

# **Inlets in the Bristol Channel and approaches**

**Area summaries**

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**1998**

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# Coasts and seas of the United Kingdom

## Marine Nature Conservation Review series

### Area summaries

#### Preface

The *Marine Nature Conservation Review* (MNCR) was initiated by the Nature Conservancy Council in 1987 as the third major resource survey, following the *Nature Conservation Review* and the *Geological Conservation Review*. Since April 1991, the MNCR has been undertaken within the Support Unit of the Joint Nature Conservation Committee. The JNCC is a forum through which the three country agencies, the Countryside Council for Wales, English Nature and Scottish Natural Heritage, deliver their special statutory responsibilities for Great Britain as a whole and internationally. These special responsibilities, known as special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems.

The MNCR is drawing together information on marine ecosystems around Great Britain with the objectives of:

- extending our knowledge of benthic marine habitats, communities and species in Great Britain, particularly through description of their characteristics, distribution and extent; and
- identifying sites of nature conservation importance.

The data collected also provide information to support more general measures to minimise adverse effects of development and pollution, particularly on sites and species of nature conservation importance.

The area included in the MNCR is the coastline of England, Scotland and Wales (excluding the Isle of Man and the Channel Isles), extending on the shore from the lower limit of terrestrial flowering plants and within marine inlets from the limit of marine influence out to the limit of British territorial seas. Saline lagoons are also included. The MNCR included a major field survey programme of the shores and near-shore subtidal zone, undertaken to standard methodology.

MNCR studies have been undertaken within particular coastal sectors around Britain (see map overleaf) or of major physiographic types, such as lagoons and sealochs. These studies are being presented, in the *Coasts and seas of the United Kingdom - MNCR series*, as *area summaries*, each of which provides an account of a discrete stretch of open coast, a marine inlet or a lagoon within the area of study. A list of *area summary* volumes and other major publications from the MNCR is given overleaf.

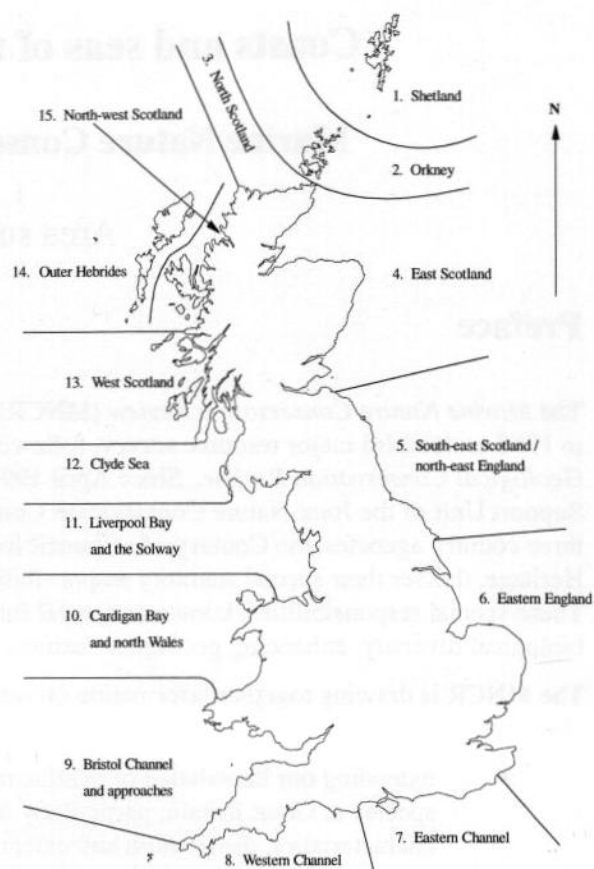
A full list of MNCR and other JNCC marine reports is available from the Marine Information Officer, JNCC. JNCC publications can be purchased from NHBS Ltd, 2-3 Wills Road, Totnes, Devon, TQ9 5XN (tel. 01803 865913; fax. 01803 865280; e-mail nhbs@nhbs.co.uk). JNCC reports are available directly from JNCC (tel. 01733 562626; fax 01733 555948).

David Connor

Joint Nature Conservation Committee

## Publications in the MNCR series

MNCR coastal sectors, as used in the *Coasts and seas of the United Kingdom - MNCR series*.



Volumes published or near publication:

| Sector                        | Title  | Authors                                | Date     |
|-------------------------------|--|--|----------|
| <i>Foundation volumes</i>     |  |  |          |
| 1-15                          | Rationale and methods  | Hiscock, <i>ed.</i>                    | 1996     |
| 1-15                          | Benthic marine ecosystems of Great Britain and the north-east Atlantic   | Hiscock, <i>ed.</i>                    | 1998     |
| <i>Biotope classification</i> |  |  |          |
| 1-15                          | Marine biotope classification for Britain and Ireland.<br>Volume 1. Littoral biotopes ( <i>JNCC Report</i> , No. 229)    | Connor, Brazier, Hill & Northen        | 1997     |
| 1-15                          | Marine biotope classification for Britain and Ireland.<br>Volume 2. Sublittoral biotopes ( <i>JNCC Report</i> , No. 230) | Connor, Dalkin, Hill, Holt & Sanderson | 1997     |
| <i>Area summaries</i>         |  |  |          |
| 1                             | Shetland   | Howson                                 | Due 1998 |
| 1-2                           | Lagoons in Shetland and Orkney   | Thorpe                                 | 1998     |
| 2                             | Orkney   | Murray, Dalkin, Fortune & Begg         | Due 1998 |
| 3, 4, 12, 13, 15              | Lagoons in mainland Scotland and the Inner Hebrides  | Covey, Fortune, Nichols & Thorpe       | 1998     |
| 5                             | South-east Scotland and north-east England   | Brazier, Davies, Holt & Murray         | 1998     |
| 6                             | Inlets in eastern England  | Hill, Emblow & Northen                 | 1996     |
| 8                             | Inlets in the western English Channel  | Moore, Smith & Northen                 | Due 1998 |
| 9                             | Inlets in the Bristol Channel and approaches   | Moore, Smith, Northen & Little         | 1998     |
| 10                            | Cardigan Bay and north Wales   | Brazier, Holt, Murray & Nichols        | Due 1998 |
| 11                            | Liverpool Bay and the Solway Firth   | Covey                                  | 1998     |
| 12                            | Sealochs in the Clyde Sea  | Dipper & Beaver                        | Due 1998 |
| 14                            | Lagoons in the Outer Hebrides  | Thorpe, Dalkin, Fortune & Nichols      | Due 1998 |

Other volumes in the series are also in preparation.

# Marine Nature Conservation Review

## Sector 9

### Inlets in the Bristol Channel and approaches

#### Area summaries

#### Synopsis

The habitats and communities of the marine inlets of south-west Britain are considered to have many physiographic and ecological similarities and have been the subject of various surveys, primarily the Harbours, Rias and Estuaries (HRE) programme commissioned by the then Nature Conservancy Council. The HRE surveys were carried out by the Field Studies Council Oil Pollution Research Unit (OPRU) between 1985 and 1989 and covered all of the major and most of the minor inlets between Portsmouth and Milford Haven.

This report contains a summary of information on fourteen marine inlets, from the River Hayle in Cornwall northwards to Milford Haven in Pembrokeshire. The data from the HRE surveys, together with data from a variety of other sources, have been analysed to classify the marine biotopes present and to describe their distribution within each inlet.

The information is presented here as fourteen *area summaries*:

1. River Hayle
2. The Gannel
3. River Camel
4. Rivers Taw and Torridge
5. River Parrett
6. River Avon (Bristol)
7. Severn estuary
8. River Wye
9. River Usk
10. River Neath
11. River Tawe
12. Burry Inlet (River Loughor)
13. Rivers Taf, Tywi and Gwendraeth
14. Milford Haven and the Cleddau

Each area is described in a standard format, giving details of its physical and biological character, the biotopes present and their distribution, current nature conservation designations, the main human influences and relevant literature. The areas surveyed and the marine biotope information are also presented in a series of maps. These *area summaries* are supported by a summary of the biotopes defined for the region (from Connor *et al.* 1997a, b) and by a list of species recorded from the surveys.

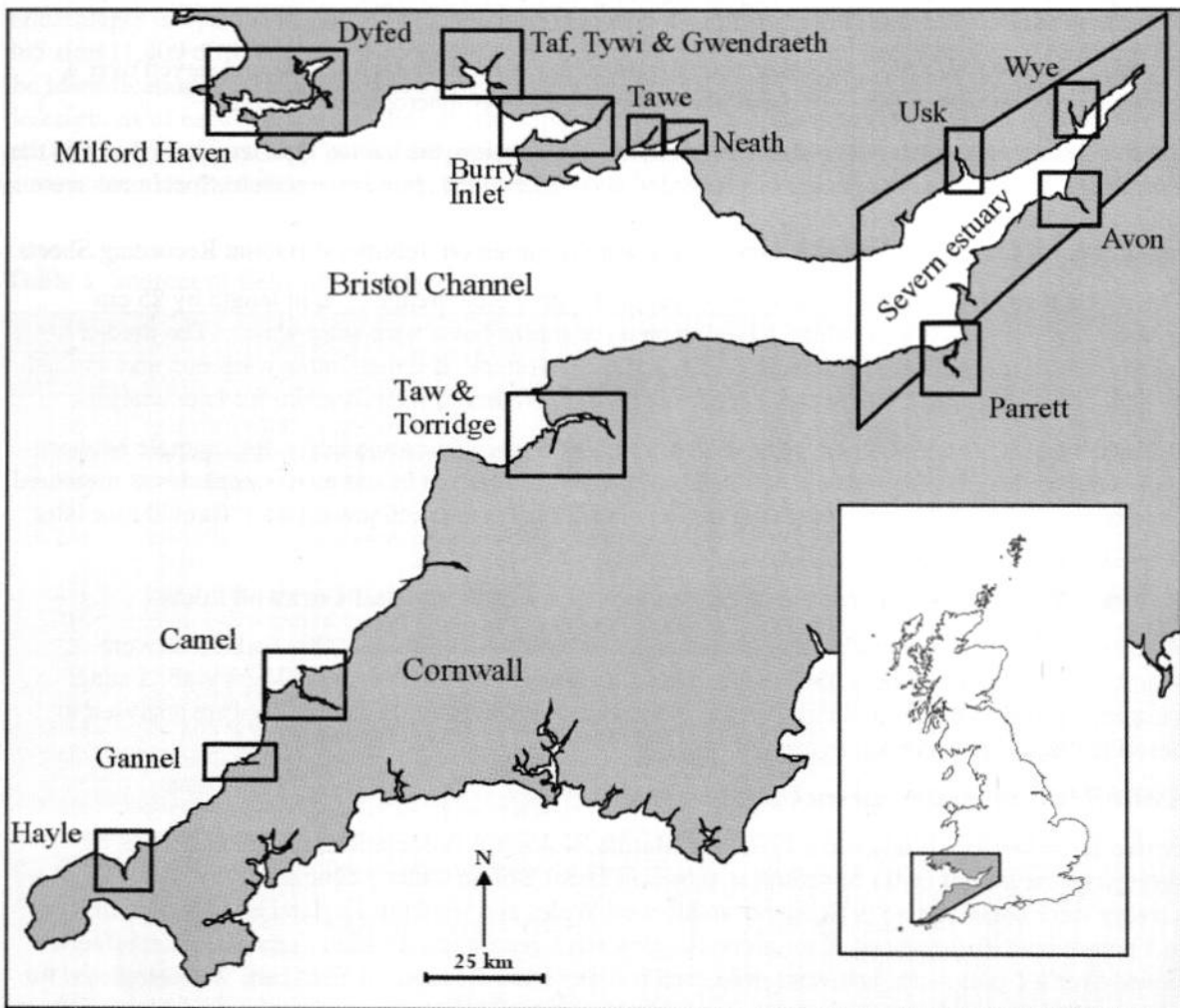
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- Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F., & Sanderson, W.G. 1997b. Marine Nature Conservation Review: marine biotope classification for Britain and Ireland. Volume 2. Sublittoral biotopes. Version 97.06. *JNCC Report*, No. 230.

## Introduction

### Background

MNCR Sector 9 extends from Cape Cornwall to Newport Bay. Fourteen marine inlets occur along this stretch of coast (see Figure 1) and these have been the subject of various surveys to describe their marine habitats and communities (together referred to as biotopes). The inlets are considered to have many physiographic and ecological similarities and a diverse range of habitats and communities are represented in them. An analysis of the available data from these inlets has been undertaken as part of the Marine Nature Conservation Review (MNCR) programme, to describe the biotopes present and their distribution within each inlet.



**Figure 1** Location of the 14 reporting areas (area summaries) in MNCR Sector 9.  
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## Data collection and the classification of biotopes

### The Harbours, Rias and Estuaries (HRE) Programme

This study, which covered all of the major and most of the minor inlets between Portsmouth and Milford Haven, was carried out between 1985 and 1989. It was commissioned by the Nature Conservancy Council (NCC) and undertaken by the Field Studies Council's Oil Pollution Research Unit (now OPRU). A series of 21 reports were produced, each comprising both a review of available information on the marine environment of the inlets and the results of descriptive fieldwork. Hard substrata and soft substrata, both in the intertidal and the subtidal (in most inlets), were surveyed using a variety of techniques based on those that had been developed for use in previous NCC surveys. Most of these techniques were the forerunners of the current MNCR methodology (Connor & Hiscock 1996).

On most shores there was a systematic description of the abundance of species in the main habitats/communities present at different heights on the open shore. Records were also made from habitats such as overhangs, gullies, rockpools and underboulders.

Intertidal sediment sampling involved four x 0.01 m<sup>2</sup> cores taken at each station and sieved over a 1 mm (or occasionally a 0.5 mm) mesh and preserved for later macrofaunal analysis.

Subtidal areas were surveyed by diving. At each survey station, the habitat type was described and the abundance of conspicuous species was recorded according to the abundance scales. Specimens were collected where necessary for species identification. Site location information, substratum type, topographical features and other habitat details were recorded on Sublittoral Habitat Recording Sheets.

The subtidal sediments in most inlets were sampled with a pipe dredge (1 m in length by 25 cm diameter) which was towed behind a fishing boat (or similar) on a wire warp winch. The dredge contents were tipped into a 30 litre skip to measure the volume, and then into a wash box and washed through a 1 mm sieve. Contents of the sieve were then preserved with formalin for later analysis.

A diver-operated suction sampler was used to sample sediments in some inlets, for example between rock outcrops and in seagrass or maerl beds. The area and volume of sediment sampled was measured approximately and the sample was later sieved over a 1 mm mesh and preserved in formalin for later analysis.

### National Rivers Authority (South West) surveys of south Devon and Cornwall inlets

A series of surveys were undertaken in sixteen inlets between 1990 and 1996. Sediments were sampled in the intertidal by 0.01 m<sup>2</sup> cores and in the subtidal by a 0.05 m<sup>2</sup> van Veen grab. Faunal samples were sieved over a 0.5 mm mesh. The available data from these surveys were analysed to describe the biotopes present in each of the inlets.

### SMBA/MBA Intertidal Survey Unit surveys

Between the late 1970s and early 1980s the Marine Biological Association undertook a series of surveys of the littoral zones of sediment shores of Great Britain under a contract to the NCC. The surveys were concentrated in Scotland, south-west Wales and southern England and were carried out in a non-quantitative manner. Conspicuous fauna were generally identified in the field and infauna, sieved over a 1 mm mesh, and were preserved for later identification. A field card was completed for each area, giving various physical details such as dominant sediment type, wave exposure, conspicuous marks (burrows, etc.) and shore morphology.

### A survey of the Lower Torridge by Tegwyn Harris

No information is available on the methods used during this survey. Records on the MNCR database provide qualitative data on species of epibiota found at sites throughout the lower Torridge estuary.



## Severn Tidal Power Group

Sampling of the Severn estuary and Bristol Channel was undertaken using a weighted Day grab (0.1 m<sup>2</sup> sample size) between April and May 1988 (Mettam *et al.* 1994). The Severn Tidal Power Group financed the survey to obtain more information on the benthic communities in the area for use in plans to construct a tidal barrage across the Severn estuary. Stations were sampled at 1.5 km intervals across a grid, where the substratum allowed. Although hard substrata is known to occur in the lower Severn estuary, due to the sampling technique of using a grab, hard substrata communities are not represented in the data.

### Data analysis

The species data from the HRE and other surveys (listed in Table 1) were analysed, in conjunction with their associated habitat data, to identify which biotopes, as defined in the MNCR national biotope classification (Connor *et al.* 1997a, b), were present in the dataset. Multivariate analytical techniques, including TWINSpan and DECORANA, were employed to facilitate the identification of distinct assemblages of species within the dataset, using the procedures given in Mills (1994). Data from 805 sites (1,409 different habitat records) from MNCR Sector 9 were used in the analyses, resulting in the identification of 148 biotopes or sub-biotopes from the national classification (Appendix A). Full descriptions of each biotope and the general approach to biotope classification are given in Connor *et al.* (1997a, b). Appendix B shows the presence of biotopes in each area. Species recorded from the surveys listed in Table 1 are given in Appendix C.

**Table 1** Sources of field survey information.

| MNCR<br>database<br>survey no. | Survey   | Source                       | No.<br>of<br>sites | No. of<br>habitats<br>surveyed |
|--------------------------------|--|------------------------------|--------------------|--------------------------------|
| 78                             | 1978-79 SWBSS of Milford Haven   | Hiscock (1981)               | 41                 | 61                             |
| 196                            | 1985 upper Severn Estuary survey   | Little <i>et al.</i> (1985)  | 8                  | 21                             |
| 246                            | 1985 HRE survey of Milford Haven and the Cleddau   | Little & Hiscock (1987)      | 39                 | 156                            |
| 255                            | 1988 HRE survey of the Camel estuary   | Gill & Mercer (1989)         | 36                 | 66                             |
| 256                            | 1988 HRE survey of Loughor estuary incorporating the Burry Inlet                           | Moore (1989)                 | 26                 | 54                             |
| 257                            | 1988 HRE survey of the Hayle estuary   | Gill (1989)                  | 9                  | 19                             |
| 258                            | 1988 HRE survey of the Taf, Tywi and Gwendraeth estuaries                                  | Mercer (1989)                | 21                 | 53                             |
| 259                            | 1988 HRE survey of the Taw and Torridge estuaries  | Little (1989)                | 42                 | 72                             |
| 265                            | 1970-1980 SMBA/MBA Great Britain intertidal survey   | Powell <i>et al.</i> (1978)  | 12                 | 12                             |
| 460                            | 1988 STPG Severn estuary sublittoral survey  | Mettam <i>et al.</i> (1994)  | 261                | 247                            |
| 486                            | 1977-78 WWA Usk and Wye estuaries sublittoral survey                                       | Wharfe <i>et al.</i> (1979)  | 30                 | 31                             |
| 487                            | 1973-76 north shore of the Bristol Channel and Severn estuary littoral survey              | Roberts (1976)               | 7                  | 7                              |
| 488                            | 1973-75 southern shore of the Severn estuary littoral infaunal survey                      | Little & Boyden (1976)       | 4                  | 46                             |
| 489                            | 1987 University of Bristol sub-estuaries of the River Severn survey                        | Morrisey & Sait (1988)       | 17                 | 88                             |
| 490                            | 1975-1978 Severn estuary rocky shore survey  | Little & Smith (1980)        | 3                  | 15                             |
| 491                            | 1982 WWA sewer outfalls in the Severn estuary near Cardiff survey                          | Welsh Water Authority (1984) | 3                  | 66                             |
| 492                            | 1980 WWA benthic macrofauna between the Severn Bridge and Cardiff survey                   | Davies & Jones (1982)        | 51                 | 51                             |
| 493                            | 1993 WWA industrial waste discharge pipe in the River Usk (Severn estuary) littoral survey | Davies & Wade (1985)         | 1                  | 14                             |
| 494                            | 1993 WWA industrial waste discharge pipe in the Severn estuary littoral survey             | Jones & Jones (1983)         | 1                  | 5                              |
| 495                            | 1973 infauna on the south coast of the Severn estuary littoral survey                      | Boyden & Little (1973)       | 17                 | 17                             |
| 609                            | 1984-85 lower Torridge estuary littoral survey   | T. Harris (unpublished data) | 13                 | 13                             |
| 623                            | 1991 NRA South Western Region Gannel estuary littoral survey                               | NRA (unpublished data)       | 5                  | 5                              |

| MNCR database survey no. | Survey   | Source                    | No. of sites | No. of habitats surveyed |
|--------------------------|--|---------------------------|--------------|--------------------------|
| 657                      | 1993 OPRU Milford Haven survey                                 | OPRU (unpublished data)   | 36           | 36                       |
| 659                      | 1989 FSCRC Dauceddau Estuary (Milford Haven) littoral survey   | Hern (1989)               | 31           | 31                       |
| 669                      | 1995 OPRU Milford Haven rocky shore littoral monitoring survey | OPRU (unpublished data)   | 31           | 141                      |
| 671                      | 1988 OPRU Cosheston Trot (Milford Haven) sublittoral survey    | OPRU (unpublished data)   | 1            | 2                        |
| 685                      | 1997 MNCR Severn estuary littoral rock survey                  | MNCR (unpublished data)   | 6            | 20                       |
| 721                      | 1990 Holm sands (Severn estuary) sublittoral survey            | Mettam (unpublished data) | 14           | 7                        |
| 722                      | 1995 Severn estuary sublittoral survey                         | Mettam (unpublished data) | 13           | 25                       |
| 760                      | 1997 AES River Parrett (Severn estuary) survey                 | AES (1997)                | 18           | 18                       |
| <b>Total</b>             |  |                           | <b>805</b>   | <b>1,409</b>             |

Abbreviations: AES = Analytical & Environmental Services; FSCRC = Field Studies Council Research Centre; HRE = surveys of Harbours, Rias & Estuaries; MNCR = Marine Nature Conservation Review (JNCC); NRA = National Rivers Authority; OPRU = Oil Pollution Research Unit; SMBA/MBA = Scottish Marine Biological Association & Marine Biological Association Intertidal Survey Unit; STPG = Severn Tidal Power Group; SWBSS = South-west Britain sublittoral survey (by OPRU); WWA = Welsh Water Authority.

### Area summaries and their format

Fourteen marine inlets occur along the coast of MNCR Sector 9 (Figure 1) and each has been described in the standard MNCR *area summary* format. The fourteen areas described are:

1. River Hayle
2. The Gannel
3. River Camel
4. Rivers Taw and Torridge
5. River Parrett
6. River Avon (Bristol)
7. Severn estuary
8. River Wye
9. River Usk
10. River Neath
11. River Tawe
12. Burry Inlet (River Loughor)
13. Rivers Taf, Tywi and Gwendraeth
14. Milford Haven and the Cleddau

Each *area summary* contains the following sections:

#### Location

The geographic location is given as the central latitude/longitude position and Ordnance Survey grid reference, together with the local government administrative area and the relevant nature conservation agency (Countryside Council for Wales or English Nature), its region and local area office. A location map shows the main features of the area, key place names and the limit of the area considered by the *area summary*. The sites surveyed are shown according to four main types of survey: recording on littoral (▲) or sublittoral (●) rock/hard substrata and sampling in littoral (Δ) or sublittoral (○) sediment habitats.

#### Marine biological surveys

Marine biological surveys of the shores and sublittoral zone which have been used in compiling the *area summary* are listed to include the survey type (littoral/sublittoral), survey method, date of survey and reference source. The distribution of survey sites is shown on the location map and sites are listed at the end of each *area summary*.

#### Introduction

This section describes the overall physical characteristics of the area and any significant human influences and activities. Water quality information is from Buck (1993).

### Physical features

A summary of the main physical features includes: the type of physiographic feature as defined in Connor & Hiscock (1996) or, for estuary types, in Davidson *et al.* (1991); the area of the inlet, taken from Buck (1993); the length of the inlet measured from the relevant 1:50,000 Ordnance Survey (Landranger series) map or Admiralty chart, taken from the mouth of the inlet to the limit of tidal influence; the bathymetry, summarised from Admiralty charts; wave exposure and tidal streams taken from Admiralty charts and field observations, as defined in Connor & Hiscock (1996); tidal range figures are for maximum spring tidal range, quoted for the nearest secondary port, and taken from Buck (1993); and the salinity is either as estimated at the time of survey or as given in available literature; categories as in Connor & Hiscock (1996).

### Marine biology

The biological nature of the area is described with reference to the biotopes present and their distribution within each area, based on the findings of the surveys listed. The heights and depths noted in the text are corrected to chart datum. The biotope codes given in parentheses are from the MNCR national classification, as listed in Appendix A and a summary of the biotopes present within each area is presented in Appendix B. Species nomenclature follows Howson & Picton (1997); that for lichens follows Purvis *et al.* (1992) and that for higher plants follows Stace (1991).

A map illustrates the distribution of the main biotopes within the area. **NOTE:** This map gives an indication of the *likely* distribution and extent of biotopes, based on the data available, including sketch maps of biotope distribution made at the time of survey, cited literature and information on Admiralty charts. In some areas data are sparse and additional data or more comprehensive survey would enable more accurate maps to be drawn.

### Nature conservation

A summary of statutory and non-statutory wildlife and landscape conservation designations for the marine and coastal parts of the area is shown (from Barne *et al.* 1996) where further information on each designation can be found.

Key to site designations in Sector 9:

|           |   |
|-----------|---|
| AONB      | Area of Outstanding Natural Beauty                |
| AoSP      | Area of Special Protection                        |
| Biosphere | Biosphere reserve                                 |
| HC        | Heritage Coast                                    |
| LNR       | Local Nature Reserve                              |
| NNR       | National Nature Reserve                           |
| NP        | National Park                                     |
| NT        | National Trust                                    |
| Ramsar    | Ramsar site                                       |
| RSPB      | Royal Society for the Protection of Birds reserve |
| cSAC/pSAC | candidate/possible Special Area of Conservation   |
| SMA       | Sensitive Marine Area                             |
| SPA       | Special Protection Area                           |
| SSSI      | Site of Special Scientific Interest               |
| WT        | County Wildlife Trust                             |
| WWT       | Wildfowl and Wetlands Trust reserve               |

### Human influences

This section describes the main uses and activities of the area, including urbanisation, industrial or commercial activities that have (or potentially have) an impact within the area

described. These may include sewage discharges, industrial effluents, development, dredging, spoil dumping, commercial fishing, recreation and shipping.

### References and further reading

This lists cited references and other relevant literature.

### Sites surveyed

This provides a listing of the sites surveyed within the area (from those surveys listed in Table 1) with information on the location of each site (OS grid reference and latitude/longitude), the date of survey and an inventory of the biotopes known to be present at the time of survey.

## Acknowledgements

Chris Mettam supplied much of the data for the Severn estuary. Anita Barnard at OPRU helped in the preparation of the area summaries.

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1

River Hayle

Location

|                          |                |                  |
|--------------------------|----------------|------------------|
| Position (centre)        | SW 550 380     | 50°11'N 05°26'W  |
| Administrative areas     | Cornwall       | Penwith          |
| Conservation agency/area | English Nature | Devon & Cornwall |

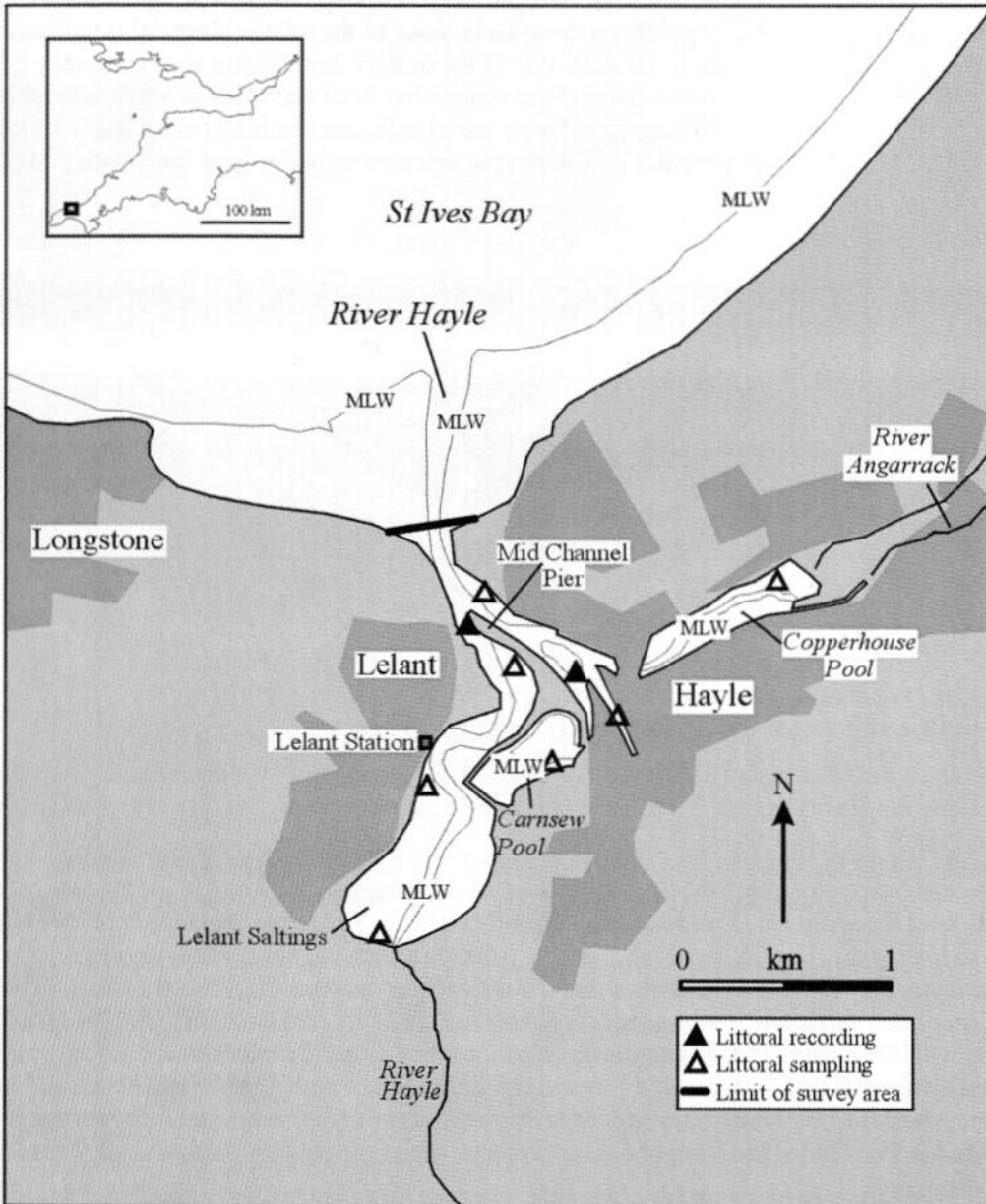


Figure 1.1 Main features of the area and sites surveyed.

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| Marine biological surveys |   |                |             |
|---------------------------|---|----------------|-------------|
|                           | Survey method                             | Date of survey | Source      |
| Littoral                  | Recording                                 | June 1988      | Gill (1989) |
|                           | Core sampling (0.01 m <sup>2</sup> cores) | June 1988      | Gill (1989) |

## Introduction

The Hayle is the most south-westerly inlet in Britain, lying on the north coast of Cornwall. It is formed from the infilled valleys of the Hayle and Angarrack Rivers and opens out into St Ives Bay. The inner estuary has been much altered by man and there is a deep reservoir at Carnsew and a storage reservoir at Copperhouse Pool. Apart from these areas, most of the inlet is intertidal (mudflats) with some saltmarsh in the inner reaches. On each side of the estuary mouth there are long, sandy beaches backed by dune systems. The water quality of the estuary has been classified as grade A (highest quality) although the inlet is recovering from heavy metal pollution resulting from mining activities. The Hayle has been a port since mediaeval times, although port activities have declined in recent years.

| Physical features   |                                 |
|---------------------|---------------------------------|
| Physiographic type  | Ria                             |
| Length of coast     | 11.5 km                         |
| Area of inlet       | 110 ha                          |
| Length of inlet     | 2 km                            |
| Bathymetry          | Shallow; dries at low tide      |
| Wave exposure range | Very sheltered                  |
| Tidal stream range  | Very weak                       |
| Tidal range         | 5.0 m                           |
| Salinity range      | Fully marine to upper estuarine |

## Marine biology

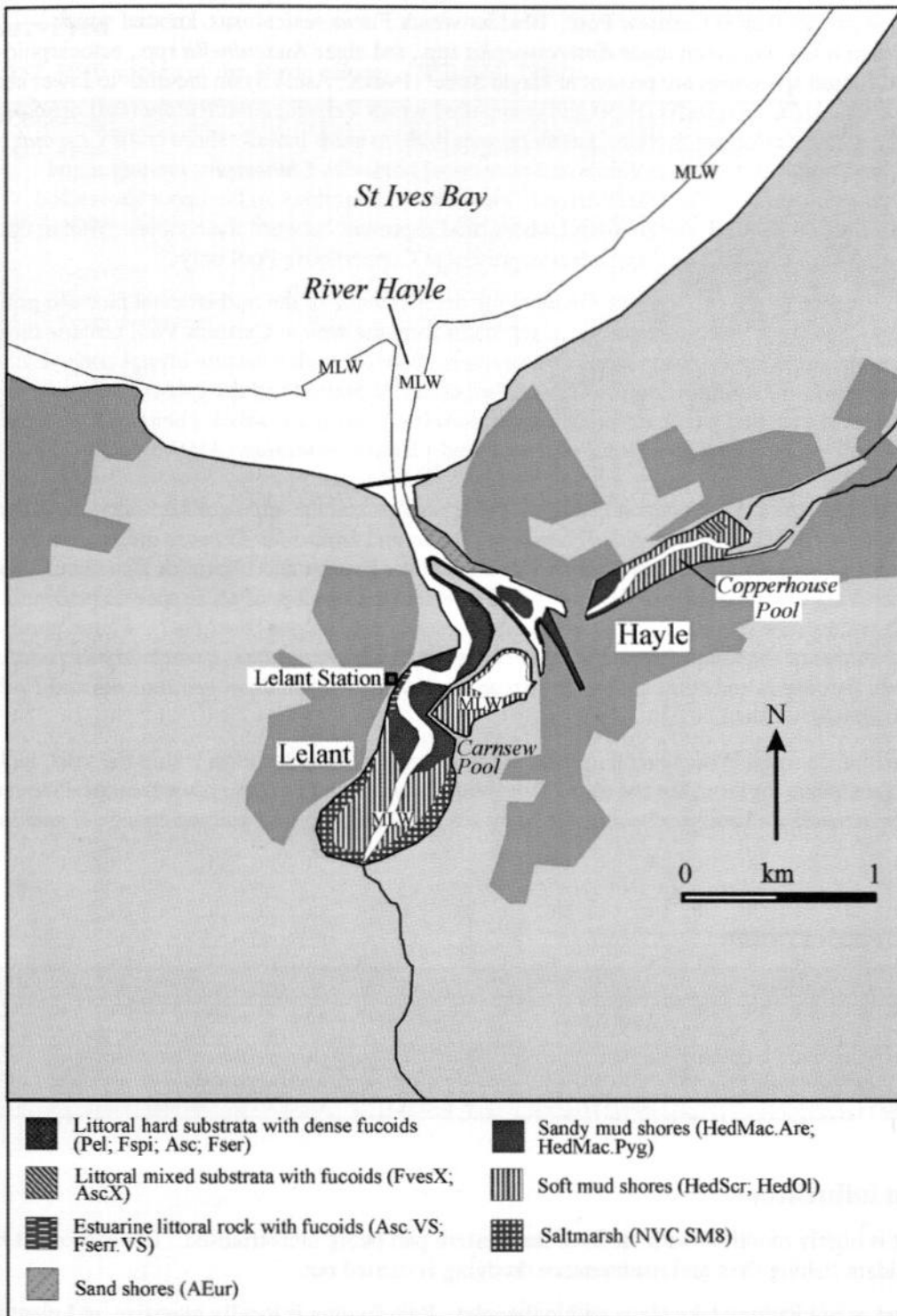
Two broad substrata have been identified from the River Hayle: the intertidal sediments; and the artificial walls and structures, and stones overlying finer sediments.

At the mouth of the inlet, sandy beaches and a sand bar support an impoverished fauna comprising predominantly the spionid worm *Pygospio elegans*, with occasional isopods *Eurydice pulchra* and oligochaetes (AEur).

Within the inlet, there are intertidal flats at the head of Copperhouse Pool and at Lelant Station; at the mid-shore level the sediment is well sorted and gently rippled. The ragworm *Hediste diversicolor* is common to both areas (HedOl; HedScr). Species richness is low, especially at Copperhouse Pool, where the fauna also comprises juvenile shore crabs *Carcinus maenas*, oligochaetes and the mud shrimp *Corophium volutator*. In the sandflats at Lelant Station spionid worms *Pygospio elegans* are numerous, with the polychaetes *Malacoceros fuliginosus* and *Capitella capitata* and the amphipod *Bathyporeia pelagica* also present. The lower shore sediments of both Copperhouse Pool and Lelant Station are predominantly sandy mud (HedMac.Pyg). Mud shrimps *Corophium volutator* are present at Copperhouse Pool and at the head of Lelant Saltings, where the peppery furrow shell *Scrobicularia plana* is also found.

In the pools at Copperhouse and at Carnsew there are patches of green algae. Here species richness and abundance are extremely low in the soft, sheltered, potentially anoxic mud; polychaetes dominate the sediment and ragworms are ubiquitous. The lugworm *Arenicola marina* is restricted to an area off Hayle Street between Carnsew and Copperhouse Pools (HedMac.Are), and cockles *Cerastoderma edule* and spionid worms are found in the slightly sandier sediments off Hayle Street and in Carnsew Pool.





**Figure 1.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 1.1, cited literature and additional field observations).

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Areas of sheltered upper and mid-shore stones are found off Hayle Street, at Carnsew Pool and at Lelant Station. Cobbles on the mid-shore are dominated by patchy bladder wrack *Fucus vesiculosus* (FvesX) with green algae widespread on the upper shore. At Hayle Street and Lelant Station, the algal

diversity is greater than at Carnsew Pool. Bladder wrack *Fucus vesiculosus*, knotted wrack *Ascophyllum nodosum*, green algae *Enteromorpha* spp., red algae *Audouinella* spp., ectocarpoid brown algae and furoid sporelings are present at Hayle Street (FvesX; Asc.VS) on the mid- to lower shore and spiral wrack *Fucus spiralis* (Fspi) and channelled wrack *Pelvetia canaliculata* (Pel) are common on the upper shore at Lelant Station. Fauna present in these areas include shore crabs *Carcinus maenas*, amphipods, littorinid molluscs and occasional barnacles *Chthamalus montagui* and *Semibalanus balanoides*. The insect *Anurida maritima* is ubiquitous on the upper shores and ragworms *Hediste diversicolor* are found where mud is present between the cobbles. Within the inlet the estuarine barnacle *Balanus improvisus* is present at Copperhouse Pool only.

At the confluence of the two arms of the inlet, the derelict walls of the mid-channel pier and golf course quay, the steep embankments at Lelant Station and the weir at Carnsew Pool provide the only hard substrata in the inlet. These areas are extremely sheltered with a narrow littoral zone. Lichens are present above the littoral fringe (YG; Ver.Ver) at Lelant Station and the golf course quay. On the upper shores, channelled wrack *Pelvetia canaliculata* (Pel) and spiral wrack *Fucus spiralis* (Fspi) are present with the barnacles *Chthamalus montagui* and *Elminius modestus*. Algal diversity increases down the shore and the mid-shore is dominated by bladder wrack *Fucus vesiculosus*; other species include knotted wrack *Ascophyllum nodosum*, other furoids and the red algae *Gelidium pusillum* and *Mastocarpus stellatus*. The hydroids *Dynamena pumila* and *Laomedea flexuosa* are present and shore crabs *Carcinus maenas* are common; under the algal cover limpets and littorinids also occur. The lower shores are the most species rich within the inlet and the number of algae species present is fairly high with widespread furoids, epiphytic and other red and green algae (Fser.Fser). Fauna present on the lower shores of the hard substrata include barnacles *Balanus crenatus*, mussels *Mytilus edulis*, amphipods, littorinids and shore crabs. Bryozoans, including *Alcyonidium gelatinosum* and *Umbonula littoralis*, are also evident.

At the weir at Carnsew Pool, several species are found at their only location within the inlet, including the kelp *Laminaria digitata*, the red algae *Palmaria palmata* and *Plumaria plumosa*, coralline red algae, the barnacle *Balanus perforatus*, the hairy sea mat *Electra pilosa* and the sponge *Hymeniacidon perleve*.

## Nature conservation

| Conservation sites                |              |            |                               |
|-----------------------------------|--------------|------------|-------------------------------|
| Site name                         | Designation  | Grid ref.  | Main features                 |
| Hayle estuary and Carrock Gladden | SSSI         | SW 550370  | Coastal habitats, ornithology |
| Cornwall                          | AONB         | SW 590 450 | Landscape, scenery            |
| Hayle estuary                     | RSPB reserve | SW 546 364 | Ornithology, coastal habitats |

## Human influences

The inlet is highly modified with much of the western part being industrialised. The harbour at Hayle has a resident fishing fleet and maintenance dredging is carried out.

No fishing or mariculture take place within the inlet. Bait-digging is locally intensive, at Lelant in particular. Leisure activities are concentrated on the beaches of St Ives Bay but some windsurfing occurs at Carnsew Pool. During the winter months birdwatchers visit the inlet.

## References and further reading

Gill, C. 1989. Surveys of harbours, rias and estuaries in southern Britain: Hayle estuary. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 1,003. (FSC Report, No. FSC/OPRU/19/88.)

## Sites surveyed

Survey 257: HRE survey of the Hayle estuary, 1988 (Gill 1989).

### Littoral sites

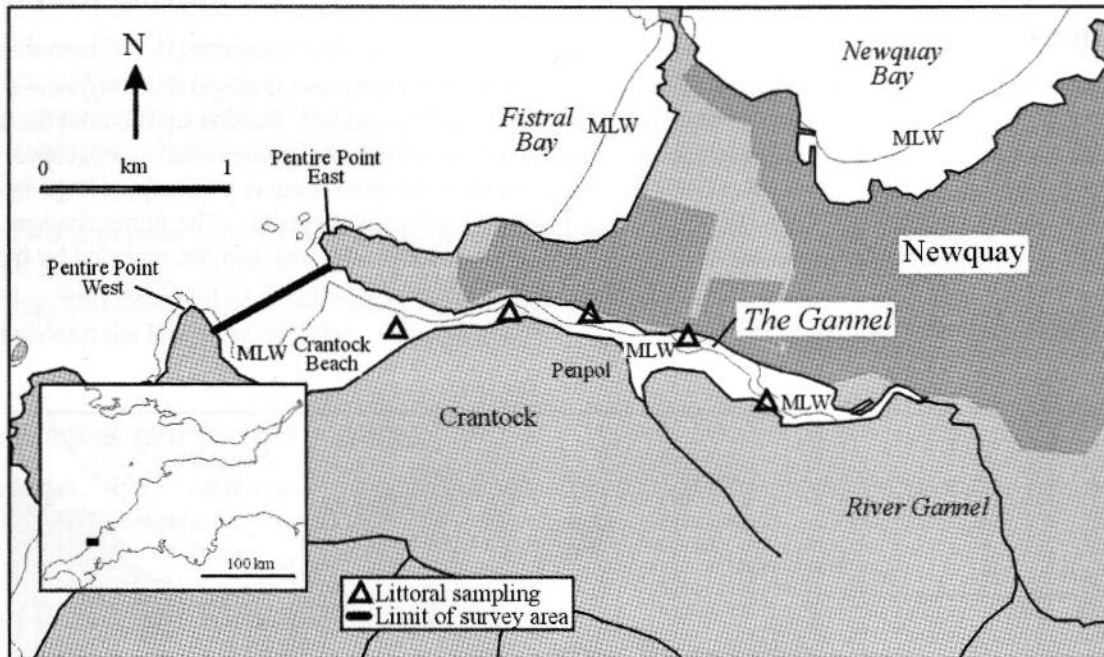
| Survey | Site | Place                    | Grid reference | Latitude/longitude  | Biotopes present                                 |
|--------|------|--------------------------|----------------|---------------------|--|
| 257    | 1    | Hayle Street, opp. works | SW 557 373     | 50°11.0'N 05°25.3'W | FvesX; HedMac.Are                                |
| 257    | 2    | Carnsew Pool             | SW 554 373     | 50°11.0'N 05°25.6'W | Fser.Fser; HedScr                                |
| 257    | 3    | Mid channel Pier         | SW 550 379     | 50°11.3'N 05°25.9'W | Pel; Fspi; Asc.Asc;<br>Fser.Fser                 |
| 257    | 4    | North Side Weir          | SW 556 376     | 50°11.2'N 05°25.4'W | AscX   |
| 257    | 5    | West of sand works       | SW 553 379     | 50°11.3'N 05°25.7'W | AEur   |
| 257    | 6    | Copperhouse Pool         | SW 567 382     | 50°11.5'N 05°24.5'W | FvesX; LMX; HedOl;<br>NVC SM8                    |
| 257    | 7    | Griggs Quay              | SW 546 364     | 50°10.5'N 05°26.2'W | HedScr   |
| 257    | 8    | Lelant Station           | SW 549 372     | 50°11.0'N 05°26.0'W | YG; Ver.Ver; Pel;<br>Fspi; Asc.VS;<br>HedMac.Pyg |
| 257    | 9    | Golf Course Quay wall    | SW 552 377     | 50°11.2'N 05°25.7'W | Ver.Ver; Pel; Asc.Asc;<br>Fser.Fser              |

Compiled by:

Jan Smith and Jon Moore

**Location**

|                                 |                |                   |
|---------------------------------|----------------|-------------------|
| <i>Position (centre)</i>        | SW 800 610     | 50°24'N 05°07'W   |
| <i>Administrative area</i>      | Cornwall       | Restormel Borough |
| <i>Conservation agency/area</i> | English Nature | Devon & Cornwall  |



**Figure 2.1** Main features of the area and sites surveyed.

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**Marine biological surveys**

|                 | <i>Survey method</i>                      | <i>Date of survey</i> | <i>Source</i>          |
|-----------------|---|-----------------------|------------------------|
| <i>Littoral</i> | Core sampling (0.01 m <sup>2</sup> cores) | 1991                  | NRA (unpublished data) |

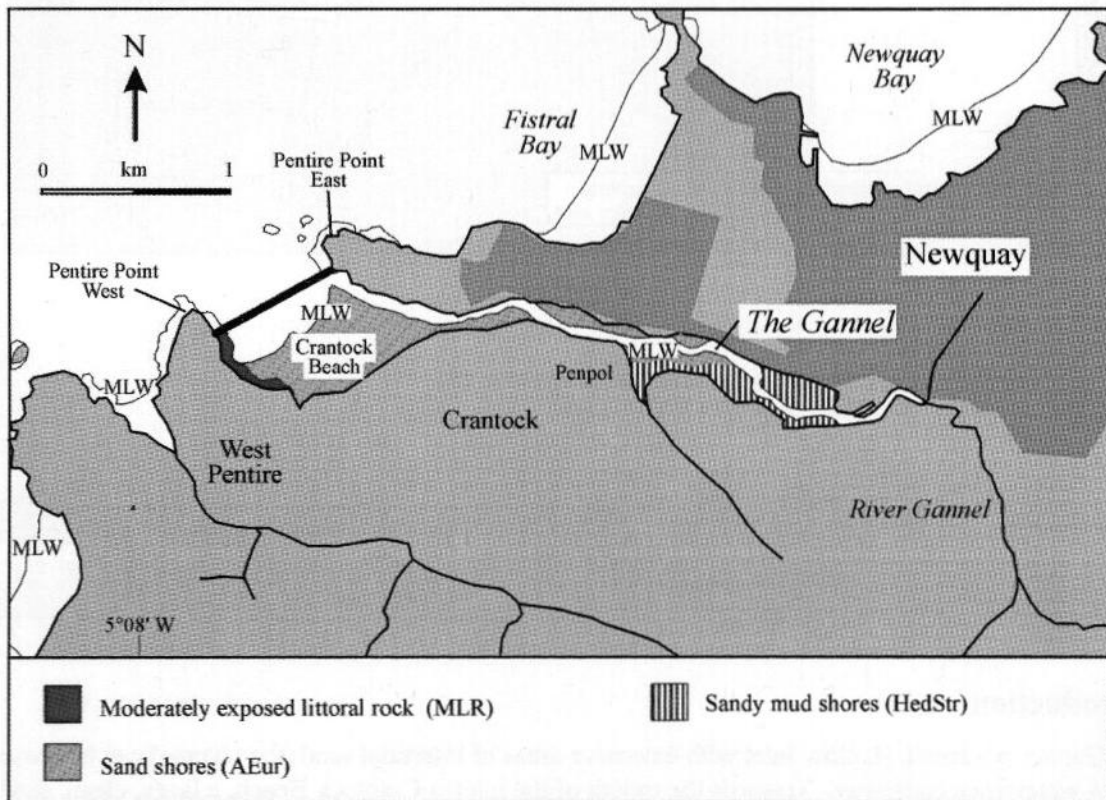
**Introduction**

The Gannel is a small, shallow inlet with extensive areas of intertidal sand; the channel can be crossed at low water via a causeway. Towards the mouth of the inlet is Crantock Beach, a large, clean, sandy beach. This sandy substratum at the mouth becomes finer further up the channel but becomes muddy at the head of the inlet. The northern shore of the Gannel has undergone more urban and industrial development than the southern shore.

| Physical features   |   |
|---------------------|---|
| Physiographic type  | Ria   |
| Length of coast     | 9.2 km  |
| Area of inlet       | 122 ha  |
| Length of inlet     | 3.7 km  |
| Bathymetry          | Mostly intertidal with a narrow, shallow channel at low water |
| Wave exposure range | Sheltered   |
| Tidal stream range  | No information  |
| Tidal range         | 6.4 m   |
| Salinity range      | Fully marine to upper estuarine                               |

### Marine biology

The clean sands at the mouth of the inlet support the amphipods *Bathyporeia elegans*, *Bathyporeia pilosa* and *Bathyporeia pelagica* and the isopod *Eurydice pulchra* (AEur). Further up the inlet these species are still numerically dominant but are joined by a few polychaete species such as *Pygospio elegans*, *Streblospio shrubsolii* and capitellids. At the head of the inlet there is an abrupt change in the nature of the substratum from clean sand to sandy mud with fringing saltmarsh. The fauna changes accordingly as the amphipods *Bathyporeia* spp. and the isopod *Eurydice pulchra* are replaced by the mud shrimp *Corophium volutator*. The most abundant polychaete in this part of the inlet is the ragworm *Hediste diversicolor* (HedStr).



**Figure 2.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 2.1, cited literature and additional field observations).

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## Nature conservation

| Conservation sites  |             |            |   |
|---------------------|-------------|------------|---|
| Site name           | Designation | Grid ref.  | Main features   |
| Kelsey Head         | SSSI        | SW 775 600 | Geology, coastal habitats, botany, invertebrates, ornithology |
| West Pentire Farm   | NT          | SW 774 610 | Cliff   |
| The Gannel, Newquay | NT          | SW 787 609 | Saltmarsh, sandhills  |

## Human influences

The Gannel has experienced some modification in the form of sea defences, a causeway and a ferry crossing. The inlet receives some effluent from industry and the urban area of Newquay. There have been proposals for a tidal barrage and a leisure barrage but at present there are no plans for these developments. High levels of lead in the sediments result from leaching of an abandoned mine further up the river.

The area is popular with holidaymakers during the summer months and the inlet is used by small boats. There are moorings for small boats along the inlet, and angling occurs. Other activities include bathing, particularly from Crantock Beach, sailing and horse-riding, and there are a number of caravan parks along the length of the inlet.

## References and further reading

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 2. South-west Britain*. Peterborough, Joint Nature Conservation Committee.

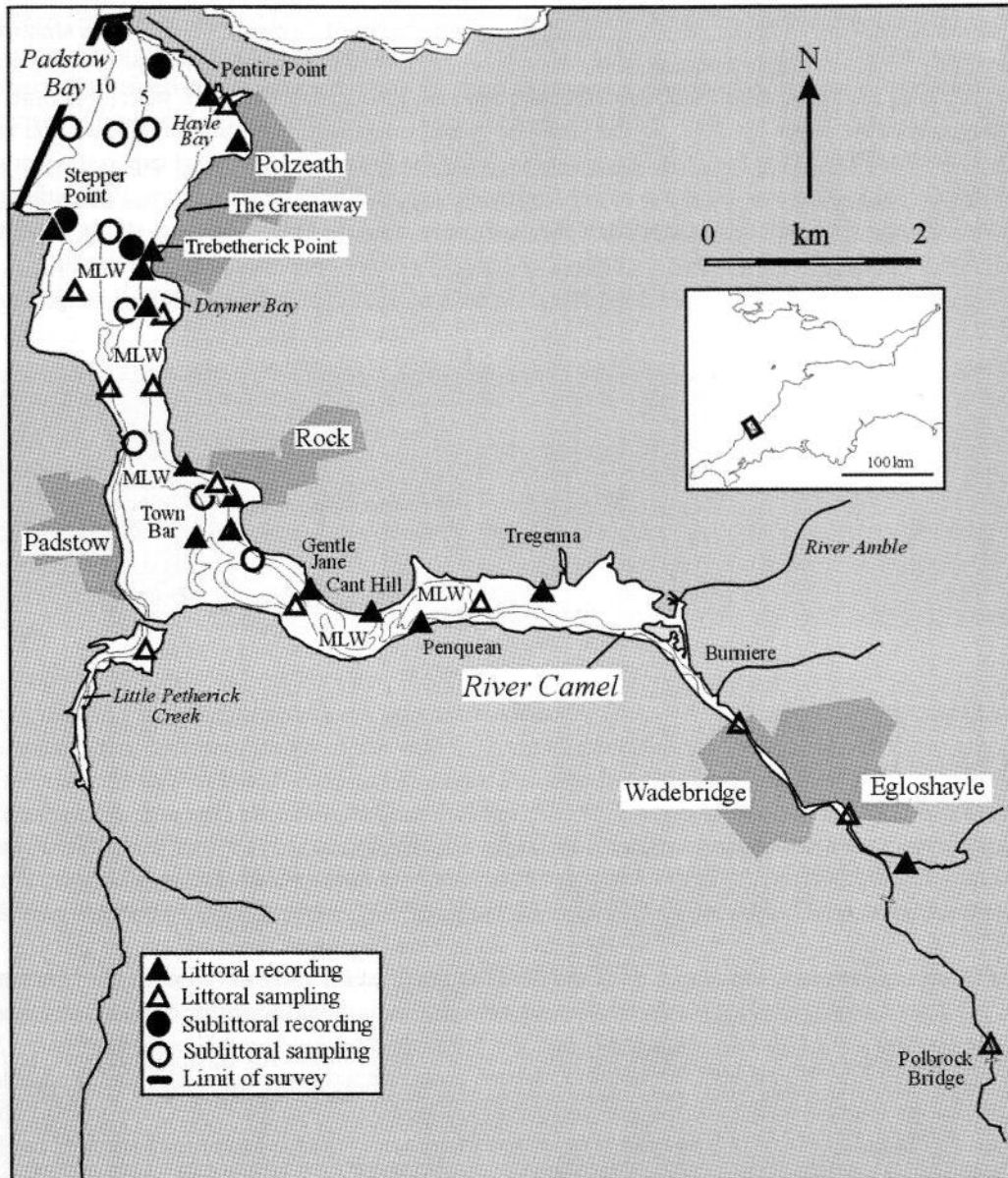
## Sites surveyed

Survey 623: National Rivers Authority South Western Region Gannel estuary littoral survey (unpublished data).

| Littoral sites |      |                       |                |                     |                  |
|----------------|------|-----------------------|----------------|---------------------|------------------|
| Survey         | Site | Place                 | Grid reference | Latitude/longitude  | Biotopes present |
| 623            | 1    | Frenance              | SW 806 607     | 50°24.2'N 05°05.2'W | HedStr           |
| 623            | 2    | Near Tidal Footbridge | SW 801 610     | 50°24.4'N 05°05.7'W | AEur             |
| 623            | 3    | Penpol                | SW 796 612     | 50°24.5'N 05°06.1'W | AEur             |
| 623            | 4    | Crantock car park     | SW 792 613     | 50°24.5'N 05°06.4'W | AEur             |
| 623            | 5    | Crantock Beach        | SW 785 612     | 50°24.4'N 05°07.0'W | AEur             |

**Location**

|                                 |                |                  |
|---------------------------------|----------------|------------------|
| <i>Position (centre)</i>        | SW 930 750     | 50°33'N 04°56'W  |
| <i>Administrative area</i>      | Cornwall       | North Cornwall   |
| <i>Conservation agency/area</i> | English Nature | Devon & Cornwall |



**Figure 3.1** Main features of the area and sites surveyed.

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| Marine biological surveys |   |                      |                             |
|---------------------------|---|----------------------|-----------------------------|
|                           | Survey method                             | Date of survey       | Source                      |
| <i>Littoral</i>           | Recording                                 | June 1988            | Gill & Mercer (1989)        |
|                           | Core sampling (0.01 m <sup>2</sup> cores) | June 1988            | Gill & Mercer (1989)        |
|                           | Recording                                 | Oct. 1976-Sept. 1977 | Powell <i>et al.</i> (1978) |
| <i>Sublittoral</i>        | Infaunal sampling (pipe dredge)           | June 1988            | Gill & Mercer (1989)        |
|                           | Recording                                 | June 1988            | Gill & Mercer (1989)        |

## Introduction

The ria of the River Camel is the largest inlet on the north coast of Cornwall. The inlet is shallow and consists mostly of sediment, deepening at the mouth where it flows into Padstow Bay. At low water, extensive areas of intertidal sand- and mudflats are exposed throughout the inlet, which become finer and more stable in the inner reaches. In the small bays and inlets saltmarsh has developed, the largest area of which is at Burniere where the River Amble joins the River Camel. Hard substrata occur mainly towards the mouth and there are rocky shores at Stepper Point, Pentire Point, Polzeath and Trebetherick Point. At Rock on the northern shore, there is a small embryo dune system. Freshwater input into the inlet is low and the water quality has been classified as grade A (highest quality).

## Physical features

|                            |   |
|----------------------------|---|
| <i>Physiographic type</i>  | Ria   |
| <i>Length of coast</i>     | 48 km   |
| <i>Area of inlet</i>       | Total 1,059 ha; intertidal 630 ha               |
| <i>Length of inlet</i>     | 16.5 km   |
| <i>Bathymetry</i>          | Very shallow; maximum depth 10 m in Padstow Bay |
| <i>Wave exposure range</i> | Very exposed to extremely sheltered             |
| <i>Tidal stream range</i>  | Max. 3.5 knots                                  |
| <i>Tidal range</i>         | 5.9 m   |
| <i>Salinity range</i>      | Fully marine to upper estuarine                 |

## Marine biology

### Littoral biotopes

There are wave-cut bedrock platforms at Trebetherick Point, north of Hayle Bay and at Stepper Point. The exposed rock communities present north of Hayle Bay are typical of the open coast: the splash zone is dominated by lichens (YG; Ver.Ver); the upper shore is dominated by channelled wrack *Pelvetia canaliculata* and barnacles *Chthamalus montagui* (PelB) above a furoid zone with abundant wrack *Fucus vesiculosus* var. *linearis* (BPat.Fvesl). Fauna on the upper shore are predominantly barnacles *C. montagui* and *Chthamalus stellatus* and limpets *Patella vulgata* (BPat.Cht). Littorinid molluscs are found among the algae. In the furoid zone, mussels *Mytilus edulis*, dogwhelks *Nucella lapillus*, the flat top shell *Gibbula umbilicalis* and the barnacle *Semibalanus balanoides* appear. Surge gullies up to 2 m in height intersect the bedrock, where coralline red and other algae are abundant and shaded overhangs support a rich community of sponges, barnacles, bryozoans and anemones. The nudibranch *Onchidella celtica* is a notable species recorded here. On the lower mid-shore is another band of bladder wrack *Fucus vesiculosus* (FvesB) with associated gastropods and barnacles. Lower shore bedrock is rugged, dominated by foliose red algae and thongweed *Himantalia elongata* (Him). Rockpools are a prominent feature of the shores both at Trebetherick Point and north of Hayle Bay (Cor.Bif; SwSed) and these are often large, occasionally deep, and contain rich algal assemblages; crabs, gobies, littorinid molluscs, limpets, top shells, anemones and sponges are also present. The most diverse fauna is found in lower shore pools where species typical of the sublittoral fringe are present (FK).



The moderately exposed bedrock shores at Trebetherick Point are afforded slightly more shelter from the prevailing south-westerly winds than the shores north of Hayle Bay. Below the lichen zone, channelled wrack *P. canaliculata* forms an upper shore band giving way to an extensive mid-shore zone dominated by barnacles, mussels and limpets (BPat). A characteristically diverse fauna is present at Trebetherick Point comprising sponges, anemones, polychaetes, bryozoans, hydroids and nudibranchs. Mussels *Mytilus edulis* (MytFR) are very numerous here but absent from the lower shore north of Hayle Bay. The lower shore supports an array of red algae and serrated wrack *Fucus serratus* (Fser.R).

At Stepper Point on the western side of the estuary mouth, the steep, moderately exposed bedrock is broken into ledges, crevices and overhangs. Boulders, with under-boulder habitats, are present on the lower shore (Fser.Fser.Bo). Algae or barnacles and limpets are dominant depending on variations in topography. Damp ledges and shaded overhangs (SR) have the greatest faunal and algal variety with many species of coralline algae, encrusting sponges, barnacles, gastropods, mussels, hydroids, bryozoans and nudibranchs present.

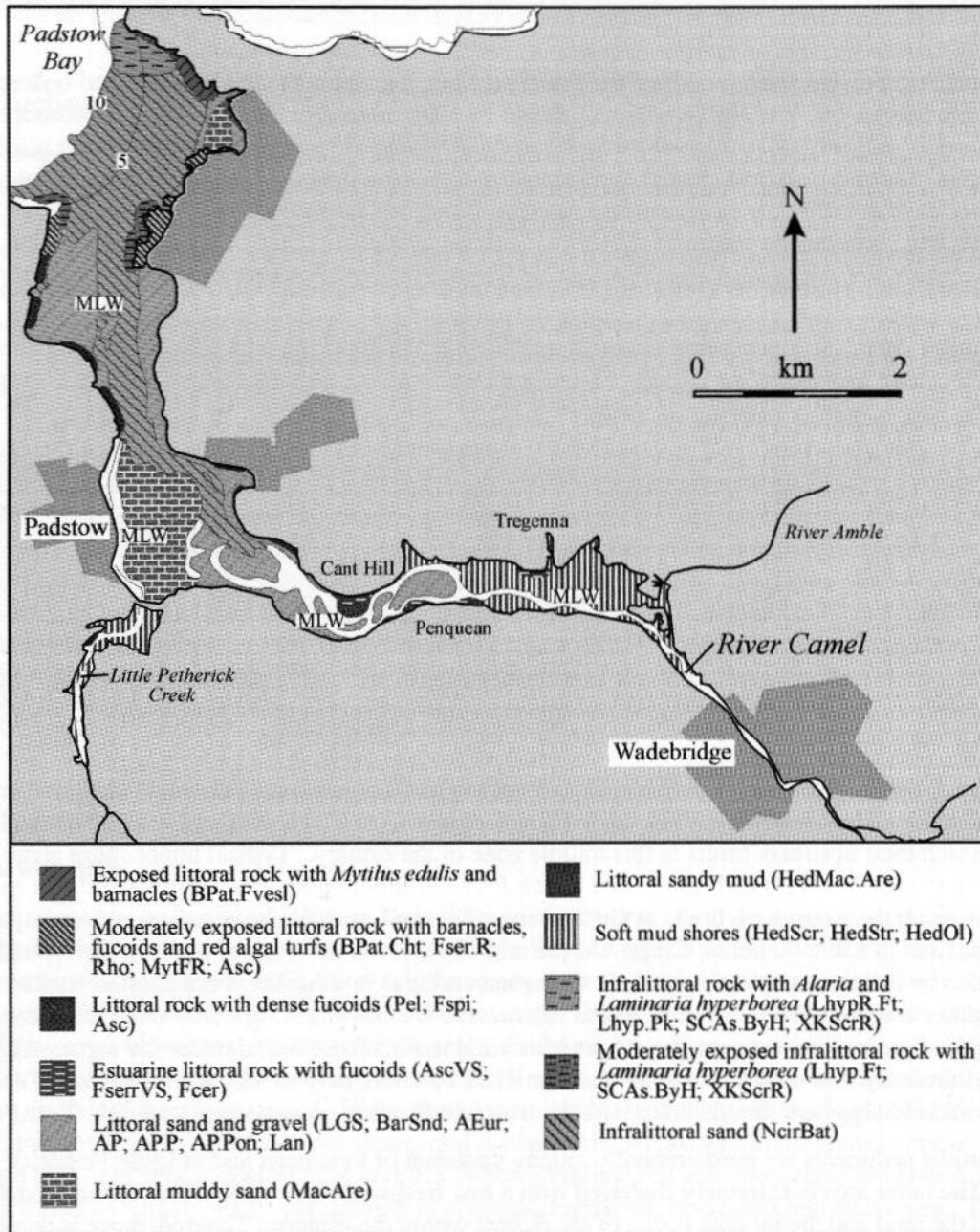
Predominantly sandy intertidal sediments are found in the lower estuary. At Hayle Bay, the beach is exposed to wave action and is used as a car park. Infauna here is sparse, being restricted to a few polychaetes (AP.P), or where muddy sand occurs cockles *Cerastoderma edule* and lugworms *Arenicola marina* (MacAre) are present. At Daymer Bay, the more sheltered sediments are inhabited by polychaetes including sand mason worms *Lanice conchilega*, lugworms *A. marina*, other polychaetes and a few amphipod species (AP.P). Sheltered sandflats at Dunbar Sands and Rock Dunes consist of stable, well-sorted sand and shell gravel (AP.Pon). At Rock Dunes, a surface mat of green algae *Enteromorpha* spp. may be present. Sediment infauna include the polychaetes *Nephtys* spp., some oligochaete species and amphipods. There are extremely sheltered sandflats at Town Bar where dense beds of cockles *C. edule* are present with lugworms and other polychaetes (MacAre). The mid-channel sand bar nearby is of tide-swept, well-drained rippled sand with an impoverished fauna of polychaetes and amphipods. Off Rock Sailing Club, the extremely sheltered lower shore is of fairly soft, poorly-drained muddy sand, anoxic just below the surface. Lugworms *A. marina*, sand mason worms *L. conchilega* and thin tellins *Angulus tenuis* are amongst the few species present (AP.Pon).

The bedrock and boulder shores between Rock Pontoon and Tregenna are extremely sheltered and mostly dominated by knotted wrack *Ascophyllum nodosum* (Asc.VS) and other fucoids. Several species reach their upstream limits in this middle zone of the estuary. Typical upper shore algae spiral wrack *Fucus spiralis* (Fspi) and channelled wrack *Pelvetia canaliculata* (Pel), limpets *Patella* sp. and barnacles reach their upstream limits at Gentle Jane. The mud snail *Hydrobia ulvae* is found upstream of Canthill and in Little Petherick Creek. At the mid-shore level, outcrops of bedrock are typically surrounded by slate gravel overlying mud. Conspicuous algae in these areas are knotted wrack *Ascophyllum nodosum*, bladder wrack *Fucus vesiculosus* and the green alga *Enteromorpha linza*. Shore crabs *Carcinus maenas*, amphipods and littorinid molluscs are found under the algae. Algal epifaunal diversity is low on the boulder shore at Rock Pontoon; here mostly serrated wrack *Fucus serratus* and red algae are found, along with the barnacle *Balanus crenatus* and hydroids (Fser.Fser).

The intertidal sediments are predominantly muddy upstream of Penquean and in Little Petherick Creek. The latter area is extremely sheltered with a low freshwater input and a proportion of shell gravel in the mud and the infauna is one of the richest within the estuary. The mid-shore is dominated by cockles and the Baltic tellin *Macoma balthica* along with numerous mud snails *Hydrobia ulvae* (HedScr; HedStr). Lower down the shore are ragworms, oligochaetes and the peppery furrow shell *Scrobicularia plana* (HedScr). The polychaete *Notomastus latericeus* and the cockle *Parvicardium exiguum* are found here and nowhere else within the estuary. Brown shrimps *Crangon crangon* and crabs are also present.

At Penquean, the muddy sediments support a higher diversity of polychaetes, the amphipod *Bathyporeia pilosa* and the isopod *Eurydice pulchra*. A mobile sand bank at Penquean supports a community of lugworms, peppery furrow shells and the polychaete *Nephtys cirrosa* (AP.P). Upper estuary shores are narrow and comprise anoxic mud and slate cobbles. Abundant ragworms are

present at Wadebridge with a few bivalves and amphipods. The mud shrimp *Corophium volutator* is abundant as far upstream as Egloshayle and oligochaetes are present as far upriver as Polbrock Bridge. Chironomid larvae are also present in the upper reaches, illustrating the increasingly riverine nature of the estuary in these parts.



**Figure 3.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 3.1, cited literature and additional field observations).

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### Sublittoral biotopes

The sediments of Padstow Bay are composed of medium sand and shell gravel and infaunal communities here are dominated by polychaetes, amphipods and cumaceans (NcirBat). Off Stepper Point at Greenaway Buoy in the middle of the estuary, the sediments are more sheltered and the communities more diverse, although still dominated by polychaetes and amphipods. Bar Buoy off Daymer Bay marks the start of the tide-swept channel and here the fauna is impoverished with the amphipod *Urothoe brevicornis* numerically dominant (NcirBat). Further up the channel, as far as Gentle Jane, the sediments are of sand and shell gravel with the spionid polychaete *Spio martinensis* becoming increasingly abundant.

The headland at Pentire Point has a subtidal area of upward-facing bedrock which is exposed to wave action and, towards Hayle Bay, experiences increasing sand scour. Community diversity is low. In shallow water a dense kelp *Laminaria hyperborea* forest is found on the tops of ridges and gullies (LhypR.Ft). Numerous ballan wrasse *Labrus bergylta* are present and the anemone *Isozanthus sulcatus* is found near the sea bed on sheltered sand-covered surfaces. Algal variety increases with depth with numerous red algae present. Animal populations on upward-facing bedrock are sparse; ascidians are frequent with a few bryozoans and sponges common.

At the less exposed Stepper Point is an area of upper infralittoral boulders. A large variety of red algae is present and lugworms are found in the sand between the boulders (XKScrR); there are also numerous crabs. Between about 6 and 7 m depth a sparse bryozoan/ascidian community is present. Under-boulder communities include the barnacle *Balanus crenatus*, the keel worm *Pomatoceros triqueter*, the common brittlestar *Ophiothrix fragilis* and encrusting bryozoans.

Off Greenaway Beach, infralittoral sand-covered bedrock ledges are common. Red algae are abundant on sunny ledges and a few dahlia anemones *Urticina felina* and barnacles *Balanus crenatus* are also found.

In the mouth of the estuary there are upper infralittoral areas of vertical and overhanging bedrock. At Stepper Point, algae dominate while at Pentire Point and off Greenaway Beach, a diverse community is present on the sides of gullies, dominated by a bryozoan/ascidian turf with some sponges (SCAs.ByH). South-east of Stepper Point the nationally rare gold and scarlet star coral *Balanophyllia regia* (Sanderson 1996) and the Devonshire cup-coral *Caryophyllia smithii* are present.

### Nature conservation

| Conservation sites                 |              |            |  |
|------------------------------------|--------------|------------|--|
| Site name                          | Designation  | Grid ref.  | Main features  |
| River Camel                        | possible SAC | SW 934 798 | Otter <i>Lutra lutra</i> , bullhead <i>Cottus gobio</i>  |
| Stepper Point                      | SSSI         | SW 915 783 | Geology  |
| Harbour Cove                       | SSSI         | SW 915 768 | Geology  |
| Rock Dunes                         | SSSI         | SW 926 765 | Dune vegetation, invertebrates, geology  |
| Amble Marshes                      | SSSI         | SW 994 746 | Flora, ornithology   |
| River Camel Valley and Tributaries | SSSI         | SW 934 798 | River habitats, fringing wetland habitats and woodland, otters, fish, invertebrates, ornithology |
| Trebetherick Point                 | SSSI         | SW 925 780 | Geology, flora, marine fauna   |
| Pentire Peninsula                  | SSSI         | SW 934 798 | Geology, flora, ornithology  |
| Cornwall                           | AONB, HC     | SW 933 813 | Landscape, scenery   |

### Human influences

The inlet has a mainly rural hinterland with little development along the shore. There are docks at Padstow and Wadebridge and small boat-building yards at Wadebridge and at Rock. There are several sources of sewage and industrial effluent into the Camel.

Exploitation of natural resources includes fisheries for mussels *Mytilus edulis* and oysters *Ostrea edulis*, potting for lobsters *Homarus gammarus* and crabs *Cancer pagurus* and some netting for fish. Pacific oysters *Crassostrea gigas* are cultivated on rakes on the foreshore. Bait-digging occurs but is restricted by access.

The River Camel is a popular sailing centre and the harbours at Padstow and Wadebridge are the focus for sailing and windsurfing. There is a water sports school at Rock and surfing and scuba diving take place in the outer estuary. Beach recreation is concentrated at Rock, Daymer Bay, Harbour Cove and Polzeath Bay, and at Hayle Bay, the upper shore is used as a car park. Wildfowling also occurs.

## References and further reading

- Gill, C., & Mercer, T. 1989. Surveys of harbours, rias and estuaries in southern Britain: the Camel estuary. (Contractor: Field Studies Council Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report, No. 954.* (FSC Report, No. FSC/OPRU/14/88.)
- Powell, H.T., Holme, N.A., Knight, S.J.T., & Harvey, R. 1978. Survey of the littoral zone of the coast of Great Britain: Report of the shores of Devon and Cornwall. (Contractor: Scottish Marine Biological Association/Marine Biological Association Intertidal Survey Unit.) *Nature Conservancy Council, CSD Report, No. 209.*
- Sanderson, W.G. 1996. Chapter 5.4. Rare sea-bed species. *In: Coasts and seas of the United Kingdom. Region 11 The Western Approaches: Falmouth Bay to Kenfig*, ed. by J.H. Barne, C.F. Robson, S.S. Kaznowski, J.P. Doody, N.C. Davidson & A.L. Buck, 98-107. Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series.)

## Sites surveyed

Survey 255: HRE survey of the Camel estuary 1988 (Gill & Mercer 1989).

Survey 265: SMBA/MBA Great Britain intertidal survey 1970-1980 (Powell *et al.* 1978).

| Littoral sites |      |                                   |                |                     |   |
|----------------|------|-----------------------------------|----------------|---------------------|---|
| Survey         | Site | Place                             | Grid reference | Latitude/longitude  | Biotopes present  |
| 255            | 1    | Trebetherick Point                | SW 924 779     | 50°33.8'N 04°55.9'W | YG; Ver.Ver; Pel;<br>Fspi; BPat.Cht; FvesB;<br>Rho; MytFR; Rkp;<br>Cor.Bif; FK; SwSed |
| 255            | 2    | N Hayle Bay                       | SW 932 797     | 50°34.7'N 04°55.2'W | YG; Ver.Ver; PelB;<br>BPat; BPat.Fvesl;<br>FvesB; Cor.Bif; Him                        |
| 255            | 3    | Pentireglaze Haven                | SW 933 797     | 50°34.7'N 04°55.2'W | AP.P  |
| 255            | 4    | Hayle Bay                         | SW 934 792     | 50°34.5'N 04°55.0'W | AP.P  |
| 255            | 5    | S of Stepper Point                | SW 915 783     | 50°33.9'N 04°56.6'W | BPat; Fser.R;<br>Fser.Fser.Bo; SR   |
| 255            | 6    | Daymer Bay                        | SW 927 774     | 50°33.5'N 04°55.6'W | AP.P  |
| 255            | 7    | Rock Dune                         | SW 926 766     | 50°33.1'N 04°55.6'W | AP  |
| 255            | 8    | Dumbar Sands (Doom Flats)         | SW 917 776     | 50°33.6'N 04°56.4'W | AP.Pon  |
| 255            | 9    | E of Georges Cove                 | SW 921 766     | 50°33.0'N 04°56.1'W | BarSnd  |
| 255            | 10   | Rock Sailing Club                 | SW 932 756     | 50°32.5'N 04°55.1'W | Lan   |
| 255            | 14   | S of Egloshayle                   | SW 999 719     | 50°30.7'N 04°49.3'W | EphX  |
| 255            | 15   | Old Railway Bridge NW of Pendasey | SX 005 714     | 50°30.4'N 04°48.8'W | Ent   |
| 255            | 16   | Polbrock Bridge                   | SX 013 695     | 50°29.4'N 04°48.1'W | HedOl   |
| 255            | 17   | S of Tregenna                     | SW 966 745     | 50°32.0'N 04°52.2'W | Asc.VS; HedScr  |
| 255            | 18   | N of Penquean                     | SW 960 742     | 50°31.8'N 04°52.7'W | Fspi; Asc.VS; HedStr;<br>AP.P   |
| 255            | 19   | Carhart Quarry Quay               | SW 954 740     | 50°31.7'N 04°53.2'W | Asc.VS  |
| 255            | 20   | Canthill                          | SW 948 742     | 50°31.8'N 04°53.7'W | Fspi; Asc.VS;<br>HedMac.Are   |
| 255            | 21   | Gentle Jane                       | SW 942 745     | 50°32.0'N 04°54.2'W | BPat; Pel; Fspi; Fves;<br>Asc.Asc; Fser.Fser  |

**Littoral sites - continued**

| <i>Survey</i> | <i>Site</i> | <i>Place</i>           | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i>                |
|---------------|-------------|------------------------|-----------------------|---------------------------|--|
| 255           | 22          | N of Ball Hill         | SW 940 744            | 50°31.9'N 04°54.4'W       | AEur                                   |
| 255           | 23          | Porthilly              | SW 934 751            | 50°32.3'N 04°54.9'W       | Pel; Fspi; Asc.VS                      |
| 255           | 24          | Town Bar               | SW 930 750            | 50°32.2'N 04°55.2'W       | MacAre                                 |
| 255           | 26          | Rock Pontoon           | SW 929 757            | 50°32.6'N 04°55.4'W       | Pel; Fspi; FvesX;<br>AscX              |
| 255           | 27          | Little Petherick Creek | SW 924 737            | 50°31.5'N 04°55.7'W       | Pel; HedScr                            |
| 255           | 28          | Wadebridge             | SW 988 727            | 50°31.1'N 04°50.3'W       | HedOl                                  |
| 255           | D1          | Padstow Bay 1          | SW 917 794            | 50°34.5'N 04°56.5'W       | NcirBat                                |
| 255           | D2          | Padstow Bay 2          | SW 922 793            | 50°34.5'N 04°56.1'W       | NcirBat                                |
| 255           | D3          | Padstow Bay 3          | SW 925 793            | 50°34.5'N 04°55.8'W       | NcirBat                                |
| 255           | D4          | Greenaway Buoy         | SW 921 785            | 50°34.1'N 04°56.1'W       | NcirBat                                |
| 255           | D5          | Bar Buoy               | SW 923 775            | 50°33.5'N 04°55.9'W       | NcirBat                                |
| 255           | D6          | The Pool               | SW 923 775            | 50°33.5'N 04°55.9'W       | NcirBat                                |
| 255           | D7          | Off Rock               | SW 931 755            | 50°32.5'N 04°55.2'W       | NcirBat                                |
| 255           | D8          | W of Canthill          | SW 935 748            | 50°32.1'N 04°54.8'W       | NcirBat                                |
| 265           | 372         | Hayle Bay              | SW 933 793            | 50°34.5'N 04°55.1'W       | MacAre                                 |
| 265           | 397         | Rock                   | SW 933 754            | 50°32.4'N 04°55.0'W       | AP.Pon                                 |
| 265           | 358         | Daymer Bay             | SW 925 775            | 50°33.5'N 04°55.8'W       | LGS                                    |
| 265           | 415         | Trebetherick           | SW 925 780            | 50°33.8'N 04°55.8'W       | Ver.Ver; Pel; Fspi;<br>Asc.Asc; Fser.R |

**Sublittoral sites**

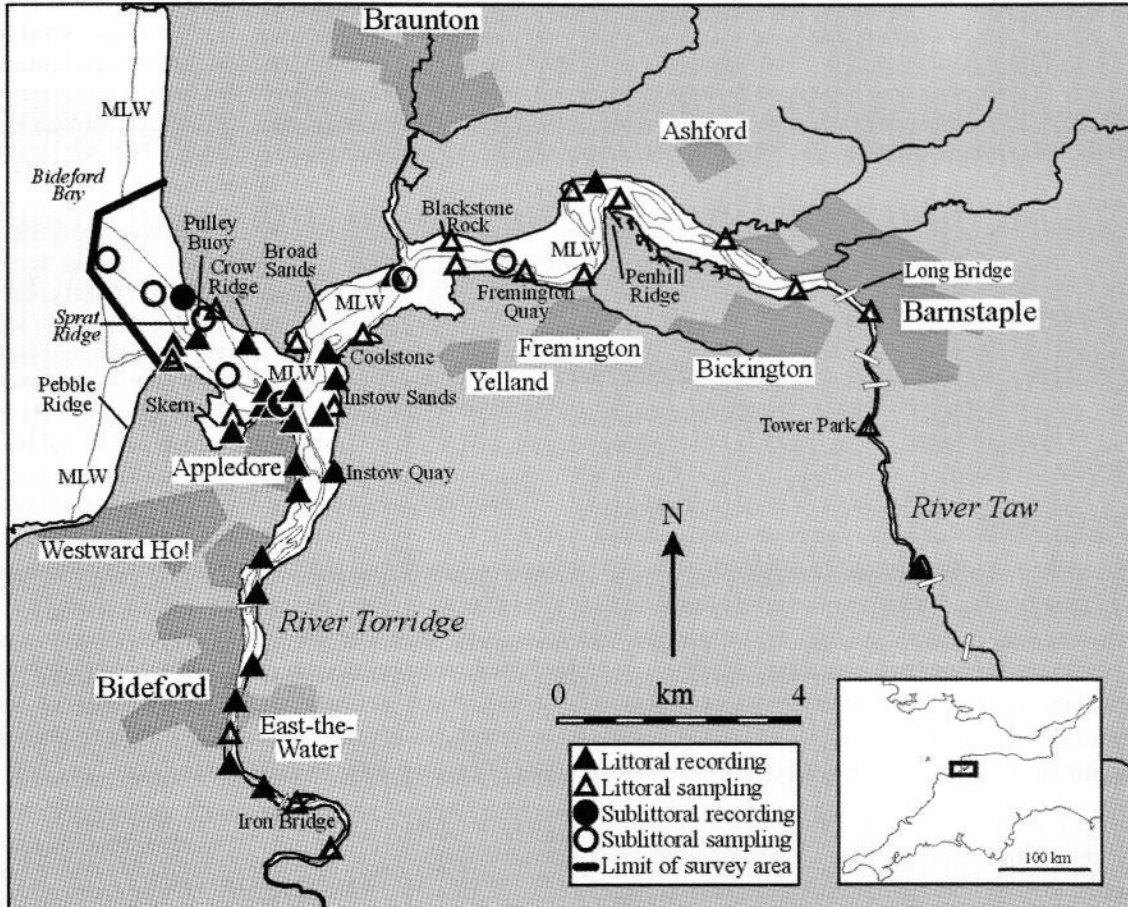
| <i>Survey</i> | <i>Site</i> | <i>Place</i>        | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i>              |
|---------------|-------------|---------------------|-----------------------|---------------------------|--------------------------------------|
| 255           | 11          | Pentire Point       | SW 922 804            | 50°35.1'N 04°56.1'W       | LhypR.Ft; SCAs.ByH;<br>XKScrR        |
| 255           | 12          | Stepper Point       | SW 926 785            | 50°34.1'N 04°55.7'W       | SCAs.ByH; XKScrR                     |
| 255           | 13          | Off Greenaway beach | SW 925 783            | 50°34.0'N 04°55.8'W       | FoSwCC; SCAs.ByH;<br>Lhyp.Ft; XKScrR |
| 255           | 25          | SE Pentire Point    | SW 926 800            | 50°34.9'N 04°55.8'W       | SCAs.ByH; Lhyp.Ft;<br>Lhyp.Pk        |
| 255           | D1          | Padstow Bay 1       | SW 917 794            | 50°34.5'N 04°56.5'W       | NcirBat                              |
| 255           | D2          | Padstow Bay 2       | SW 922 793            | 50°34.5'N 04°56.1'W       | NcirBat                              |
| 255           | D3          | Padstow Bay 3       | SW 925 793            | 50°34.5'N 04°55.8'W       | NcirBat                              |
| 255           | D4          | Greenaway Buoy      | SW 921 785            | 50°34.1'N 04°56.1'W       | NcirBat                              |
| 255           | D5          | Bar Buoy            | SW 923 775            | 50°33.5'N 04°55.9'W       | NcirBat                              |
| 255           | D6          | The Pool            | SW 923 775            | 50°33.5'N 04°55.9'W       | NcirBat                              |
| 255           | D7          | Off Rock            | SW 931 755            | 50°32.5'N 04°55.2'W       | NcirBat                              |
| 255           | D8          | W of Canthill       | SW 935 748            | 50°32.1'N 04°54.8'W       | NcirBat                              |

Compiled by:

Jan Smith and Jon Moore

**Location**

|                                 |                |                          |
|---------------------------------|----------------|--------------------------|
| <i>Position (centre)</i>        | SS 460 310     | 51°06'N 04°12'W          |
| <i>Administrative area</i>      | Devon          | North Devon and Torridge |
| <i>Conservation agency/area</i> | English Nature | Devon & Cornwall         |



**Figure 4.1** Main features of the area and sites surveyed.

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**Marine biological surveys**

|                    | <i>Survey method</i>                      | <i>Date of survey</i>  | <i>Source</i> |
|--------------------|---|------------------------|---------------|
| <i>Littoral</i>    | Recording                                 | May 1988               | Little (1989) |
|                    | Core sampling (0.01 m <sup>2</sup> cores) | May 1988               | Little (1989) |
|                    | Recording                                 | Nov. 1984 - March 1985 | Harris (1985) |
| <i>Sublittoral</i> | Infaunal sampling (pipe dredge)           | May 1988               | Little (1989) |
|                    | Recording                                 | May 1988               | Little (1989) |

## Introduction

The combined estuary of the Taw and Torridge Rivers lies on the north coast of Devon. The land surrounding the estuary is a low-lying floodplain across which the rivers wind. The two rivers converge near Instow and flow west through a narrow combined channel, opening into Bideford Bay. The estuary consists predominantly of sediment with only limited areas of hard substratum (mainly bedrock and boulders). Large areas of saltmarsh are found at Yelland and Penhill within the Taw and extensive sand dune systems (Braunton Burrows to the north and Northam Burrows to the south) flank both sides of the estuary mouth.

Sewage and agricultural effluents enter the rivers but there is little industry within the catchment area. The water quality of the estuary is classified as grade A (highest quality).

### Physical features

|                            |   |
|----------------------------|---|
| <i>Physiographic type</i>  | Bar built estuary                             |
| <i>Length of coast</i>     | 80 km   |
| <i>Area of inlet</i>       | 1,750 ha                                      |
| <i>Length of inlet</i>     | 19 km   |
| <i>Bathymetry</i>          | Shallow except in channels; maximum depth 8 m |
| <i>Wave exposure range</i> | Exposed to extremely sheltered                |
| <i>Tidal stream range</i>  | Max. 4 knots                                  |
| <i>Tidal range</i>         | 7.3 m   |
| <i>Salinity range</i>      | Variable to upper estuarine                   |

## Marine biology

### Littoral biotopes

The dominant habitat at the mouth of the estuary is wave-exposed fine sand or gravel (AEur) and these sediments are in a high energy environment due to wave exposure and tidal streams. Well-sorted patches of gravel are found on the surface and within the fine sands and the infauna here is sparse and species poor; the commoner animals present are polychaetes and amphipods. Parts of Sprat Ridge, off Appledore, are relatively sheltered and stable and include pebbles and small cobbles. These areas are colonised by mussels *Mytilus edulis* and the bladder wrack *Fucus vesiculosus* with scattered common periwinkles *Littorina littorea* (MytX). Cobbles are sparsely covered by barnacles.

Boulders underlie much of the sands to the south of the estuary mouth, possibly marking former positions of the Pebble Ridge. The boulders are 'cemented' together in places by apparently natural concrete while others are mobile. Extensive areas of boulders and cobbles, which are free from sand scour, are colonised by furoid algae and between catastrophic storms a typical rocky shore community develops. Faunal species include limpets *Patella* spp., beadlet anemones *Actinia equina*, shore crabs *Carcinus maenas* and occasional barnacles. Some boulders on the upper shore are coloured by the lichen *Verrucaria mucosa* (Ver.Ver) and some algae *Porphyra* spp. and *Enteromorpha* sp. are present; however, the communities are transient. Pools on the mid-shore are a semi-permanent habitat and contain a wider variety of algae and fauna than the surrounding shores. Shore crabs *C. maenas* and top shells *Gibbula* sp. are frequent; pools in the mussel beds at Sprat Ridge have dense stands of the sand mason worm *Lanice conchilega* and surfaces bare of mussels have luxurious growths of the hydroid *Obelia longissima* (MytX; H).

Tide-swept boulders on the lower shores of Sprat Ridge and the broken bedrock ridges at West Crow Ridge and Skern Point on the lower shore have rich communities similar to those of the mussel-bed pools. However, algae are much more in evidence, especially foliose and finely branching red algae (FserX). Fauna typical of this habitat, in addition to the mussels *Mytilus* and sand mason worms *L. conchilega*, include the dogwhelk *Nucella lapillus*, the chiton *Lepidochitona cinerea*, the breadcrumb sponge *Halichondria panicea* and hydroids.

At the confluence of the Taw and the Torridge, the moderately wave-exposed rocky shores are an unusual estuarine environment. These shores comprise extensive areas of gradually sloping, very broken wave-cut platform, with many rock fragments on the surface. The shores are subject to variable salinity conditions and they possess a rich variety of microhabitats; pools, crevices, overhangs and boulders support a diverse flora and fauna. Splash zones are lichen-dominated (YG; Ver), especially by *Verrucaria maura*, with abundant rough periwinkles *Littorina saxatilis* var. *rudis*. Upper shore surfaces are dominated by spiral wrack *Fucus spiralis* (Fspi) with an upper band of channelled wrack *Pelvetia canaliculata* (Pel) at Skern Point. Upper shore pools at Coolstone and Skern Point support an unusual biotope, where thick layers of encrusting brown algae *Ralfsia* sp. or *Pseudolithoderma* sp. carpet the bottoms of the pools. These algae are grazed upon by large densities of winkles. Other animals include top shells *Gibbula* sp., limpets, mud snails *Hydrobia ulvae*, dogwhelks and chitons. Red and green algae, including encrusting coralline reds, are also present. Pools on the mid-shore contain sponges, coralline algae and sea lettuce *Ulva lactuca* (Cor). Sand, accumulated in the southern edge of the pools, contains sand mason worms *L. conchilega* and cockles *Cerastoderma edule*. Among the other fauna present are three species of chiton, two top shell *Gibbula* spp. and the keel worm *Pomatoceros triqueter*. Many algal species are also present and rockpool fish include the painted goby *Pomatoschistus pictus*. The lower shore at Skern Point is dominated by mussels *Mytilus edulis* (MytX).

Within the estuary, the majority of the intertidal area from Bideford New Bridge to Penhill Ridge comprises fine sands of varying stability and muddiness. The more stable sediments have the greater species diversity and species richness also increases towards the estuary mouth. There is much local variability: for example, east of Blackstone Rock the sediments are moderately rich with the Baltic tellin *Macoma balthica* and oligochaetes numerically dominant (HedMac.Are). However, across the channel north of Stone Row, the infauna is sparse with very few species and individuals (AEur). The richest intertidal sands are at Skern and at Instow Sands, at the confluence of the Taw and the Torridge. Bivalves, including peppery furrow shells *Scrobicularia plana* and cockles, and the polychaetes *Ampharete lindstroemi* and *Pygospio elegans* are common but patchily distributed. The polychaete *Nephtys cirrosa* and the amphipods *Bathyporeia sarsi* and *Urothoe brevicornis* are also present (MacAre; HedScr).

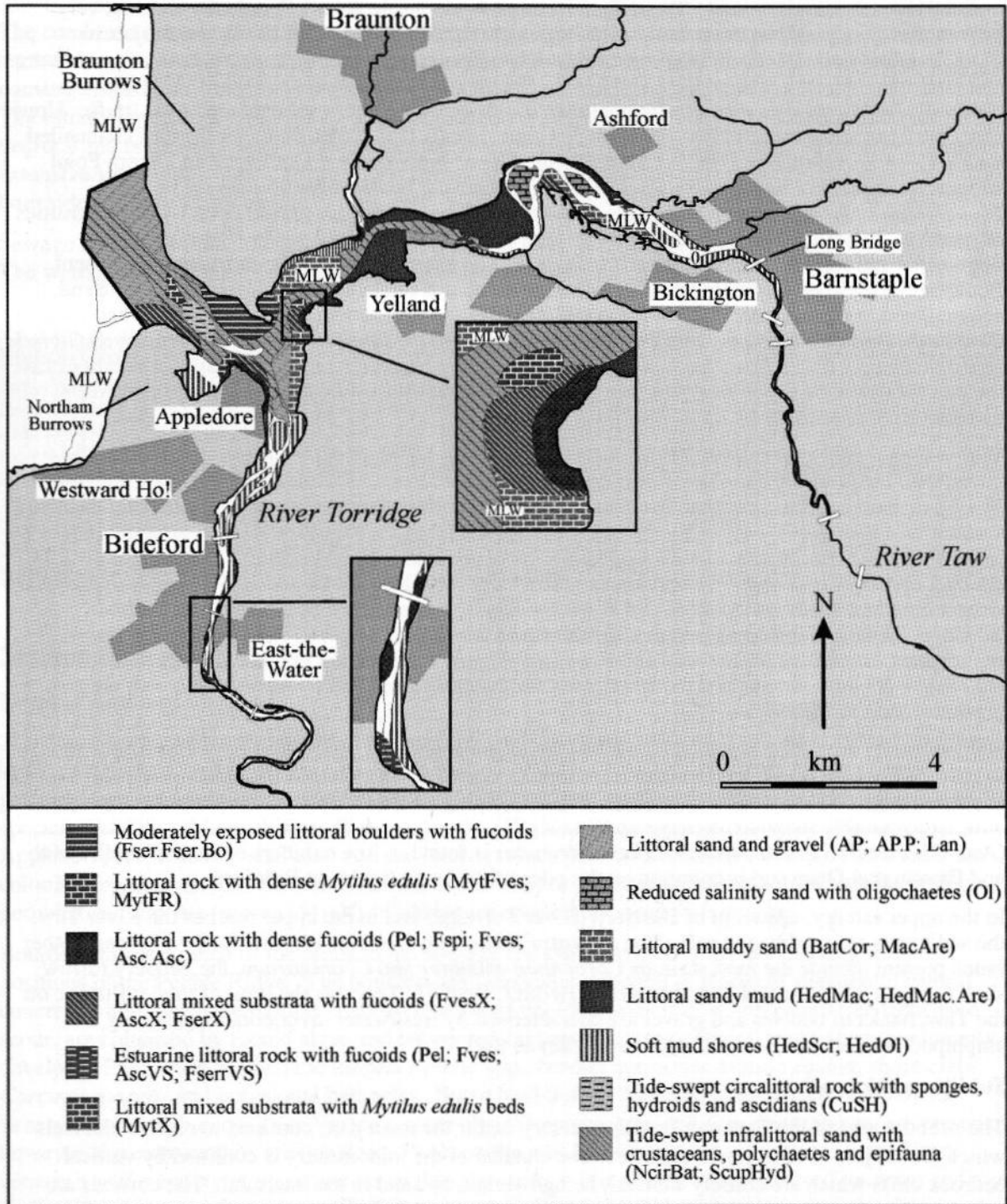
Hard substrata are found at or just below low water in the channel, from just above Barnstaple Bridge to Allen's Rock on the River Taw and from Iron Bridge to downstream of Bideford New Bridge on the River Torridge. These areas are dominated by luxuriant growths of the hydroid *Coryne muscoides* with large mussels abundant on some shores (MytX), sometimes with fucoids on the zone above (Asc.VS; Fserr.VS). The barnacle *Balanus crenatus* is found in low numbers between Penhill Point and Fremington Quay and is common on the piles of the Long Bridge at Bideford.

In the upper estuary, upstream of Bideford (River Torridge) and in the upper reaches the River Taw, the sediments are muddy and soft. The ragworm *Hediste diversicolor* is numerically dominant; other fauna present include the mud shrimps *Corophium volutator* and *C. arenarium*, the peppery furrow shell *S. plana*, oligochaetes and nematodes (HedScr; HedOl). Towards the limit of tidal influence on the Taw, banks of cobbles and gravel are characterised by freshwater invertebrates including the amphipod *Gammarus chevreuxi* and mayfly larvae (Ol).

### Sublittoral biotopes

The subtidal area of the Taw and Torridge estuary is, for the most part, confined to narrow channels which are subject to strong tidal currents. The channel of the joint estuary is confined by vertical bedrock cliffs which are entirely subtidal, being overlain by sand in the intertidal. The currents are strong and the associated communities are species-poor but with high biomass. Hydroids *Obelia longissima*, breadcrumb sponges *Halichondria panicea* and barnacles *Balanus crenatus* are dominant, with frequent shore crabs and mussels *Mytilus edulis* (CuSH). Anemones, dogwhelks *Nucella lapillus* and the sea lemon *Archidoris pseudoargus* are present. At the bottom of the subtidal cliff at Outer Pulley Buoy is a cobble and boulder plain. Hard surfaces here are dominated by hydroids *Obelia longissima* and *Sertularia cupressina* (Flu.SerHyd) and the spaces between boulders and cobbles are inhabited by mussels and sand mason worms *L. conchilega*. An otherwise similar community to that of the bedrock cliff above is present with additional anemones, crabs, branching bryozoans and sparse fine red algae.





**Figure 4.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 4.1, cited literature and additional field observations).

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Tide-swept pebbles, gravel, shells, shell gravel and fine sand are on the floor of the channel from the mouth of the estuary upstream to at least Fremington on the Taw. The infauna of these sediments is characterised by opportunistic or mobile species indicative of high energy disturbance. These include the amphipods *Haustorius arenarius* and *Bathyporeia sarsi*, the polychaete *Nephtys cirrosa* and sand mason worm *L. conchilega* (NcirBat). Mussels *Mytilus edulis* constitute the majority of the epifauna on stones and shells. Other species include hydroids and the ubiquitous sublittoral barnacle *Balanus crenatus* (ScupHyd).

## Nature conservation

| Conservation sites     |                               |                           |   |
|------------------------|-------------------------------|---------------------------|---|
| Site name              | Designation                   | Grid ref.                 | Main features   |
| Braunton Burrows       | Biosphere reserve, cSAC, SSSI | SS 455 340                | Dune habitats, petalwort <i>Petalophyllum ralfsii</i> |
| Northam Burrows        | SSSI                          | SS 445 305                | Coastal habitats, flora, ornithology                  |
| Taw-Torridge estuary   | SSSI                          | SS 470 310                | Ornithology, flora, fish                              |
| Fremington Claypits    | SSSI                          | SS 530 315                | Geology   |
| Fremington Quay Cliffs | SSSI                          | SS 517 340                | Geology   |
| Isley Marsh            | RSPB                          | SS 492 328                | Ornithology, coastal habitats                         |
| North Devon            | HC, AONB                      | SS 574 476-<br>SS 467 318 | Scenery   |

## Human influences

There are harbours at Appledore, Bideford and Barnstaple and ship- and boat-building and repair yards at Appledore and Watertown. There is an oil jetty at Yelland. Sand and gravel extraction occurs within the mouth of the estuary and maintenance dredging is also carried out. The Torridge is a major tourist attraction with large numbers of visitors to Appledore, Bideford and Instow.

Seine-netting for salmon *Salmo salar* has long been carried out on the estuary although the number of licenses has decreased in recent years. Mussels *Mytilus edulis* are collected and there is also an oyster fishery. Bait-digging and collecting occur and there is some grazing on the saltmarshes.

Leisure activities are numerous and particularly intensive during the summer. Water-based sports include sailing, windsurfing and water-skiing, mostly at the mouth of the estuary, and there is a yacht club at Instow and moorings at Appledore, Barnstaple and Bideford. Beach recreation, sand-yachting, riding and other land-based activities occur primarily on the sandy shores around the mouth of the estuary. Wildfowling occurs north of Hollowcombe and around the River Caen.

## References and further reading

- Harris, T. 1985. *A littoral ecological study of the lower Torridge estuary*. Unpublished, Torridge Action Group.
- Little, A.E. 1989. Surveys of harbours, rias and estuaries in southern Britain: Taw and Torridge estuary. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 1,002. (FSC Report, No. FSC/OPRU/10/88.)
- Powell, H.T., Holme, N.A., Knight, S.J.T., & Harvey, R. 1978. Survey of the littoral zone of the coast of Great Britain: Report of the shores of Devon and Cornwall. (Contractor: Scottish Marine Biological Association/Marine Biological Association Intertidal Survey Unit.) *Nature Conservancy Council, CSD Report*, No. 209.

## Sites surveyed

Survey 259: HRE survey of the Taw and Torridge estuary 1988 (Little 1989).

Survey 609: Lower Torridge estuary littoral survey, 1984-1985 (unpublished data).

| <b>Littoral sites</b> |             |                                      |                       |                           |  |
|-----------------------|-------------|--------------------------------------|-----------------------|---------------------------|--|
| <i>Survey</i>         | <i>Site</i> | <i>Place</i>                         | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i>  |
| 259                   | 2           | Pulley Ridge                         | SS 449 323            | 51°04.1'N 04°12.8'W       | MytFR; MytX; H   |
| 259                   | 3           | N of Grey Sands                      | SS 445 319            | 51°03.8'N 04°13.1'W       | Fves; G; AP.P  |
| 259                   | 4           | W Crow Ridge                         | SS 457 322            | 51°04.0'N 04°12.1'W       | FvesB; Fser.Fser.Bo;<br>FK   |
| 259                   | 5           | N and W of Crow Ridge                | SS 453 327            | 51°04.3'N 04°12.5'W       | AP; AEur   |
| 259                   | 6           | The Skern                            | SS 454 310            | 51°03.4'N 04°12.3'W       | HedScr   |
| 259                   | 7           | Penhill Ridge                        | SS 518 345            | 51°05.4'N 04°06.9'W       | Pel; Fspi; FvesX;<br>BatCor  |
| 259                   | 8           | Foxhole                              | SS 514 349            | 51°05.6'N 04°07.3'W       | BPat.Cat; Ent; Rho;<br>Pel; Asc.Asc                                |
| 259                   | 9           | Bassetts Ridge                       | SS 512 348            | 51°05.5'N 04°07.5'W       | AEur   |
| 259                   | 10          | Fremington Pill                      | SS 513 332            | 51°04.7'N 04°07.3'W       | HedScr   |
| 259                   | 11          | Fremington Rock to Allen's Rock      | SS 503 333            | 51°04.7'N 04°08.2'W       | Pel; Fves; Asc.VS;<br>Fserr.VS                                     |
| 259                   | 12          | E of Blackstone Rock                 | SS 491 339            | 51°05.0'N 04°09.2'W       | HedMac.Are; HedScr   |
| 259                   | 13          | N of Stone Row                       | SS 492 335            | 51°04.8'N 04°09.1'W       | AEur   |
| 259                   | 14          | S of Pill's Mouth                    | SS 483 334            | 51°04.7'N 04°09.9'W       | Pel; Fspi; Fves; Asc;<br>Fser                                      |
| 259                   | 15          | Skern Point                          | SS 460 311            | 51°03.4'N 04°11.8'W       | YG; Ver.Ver;<br>BPat.Cht; Ent; Pel;<br>Fspi; Asc.Asc; MytX;<br>Cor |
| 259                   | 16          | Broad Sands                          | SS 465 321            | 51°04.0'N 04°11.4'W       | EphX; BatCor; HedScr   |
| 259                   | 17          | Sprat Ridge                          | SS 463 313            | 51°03.5'N 04°11.6'W       | MytX; H  |
| 259                   | 18          | Cool Stone                           | SS 471 321            | 51°04.0'N 04°10.9'W       | Pel; Fspi; Asc.Asc;<br>MytFR; Rkp; Cor;<br>SwSed                   |
| 259                   | 19          | N of Instow Barton Marsh             | SS 475 322            | 51°04.1'N 04°10.6'W       | HedScr   |
| 259                   | 20          | Instow Sands                         | SS 472 312            | 51°03.5'N 04°10.8'W       | MacAre   |
| 259                   | 21          | Hallspill                            | SS 470 237            | 50°59.5'N 04°10.8'W       | HedOl  |
| 259                   | 22          | (Pillmouth) Iron Bridge              | SS 463 246            | 50°59.9'N 04°11.4'W       | Fspi; Fves; FvesX;<br>Fcer; HedScr; HedOl                          |
| 259                   | 23          | E of Upcott                          | SS 453 253            | 51°00.3'N 04°12.3'W       | Fves   |
| 259                   | 24          | S of Bideford                        | SS 453 257            | 51°00.5'N 04°12.3'W       | YG; Ent; Fves;<br>Asc.Asc; HedScr                                  |
| 259                   | 25          | Bideford Long Bridge                 | SS 455 264            | 51°00.9'N 04°12.1'W       | BPat; Fves; Ent  |
| 259                   | 26          | Bideford New Bridge                  | SS 459 278            | 51°01.7'N 04°11.8'W       | Pel; Fves  |
| 259                   | 27          | N of the Cleve                       | SS 459 287            | 51°02.1'N 04°11.8'W       | Ver.Ver; Pel; Fspi;<br>Fves; Asc.Asc; FserX;<br>HedScr             |
| 259                   | 28          | S of Stray Park wood                 | SS 568 284            | 51°02.1'N 04°02.5'W       | Ol   |
| 259                   | 29          | E of Tower Park                      | SS 560 308            | 51°03.4'N 04°03.3'W       | HedOl  |
| 259                   | 30          | SE of Long Bridge                    | SS 561 327            | 51°04.5'N 04°03.2'W       | HedOl  |
| 259                   | 31          | E of Pottington Estate               | SS 548 332            | 51°04.7'N 04°04.3'W       | Sm   |
| 259                   | 32          | W of Pottington Estate               | SS 537 339            | 51°05.1'N 04°05.3'W       | Fves; Fcer; HedMac   |
| 609                   | 1           | Instow Sands                         | SS 470 310            | 51°03.4'N 04°11.0'W       | BarSnd   |
| 609                   | 2           | Instow Sands (North)                 | SS 472 316            | 51°03.8'N 04°10.8'W       | Pel; Fves; Asc   |
| 609                   | 4           | W Of Westleigh                       | SS 465 297            | 51°02.7'N 04°11.4'W       | Pel; FvesX; HedScr   |
| 609                   | 5           | W of East-the-Water                  | SS 457 268            | 51°01.1'N 04°11.9'W       | HedScr   |
| 609                   | 6           | Saltmarsh S of Bideford Bridge       | SS 458 248            | 51°00.1'N 04°11.8'W       | Sm   |
| 609                   | 7           | Appledore, opposite Instow Quay      | SS 465 302            | 51°03.0'N 04°11.4'W       | Fves; Fser.Fser; Zmar  |
| 609                   | 8           | Appledore, below the church          | SS 465 306            | 51°03.2'N 04°11.4'W       | Pel; AscX; FvesX;<br>FserX; Lan                                    |
| 609                   | 9           | Appledore, N of the church           | SS 463 310            | 51°03.4'N 04°11.6'W       | FvesX; LMX; Pel  |
| 609                   | 10          | Appledore, opposite Braunton Burrows | SS 459 311            | 51°03.4'N 04°11.9'W       | MytX   |
| 609                   | 11          | Skern                                | SS 455 308            | 51°03.3'N 04°12.2'W       | HedScr   |
| 609                   | 12          | Northern end of Northam Burrows      | SS 445 320            | 51°03.9'N 04°13.1'W       | FvesX; FserX   |
| 609                   | 13          | The Pole Sand                        | SS 460 314            | 51°03.6'N 04°11.8'W       | FvesX; AP  |

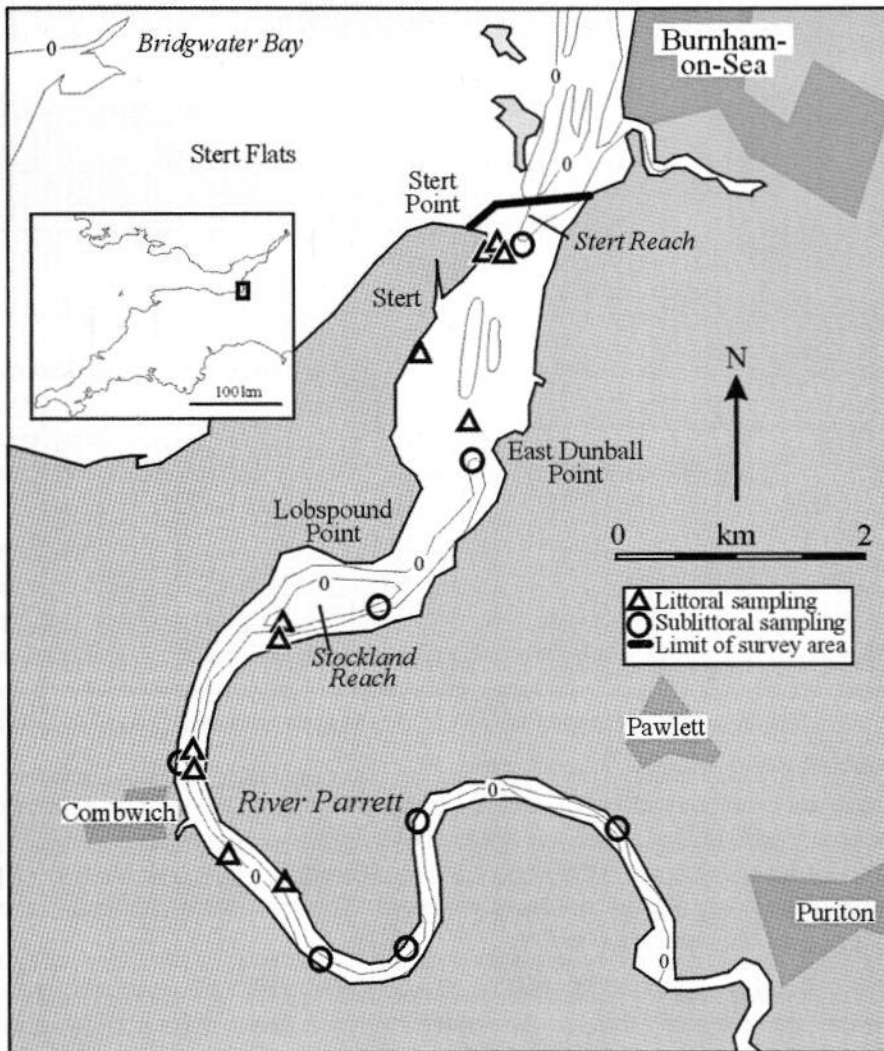
| <b>Sublittoral sites</b> |             |                                      |                       |                           |                         |
|--------------------------|-------------|--------------------------------------|-----------------------|---------------------------|-------------------------|
| <i>Survey</i>            | <i>Site</i> | <i>Place</i>                         | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i> |
| 259                      | 35          | Outer Pulley Buoy (to Old Wall Rock) | SS 448 328            | 51°04.3'N 04°12.9'W       | CuSH; Flu.SerHyd        |
| 259                      | D1          | Bideford Bar                         | SS 435 335            | 51°04.7'N 04°14.0'W       | NcirBat                 |
| 259                      | D2          | Middle Ridge                         | SS 441 332            | 51°04.5'N 04°13.5'W       | ScupHyd                 |
| 259                      | D3          | Outer Pulley                         | SS 449 327            | 51°04.3'N 04°12.8'W       | NcirBat                 |
| 259                      | D4          | Off Grey Sands                       | SS 453 316            | 51°03.7'N 04°12.4'W       | ScupHyd                 |
| 259                      | D5          | Allen's Rock                         | SS 502 335            | 51°04.8'N 04°08.3'W       | NcirBat                 |
| 259                      | D6          | Off Pill's Mouth                     | SS 484 334            | 51°04.7'N 04°09.8'W       | NcirBat                 |
| 259                      | D7          | Skern Point                          | SS 462 312            | 51°03.5'N 04°11.6'W       | NcirBat                 |

Compiled by:

Jan Smith and Jon Moore

**Location**

|                                 |                |                   |
|---------------------------------|----------------|-------------------|
| <i>Position (centre)</i>        | ST 270 440     | 51°12'N 03°01'W   |
| <i>County/district</i>          | Somerset       | West Somerset     |
| <i>Conservation agency/area</i> | English Nature | Somerset and Avon |



**Figure 5.1** Main features of the area and sites surveyed.

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**Marine biological surveys**

|                    | <i>Survey method</i>                                | <i>Date of survey</i> | <i>Source</i>                              |
|--------------------|---|-----------------------|--|
| <i>Littoral</i>    | Infaunal sampling (cores)                           | September 1997        | Analytical & Environmental Services (1997) |
|                    | Infaunal sampling (0.1m <sup>2</sup> Van Veen grab) | September 1997        | Analytical & Environmental Services (1997) |
| <i>Sublittoral</i> | Infaunal sampling (0.1m <sup>2</sup> Van Veen grab) | September 1997        | Analytical & Environmental Services (1997) |

## Introduction

The River Parrett is a bar-built estuary that flows into the Bristol Channel via the Bridgwater Bay embayment. From its mouth, at Stert Point, to Bridgwater, the inlet is a meandering channel, bounded for much of its length by sea defences. Beyond Bridgwater the river is increasingly canalised to the limit of sea water penetration.

### Physical features

|                            |  |
|----------------------------|--|
| <i>Physiographic type</i>  | Bar-built estuary  |
| <i>Length of coast</i>     | 80 km  |
| <i>Area of inlet</i>       | 575 ha (approx.)   |
| <i>Length of inlet</i>     | 38 km (from Stert Point)   |
| <i>Bathymetry</i>          | Main channel extremely shallow, generally 0.3 m with 1.8 m max depth (channel dries at East Dunball Point) |
| <i>Wave exposure range</i> | Sheltered  |
| <i>Tidal stream range</i>  | Not known  |
| <i>Tidal range</i>         | 9.7 m  |
| <i>Salinity range</i>      | Full to upper estuarine  |

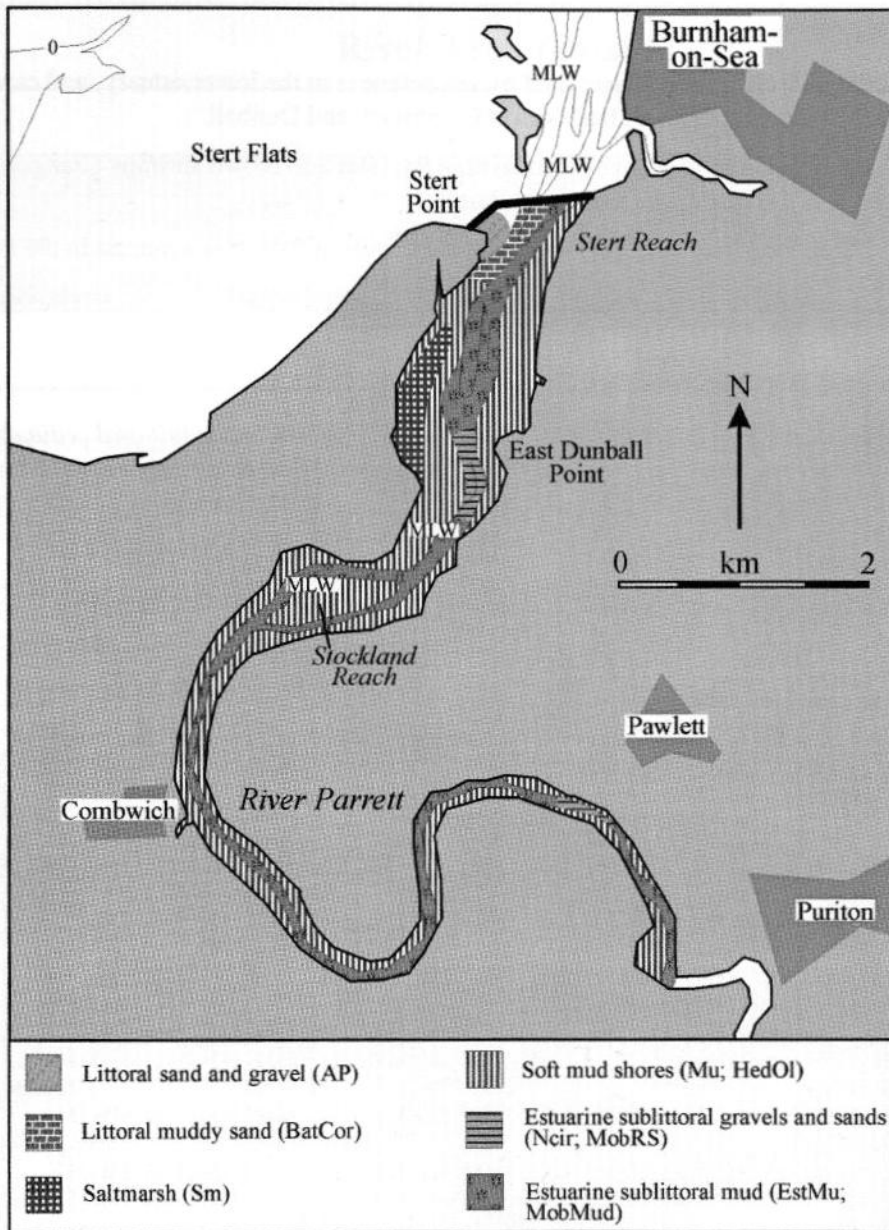
## Marine biology

In common with the other sub-estuaries of the Severn, the River Parrett is dominated by mud which is influenced by low salinities and strong tidal currents. At low water the soft, muddy sediments form extensive mudflats, and the subtidal forms a narrow, steep-sided channel which almost completely dries out on low spring tides. Where artificial hard substratum occurs, such as wooden groynes, it supports fucoid algae.

The River Parrett supports an impoverished fauna. At the mouth of the estuary, off Stert Point, the upper banks of littoral pebbles, shell and sand support the mud shrimp *Corophium volutator* (AP). The sand of the upper shore grades to muddy sand on the mid- to lower shore, where the mud shrimp *C. volutator* is joined by the amphipod *Bathyporeia pilosa* (BatCor). Most of the littoral mud is dominated by mud shrimps *C. volutator* and ragworms *Hediste diversicolor* (HedOI); the mud shrimp *C. volutator* is abundant in extremely high numbers in these muds with very little other infauna present.

Areas of saltmarsh are prominent along the estuary, particularly along the mud banks east of Stert. Off Stockland Reach saltmarsh has colonised the banks above the wooden groynes; below the groynes there is soft littoral mud with ragworms *Hediste* and mud shrimps *Corophium* (HedOI). Upstream of Combwich the channel is very narrow and steeply banked. The soft mud is characterised by ragworms *Hediste* and enchytraeid oligochaetes (HedOI).

The sublittoral zone is restricted to small, shallow channels consisting of mud which, as a result of the strong tidal currents, are extremely mobile. South of Combwich Reach there is a high clay content in these mobile, muddy sands with the amphipod *Gammarus salinus* (EstMu). Around Stokeland Reach mobile, muddy sand supports an impoverished fauna of polychaete worms *Nephtys* spp. and the Baltic tellin *Macoma baltica* (MobMud).



**Figure 5.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 5.1, cited literature and additional field observations).

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## Nature conservation

| Conservation sites |   |            |  |
|--------------------|---|------------|--|
| Site name          | Designation                               | Grid ref.  | Main features  |
| Severn estuary     | possible SAC                              | ST 480 830 | Estuarine habitats, intertidal mudflats and sandflats, subtidal sandbanks, saltmarsh |
| Bridgwater Bay     | Ramsar, SPA, part ST 290 480<br>NNR, SSSI |            | Ornithology, coastal habitats, flora, invertebrates                                  |

## Human influences

The course of the inlet is heavily constrained by sea defences in the lower estuary, and canalisation in the upper parts. There are ports and harbours at Combwich and Dunball.

Fishing for eels *Anguilla anguilla* takes place within the inlet and brown shrimps *Crangon crangon* are fished in the bay just outside the mouth of the Parrett.

Sailing and motorboating take place in the mouth of the inlet and there is a marina in the former docks at Bridgwater.

## References and further reading

Analytical & Environmental Services. 1997. *Survey of the littoral and sublittoral sediments of the River Parrett, Severn estuary, Somerset.* (Contractor: Analytical & Environmental Services, Wallsend.) Unpublished report to the Joint Nature Conservation Committee. (AES Report, No. 02094RR002il.)

## Sites surveyed

Survey 760: Analytical & Environmental Services (AES) River Parrett, Severn estuary, survey 1997 (AES 1997).

| Littoral sites |      |  |                |                     |                  |
|----------------|------|--|----------------|---------------------|------------------|
| Survey         | Site | Place  | Grid reference | Latitude/longitude  | Biotopes present |
| 760            | 1    | Windmill Point   | ST 278 412     | 51°09.9'N 03°01.8'W | Mu               |
| 760            | 2    | West Clyce   | ST 268 417     | 51°10.2'N 03°02.7'W | Mu               |
| 760            | 3    | By fence opposite Combwich                                 | ST 263 427     | 51°10.7'N 03°03.2'W | HedOl            |
| 760            | 4    | Saltmarsh downstream of pylons near Stockland Reach        | ST 270 437     | 51°11.2'N 03°02.6'W | Mu               |
| 760            | 5    | Nr Stockland Reach upstream of pylons below wooden pilings | ST 269 438     | 51°11.3'N 03°02.6'W | Mu               |
| 760            | 6    | Stert Point High Shore                                     | ST 289 469     | 51°12.9'N 03°01.0'W | AP               |
| 760            | 7    | Stert Point Mid-Shore                                      | ST 289 468     | 51°12.9'N 03°01.0'W | BatCor           |
| 760            | 8    | Stert Point Lower Shore                                    | ST 290 468     | 51°12.9'N 03°00.9'W | BatCor           |
| 760            | 9    | Saltmarsh gully upstream of Fenning Island                 | ST 282 460     | 51°12.5'N 03°01.6'W | Mu               |
| 760            | 10   | Upstream of Combwich                                       | ST 263 420     | 51°10.3'N 03°03.2'W | Mu               |
| 760            | 13   | Combwich Reach S opposite Whalebone Sculpture              | ST 271 410     | 51°09.8'N 03°02.5'W | EstMu            |

| Sublittoral sites |      |   |                |                     |                  |
|-------------------|------|---|----------------|---------------------|------------------|
| Survey            | Site | Place   | Grid reference | Latitude/longitude  | Biotopes present |
| 760               | 11   | Opposite Brickyard Farm                             | ST 296 419     | 51°10.3'N 03°00.3'W | MobRS            |
| 760               | 12   | Marchants Reach opposite beacon                     | ST 280 422     | 51°10.4'N 03°01.7'W | MobRS            |
| 760               | 13   | Combwich Reach S opposite Whalebone Sculpture       | ST 271 410     | 51°09.8'N 03°02.5'W | EstMu            |
| 760               | 14   | Combwich Reach NW bank                              | ST 260 428     | 51°10.7'N 03°03.4'W | Mu               |
| 760               | 15   | Stockland Reach opposite outfall                    | ST 277 439     | 51°11.3'N 03°02.0'W | MobMud           |
| 760               | 16   | SE east Dunball Point opposite red and white beacon | ST 286 451     | 51°12.0'N 03°01.2'W | Ncir             |
| 760               | 17   | NW of East Dunball Point                            | ST 284 455     | 51°12.2'N 03°01.4'W | MobMud           |
| 760               | 18   | Stert Reach   | ST 292 468     | 51°12.9'N 03°00.8'W | MobMud           |

Compiled by: Kate Northen and Mike Little

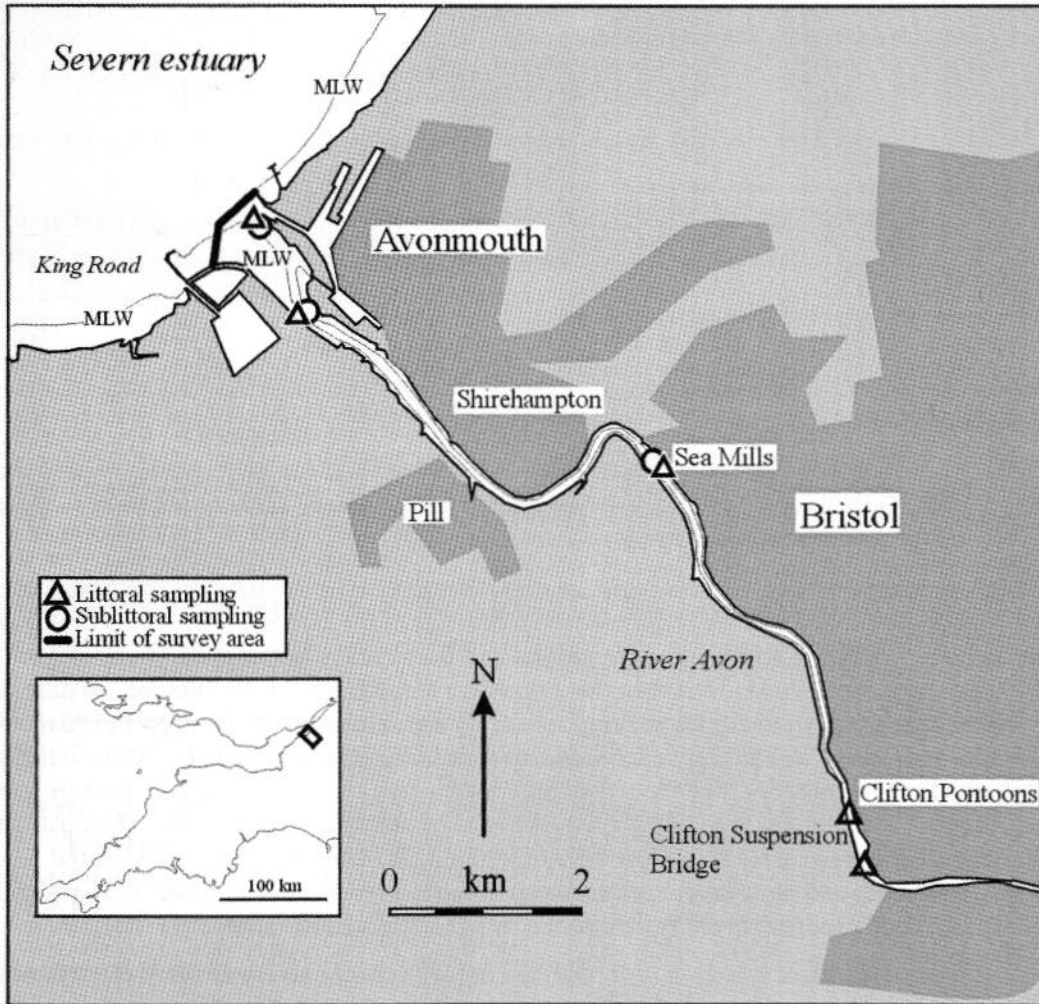


## 6

## River Avon (Bristol)

## Location

|                                 |                          |   |
|---------------------------------|--------------------------|---|
| <i>Position (centre)</i>        | ST 535 760               | 51°29.5' N 02°42.5' W                           |
| <i>Administrative area</i>      | Gloucestershire, Bristol | City & County of Bristol, South Gloucestershire |
| <i>Conservation agency/area</i> | English Nature           | Somerset and Avon                               |



**Figure 6.1** Main features of the area and sites surveyed.

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## Marine biological surveys

|                    | <i>Survey method</i>                                    | <i>Date of survey</i> | <i>Source</i>           |
|--------------------|---|-----------------------|-------------------------|
| <i>Littoral</i>    | Infaunal sampling (2 x 0.1m <sup>2</sup> Van Veen grab) | June 1987             | Morrissey & Sait (1988) |
| <i>Sublittoral</i> | Infaunal sampling (2 x 0.1m <sup>2</sup> Van Veen grab) | June 1987             | Morrissey & Sait (1988) |

## Introduction

The River Avon is narrow and bounded in its upper reaches by the Avon Gorge. At Avonmouth the surrounding land is flat and has been extensively modified by man and there are a number of docks and a large industrial complex. The tidal range is large, tidal streams are rapid and most of the intertidal area consists of steep banks of fine sediments. The inlet receives domestic effluents from the residential areas of Bristol that surround the upper estuary, and it receives industrial wastes at Avonmouth. The combination of small tidal area and pollution results in a low species diversity and the inlet currently does not have high conservation interest.

### Physical features

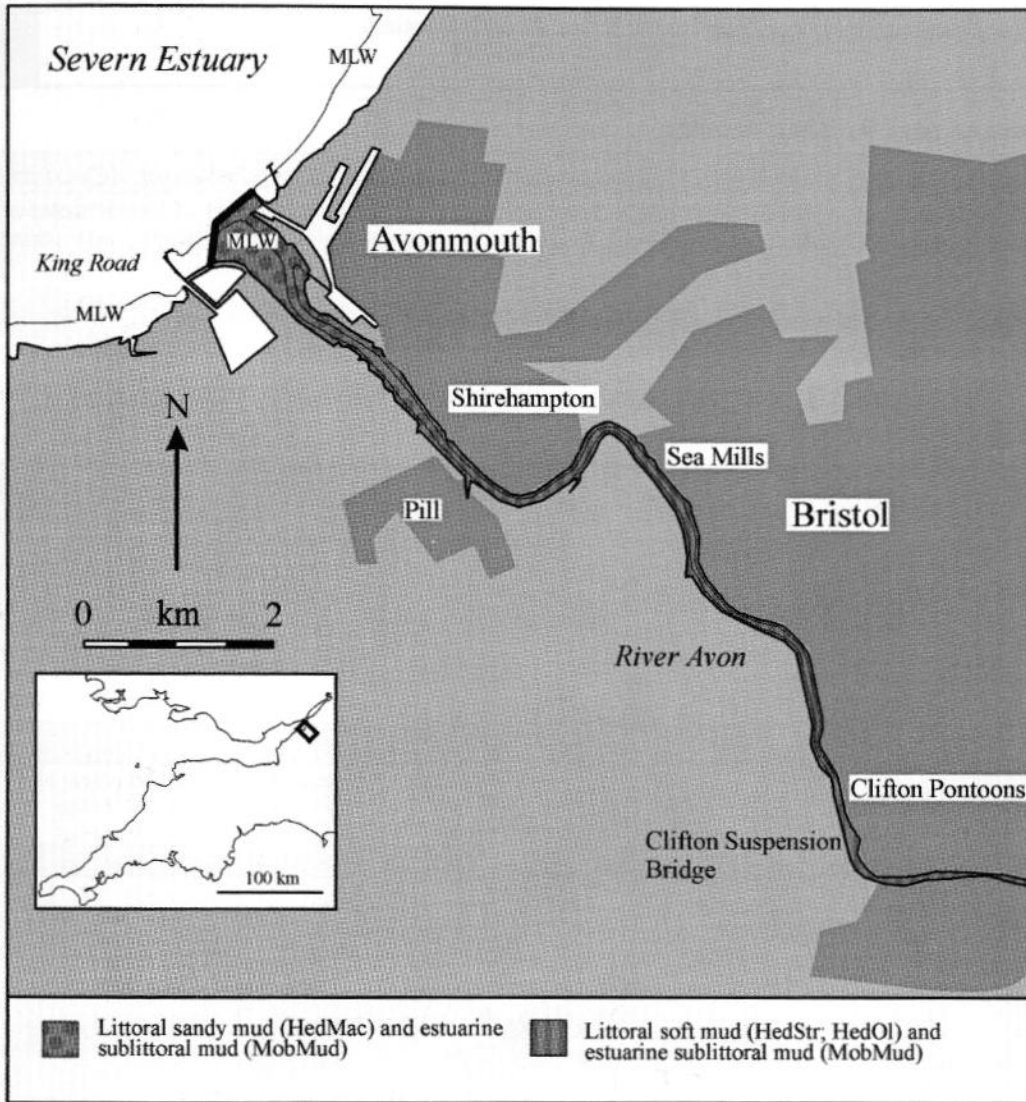
|                            |   |
|----------------------------|---|
| <i>Physiographic type</i>  | Coastal plain estuary   |
| <i>Length of coast</i>     | 24 km   |
| <i>Area of inlet</i>       | 3 km <sup>2</sup>   |
| <i>Length of inlet</i>     | 12 km   |
| <i>Bathymetry</i>          | Mid-estuary channel 0.2 m to 0.9 m deep, lower estuary 1 m to 4 m deep; 5 m contour 1 nm off the mouth of the estuary |
| <i>Wave exposure range</i> | Sheltered   |
| <i>Tidal stream range</i>  | Very strong   |
| <i>Tidal range</i>         | 12.2 m (Avonmouth); 11.5 m (Shirehampton)   |
| <i>Salinity range</i>      | Estuarine   |

## Marine biology

The whole estuary is dominated by soft, muddy sediments which are influenced by low salinities and strong tidal currents. The narrow channel has steep sides and almost completely dries on low spring tides. The subtidal zone is confined to the centre of the estuary channel and has not been surveyed; littoral hard substrata (sea walls) have also not been described.

The muddy sands at the mouth of the estuary are exposed to relatively higher salinities and support a greater diversity of infaunal species in comparison to the rest of the estuary. The sediment infauna in this area is similar to the lugworm *Arenicola marina* and Baltic tellin *Macoma balthica* biotope (HedMac), although diversity is lower than that normally characteristic of this biotope. Within the estuary the reduced salinity conditions are emphasised by the dominance of the ragworm *Hediste diversicolor*, oligochaetes and the Baltic tellin *Macoma balthica* (HedStr; HedOl). A few other species able to tolerate the low salinities, like the polychaete *Streblospio* sp. and the isopod *Cyathura carinata*, are also present. Grab samples typically contained a total of just five or six species. Upstream of the M5 motorway bridge the salinity is too low to support the Baltic tellin *Macoma balthica*, the polychaete *Streblospio* and most other species except oligochaetes and low numbers of ragworm *Hediste*. These muddy sediments are typical of the riverine oligochaete biotope (HedOl).

Subtidal sediments are characterised by soft, mobile mud with few or no species present (MobMud).



**Figure 6.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 6.1, cited literature and additional field observations).

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## Nature conservation

### Conservation sites

| Site name  | Designation                | Grid ref.  | Main features            |
|------------|----------------------------|------------|--------------------------|
| Avon Gorge | part NNR, SSSI,<br>part NT | ST 560 743 | Woodland, flora, geology |

## Human influences

The conurbation of Bristol extends from the city centre westwards along the north bank of the River Avon, and merges with the industrial area of Avonmouth, where there are several docks. There are a number of sewage discharges into this stretch of river, only a small proportion of which carry treated effluent. The south bank of the river, by comparison, is less urbanised, with forested walks along the Avon Gorge National Nature Reserve which follows the river.

The main leisure activity occurring on the River Avon is boating.

### References and further reading

Morrisey, D.J., & Sait, S.M. 1988. *Ecology of the sub-estuaries of the River Severn*. (Contractor: University of Bristol, Department of Zoology, Bristol.) Unpublished report to Department of Energy, Energy Technology Support Unit. (ETSU Report, No. ETSU-TID-4057.)

### Sites surveyed

Survey 489: University of Bristol sub-estuaries of the River Severn survey 1987 (Morrisey & Sait 1988).

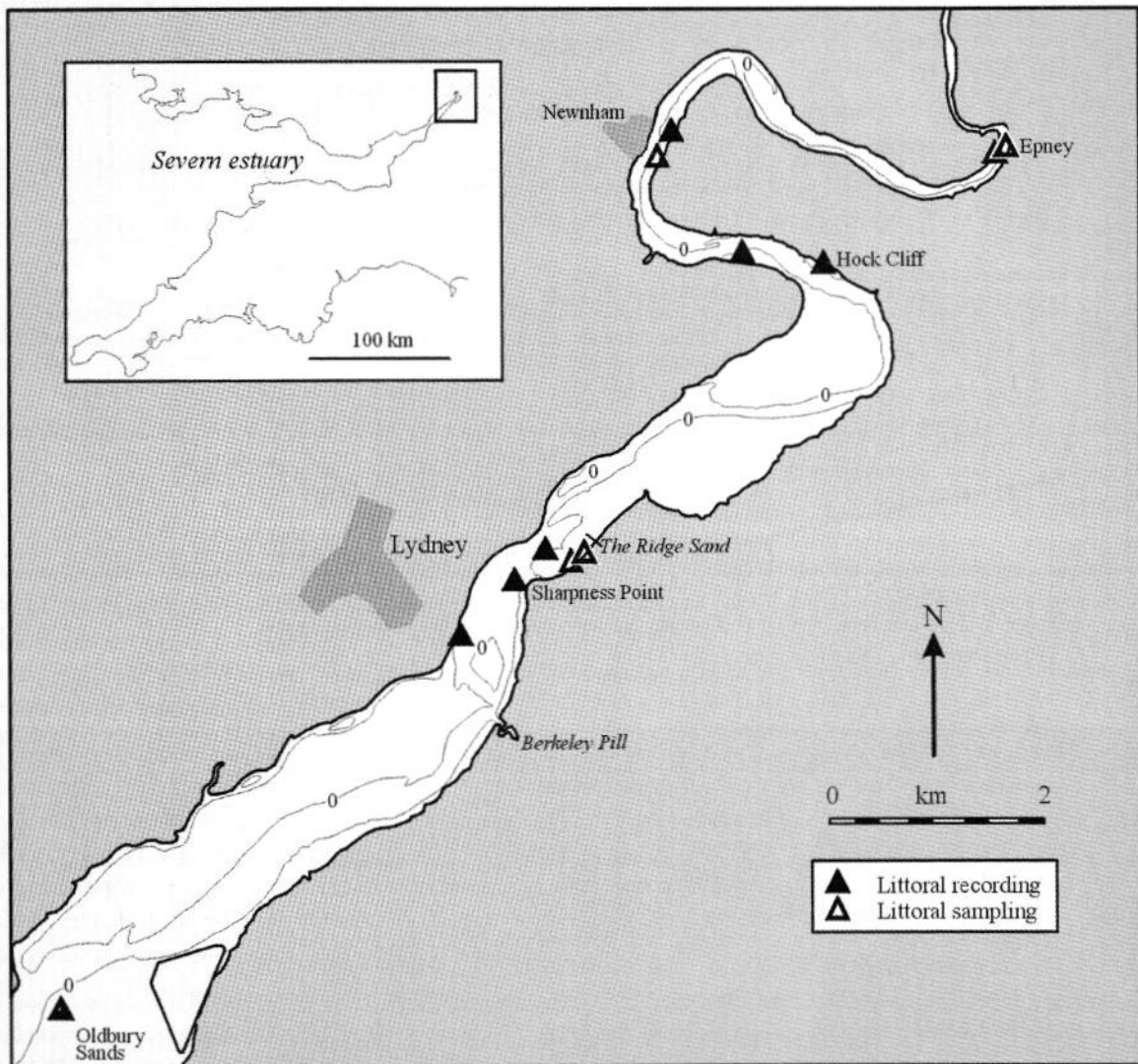
| Littoral sites |      |                  |                |                     |                  |
|----------------|------|------------------|----------------|---------------------|------------------|
| Survey         | Site | Place            | Grid reference | Latitude/longitude  | Biotopes present |
| 489            | 1    | Avon Bridge      | ST 565 723     | 51°26.8'N 02°37.5'W | HedOI            |
| 489            | 2    | Clifton pontoons | ST 565 729     | 51°27.1'N 02°37.5'W | HedOI            |
| 489            | 3    | Sea Mills        | ST 545 765     | 51°29.1'N 02°39.3'W | HedOI            |
| 489            | 4    | Nelson Point     | ST 507 778     | 51°29.7'N 02°42.6'W | HedStr; HedOI    |
| 489            | 5    | Avonmouth        | ST 503 788     | 51°30.3'N 02°42.9'W | HedOI; HedMac    |

| Littoral sites |      |              |                |                     |                  |
|----------------|------|--------------|----------------|---------------------|------------------|
| Survey         | Site | Place        | Grid reference | Latitude/longitude  | Biotopes present |
| 489            | 3    | Sea Mills    | ST 545 765     | 51°29.1'N 02°39.3'W | MobMud           |
| 489            | 4    | Nelson Point | ST 507 778     | 51°29.7'N 02°42.6'W | MobMud           |
| 489            | 5    | Avonmouth    | ST 503 788     | 51°30.3'N 02°42.9'W | MobMud           |

## Severn estuary

## Location

|                                 |  |   |
|---------------------------------|--|---|
| <i>Position (centre)</i>        | ST 400 800   | 51°29'N 02°56'W   |
| <i>Administrative area</i>      | Gloucestershire, Somerset,<br>Monmouthshire, Vale of Glamorgan | S Gloucestershire, City & County of Bristol,<br>Forest of Dean, Stroud, Sedgemoor,<br>N Somerset, W Somerset Newport, Cardiff,<br>Vale of Glamorgan |
| <i>Conservation agency/area</i> | English Nature<br>Countryside Council for Wales                | Somerset, Three Counties<br>South   |



**Figure 7.1** Main features of the upper Severn estuary and sites surveyed.

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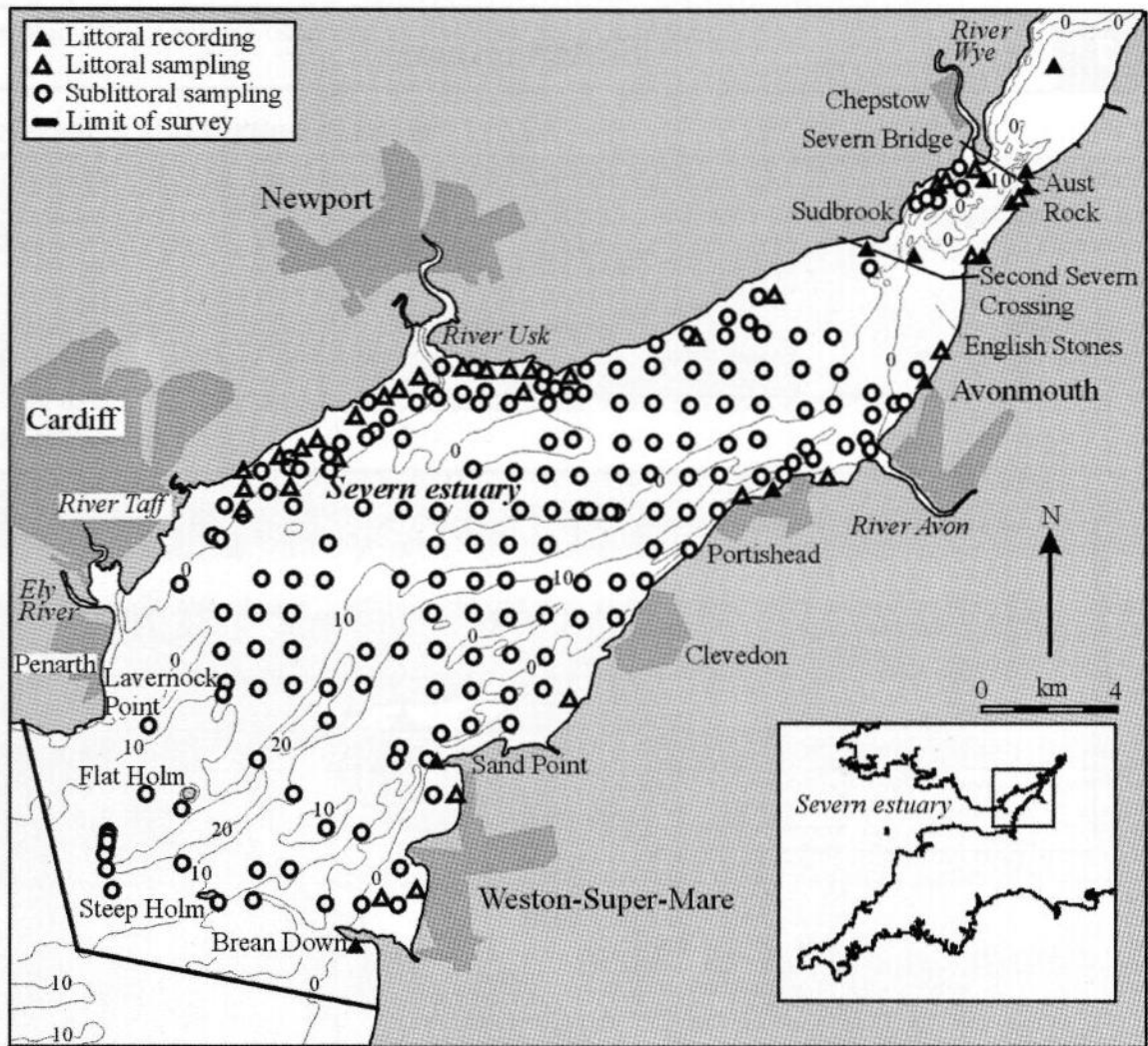


Figure 7.2 Main features of the lower Severn estuary and sites surveyed.

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**Marine biological surveys**

|                    | <i>Survey method</i>                                 | <i>Date of survey</i>       | <i>Source</i>                                |
|--------------------|--|-----------------------------|--|
| <b>Littoral</b>    | Recording  | Jan. 1973-Dec. 1976         | Roberts (1976)                               |
|                    | Recording  | Jan.-Dec. 1978              | Little & Smith (1980); Smith & Little (1980) |
|                    | Recording  | Aug. 1985                   | Little <i>et al.</i> (1985)                  |
|                    | Infaunal sampling (box cores)                        | July-Oct. 1972              | Boyden & Little (1973)                       |
|                    | Infaunal sampling (box cores)                        | Jan. 1973-Nov. 1975         | Little & Boyden (1976)                       |
|                    | Infaunal sampling (Hunter grab)                      | July-Aug. 1980              | Davies & Jones (1982)                        |
|                    | Infaunal sampling (cores)                            | March-April 1982            | Welsh Water Authority (1984)                 |
|                    | Infaunal sampling (cores)                            | April 1982                  | Jones & Jones (1983)                         |
|                    | Recording  | July 1997                   | MNCR survey 685                              |
| <b>Sublittoral</b> | Infaunal sampling (Day grab and naturalist's dredge) | Aug. 1972, Feb. & Aug. 1973 | Warwick & Davies (1977)                      |
|                    | Infaunal sampling (Hunter grab)                      | July-August 1980            | Davies & Jones (1982)                        |
|                    | Infaunal sampling (Hunter grab)                      | April 1982                  | Welsh Water Authority (1984)                 |
|                    | Infaunal sampling (grab)                             | April 1990                  | Mettam (unpublished data)                    |
|                    | Infaunal sampling (grab)                             | May 1995                    | Mettam (unpublished data)                    |
|                    | Infaunal sampling (Day grab)                         | April-May 1988              | Mettam <i>et al.</i> (1994)                  |

## Introduction

The Severn estuary is the largest coastal plain estuary in the British Isles and has the second highest tidal range in the world (after the Bay of Fundy, Canada). There is a significant freshwater input and so conditions within the estuary vary from essentially marine in the eastern Bristol Channel to upper estuarine at Sharpness. The predominant substrata are muds and sands and yet, owing to its large size, a wide variety of biotopes occur within the Severn estuary. Large areas of the outer channel consist of hard, scoured sea bed with accumulations of the reef-building honeycomb worm *Sabellaria alveolata*. The rapid tidal streams, scoured sea bed, high turbidity and presence of these reefs distinguishes the Severn estuary from the other marine inlets in south-west Britain. This difference is linked to the geomorphology of the inlet, as its shape accentuates the amplitude of the tide resulting in exceptional dynamic conditions.

The estuary has been the subject of a number of studies, many associated with the Severn Tidal Barrage that was proposed in the 1980s. The results of these studies are summarised in a series of reports by the Severn Tidal Power Group with the environmental aspects covered by volume IV (STPG 1989).

| Physical features          |  |
|----------------------------|--|
| <i>Physiographic type</i>  | Coastal plain estuary  |
| <i>Length of coast</i>     | 353 km   |
| <i>Area of inlet</i>       | 55,685 ha  |
| <i>Length of inlet</i>     | 111 km   |
| <i>Bathymetry</i>          | 40 m maximum depth (lower estuary); generally less than 20 m mid-estuary |
| <i>Wave exposure range</i> | Moderately exposed to very sheltered                                     |
| <i>Tidal stream range</i>  | Very strong to moderately strong   |
| <i>Tidal range</i>         | 13.2 m MHWS (Bristol); 15 m MHWS (Avonmouth)                             |
| <i>Salinity range</i>      | Full salinity to reduced   |

## Marine biology

Apart from the muddy and sandy substrates and its mobility, the major factor determining species distribution within the estuary is salinity; no marine species are found permanently higher upstream than Sharpness. In common with its sub-estuaries (the Avon, Wye, and Usk), greater species diversity and numbers of individuals occur at the sides of the channel and in the intertidal, rather than in the main sandy, subtidal bed of the estuary.

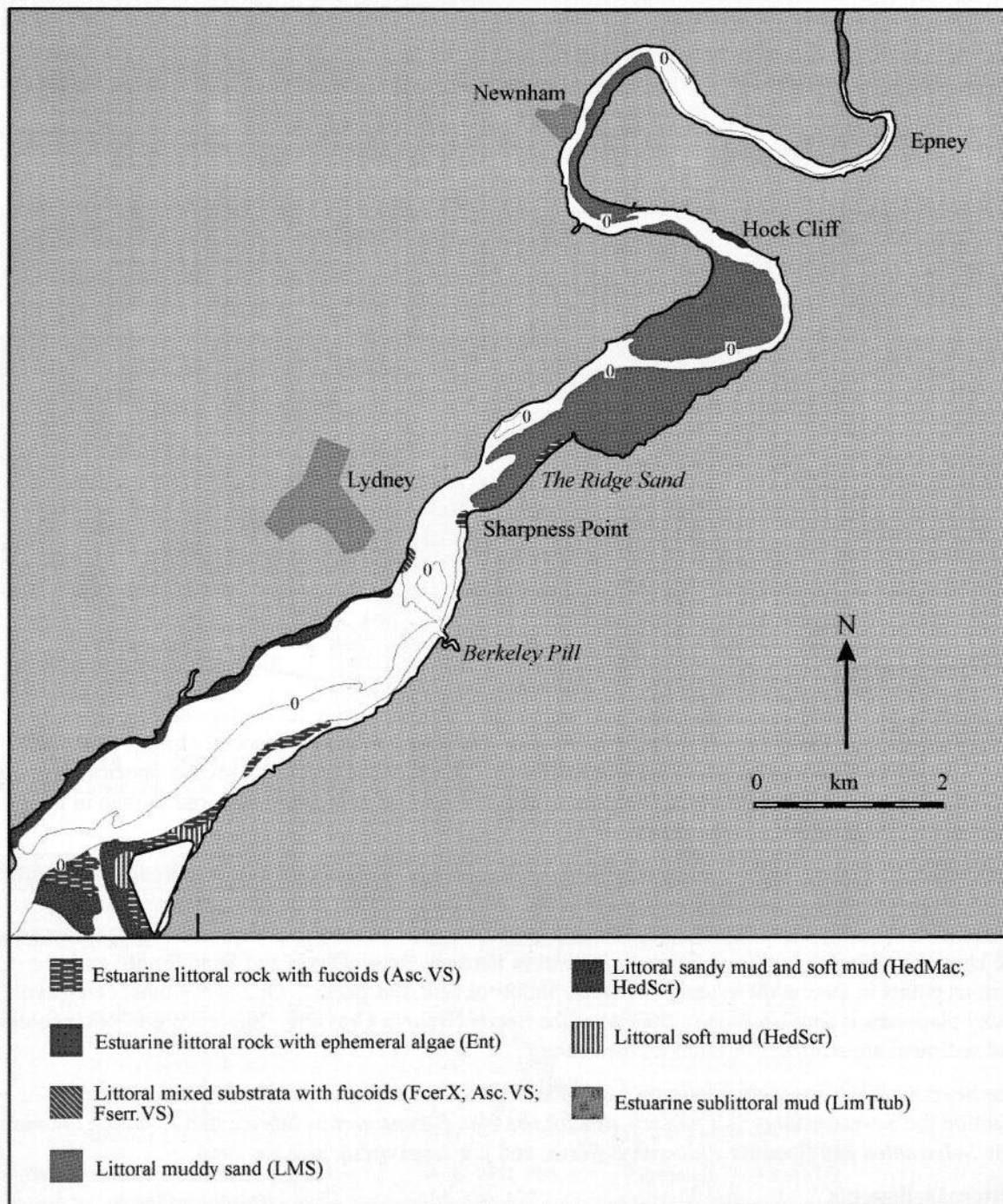
The distribution of intertidal substrata consists predominantly of relatively uniform muddy and sandy sediments with some areas of rock. Muddy sediments occur in the middle reaches of the estuary whereas more sandy beaches occur at the head and in the outer estuary. Rocky shores are present near the entrance to the estuary (e.g. Lavernock Point to Penarth, Brean Down and Sand Point) and at various points in the middle estuary (between Sudbrook and Sharpness). One of the most extensive rocky platforms is English Stones, the site of the Second Severn Crossing. Shores of cobbles, pebbles and sediment are scattered throughout the estuary.

The Severn estuary supports important runs of salmon *Salmo salar* and sea trout *Salmo trutta*. In addition the Severn estuary is a nursery area for sea bass *Dicentrarchus labrax*, dab *Limanda limanda*, sole *Solea solea* and flounder *Platichthys flesus*, and it is a spawning area for sprat.

## Littoral sediments

Most of the available data for the intertidal sediments are from muddy habitats along the north shore of the estuary between Cardiff and Sudbrook. The mud in this area is generally soft and, to a certain extent, mobile and is colonised by high densities of relatively few species characteristic of the *Nephtys hombergii* biotope (HedStr). Other typical species include the Baltic tellin *Macoma balthica*, the ragworm *Hediste diversicolor* and the mud snail *Hydrobia ulvae* (HedMac). The mud shrimp *Corophium volutator* is also widespread on muddy substrata which is often replaced by another mud

shrimp species, *C. arenarium*, in more sandy muds. In some upper mid-shore areas with sandier sediments, the lugworm *Arenicola* and Baltic tellin *Macoma* biotope (MacAre) are present. Here there is a lower diversity of infauna with many of the same dominant species, with the exception of ragworms *Hediste diversicolor* and the addition of lugworms *Arenicola marina*.



**Figure 7.3** Indicative distribution of the main biotopes in the upper Severn estuary (based on data from survey sites shown in Figure 7.1, cited literature and additional field observations).

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The south side of the lower estuary has pockets of littoral sand on the upper shore of Weston Bay (Weston-Super-Mare) and Sand Bay (LGS). Lower down the shore the sediments become muddier (HedMac; HedScr). Littoral mud south-west of Clevedon is so mobile that it supports little or no infauna (Mob).

Upstream of Sudbrook the intertidal sediment shore infauna becomes less diverse as the salinity decreases. The ragworm *Hediste diversicolor* biotope (HedOI) is present at many sites, where it includes large numbers of ragworms, oligochaetes *Tubificoides* spp. and a few other species, but as the salinity decreases further up the estuary the oligochaetes dominate the biotope (HedOI).

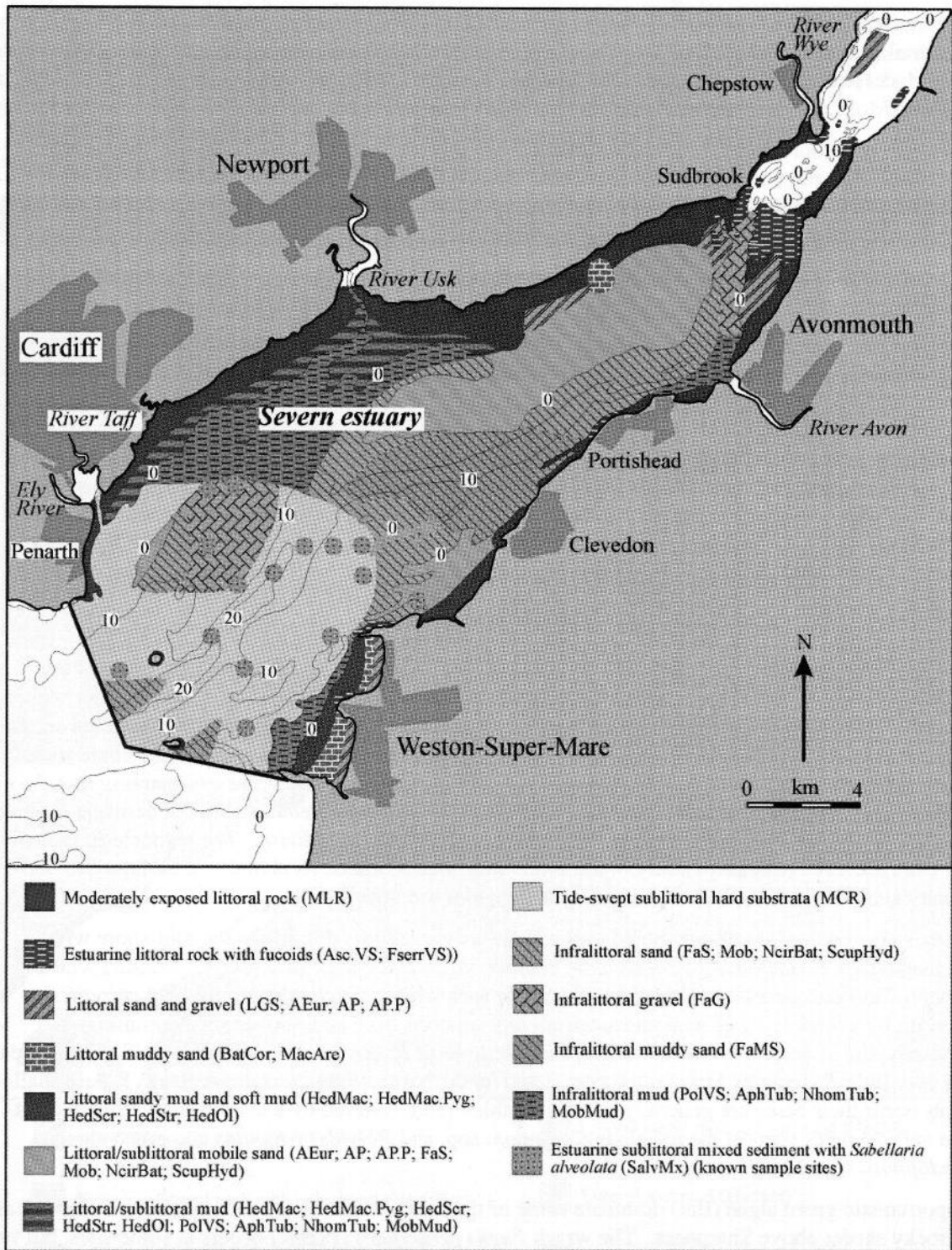
### Littoral rock

Rocky shores near the mouth of the estuary at Lavernock Point and Sand Down have large areas of rock platforms and a variety of typical rocky shore biotopes. Biotope descriptions are limited for these shores, but it is known that they include upper shore *Pelvetia canaliculata* (Pel) and *Fucus spiralis* (Fspi) biotopes, mid-shore barnacle and limpets *Patella* (BPat) biotope and the knotted wrack *Ascophyllum nodosum* (Asc) and some lower shore serrated wrack *Fucus serratus* (Fserr) biotopes. The lower shore spiral wrack *Fucus serratus* community is, however, limited in extent and species diversity, owing to the scouring effects of the strong tides and surrounding mobile sediment. Mixed substratum shores in the lower estuary are colonised by examples of the mid-shore bladder wrack *Fucus vesiculosus* and common periwinkle *Littorina littorea* biotope (FvesX) and the upper shore spiral wrack *Fucus spiralis* biotope (Fspi).

Mid-way up the estuary is English Stones, an extensive sandstone platform across which the second Severn Bridge has been built; this area is dominated by fucoids. The extensive mid-shore of this shallow sloping rock is dominated by serrated wrack *Fucus serratus* with occasional bladder wrack *Fucus vesiculosus* and knotted wrack *Ascophyllum nodosum*, grazed by littorinids. Scattered serrated wrack *Fucus serratus* (Fserr.VS) occurs on the lower shore platform, amidst patches of bare rock, while the estuarine barnacle *Balanus improvisus* occurs on vertical faces and overhanging rock. Sublittoral fringe rock supports the honeycomb worm *Sabellaria alveolata* with the barnacle *Balanus improvisus* and the hydroids *Sertularia cupressina* and *Tubularia indivisa*. The barnacle *B. improvisus* has been recorded extremely rarely in the south-west marine inlets; its abundance at these Severn estuary sites emphasises the very different character of the Severn.

Further upstream at Aust Rock, bladder wrack *Fucus vesiculosus* dominates the mid-shore with serrated wrack *Fucus serratus* beneath the bladder wrack *F. vesiculosus* canopy. Knotted wrack *Ascophyllum nodosum* dominates the lower shore rock which, despite the strong tidal currents, is overlain by a thick layer of mud and subsequently supports only an impoverished community. Similarly, the lower shore reduced salinity serrated wrack *F. serratus* biotope (Fserr.VS) in this area has very little *F. serratus* and is often dominated by the barnacle *Balanus improvisus*. Where shallow pools occur their bases are generally covered in thick mud, covered by a diatom film, while the silt-free vertical faces support the red algae *Ceramium* spp. and *Polyides rotundus* and green algae *Cladophora* spp. and *Ulva* spp.

Opportunistic green algae (Ent) dominate some of the rocky shores in the estuary above Sudbrook and all rocky shores above Sharpness. The wrack *Fucus ceranoides* (FcerX) occurs at some sites, but very low salinity and freshwater run-off typically result in the dominance of green algae *Enteromorpha* spp. and various films of green algae (Ent). Sparse fucoids (bladder wrack *Fucus vesiculosus* and knotted wrack *Ascophyllum nodosum*; Asc.VS) can be found as far upstream as Sharpness Point, although the associated fauna found lower down the estuary (barnacles, littorinid molluscs and limpets *Patella*) are absent.



**Figure 7.4** Indicative distribution of the main biotopes in the lower Severn estuary (based on data from survey sites shown in Figure 7.2, cited literature and additional field observations).

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### Sublittoral

Some gravel sediments with communities similar to the trough shell *Spisula elliptica* biotope are present near the mouth of the estuary, south-east of Cardiff (FaG). These tide-swept gravels are dominated by polychaete worms *Pygospio elegans*, *Streblospio shrubsolei*, *Mediomastus fragilis*, *Melinna cristata* and *Neoamphitrite figulus* together with the sipunculid worm *Golfingia vulgaris vulgaris*. Clumps of honeycomb worm *Sabellaria alveolata* also occur in this area and overlaps with the SalvMx biotope.

In general, the subtidal sediment fauna of the Severn estuary is species-poor because of scouring by mobile sediment and the mobility of substrata; this results from its large tidal range and strong tidal streams (Mettam *et al.* 1994). The large tidal amplitude and high tidal streams result in areas of hard substrata in the lower estuary but elsewhere most areas consist of muddy and sandy sediments. Areas of ground are generally too scoured to allow colonisation by many species, and, with the added stress of high turbidity, macroalgae are absent. The barnacle *Balanus improvisus* occurs in the shallow subtidal in some areas.

The reef-building honeycomb worm *Sabellaria alveolata*, however, occupies a niche in these scoured hard ground areas. The species is known to dominate hard surfaces in the lower Severn (between Brean Down on the south coast and Cardiff on the north) and extensive areas of the Bristol Channel (SalvMx) (Mettam 1997). Descriptions of these reefs are limited, since hard substrata cannot be sampled by grab. However, grab samples from adjacent areas show that areas of coarse sand and gravel are also dominated by surface-binding tubes of the honeycomb worm *S. alveolata*. The stability resulting from this binding has led to increased diversity of polychaetes and other species, particularly of mobile errant polychaetes such as *Typosyllis armillaris* and the *Eulalia tripunctata*. In the UK the formation of these subtidal reefs (*S. alveolata*) is unique to the Severn estuary and Bristol Channel. Honeycomb worm *S. alveolata* reefs are normally restricted to the intertidal zone on Britain's west coast.

The mid-channel sediments are mainly sandy, with a low mud content, and are very mobile and characteristic of the polychaete *Nephtys cirrosa* biotope (Ncir; Mob). This biotope is fairly species-poor, with grab samples typically containing only five or six species in low abundance. The polychaete *Nephtys cirrosa*, the amphipods *Bathyporeia pelagica* and *B. pilosa* and the isopod *Eurydice pulchra* are often, but not always, present. Where muddier sands occur, for example north-west of Clevedon, sediments support an impoverished fauna with the polychaetes *Capitella capitata*, *Scoloplos armiger*, *Nephtys* spp., the amphipod *Gammarus salinus* and isopod *E. pulchra*, none of which occur in great abundance (FaMS).

Outside the channels and near the edges of the Severn, but still in areas subjected to strong tidal currents, mobile, muddy sediments dominate. The infauna of these sediments is more diverse than the mobile sands, but is still impoverished compared with the typical estuarine subtidal mud biotope (NhomTub) that, in the Severn, occurs only in a few relatively stable areas of mud. The polychaetes *Nephtys hombergii* and *Streblospio shrubsolei* are present in moderate abundance in these mobile muds. Other characteristic species include the oligochaete *Tubificoides benedii* and the normally intertidal ragworm *Hediste diversicolor*, Baltic tellin *Macoma baltica* and mud snail *Hydrobia ulvae* (NhomTub). This biotope has not been recorded from any of the other south-west marine inlets.

The mobile sand and mud biotopes described above dominate the subtidal areas of the lower estuary and extend into the upper estuary. The reduced salinity in the upper estuary results in a further reduction in species diversity, but the biotopes are essentially the same. Even further upstream, towards Gloucester, muddy sediments in the transitional zone between marine and fresh water are characterised by the oligochaetes *Limnodrilus hoffmeisteri* and *Tubifex* spp. (LimTub).

## Nature conservation

| Conservation sites                  |                        |            |  |
|-------------------------------------|------------------------|------------|--|
| Site name                           | Designation            | Grid ref.  | Main features  |
| Brean Down                          | SSSI, AoSP, NT         | ST 290 590 | Geology, grassland flora, ornithology  |
| Steep Holm                          | SSSI                   | ST 228 607 | Flora, ornithology   |
| Middle Hope                         | SSSI, NT, WT           | ST 335 665 | Geology, coastal grassland flora   |
| Clevedon Shore                      | SSSI                   | ST 402 719 | Geology  |
| Portishead Pier to Black Nore       | SSSI                   | ST 464 776 | Geology  |
| Aust Cliff                          | SSSI                   | ST 565 894 | Geology  |
| Severn Estuary                      | possible SAC           | ST 480 830 | Estuaries, intertidal mudflats and sandflats, subtidal sandbanks, Atlantic salt meadows              |
| Severn Estuary                      | SPA, Ramsar, SSSI, SMA | ST 480 830 | Ornithology, marine and estuarine habitats, flora, invertebrates, fish, marine biological importance |
| Purton Passage                      | SSSI                   | SO 687 045 | Geology  |
| Upper Severn Estuary                | SPA, Ramsar, SSSI      | SO 710 060 | Ornithology, estuarine habitats, saltmarsh flora   |
| Garden Cliff                        | SSSI                   | SO 718 128 | Geology  |
| Lydney Cliff                        | SSSI                   | SO 654 020 | Geology  |
| Gwent Levels: Magor & Undy          | SSSI, part NT          | ST 440 860 | Lowland wet grassland, flora, invertebrates  |
| Gwent Levels: Redwick & Llandeenny  | SSSI                   | ST 410855  | Lowland wet grassland, flora, invertebrates  |
| Gwent Levels: Whitson               | SSSI                   | ST 390 840 | Lowland wet grassland, flora, invertebrates  |
| Gwent Levels: Nashcliff & Goldcliff | SSSI                   | ST 350 850 | Lowland wet grassland, flora, invertebrates  |
| Gwent Levels: St Brides             | SSSI, part NT          | ST 290 825 | Lowland wet grassland, flora, invertebrates  |
| Flat Holm                           | SSSI, LNR              | ST 220 649 | Ornithology, flora   |
| Redcliffe Bay                       | NT                     | ST 440 762 | Coastal belt   |

## Human influences

There has been extensive land-claim along the Severn estuary for agriculture and industry. Parts of the land surrounding the estuary are highly urbanised and industrialised and consequently there is a considerable amount of industrial waste and sewage effluent input to the estuary. The major industrial towns include Cardiff, Newport and Avonmouth.

The estuaries of the Rivers Taff, Ely and Cardiff Bay, which adjoin the Severn estuary on the north bank, will undergo significant changes with the construction of the Cardiff Bay barrage. This is due to be completed by autumn 1999. Once complete, the total exclusion barrage will create a freshwater lake within Cardiff Bay.

The Severn estuary is the largest fishery for eelers *Anguilla anguilla* in Britain and eels are also caught as a bycatch in salmon putchers in the upper Severn estuary (Aprahamian & Robson 1996).

The estuary is widely used for recreational activities including sailing, with several marinas and areas of moorings, angling and water sports including canoeing.

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### Sites surveyed

- Survey 196: Upper Severn estuary survey 1985 (Little *et al.* 1985).
- Survey 460: Severn Tidal Power Group (STPG) Severn estuary sublittoral survey 1988 (Mettam *et al.*, 1994).
- Survey 487: North shore of the Bristol Channel and Severn estuary littoral survey 1973-1976 (Roberts 1976).
- Survey 488: Southern shore of the Severn estuary littoral infaunal survey 1973-1975 (Little & Boyden 1976).
- Survey 490: Severn estuary rocky shore survey 1975-1978 (Little & Smith 1980).
- Survey 491: Welsh Water Authority: Sewer outfalls in the Severn estuary near Cardiff survey 1982 (Welsh Water Authority 1984).
- Survey 492: Welsh Water Authority: Benthic macrofauna between the Severn Bridge and Cardiff survey 1980 (Davies & Jones 1982).
- Survey 494: Welsh Water Authority: An industrial waste discharge pipe in the Severn estuary littoral survey 1982 (Jones & Jones 1983).
- Survey 495: Infauna on the south coast of the Severn estuary littoral survey 1973 (Boyden & Little 1973).
- Survey 685: MNCR Severn estuary littoral rock survey 1997 (MNCR unpublished data).
- Survey 721: Holm sands, Severn estuary, sublittoral survey 1990 (Mettam, unpublished data).
- Survey 722: Severn estuary sublittoral survey 1995 (Mettam, unpublished data).

| Littoral sites |      |  |                |                     |                                       |
|----------------|------|--|----------------|---------------------|---------------------------------------|
| Survey         | Site | Place                                    | Grid reference | Latitude/longitude  | Biotores present                      |
| 196            | 1    | Chittening Warth, Upper Severn estuary.  | ST 525 813     | 51°31.6'N 02°41.0'W | Sm; HedMac                            |
| 196            | 2    | New Passage, Upper Severn estuary.       | ST 549 866     | 51°34.5'N 02°39.0'W | Fspi; Asc.VS;<br>Fserr.VS             |
| 196            | 3    | Aust, Upper Severn estuary.              | ST 567 894     | 51°36.0'N 02°37.5'W | Fspi; Asc.VS;<br>Fserr.VS; Ol; HedMac |
| 196            | 4    | Sharpness, Upper Severn estuary.         | SO 672 034     | 51°43.6'N 02°28.5'W | Fspi; Fserr.VS; AP;<br>Sm; Mu         |
| 196            | 5    | Hock Cliff, Upper Severn estuary.        | SO 710 092     | 51°46.8'N 02°25.2'W | Sm                                    |
| 196            | 6    | Arlingham Passage, Upper Severn estuary. | SO 696 115     | 51°48.0'N 02°26.4'W | AEur; HedOl                           |
| 460            | 297  | Site 297, Severn estuary.                | ST 232 763     | 51°28.8'N 03°06.3'W | HedStr                                |
| 460            | 298  | Site 298, Severn estuary.                | ST 232 763     | 51°28.8'N 03°06.3'W | HedStr                                |
| 460            | 299  | Site 299, Severn estuary.                | ST 247 778     | 51°29.6'N 03°05.0'W | HedStr                                |
| 460            | 300  | Site 300, Severn estuary.                | ST 262 778     | 51°29.6'N 03°03.7'W | HedStr                                |
| 460            | 304  | Site 304, Severn estuary.                | ST 292 808     | 51°31.2'N 03°01.2'W | HedStr                                |
| 460            | 345  | Site 345, Severn estuary.                | ST 320 808     | 51°31.3'N 02°58.7'W | HedStr                                |
| 460            | 346  | Site 346, River Usk.                     | ST 321 821     | 51°32.0'N 02°58.6'W | HedStr                                |
| 460            | 347  | Site 347, Severn estuary.                | ST 336 821     | 51°32.0'N 02°57.4'W | HedStr                                |
| 460            | 349  | Site 349, Severn estuary.                | ST 366 821     | 51°32.0'N 02°54.8'W | HedMac                                |
| 460            | 353  | Site 353, Severn estuary.                | ST 410 831     | 51°32.6'N 02°51.0'W | HedMac                                |
| 460            | 355  | Site 355, Severn estuary.                | ST 439 834     | 51°32.8'N 02°48.4'W | MacAre                                |
| 460            | 356  | Site 356, Severn estuary.                | ST 440 842     | 51°33.2'N 02°48.4'W | MacAre                                |
| 460            | 357  | Site 357, Severn estuary.                | ST 455 850     | 51°33.6'N 02°47.1'W | HedMac.Pyg                            |
| 460            | 361  | Site 361, Severn estuary.                | ST 425 820     | 51°32.0'N 02°49.7'W | AP.P                                  |
| 460            | 363  | Site 363, Severn estuary.                | ST 410 806     | 51°31.2'N 02°50.9'W | AP.P                                  |
| 460            | 394  | Site 394, Severn estuary.                | ST 499 863     | 51°34.4'N 02°43.3'W | HedOl                                 |
| 460            | 423  | Site 423, Severn estuary.                | ST 303 599     | 51°20.0'N 02°59.9'W | HedScr                                |

## Littoral sites - continued

| Survey | Site | Place   | Grid reference | Latitude/longitude  | Biotopes present        |
|--------|------|---|----------------|---------------------|-------------------------|
| 460    | 425  | Site 425, Severn estuary.   | ST 305 614     | 51°20.8'N 02°59.8'W | HedMac                  |
| 460    | 430  | Site 430, Severn estuary.   | ST 318 644     | 51°22.4'N 02°58.7'W | HedMac                  |
| 460    | 432  | Site 432, Severn estuary.   | ST 317 659     | 51°23.2'N 02°58.8'W | HedOl                   |
| 460    | 562  | Site 562, Severn estuary.   | ST 499 791     | 51°30.5'N 02°43.3'W | HedOl                   |
| 460    | 566  | Site 566, Severn estuary.   | ST 454 776     | 51°29.6'N 02°47.1'W | AEur                    |
| 460    | 611  | Site 611, Severn estuary.   | ST 335 762     | 51°28.8'N 02°57.3'W | AEur                    |
| 487    | 1    | Lydney, north shore of the Bristol Channel and Severn.            | SO 650 020     | 51°42.9'N 02°30.4'W | Asc.VS; Fserr.VS; FcerX |
| 487    | 2    | Sudbrook, north shore of the Bristol Channel and Severn.          | ST 500 870     | 51°34.7'N 02°43.3'W | Fspi; Asc.VS; Fserr.VS  |
| 488    | 1    | Sharpness, Severn estuary.  | SO 680 030     | 51°43.4'N 02°27.8'W | BatCor; HedMac          |
| 488    | 2    | Portishead, Severn estuary.                                       | ST 448 766     | 51°29.1'N 02°47.6'W | MacAre; HedMac          |
| 488    | 3    | Weston-Super-Mare, Severn estuary.                                | ST 300 600     | 51°20.0'N 03°00.2'W | BatCor; HedMac          |
| 489    | 8    | Beachley Point.   | ST 539 904     | 51°36.6'N 02°39.9'W | HedMac                  |
| 490    | 1    | Aust, south shore of the Severn estuary.                          | ST 560 890     | 51°35.8'N 02°38.1'W | Fspi; Fserr.VS          |
| 490    | 2    | Portishead.   | ST 460 770     | 51°29.3'N 02°46.6'W | BPat; Fserr.VS          |
| 490    | 3    | Sand Point.   | ST 310 650     | 51°22.7'N 02°59.4'W | BPat; Asc.VS; Fserr.VS  |
| 491    | 2    | Ystradyfodwg and Pontpridd outfall, Severn estuary, Cardiff area. | ST 240 760     | 51°28.6'N 03°05.6'W | HedMac; HedOl           |
| 491    | 3    | Rhymney Valley outfall, Severn estuary, Cardiff area.             | ST 260 770     | 51°29.2'N 03°03.9'W | HedMac; HedStr; HedOl   |
| 492    | 1    | Site 1, north shore of the Severn estuary.                        | ST 240 770     | 51°29.1'N 03°05.6'W | HedStr                  |
| 492    | 2    | Site 2, north shore of the Severn estuary.                        | ST 240 760     | 51°28.6'N 03°05.6'W | HedStr                  |
| 492    | 3    | Site 3, north shore of the Severn estuary.                        | ST 240 780     | 51°29.7'N 03°05.6'W | HedStr                  |
| 492    | 5    | Site 5, north shore of the Severn estuary.                        | ST 256 783     | 51°29.8'N 03°04.3'W | HedMac                  |
| 492    | 7    | Site 7, north shore of the Severn estuary.                        | ST 262 786     | 51°30.0'N 03°03.8'W | HedOl                   |
| 492    | 9    | Site 9, north shore of the Severn estuary.                        | ST 270 790     | 51°30.2'N 03°03.1'W | HedStr                  |
| 492    | 11   | Site 11, north shore of the Severn estuary.                       | ST 277 784     | 51°29.9'N 03°02.5'W | HedScr                  |
| 492    | 13   | Site 13, north shore of the Severn estuary.                       | ST 286 802     | 51°30.9'N 03°01.7'W | HedMac                  |
| 492    | 15   | Site 15, north shore of the Severn estuary.                       | ST 297 807     | 51°31.2'N 03°00.8'W | HedMac                  |
| 492    | 17   | Site 17, north shore of the Severn estuary.                       | ST 305 812     | 51°31.5'N 03°00.1'W | HedMac                  |
| 492    | 18   | Site 18, north shore of the Severn estuary.                       | ST 312 808     | 51°31.2'N 02°59.5'W | HedStr                  |
| 492    | 19   | Site 19, north shore of the Severn estuary.                       | ST 313 816     | 51°31.7'N 02°59.4'W | HedMac                  |
| 492    | 21   | Site 21, north shore of the Severn estuary.                       | ST 330 820     | 51°31.9'N 02°57.9'W | HedStr                  |
| 492    | 22   | Site 22, north shore of the Severn estuary.                       | ST 330 810     | 51°31.4'N 02°57.9'W | HedMac                  |
| 492    | 25   | Site 25, north shore of the Severn estuary.                       | ST 350 820     | 51°31.9'N 02°56.2'W | HedOl                   |
| 492    | 26   | Site 26, north shore of the Severn estuary.                       | ST 365 815     | 51°31.7'N 02°54.9'W | Salv                    |
| 492    | 27   | Site 27, north shore of the Severn estuary.                       | ST 355 810     | 51°31.4'N 02°55.7'W | HedOl                   |
| 492    | 28   | Site 28, north shore of the Severn estuary.                       | ST 360 820     | 51°31.9'N 02°55.3'W | HedMac                  |
| 492    | 30   | Site 30, north shore of the Severn estuary.                       | ST 375 810     | 51°31.4'N 02°54.0'W | HedStr                  |
| 492    | 31   | Site 31, north shore of the Severn estuary.                       | ST 375 817     | 51°31.8'N 02°54.0'W | HedStr                  |
| 492    | 33   | Site 33, north shore of the Severn estuary.                       | ST 395 820     | 51°31.9'N 02°52.3'W | AEur                    |
| 492    | 34   | Site 34, north shore of the Severn estuary.                       | ST 426 834     | 51°32.7'N 02°49.6'W | HedMac                  |
| 492    | 35   | Site 35, north shore of the Severn estuary.                       | ST 450 840     | 51°33.1'N 02°47.6'W | HedStr                  |
| 492    | 36   | Site 36, north shore of the Severn estuary.                       | ST 460 850     | 51°33.6'N 02°46.7'W | HedStr                  |
| 492    | 37   | Site 37, north shore of the Severn estuary.                       | ST 518 888     | 51°35.7'N 02°41.7'W | HedMac                  |
| 492    | 39   | Site 39, north shore of the Severn estuary.                       | ST 517 887     | 51°35.6'N 02°41.8'W | HedStr                  |
| 492    | 40   | Site 40, north shore of the Severn estuary.                       | ST 524 890     | 51°35.8'N 02°41.2'W | HedMac                  |
| 492    | 41   | Site 41, north shore of the Severn estuary.                       | ST 522 892     | 51°35.9'N 02°41.4'W | HedMac                  |
| 492    | 43   | Site 43, north shore of the Severn estuary.                       | ST 524 894     | 51°36.0'N 02°41.2'W | HedStr                  |
| 492    | 44   | Site 44, north shore of the Severn estuary.                       | ST 533 895     | 51°36.1'N 02°40.4'W | HedOl                   |
| 492    | 45   | Site 45, north shore of the Severn estuary.                       | ST 532 897     | 51°36.2'N 02°40.5'W | HedStr                  |
| 492    | 47   | Site 47, north shore of the Severn estuary.                       | ST 530 897     | 51°36.2'N 02°40.7'W | HedOl                   |
| 492    | 49   | Site 49, north shore of the Severn estuary.                       | ST 538 903     | 51°36.5'N 02°40.0'W | HedStr                  |
| 492    | 51   | Site 51, north shore of the Severn estuary.                       | ST 541 902     | 51°36.5'N 02°39.7'W | HedMac                  |
| 494    | 1    | Near Ashton paper mill, north shore of the Severn estuary.        | ST 500 870     | 51°34.7'N 02°43.3'W | HedMac; HedMac.Pyg      |
| 495    | 1    | Epney, south shore of the Severn estuary.                         | SO 758 111     | 51°47.8'N 02°21.0'W | MS                      |
| 495    | 2    | Arlingham, south shore of the Severn estuary.                     | SO 695 111     | 51°47.8'N 02°26.5'W | BatCor                  |

**Littoral sites - continued**

| <i>Survey</i> | <i>Site</i> | <i>Place</i>  | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotores present</i>             |
|---------------|-------------|---|-----------------------|---------------------------|-------------------------------------|
| 495           | 3           | Sharpness, south shore of the Severn estuary.         | SO 678 033            | 51°43.6'N 02°27.9'W       | HedMac                              |
| 495           | 4           | Aust, south shore of the Severn estuary.              | ST 564 889            | 51°35.8'N 02°37.7'W       | HedMac                              |
| 495           | 5           | New Passage, south shore of the Severn estuary.       | ST 546 865            | 51°34.5'N 02°39.3'W       | HedMac                              |
| 495           | 6           | Avonmouth, south shore of the Severn estuary.         | ST 532 827            | 51°32.4'N 02°40.4'W       | HedMac                              |
| 495           | 7           | Portbury, south shore of the Severn estuary.          | ST 485 774            | 51°29.5'N 02°44.5'W       | HedMac                              |
| 495           | 8           | Portishead, south shore of the Severn estuary.        | ST 459 769            | 51°29.2'N 02°46.7'W       | HedMac                              |
| 495           | 9           | Clevedon, south shore of the Severn estuary.          | ST 379 683            | 51°24.5'N 02°53.5'W       | HedMac                              |
| 495           | 10          | Sand Bay, south shore of the Severn estuary.          | ST 331 645            | 51°22.5'N 02°57.6'W       | HedMac                              |
| 495           | 11          | Weston Bay, south shore of the Severn estuary.        | ST 316 607            | 51°20.4'N 02°58.9'W       | MacAre                              |
| 495           | 12          | Brean, south shore of the Severn estuary.             | ST 296 586            | 51°19.3'N 03°00.6'W       | HedMac                              |
| 685           | 1           | Aust Rocks, Severn estuary.                           | ST 565 902            | 51°36.5'N 02°37.6'W       | Fves; Asc.VS;<br>Fserr.VS; SwSed    |
| 685           | 2           | Chapel Rock, Severn estuary.                          | ST 549 898            | 51°36.2'N 02°39.0'W       | YG; Ver.Ver; Pel;<br>Fspi; Fserr.VS |
| 685           | 3           | SE of Pillhouse Rocks, Oldbury Sands, Severn estuary. | ST 577 945            | 51°38.8'N 02°36.6'W       | S                                   |
| 685           | 5           | Sharpness Point, Severn estuary.                      | SO 667 029            | 51°43.4'N 02°28.9'W       | Eph; Fves; Asc.VS                   |
| 685           | 6           | English Stones, Severn estuary.                       | ST 518 867            | 51°34.6'N 02°41.7'W       | Fser.Fser.Bo; Salv;<br>Fserr.VS     |
| 685           | 7           | Hock Cliff, SW Fretherne, Severn estuary.             | SO 726 093            | 51°46.8'N 02°23.8'W       | Ent                                 |

**Sublittoral sites**

| <i>Survey</i> | <i>Site</i> | <i>Place</i>                          | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotores present</i> |
|---------------|-------------|---------------------------------------|-----------------------|---------------------------|-------------------------|
| 196           | 7           | Maisemore Weir, Upper Severn estuary. | SO 815 186            | 51°51.9'N 02°16.1'W       | LimTub                  |
| 196           | 8           | Haw Bridge, Upper Severn estuary.     | SO 848 278            | 51°56.8'N 02°13.2'W       | LimTub                  |
| 460           | 61          | Site 61, Severn estuary.              | ST 200 674            | 51°23.9'N 03°08.9'W       | FaG                     |
| 460           | 63          | Site 63, Severn estuary.              | ST 200 646            | 51°22.4'N 03°08.9'W       | SalvMx                  |
| 460           | 127         | Site 127, Severn estuary.             | ST 216 735            | 51°27.2'N 03°07.6'W       | FaG                     |
| 460           | 129         | Site 129, Severn estuary.             | ST 246 733            | 51°27.2'N 03°05.0'W       | SalvMx                  |
| 460           | 130         | Site 130, Severn estuary.             | ST 261 733            | 51°27.2'N 03°03.8'W       | SalvMx                  |
| 460           | 131         | Site 131, Severn estuary.             | ST 274 733            | 51°27.2'N 03°02.6'W       | FaG                     |
| 460           | 133         | Site 133, Severn estuary.             | ST 306 733            | 51°27.2'N 02°59.9'W       | Mob                     |
| 460           | 134         | Site 134, Severn estuary.             | ST 320 733            | 51°27.2'N 02°58.7'W       | FaMS                    |
| 460           | 135         | Site 135, Severn estuary.             | ST 335 733            | 51°27.2'N 02°57.4'W       | Mob                     |
| 460           | 136         | Site 136, Severn estuary.             | ST 350 732            | 51°27.2'N 02°56.1'W       | FaMS                    |
| 460           | 137         | Site 137, Severn estuary.             | ST 364 732            | 51°27.2'N 02°54.8'W       | NhomTub                 |
| 460           | 138         | Site 138, Severn estuary.             | ST 379 732            | 51°27.2'N 02°53.5'W       | FaMS                    |
| 460           | 139         | Site 139, Severn estuary.             | ST 394 732            | 51°27.2'N 02°52.2'W       | MobMud                  |
| 460           | 140         | Site 140, Severn estuary.             | ST 408 732            | 51°27.2'N 02°51.0'W       | FaMS                    |
| 460           | 141         | Site 141, Severn estuary.             | ST 424 746            | 51°28.0'N 02°49.7'W       | MobMud                  |
| 460           | 142         | Site 142, Severn estuary.             | ST 410 746            | 51°28.0'N 02°50.9'W       | FaMS                    |
| 460           | 143         | Site 143, Severn estuary.             | ST 395 761            | 51°28.8'N 02°52.2'W       | MobMud                  |
| 460           | 144         | Site 144, Severn estuary.             | ST 380 761            | 51°28.8'N 02°53.5'W       | FaMS                    |
| 460           | 145         | Site 145, Severn estuary.             | ST 365 747            | 51°28.0'N 02°54.8'W       | FaMS                    |
| 460           | 146         | Site 146, Severn estuary.             | ST 349 747            | 51°28.0'N 02°56.1'W       | FaMS                    |
| 460           | 147         | Site 147, Severn estuary.             | ST 335 748            | 51°28.0'N 02°57.4'W       | MobMud                  |
| 460           | 148         | Site 148, Severn estuary.             | ST 321 748            | 51°28.0'N 02°58.6'W       | Mob                     |
| 460           | 151         | Site 151, Severn estuary.             | ST 275 748            | 51°28.0'N 03°02.5'W       | NhomTub                 |
| 460           | 154         | Site 154, Severn estuary.             | ST 231 749            | 51°28.0'N 03°06.4'W       | NhomTub                 |
| 460           | 156         | Site 156, Severn estuary.             | ST 230 689            | 51°24.8'N 03°06.4'W       | Mob                     |
| 460           | 161         | Site 161, Severn estuary.             | ST 215 638            | 51°22.0'N 03°07.6'W       | Mob                     |



## Sublittoral sites - continued

| Survey | Site | Place                     | Grid reference | Latitude/longitude  | Biotopes present |
|--------|------|---------------------------|----------------|---------------------|------------------|
| 460    | 162  | Site 162, Severn estuary. | ST 214 616     | 51°20.8'N 03°07.6'W | SalvMx           |
| 460    | 201  | Site 201, Severn estuary. | ST 273 600     | 51°20.0'N 03°02.5'W | SS               |
| 460    | 206  | Site 206, Severn estuary. | ST 229 600     | 51°20.0'N 03°06.3'W | Mob              |
| 460    | 262  | Site 262, Severn estuary. | ST 231 719     | 51°26.4'N 03°06.3'W | Mob              |
| 460    | 263  | Site 263, Severn estuary. | ST 231 705     | 51°25.6'N 03°06.3'W | Mob              |
| 460    | 264  | Site 264, Severn estuary. | ST 230 688     | 51°24.7'N 03°06.3'W | Mob              |
| 460    | 266  | Site 266, Severn estuary. | ST 274 631     | 51°21.7'N 03°02.4'W | NhomTub          |
| 460    | 301  | Site 301, Severn estuary. | ST 276 779     | 51°29.7'N 03°02.5'W | NhomTub          |
| 460    | 303  | Site 303, Severn estuary. | ST 291 792     | 51°30.4'N 03°01.2'W | MobMud           |
| 460    | 306  | Site 306, Severn estuary. | ST 291 763     | 51°28.8'N 03°01.2'W | NhomTub          |
| 460    | 308  | Site 308, Severn estuary. | ST 260 764     | 51°28.9'N 03°03.8'W | FaMx             |
| 460    | 309  | Site 309, Severn estuary. | ST 246 719     | 51°26.4'N 03°05.1'W | FaG              |
| 460    | 310  | Site 310, Severn estuary. | ST 245 705     | 51°25.6'N 03°05.1'W | FaG; SalvMx      |
| 460    | 311  | Site 311, Severn estuary. | ST 245 689     | 51°24.8'N 03°05.0'W | FaG              |
| 460    | 313  | Site 313, Severn estuary. | ST 245 659     | 51°23.2'N 03°05.1'W | SalvMx           |
| 460    | 316  | Site 316, Severn estuary. | ST 244 614     | 51°20.8'N 03°05.1'W | Mob              |
| 460    | 317  | Site 317, Severn estuary. | ST 244 600     | 51°20.0'N 03°05.0'W | NhomTub          |
| 460    | 343  | Site 343, Severn estuary. | ST 306 791     | 51°30.3'N 02°59.9'W | NhomTub          |
| 460    | 350  | Site 350, Severn estuary. | ST 380 821     | 51°32.0'N 02°53.5'W | SS               |
| 460    | 351  | Site 351, Severn estuary. | ST 395 821     | 51°32.0'N 02°52.3'W | Mob              |
| 460    | 352  | Site 352, Severn estuary. | ST 409 820     | 51°32.0'N 02°51.0'W | Mob              |
| 460    | 354  | Site 354, Severn estuary. | ST 424 836     | 51°32.8'N 02°49.7'W | Mob              |
| 460    | 358  | Site 358, Severn estuary. | ST 455 835     | 51°32.8'N 02°47.1'W | Mob              |
| 460    | 359  | Site 359, Severn estuary. | ST 454 820     | 51°32.0'N 02°47.2'W | Mob              |
| 460    | 360  | Site 360, Severn estuary. | ST 440 820     | 51°32.0'N 02°48.4'W | Mob              |
| 460    | 362  | Site 362, Severn estuary. | ST 425 805     | 51°31.2'N 02°49.7'W | Mob              |
| 460    | 364  | Site 364, Severn estuary. | ST 395 805     | 51°31.2'N 02°52.3'W | MobMud           |
| 460    | 367  | Site 367, Severn estuary. | ST 305 762     | 51°28.8'N 02°59.9'W | NhomTub          |
| 460    | 368  | Site 368, Severn estuary. | ST 305 662     | 51°23.4'N 02°59.9'W | Mob              |
| 460    | 371  | Site 371, Severn estuary. | ST 260 719     | 51°26.4'N 03°03.8'W | FaG              |
| 460    | 372  | Site 372, Severn estuary. | ST 260 704     | 51°25.6'N 03°03.8'W | Mob              |
| 460    | 373  | Site 373, Severn estuary. | ST 260 689     | 51°24.8'N 03°03.8'W | SalvMx           |
| 460    | 376  | Site 376, Severn estuary. | ST 260 644     | 51°22.4'N 03°03.7'W | SalvMx           |
| 460    | 378  | Site 378, Severn estuary. | ST 259 614     | 51°20.8'N 03°03.8'W | SalvMx           |
| 460    | 380  | Site 380, Severn estuary. | ST 288 629     | 51°21.6'N 03°01.3'W | FaG              |
| 460    | 384  | Site 384, Severn estuary. | ST 275 674     | 51°24.0'N 03°02.4'W | Mob              |
| 460    | 385  | Site 385, Severn estuary. | ST 275 688     | 51°24.8'N 03°02.4'W | SalvMx           |
| 460    | 387  | Site 387, Severn estuary. | ST 439 806     | 51°31.2'N 02°48.4'W | FaMS             |
| 460    | 388  | Site 388, Severn estuary. | ST 454 806     | 51°31.2'N 02°47.1'W | Mob              |
| 460    | 389  | Site 389, Severn estuary. | ST 470 821     | 51°32.1'N 02°45.8'W | Mob              |
| 460    | 396  | Site 396, Severn estuary. | ST 335 719     | 51°26.5'N 02°57.4'W | Mob              |
| 460    | 397  | Site 397, Severn estuary. | ST 319 718     | 51°26.4'N 02°58.7'W | FaMS             |
| 460    | 398  | Site 398, Severn estuary. | ST 320 704     | 51°25.6'N 02°58.6'W | SalvMx           |
| 460    | 399  | Site 399, Severn estuary. | ST 305 704     | 51°25.6'N 02°59.9'W | SalvMx           |
| 460    | 400  | Site 400, Severn estuary. | ST 290 703     | 51°25.6'N 03°01.2'W | SalvMx           |
| 460    | 401  | Site 401, Severn estuary. | ST 289 689     | 51°24.8'N 03°01.2'W | Mob              |
| 460    | 410  | Site 410, Severn estuary. | ST 336 807     | 51°31.2'N 02°57.3'W | FaMS             |
| 460    | 411  | Site 411, Severn estuary. | ST 350 807     | 51°31.3'N 02°56.1'W | PolVS            |
| 460    | 412  | Site 412, Severn estuary. | ST 365 807     | 51°31.2'N 02°54.8'W | FaMx             |
| 460    | 414  | Site 414, Severn estuary. | ST 376 790     | 51°30.4'N 02°53.9'W | Mob              |
| 460    | 415  | Site 415, Severn estuary. | ST 395 790     | 51°30.4'N 02°52.2'W | Mob              |
| 460    | 416  | Site 416, Severn estuary. | ST 409 790     | 51°30.4'N 02°51.0'W | Mob              |
| 460    | 417  | Site 417, Severn estuary. | ST 424 790     | 51°30.3'N 02°49.7'W | Mob              |
| 460    | 418  | Site 418, Severn estuary. | ST 440 789     | 51°30.3'N 02°48.4'W | Mob              |
| 460    | 419  | Site 419, Severn estuary. | ST 424 776     | 51°29.6'N 02°49.7'W | Mob              |
| 460    | 421  | Site 421, Severn estuary. | ST 288 599     | 51°20.0'N 03°01.2'W | NhomTub          |
| 460    | 433  | Site 433, Severn estuary. | ST 321 669     | 51°23.8'N 02°58.5'W | Mob              |
| 460    | 456  | Site 456, Severn estuary. | ST 304 659     | 51°23.2'N 02°59.9'W | SalvMx           |
| 460    | 460  | Site 460, Severn estuary. | ST 334 673     | 51°24.0'N 02°57.4'W | FaMS             |
| 460    | 461  | Site 461, Severn estuary. | ST 349 673     | 51°24.0'N 02°56.0'W | SalvMx           |
| 460    | 464  | Site 464, Severn estuary. | ST 364 687     | 51°24.8'N 02°54.8'W | Mob              |

## Sublittoral sites - continued

| Survey | Site | Place                                       | Grid reference | Latitude/longitude  | Biotores present |
|--------|------|---|----------------|---------------------|------------------|
| 460    | 469  | Site 469, Severn estuary.                   | ST 394 717     | 51°26.4'N 02°52.3'W | FaMS             |
| 460    | 471  | Site 471, Severn estuary.                   | ST 379 717     | 51°26.4'N 02°53.5'W | FaMS             |
| 460    | 472  | Site 472, Severn estuary.                   | ST 364 718     | 51°26.4'N 02°54.8'W | FaMS             |
| 460    | 473  | Site 473, Severn estuary.                   | ST 349 717     | 51°26.4'N 02°56.1'W | FaMS             |
| 460    | 474  | Site 474, Severn estuary.                   | ST 349 703     | 51°25.6'N 02°56.1'W | Mob              |
| 460    | 538  | Site 538, Severn estuary.                   | ST 319 688     | 51°24.8'N 02°58.7'W | SalvMx           |
| 460    | 539  | Site 539, Severn estuary.                   | ST 334 687     | 51°24.7'N 02°57.4'W | Mob              |
| 460    | 540  | Site 540, Severn estuary.                   | ST 350 686     | 51°24.7'N 02°56.0'W | Mob              |
| 460    | 556  | Site 556, Severn estuary.                   | ST 394 761     | 51°28.8'N 02°52.3'W | Mob              |
| 460    | 557  | Site 557, Severn estuary.                   | ST 410 762     | 51°28.8'N 02°50.9'W | Mob              |
| 460    | 558  | Site 558, Severn estuary.                   | ST 423 761     | 51°28.8'N 02°49.8'W | Mob              |
| 460    | 559  | Site 559, Severn estuary.                   | ST 437 761     | 51°28.8'N 02°48.6'W | Mob              |
| 460    | 560  | Site 560, Severn estuary.                   | ST 467 780     | 51°29.9'N 02°46.0'W | NhomTub          |
| 460    | 565  | Site 565, Severn estuary.                   | ST 454 791     | 51°30.5'N 02°47.1'W | Mob              |
| 460    | 567  | Site 567, Severn estuary.                   | ST 437 776     | 51°29.6'N 02°48.6'W | FaMS             |
| 460    | 594  | Site 594, Severn estuary.                   | ST 366 791     | 51°30.4'N 02°54.8'W | Mob              |
| 460    | 596  | Site 596, Severn estuary.                   | ST 484 805     | 51°31.2'N 02°44.6'W | Mob              |
| 460    | 598  | Site 598, Severn estuary.                   | ST 484 834     | 51°32.8'N 02°44.6'W | Mob              |
| 460    | 601  | Site 601, Severn estuary.                   | ST 334 703     | 51°25.6'N 02°57.4'W | Mob              |
| 460    | 602  | Site 602, Severn estuary.                   | ST 364 702     | 51°25.6'N 02°54.8'W | Mob              |
| 460    | 603  | Site 603, Severn estuary.                   | ST 365 762     | 51°28.8'N 02°54.8'W | Mob              |
| 460    | 604  | Site 604, Severn estuary.                   | ST 380 762     | 51°28.8'N 02°53.5'W | Mob              |
| 460    | 605  | Site 605, Severn estuary.                   | ST 380 776     | 51°29.6'N 02°53.5'W | Mob              |
| 460    | 606  | Site 606, Severn estuary.                   | ST 394 777     | 51°29.7'N 02°52.3'W | Mob              |
| 460    | 607  | Site 607, Severn estuary.                   | ST 409 777     | 51°29.6'N 02°51.0'W | Mob              |
| 460    | 608  | Site 608, Severn estuary.                   | ST 365 777     | 51°29.6'N 02°54.8'W | Mob              |
| 460    | 609  | Site 609, Severn estuary.                   | ST 350 778     | 51°29.7'N 02°56.1'W | NcirBat          |
| 460    | 610  | Site 610, Severn estuary.                   | ST 350 762     | 51°28.8'N 02°56.1'W | Mob              |
| 460    | 612  | Site 612, Severn estuary.                   | ST 320 763     | 51°28.9'N 02°58.7'W | ScupHyd          |
| 460    | 613  | Site 613, Severn estuary.                   | ST 335 778     | 51°29.7'N 02°57.4'W | FaMS             |
| 488    | 3    | Weston-Super-Mare, Severn estuary.          | ST 300 600     | 51°20.0'N 03°00.2'W | AphTub; NhomTub  |
| 489    | 8    | Beachley Point.                             | ST 539 904     | 51°36.6'N 02°39.9'W | IMU              |
| 491    | 1    | Cardiff East outfall, Severn estuary.       | ST 230 750     | 51°28.0'N 03°06.5'W | NhomTub; MobMud  |
| 492    | 4    | Site 4, North shore of the Severn estuary.  | ST 250 770     | 51°29.1'N 03°04.8'W | NhomTub          |
| 492    | 6    | Site 6, North shore of the Severn estuary.  | ST 260 780     | 51°29.7'N 03°03.9'W | NhomTub          |
| 492    | 8    | Site 8, North shore of the Severn estuary.  | ST 260 785     | 51°30.0'N 03°03.9'W | AphTub           |
| 492    | 10   | Site 10, North shore of the Severn estuary. | ST 275 785     | 51°30.0'N 03°02.6'W | AphTub           |
| 492    | 12   | Site 12, North shore of the Severn estuary. | ST 280 790     | 51°30.2'N 03°02.2'W | NhomTub          |
| 492    | 14   | Site 14, North shore of the Severn estuary. | ST 295 795     | 51°30.5'N 03°00.9'W | NhomTub          |
| 492    | 16   | Site 16, North shore of the Severn estuary. | ST 300 800     | 51°30.8'N 03°00.5'W | NhomTub          |
| 492    | 20   | Site 20, North shore of the Severn estuary. | ST 320 810     | 51°31.4'N 02°58.8'W | NhomTub          |
| 492    | 23   | Site 23, North shore of the Severn estuary. | ST 340 820     | 51°31.9'N 02°57.0'W | NhomTub          |
| 492    | 24   | Site 24, North shore of the Severn estuary. | ST 340 810     | 51°31.4'N 02°57.0'W | MobMud           |
| 492    | 29   | Site 29, North shore of the Severn estuary. | ST 370 813     | 51°31.5'N 02°54.4'W | NhomTub          |
| 492    | 32   | Site 32, North shore of the Severn estuary. | ST 380 810     | 51°31.4'N 02°53.6'W | MobMud           |
| 492    | 38   | Site 38, North shore of the Severn estuary. | ST 520 887     | 51°35.6'N 02°41.5'W | MobMud           |
| 492    | 42   | Site 42, North shore of the Severn estuary. | ST 527 890     | 51°35.8'N 02°40.9'W | MobMud           |
| 492    | 46   | Site 46, North shore of the Severn estuary. | ST 537 895     | 51°36.1'N 02°40.1'W | MobMud           |
| 492    | 48   | Site 48, North shore of the Severn estuary. | ST 540 900     | 51°36.3'N 02°39.8'W | MobMud           |
| 492    | 50   | Site 50, North shore of the Severn estuary. | ST 545 902     | 51°36.5'N 02°39.4'W | MobMud           |
| 721    | 1    | 4, Holm Sands.                              | ST 184 628     | 51°21.5'N 03°10.2'W | FaG              |
| 721    | 2    | 5, Holm Sands.                              | ST 184 626     | 51°21.4'N 03°10.2'W | FaS              |
| 721    | 3    | 6, Holm Sands.                              | ST 184 624     | 51°21.2'N 03°10.2'W | FaS              |
| 721    | 4    | 7, Holm Sands.                              | ST 184 623     | 51°21.2'N 03°10.2'W | FaS              |
| 721    | 5    | 8, Holm Sands.                              | ST 184 620     | 51°21.0'N 03°10.2'W | FaS              |
| 721    | 6    | 9, Holm Sands.                              | ST 184 619     | 51°21.0'N 03°10.2'W | FaG              |
| 721    | 7    | 12, Holm Sands.                             | ST 184 613     | 51°20.7'N 03°10.2'W | FaG              |
| 722    | 1    | 20, Avonmouth.                              | ST 510 806     | 51°31.3'N 02°42.3'W | FaMx             |
| 722    | 2    | 33, Avonmouth.                              | ST 475 785     | 51°30.1'N 02°45.3'W | Mob              |
| 722    | 3    | 560, Avonmouth.                             | ST 467 773     | 51°29.5'N 02°46.0'W | FaS, IMU, FaMx   |
| 722    | 4    | 561, Avonmouth.                             | ST 486 772     | 51°29.4'N 02°44.4'W | MobMud           |

**Sublittoral sites - continued**

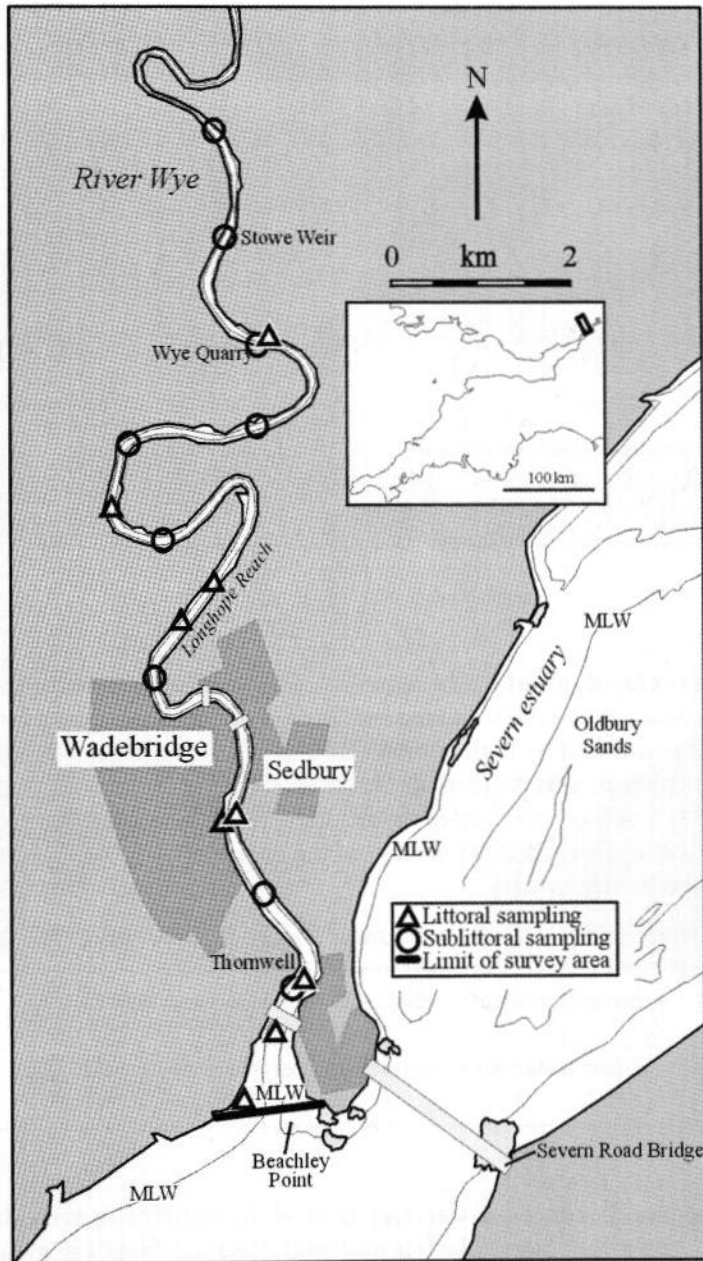
| <i>Survey</i> | <i>Site</i> | <i>Place</i>    | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i> |
|---------------|-------------|-----------------|-----------------------|---------------------------|-------------------------|
| 722           | 5           | 562, Avonmouth. | ST 500 787            | 51°30.2'N 02°43.2'W       | IMU                     |
| 722           | 6           | 563, Avonmouth. | ST 488 788            | 51°30.3'N 02°44.1'W       | Mob                     |
| 722           | 7           | 564, Avonmouth. | ST 473 788            | 51°30.3'N 02°45.5'W       | Mob                     |
| 722           | 8           | 578, Avonmouth. | ST 514 804            | 51°31.2'N 02°42.0'W       | MobMud                  |
| 722           | 9           | 579, Avonmouth. | ST 519 819            | 51°32.0'N 02°41.5'W       | FaG                     |
| 722           | 10          | 590, Avonmouth. | ST 500 811            | 51°31.5'N 02°43.1'W       | SS                      |
| 722           | 11          | 591, Avonmouth. | ST 501 803            | 51°31.1'N 02°43.1'W       | FaG                     |
| 722           | 12          | 595, Avonmouth. | ST 473 803            | 51°31.1'N 02°45.5'W       | FaMS                    |
| 722           | 13          | 597, Avonmouth. | ST 486 819            | 51°32.0'N 02°44.4'W       | Mob                     |

Compiled by:

Kate Northen, Jon Moore &amp; Mike Little

## Location

|                                 |   |                            |
|---------------------------------|---|----------------------------|
| <i>Position (centre)</i>        | ST 545 915                                      | 52°30.8'N 02°40'W          |
| <i>Administrative area</i>      | Monmouthshire<br>Gloucestershire                | Monmouth<br>Forest of Dean |
| <i>Conservation agency/area</i> | Countryside Council for Wales<br>English Nature | South<br>Three Counties    |



**Figure 8.1** Main features of the area and sites surveyed.  
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| Marine biological surveys |   |                                |                             |
|---------------------------|---|--------------------------------|-----------------------------|
|                           | Survey method                                     | Date of survey                 | Source                      |
| <i>Littoral</i>           | Infaunal sampling (cores)                         | July 1987                      | Morrisey & Sait (1988)      |
|                           | Infaunal sampling (Van Veen grab and Craib corer) | Nov/Dec. 1977<br>May/June 1978 | Wharfe <i>et al.</i> (1979) |
|                           | Infaunal sampling (Van Veen grab and Craib corer) | Nov/Dec. 1977<br>May/June 1978 | Wharfe <i>et al.</i> (1979) |
| <i>Sublittoral</i>        | Infaunal sampling (cores)                         | July 1987                      | Morrisey & Sait (1988)      |

## Introduction

The River Wye is long and narrow with a high freshwater input. The narrowness derives from erosion by water during the last glaciation, when sea levels were lower than they are now. A number of weirs maintain water levels at low tide and stimulate mixing; turbidities within the inlet are generally high (Countryside Council for Wales 1993). The banks of the inlet are dominated by muds except for a few rock outcrops; however, there are approximately 43 ha of saltmarsh at the mouth of the river on the Welsh side.

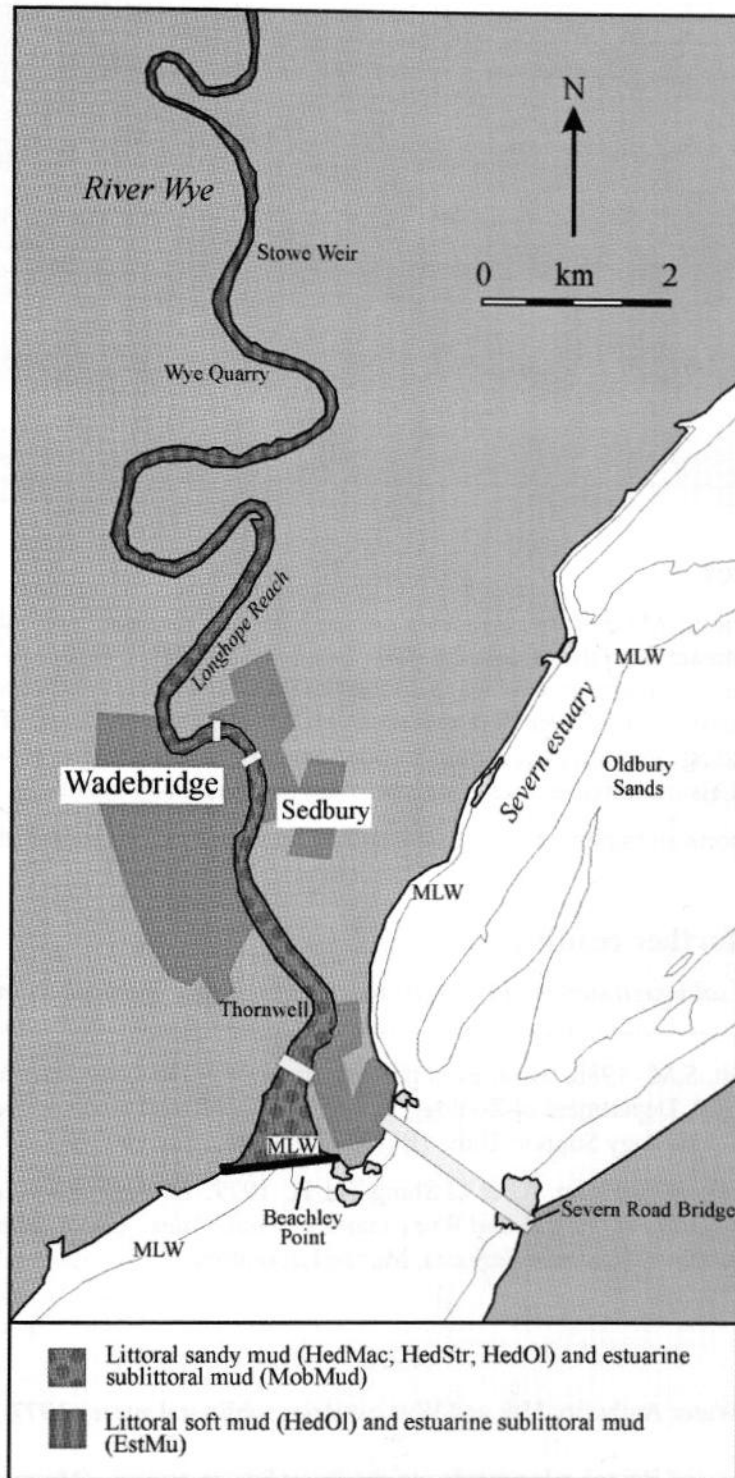
## Physical features

|                            |   |
|----------------------------|---|
| <i>Physiographic type</i>  | Coastal plain estuary                               |
| <i>Length of coast</i>     | 27 km   |
| <i>Area of inlet</i>       | 3 km <sup>2</sup>                                   |
| <i>Length of inlet</i>     | 14 km   |
| <i>Bathymetry</i>          | 3.3 m maximum depth, though generally less than 2 m |
| <i>Wave exposure range</i> | Very sheltered                                      |
| <i>Tidal stream range</i>  | Not known   |
| <i>Tidal range</i>         | 12 m MHWS (at mouth)                                |
| <i>Salinity range</i>      | Reduced to upper estuarine                          |

## Marine biology

The mouth of the inlet is characterised by the ragworm *Hediste diversicolor*, the mud snail *Hydrobia ulvae*, the Baltic tellin *Macoma balthica* and the mud shrimp *Corophium volutator* (HedMac). Further upstream the inlet is characterised by high numbers of the oligochaete worm *Heterochaeta costata* (HedOl). In the upper channel, where the muds are transitional between brackish water and freshwater, the fine, silty muds are dominated by the oligochaete worm *Tubifex* spp. (Tub; LimTtub). Morrisey & Sait (1988) considered that the density of the animals within the Wye was greater than equivalent habitats in the Severn estuary.

The Wye is an important river for salmon *Salmo salar* and trout *Salmo trutta* and it is also used by twaite shad *Alosa fallax*.



**Figure 8.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 8.1, cited literature and additional field observations).

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## Nature conservation

| Conservation sites                   |              |                           |  |
|--------------------------------------|--------------|---------------------------|--|
| Site name                            | Designation  | Grid ref.                 | Main features  |
| River Wye/Afon Gwy                   | possible SAC | ST 480 830                | Various fish species including allis shad <i>Alosa alosa</i> , twaite shad <i>Alosa fallax</i> , river lamprey <i>Lampetra fluviatilis</i> , sea lamprey <i>Petromyzon marinus</i> and Atlantic salmon <i>Salmo salar</i> ; otter <i>Lutra lutra</i> , white-clawed crayfish <i>Austropotamobius pallipes</i> , river habitat. |
| Thorn Cliff & Caswell Woods          | SSSI         | SO 540 005                | Woodland, flora  |
| Lower Wye Gorge                      | SSSI         | ST 548 983                | Woodland, flora  |
| River Wye (Lower Wye)                | SSSI         | ST 544 912-<br>SO 230 429 | River habitats, flora, invertebrates, fish, birds, otters, geology   |
| Pierce, Alcove and Piercefield Woods | SSSI         | ST 530 958                | Woodland   |
| Blackcliff-Wyndcliff                 | SSSI         | ST 531 979                | Woodland   |
| Wye Valley                           | AONB         | SO 550 005                | Scenery  |

## Human influences

The Severn Road Bridge (M4 motorway) crosses the north bank of the Severn estuary at the mouth of the River Wye. Upstream from the bridge, the lower reaches of the River Wye flow past the town of Chepstow. Here there are a number of sewage discharges into the Wye, only a proportion of which are treated. North of Chepstow, the River Wye meanders through the rural landscape of the Wye Valley. Much of the surrounding steep valley sides are wooded and provide popular forest walks such as the Wye Valley Walk. Leisure activities on the waterway are predominantly boating.

The River Wye supports an important trout *Salmo trutta* and salmon *Salmo salar* fishery.

## References and further reading

- Burd, F. 1989. *The saltmarsh survey of Great Britain. An inventory of British saltmarshes.* Peterborough, Nature Conservancy Council. (Research and survey in nature conservation, No. 17.)
- Morrisey, D.J., & Sait, S.M. 1988. *Ecology of the sub-estuaries of the River Severn.* (Contractor: University of Bristol, Department of Zoology, Bristol.) Unpublished report to Department of Energy, Energy Technology Support Unit. (ETSU Report, No. ETSU-TID-4057.)
- Wharfe, J.R., Flynn, E., Richardson, A., & Li Shing Tat, B. 1979. *Ecological studies of the benthic invertebrate macrofauna of the Usk and Wye estuaries, south Wales.* Unpublished, Welsh Water Authority, Directorate of Scientific Services, Marine Laboratory.

## Sites surveyed

Survey 486: Welsh Water Authority Usk and Wye estuaries sublittoral survey 1977-1978. (Wharfe *et al.* 1979).

Survey 489: University of Bristol sub-estuaries of the River Severn survey. (Morrisey & Sait 1988).

| Littoral sites |      |  |                |                     |                  |
|----------------|------|--|----------------|---------------------|------------------|
| Survey         | Site | Place                                  | Grid reference | Latitude/longitude  | Biotores present |
| 486            | 17   | Wye site A                             | ST 540 900     | 51°36.3'N 02°39.8'W | HedMac           |
| 486            | 18   | Site B, Usk and Wye sub-estuaries.     | ST 540 910     | 51°36.9'N 02°39.8'W | HedMac           |
| 486            | 19   | Wye site C                             | ST 540 910     | 51°36.9'N 02°39.8'W | HedMac           |
| 486            | 20   | Wye site D                             | ST 530 930     | 51°38.0'N 02°40.7'W | HedMac           |
| 486            | 22   | Wye site F                             | ST 530 930     | 51°38.0'N 02°40.7'W | HedOl            |
| 486            | 23   | Wye site G                             | ST 530 950     | 51°39.0'N 02°40.7'W | HedOl            |
| 486            | 24   | Usk site H, Usk and Wye sub-estuaries. | ST 540 960     | 51°39.6'N 02°39.9'W | HedMac           |

**Littoral sites - continued**

| <i>Survey</i> | <i>Site</i> | <i>Place</i>   | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i> |
|---------------|-------------|----------------|-----------------------|---------------------------|-------------------------|
| 486           | 25          | Wye site J     | ST 530 950            | 51°39.0'N 02°40.7'W       | HedMac                  |
| 486           | 26          | Wye site K     | ST 520 960            | 51°39.6'N 02°41.6'W       | HedMac                  |
| 489           | 9           | Thornwell      | ST 545 916            | 51°37.2'N 02°39.4'W       | HedStr; HedOI           |
| 489           | 10          | Longhope Reach | ST 533 952            | 51°39.1'N 02°40.5'W       | HedOI; HedMac           |
| 489           | 11          | Wye Quarry     | ST 543 979            | 51°40.6'N 02°39.6'W       | HedOI                   |

**Sublittoral sites**

| <i>Survey</i> | <i>Site</i> | <i>Place</i>   | <i>Grid reference</i> | <i>Latitude/longitude</i> | <i>Biotopes present</i> |
|---------------|-------------|----------------|-----------------------|---------------------------|-------------------------|
| 486           | 27          | Wye site L     | ST 530 970            | 51°40.1'N 02°40.7'W       | MobMud                  |
| 486           | 28          | Wye site M     | ST 540 970            | 51°40.1'N 02°39.9'W       | Tub                     |
| 486           | 29          | Wye site N     | ST 530 980            | 51°40.7'N 02°40.7'W       | Tub                     |
| 486           | 30          | Wye site P     | ST 530 990            | 51°41.2'N 02°40.8'W       | LimTub                  |
| 489           | 9           | Thornwell      | ST 545 916            | 51°37.2'N 02°39.4'W       | MobMud                  |
| 489           | 10          | Longhope Reach | ST 533 952            | 51°39.1'N 02°40.5'W       | MobMud                  |
| 489           | 11          | Wye Quarry     | ST 543 979            | 51°40.6'N 02°39.6'W       | Tub; MobMud             |
| 489           | 12          | Stowe Weir     | ST 538 988            | 51°41.1'N 02°40.1'W       | Tub; MobMud; EstMu      |

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