

**Glamorgan-Gwent Archaeological Trust
Contracts Division**

Swansea Bay Intertidal Survey

**Report prepared by N Nayling MA AIFA
for Cadw (Welsh Historic Monuments)**

**GGAT Report no. 00/98
Cadw Project GGAT 58**

Contents

ACKNOWLEDGEMENTS.....	2
INTRODUCTION	2
PROJECT OBJECTIVES.....	3
METHODOLOGY	4
INTERTIDAL PEATS: PREVIOUS OBSERVATIONS AND INVESTIGATIONS	5
INTERTIDAL PEATS: SURVEY RESULTS	7
<i>P1: Oystermouth (Map 1)</i>	8
<i>P*: Blackpill (Map 1)</i>	8
<i>P2: Brynmill (Maps 1 and 2)</i>	9
<i>P3: Brynmill 2 (Map 2)</i>	9
<i>P4: Margam (Map 3)</i>	10
<i>P5: Kenfig (Map 4)</i>	11
STONE FISH WEIRS BETWEEN THE RIVER TAWE AND MUMBLES	12
<i>The documentary evidence</i>	12
<i>Cartographic Evidence</i>	18
<i>Aerial Photographs</i>	19
<i>Field observations</i>	19
<i>Parallels</i>	19
MISCELLANEOUS WOODEN FISH TRAPS	20
THE 'OLD QUAY'	21
THE OYSTER FISHERY	21
<i>Jetty</i>	22
<i>Perches</i>	22
<i>Wrecks associated with the oyster fishery?</i>	22
MISCELLANEOUS	23
<i>Wrecks</i>	23
<i>Pits on the foreshore</i>	24
CONCLUSIONS.....	25
DOCUMENTARY AND CARTOGRAPHIC SOURCES CONSULTED.....	26
<i>West Glamorgan Record Office</i>	26
<i>Swansea Reference Library</i>	27
<i>University of Wales, Swansea (Rare Books Section)</i>	27
APPENDIX I: INDEX OF AERIAL PHOTOGRAPHS	28
BIBLIOGRAPHY	33
FIGURES	1
MAPS	44

Acknowledgements

Much of the fieldwork and documentary research was carried out with the assistance of Rosie Irons, Project Assistant whose enthusiasm and determination is gratefully acknowledged.

In addition, a number of individuals either proffered advice or endured repeated requests for information with good grace:

Enid Taylor and Derek ... from the Aerial Photographs department of the Welsh Office, Cathays Park, Cardiff

Archivists at the West Glamorgan Records Office

Elisabeth Bennett, archivist for the Local Archives Collection at Swansea University Library

Staff at Swansea Reference Library

Richard Davies, Swansea Museum and the Maritime and Industrial Museum

Mr. Richard Brighton, Cambrian Index at Swansea Reference Library

Mr. Bernard Morris, Swansea for advice and information regarding fish weirs

Miss Rebecca Wright, Countryside Council for Wales, Swansea

Mr M. R. Fordy, Dept of Zoology, University of Wales, Swansea

Mr A Moran formerly Dept of Oceanography, University of Wales, Swansea for permission to refer to his unpublished paper on the Mumbles/Blackpill quay.

Mr Salaam Matti, Swansea City and County Council

Introduction

Swansea Bay forms one of the major embayments of the Bristol Channel, and includes an extensive intertidal zone containing much of archaeological interest. Flandrian deposits that have accumulated against a background of predominantly post-glacial sea level rise have been observed for centuries, although their study has been limited and intermittent. Seminal studies of peat horizons encapsulated within these by Godwin, before the Second World War, provided some of the first proofs of the potential of pollen analysis for characterising Holocene environmental change. Recent surveys of other intertidal areas, especially in the Severn Estuary, have stressed the potential of such deposits for producing archaeological evidence with excellent preservation, and stratigraphic and environmental association. In more recent periods, this foreshore has been the focus for specialised economic activities including fishing and transport which again have left their mark in an environment which has encouraged good preservation.

This report summarises the results of a rapid survey of this foreshore resource through study of aerial photographs and documentary evidence followed by field evaluation commissioned by Cadw: Welsh Historic Monuments and carried out by staff from the Glamorgan-Gwent Archaeological Trust. This study builds on recent coastal survey of the area forming part of a pan-Wales initiative aimed at evaluating the archaeological resource of Wales' coastal heritage.

Project Objectives

The initial project design focused on study of intertidal peats known to exist between Mumbles in the west and Sker Point in the east. The stimulus for the study came from relatively recent work by GGAT on an exposed section of trackway at Brynmill (Williams 1993), the success of the Gwent Levels Intertidal Peat Survey (Bell and Neumann 1997), and the recurrent recovery of late prehistoric metalwork by metal detectors. The Severn Estuary survey highlighted the potential of aerial photography for intertidal work and suggested that a similar approach might be applicable to the Swansea Bay exposures, whilst recent finds implied that a systematic survey might be fruitful. It was recognised that the recent coastal survey of this part of the Welsh coastline (Locock 1996) whilst providing a useful summary of known and newly identified sites close to the High Water mark, had not allowed for systematic examination of the full extent of the very considerable foreshore. This was especially true in the west part of the bay, between Swansea Harbour and Mumbles, where the distance between high and low water often exceeds 1.5km.

The primary objectives, as stated in the original project design were:

- mapping of intertidal peats through digitising large-scale vertical aerial photographs
- fieldwalking of exposures when conditions most suitable
- evaluation of identified sites
- production of map base and associated database of sites/finds
- SMR enhancement
- report outlining findings

During the selection of aerial photographs for plotting, a number of previously unrecorded features were observed which, although not strictly relevant to the main research objectives stated in the initial project design, were clearly of archaeological interest. The main group here consisted of an extensive palimpsest of large, V-shaped fish weirs between West Cross and Swansea Harbour, although a number of additional shipwrecks and possible relict perches associated with the former oyster fishery at Mumbles were also observed. Following discussion with Cadw, the project design was updated to include these features. In part this was a reflection of the limited number of peat exposures identified on aerial photographs but also a pragmatic decision which recognised the merits of dealing with these new sites whilst being active in the area. This shift in focus necessitated additional documentary research, particularly regarding the system of large fish traps, which have not been the subject of recent publication.

Methodology

Given the status of some parts of the foreshore (around Crymlyn Burrows and Oystermouth) the Countryside Council for Wales was consulted in advance of fieldwork, as were the relevant Unitary Authorities and major industrial companies with large facilities adjacent to the foreshore.

The approach employed to enhance the record of intertidal peats in the Bay closely followed that used in a recent survey of the peats of the Gwent Levels foreshore (Bell and Neumann 1997). Whilst a number of potential sources of large-scale, vertical aerial photographs were consulted, including the Hydrographic Office (Taunton), the Environment Agency and Unitary Authorities, it became clear that the most substantial collection of potentially suitable, and accessible, material resided in the Welsh Office. A large number of sorties, both military and commercial, were examined (see Appendix I). Preference was given to colour images at a scale of 1:10,000 or greater where the tide was sufficiently well out to allow examination of a reasonable expanse of the foreshore. The degree to which mobile sediment obscured the Quaternary deposits under study varied over time, and photographs from immediately after the Second World War to very recent sorties were examined. Earlier images were generally black and white, making discrimination between areas of coal wash and exposed sections of peat horizons problematic. On the other hand, some features that had become less clear on later images due to erosion over time were more clearly defined on these early photographs. Once an image had been selected for extraction of data, it was covered with an acetate sheet and the relevant features traced with fine-nibbed, coloured markers. The recent coastal survey of the area (Locock 1996) proved invaluable during this process, both in providing an up to date summation of the archaeological record, and map bases which allowed the identification of reference points which were visible both on the aerial photograph and large scale Ordnance Survey maps. As many of these reference points as possible were traced to allow accurate transcription of the archaeological features onto the map base.

The process of transcription was achieved by first digitising selected parts of 1:10,000 Ordnance Survey maps, including control points previously identified during the tracing procedure, using AutoCAD™ (Release 12) to provide a computerised map base, and then digitising the traces of the aerial photographs. This process requires geometric rectification of the traced data that is distorted, particularly towards the edges of the parent photograph. AutoCAD allows the use of three methods of geometric transformation of the data to redress this distortion (orthogonal, projective and affine). A pragmatic approach was taken to the selection of transformation procedure with that which gave the smallest RMS being used on each trace. Digitising is a time-consuming process requiring considerable care and technological awareness. The time taken on this part of the project could have been considerably reduced, and the accuracy of the final maps probably improved, by the use of OS digital map data. To have leased the data from the OS, for the duration of the project at commercial rates, would have cost several thousands of pounds, making this an unrealistic

option.

Once the maps had been completed, these were printed out as required for each of a succession of field evaluation visits, along with grid references for spot features to be included within the day's field visit. This enabled rapid location of features that were still visible in conjunction with the use of a hand-held Global Positioning System (GPS). In addition to recording notes on features identified during examination of aerial photographs, any previously unrecorded structures or exposures seen during field evaluation were recorded and approximate national grid references (NGR) generated using the GPS. Where possible, stretches of foreshore were visited more than once, particularly if a previous visit had encountered thick surface layers of sand or other semi-mobile sediments that had obscured possible peat exposures recorded during examination of the photographs. Spring tides were favoured for visits to structures that lay close to Mean Low Water.

During periods when either the time or depth of low tide made field visits less productive or impossible, background documentary and cartographic research was carried out.

Examination of the Regional Sites and Monuments Record was supplemented by reference to the recent coastal survey from Loughor to Sker Point (Locock 1996). Historical observations of peat exposures were sought along with formative papers (e.g. Godwin 1938) on the analysis of these horizons. In addition to publications held in the University of Wales, Swansea Library (including the archive and rare books section), records held by Swansea Museum and Art Galleries and West Glamorgan County Record Office were consulted. Given the limited peat exposures recorded during photograph transcription and fieldwork, attempts were made to gain copies of recent borehole data from close to the present shoreline.

Intertidal peats: previous observations and investigations

In a description of Oystermouth given by Isaac Hamon to Edward Lhuyd, in 1697 during the latter's compilation of his geographical dictionary of Wales, Hamon wrote:

"The sea hath encroached upon a great part of the low grounds of this parish, as appears by the roots of trees, and whole trees that lyes in the sands and other tokens...." (Gabb 1986, 23)

Whilst this observation is given in relation to local legends of major flooding of former farmland in Swansea Bay in the early 17th century, it undoubtedly represents an early observation of exposed prehistoric submerged forest.

With the creation or expansion of the dock facilities in Swansea Bay at Swansea (Moggeridge 1856) and Port Talbot (Strahan 1907), deeply buried peats were systematically recorded for the first time.

The growth of the town of Swansea also provided opportunities to observe peat horizons which had accumulated over glacial drift along the edge of hard geology of Swansea's hilly hinterland. In 1892-3, "Trunks of Oak and other Trees, Hazel Wood and Nuts, Fern Roots and seeds, found at the Swansea Gas works in peat 25 feet under the surface" were presented to

the museum of the Royal Institution of South Wales (Report 1892-3, 38).

Stevens (1930) outlined a sequence of deposits including 1ft 6in of peat overlying clay and underlying 5ft of made ground near the west end of the L.M.S. Railway Goods Shed at Victoria Station, Swansea.

Intertidal exposures of the uppermost of these peat horizons were briefly described in the late 1920's. Cundall and Landman (1925, 20) noted exposures of 'submerged tree stools rooted in deep black soil' particularly at Blackpill and West Cross but also extending throughout the area of Swansea Bay exposed at low tide. Rider and Trueman (1929, 16) described submerged forest in Swansea Bay exposed just below the high water mark, with roots and stumps of trees in the position of growth. George summarised the overall sequence of the 'Submerged Forest' in Swansea Bay as an introduction to an early description of exposures in Gower (1930) drawing on evidence from the foreshore where the 'Forest Bed' was described as extending 'but a short way towards the sea', usually for only 6-8 yards. A recurrent feature of this horizon was the quantity of wood, with George giving identifications of alder, birch, elder and hazel. Von Post (1933) carried out the first pollen studies of these deposits from foreshore boreholes at Blackpill.

During the construction of a new main trunk sewer between Mumbles in the south-west and Clydach in the north-east between 1932 and 1935, a number of observers recorded peat exposures. Cole (1934) described peat exposed in excavations in the north-west corner of the Recreation Ground, near Brynmill Lane as 5ft thickness of peat and tree trunks overlying clay and underlying 7ft 6ins of sand and loam. George (1936) recorded the exposed geology in open excavations and manholes between tunnelled sections, and described boreholes taken along the route. His descriptions, for the first time began to provide sufficient detail to allow reconstruction of the extent and distribution of these peat beds in the western part of the Bay between Mumbles and the River Tawe. The estimated landward extent of these peats, as given by George, are shown on the relevant maps (See Maps 1 and 2).

Godwin (1940), in a formative paper demonstrating the potential of pollen records in peat sequences for both relative dating and palaeoenvironmental reconstruction, carried out analysis of samples from an exceptionally deep peat bed at Crymlyn Bog and a run of boreholes taken in 1931 adjacent to the east end of King's Dock, Swansea. He then linked these findings to the peat beds analysed by von Post (1933) at Blackpill, George's earlier work (1936 and George and Griffiths 1938) and early observations at North Dock, Swansea (Moggeridge 1856) and Port Talbot (Gibson, in Strahan 1907), concluding that these horizons could be correlated with beds at similar depths indicating eight or nine levels dating from the pre-Boreal onwards reflecting periods of standstill or slight inversion of a general marine transgression.

Pringle and George (1948, 96 and fig 29) described post-Glacial deposits in Swansea Bay as the Submerged Forest Series and illustrated seven vertical sections within the study area from West Cross, St Helens, the mouth of the Tawe, Swansea North Dock, Crymlyn Bog, Port

Talbot Dock and Aberavon.

Culver (1976) used foraminiferal analysis of samples (from onshore and offshore drilling and offshore gravity coring) to further interpretation of the post-glacial development of the Swansea Bay area, identifying for the first time, deeply buried peats lying between two deep rock basins, now located underwater off Mumbles Head. Pollen analysis of peat samples from these cores (Culver and Bull 1979), along with the analyses carried out by previous workers form the main dating framework through zonation for the Flandrian sequence of sea level rise and alluvial accretion within Swansea Bay (Table 1), supplemented by a group of radiocarbon dates from the Port Talbot sequence (Godwin and Willis 1964).

Pollen Zones	Crymlyn Bog (Godwin 1940)	Boreholes (Godwin 1940)	Crymlyn Bog (James 1971)	Blackpill (von Post 1933)	Subtidal core G71 (Culver and Bull 1979)	Subtidal core G88 (Culver and Bull 1979)	Port Talbot borehole (Godwin and Willis 1964)
VIII							
VIIb							
VIIa							
VIc							
VIb							
VIa							
V							
IV							
III							
II							

Table1 Pollen zonation of selected peat columns

During the 1990's, boreholes taken in advance of proposed redevelopment of the gasworks site north of Oystermouth Road (PRN 03264W - see also Evans 1992), and as part of the Swansea Bay Bathing Water Improvement Scheme (Matti pers comm), have provided additional data on the location of peat horizons at or near to the present coastline.

It is clear from these various studies that the peats exposed on the foreshore are likely to date to later prehistoric periods (predominantly Pollen Zone VIII).

Intertidal peats: survey results

Peat exposures which were well attested, and reasonably closely located; seen on aerial photographs but not identified during survey, and exposures mapped during field evaluation

are described below and given a code number with the prefix "P" which relates to codes given on the illustrations.

P1: Oystermouth (Map 1)

Hummocky mussel beds and shingle that are visible on aerial photographs obscure this area of the foreshore. During field visits, lower lying parts of the shore were often covered by a thin film of fine mobile sediment that while not obscuring the topography of the underlying sediments did make identification of peat even more difficult.

Nonetheless, a thin exposure of peat was observed running for c 150m as a shallowly curving crescent with the seaward face of the peat most noticeable as a slight nick point with a drop in the height of the foreshore of approximately 0.2m. The peat was exposed for no more than 0.5m, often less, with the landward edge covered by coarse sediment. No substantial timbers or other features protruded from the peat surface that appeared to be heavily scoured. The depth of peat seen along the seaward edge did not exceed 0.2m.

This outcrop mirrors a lenticle of peat observed by George (1936) north of Mumbles, apparently occupying the mouth of the depression in which Oystermouth lies where an outcrop of relatively soft Millstone Grit has been eroded below the level of the flanking, harder, Carboniferous limestone. The surface level of this peat lay between 1ft and 8ft above OD (0.3-2.4m OD), up to 3ft (0.9m) thick and was overlain by alluvium.

Given the location of this outcrop, in a low-lying part of the shore that tends to trap fine sediment between the hummocks of mussel beds, it is unlikely that larger exposures will be available for regular meaningful study. Two prehistoric finds from the vicinity are recorded in the Sites and Monuments Record; a polished diorite axe found in Oystermouth, found in or before 1909 (PRN468) and a Penard type, Bronze Age sword (PRN912W).

P*: Blackpill (Map 1)

Many of the above mentioned authors refer to exposed submerged forest occurring at Blackpill, and George (1936) recorded extensive peat deposits along this stretch of the sewer main running parallel to but just landward of the present coastline. Prehistoric finds associated with the area include a whetstone of Pennant sandstone found embedded in peat in 1927 and a flint flake, apparently part of a polished axe-head, from just above the 'submerged forest area' near Vivian Stream Bridge (PRN 413) and thought to date to the Neolithic. A human skull, found on the foreshore at a depth of 3ft 6in (1.1m) is thought to be Iron Age (PRN 416).

Dark zones on this part of the foreshore were observed on a number of aerial photographs that could have been peat exposures. No such exposures were observed during fieldwork even though repeated visits were made to the area throughout the duration of the survey. It may be that shifting sand has temporarily obscured these deposits but it seems more probable that recent beach management (see conclusions) has led to their partial or total

destruction.

P2: Brynmill (Maps 1 and 2)

This area of peat was the focus for fieldwork carried out by the Glamorgan-Gwent Archaeological Trust in 1993 (Williams) on behalf of Cadw: Welsh Historic Monuments, following the identification of a brushwood trackway. The main area investigated lay to the west of the Brynmill sewer outfall, and consisted of 80 pieces of transversely laid brushwood on an east-west alignment. These sat on the surface of the exposed peat at c 0.70m OD and produced a radiocarbon determination of 1980 +/- 50BP (Beta 67930). Calibration using Oxcal version 2.12 and the most recent calibration curve (Stuiver and Kra 1986) gave a probability range at 95% confidence of 103 BC - 118 AD. Other features of interest identified during this work included a possible worked plank and a number of 'upright posts'. A Red Deer right metacarpal, was recovered from towards the eastern end of the Brynmill peat shelf in 1992 (PRN 2914W).

The outcrop was clearly visible on aerial photographs as a thin, irregular line of peat, its dark hue in stark contrast to the surrounding sand, close to the high water mark. The mapped plot combines data from Meridian sorties taken in 1968 and 1979 and EDM survey carried out in 1993. Overall, the outcrop extends to a maximum of 1.3km with a maximum width of some 30m. During field evaluation, exposed sections were examined, and the location of the section of trackway identified. No new structures or finds were identified.

Williams gives a height of 0.68m OD for the surface of this peat exposure. George (1936, 342) recorded an upper peat in one of two boreholes on the site of the Brynmill outfall with a base height of 8ft above OD (2.4m OD). He correlates this with peat seen in excavations between the Clyne River and Brynmill with a surface height of between 5ft and 15ft above OD (1.5-4.6m OD). A lower peat was also noted in the outfall boreholes with a base height of 4.5-6ft below OD (-1.4m to -1.8m OD) and a thickness of approximately 3ft (1.2m). It seems reasonable to equate the features recorded by Williams with the upper peat recorded by George, although the heights OD are not directly comparable.

P3: Brynmill 2 (Map 2)

During only one of a number of field visits made to the middle foreshore off Brynmill, a sheet of peat (covered to the west by sand, to the east by shingle and, landward, to the north by clay) was observed with a thin covering of fine mobile clay (Fig 1). This sheet formed an irregular area of approximately 0.01km² that had not been identified on aerial photographs. The depth of peat appeared thin at approximately 0.1m. No structures were observed in association with this exposure although poor visibility hindered examination. Without absolute OD heights, it is not possible to correlate this peat with great confidence with either the 'Upper' or 'Lower' peat observed by George. It is certainly at a lower level than the peat exposed close to high water mark.

P4: Margam (Map 3)

The most extensive exposure of peat and associated Flandrian deposits on the foreshore of Swansea Bay occurs at Margam on Morfa Beach. This has been the apparent source of a number of stray prehistoric finds, and was identified as a new 'site' in the recent coastal survey (Locock 1996) and assigned PRN 3140W. The peat was most clearly defined on a 1991 Geonex sortie that was used to map the exposure extending over 1.3km along the beach. Field visits did not identify any sites or finds but did allow an assessment of the nature of the deposits and their condition.

At the southernmost exposure, a few hundred metres north from where the River Cynfig debouches onto the beach, the peat is relatively thin (approximately 25m wide) and only c 0.1-0.2m deep with a low shelf along its seaward edge. Towards the north, the exposure widens (up to 150m) and the shelf deepens to over 0.5m. Here it is clear that there are two peats separated by a clay horizon. The peat surface has been scoured by mobile beach deposits producing a polished surface cut by frequent gulleys in which stone and gravel have become wedged (Fig 2). The only visible features on this surface were occasional pieces of wood (oak, *Quercus spp.*?), all apparently natural.

The effluent outfall and pipe from the steel works define the northern extent of the exposure. Here, the flow of water strips all sand cover from the sloping foreshore exposing Flandrian clays underlying the peats all the way down to the low water mark (as seen on the lowest tide of 1998). Although darker areas of sediment were observed on aerial photographs, immediately to the south of the docks at Port Talbot, these were not seen during fieldwork and could have been a combination of 'made ground' and coal wash.

As with many metal detector finds, the context of many of the items of prehistoric metalwork recovered from these peat exposures is not well-defined. It would appear that the majority has been found within eroded gulleys along the edge of the outcrops. Overlaying given find spots with the mapped exposure would seem to support this view (Map 3, Table 2). Hence, it is reasonable to conclude that most of these finds have been eroded out of deposits and then 'captured' within gulleys in the peat shelf.

PRN	Description
731W	Frontal part of a human skull, part of a second skull, and 'with it lay the sacrum of Irish elk, which was extinct in England before the introduction of bronze, say 3000 BC'.
961W	At Aberavon a Neolithic axehead of uralitic gabbro, presumed to be of Cornish origin, was found on the foreshore. Part of the birchwood handle was still attached, & has been preserved at NMW. Axe may have been washed up by the sea in a large mass of peat, maybe from sand dunes at Port Talbot.
1211W	A small cast bronze flanged axe was found embedded in the top of a layer of

	blue estuarine clay, on the beach W of the Abbey steelworks at Margam.
2251W	Small looped Bronze Age axe found by Richard Player.
2343W	4 bronze axes, found in the inwashed fill of a channel cut through the peat & lower blue-grey clay.
2344W	Early Iron Age ring-headed pin, found in washed-in fill of a gulley.
2921W	Footprints, somewhat eroded, of large mammal. Observed and photographed by J Parkhouse, but photos have not been located.
2954W	Bucket handle, late Bronze Age. Metal detector's find.
2955W	Two bronze axes. Metal detector's find.
2956W	Axe fragment. Metal detector's find.
2957W	Bronze needle. Metal detector's find.
2958W	Bronze ring. Metal detector's find.
2959W	Antler pick. Metal detector's find.
2960W	Antler tool. Metal detector's find.
2964W	Palstave. Metal detector's find.
03129W	Find/Bronze Age ring NMW acc no. 91.254/1
03131W	Finds/pre (= 2959w, 2960w)
03133W	Find/IA pin NMW acc. no. 88.48H
03134W	Find/Bronze Age (Middle BA) palstave NMW acc. no. 88.200H
03135W	Find/pre socketed axe blade
03136W	Find/Bronze Age four socketed axes; NMW acc. no. 88.498
03137W	Find/Bronze Age socketed axe, NMW acc. no. 88.199H

Table 2 Descriptions of prehistoric finds in the vicinity of peat exposures at Margam.

P5: Kenfig (Map 4)

A less well-defined peat exposure occurs between Sker Point and the Gwely'r Misgyl (Mussel Rock). This was assigned PRN 02566M following the recent coastal survey. This suffers from even more severe erosion than the Margam exposure due to the proximity of mobile, coarse beach sediment concentrated by longitudinal drift and erosion of Sker Point and the Mussel Rock. The exposure was observed on aerial photographs as a narrow dark band running for a distance of some 150m. Again, numerous gulleys have been scoured into its surface, and no structural evidence was observed during field visits, nor would these be likely to survive under such conditions.

Stone fish weirs between the River Tawe and Mumbles

During the initial stages of aerial photographic searches, a series of large, V-shaped structures were seen on the foreshore between the western arm of Swansea Docks and Blackpill, with a number of outlying structures further to the west, which had not been identified during the recent coastal survey. Their considerable distance from the high water mark may have led to this oversight. Their scale and regularity suggested they might have formed part of the Second World War defences, possibly tank traps. On closer inspection of larger scale plots however, it became clear that there was a palimpsest of features implying rebuilding and usage over a considerable period of time. References to standard, and readily available texts (e.g. Jenkins 1974, 36-7; 1978) suggested these features were remnants of a system of stone and wattle walled weirs, which had been in use until the late 19th century. An initial field visit confirmed this suspicion, with elements of the weirs still being visible. Following consultation with Cadw, it was agreed to include this system within the survey. The results of this research are presented here within sub-sections on documentary and cartographic evidence followed by aerial photograph study and field observations. It should be stressed that no accurate field survey of this system has been possible within the confines of this study, and no sampling or excavation of any of these structures has been carried out.

The documentary evidence

Evaluation of documentary references to fishing in Swansea Bay can at times be problematic. Different references, even when contemporary, can be contradictory. In part this may be a function of the different interest groups involved, along with genuine confusion over the status and rights of the fishery. Repeated references to declines in catches may be real or motivated by parties wishing to either close the fishery or engage the sympathy of the owner and hence reduce rentals. Early references are on occasion unclear about the location of weirs particularly as to whether they were situated in the Tawe or on the foreshore. Rather than attempt to 'sanitise' the records, for the sake of brevity, references from different parties are given with relatively little comment, generally in chronological order.

In his extensive study of the history of Swansea, Jones (1992, 25 and 56-7) noted 15th century references to named weirs in the River Tawe (cf Rogers 1946, 106 and 113-4). These are taken to be seasonal salmon (and possibly eel?) weirs and will not have survived industrialisation of the lower Tawe.

Late 16th and 17th century surveys provide the earliest written evidence identified to date for the presence of fish weirs on the foreshore of the western portion of Swansea Bay (Baker and Francis 1870). A 1583 survey of Gower Anglicana, the eastern boundary of which was the River Tawe, includes a paragraph, which implies the presence of some form of fishery in this part of the bay:

"To the Tenth article we say that there are certaine fishings in several of y^e members

of this Lo^{pp}, for y^e which the Lord hath a certaine rent, and that the tenants and inhabitants have liberty to fish freely tyme out of minde, in any other places than such as are allready under rent, as farre as we know" (Baker and Francis 1870, 117).

Unequivocal evidence for the presence of weirs on the foreshore occurs in the Cromellian survey of the manor of Oystermouth dated AD 1650. The bounds of this manor are given as "the sea of the east and south parts ...and the brooke of Rheed y devaid on the north and north easte parte" (*ibid*, 50). In addition to mentioning a David Griffith as the holder of 'halfe the fishinge of a wear', numerous weirs are mentioned in rentals lists for freeholders and tenants.

The Freeholders of the said Manor with the Rents they pay.					
I conceive all these areas following are Welsh acres					
<i>DUNNES</i>	a	r	li	s	d
William Robin for lands and halfe a wear	01	0	00	00	01
<i>NORTON</i>					
David Mathew for a fishing wear	00	0	00	00	06
The customary houlders of the said Mannor with the rents they pay					
<i>NOTTAGE</i>					
Co ^{ll} Phillip Jones for a messuage and lands and one fishing wear at Nottage	23	00	00	06	09½
<i>MAYALLS</i>					
Edward Mansell Gent. for a messuage and lands at Mayalls and half a wear	09	0	00	05	00½
<i>BLACKEPILL</i>					
Evans Seys Esq ^r for half a wear	00	0	00	00	02
<i>NORTON</i>					
The same [Henry Bragg] for lands at Norton and halfe a wear	05	0	00	13	11
<i>NEWTON</i>					
Rees Russell for lands and halfe a wear there	00	2	00	00	06
John Robin for a messuage and lands and a quarter of a wear at Newton	08	2	00	07	04
<i>COULT'S HILL</i>					
Charles Lloyd and Robert Bydder for a messuage and lands and half a wear at Coult's Hill	18	0	00	12	11
<i>NORTON</i>					
George Robin for a messuage and lands and half a wear at Norton	17	0	00	16	08
John William for two messuages and lands and half a wear there	27	0	01	04	00½
<i>BOARSPITT</i>					
John Thomas Rees for a messuage and lands and a wear and a halfe at Boarspitt	25	0	00	14	06
Richard Hamon for a wear	00	0	00	00	04
<i>WHITSTONE</i>					
Morgan Lloyd for a fishing wear					
<i>DUNNES</i>					
William Madocke for a messuage and lands and halfe a wear at Dunnes	02	2	00	02	06
<i>FFISTLEBOON</i>					
George Robin for a messuage and lands there and a quarter of a wear	06	0	00	05	08
John William for a messuage and lands at Ffistleboon and halfe a wear and a quarter of a wear	09	0	00	08	04
<i>DUNNES</i>					
Griffith Rosser for lands and a wear	02	0	00	02	08
John Woolcocke for a messuage and lands there and halfe a wear	02	2	00	01	08

Table 3 Mentions of weirs and their associated rentals in the 1650 Survey of Oystermouth: the columns relate to acres and rods, and pounds, shillings and pence (// s d).

The total number of weirs listed approximates to thirteen, a figure that recurs in later accounts and in the only map giving the supposed location of the original weirs (Fig 11).

It would seem common for the two arms of a single weir to be held by different individuals. How this situation came into being is not clear, nor the advantages, if any, of such an arrangement. It may be that during the division of property upon inheritance, that ownership was divided between heirs. Presumably, anyone wishing to fish a weir would need to secure leases from the owners of both arms.

The earliest apparent reference relating to fish weirs on the foreshore adjacent to the mouth of the Tawe (rather than in the lower reaches of river debouching into the bay) is precised by Harris (1934, 94; cf Rogers 1947, 156) in his study of the development of the Port of Swansea:

"In 1686 there were four fishing weirs upon the salt sands opposite St. Thomas' Chapel, within the Manor of Kilvey, which were held by Bussey Mansel at rentals payable to the Lord of the sand Manor. The survey of Kilvey taken in that year states that one of these weirs had been lately erected upon a new foundation and that no freeholder of the Manor could set up any weirs, engines or fence for taking fish without the consent of the Lord".

The area of foreshore mentioned is now occupied by Swansea Docks, which were extended out into the bay during the 19th century. It is not clear whether these weirs were designed primarily for the exploitation of migratory fish, as in the case of weirs located in the Rivers Tawe and Neath or for marine species. Given the proximity of the weirs to the contemporary mouth of the Tawe, shoaling salmon may have been the intended catch.

In the Title Deeds of Ty Gwyn, 1735-1825 (Rogers 1946, 376-9) two references to weirs, are recorded:

28th Sept. 1779 *Catherine Williams releases Gabriel Powell Esquire for £3.20 a moiety or western arm of a fishing wear in the sand on the east of and adjoining to Blackpill river called Y Gored Vawr, in possession of Richard Rosser, the eastern arm being the property of the said G.P.*

3rd Sept 1828 *The fishery or Wear known as Y Gored Fawr (formerly in possession of Richard Rosser) and lying between the Fishery called Rees Harry's Wear on the west and the Fishery or wear called Pumade formerly in Simon Jones's occupation on the east, and situate in Swanzey Bay*

A copy of part of the Singleton Deeds held in the Graham Vivian Collection (GV A.18, UWS) reads:

24th June 1784 *Matthew Virley of Sketty aged 87 years has this day declared before us that about 30 years ago or upwards, he rented a Wear for fishing of Robert Thomas (which wear was and is situate between the two Wears of Simon Simons of Sketty [Isha?] and Roger Rogers of Gwern [Avith?] at the yearly rent of 6 shillings or 3 shillings per side. John Rosser of Ty Gwyn was partner with the above Matthew Virley in the Wear.*

Early attempts to establish a deep-sea fishery at Swansea in 1775 (GF Bb, UWS) were promoted through the distribution of broadsheets. One of these mentions the weirs in passing, arguing for the benefits of superior, and more consistent catches from deep-sea fisheries:

"...and particularly Soles of a much larger fize than ufually caught in the Wears upon the fhore".

Advertisements in the Cambrian News (CN) give some record of changes in ownership. The first reference identified includes the offer of sale of 'a FISHING WEAR on the Mumble Sands' along with a dwelling house (CN, 27/04/1805). One of a number of lots offered for auction in 1808 (CN, 19/03/1808) comprised 'a copyhold house and garden, situate at the Mumbles; and also a fishing weir, on Mumbles Sands, lately occupied by David Lloyd'. It is unclear whether the named individual was the former occupant of the house, or worked the weir, but it would appear that weirs were often attached/associated with particular landholdings. Several lots near Newton, in the parish of Oystermouth, offered for sale at auction including a 'fishing weir, next the Mumbles, in hand' were described in an advertisement as 'held by Tenants from year to year' (CN 01/08/1840). If this can be taken literally, it suggests that weirs were not owned by those who worked them, but rented by the fisherman from the owner.

An advertisement for the sale of one arm of a fishing weir at Oystermouth Bay (CN 14/6/1850) again indicates the practice of separate ownership of individual weir arms.

A short article recounting the visit of a Royal Commission on Deep Sea Fisheries to Swansea in 1864 (CN 14/10/1864) is dominated by complaints by a number of parties concerning the damaging effects of the weirs on fish stocks. It would appear that oyster fisherman in particular considered the weirs a nuisance, although their views may have been coloured by the fact that many of the same fisherman long-lined for fish during the oyster close season, and may have considered the weirs as competition. One oyster fisherman, in linking the existence of the weirs to a decline in fish stocks, mentioned that this mode of fishing had been in use for 'upwards of thirty years'. The only witness to defend the weirs was William Benson who described himself as the proprietor of two weirs and claimed never to have observed any dead fish during visits to the weirs to collect the small catch. He claimed to pay £1 rent to the Duke of Beaufort for each weir, and that the building of the weirs cost £30 each.

One of a number of fine seascapes of Swansea and Gower painted by Edward Duncan between 1845 and his death in 1882 takes the collection of fish from one of the Swansea Bay weirs as its subject (Fig 3). The picture depicts a scene at low tide viewed towards the east with Kilvey Hill in the background. The right foreground is dominated by a group of three men and a boy apparently checking a woven basket located at the apex of a weir. To the right of the figures, the construction of the weir arm is clear: a combination of wattled wooden uprights bound on the outside by rocks and wooden stakes. The basket itself is secured by a similar edging of stone and stakes, and weighted down with at least one stone. One of the

figures leaning over the basket, and another sitting in the left foreground, have some form of push net with a long handle and shallowly curved 'blade'. Another carries baskets and sacks, presumably to carry the catch. This is the only contemporary illustration of these weirs yet identified.

Dillwyn in his collection of miscellaneous observations (1840, 58 *passim*) notes a number of unusual fish catches including some from this system of weirs, but frustratingly does not describe a typical catch.

Further light (but also some confusion!) is shed on ownership and rights by two court actions involving Mr Graham Vivian who purchased the Clyne (formerly Woodland) Castle estate in 1859. In the first case, a Mr Ashford, who had placed a stop net on the shore, having paid rental to the agent of the Duke of Beaufort, sought damages from Mr Vivian who had had the net removed, claiming ownership of a (disused) weir seaward of the location of the new net (CN 7/5/1869 and 11/6/1869). The convoluted claims and counter claims of various parties indicate a high degree of confusion and the judgement of Judge Falconer does little to clarify matters. It would appear that some parties paid rent for the right to fish some of the sites to the agent of the Duke. Some of the weirs appeared to have been rebuilt some 25 years previously, approximately 300 yards closer to the shore compared with their original location, and that many of the weirs had fallen into disuse or been replaced by stop nets. In a second case, brought in 1885, Vivian sought to 'recover the sum of £3 for use and occupation of a weir situated at Blackpill' from a Samuel Britton who had placed a net in front of the said weir (GV A.18, UWS). A hand-written transcript of the proceedings, largely consisting of interviews of fishermen, indicates that the original wattle and stone weir had fallen into disuse some 40 years previously and that only two stone and wattle weirs were still in use (belonging to Singleton). Thereafter, the site had been fished by a stop net 'much in the shape of the weir located approximately 10 yards forward of it', with the fisherman paying rent to the owner of the Woodland Castle Estate.

Matheson (1929, 63), refers to the Report of the Royal Commission on Sea Fisheries of 1863, describing the weirs as *'about six feet high, ...composed of stakes driven into the sand, and wattled so as to constitute a fence. Through such a fence the water readily passes, and the tide, flowing around the weir and finally submerging it, leaves the fish, which, unless they escape again before the ebb, cannot pass through the meshes. The arms of the weir formed an angle of approximately ninety degrees, and each measured up to about 200 yards in length. At the junction of the arms, near low water mark, was a closely woven conical basket, with its entrance facing the inner side of the weir. In order to retain some water when during spring tides the tide ebbed beyond the limit of the weir, a layer of bushes and matting extended, close to the ground, along each arm of the weir, to a distance of about fifty yards from the basket. Sometimes a continuous trap of two or three miles in length would be formed by a line of these weirs, the inner ends of the adjacent arms being in some cases united. Complaints about the destruction of young fish by these engines were frequent, and in some*

cases nets were substituted for the wattle fence, this being said to result in the capture of fewer small fish.'

A rare, early documentary reference to the use of net weirs is given by a brief appeal on behalf of one Thomas Owen, a fisherman who 'had saved sufficient to purchase nets and material for the formation of two weirs has been a heavy loser his weirs and nets having been nearly destroyed by the gale' (CN 28/10/1870)

In an essay submitted to the 1884 National Eisteddfod, some indication of the staple fish caught in the weirs is given (Davies, 1885):

"Between the Mumbles and Swansea a good deal of fishing goes on, but chiefly by means of weirs and fixed nets. Of the former there are thirteen, and of the latter three, or sixteen altogether; and the owners are very tenacious of their ancient rights. The bottom of the bay outside of these weirs is, naturally, a clean sand with patches of mud. Cod, conger, bass mullet, whiting, soles and plaice are taken here with a few brill, turbot, and salmon. Inside the bay there has of late years been a decrease in the quantity of fish taken which is by some attributed chiefly to the destruction of small fish inside the weirs and fixed nets; also to the pollution of the water owing to the dredging operations going on in connection with the harbour works in course of construction; and also, and chiefly, to the great increase of copper, iron, tin-plate and other works during the last forty years."

Whatever the causes of the decline in catches, there appears to have been a shift from the use of wattled weirs to stake nets at the end of the 19th century. By 1904, the most characteristic form of fishing was "the setting of stake-nets for cod, whiting, flat fish and some other kinds. Those who travel to the Mumbles Pier by the light railway have an opportunity of seeing miles of these nets along the shore" (Aflalo 1904, 338).

During the 1930's, the Swansea Borough Corporation sought to gain control of the foreshore in order either to more closely police the fishery or, in the face of various complaints, to close it down. Documents relating to the South Wales Sea Fisheries District Committee include notes to the effect that of the 13 original weir sites, four now belonged to the Corporation and some to Admiral Walker Heneage Vivian C.B. with rents being payable to both the Corporation and Clyne Castle Estate (claimed under ancient manorial rights). A separate document indicates that the trustees of Sketty Isha Estate were leasing parts of the foreshore (including the right to use stake nets) to a Mr F. Scrines. Another letter documents failed attempts to intercept fisherman returning from the nets with carts of under-sized fish (WGRO, D/D SWSF 19/2).

An enquiry, undertaken by the South Wales Sea Fisheries District Committee in 1935, noted that these nets caught only half the quantity of fish that had been taken 30 years earlier and that species such as cod, skate, hake, ling and sole were no longer caught. The nets were said to take approximately 1½cwt of fish each to a total value of £5 on each tide. Evidence given by one Jack Davies, who had worked the nets for 60 years and his family for over 200 years claimed to catch whiting, herring, mackerel and flukes. He described the nets as

requiring 10 x 100 yards of nets 'per weir' plus 50 yards for the 'cage', hung on 300 poles (WGRO D/D SWSF 19/2: "Swansea Bay Nets").

Morris (pers comm) recalls seeing these nets 'on tall stakes, set in V patterns on the foreshore, still there in c1948-50', and believes that this last manifestation of the local fishing weir tradition fell into disuse because people used to steal the fish before the last fisherman who worked them could recover his catch.

Davis' account of fishing gear in use in England and Wales in the middle of this century makes clear that the use of wattle and stone leaders had been superseded by large V-shaped nets apparently with similar dimensions and location to the original weirs (Davis 1958, 30):

"In Swansea Bay there are several large V-shaped stake nets, locally known as 'Stop Nets' or 'Kettle Nets'. They are the largest nets of the type found in the country, the total length of the two arms of each net amounting to about 700 yards. They are usually set in series with the tips of the arms of adjacent nets almost meeting, and with the axis of the net almost at right angles to the foreshore, the tips of the arms not reaching high-water mark. The net is about 7 feet high, set on stakes, and of 1-inch bar mesh. At the apex there is a circular, roofed cage about 12 yards in circumference, prolongations of the arms into which form the usual type of non-return trap. Local byelaws require the cage to be in such a position that a pool is left in it at low water."

Cartographic Evidence

The tithe map for the parish of Swansea (1843) shows nothing on the foreshore apart from "sand hills". That for Oystermouth describes the main foreshore (numbered 1217) as 1008 acres of wastes (mud and sands below water mark at spring tides) owned by the Duke of Beaufort and occupied by the "Lord of the Manor". No tithes are listed for these areas.

The first edition OS maps (25 inch, 1878) for the Blackpill/Brynmill and Oystermouth Road areas below high water mark indicate only stippling (areas of stones?) and "targets", but no fish weirs. The extent of foreshore included would have encompassed the areas where the weirs were located so their absence would seem to be a consequence of selective mapping.

An undated map forming part of a bundle of documents relating to the South Wales Sea Fisheries District Committee (WGRO D/D SWSF 19/2: "Swansea Bay Nets"), probably relating to enquiries made in 1935 (Fig 4, see also above) indicates the former location of the original weirs. By this time, only five or six of the sites were being worked and then with nets. The Admiralty Chart for Swansea Bay (sheet 1161), mapped in 1949, marks eight possible weir sites. Those in the east, seaward of Brynmill, can be equated with weirs identified during this study from aerial photographs and field evaluation. On the other hand, a large weir marked off Oystermouth, and also remnants of two off Blackpill can not be so readily correlated. Although shingle/gravel expanses off Brynmill and County Hall are shown on both this map and the recent chart published in 1994, there are no indications of weirs on the current Admiralty Chart.

Aerial Photographs

Plots of selected sorties, which showed this system of weirs most clearly, form the basis of the attached maps. Even on relatively small scale aerial plates, many of the weirs can be identified as long as the state of the tide was sufficiently low when the photographs were taken. A single infra-red plate, taken at relatively low tide, shows weirs both above and below the water, highlighting the potential of this spectrum for detecting features in shallow, clear water (Fig 5).

The weirs have generally been plotted from 1:6000 plates derived from a Meridian sortie. The accuracy of the mapping is likely to be poorer towards the west, where reference points are few on the relevant plates.

Field observations

The sites of the weirs were visited on a number of occasions, photographs taken of selected, particularly well-preserved examples, brief notes made on the form of construction and GPS readings taken usually at the apices of the weirs to check the accuracy of the plots derived from the aerial photographs. Many of those seen on the sortie plates were obscured by sand or shingle, and observation of those situated near to the low water mark was compounded by being visible only at the lowest state of spring tides.

The walls of the arms characteristically consisted of stone 1-2m wide with small, usually roundwood, posts running along the inner edge. Often further lines of posts could be seen several metres in from these walls, possibly the former location of stop-nets which replaced the original weirs. The more complete walls were generally 120-170m in length with the enclosed angle between them ranging from 70° to 100° (Fig 6). At the apex of the weirs, where the mouths were better preserved, the walls became progressively more parallel to one another and the wooden posts continued beyond the walls to form a gradually narrowing 'snout' traceable for up to 20m (Fig 7).

The visible weirs can be divided into four main groups. Immediately to the west of the western arm of Swansea Harbour, an inter-linked group of at least 6 weirs can be traced with their apices some 550-650m from the present high water mark (Map 2). Further to the west, separated by a distance of c 300m a second group of at least 6 weirs is located 850-900m out from sea wall. Some 350m inshore of this group, two adjoining weirs, with walls 150-200m long and enclosed angles of 90-100° could be later rebuilds implied in the (somewhat garbled) court proceedings of 1869. A fourth, possible group, noted on aerial photographs and only briefly glimpsed before a retreat from the incoming tide proved judicious is located considerably further to the south west near to Oystermouth (centred on SS62598883, Map 1).

Parallels

The form and location of these weirs is strikingly similar to those illustrated by Duhamel du Monceau (1769), who described gear and fisheries in France in the 18th century. The

illustration shown in Fig 8 was reproduced by Cushing (1988) in a review of pre-industrial fisheries. The substantial arms of wattle and stone run from close to the high water mark down to an apex where a conical net (rather than basket) is attached to collect the catch. Similar systems of large V-shaped stone weirs have been observed in the Bristol Channel at Minehead (McDonnell 1980 and forthcoming), large wooden systems in Bridgewater Bay (McDonnell 1995), and smaller stone weirs in Porlock Bay (Canti *et al* 1996). Whilst substantial stone weirs have been identified in a number of locations, e.g. Menai Straits, these large V-shaped structures are only likely to occur in major embayments where the distance between high and low water mark is considerable and there is sufficient space to allow their placement without hampering navigation. A classic, if wooden, Welsh example is the famous weir Cored Rhos Fynach at Rhos-on-Sea (Evans 1995). It should be stressed however, that no system of weirs in Wales can be considered to have been as extensive as that in Swansea Bay.

Miscellaneous Wooden Fish traps

Although the traps with stone walls were often clear on aerial photographs, and sometimes the wooden elements of these were also visible, a number of trap structures were observed during field evaluation which could not be seen on these photographs. Brief notes were made on these, and their positions identified using GPS. These have been given individual structure numbers with the prefix 'WF' for wooden fish trap. Each of these structures is given a grid reference and brief description and interpretation.

WF1 (SS6259 8965, Map 1)

A crescent of small, square, softwood pegs (c20mm square and 0.25m apart) with less frequent, taller posts measured c140m across its mouth, and c30m deep with the mouth facing towards the shore. The exclusive use of softwood and the continuing practice of setting a net nearby encourage its interpretation as a relatively recent feature. The overall form and the more substantial posts suggest it may have been one of the crescent shaped stake nets that Davis (1958, 35 and fig 33A) describes as characteristic of the south Wales coast, with the posts holding the net upright, and the pegs securing its bottom. The nearby, modern net is secured with metal pegs, using floats rather than stakes to keep the net up and is only permitted outside of the salmon season.

WF2 (SS6275 8928, Map 1)

Located close to the low water mark, this structure comprised multiple, broadly parallel lines of closely spaced wooden uprights, protruding only a few centimetres above the sand, running NW-SE for at least 90m (Fig 9). It is unclear how these may have operated. Indeed it seems unlikely that they are contemporary as the easternmost is made almost exclusively from split oak whereas the westernmost is made up of mostly softwood in the round. The

close spacing of these posts argues against their use to hold up a net. Possibly they acted as leaders guiding fish into some form of bag net or basket for which no evidence has survived.

WF3 (SS6505 9155, Map 2)

Again located close to the low water mark, this large V-shaped trap is similar in scale and configuration to the more common wood and stone weirs. The western arm exceeds 150m in length, whereas the eastern arm can be traced for no more than 90m, the angle between them being c65°. Surprisingly, given the absence of any stone, this structure was noted on one of the aerial photographs (Meridian 4/66/114, 1:6000) with the separate lines of posts discernible. Generally the posts are small, either roundwood or split (Fig 10). Further rows of posts ran perpendicular to and across the western arm, and a short stretch of another, separate NW-SE oriented arm, also probably wooden, was plotted from the aerial photograph but not seen in the field.

The 'Old Quay'

A map by George Yates dated to 1794 indicates the presence of an old quay in the intertidal zone off Blackpill (Fig 11). The SMR refers to this documentary evidence as PRN 1557W and estimates its position as SS6295 9055. Fieldwork by Moran (undated) identified the site in the field and linked it to the 'key of Mumbles' described by Merrick in 1578, mentioned in the Cromwellian survey of the Lordship of Gower (Baker and Francis 1870, 68) and associated with the documented trade in coal from Clyne Forest. This trade peaked in the 16th and 17th centuries and had become unprofitable by the mid-18th century. Scatters of North Devon and other wares found in the vicinity probably date to this latter period. The site is described by Moran (undated, fig 2) as an arc of stone (predominantly limestone) some 80m across with a sloping ramp, some 60m long approaching it from landward. A substantial wooden post was observed close to its seaward face and tentatively interpreted as a mooring post.

During examination of aerial photographs, the site was identified as a concentration of stone/shingle in a relatively stone-free part of the foreshore and plotted from a 1:6000 plate (Meridian 4/66/155). A subsequent field visit located the site more accurately using GPS giving a revised centre point of SS6238 8989 (Map1). The structure appeared somewhat larger than the dimensions given by Moran, but the overall form was similar. The 'mooring post' was also seen protruding from the structure's forward edge. This appears to be a mature, curving oak bole with a large iron fitting (spike?) with a length of modern (?) rope attached (Fig 12).

The Oyster Fishery

The former oyster fishery at Oystermouth no doubt has ancient origins, but peaked during the late 19th century before declining at the turn of the century. Over-fishing followed by infection of the oyster beds in the 1920's appears to have been the cause of this industry's demise. A

number of features associated with this important aspect of Swansea Bay's economy were recorded during the survey.

Jetty

With the extension of the Mumbles railway in the 1890's, a shingle spit used traditionally as a lay-up for the oyster dredgers, sometimes referred to as the 'Horseshoe Lay-up' was lost. A wooden jetty was then built to provide shelter (King and Osborn 1969). By 1923, this had fallen into disrepair (WGRO, D/D 9/2). This structure could well be a curving feature, adjacent to the modern concrete slipway observed on a 1966 aerial photograph (Meridian 4/66/162) that was subsequently identified in the field at SS6197 8799 (Map 1). This comprised a double row of substantial squared softwood posts, now eroded level with the foreshore, 6.5m wide with a curving length of c 80m.

Perches

Perches were small enclosures defined by lines of large pebbles, marked at high tide by log 'buoys' where marketable oysters, belonging to an individual fisherman or crew, were stored and allowed to feed until they were required for sale. These were rented from the Duke of Beaufort. Oysters not of marketable size were held in plantations only uncovered at or near extreme low water of spring tides. Remains of the latter could still be seen near Mumbles pier at spring tides in the late 1960's. (King and Osborn 1969, Thomas 1978)

The tithe map for Oystermouth Parish (1845) shows a parcel on the foreshore off the Knab (numbered 1214) described as "Oyster Perches" owned by the Duke of Beaufort, occupied by "David Davies and others", and an area of some two acres. No figure was given in the rent column.

Aerial photographs from 1966 show a system of rectangular enclosures, west of the Mumbles pier, which appear to respect the slipway covering an area of c 0.04km² (Map 1). Subsequent photographs taken in 1979 show only fragments of these. They are interpreted as the remains of this system of perches. The larger area covered by these in comparison with the tithe map probably reflects expansion of the industry in the late 1800's. Their erosion in recent decades has probably been accelerated by the use of this area for the mooring of pleasure craft.

Today they are not clearly visible on the ground.

Wrecks associated with the oyster fishery?

Traditionally, up till about the middle of the 19th century, oyster dredging was conducted from small rowing boats. With the expansion of the industry, larger 'skiffs' (decked sailing boats of eight to ten tons laden) were introduced with about 90 of these vessels working during the 1860's (Matheson 1935, 82-3). According to the Select Committee on the Oyster Fisheries (1876), the number of boats peaked in 1870's.

During field evaluation in the vicinity of the peat exposure near Oystermouth, two wrecks

noted on an aerial photograph (Meridian 4/66/162) were observed. It seems these were both marked by a single wreck symbol on the 1949 and 1994 Admiralty Charts.

WR1 (SS6180 8818, Map 1)

Overall dimensions c12m by 4m. Oak framing timbers and both oak posts, softwood ceiling and hull planks. One of the posts extends back along the centreline to form a keelson covering about one third of the overall vessel length.

WR2 (SS6195 8809, Map 1)

Overall dimensions c20m by 5m. The hull bottom survives in reasonably good condition with oak framing timbers and both oak posts, and softwood ceiling and hull planks and keelson. Both posts exhibit sharp angles.

Miscellaneous

Wrecks

Shipwrecks and portions of wrecks were observed at a variety of locations during examination of aerial photographs and subsequent fieldwork. Some of these wrecks, especially more recent metal vessels, are permanently exposed. In other instances, the remains are only periodically exposed owing to environmental factors that lead to beach erosion. This would appear to be the case with a wreck exposed off Crymlyn Burrows in 1996 (Nayling 1997). Many of these wrecks are included in the recent coastal survey for the area (Locock 1996). Following reports of a variety of wrecks becoming exposed on the beach at Kenfig in early January 1998, the beach was visited (with kind assistance from staff at the Kenfig Nature Reserve) and rapid notes made on new exposures which are included here.

WR3 (SS7782 8306, Map 4)

A fragment of hull three planks wide, lying with its outer face uppermost with an overall exposed length of 15m. The planks were substantial (c150mm wide and 60mm thick) with staggered wooden treenails generally 540mm apart. The central plank was more substantial and could have been either a rubbing strake or a keel plank possibly made from a non-native hardwood.

WR4 (SS7796 8231, Map 4)

The remains of a wooden hull that had become largely recovered with sand by the time of the site visit. The timbers that could be seen lay in a deep pool of water. These included apparent floor timbers c 150mm sided by 120mm moulded attached to planks c50mm thick and 200mm wide by wooden treenails and iron fittings. The distance between frames was c300mm. Much of the hull bottom that remained exposed was covered by what appeared to be a concreted

mass of ballast(?). Carvel construction.

Pits on the foreshore

Rectangular pits have been observed cutting into the Flandrian deposits on the foreshore, usually off Brynmill by a number of observers. Papers debating the function of these are housed in the SMR under PRN01565W. Interpretations put forward include pits dug for clay for brickworks or pottery kilns such as that found at Wassail Place. In a Guild Book held at the University of Wales, Swansea Archives, reference is made to a license issued to one Henry Jones, dated 24th November 1770, to dig and carry away three cart loads of clay from below the beach but on no account to cut anywhere near the beach (Mr. M Fordy, pers. comm.). A passing reference in court proceedings relating to a fishing dispute in 1869 asserts that "The Duke [of Beaufort] takes clay from the beach" but does not explain for what purpose (CN 7/5/1869). The fact that the pits do not tend to inter-cut one another and sometimes appear to contain timber settings suggest they may have served some function such as housing shellfish. It seems unlikely that they were associated with the oyster fishery as perches and plantations are said to be located at Mumbles.

PRN01565W (SS636 917)

Coastal erosion revealed a network of predominantly square or rectangular cuttings into the marine clay and peat of Swansea Bay.

From 4.3.82:

"The site was visited but very much less was showing than was visible last autumn; however Dr Moran informed us that such drift was a normal winter occurrence, and the process would be reversed in the summer. The posts were studied and it was noted that both trimmed and untrimmed wood had been used. The posts were set in extremely firmly and in good condition, being in now way rotten. An apparent pattern was noted in the arrangement of the posts, taking the form of two seaward-facing courses with a pair of discrete posts between these lines." These were not observed during field evaluation as the area was obscured by sand.

Pit 1 (SS6464 9196, Map 2)

A large exposure of rectangular pits were visible on aerial photographs from the 1960's (Meridian 4/66/101 and 55/68/077) encompassing an area of some 0.0134km². These were not observed during field evaluation as the area was obscured by sand.

Pit 2 (SS6459 9130, Map 2)

During field evaluation, the edge of a possible rectangular pit was exposed cutting through Flandrian deposits where shingle did not obscure it.

Conclusions

The condition of the peat exposures observed during field evaluation contrasts markedly with the descriptions given of these until relatively recently. Although peat exposures have been noted in many of the expected locations, in other cases such as at Blackpill, no Flandrian deposits were observed. In part this will be a function of periodic exposure i.e. some of the anticipated peat deposits may have been temporarily obscured by shifting sand. Nonetheless, even where peats have been observed in the field no well-preserved concentrations of submerged forest were encountered. Close to the present high water mark to the west of the Tawe, this could be the result of recent beach management by Swansea City Council.

Llewellyn (1996) in a study of invertebrate populations in the bay, noted the introduction of mechanical beach cleaning procedures in 1983 aimed at providing an attractive beach environment for tourists. An adapted potato harvester, which can operate to a depth of 0.2m is used to remove stones, glass and larger debris and a second machine with a conveyor belt raking mechanism removes wrack and scours the sand to a depth of 50mm. Cleaning takes place over the entire upper shore and extends into the midshore zone. The use of these machines may well have caused irreversible damage to peat exposures, particularly in areas of high tourist pressure such as Blackpill. A more robust response from archaeological curators will be needed in the future if developments similar to the recent Swansea Bay Water Improvement Scheme are to generate new information during destruction of sections of these Flandrian deposits. Liaison with bodies and companies carrying out ground works, which do not require planning permission, could also be enhanced.

Given the eroded state of the more commonly, intertidally exposed sections of peat, probably the most effective means of continuing to gather data will be through fostering of contacts with metal detectorists active in Swansea Bay. Whether changes in legislation and procedures for dealing with portable antiquities helps or hinders this process is as yet unclear.

The system of stone and wooden fish weirs appears to have been well-established by the time of the Cromellian manorial surveys with individual weirs having become subdivided between separate tenants or freeholders. Detailed field survey, structural analysis to attempt to determine the sequence of rebuildings represented by the palimpsest of remains, and subsequent selective excavation, sampling and dating (radiocarbon) could potentially extend the known time depth of this system. In addition, further documentary research could be fruitful, particularly of unpublished wills, deeds and estate papers. The Blue Books of the Royal Commission on Salmon Fisheries and the Royal Commission on Deep Sea Fisheries have not been consulted and could provide further information.

The 'quay' off Blackpill has not been accurately surveyed and the finds previously collected from the site might well date to the last few decades of its use. Rapid EDM survey and possibly limited excavation in the vicinity of the 'mooring post' and subsequent tree-ring sampling might clarify its original form and construction date.

The rectangular pits recorded in the SMR, seen on aerial photographs and in the field remain an enigma. Searches of the Cambrian Index produced no references to these. As they are located on the foreshore claimed by the Duke of Beaufort, there might be references to these in estate papers. Limited excavation and examination of timber settings might also help to characterise and date these.

The transitory exposure of sections of beached wreck, particularly along the middle and eastern sections of the Swansea Bay foreshore, create considerable public and press interest. These remains need to be quickly assessed and recorded as they are often rapidly either re-buried by sand or further broken up and scattered by the sea. Meeting this challenge can prove difficult given the project-oriented funding of most professional archaeologists. The long-term answer may be to harness local interest by co-ordinating and training volunteers to assist in rapid survey and sampling of these remains. In the shorter term, without changes in the procedures for fieldwork financing, it is difficult to see how field staff can respond sufficiently quickly.

This survey of the intertidal archaeology of Swansea Bay highlights a number of points often observed in foreshore studies. Stratified Flandrian deposits are intermittently exposed and suffering erosion through natural processes of coarse sediment transport and human processes of development and management. The effects of dredging and aggregate extraction are far from understood. Later relict structures, particularly relating to fishing, survive over extensive areas but await detailed recording. Parallel documentary research here is needed to enable informed interpretation. Above all, perhaps, it should be stressed that the dynamic environment of foreshore archaeology means that previously unknown sites and artefacts will continue to be exposed and, hopefully, observed and recorded along the shore of Swansea Bay.

Documentary and Cartographic Sources Consulted

West Glamorgan Record Office

South Wales Sea Fisheries District Committee

D/D SWSF 19/2: Stake nets in Swansea Bay.

D/D SWSF 19/3: Mumbles Layup.
D/D SWSF 19/4: Inshore fishing.
D/D SWSF 19/15: Obstructions in Swansea Bay.
D/D SWSF 22/1: Notes on oyster fishery.
D/D SWSF 22/2: Photographs of Mumbles.
D/D SWSF 29/12: Removal of sand by Cynnfig.
D/D SWSF 29/15: Swansea docks.
D/D SWSF 32/2: Maps of South Wales coastline.
D/D SWSF 41/4: Miscellaneous correspondence, especially inshore fishing.

Maps

Tithe Map: Oystermouth Parish 1845
Tithe Map: Swansea Parish 1843
Ordnance Survey 25" to 1 mile 1st Edition (1878)
Blackpill/ Brynmill area, Oystermouth Road area (sheet 249)

Swansea Reference Library

Admiralty Charts of Swansea Bay (sheet 1161) from 1994 and 1949.

Local Archives Collection: Corporation of Swansea

C5-C9: Estate rental and account books 1802-1857
H6: Correspondence re disputes over Swansea Harbour rights etc. 1839-48.

University of Wales, Swansea (Rare Books Section)

GF Bb: Grant Francis Collection: broadsheets relating to Swansea and Glamorgan
GV A.18: Graham Vivian Collection: documents relating to disputes regarding a fish weir at Blackpill (1869-86)

Appendix I: Index of Aerial Photographs

Plots taken from all photographs listed unless stated otherwise.

Sortie/Lib No.		Date	Frame number	Scale	Area	Comments
O.S. 63.69		1969		1:12600	Swansea Bay/Barry	Infrared. Whole set examined. 1 plot taken of groynes/fish traps south west of Swansea docks.
Geonex 9201	6892	1992	83-87	1:5000	Witford Point	1 plot taken.
Geonex 9201	6892		152-156	1:5000		Recent made ground?
Geonex 9201	6892		158-161	1:5000		1 plot taken. More made ground and possible peat.
Geonex 9201	6892		217-218	1:5000		Not used.
Geonex 9201	6892		283-284	1:5000		Not used.
Geonex 9201	15392		98-101	1:5000		Not used.
Geonex 9201	15392		106-110	1:5000		Not used.
Geonex 9201	15392		218-221	1:5000		1 plot taken.
Geonex 9201	15392		226-227	1:5000		Not used.
Geonex 9201	9092		405-411	1:5000?		Not used.
Geonex 9201	7392		213-215	1:5000?		Not used.
Geonex 9139	6491	1991	038	1:10000	Margam	1 plot taken.

Geonex 9139	6491		043	1:10000	Margam	1 plot taken.
Geonex 9139	6591		170	1:10000		Not used.
Geonex 9139	6591		175	1:10000		Not used.
Geonex 9139	6591		180	1:10000		Not used.
Geonex 9139	6591		185	1:10000	Margam	1 plot taken (same as 190?)
Geonex 9139	6591		190	1:10000	Margam	1 plot taken (same as 185?)
Geonex 9139	7391		045	1:10000		Not used.
Geonex 9139	7391		050	1:10000		Not used.
Geonex 9139	7391		055	1:10000		Not used.
Geonex 9139	7391		060	1:10000	Sker Point	1 plot taken.
Geonex 9139	7391		065	1:10000		Not used.
Geonex 9139	7391		069	1:10000		Not used.
Meridian	4/66	7/3/1966	084	1:6000	Witford Point	
6607(b)			099		Swansea Docks	Fish weirs
			101		Swansea	Fish weirs
			112		West of Swansea	Fish weirs
			114		Swansea	Fish weirs
			116		Swansea	Fish weirs
			152		By the university	
			154		Blackpill	
			162		Mumbles	Shipwrecks, possible old breakwater, shingle, possible fish traps, possible oyster

						perches, slipways, intertidal structures.
			165		Mumbles	See 162.
Meridian 7919	37/79	10/9/1979	007	1:6000	Sker Point	
			009		Cynffig Sands	Possible shipwreck
			013		Margam Sands	
			015		Margam Works	Plotted onto same sheet as 017
			017		Margam Works	Plotted onto same sheet as 015
			059		Brynmill and Blackpill	Peat shelf at Brynmill and dark area by Blackpill.
			061		Brynmill	Fish traps
			102		Swansea Marina	Fish traps
			141		Brynmill	Fish traps by the dark thing
			156		Blackpill	Possible peat
			167		Mumbles	
Meridian 6810	55/68	28/7/1968	054	1:5000	Brynmill	Peat shelf
			077		Oystermouth Road	Sub-rectangular pits
	54/68		031	1:3000	Swansea	
			179		Brynmill	Peat shelf
			181		University/ Brynmill	Peat shelf
Meridian 6908	3/69	19/1/1969	134	1:6000	Port Talbot New Dock.	Not plotted. Shows construction of New Dock

187

incorrectly dated 1982 by
ML, and wreck (ML site SS
78 NE north part no. 6)
previously seen on set 1266
from 1947.

Not plotted, but this is a
particularly good photograph
of the fish traps. This whole
set is of very high quality. It
shows the same sort of
things as the other sets, but
the tide is very low and the
images are clear, so it may
be worth returning to for
more detail of fish traps and
pits, and for getting prints off.
The peat shelf around
Brynmill and Blackpill is
shown very clearly.

440 (RAF)	106 G UK 1275	23/3/1946	1:4500
590 (RAF)	CPE UK 1989	12/4/1947	1:4500

Set referred to but no plots
taken. Brynmill peat shelf
and fish weirs present.
Set referred to but no plots
taken. Brynmill peat shelf

						and fish weirs present, but the tide is quite high and the quality poor.
4705 (RAF)	CPE UK 2264	27/8/1947		1:26000		Referred to but not plotted.
1245 (RAF)	540 RAF 699	27/3/1952		1:5000		High tide, scale too small. Referred to but not plotted.
						Sub-rectangular pits and fish weirs present by the docks, plus the post row following the line of the road near County Hall.
1266 (RAF)	540 RAF 748	1947	5001-503 1	?		Could have been useful, but not printed.
			5043		Port Talbot docks	Not plotted. Shows wreck (war damage), immediately north of northern breakwater.
			5045		Port Talbot docks	Not plotted. Shows dark zone mid beach immediately south of original southern arm (area within New Dock).
1285 (RAF)	540 RAF 758	?		?	Around Crymlyn Burrows	Referred to but not plotted.
9141	VI I PRU 2301	10/9/1991		1:35000		Scale too small. Not plotted.

Bibliography

- | | | |
|---|------|--|
| Acer
Environmental | 1994 | <i>Swansea Bay Bathing Waters Improvement Scheme: Environmental Statement.</i> Welsh Water South Western Division. |
| Aflalo F. G. | 1904 | <i>The Sea-Fishing Industry of England and Wales: A Popular Account of the Sea Fisheries and Fishing Ports of those Countries.</i> London: Edward Stanford. |
| Baker C. &
Francis G.G. | 1870 | <i>Surveys of Gower and Kilvey.</i> Supplement to <i>Archaeologia Cambrensis</i> |
| Balchin W. G. V.
(ed.) | 1971 | <i>Swansea and Its Region.</i> Swansea: University College of Swansea. |
| Bell M. &
Neumann H. | 1997 | Prehistoric intertidal archaeology and environments in the Severn Estuary, Wales <i>World Archaeology</i> 29(1), 95-113 |
| Canti M., Heal V.,
McDonnell R.,
Straker V. &
Jennings S. | 1996 | Archaeological and palaeoenvironmental evaluation of Porlock Bay and Marsh <i>Archaeology in the Severn Estuary 1995. Ann. Rep. Severn Estuary Levels Research Committee</i> 6, 49-70 |
| Chambers F. M. | 1996 | "Great Britain – Wales." In: Berglund B. E., Birks H. J. B., Ralska-Jasiewiczowa M. and Wright H. E. (eds.). <i>Palaeoecological Events During the Last 15000 Years: Regional Syntheses of Palaeoecological Studies of Lakes and Mires in Europe</i> , pp.77-94. Chichester: John Wiley. |
| Cole L. C. H. | 1934 | Notes on the ground exposed during the construction of the Swansea new main drainage. <i>Proceedings of the Swansea Scientific and Field Naturalists Society</i> vol. 1, pp. 233-4 |
| Collins M. B.,
Banner F. T.,
Tyler P. A.,
Wakefield S. J.
and James A. E.
(eds.) | 1980 | <i>Industrialised Embayments and their Environmental Problems: A case study of Swansea Bay.</i> Pergamon Press. |
| Cousens S. H. | 1971 | Settlement before the Norman Conquest, In Balchin W. G. V. (ed.), 133-145. |
| Culver S. J. | 1976 | <i>A Study of the Post-Glacial Foraminiferida of Swansea Bay, South Wales.</i> Swansea: University College of Swansea (Thesis). |
| Culver S. J. | 1980 | Palaeolithic to Iron Age archaeology and palaeoenvironment in the Swansea Area, In Collins M. B. et al (eds.), 59-69. |

- | | | |
|---|------|--|
| Culver S. J. and
Bull P. A. | 1979 | Late Pleistocene rock-basin lakes in South Wales, <i>Geological Journal</i> 14, pt. 2, 107-116. |
| Culver S. J. and
Bull P. A. | 1980 | The Quaternary Deposits of Swansea Bay, In Collins M. B. <i>et al</i> (eds.), 39-49. |
| Cundall L. B. and
Landman T. | 1925 | <i>Wales: An Economic Geography</i> . London: Routledge. |
| Cushing D. H. | 1988 | <i>The Provident Sea</i> . Cambridge: Cambridge University Press. |
| Davies D. C. | 1885 | The Fisheries of Wales In: Owen W. R. (ed.). <i>Transactions of The Royal National Eisteddfod of Wales, Liverpool, 1884</i> , 283-320. Liverpool: Isaac Foulkes. |
| Davis F. M. | 1958 | <i>An Account of the Fishing Gear of England and Wales</i> . Fishery Investigations Series II Vol XXI No 8. London: HMSO. |
| Dillwyn L. | 1840 | <i>Contributions towards a history of Swansea</i> . Swansea: published by the author. |
| Duhamel du
Monceau | 1769 | <i>Traité général des Pesches et histoire des Poisons</i> vols 1-3
Paris: Sailant et Nym, Desdaint. |
| Evans E. | 1995 | <i>Traditional Fishing in Wales</i> . Welsh Heritage Series No. 5.
Llanrwst:Gwasg Carreg Gwalch. |
| Gabb G. | 1986 | <i>The Story of the Village of Mumbles</i> . Cowbridge: D. Brown. |
| George T. N. | 1930 | The Submerged Forest of Gower <i>Proceedings of the Swansea Scientific and Field Naturalists Society</i> vol. 1, 100-8. |
| George T. N. | 1936 | The Geology of the Swansea Main Drainage Excavations.
<i>Proceedings of the Swansea Scientific and Field Naturalists Society</i> vol. 2, 331-360. |
| George T. N. &
Griffiths J.C. | 1938 | The superficial deposits at the mouth of the River Tawe <i>Proc. Swansea Sci. Fld. Nat. Soc.</i> 2. |
| Godwin H. | 1940 | Data for the Study of Post-Glacial History: A Boreal transgression of the sea in Swansea Bay <i>New Phytologist</i> vol. 39, 308-321. |
| Godwin H. | 1981 | <i>The archives of the peat bogs</i> . Cambridge: Cambridge University Press. |
| Godwin H. and
Willis E. H. | 1964 | Cambridge University Natural Radiocarbon Measurements
<i>Radiocarbon</i> 6, 116-137 |
| Green H. | 1985 | Four Bronze Age Sword-Finds from Wales. <i>Bulletin of the Board of Celtic Studies</i> 32, 283-284. |
| Griffin T. L. C.,
Matthews R. P.
and Williams G.
J. (eds.) | 1959 | <i>The Swansea Geographer</i> . Swansea: The Geographical Society of the University College of Swansea. |
| Groom G. E. | 1971 | Geomorphology In Balchin W. G. V. (ed.) <i>Swansea and Its</i> |

- Region, 29-40. Swansea: University College of Swansea.
- Harris A. E. 1934 *Swansea: Its Port and Trade and their Development.*
- Howell R. G. 1987 *Under Sail: Swansea Cutters, Tallships and Seascapes 1830-1880.* Bridgend: Brown & Sons.
- James 1971
- Jenkins J. G. 1969 *Studies in Folk Life: Essays in honour of Iorwerth C. Peate.* (ed.) London: Routledge and Kegan Paul.
- Jenkins J. G. 1974 *Nets and Coracles.* London: David and Charles.
- Jenkins J. G. 1978 *The Inshore Fishermen of Wales.* Cardiff: Dent.
- Jones W. H. 1992 *The History of Swansea and the Lordship of Gower.* Vol II. Swansea: RISW
- King P. E. & 1969 Oyster Dredging. *Gower* 20, 76-81
- Osborn A.
- Llewellyn P. 1996 *Factors affecting the invertebrate population abundance of the strandline, the littoral fringe and supralittoral zones, of soft sediment beaches.* Thesis submitted for the degree of Master of Philosophy, University of Wales, Swansea.
- Locock M. 1996 *GGAT 50: Coastal Survey (Glamorgan). Loughor, West Glamorgan to Sker Point, Mid Glamorgan.* Cadw Project No. GGAT 50, GGAT Report No. 96/015
- Matheson C. 1929 *Wales and the Sea Fisheries.* Cardiff: The National Museum of Wales and The Press Board of the University of Wales.
- Matheson C. 1935 The Oyster Fishery at Mumbles, Glamorgan *Report and Transactions of the Cardiff Naturalists Society* 66, 81-86.
- McDonnell R. 1980 Tidal fish weirs, West Somerset. In *Somerset Archaeology*, 1979. *Proceedings of the Somerset Archaeological and Natural History Society* 123, 75-82
- McDonnell R. 1995 Bridgewater Bay: a summary of its geomorphology, tidal characteristics and intertidal cultural resource. *Archaeology in the Severn Estuary* 1994 5, 87-114
- McDonnell R.& 1997 Minehead Sea Defences: report on archaeological surveillance. . *Archaeology in the Severn Estuary* 1997 8
- Jones J
- Moggeridge M. 1856 On the Section exposed in the Excavation of the Swansea Docks *Quarterly Journal of the Geological Society*, XII, 169
- Moran A. Unda *The key of Mumbles: its trade, probable site and some recent discoveries.* Unpublished paper.
- Morris B. 1964 The Drowned Lands of Swansea Bay *Gower* 16, 69-71.
- Nayling N. 1997 *Crymlyn Burrows Wreck Intertidal Wreck: Archaeological Evaluation.* GGAT Report 021/97, Cadw Project GGAT 56

- | | | |
|---|------|--|
| Owen T. M. | 1969 | Historical Aspects of Peat-cutting in Wales In Jenkins J. G. (ed.) <i>Studies in Folk Life: Essays in honour of Iorwerth C. Peate</i> , 123-155. London: Routledge and Kegan Paul. |
| Owen T. R.* | 1962 | The Evolution of Swansea Bay <i>Gower</i> 15, 35-39. |
| Owen T. R. | 1971 | Geology, In: Balchin W. G. V. (ed.) <i>Swansea and Its Region</i> , 11-28. Swansea: University College of Swansea. |
| Price C. R. and
Brooks M. | 1980 | Swansea Bay: bedrock geology and its influence over geomorphological development, Collins M. B. et al (eds.), 23-38. |
| Price M. | 1990 | <i>The Account Book for the Borough of Swansea, Wales 1640-1660: A Study in Local Administration During the Civil War and Interregnum</i> . Lewiston: Edwin Mellen Press. |
| Pringle J. and
George T. N. | 1948 | <i>British Regional Geology: South Wales</i> (2nd ed.). London: HMSO. |
| Rider S. W. and
Trueman A. E. | 1929 | <i>South Wales: A Physical and Economic Geography</i> . London: Methuen. |
| Rogers W. C. | 1946 | <i>Swansea and Glamorgan Calendars. Part II Vol III. Miscellaneous Documents</i> . Swansea |
| Rogers W. C. | 1947 | <i>The Swansea and Glamorgan Calendar. Part I (Apps) Vol II</i> . Swansea |
| Shackley S. E.,
King P. E. and
Rhydderch J. | 1980 | Fish and Fisheries in Greater Swansea Bay In Collins M. B. et al (eds.), 555-563. |
| Strahan A. | 1907 | The country around Swansea <i>Mem. Geol. Survey</i> , 247 |
| Stevens P. G. | 1930 | A note on the geology of Swansea Bay <i>Proceedings of the Swansea Scientific and Field Naturalists Society</i> 1, 31-2. |
| Thomas N. L.. | 1978 | <i>Of Swansea West: The Mumbles Past and Present</i> . Swansea: UBS. |
| von Post L. | 1933 | A Gothiglacial transgression of the sea in south Sweden. <i>Geogr. Ann., Stockh.</i> 15. |
| Watkins G. J. | 1959 | The Fishing Industry at Swansea, In: Griffin T. L. C., Matthews R. P. and Williams G. J. (eds.) <i>The Swansea Geographer</i> , 63-67. Swansea: The Geographical Society of the University College of Swansea. |
| Williams, D. N. | 1993 | <i>Archaeological Field Evaluation, Brynmill peat shelf, Swansea Bay</i> . GGAT Report No.93/066. |

Figures



Figure 1 Peat exposure P3 off Brynmill. Scale 0.5m.



Figure 2 Peat exposure at Margam, looking seaward. Note the deep gulleys cut by mobile beach deposits. Taken at extreme low tide.



Figure 3. Detail from *Fishing the Weir* by Edward Duncan RWS, signed 1847. From Howell 1987

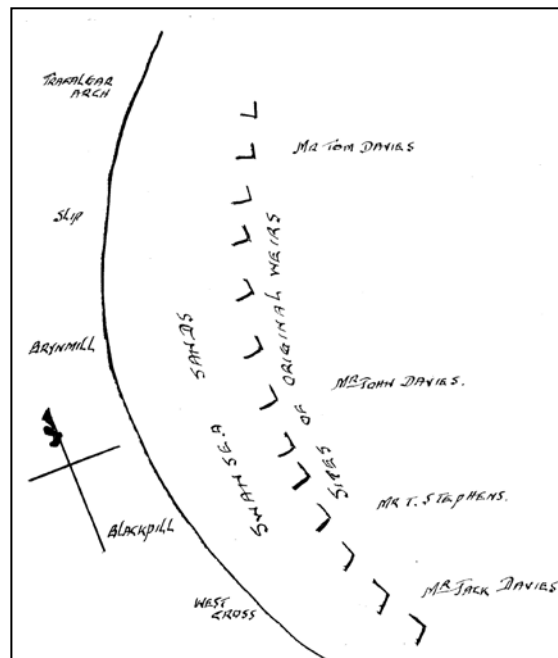


Figure 4 Undated map of original sites of Swansea Bay weirs (GWRO D/D SWSF 19/2)

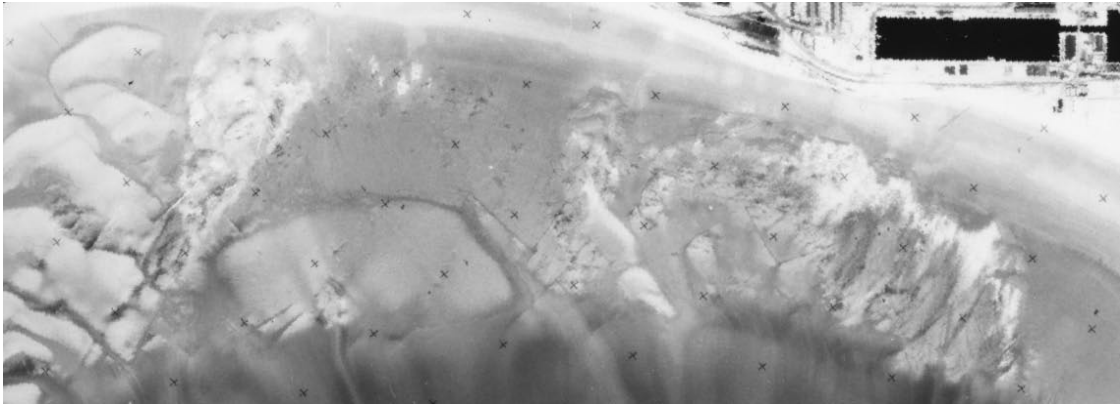


Figure 5. 1:12,600 Infrared aerial photograph of Swansea Bay. The western extent of Swansea Docks is clearly visible (upper right), and fish weirs less clearly as a palimpsest of zig-zag lines on the foreshore



Figure 6. Stone fish weir in Swansea Bay. Taken from the apex of the weir looking landward. In addition to the stone remnants of this weir, parts of other weirs can be seen crossing it. Scale 0.5m



Figure 7. Detail of the apex of the above weir. Wooden pegs and stone delineate the former location of the basket trap. Scale 0.5m

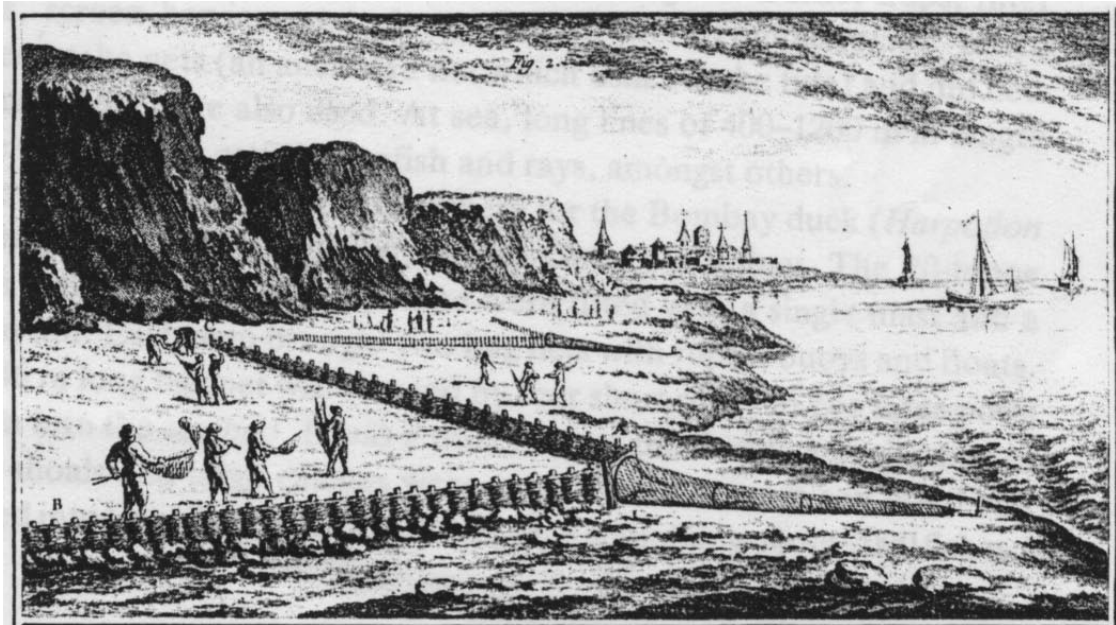


Figure 8. 18th century line drawing illustrating intertidal fish traps in use on the French Coast (after Duhamel du Monceau 1769)



Figure 9. Wooden weir WF2, looking landward. Scale 0.5m.



Figure 10. Wooden weir WF3, taken from the apex of the weir looking landward. The new County Hall is visible in the right background. Scale 0.5m

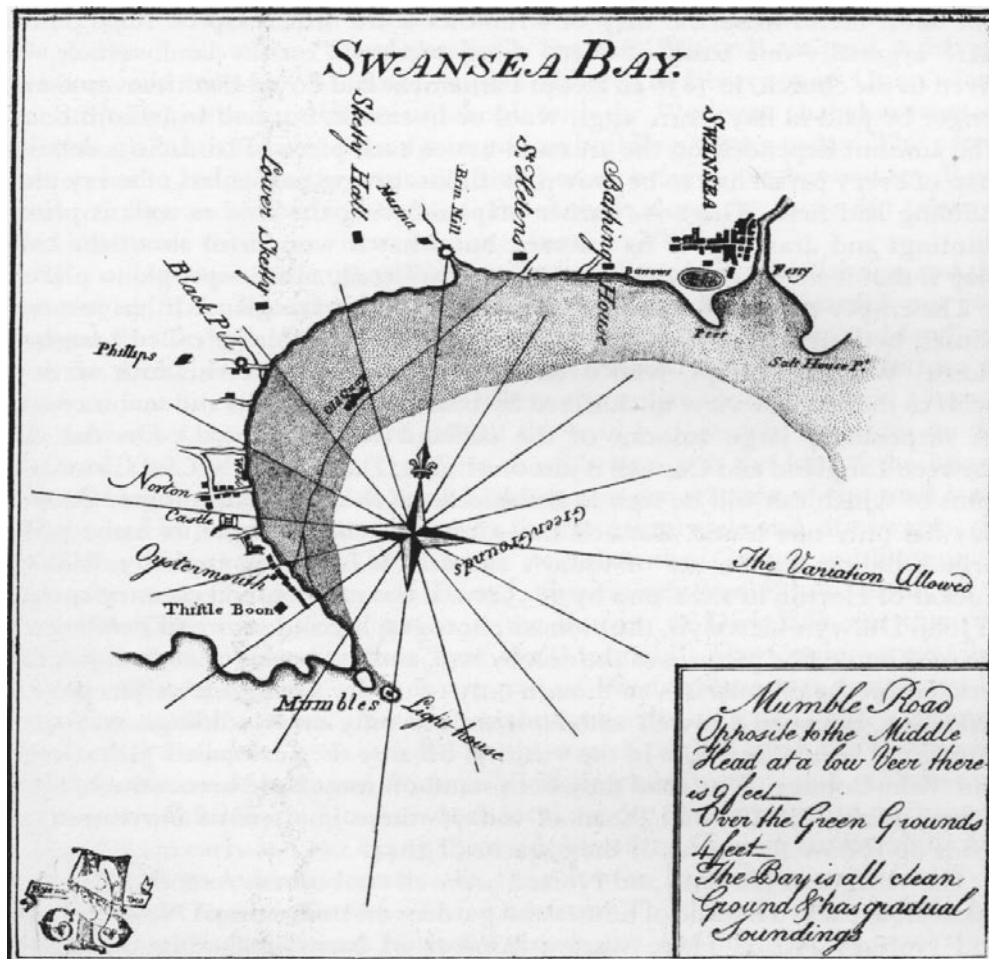


Figure 11. Map of Swansea Bay by George Yates dated 1794 showing the 'old quay'. After Gabb 1986, from Swansea Museum.

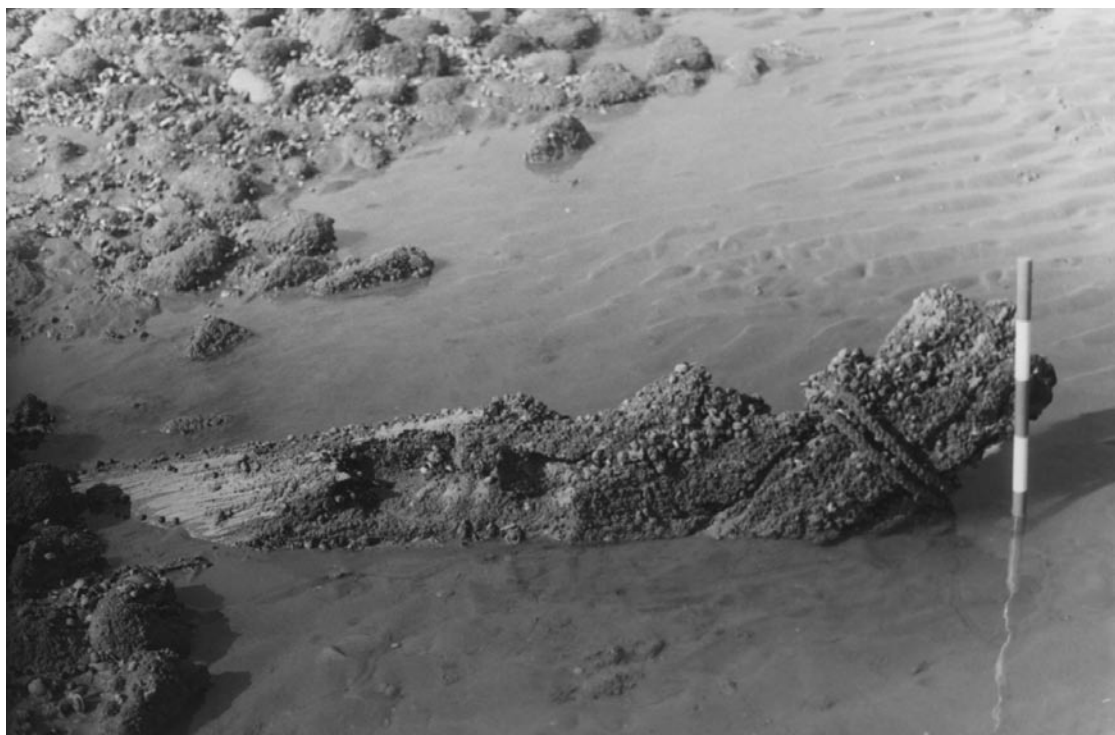
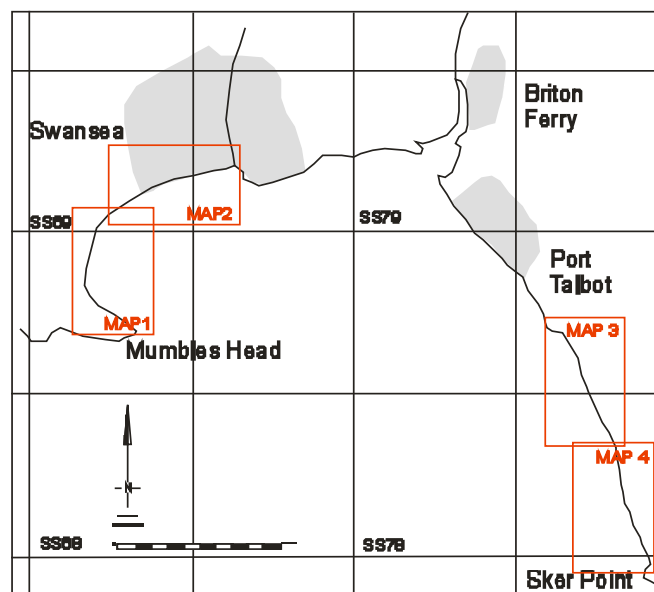


Figure 12. Post exposed on seaward edge of 'quay' remains off Blackpill. Scale 0.5m

Maps

Four maps at a scale of 1:10,000 are used to present the survey results graphically. These cover those areas of Swansea Bay where peat exposures or numerous, newly mapped features were encountered. Whilst many symbols are used in common on all maps (see legend), there are some differences between the overlapping pair covering the area from Mumbles Point to the River Tawe (Maps 1 and 2) and the overlapping pair covering the area from Port Talbot to Sker Point (Maps 3 and 4). The western pair of maps is based on the 1:25,000 Admiralty chart with the extents of the intertidal zone defined by Highest and Lowest Astronomical Tide, whilst the eastern pair are based on Ordnance survey 1:10,000 maps with the intertidal zone defined by Mean High and Low Water. All maps are displayed with the Ordnance Survey National Grid.



Legend	
Stone Fish Trap	
Wooden Fish Trap	 WF1
Previously recorded find	 PRN 0000
Wooden wreck	 WR1
Peat exposure	 P1
Borehole reported by George (1936)	 Bh6