

Report of the
MILFORD HAVEN WATERWAY
ENVIRONMENTAL MONITORING
STEERING GROUP



MHWEMSG

1994/5

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ACKNOWLEDGEMENTS

In order for the Milford Haven Waterway Group (MHWEMSG) to continue with its agreed long term programme it has to be well resourced. This resourcing includes:-

- Provision of manpower, equipment and facilities by Group members
- Commitment and expertise brought to the Group by its members

Presently the supporters of the Group are as follows:

Countryside Council for Wales	National Power
Elf Oil Refinery	National Rivers Authority
Gulf Oil Refinery	Pembrokeshire Coast National Park
Dyfed County Council	Preseli Pembrokeshire District Council
Milford Haven Port Authority	South Pembrokeshire District Council
Milford Port Health Authority	Texaco Refinery

The MHWEMSG gatherings are hosted by the Milford Haven Port Authority and the National River Authority provide the venue for the Project Sub-Group meetings.

The cover of the report was designed and produced by the Civil Protection Planning Unit and the graphic is reproduced by courtesy of Pembrokeshire Coast National Park.

INTRODUCTION

This is the third report produced by the Milford Haven Waterway Environmental Monitoring Steering Group (MHWEMSG).

The constitution of the Group has not changed significantly since the last report. The Group has met four times during the year. The function of the MHWEMSG is primarily administrative and the progressive work is undertaken by the Projects Sub-Group which is responsible for running the programme of activities.

In order to instigate the agreed programme of work adequate finances are required. Due to monetary constraints, certain members have had to reduce or cease their support during this financial year. However, all of the funding available is spent exclusively on the programme of work which the Group was established to undertake initially. This is possible due to administration costs being absorbed by the participants thus reducing overheads to a minimal level. This is unique for such a project.

It has been decided to add a little more detail to this year's report particularly in key areas of monitoring and analysis. The purpose is to offer the reader a better insight as to the purpose and validity of the activities undertaken.

Over the period covered by this report the major areas of work undertaken by the group have been:-

- Water quality monitoring
- Inter-tidal soft sediment monitoring
- Reporting of the seabed sediment biology and chemistry

Through collaboration and assistance in kind with manpower, survey vessels, analysis etc. from Group members it has been possible to continue to provide value for money and successfully complete the planned work programme.

Already the value of the information being provided by the Group's work has been recognised by its extensive use in environmental impact assessments produced by independent consultants.

The importance of the Steering Group's work has acquired extra significance by the possibility of the Milford Haven Waterway becoming part of a marine Special Area of Conservation (SAC) under the European Habitats Directive. After widespread consultation the Government will decide whether the proposal should go forward for further consideration.

Earlier this year the National Rivers Authority (NRA) published its Action Plan for the Cleddau catchment, including the Milford Haven Waterway and the Daugleddau Estuary. In the plan several issues and actions are addressed, to be achieved by the NRA together with other organisations. One of the issues is the bacteriological quality. The Group have been monitoring this, and a summary of the findings are included later in this report.

Over the next twelve month the frequency of Group meetings is likely to decrease as much of work associated with the monitoring programme is transacted through the Projects Sub-Group. However there are areas which will be examined by the Group as a whole which include:-

Copyright matters concerning reports commissioned under the work programme.

The matter of copyright will be addressed in all future reports issues by the Group by including the following statement in all published documents.

"Copyright - No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means - electronic, mechanical, photocopying, recording or otherwise, unless the permission of the Milford Haven Waterway Environmental Monitoring Group has been given beforehand."

A document management system.

The issue of document management has been addressed in a simple and uncomplicated manner. All future reports which are commissioned by the Group will be subject to the scheme. All new reports will be published under a cover provided by the Group ensuring there is no ambiguity over ownership of the content. Each copy will be numbered and display the person or organisation to which it was issued. This information will be retained by the Group.

All members of the Group will automatically receive copies of reports. Additionally copies of the reports will be displayed in the main libraries in Pembrokeshire and a single unbound copy will be provided to the appropriate education authority for use in schools.

The transition of local authorities to Unitary status.

This matter will begin to be addressed immediately the Pembrokeshire Shadow Unitary Authority is established. The new Authority will be invited to take over the chairmanship of the Group on 1st April 1996 and to shadow its ongoing activities up to 31st March 1996.

During 1995/96 the most important areas of work for the Group will be:-

- Monitoring of inter-tidal rocky shore and rocky seabed biology. This is the largest area of field work in the present year's programme.
- Completion of the sediment oil and metals analysis targeted from the 1994/95 sediment monitoring programme.
- On-going water quality monitoring programme.
- Continuation of routine ornithological monitoring.
- Undertaking the first phase of the identification of the sources of contamination within the environment of the Milford Haven Waterway.

TREVOR D. LLOYD, Chairman MHWEMSG.
26th April 1995

WATER QUALITY MONITORING 1994

The monitoring programme was designed to provide an assessment of the background water quality at mid-channel sites throughout the Haven. This was undertaken at nine sites within the Waterway, a "control" at Skomer, and the two main freshwater inputs to the estuary on the Eastern and Western Cleddau rivers.

A full report of the water quality data for 1993/94 is currently being produced by the Field Studies Council Research Centre at Fort Popton on behalf of the Group.

It is the intention in each annual report to address one aspect of water quality in more detail. This year the results of the bacteriological monitoring are summarised.

The presence of certain bacteria in water are used as "indicators" in that their presence, particularly the presence of faecal coliforms, can indicate the presence of sewage derived pollution. However these bacteria can also be found in large numbers in runoff from catchments where intensive livestock agriculture is practised, such as in the catchment of the Haven.

The results of monitoring for total and faecal coliform (E.coli) bacteria during 1993/94 at ten stations from Landshipping to Skomer are shown in Figure 1. The locations of the sampling stations are shown below.

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Landshipping 2. Beggars Reach 3. Lawrenny 4. Neyland 5. Pennar Mouth | <ol style="list-style-type: none"> 6. Newton Noyes 7. Popton Point 8. Between Stack Rock and Thorn Island 9. Between West Dale and West Angle 10. Skomer |
|---|---|

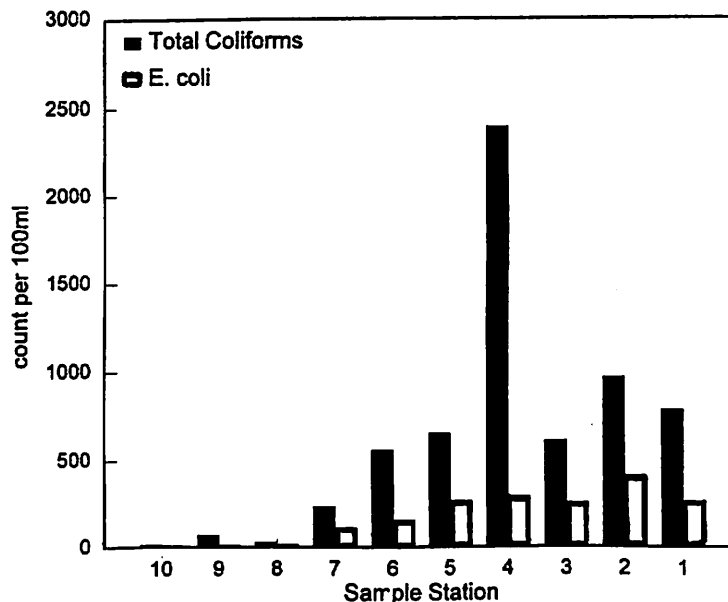


Figure 1 MEAN LEVELS OF TOTAL COLIFORM & E. COLI BACTERIA 1993/94

The sampling stations are situated approximately in mid-channel and the samples are taken at the surface. These data provide background values for the bacteriological quality in the Haven at these points.

On examination of the data summarised in Figure 1 it can be seen that the level of bacteria is higher in the stations in the Daugleddau when compared with those in the mouth of the Haven. There is a general trend to lower levels of bacteria the nearer the station is to the open sea. The only result that varies significantly from this trend is at station 4, between Neyland and Hobbs Point.

The general trend of lower levels of bacteria lower down the estuary is as expected. The main sources of the bacteria being analysed for would be from sewage effluent and freshwater inputs. The affect of increasing dilution and the bacteria dying off will result in lower levels at the mouth of the Haven.

The peak at station 4 indicates that there is an additional source of bacteria being detected at this point. In fact the sewage from Pembroke and Pembroke Dock is discharged off Carrs Rock approximately 1 kilometre west of station 4. This sewage discharge is responsible for the elevated level of bacteria measured at this point.

At the time of the monitoring in 1993 and 1994 the sewage was crude, having no treatment prior to being discharged. This situation has now improved significantly as a new sewage treatment works, recently completed this May, has been installed by Dwr Cymru Welsh Water providing biological treatment for all the sewage from Pembroke and Pembroke Dock.

These results provide the essential baseline information against which it will be possible in future years to quantify the improvement in bacteriological quality resulting from the provision of sewage treatment. Without this, and all the other information being gathered as a result of the Group's work, it would not be possible to monitor any changes within the Haven.

The other significant sewage discharge is from Milford Haven near to station 7. This discharge presently receives only screening before being discharged off Hakin Point. This is not evident from the results of the mid channel sampling at station 7. However this outfall of crude sewage will have an influence on the general background levels of bacteria.

Construction of a new sewage treatment works to serve the town of Milford Haven has begun by Dwr Cymru Welsh Water. This is due to be completed in 1996. Examination of the monitoring results in future years should provide information on the effect both schemes, at Pembroke Dock and Milford Haven, have had on the bacteriological quality of the Haven Waterway.

The provision of survey vessels by MPHA and CCW and assistance with manpower and analysis at cost by the NRA is enabling this programme to continue at minimal cost.

MILFORD HAVEN SEABED SEDIMENT MACROBENTHIC SURVEY OCTOBER 1993

This report summarises the results of the Macrobenthic Survey of the Milford Haven Waterway carried out by the Field Studies Council Research Centre. This was performed as a contract for the Milford Haven Waterway Environmental Monitoring Steering Group in October 1993.

The objective of the survey was to provide information on the range of sea-bed sediment biology throughout the length of the waterway.

A total of forty samples stations, located from the lower reaches of both eastern and western Cleddau through the waterway to the entrance of Milford Haven off St Ann's Head, were sampled for biology and sediment composition. A "reference" station was sampled adjacent to the offshore island of Skomer for comparative purposes. These stations are shown in Figure 1.

Three replicate quantitative biological samples were obtained from thirty six stations, by 0.1m² Day grab. Qualitative samples were obtained from two stations and two stations were found to be unsuitable for grab sampling due to the presence of exposed bedrock or stones. Sediment samples were obtained at each location for faunal and sedimentological analyses and samples for sediment hydrocarbon content analyses were obtained and placed in storage for possible future analyses.

The processing of the biological samples was carried out separately on both 1.0mm and 0.5mm sieve mesh size fractions. This was to enable comparability of data with past macrobenthic surveys within the waterway. Biological sample processing involved over 1840 man hours of sorting an identification of more than 125,400 individual animals from 418 quantitative and 38 quantitative taxa.

The returns for the increased effort in processing time for the smaller size fraction is considered to be of value, in the increased community definition, particularly in the upper estuary. It is stressed however, that the two size fractions should continue to be processed independently, as this would retain the flexibility to process only a proportion of the samples in the future surveys on the smaller size category, should costs become prohibitive. This would still enable overall comparison of trends through the waterway to be based upon 1.0mm data.

Sediment samples were analysed for grain size characteristics and organic content.

Additional data concerning concentrations found in sediments were provided by the National Rivers Authority. These data were generated from sediment samples obtained at ninety three stations in March 1993 and analysed at the NRA Llanelli Laboratories.

All raw data generated by the analyses of samples are included as appendices to the full report and form an important source for comparison with both past and future macrobenthic work within Milford Haven.

Biological data were subjected to a range of univariate and multivariate statistical procedures. Examples of species distributions and macrobenthic community parameters are presented in graphic and tabular summary form. Classifications of stations on the basis of the similarity of their benthic communities was also performed and presented in summarised graphics.

Summary of Results

An increase in species richness and community diversity was found in the progression from the upper estuary brackish region, through the system to the open sea, marine environment. This confirms to the expected trends widely described in the scientific literature. Several distinct communities, separated on the basis of multivariate ordination and classification of the biological data, are described and were found to be associated with different regions within the waterway.

Comparison with previous macrobenthic surveys, where possible, suggests that this survey describes some genuine changes in community richness in the lower estuary. However caution is expressed in interpreting some of these observed differences which are undoubtedly influenced by adequacy of sampling, worker analytical efficiency, differences in methodologies and accuracy of station positioning.

The sediments analysed from thirty eight stations within the waterway were mostly poorly sorted heterogeneous mixtures of mud, sand and gravel. Sheltered depositional areas, such lateral pills and deeper water in the lower estuary, possessed fine muddy sediments. The sediments of the mid channel and outer estuary were generally coarser with a gravel fraction consisting of both lithic and biogenic particles.

Sediment organic matter contents were positively correlated with sediment mud content. Levels were generally less than 5% in the lower estuary (below the Cleddau Bridge) and greater than 5% in the upper estuary. High values at some stations were tentatively attributed to enrichment by sewage but there was no obvious pattern of organic enrichment which would be related to the presence of outfalls within the Haven.

Minimum sediment metal concentrations were found in the lower estuary, west of Stack Rock. In comparison with a world wide standard and argillaceous sediment, many elements had elevated concentrations; copper and zinc were enriched at all stations and lead at all but five stations. Anthropogenic inputs of these metals were considered to be responsible for at least part of this enrichment. However, copper in particular may also have a natural source within the waterway. Sewage, refinery effluents and road runoff were considered to be important anthropogenic sources for those metals exhibiting elevated concentrations.

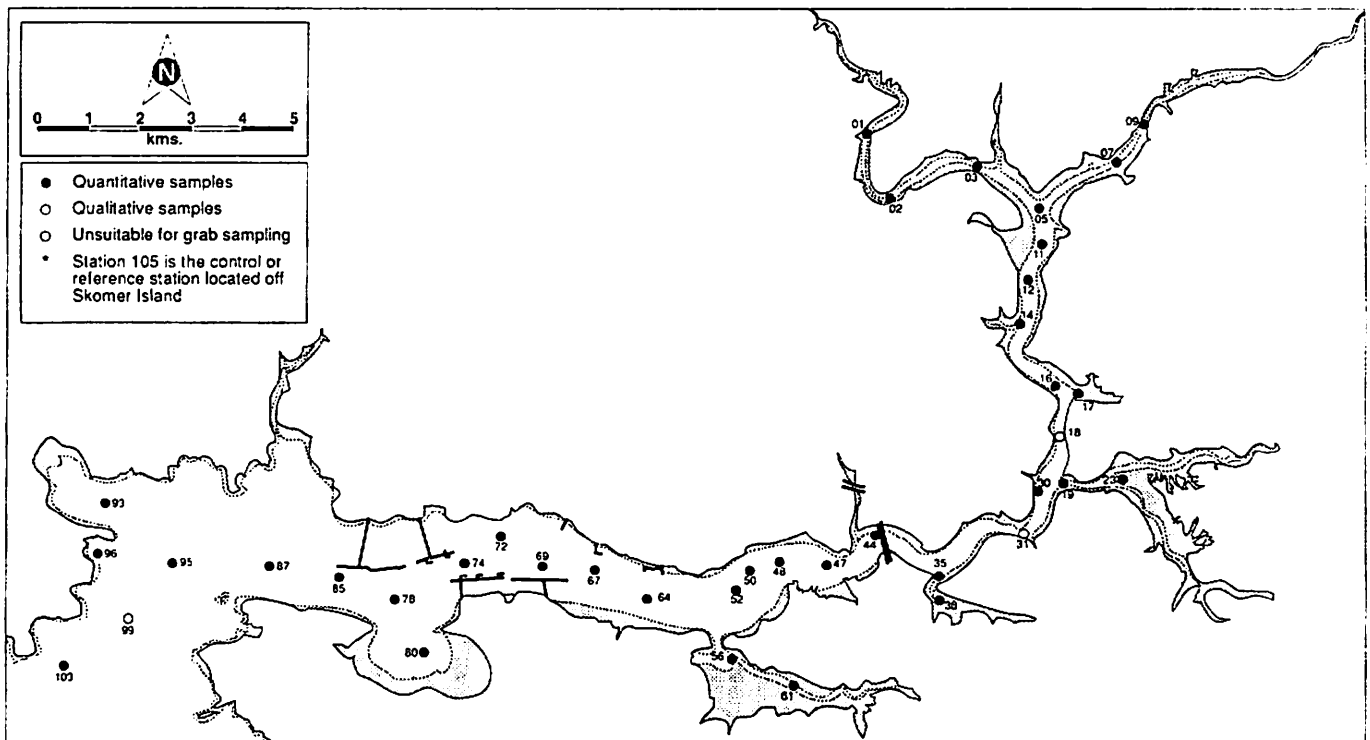
Elemental concentrations within sediments of the Milford Haven Waterway were compared to those from 24 estuaries in south west Britain. All mean elemental concentrations except copper were equal to or lower than values from these estuaries. Maximum concentrations of all metals except cobalt were within the ranges of concentrations determined elsewhere.

Comparisons with previous sedimentological studies of the Milford Haven Waterway suggested that the sediments were essentially similar in 1993 to those analysed in previous years. Changes in sediments between 1982 and 1993 were attributed to differences in methodology between the two surveys. However, the distribution histograms showed the sediments to be essentially similar with regards to the presence of the fine sand mode which comprised the bulk of many sediments.

The importance of accurate sample station positioning was highlighted by one intentional and one unintentional relocation of sample stations, leading to significant differences in community composition and sediment characteristics over relatively short distances.

It is recommended that the "broadbush" descriptive survey of the waterway should be repeated on a regular long-term basis to monitor significant change, if any, throughout the whole waterway. A seven to ten year interval is considered appropriate and would continue the sequence previously established in the late 1970s and mid 1980s.

It is recommended that the focus of attention for macrobenthic surveys in intervening years should be to determine the smaller scale impact of anthropogenic influences such as industrial or urban discharges and sedimentary contaminant sinks. These will require a more intensive survey strategy particularly with respect to number, relative proximity and coverage of sample stations. It is considered important to retain the link with the "broadbush" database by ensuring that at least one of the "broadbush" stations is included in any future survey of specific areas of interest.



**Fig.1 LOCATION OF SAMPLE STATIONS, MILFORD HAVEN
MACROBENTHIC SURVEY, OCTOBER 1993**

Extract from a report to the Milford Haven Waterway Environmental Monitoring Steering Group from the Field studies Council Research Centre, Fort Popton, Pembroke (August 1994) by D.Levell, J.Smith and G.Hobbs.

THE MACROBENTHOS OF THE FORESHORE SOFT SEDIMENTS OF MILFORD HAVEN OCTOBER AND NOVEMBER 1994

This work was commissioned in autumn 1994 with the objective of sampling intertidal sediments at locations throughout the Milford Haven waterway to:

- describe sediment biology
- prepare and store sediment samples for physical analyses

The fieldwork was carried out over two consecutive periods of low water spring tides. These were from October 17th to 23rd and November 1st to 6th 1994. Field excursions were generally made by inflatable boat, using Hobbs Point jetty as a suitable, central departure venue. During bad weather however, it was considered safer to use road access, and two sites (Angle Bay and Dale Flats) were sampled from a land base. Each day the field team loaded the necessary equipment onto the boat, and motored to the chosen site location. Navigational charts were used in order to locate each of the sites pre-designated during the planning stage. Upon arrival, one member of the team took site photographs, station positions using both GPS and normal compass techniques, and recorded notes, instrument readings and visual observations about the site onto a plastic paper, proforma recording sheet. Other team members sampled each designated station along the transect. At each station, 4 biological samples were obtained using steel corers of 0.01m² area. These were marked at 20cm to ensure a standard sample volume. Samples were placed into labelled plastic buckets. One additional sample for granulometric/organic analyses was collected using a plastic corer of 5cm diameter and marked at a length of 15cm, another sample for hydrocarbon analysis was collected in a solvent washed steel scoop and placed into a labelled, solvent washed aluminium container. A third extra sample was collected in a plastic bag for metal analyses. Then a garden fork was used to dig over sediment for visible macrofauna. Redox measurements were taken at 5cm and 10cm depths in a core sample from each station. The meter was a new, portable model with a pH combined electrode and an integrated temperature sensor. The core was also photographed to provide an illustration of the sediment profile at that station.

Sites were not sampled in any pre determined order, decisions being made on a daily basis according to weather, travel time and time of low water. In total, 15 sites were visited and 65 stations sampled. A summary of the sites is provided in Table 1. These sites are shown marked on Figures 1.

Table 1. The sites visited during the survey of Milford Haven soft sediment intertidal macrofauna.

Site name	Site No.	No. of Stations
Slebech Woods	1	3
Eastern Cleddau	2	3
Picton Point	3	3
Black Hill	4	3
Hook Quay	5	3
Underwood	6	3
Sprinkle Pill	7	4
Garron Pill	8	5
Carew River	9	6
Cosheston Pill	10	6
Pembroke River	11	6
Pwllcrochan	12	4
Angle Bay	13	5
Sandy Haven	14	5
Dale Flats	15	6

Summary of Results

It appears from the results of both the present survey and that of Levell et.al (1994) that there are recognisable zones of change in the estuarine environment. In the lower estuary, diversity as indicated by subtidal samples were quite high, with marine influences extending almost to the Cleddau Bridge. In the intertidal regions, several marine species were not found eastwards of Pwllcrochan. However, there were no other intertidal sites located adjacent to the main channel in this region for comparisons.

Dale (Gann) Flats was by far the most biologically diverse intertidal site, in spite of constant use by bait diggers. This was because of the proximity to the sea, shelter from the elements and a heterogeneous substratum. The community recognised was similar to that described by Edwards et.al. (1990) who documented changes on the Gann Flats thirty years after the original survey of Bassindale and Clark (1960). Unfortunately, the diversity of the original community was not ascertained.

Whilst Angle Bay bears some resemblance to Dale Flats, there were fewer species present, particularly on the upper shore. It was suggested (McLaren and Little, 1987) that fine sediments are being eroded from Angle Bay and contaminant concentrations depleted. The upper shore stations at Angle are similar to stations in Sandy Haven and this may be the result of similar sediment type.

Estuarine mudflat sites between Pembroke River and the upper Daugleddau showed gradual faunal changes. Many of these mudflat areas were extensive, and quite diverse with large numbers of individuals. A second boundary region occurred close to Sprinkle Pill where both lower shore and subtidal diversities decreased. Upstream of this region, the more euryhaline species were present. The topmost sites in the Western Cleddau were different from other upper estuarine regions.

Extracts from a draft report to the Milford Haven Waterway Environmental Monitoring Steering Group from SubSea Survey, Pembroke (April 1995) by Dale M.Rostron

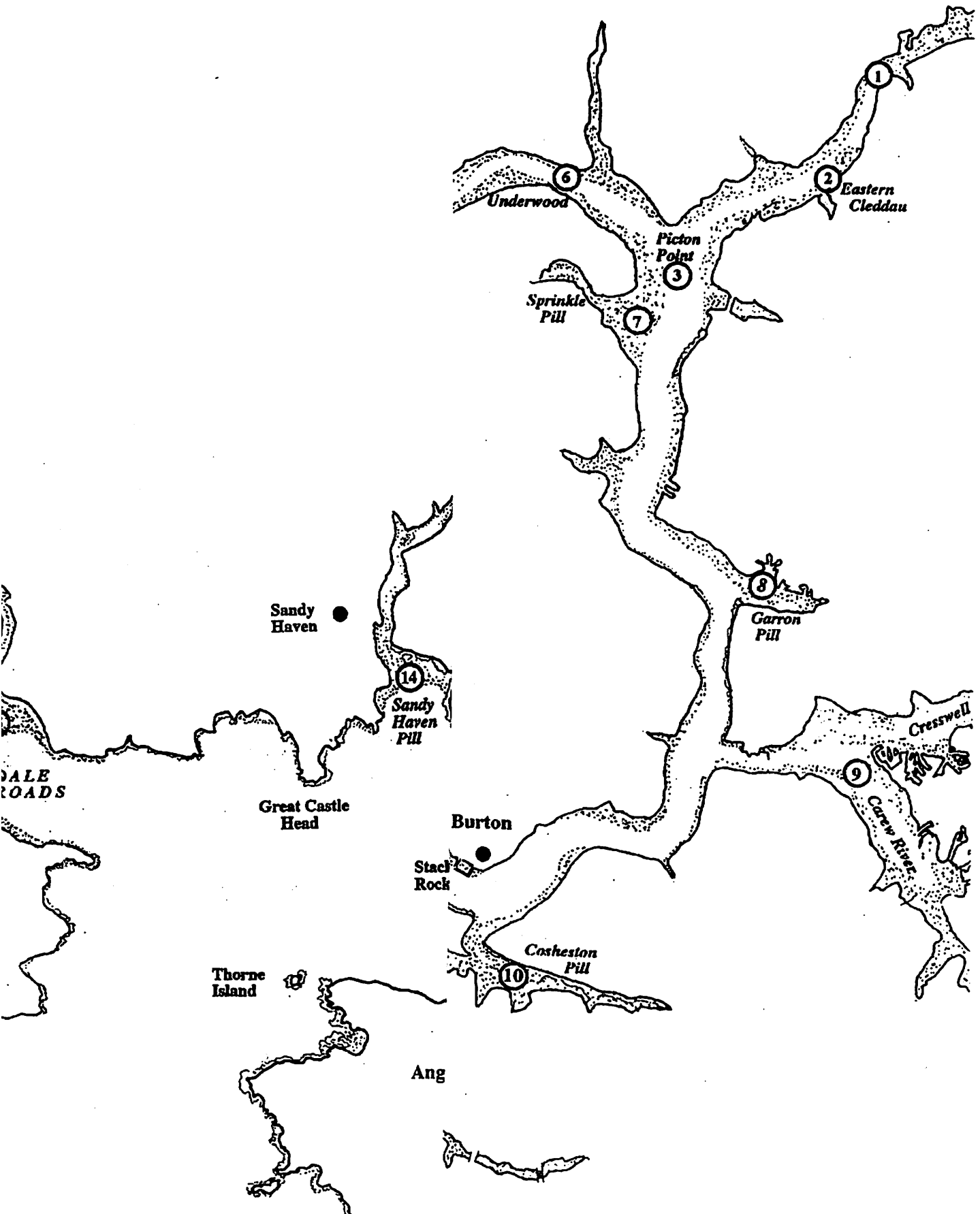


Fig. 1 SURVEY SITES FOR SOFT SED

Daugleddau Estuary & Milford Haven Waterway

WINTER WILDFOWL & WADER COUNTS 1994/5

1. Introduction

The Daugleddau Estuary and Milford Haven Waterway hold large numbers of wildfowl and waders during the winter months, with numbers of Shelduck, Teal, Dunlin, Curlew and Redshank reaching levels of "national importance" in most years.

The monthly counts of wildfowl and waders on the Cleddau Estuary are carried out throughout the winter as part of the national Wetland Bird Survey (WeBS). Since the winter of 1993/94 these counts have been incorporated into a rolling programme of research and survey initiated by the Milford Haven Waterway Environmental Monitoring steering Group (MHWEMSG).

2. Methods

The dates of the count are determined by Webs to coincide with high spring tides. The estuary is divided into fifteen sectors and is counted by a team of observers. Counts normally take place within two hours either side of high tide when most species are assembled in high roosts. Sectors are counted by a combination of walking the shore and counting from fixed points depending on accessibility. All sites were covered for all counts from September 1994 to March 1995, and additional data for August were collected by Jane Hodges, Pembrokeshire Coast National Park, during her Shelduck survey.

3. Results

During the peak period between November 1994 and February 1995 mean monthly totals of 3,938 wildfowl and 7,284 waders were present. The peak monthly count for wildfowl was 4,779, and for waders 10,381, both in January. Curlew (max. 1,732) and Shelduck (max. 1,178) exceeded levels of national importance.

Ten species of duck, together with one swan and three goose species were present. Mute swans were present in rather higher numbers than recent years, peaking at over 40 in November and December. Twenty species of wader were present, with Oystercatcher, Curlew, Dunlin and Snipe in their usual numbers, and there was a record peak of 5,400 Lapwing in January. Grey Plover numbers were also boosted (to 125) by an influx of birds in January.

Apart from the above mentioned species, numbers were generally lower than usual with Teal and Redshank being particularly disappointing – numbers of both species being well down on those required for levels of national importance.

4. Discussion

The continuing mild winters are almost certainly responsible for the decrease in numbers of birds of various species in the Cleddau Estuary complex. Levels of national and international importance are periodically revised according to fluctuations in the number of each species counted each winter. For most species the number has been increased, hence only two species reached the criteria this winter. This should not be taken as an indication that the Cleddau is of decreasing importance, however. A period of cold weather in January or February will almost certainly boost the numbers of birds wintering on the Cleddau system, as happened in 1986/87. The influx of Lapwing in late January coincided with the period of extensive flooding of their grassland feeding grounds in the Netherlands, Belgium and France and may well have been the result of birds being forced to move west during this period. Numbers of Mute Swans on the estuary declined drastically after an oiling incident in 1990/91, but have now returned to their normal level.

An oiling incident occurred in Milford Docks in early March 1995. However, many birds had left the estuary by then, and of those that remained, there were no reports of any being affected by oil.

Annie Poole & Richard Ellis
WeBS Co-ordinators for the Cleddau Estuary
Pembrokeshire Ornithological Research Committee
Dyfed Wildlife Trust
April 1995

Daugleddau Estuary & Milford Haven Waterway

ANNUAL SHELDUCK CENSUS - 1994

1. Introduction and methods

The Daugleddau Estuary and Milford Haven Waterway hold nationally important numbers of shelducks during the winter months, and a small but significant summer breeding population. The number of breeding shelducks have been assessed at various times during the 1960's and 1970's, and full surveys have been carried out on an annual basis since 1991. Since 1993, the annual summer shelduck census has been included in the rolling programme of research and monitoring devised by the Milford Haven Waterway Environmental Monitoring Steering Group (MHWEMSG). The survey was repeated in 1994 by National Park staff using the water ranger's small rigid hulled inflatable boat. Field work was carried out in June and August during which the following information was collected:-

- location of pairs with broods;
- numbers of ducklings in each brood;
- other shelducks;
- high tide roosts;
- numbers and distribution of other birds.

As in previous years, the survey was carried out in two phases, in June and early August. All major pills, tributaries and embayments were surveyed from the boat on high spring tides.

2. Results

Shelducks

In June 1994, 9 pairs of shelducks with broods were located, on the Western Cleddau (2), Eastern Cleddau (2), Carew River (2), Pembroke River (2) and in Angle Bay (1). Generally, the broods were smaller than in previous years, and the Angle Bay brood comprised one solitary duckling. A total of 107 non-breeding shelducks were present in June, the majority of which were found on the Eastern and Western Cleddau.

In early August, there were very few shelducks left - 2 pairs (with their broods) and a single adult on its own. No creches were found, and the majority of the year's young had flown, along with the adults.

Other water birds

During the first phase of the survey, a total of 722 waders and ducks (other than shelducks) were counted, representing nine species. This total included 319 curlew, 127 Canada geese (the resident population of Little Milford on the Western Cleddau) and 118 mallard. By early August, numbers of waders and wildfowl had increased to 3,133; 1,744 of which were curlew. Many of the curlews were almost certainly migrating south for the winter, and were using the estuary system as a "stop-over" (for resting and feeding).

Other passage migrants included small numbers of whimbrel. The majority of the 2,811 waders present were counted at high tide roosts (fringing salt marsh, shingle and selected fields immediately adjacent to the foreshore) on the Western Cleddau, Eastern Cleddau, Carew, Cresswell and Pembroke rivers, and in Angle Bay.

3. Discussion of results

The results of the 1994 summer shelduck census were again disappointing with fewer and smaller broods than in 1993 (which itself was poorer than 1992). No late broods appeared after June. There were several factors that may account for the relatively poor breeding success, including cold, wet weather during April and May (critical months for egg-laying and incubation). Predation by ground predators and disturbance can lead to chilling of eggs, or allow predators to achieve their objectives. Competition for suitable nest sites (which may be in short supply) is a further possible contributory factor.

4. Future Monitoring

The census will be repeated in 1995, as part of the annual monitoring programme drawn up by the MHWEMSG.

A detailed account of the 1994 census is contained in an unpublished report to the MHWEMSG and the Dyfed Wildlife Trust's Pembrokeshire Ornithological Research Committee.

**Jane Hodges,
Pembrokeshire Coast National Park
April 1995**

Milford Haven Waterway and Daugleddau Estuary

MONITORING OF EEL GRASS POPULATIONS

1. Introduction and methods

The Milford Haven Waterway and Daugleddau Estuary support significant populations of eel grass, Zostera angustifolia, a nationally scarce species of flowering plant. In the 1970's and early 1980's, the plant was recorded at several locations, including Angle Bay and Pembroke River and Sandy Haven, where it grows on muddy/sandy sediments on the foreshore. The populations in Angle Bay and Pembroke River in particular were large. However, the eel grass has not been subject to recent monitoring. In view of the significance of the populations in the Milford Haven Waterway and Daugleddau Estuary, re-survey and subsequent monitoring of known populations has been included in the rolling programme of research and monitoring administered by the Milford Haven Waterway Environmental Monitoring Steering Group (MHWEMSG).

As a first step, all previously known stations for Zostera angustifolia were revisited in the summer of 1994. The approximate locations and coverage by the plant were plotted onto 1:10,000 scale maps and numbers of plants were estimated. Lists of associated species were made for each station.

2. Results

Attempts were made to re-locate and assess eel grass populations in Angle Bay, Pwllcrochan Flats, Sandy Haven, Pembroke River and Garron Pill. Extremely healthy and extensive populations were found on the south side of Pembroke River and in Angle Bay (east side, between Sawdern and the old BP tank farm). No eel grass was found at Sandy Haven, Garron Pill, or on Pwllcrochan Flats.

The Angle Bay and Pembroke River populations comprise 100,000's of mature plants and 1000's of seedlings covering large areas of the foreshore below Extreme High Water Mark. The substrates on which the eel grass was growing ranged from firm mud with fine sand to very sloppy mud. In Angle Bay, craters left by bait-diggers were common within the eel grass beds. Bait digging appeared to cause localised damage to the eel grass beds.

The failure to re-locate eel grass at three of its five previously known stations suggests it has disappeared from these sites for reasons unknown. However, it may well be under recorded elsewhere within the estuary system.

3. Future Monitoring

In view of the significance of the eel grass population in the estuary system and of its apparent disappearance from three former locations, further monitoring is recommended. The following aspects in particular should be covered:-

- continued monitoring of the existing populations in Angle Bay and Pembroke River:
- survey of other embayments and tributaries where there appears to be suitable habitats to establish the current distribution of eel grass in the estuary as a whole:
- occurrence/distribution below Mean Low Water Mark.

In addition to monitoring Zostera angustifolia, it is recommended that the distribution and status of Zostera marina in the Milford Haven Waterway be reassessed. This closely related species is entirely sub-tidal, and a diving survey would be required.

The 1994 survey of Zostera angustifolia is described in detail in an unpublished report to the MHWEMSG.

Mike Howe
Pembrokeshire Coast National Park
April 1995

FINANCIAL SUMMARY

The statement below reflects the financial status of the Milford Haven Waterway Environmental Monitoring Steering Group (MHWEMSG). The figures for commitments have been rounded up to the nearest thousand pounds as exact figures will not be available until invoices are submitted.

Brought forward from 1993/4	£40,901 – 89	
Contributions 1994/5	£41,500 – 00	
Other income	£46 – 50	
	<hr/>	
Total credit	£82,448 – 39	£82,448 – 39
	<hr/>	
Payments 1994/5	£22,411 – 62	
Commitments (see programme)		
Item 3		
FSC, Water Quality data review 1993 & 1994	£1,000 – 00	
Item 3		
NRA, Water Quality analysis 1994/1995	£11,000 – 00	
Items 4(ii) & 5(iii)		
Hydrocarbon analysis	£10,000 – 00	
Item 5(i)		
Subsea Survey balance 1994/1995	£11,000 – 00	
Item 5(ii)		
Sediment metals analysis 1994/1995	£5,000 – 00	
Item 9		
PORC, Wildfowl & waders 1995	£1,000 – 00	
Item 13(i)		
Rocky shore monitoring 1995	£20,000 – 00	
	<hr/>	
Total debit	£81,411 – 62	£81,411 – 62
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Account balance 1994/5		£1,036 – 77
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The Project Sub-Group of MHWEMSG has proposed that the following new work should be initiated in the year 1995/1996 and has submitted the following estimates of cost.

Proposed commitments (see programme)

Item 1		
	Database maintenance	£1,000 - 00
Item 2		
	Administrative support	£2,000 - 00
Item 3		
	Water quality monitoring	£16,000 - 00
Item 10(i)		
	Water quality contaminant sourcing	£5,000 - 00
Item 13(ii)		
	Rocky seabed survey	£12,000 - 00
		<hr/>
Total		£36,000 - 00
		<hr/>

Contributors to the work of the Group will be requested to make their payments before mid-year 1995 to ensure the exact sum of money which can be spent on programmed work is known thus allowing stringent financial control during the transition period when the administration of the Group will move from Dyfed to the new Pembrokeshire Unitary Council on 1st April 1996.


REVISED WORK PROGRAMME


The Milford Haven Waterway Environmental Monitoring Steering Group have felt it necessary to revise the programme of work based on the knowledge and experience gained since the Group's inception. The results of the amendments are found on the following page.

**MILFORD HAVEN WATERWAY ENVIRONMENTAL MONITORING STEERING GROUP
- PROGRAMME OF WORK (update of appendix 2 to December 1992 report)**

ACTIONS		PRIORITY	COST £ 000's	1995	1996	1997	1998	1999	2000	FUTURE
1	Database maintenance.	1	1	████████	████████	████████	████████	████████	████████	
2	Administrative support.	1	2	████████	████████	████████	████████	████████	████████	
3	Water quality monitoring.	1	16	████████	████████	████████	████████	████████	████████	
4	Seabed sediments. i) biology (5 year repeat at selected sites). ii) hydrocarbon analysis.	1	4				██████	██████		
		1		████████				██████	██████	
5	Inter tidal sediments. i) biology (5 year repeat at selected sites). ii) metals analysis. iii) hydrocarbon analysis.	1	20	██████						
		1		5	██████					
		1		6	██████					██████
6	Sediment "Hotspots" (priorities to be decided from 4 and 5 above).	1			██████	██████				
7	Suspended sediment analysis (linked to 6 above).	2				██████	██████			
8	Sediment sinks (linked to 5 above, done with 7).	2				██████	██████			
9	Wildfowl and Wader populations (PORC). i) Wintering ii) Breeding Shelduck Census (PCNP).	1	1	████████	████████	████████	████████	████████	████████	████████
		1								
10	Contaminant sourcing. i) Water quality input budgets. ii) linked to results of 6.	1	5	████████	████████					
		2				██████	██████			
11	Use of Skomer as "reference".	1		████████	████████	████████	████████	████████	████████	████████
12	GIS system development.	2					██████	██████		
13	Rocky shore and seabed monitoring. i) Inter tidal survey. ii) Seabed survey.	1	20	██████						
		1		12	██████					
14	Salt marsh monitoring.	2					██████	██████		
15	Eel Grass beds (review following PCNP report).	2			██████	██████				
16	Post-spill impact surveys (ad-hoc).	2								
17	TBT contamination.	2			██████	██████				
18	Bioaccumulation.	2			██████	██████				
19	Dredging impacts on sediment transport (MAFF - MHWEMSG to assist).	2								
20	Recreation use survey.	3								
21	Bait digging / changes in community structure (linked to results of 5 i) and 15).	2			██████	██████				
22	Inter tidal terrestrial invertebrates.	3								

KEY


 Costs of 1995/1996 work only


 Possible / suggested period for work in future years given current priorities.