design, some rectilinear, some curvilinear. The former are known to have been used in living memory and dendrochronological dates from the Ogwen Weir has given dates in the early 17th century (Hopewell 2000). There are documentary records of some of the weirs in medieval records and attempts need to be made to date the curvilinear weirs. The weirs are typically constructed so that they project just below present mean low water. With sea-level changes, this means that prehistoric weirs might be found even lower on the beach, and there are few exposures of intertidal peat at that level.

Study of aerial photographs has allowed mapping of a number of features in the intertidal zone that were already known but not mapped. A number of previously unrecorded features have also been noted and mapped, all probably post-medieval in date but worthy of record including fish traps, possible fish netting posts as well as jetties and breakwaters.

Indirect archaeological evidence of human presence and activity from the intertidal peats comes from environmental samples from Conwy, Penrhos Bay and Tywyn (Caseldine and Griffith above). These peats all developed in reed marsh and contained some charcoal, regarded as a good indicator of human activity nearby, based on work in the Severn Estuary. Similarly, animal bones have been found at Llanaber, Barmouth, from the clay beneath the peat, from Holyhead Bay (trawled) and from Penrhyn Bay, Rhos-on-sea. The finds include red deer bones, shed red deer antlers, *Bos primigenius* and elk. The marshland would have provided good pasture at certain times of the year and shed antlers may indicate pre-rutting fights between males while the other bones could indicate that some individuals became trapped in the bog. None of these prove human activity but this is an area where animals would have been vulnerable and evidence of hunting is likely to be present. The red deer remains have been found occasionally over the years, after exposure by storms, and it is only with repeated visits that any archaeological evidence will be found. Prehistoric animal bone evidence is almost entirely absent from terrestrial sites in north-west Wales because of the unfavourable conditions so the intertidal remains are of great value and should be carefully collected for study. At present they are undated and are dispersed in private ownership. Several animal bones and antlers have come from the clay beneath the peat at Llanaber and cross-dating with nearby peat is needed to find whether the bones pre-date the peat or whether they sank into the underlying clay.

The intertidal peats are found at different levels on the beaches (Table 2) and these may represent quite different periods of peat development, relating to different sea-levels. ‘Upper’ and ‘lower’ peats were identified at Rhyl for instance and upper, middle and lower peats at the Afon Ganol. The upper two of the latter were associated with radiocarbon dates of *c*. 4000 cal BC and of *c*. 5000 cal BC respectively at absolute levels that may correspond to middle and lower intertidal exposures. The two radiocarbon dates from intertidal deposits in Gwynedd both come from lower beach exposures and are both *c*. 5750 cal BC so the correspondence between peat levels is uncertain.

Location	*Upper beach*	*Middle beach*	*Lower beach*
Tywyn		●	●
Llanaber	●		
Porth Neigwl		●	
Dinas Dinlle		●	
Llanddwyn			●
Trearddur		●	
Penrhos Bay	●	●	
Morfa Conwy	●		
Llandudno North Shore		●	●
Penrhyn Bay		●	

Table 2 Simplified summary of levels of intertidal peat exposures

Several of the peat deposits appear to be continuations of inland peat at relatively high levels, overlain by raised shingle storm banks, behind which are areas of low-lying marshland (or blown sand in the case of Morfa Conwy). These higher peats might be quite recent in date, as suggested by the Medieval trackway and a Romano-British radiocarbon date from a tree stump at Llanaber (Musson *et al* 1989). However, a rare Late Bronze Age sheet bronze bucket was found at Arthog, Meirionnydd, in the middle of the 19th century in the peat of the coastal fringe (Hawkes and Smith 1957, Hemp 1960). Other peat exposures at lower levels appear to be continuations of deeply buried inland peat within silted in valleys or channels. Such inland 'palaeo' peats have been sampled at the Afon Ganol and have been recognised in the Malltraeth Marsh, Anglesey, a former sea inlet, during construction work for the A55 road. Similar peats can be expected elsewhere, as at Porth Neigwl, Llyn and Penrhos Bay and Trearddur, Anglesey. These could be a valuable resource and should be recognised in case of exposure by future development. Only at Dinas Dinlle does the topography suggest marsh on an open coastal plain and because it is closely related to the promontory on which the Iron Age hillfort lies, a radiocarbon date for this exposure would be particularly interesting.

Without direct archaeological evidence and aside from the osteo-archaeological finds the main value of the peat exposures is in their environmental evidence, in particular where it relates to periods where such evidence may be absent or rare and this is true for the Mesolithic and Neolithic periods. The macrobotanical evidence will show only the immediate flora of the marsh but pollen analysis will give a wider picture of the environment and may show evidence of human activity, for instance in the form of weeds of cultivation. Such evidence is likely to be most useful where intertidal exposures are adjacent to known focuses of inland archaeology, as at Penrhos Bay, near to Trefignath chambered tomb or at Llandudno, close to the Great Orme, with its chambered tomb and copper mining.

The coastal exposures are all valuable in providing the type of exposure that is unlikely to be available elsewhere, even if similar period deposits are identified inland. They also demonstrate the value of these inland buried peats, with the potential for exceptional environmental and archaeological; evidence, if suitable techniques of investigation can be developed. There is a need to identify horizons where buried peats survive and to develop a method of identifying the topographic points where activity may be expected as has been carried out in the East Anglian Fens and Somerset Levels. Such deposits exist but have never been recorded here with the exception of work carried out in connection with the Iron Age Llyn Cerrig Bach hoard (Macdonald and Young 1995).

6.2 ASSESSMENT OF CONDITION AND THREATS

The survey has shown that all these exposures are eroding to some degree, understandable considering that most lie on open coasts. In this they contrast with the Severn Estuary, a gentler environment in which deposition of muds is more typical than depletion. Erosion on the coast is fastest when blocks of peat have become isolated. The peat itself provides a fairly cohesive, resistant surface but the silt or clay beneath is more prone to gullying and collapse. The surfaces of all peat exposures are also depleted by erosion to some extent, as demonstrated by the exposure of root systems at the base of stumps, or in some cases where only the root systems survive, the stumps having gone. Detailed structural evidence is therefore unlikely to be discovered on the exposed surfaces

but any features that are intrusive such as posts or hearth pits could survive. In several cases peat can be seen to continue from the exposures under sand or upper beach material and so there must be many areas of quite fresh and un-eroded surfaces that in future could provide new finds. Fuller peat profiles for pollen analysis could also be achieved by limited excavation in the buried areas of the beach.

In summary, the threats to most of the coastal peats must be seen as sporadic because of their infrequent exposure. The threats can be seen as long term, with periods of stability interspersed with occasional brief episodes of severe erosion. In some cases the occurrence of frequent exposure on open, well-used beaches means that erosion is more serious on a continuous basis and this is the case at Conwy and Trearddur Bay. If no direct archaeological evidence is found the peats must be considered as just a general source of environmental information. However, as preserved old land surfaces, their potential should not be forgotten. As erosion continues the exposures change and it is possible that archaeological evidence may be revealed. If this happens then a rapid response is needed to survey and record the evidence because it could quickly be destroyed or lost to view again.

6.3 EVALUATION OF THE METHODOLOGY

Desk-top work was 'site' based and concentrated on identifying previous finds and records of intertidal exposures. This was sufficient for the purposes of such a rapid survey. It can now be seen that a more holistic approach would be useful in future, if more time consuming, looking at the whole coast in terms of topography and geomorphological evolution. This would aid the understanding of the form and location of intertidal exposures, and probably where such exposures may exist still hidden beneath sediments. Fulford and Champion (1997, 227) have said of desk-top assessments 'such reviews should include consideration of the geological context, and of the hinterland and sub-tidal resource, as well as the intertidal resource'.

Field visits were constrained by the infrequency of intertidal peat exposures and by the very few good time 'windows' of lowest tides that there are through the year. With suitable tide times essential, multiple visits in a day to different sites are rarely possible. Single visits are also insufficient where there is an extensive exposure as repeated visits always produce new information, whether by chance visibility or changing light, moving sediment or erosion of surfaces. Large timbers embedded in the peat can be hidden by a few centimetres of silt, while small stakes or faint features may be unappreciated on first viewing.

Rapid surveys are a necessary first step in field work to assess the resource but of the work in England it has been said that 'The surveys which have been most effective in deepening our understanding of the archaeological resource as a whole have been those with comparatively limited objectives, whether geographical or thematic (such as Goldcliff or the Stumble)' (Tyson *et al* 1997, 102).

More detailed assessment of four areas of more extensive intertidal exposures has been carried out. These are very dense in information in terms of stratigraphy, deposits and variety of woody remains. Simple walk-over, sampling and sketch plotting provide only a preliminary record and need to be backed up by measured survey before any serious environmental work is carried out.

6.4 RECOMMENDATIONS

- With all future work it should be recognised that surveys need to be carried out as and when exposures make it possible. There needs to be monitoring of beach conditions particularly during times of extreme low tides so that study and survey can be carried out. This is similar to the provisions made for aerial photographic work, which can be carried out only when light and soil conditions are suitable. At the same time this can only be accomplished by building up a network of interested local contacts.

- Desk-top work needs to be supported by study of geology and geomorphology of the adjoining inland and sub-tidal areas.

- New aerial photographs are needed of some parts of the coast, particularly Meirionnydd. The larger exposures should be targeted for more detailed aerial photography, at Tywyn, Llanaber and Conwy.

- Fieldwork is needed in the 'near tidal' lowland zone, below 5m OD, for its relevance to the intertidal deposits and for its vulnerability to rising sea-levels (identified as such during the Coastal Erosion survey). The potential of this zone has been shown by the work on the Afon Ganol, Colwyn Bay, and opportunities have been missed during the construction of the Conwy marina, for instance, and in future with possible new marinas, for example those proposed at Deganwy and Gallows Point, Beaumaris.

- A capability for augering surveys should be developed requiring purchase of equipment and trial work. Transect augering was carried out with very useful results to a depth of –6m, through soft intertidal sediments at Goldcliff on the Severn estuary, for instance (Bell 2000, 21-32). Augering can provide a useful addition to geophysical survey in some cases.

- Basic measured survey and levelling are needed for all exposures as the only way they can be assessed in relation to each other and to other dated deposits related to changes in sea-level.

- Full measured survey is ideally needed for all exposures but certainly for those selected for detailed assessment:
  a. To locate any samples taken.
  b. To record the stratigraphy and understand the formation processes.
  c. To understand and quantify erosion, by re-mapping at repeated visits.

- All exposures need dating, where possible by dendrochronology because all exposures form part of one regional environmental pattern in relation to changing sea-levels and need to be fitted in to the wider national evidence.

- Scientific co-operation or rather involvement in such work needs to be sought as research in this environment is more the province of sedimentary geology and biology than of archaeology, and much is happening with the development of marine conservation areas, monitoring of erosion with rising sea-levels and control of pollution with EU directives on waste disposal.

- Continuation of the work should take the form of:

a. Basic measured survey and levelling of all exposures.
b. Detailed mapping, levelling, recording and sampling of the more extensive exposures.
c. Developing a radiocarbon dated sequence from selected sites and samples.

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Appendix 1: Coastal peats summary list

PRN	SITENAME	NGR
952	Timber trackway, Egryn	SH59101940
953	Field ditches, Egryn	SH59201930
1848	Llandudno, borehole	SH775 819A
2505	Flints & human bones - findspot, Penrhos Beach	SH26308160A
3445	Morfa Dyffryn submerged forest	SH59651855
4793	Perforated antler fragment, Mochras	SH55002600A
5136	Morfa Dyffryn Medieval timber trackway	SH59201950A
5331	Wooden object, Tal y Bont, Dyffryn Ardudwy	SH58302060A
6396	Llanddwyn beach submerged peats	SH395 633A
6470	Llandudno, North Shore submerged peats	SH789 825A
6889	Animal bones - Findspot, Barmouth	SH60201734
7286	Turbary at Tywyn	SN58189932
7294	Timber trackway at Morfa Dyffryn	SH59221924
15949	Dinas Dinlle submerged peats	SH434 560A
15950	East of Caer Arianrhod, submerged peats	SH432 547A
15951	Trefor, submerged peats	SH377 474A
16570	Lavan Sands submerged peats	SH62 76A
16571	Llangwyfan Bay submerged peats	SH337 683A
16572	Trearddur Bay	SH254 789A
16573	Bodlasan submerged peats	SH290 825A
16574	Red Wharf Bay submerged peats	SH54 81A
16575	Llanrhwydrys submerged peats	SH318 932A
16576	Carreg Llwyd Cove submerged peats	SH257 768A
16577	Traeth Dulas submerged peats	SH483 885A
16578	Traeth Llydan submerged peats	SH322 722A
16579	Antler dredged from Holyhead Harbour	SH250 826A
16580	Llandudno West shore submerged peats	SH773 800A
16581	Penrhyn Bay submerged peats	SH826 821A
16582	Conwy Morfa beach submerged peats	SH756 789A
16583	Borth Wen submerged peats	SH275 750A

PRN	SITENAME	NGR
16584	Porth Cwyfan submerged peats	SH339 681A
16585	Lligwy beach submerged peats	SH497 876A
16586	Glan y Mor submerged peats	SH66637430
16587	Porth Neigwl A submerged peats	SH288 255A
16588	Afon Wen submerged peats	SH451 370A
16589	Criccieth submerged peats	SH483 370A
16590	Llanaber submerged forest	SH590 195A
16599	Carreg y Defaid submerged forest	SH3435 3290
16600	Mochras Island	SH55 26A
16601	Peat exposures at Tywyn	SN58559853
16602	Red deer antler, Tal y Bont	SH590 195A
16603	Aber Ogwen submerged forest	SH61007235
16605	Penrhos Bay submerged peats	SH263 818A

Appendix 2: Field Recording Form

YMDDIRIEDOLAETH ARCHAEOLEGOL GWYNEDD ARCHAEOLOGICAL TRUST								
COASTAL PEAT SURVEY, G1679, *Form 1:*							*MAP*	
DESCRIPTION	*Site Name*						*PRN*	
Gen. area				*Authority*				
Coast facing	*N*	*NE*	*E*	*SE*	*S*	*SW*	*W*	*NW*
Gen. coastal type	*Open*	*Open lee*	*Bay*	*Bay lee*	*Estuary*	*Enclosed*		
Land type	*Low*	*Raised*	*Hill*	*Valley*	*Marsh*	*Dunes*		
Land use	*Wood*	*Scrub*	*R. grazing*	*Pasture*	*Arable*	*Housing*	*Industry*	
Land edge type	*Rock cliff*	*Soft cliff*	*Alluvial*	*Artficial*				
Foreshore type	*Mud/clay*	*Silt*	*Sand*	*Pebble*	*Cobble*	*Boulder*	*Rock*	*Mix*
Intertidal type	*Mud/clay*	*Silt*	*Sand*	*Pebble*	*Cobble*	*Boulder*	*Rock*	*Mix*
Intertidal vegetn	*Nil*	*Wrack*						
Threat type	*Natural erosion*	*Coast protection*	*Industry*	*Shipping*	*Dredging*	*Fishing*	*Bait digging*	*Visitors*
Threat class	*Low*	*Medium*	*High*					
Threat time	*Long*	*Medium*	*Short*	*Active*				

PEAT DESCRIPTION							
Extent	*Extensive*		*Separate blocks*		*Isolated frags only*		
Depth, mm							
Substrate	*Mud/clay*	*Silt*	*Sand*	*Pebble*	*Cobble*	*Boulder*	*Rock*
Profile condition	*Complete*		*Partly eroded*		*Badly truncated*		
Tree stumps	*Common*	*Few*	*Frags*	*Roots only*			

TEXT DESCRIPTION

Photo ref col neg			*Photo ref col trans*			*Visit date*	
Visit time period		*Low water Liverpool*		*Low water local, estim.*		*Tide low height*		*Visit by*	

Appendix 3: Catalogue of Field Record

PRN	*SITENAME*	*NGR*	*OSMAP*	*Coast facing*
5331	**Wooden object, Tal y Bont, Dyffryn Ardudwy**	SH58302060A	SH52SE	SW

Coastal type	*Land type*	*Land use*	*Land edge type*
Open	Low/marsh	Pasture/Leisure	Artificial cobble/storm beach

Foreshore type	*Intertidal type*	*Intertidal vegetation*	*Threat type*
Sand/cobble	Sand		Natural erosion

Threat class	*Threat time*	*Peat extent*	*Peat depth*
Medium	Active	Extensive	300-500mm

Peat substrate	*Profile condition*	*Tree stumps*	*Timbers*
Mud/clay	Partly eroded	Few/roots only	Frequent horizontal fallen? timbers

Photorefcolneg 1	*Photorefcoltrans 1*	*Visit1 time*	*Lowtidetimelivpl 1*
11/1-2	12/1-2	14.00-15.00	17.37

Tidelowheight 1	*Lowtidetimelocal 1*	*Visit1 date*	*Visit1 by*
1.1	14.37	28/01/2002	GHS

Photorefcolneg 2	*Photorefcoltrans 2*	*Visit2 time*	*Lowtidetimelivpl 2*

Tidelowheight 2	*Lowtidetimelocal 2*	*Visit2 date*	*Visit2 by*
0			

Photorefcolneg 3	*Photorefcoltrans 3*	*Visit3 time*	*Lowtidetimelivpl 3*

Tidelowheight 3	*Lowtidetimelocal 3*	*Visit3 date*	*Visit3 by*
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
6396	**Llanddwyn beach submerged peats**	SH395 633A	SH36SE	S

Coastal type	Land type	Land use	Land edge type
Open lee	Low/dunes	Wood	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand	Sand/pebble/cobble		Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Detached block only	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
95/33-6, 97/1-2	96/33-6, 98/1-2	14.30-16.30	17.11

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
1.7	15.20	12/01/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
			0

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	0		

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
6470	**Llandudno, North Shore submerged peats**	SH789 825A	SH78SE	NE

Coastal type	Land type	Land use	Land edge type
Bay	Low	Housing	Artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble	Sand	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Not extensive	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
15/1-4	16/1-4	05.15-06.15	18.54

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
-0.3	17.54	28/02/2002	GHS, TW, NB.

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
15949	**Dinas Dinlle submerged peats**	SH434 560A	SH45NW	W

Coastal type	Land type	Land use	Land edge type
Open	Low/raised	Pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/pebble	Sand/cobble	Dulse/laver	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
		07.00-07.30	07.34

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.3	0.700	23/07/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
		17.30-18.15	19.30

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
-0.7	18.00	01/03/2002	GHS

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
17/1-6	18/1-6	16.15 to 17.15	18.23

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
1.2	17.00	14:03:02	GHS

PRN	SITENAME	NGR	OSMAP	Coast facing
15951	**Trefor, submerged peats**	SH377 474A	SH34NE	NW

Coastal type	Land type	Land use	Land edge type
Bay lee	Raised	Scrub/pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble/cobble/boulder	Sand/boulder	Wrack/various	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	NIL	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
3/9-18	4/9-18	07.00-07.30	08.20

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.3	07.50	24/07/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
			0

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	0		

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16572	Trearddur Bay	SH254 789A	SH27NW	W

Coastal type	Land type	Land use	Land edge type
Bay	Dunes	Housing	Alluvial
Foreshore type	**Intertidal type**	**Intertidal vegetation**	**Threat type**
Sand/rock	Sand/rock	Nil	Natural erosion/visitors
Threat class	**Threat time**	**Peat extent**	**Peat depth**
High	Medium	Extensive	100-300
Peat substrate	**Profile condition**	**Tree stumps**	**Timbers**
Mud/clay	Partly eroded	Few	
Photorefcolneg 1	**Photorefcoltrans 1**	**Visit1 time**	**Lowtidetimelivpl 1**
		08.30	09.06
Tidelowheight 1	**Lowtidetimelocal 1**	**Visit1 date**	**Visit1 by**
0.6	09.00	25/07/2001	AD
Photorefcolneg 2	**Photorefcoltrans 2**	**Visit2 time**	**Lowtidetimelivpl 2**
Tidelowheight 2	**Lowtidetimelocal 2**	**Visit2 date**	**Visit2 by**
0			
Photorefcolneg 3	**Photorefcoltrans 3**	**Visit3 time**	**Lowtidetimelivpl 3**
Tidelowheight 3	**Lowtidetimelocal 3**	**Visit3 date**	**Visit3 by**
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16573	Bodlasan submerged peats	SH290 825A	SH28SE	W

Coastal type	Land type	Land use	Land edge type
Bay	Low	Pasture	Soft cliff
Foreshore type	**Intertidal type**	**Intertidal vegetation**	**Threat type**
Sand, pebble	Sand	Nil	Natural erosion
Threat class	**Threat time**	**Peat extent**	**Peat depth**
Low	Long	Nil	
Peat substrate	**Profile condition**	**Tree stumps**	**Timbers**
Photorefcolneg 1	**Photorefcoltrans 1**	**Visit1 time**	**Lowtidetimelivpl 1**
		06.30-06.45	08.00
Tidelowheight 1	**Lowtidetimelocal 1**	**Visit1 date**	**Visit1 by**
0.7	07.15	01/02/2002	GHS
Photorefcolneg 2	**Photorefcoltrans 2**	**Visit2 time**	**Lowtidetimelivpl 2**
			0
Tidelowheight 2	**Lowtidetimelocal 2**	**Visit2 date**	**Visit2 by**
0	0		
Photorefcolneg 3	**Photorefcoltrans 3**	**Visit3 time**	**Lowtidetimelivpl 3**
			0
Tidelowheight 3	**Lowtidetimelocal 3**	**Visit3 date**	**Visit3 by**
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16574	Red Wharf Bay submerged peats	SH54 81A	SH58SW	NE

Coastal type	Land type	Land use	Land edge type
Bay lee	Raised/valley/marsh	Wood/scrub/housing/leisure	Rock cliff/alluvial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/cobble	Sand/cobble	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
1/29-36, 3/1-4	2/29-36, 4/1-4	09.15-10.45	08.25

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.8	09.00	25/06/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
3/1-2	4/1-2		

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0		25/06/2001	GHS

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
3/3-4	4/3-4		

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0		25/06/2001	GHS

PRN	SITENAME	NGR	OSMAP	Coast facing
16575	Llanrhwydrys submerged peats	SH318 932A	SH39SW	NW

Coastal type	Land type	Land use	Land edge type
Bay	Raised	Pasture	Rock cliff/soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Cobble/rock	Sand/cobble/rock		Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
11/7-12	12/7-12	07.00-08.20	08.00

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.7	07.15	01/02/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
11/13-14	12/13-14	07.45-08.45	08.44

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0.9	08.00	02/02/2002	GHS

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16576	**Carreg Llwyd Cove submerged peats**	SH257 768A	SH27NW	SW

Coastal type	Land type	Land use	Land edge type
Open	Raised	Rough grazing	Rock cliff, Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Rock, Silt	Rock, Sand	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
17/21-26	18/21-26	15.00-15.30	15.33

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
2.9	14.15	07/04/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16577	**Traeth Dulas submerged peats**	SH483 885A	SH48NE	NE

Coastal type	Land type	Land use	Land edge type
Bay lee/Estuary	Hill/marsh	R. grazing/pasture	Rock cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Silt / cobble	Silt/sand/cobble/boulder	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
11/5-6	12/5-6	07.30-08.30	07.18

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.7	06.50	31/01/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16578	**Traeth Llydan submerged peats**	SH322 722A	SH37SW	SW

Coastal type	Land type	Land use	Land edge type
Open bay	Dunes		Alluvial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Mix	Mix	Wrack	

Threat class	Threat time	Peat extent	Peat depth
		Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
		11.30	11.26

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
2.8	11.30	13/08/2001	AD

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16580	**Llandudno West shore submerged peats**	SH773 800A	SH78SE	W

Coastal type	Land type	Land use	Land edge type
Estuary	Low, Dunes	Housing, Leisure	Soft cliff, Artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble, Cobble	Silt, Sand, Pebble	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
17/11-12	18/11-12	12.30- 13.30	14.12

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
3.2	13.12	06/04/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16581	**Penrhyn Bay submerged peats**	SH826 821A	SH88SW	NE

Coastal type	Land type	Land use	Land edge type
Open lee	Low	Housing	Artificial
Foreshore type	**Intertidal type**	**Intertidal vegetation**	**Threat type**
Cobble	Sand	Nil	Natural erosion/visitor
Threat class	**Threat time**	**Peat extent**	**Peat depth**
Medium	Medium	Separate blocks	200mm
Peat substrate	**Profile condition**	**Tree stumps**	**Timbers**
Mud/clay	Badly truncated	Roots only	
Photorefcolneg 1	**Photorefcoltrans 1**	**Visit1 time**	**Lowtidetimelivpl 1**
15/24-30	16/24-30	08.00-08.45	08.26
Tidelowheight 1	**Lowtidetimelocal 1**	**Visit1 date**	**Visit1 by**
1.3	08.26	03/03/2002	GHS
Photorefcolneg 2	**Photorefcoltrans 2**	**Visit2 time**	**Lowtidetimelivpl 2**
Tidelowheight 2	**Lowtidetimelocal 2**	**Visit2 date**	**Visit2 by**
0			
Photorefcolneg 3	**Photorefcoltrans 3**	**Visit3 time**	**Lowtidetimelivpl 3**
Tidelowheight 3	**Lowtidetimelocal 3**	**Visit3 date**	**Visit3 by**
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16582	**Conwy Morfa beach submerged peats**	SH756 789A	SH77NE	N/NW

Coastal type	Land type	Land use	Land edge type
Estuary	Low/dunes	Housing/leisure	Soft cliff/Artificial
Foreshore type	**Intertidal type**	**Intertidal vegetation**	**Threat type**
Sand/pebble/cobble	Mud/clay/sand/pebble	Nil	Natural erosion
Threat class	**Threat time**	**Peat extent**	**Peat depth**
High	Short/Active	Extensive	
Peat substrate	**Profile condition**	**Tree stumps**	**Timbers**
Mud/clay	Partly eroded	Few	
Photorefcolneg 1	**Photorefcoltrans 1**	**Visit1 time**	**Lowtidetimelivpl 1**
5/23-4	6/23-4	15.30-16.30	18.19
Tidelowheight 1	**Lowtidetimelocal 1**	**Visit1 date**	**Visit1 by**
0.8	17.19	16/11/2001	GHS, TW, NB
Photorefcolneg 2	**Photorefcoltrans 2**	**Visit2 time**	**Lowtidetimelivpl 2**
		08.30-11.00	07.35
Tidelowheight 2	**Lowtidetimelocal 2**	**Visit2 date**	**Visit2 by**
1.9	08.05	18/12/2001	GHS
Photorefcolneg 3	**Photorefcoltrans 3**	**Visit3 time**	**Lowtidetimelivpl 3**
Tidelowheight 3	**Lowtidetimelocal 3**	**Visit3 date**	**Visit3 by**
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16583	Borth Wen submerged peats	SH275 750A	SH27SE	S

Coastal type	Land type	Land use	Land edge type
Bay	Low	Scrub, Housing	Rock cliff, Soft cliff, Artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble	Sand, Pebble	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
17/17-20	18/17-20	14.00-14.30	15.33

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
2.9	14.00	07/04/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16584	Porth Cwyfan submerged peats	SH339 681A	SH36NW	SW

Coastal type	Land type	Land use	Land edge type
Bay	Low	Pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/pebble/rock	Sand/rock	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
		08.15-09.00	08.20

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.3	08.00	24/07/2001	AD

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16585	**Lligwy beach submerged peats**	SH497 876A	SH48NE	NE

Coastal type	Land type	Land use	Land edge type
Bay lee	Low/hill/dunes	Pasture/Leisure	Rock cliff/sand

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand	Sand/pebble		Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
		06.45-07.15	07.18

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.7	06.50	31/01/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16586	**Glan y Mor submerged peats**	SH66637430	SH67SE	NW

Coastal type	Land type	Land use	Land edge type
Open lee	Low	Pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Mud/clay/cobble	Silt/sand	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers
		one	

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
95/25-32	96/25-32	07.30-09.00	08.55

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
1.6	08.30	04/01/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16587	Porth Neigwl A submerged peats	SH288 255A	SH22SE	SW

Coastal type	Land type	Land use	Land edge type
Open/Bay	Low/Dunes	Pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/Pebble/Cobble	Sand/Pebble/Cobble	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
High	Active	Isolated block	220-400mm

Peat substrate	Profile condition	Tree stumps	Timbers
Mud/Clay/Pebble	Partly eroded	Few	Few

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
5/19-20	6/19-20	13.15-14.15	17.35

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.8	14.15	15/11/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
15/5-22	16/5-22	16.15-18.15	20.17

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	17.17	02/03/2002	GHS

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by

PRN	SITENAME	NGR	OSMAP	Coast facing
16588	Afon Wen submerged peats	SH451 370A	SH43NW	S

Coastal type	Land type	Land use	Land edge type
Open lee	Low	Rough grazing/pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble	Sand/cobble	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
93/33-4	94/33-4	14.30-14.45	18.05

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
1.3	14.00	15/12/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
			0

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	0		

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16589	**Criccieth submerged peats**	SH483 370A	SH43NE	S

Coastal type	Land type	Land use	Land edge type
Open lee	Low	R. grazing/pasture	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble	Pebble/cobble/boulder	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
95/1-2	96/1-2	15.00-15.30	18.08

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
1.3	15.05	15/12/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
			0

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	0		

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16599	**Carreg y Defaid submerged forest**	SH3435 3290	SH33SW	SE

Coastal type	Land type	Land use	Land edge type
Open lee	Raised/dunes	Rough grazing/pasture	Rock cliff/artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/pebble	Sand/pebble	Some	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Medium	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
5/21-2	6/21-2	14.30-15.30	17.35

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.8	13/01/1900	15/11/2001	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
			0

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0	0		

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3
			0

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0	0		

PRN	SITENAME	NGR	OSMAP	Coast facing
16600	**Mochras Island**	SH55 26A	SH52NW	W

Coastal type	Land type	Land use	Land edge type
Open	Low/dunes	Pasture/leisure	Soft cliff/dunes

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand/cobbles/boulders/mix	Sand/cobble/boulder		Natural erosion/visitors

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
9/19-24	10/19-24	11.30-12.45	17.37

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
1.1	14.37	28/01/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16601	**Peat exposures at Tywyn**	SN58559853	SN59NE	W

Coastal type	Land type	Land use	Land edge type
Open	Low/marsh	Pasture	Shingle storm bank

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Cobble	Sand	Nil	Natural erosion/visitors

Threat class	Threat time	Peat extent	Peat depth
Medium	Medium	Extensive	up to 1000mm

Peat substrate	Profile condition	Tree stumps	Timbers
Mud/clay	Complete	Few	Fallen timbers common

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
5/19-36	6/19-36	13.30-15.30	17.20

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.8	17.20	26/02/2002	GHS, AC

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16602	Aber Ogwen submerged forest	SH61007235	SH67SW	NE

Coastal type	Land type	Land use	Land edge type
Bay, lee	Low, Valley	Wood, Pasture	Soft cliff, Artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Pebble, Cobble	Mud/clay, Silt	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers
		Common	

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
17/7-10	18/7-10	17.15-17.45	17.48

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0.3	17.15	28/03/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16603	Cymyran submerged forest	SH305745A	SH37SW	SW

Coastal type	Land type	Land use	Land edge type
Open	Low	Scrub, Military	Soft cliff

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand, Pebble	Sand, Pebble	Wrack	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Long	Nil	

Peat substrate	Profile condition	Tree stumps	Timbers

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1
17/13-16	18/13-16	13.00-13.30	15.33

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
2.9	14.00	07/04/2002	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
0			

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

PRN	SITENAME	NGR	OSMAP	Coast facing
16604	**Penrhos Bay submerged peats**	SH263 818A	SH28SE	N

Coastal type	Land type	Land use	Land edge type
Bay lee	Low. Raised	Leisure, Industry	Rock cliff, Soft cliff, Artificial

Foreshore type	Intertidal type	Intertidal vegetation	Threat type
Sand, Pebble	Sand, Rock	Nil	Natural erosion

Threat class	Threat time	Peat extent	Peat depth
Low	Medium	Separate blocks	100

Peat substrate	Profile condition	Tree stumps	Timbers
Clay	Partly eroded	Few	None

Photorefcolneg 1	Photorefcoltrans 1	Visit1 time	Lowtidetimelivpl 1

Tidelowheight 1	Lowtidetimelocal 1	Visit1 date	Visit1 by
0		04/10/1999	GHS

Photorefcolneg 2	Photorefcoltrans 2	Visit2 time	Lowtidetimelivpl 2
17/27-28	18/27-28	16.00-16.30	15.33

Tidelowheight 2	Lowtidetimelocal 2	Visit2 date	Visit2 by
2.9	15.00	07/04/2002	GHS

Photorefcolneg 3	Photorefcoltrans 3	Visit3 time	Lowtidetimelivpl 3

Tidelowheight 3	Lowtidetimelocal 3	Visit3 date	Visit3 by
0			

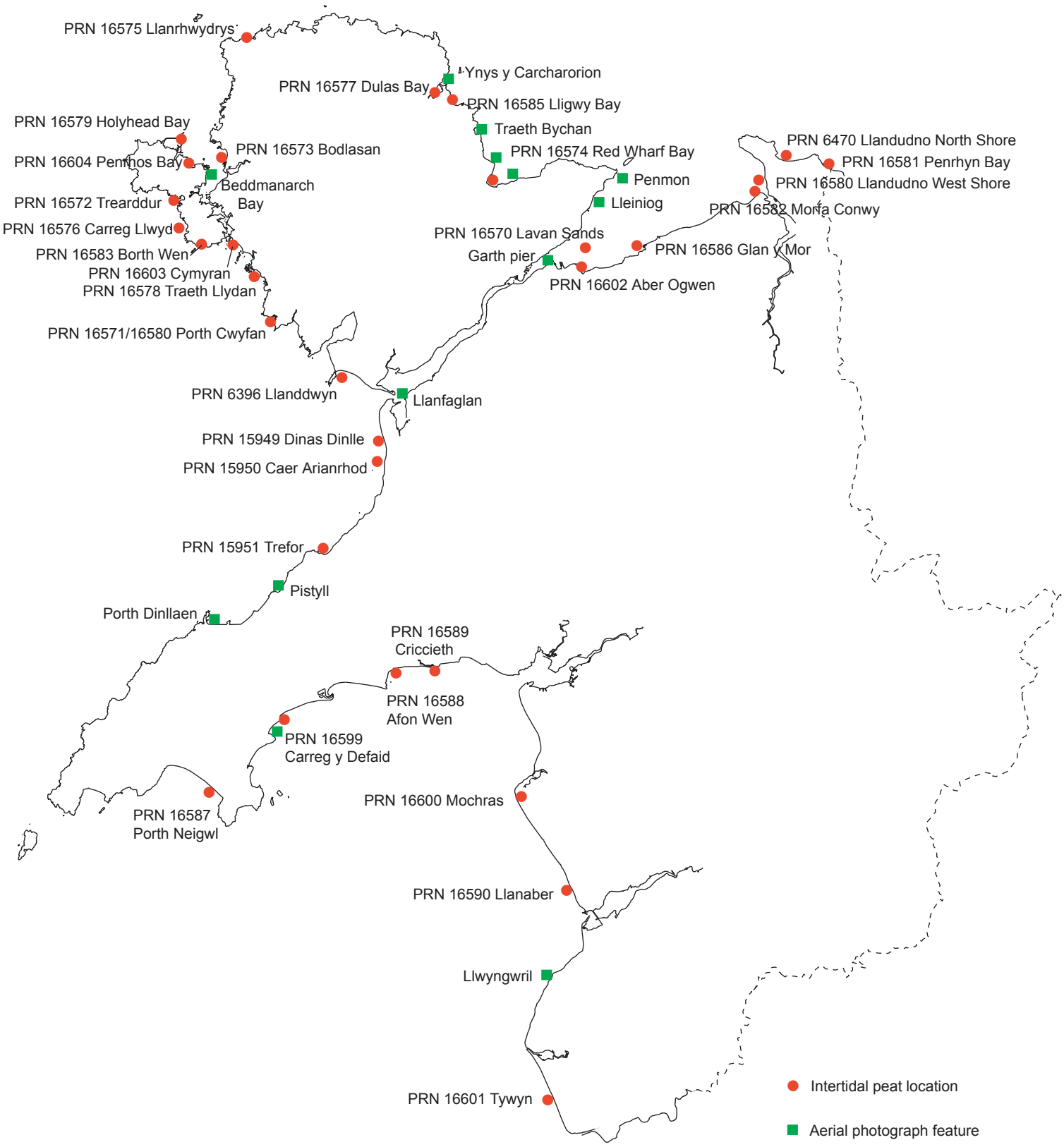

Fig. 1 General location of all reported intertidal peat exposures in north-west Wales

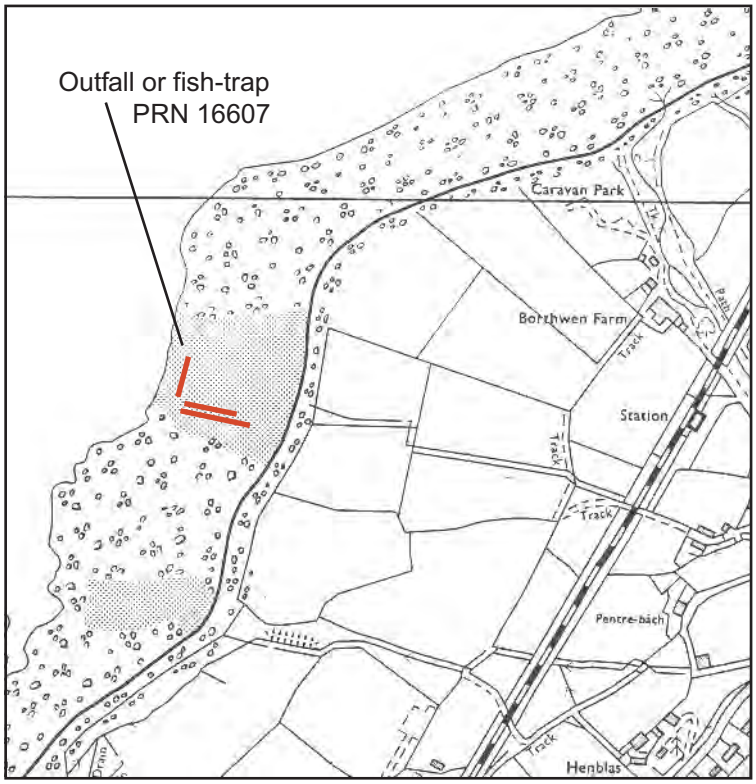

Fig. 2 Llwyngwril, Meirionnydd, aerial photograph plot. Scale 1:10,000

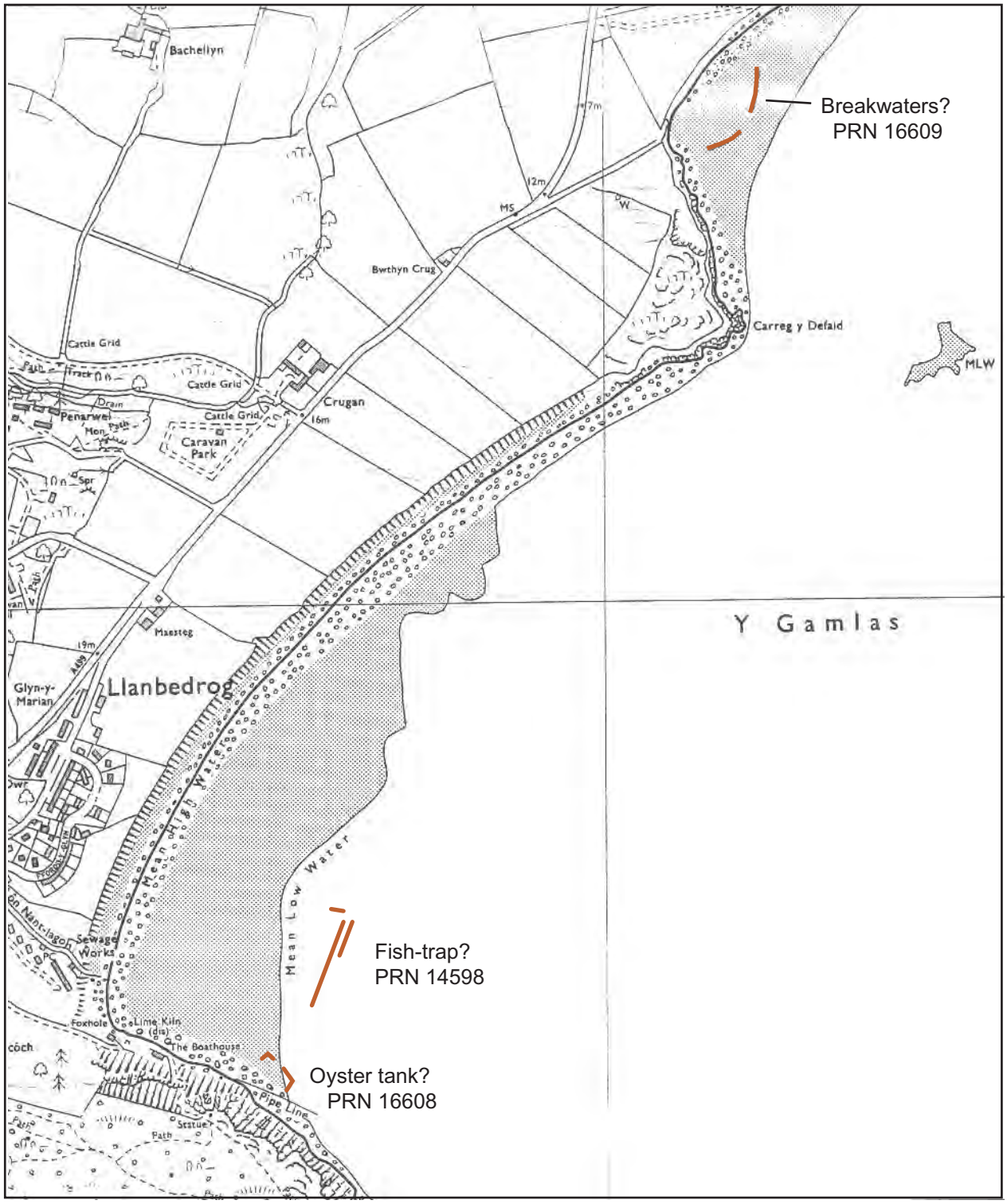

Fig. 3 Llanbedrog and Carreg y Defaid, Llyn, aerial photograph plot. Scale 1:10,000

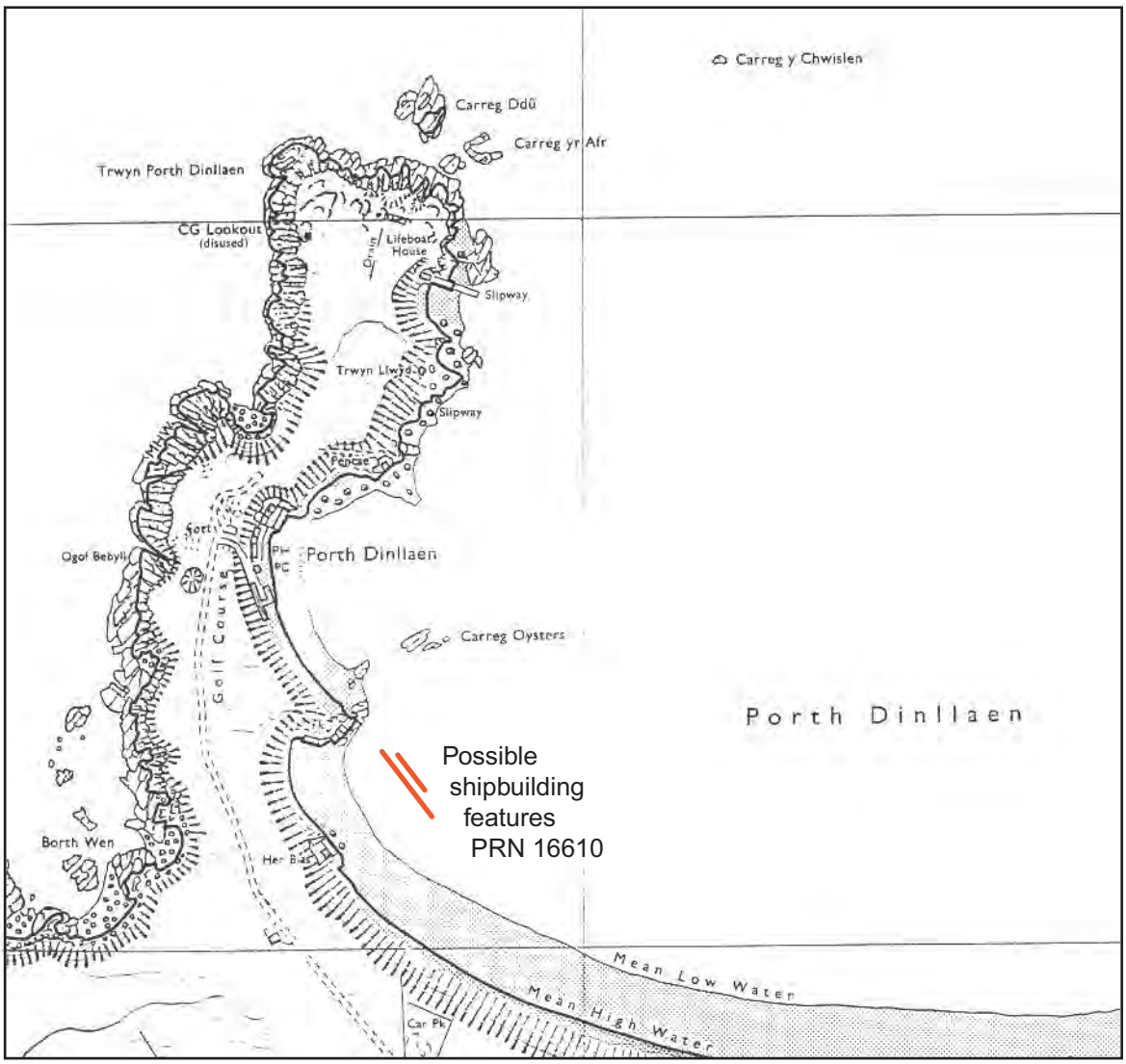

Fig. 4 Porth Dinllaen, Nefyn, Llyn, aerial photograph plot. Scale 1:10,000

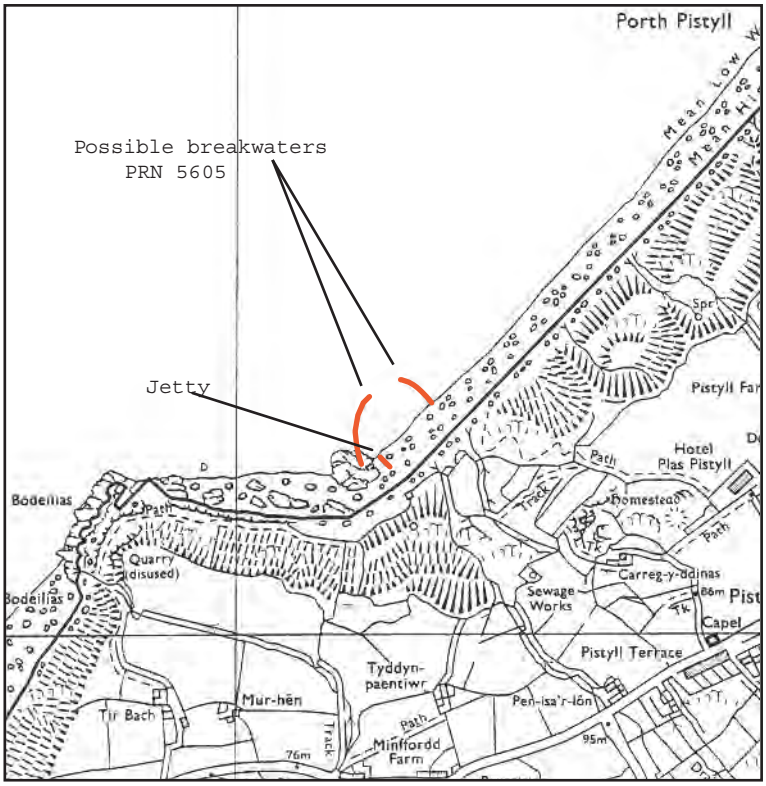

Fig. 5 Pistyll, Nefyn, Llyn, aerial photograph plot. Scale 1:10,000

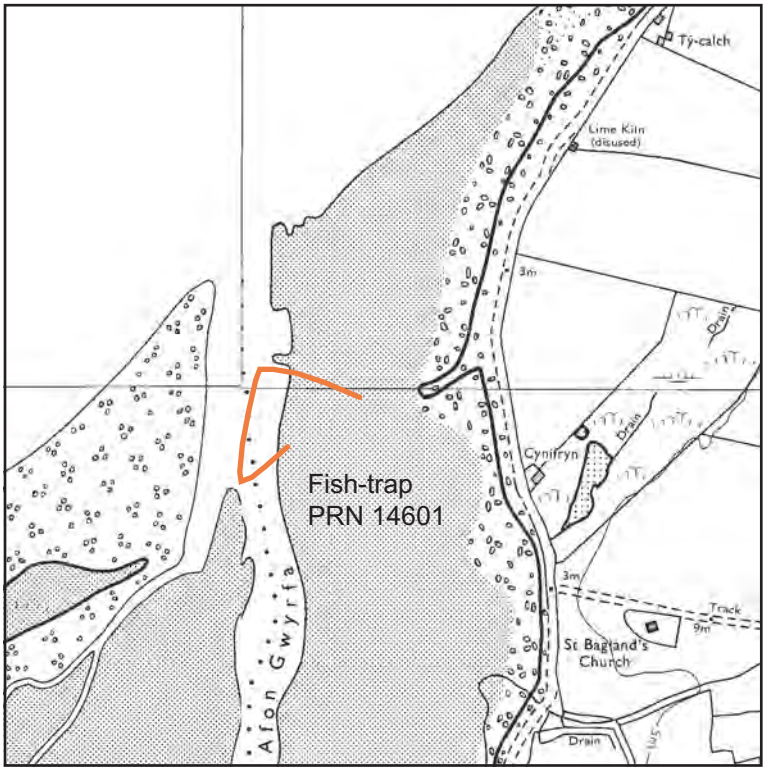

Fig. 6 Cored Gwyrfai, Llanfaglan, Caernarfon, aerial photograph plot. Scale 1:10,000

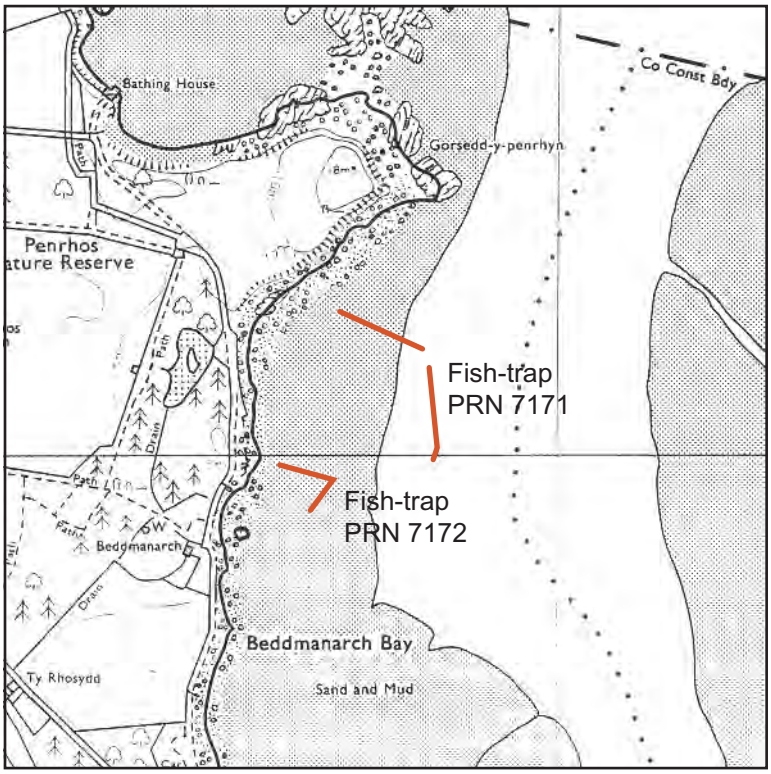

Fig. 7 Beddmanarch Bay, Holyhead, aerial photograph plot. Scale 1:10,000

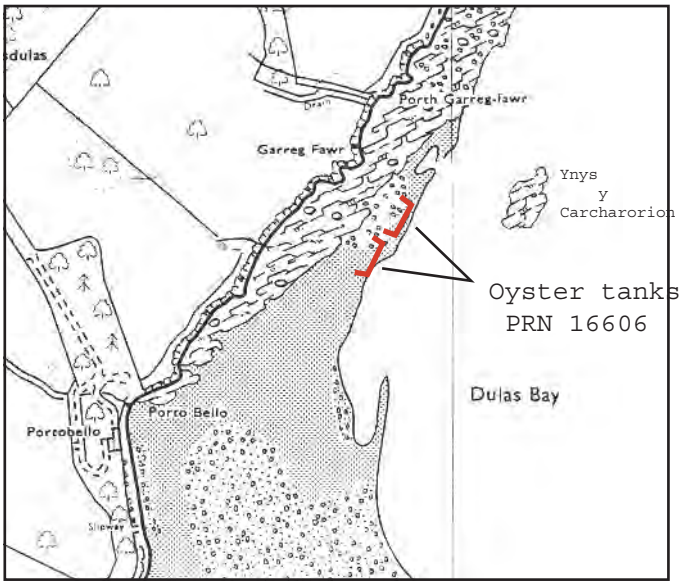

Fig. 8 Dulas Bay, Anglesey, aerial photograph plot. Scale 1:10,000

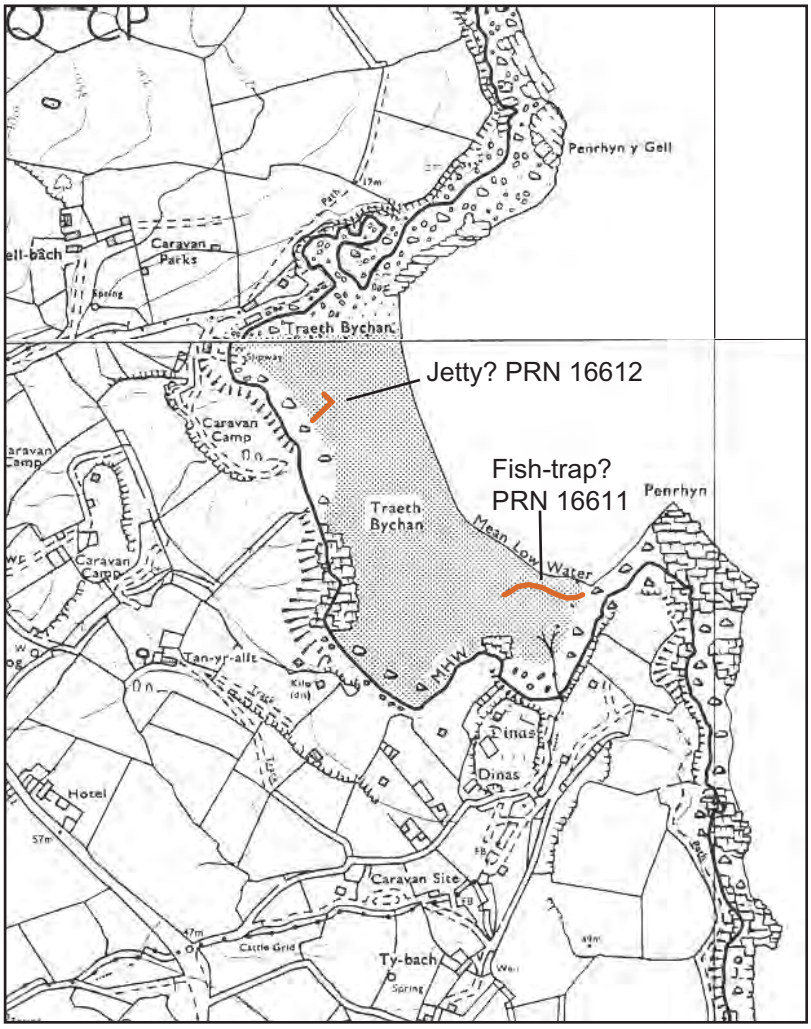

Fig. 9 Traeth Bychan, Anglesey, aerial photograph plot. Scale 1:10,000

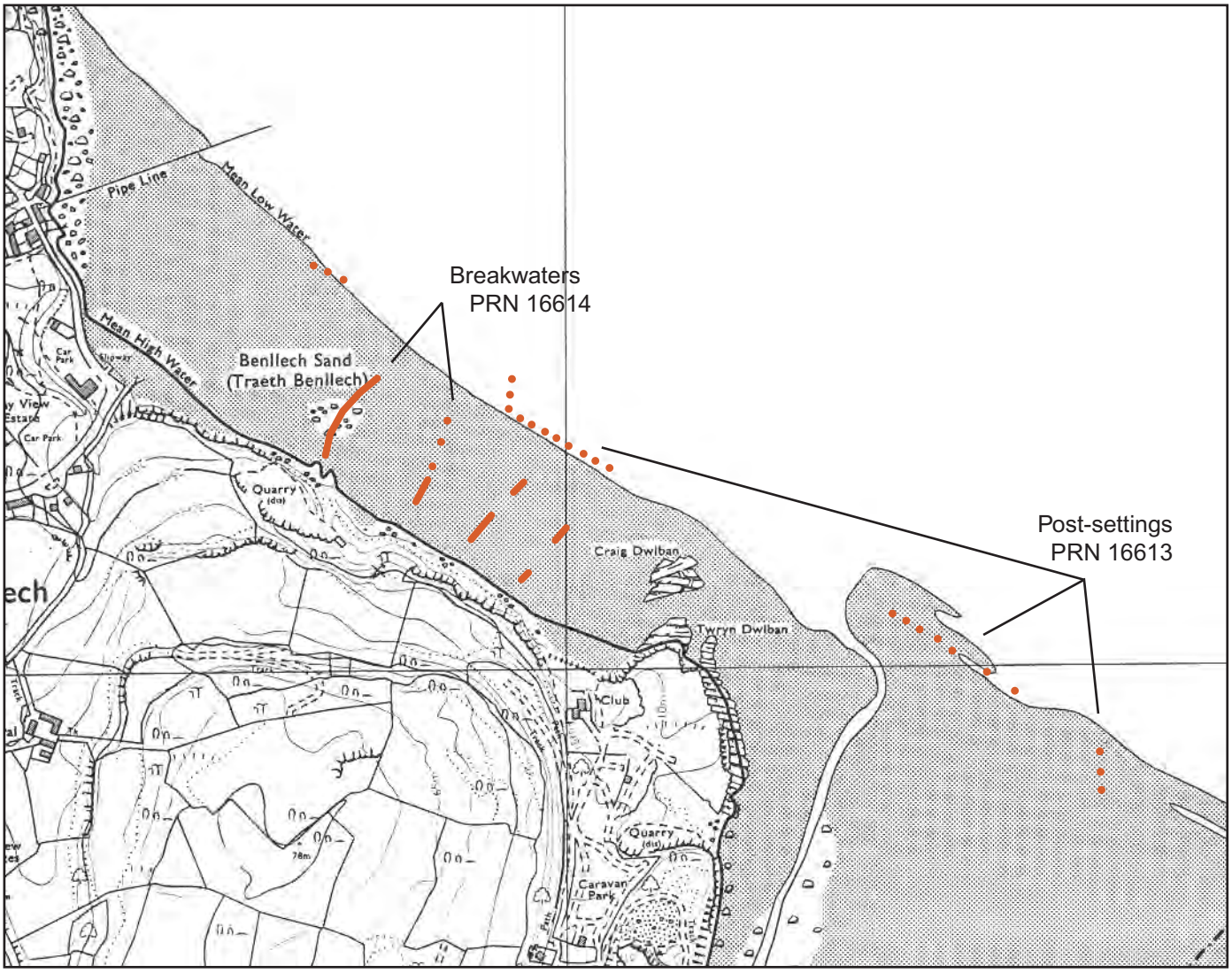

Fig. 10 Red Wharf Bay West, Benllech, Anglesey, aerial photograph plot. Scale 1:10,000
(See also Fig. 28)

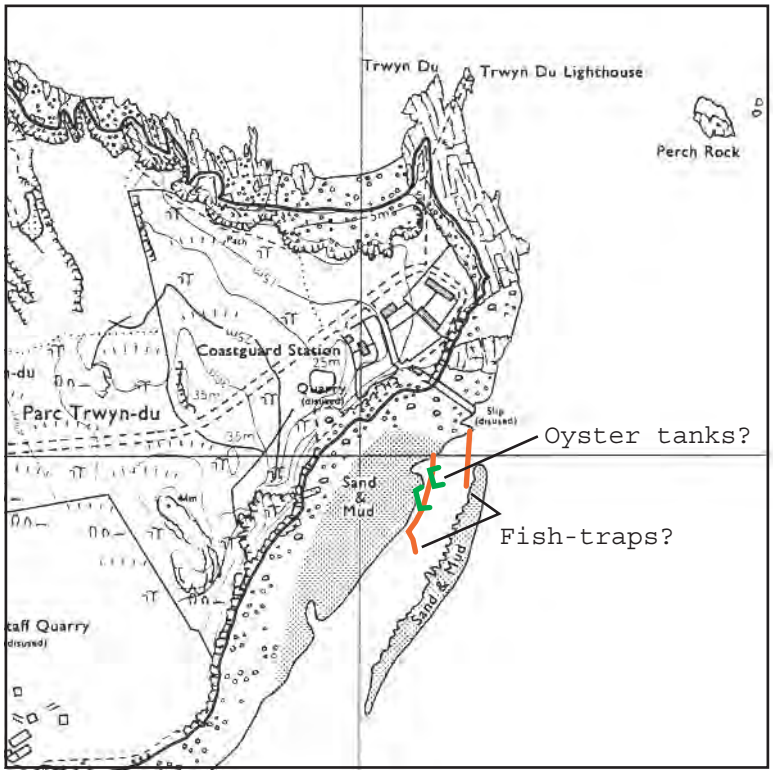

Fig. 11 Penmon, Anglesey, aerial photograph plot. Scale 1:10,000

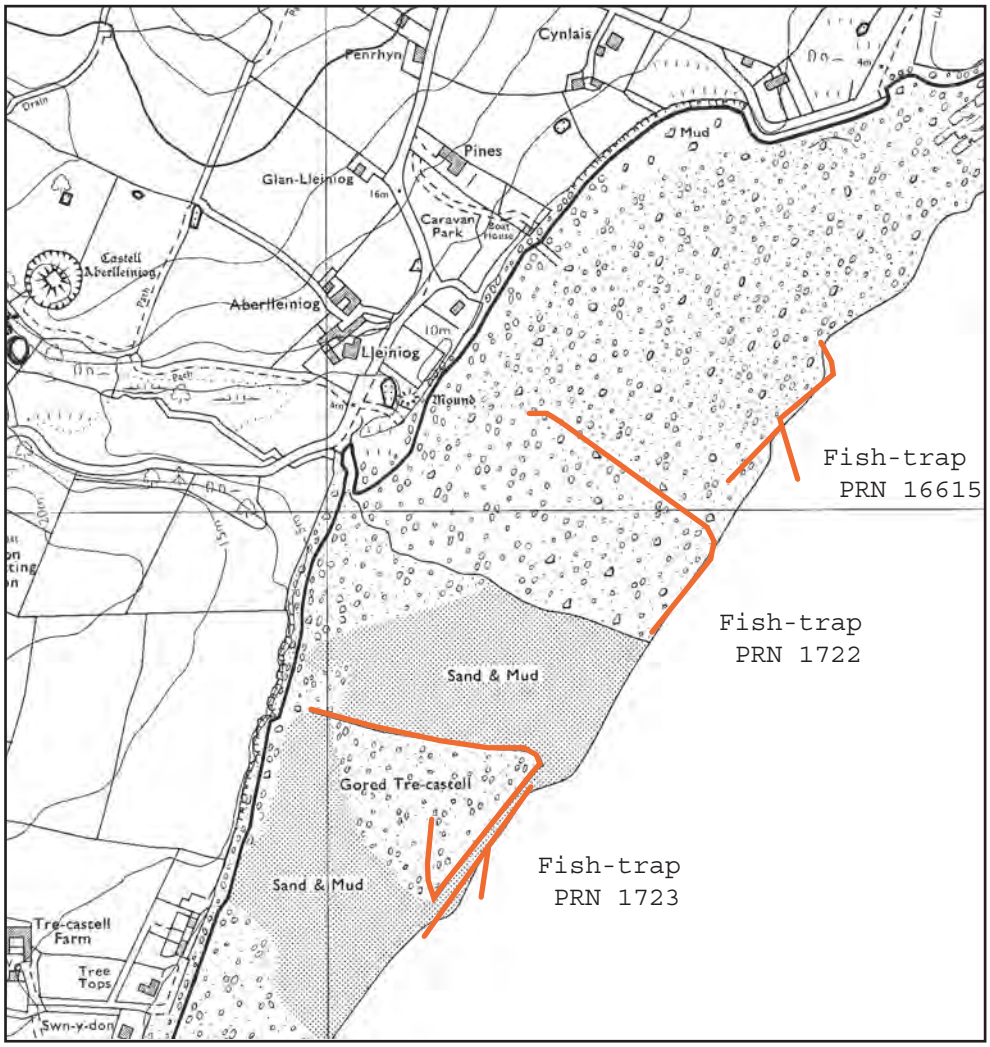

Fig. 12 Aberlleiniog East, Beaumaris, Anglesey, aerial photograph plot. Scale 1:10,000

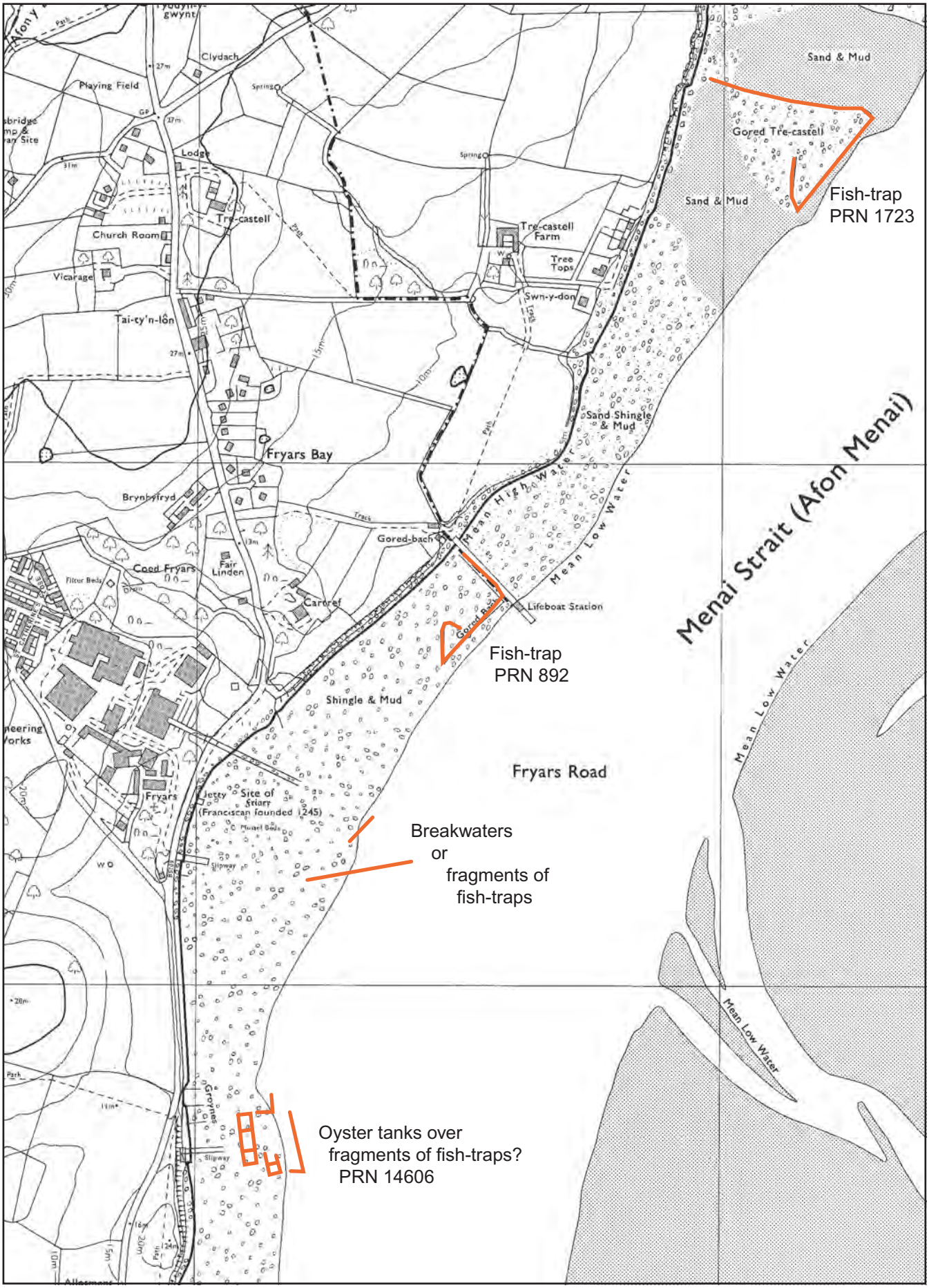

Fig. 13 Aberlleiniog West, Beaumaris, Anglesey, aerial photograph plot. Scale 1:10,000

Fig. 14 Garth, Bangor, aerial photograph plot. Scale 1:10,000

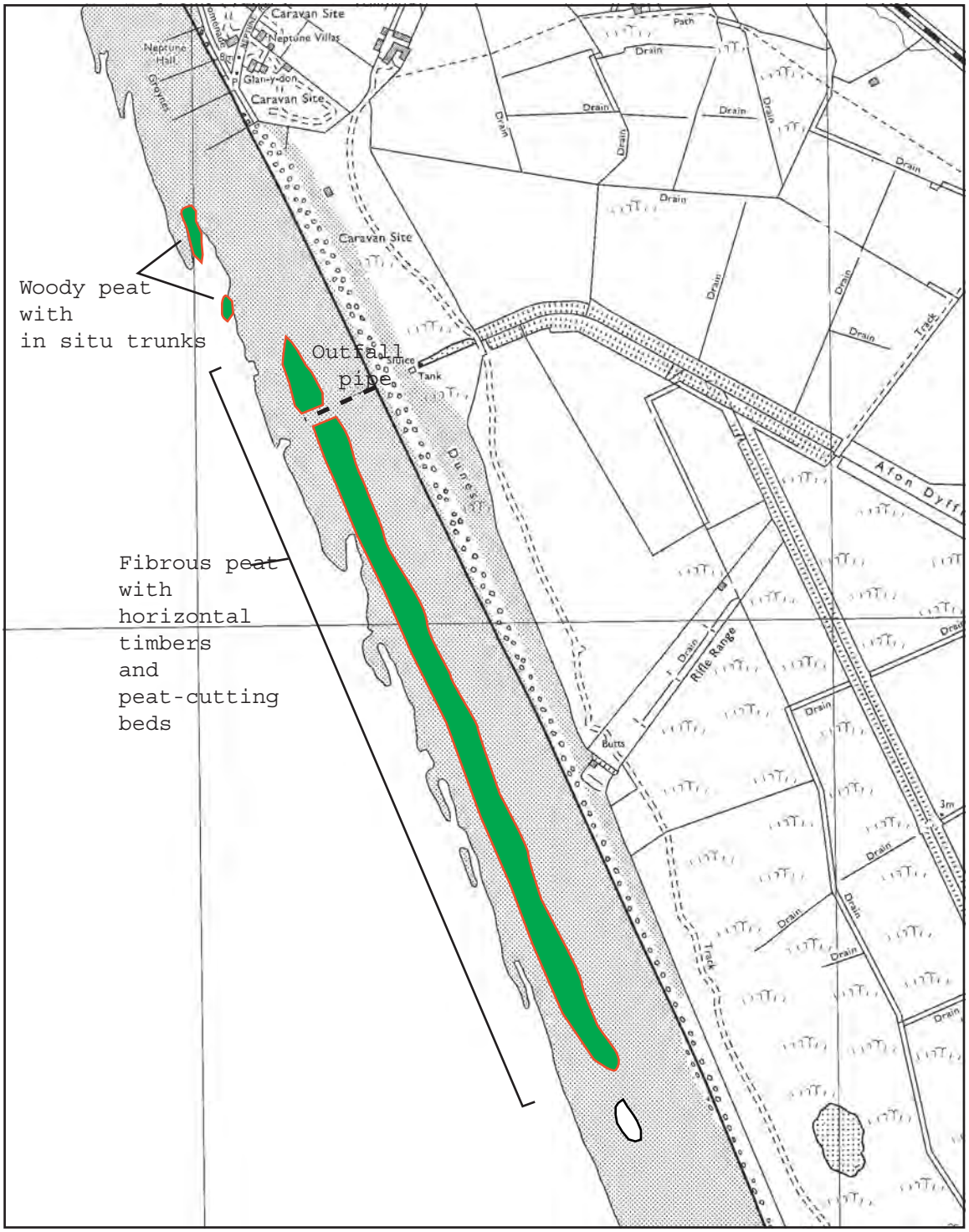

Fig. 15 Tywyn, Meirionnydd, PRN 16601, sketch location of intertidal peat exposures. Scale 1:10,000

Fig. 16 Tywyn, Meirionnydd, PRN 16601, water-filled peat-cuts

Fig. 17 Tywyn, Meirionnydd, PRN 16601, fallen tree
exposed by peat-cutting, 1m scale.

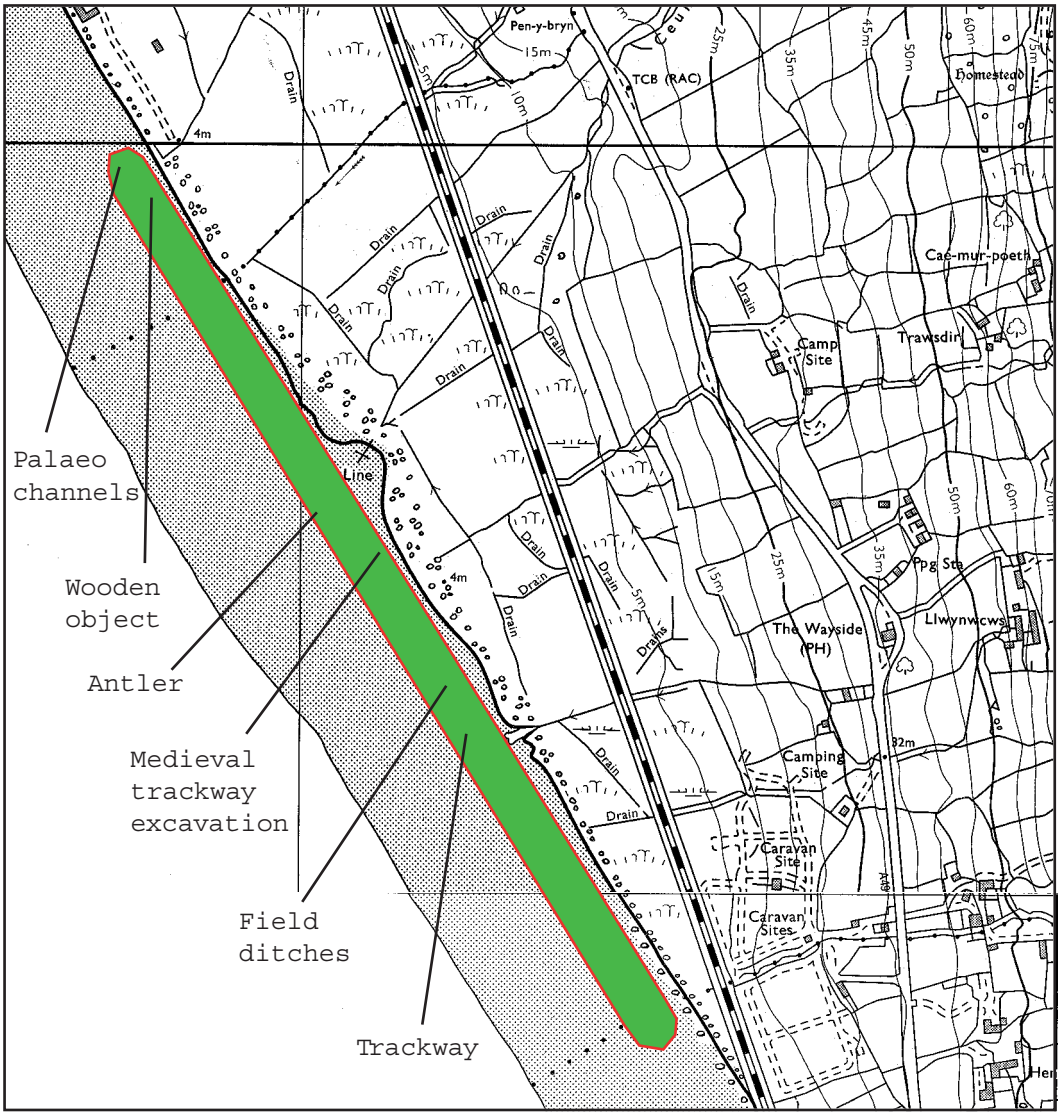

Fig. 18 Llanaber, Meirionnydd, PRN 16590, location of individual finds and sketch location of intertidal peats. Scale 1:10,000

Fig. 19 Llanaber, Meirionnydd, PRN 16590, peat-filled palaeo-channel, 1m scale.

Fig. 20 Llanaber, Meirionnydd, PRN 16590, showing immature red deer antler in situ in clay, predating peat deposits

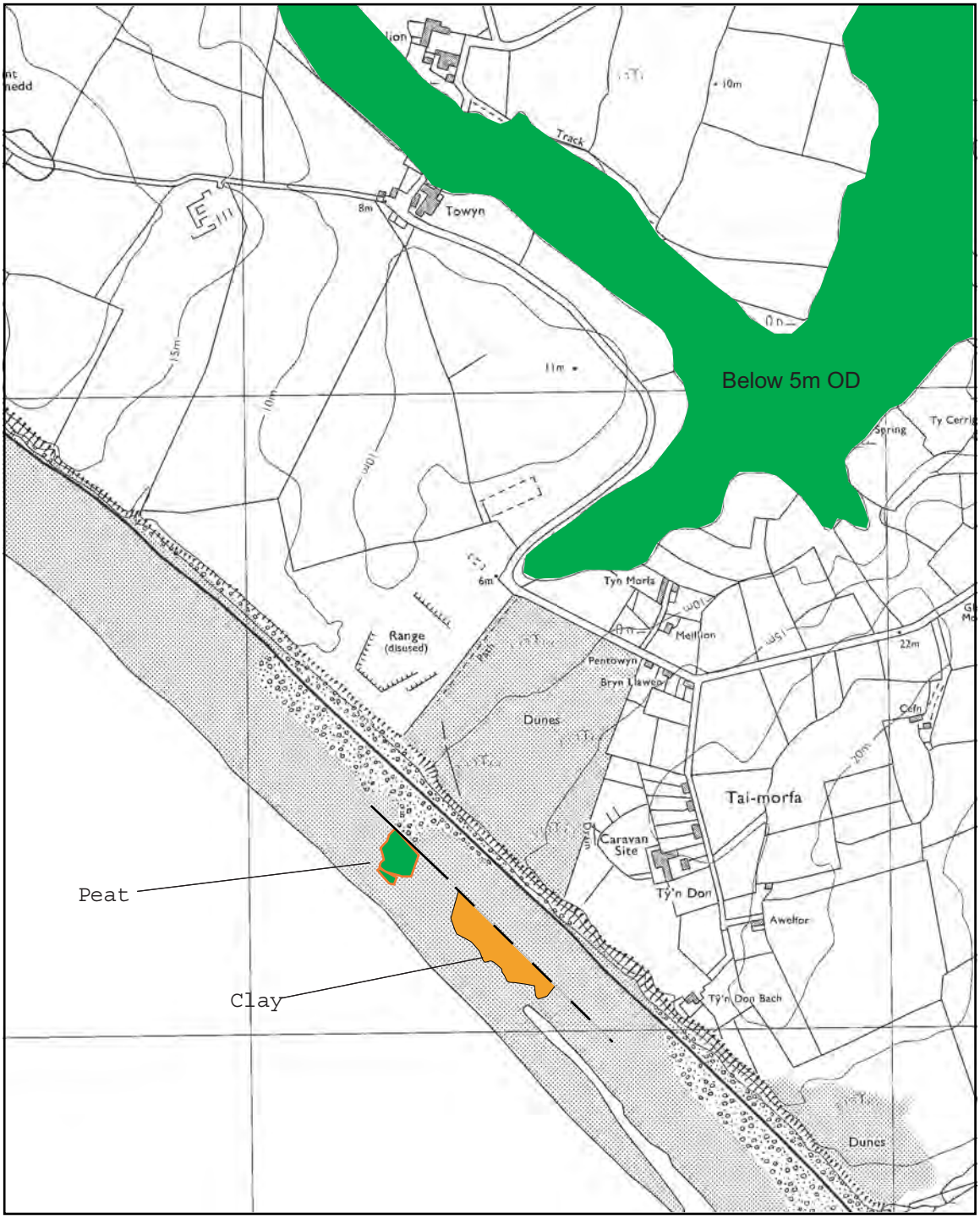

Fig. 21 Porth Neigwl, Llyn, PRN 16587, sketch location of peat, clay and the course of old river channel (below 5m OD). Scale 1:10,000

Fig 22 Porth Neigwl, llyn, PRN 16587, General view of peat exposure

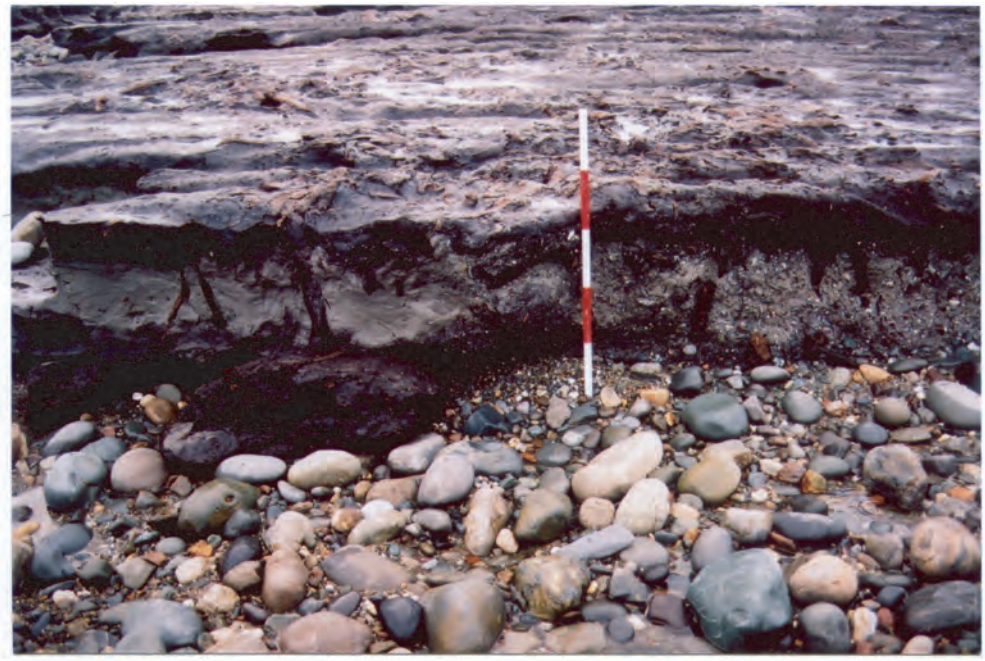

Fig. 23 Porth Neigwl, Llyn, PRN 16587, showing two peat horizons and variation in the clay horizon, 1m scale.

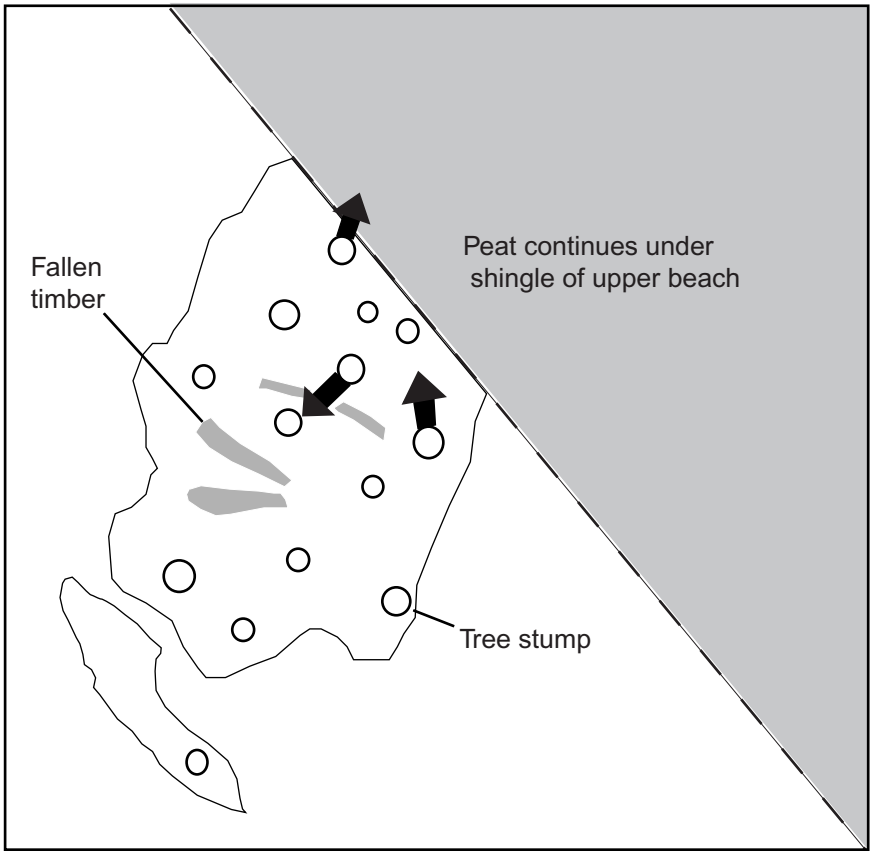

Fig. 24 Porth Neigwl, Llyn, PRN 16587, sketch plan of peat exposure showing timbers and direction of tree-fall. Scale approx 1:400.

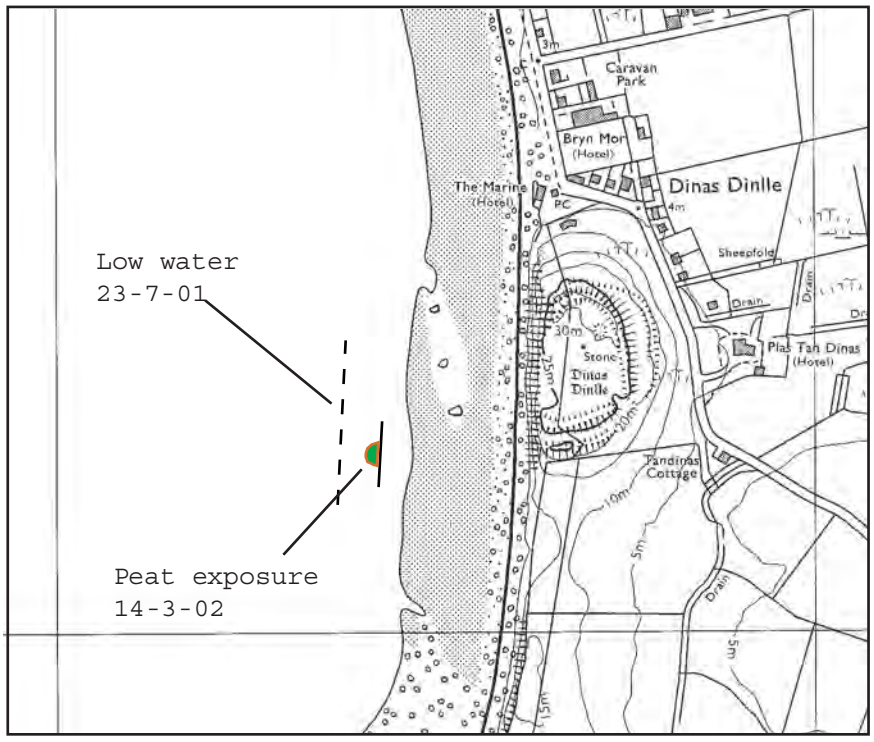

Fig. 25 Dinas Dinlle, PRN 15949, showing spring low tide line and approx. position of peat exposure in relation to the hillfort. Scale 1:10,000

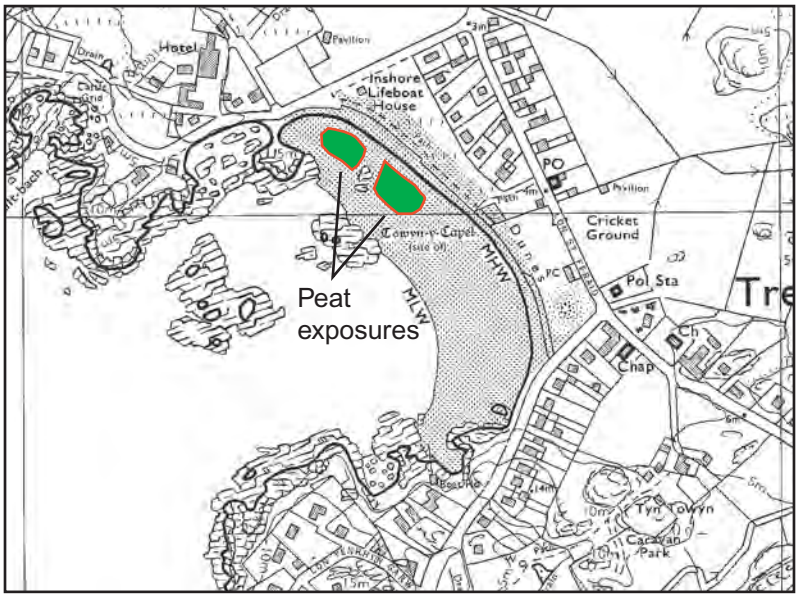

Fig. 26 Trearddur Bay, Holyhead, Anglesey, PRN 16572, sketch location of intertidal peat exposures. Scale 1:10,000

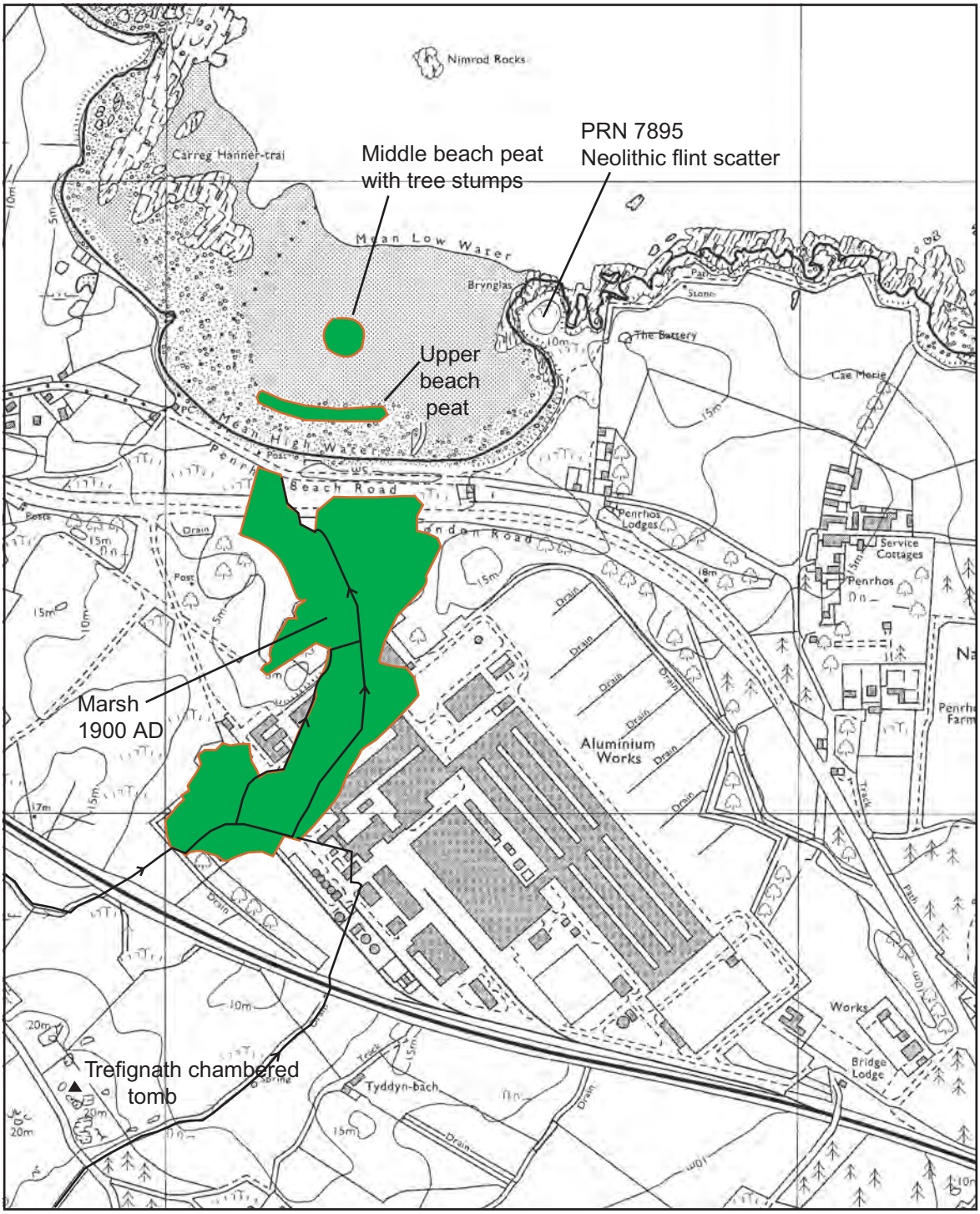

Fig. 27 Penrhos Bay, Holyhead, Anglesey, PRN 16604, sketch location of intertidal peat and former valley. Scale 1:10,000

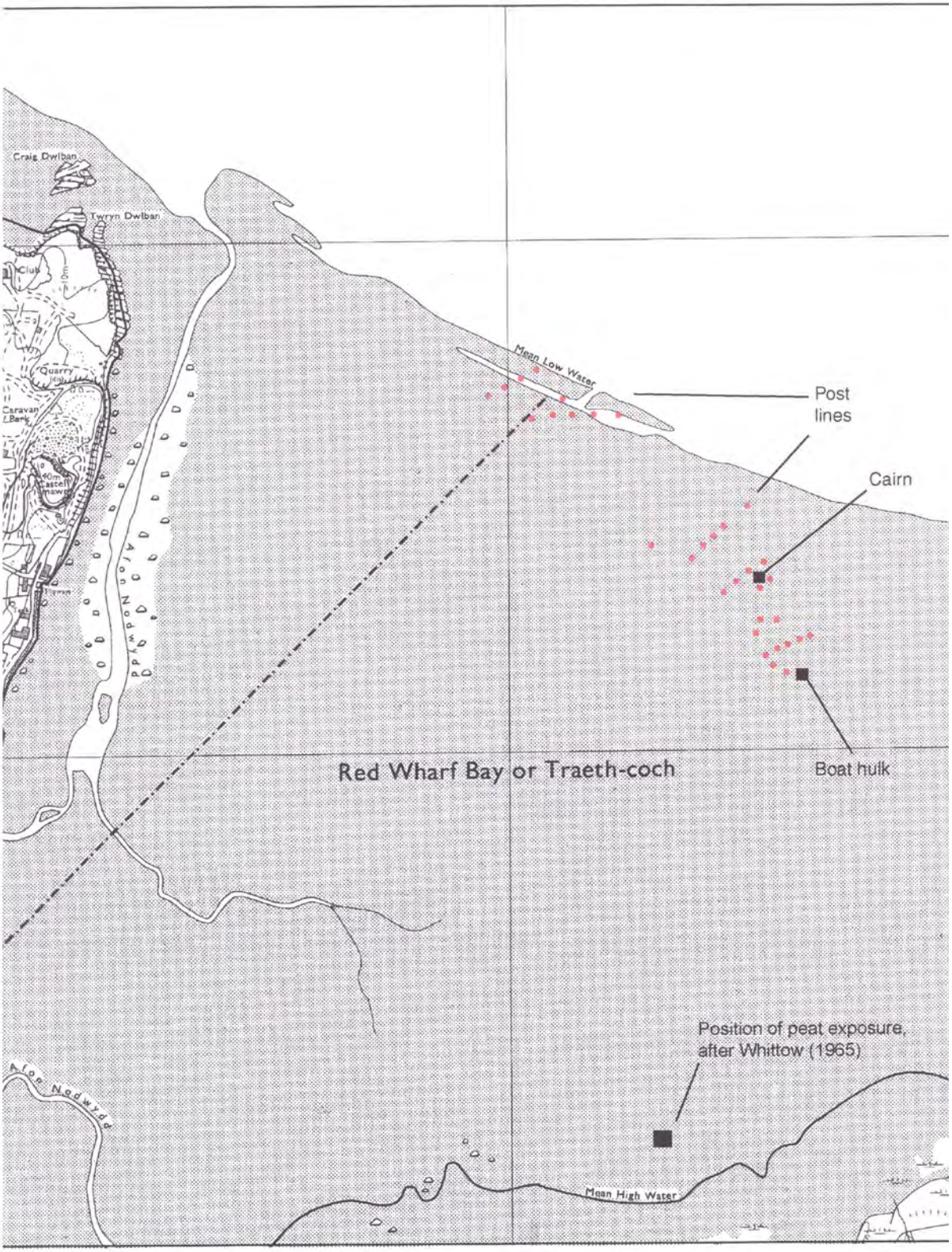

Fig. 28 Red Wharf Bay Central, Benllech, Anglesey, PRN 16574, sketch location of post-lines, cairn and boat hulk. Scale 1:10,000. (See also Fig. 10).

Fig. 29 Red Wharf Bay Central, Anglesey, post line, 1m scale

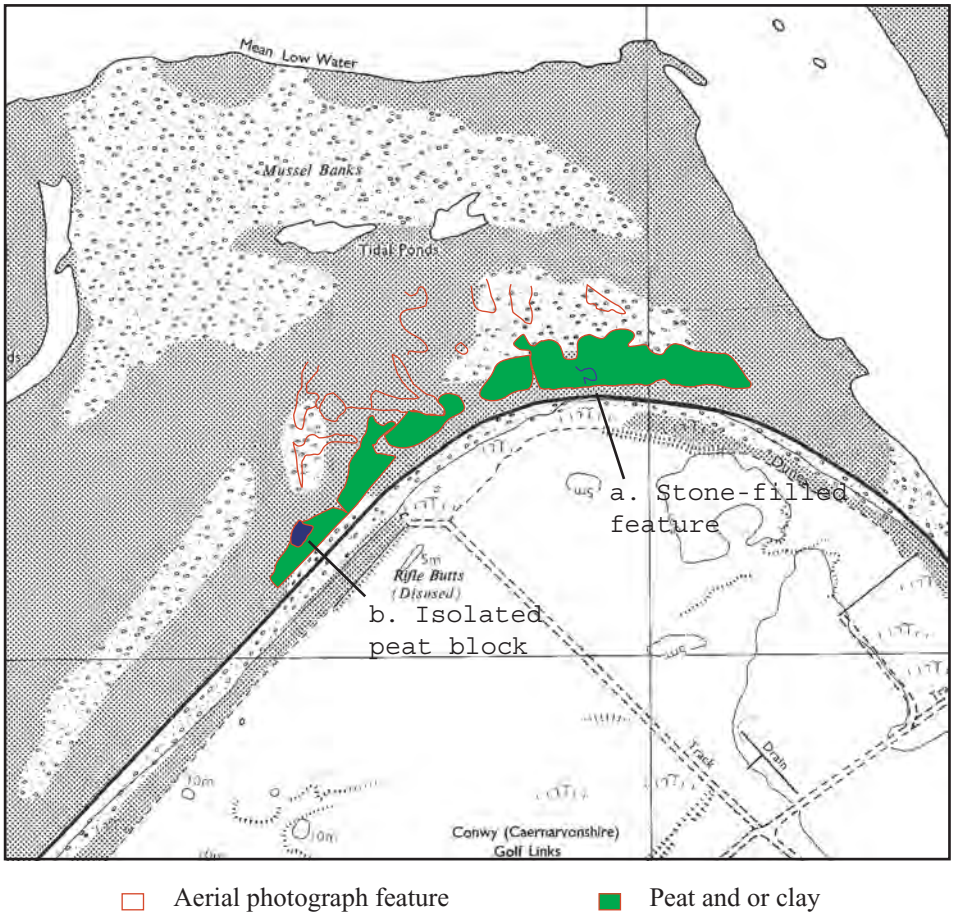

Fig. 30 Morfa Conwy, PRN 16582, sketch location and aerial photograph plot of intertidal deposits. Scale 1:10,000

Fig. 31 Morfa Conwy, PRN 16582, tree stump partly buried by sand, with Astrid Caseldine, 1m scale

Fig. 32 Morfa Conwy, PRN 16582, tree stump and Nigel Bannerman

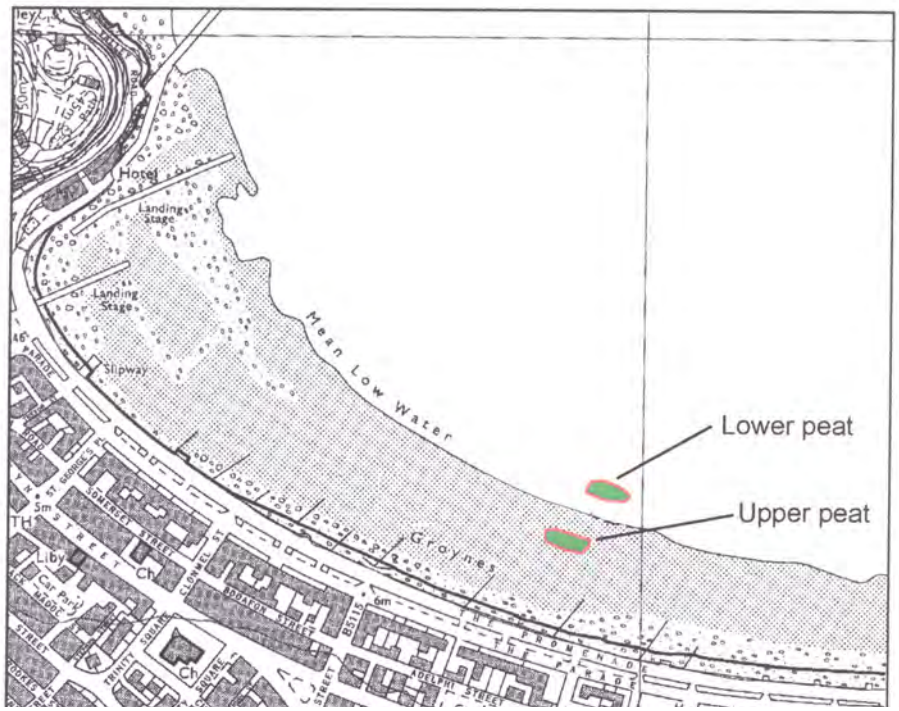

Fig. 33 Llandudno North Shore, PRN 6470. Location of intertidal peat exposures. Scale 1:10,000.

Fig. 34 Penrhyn Bay, Conwy, PRN 16581. Horizontal timbers in situ in top of peat exposure, partly masked by sand. 1m scale