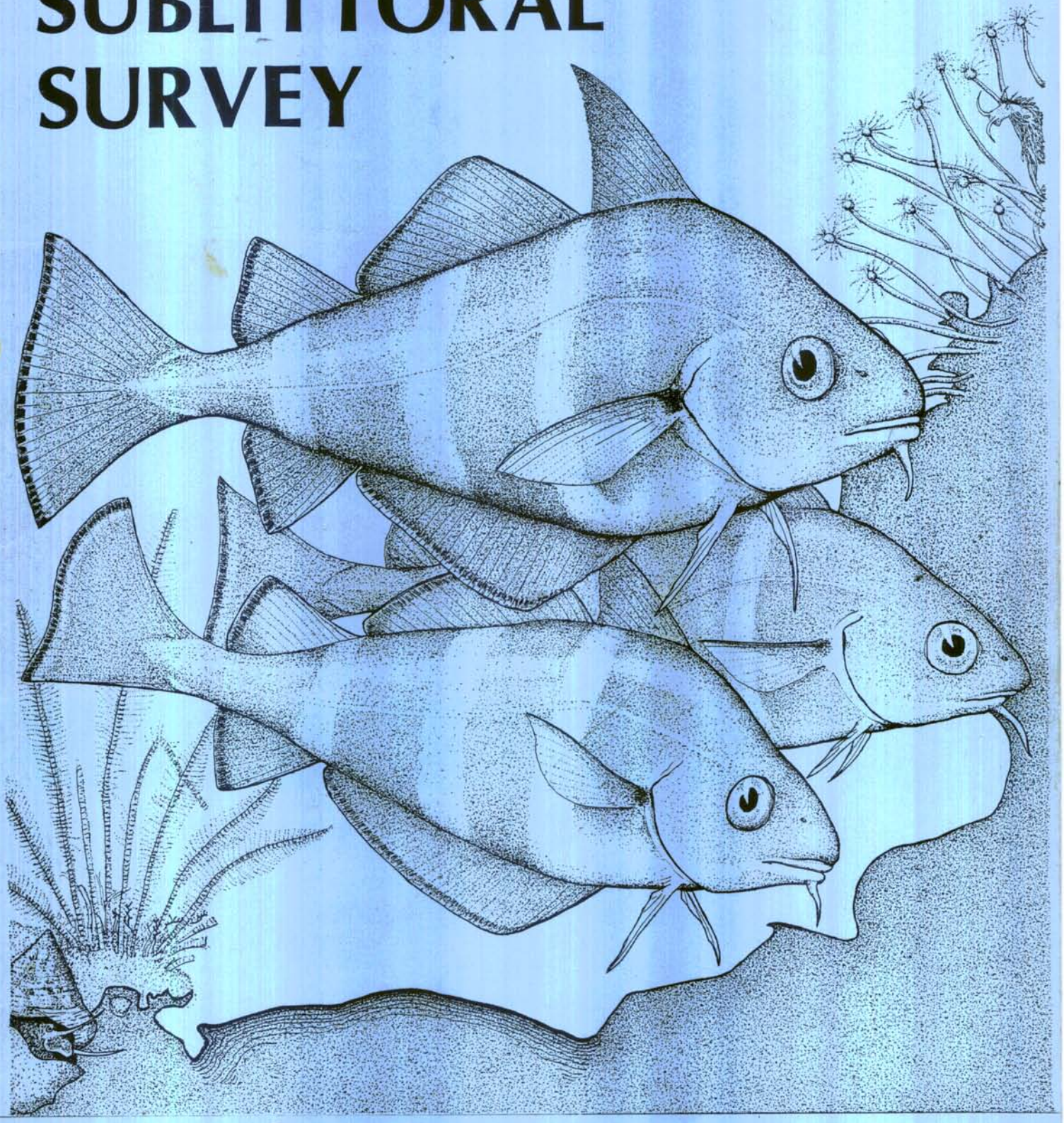
SUSSEX SUBLITTORAL SURVEY



MARINE CONSERVATION SOCIETY

SOUTH - EAST BRANCH

Sussex Sublittoral Survey

Selsey Bill to Beachy Head

Project Leader and Editor
Christopher Wood

This work was commissioned by the Nature Conservancy Council as part of its programme of research into nature conservation.

The conclusions and recommendations in this report are those of the authors alone and do not necessarily represent the views of the Marine Conservation Society (formerly Underwater Conservation Society) or of any of the other bodies mentioned herein.

April 1984

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Summary

This report comprises the results of sublittoral surveys carried out by amateur divers of the Marine Conservation Society, South-East Branch during 1982 and 1983, together with a compilation of information on human pressures on the area, coastal conservation sites, a bibliography and the Branch's conclusions and recommendations for conservation of the marine environment in the study area.

The study area covers the Sussex coast from Selsey Bill in the west to Beachy Head in the east. Information from the diving studies covers 60 different sites including representatives of all the known sublittoral habitats in the area. Information collected underwater was recorded on separate habitat and species forms, the species being divided into two separate lists, one for 33 'basic', easily recognised, species and the other for all other records (Chapter 2, Appendices 1 & 2).

The coastline in the study area is reasonably straight and is exposed to southerly winds and heavy seas. The western part has low pebble foreshores contrasing with the high chalk cliffs in the area east of Brighton which have flat chalk platforms at sea level (Chapter 3.1).

Much of the substratum in the study area consists of relatively unstable deposited material, mostly pebble and cobble, but including some finer and coarser deposits. Shallow areas of this type are relatively exposed to swell and wave surge and microhabitats are limited. In some areas living animals, notably Crepidula fornicata, the slipper limpet and Mytilus edulis, the common mussel, form the substratum. Foliaceous algal cover is high on sites down to about 10 metres (Chapter 3.5 - 3.7).

Rocky habitats are based on sedimentary rocks and are all relatively soft, ranging from stiff clay through chalk to limestone and sandstone. Chalk reefs occur in the east of the area, are coastal and typically form alternate ridges and gullies (Chapter 3.8). Chalk cliffs outcrop along two lines and are 1m to 4m in height (Chapter 3.10). The major clay cliff in the area is the Mixon Hole with a height of about 20m. (Chapter 3.11). The sandstone reefs are all in the western part of the study area (Chapter 3.9).

All the reefs and cliffs are subject to erosion by boring organisms, notably the piddock, Pholas dactylus. The Mixon clay cliff is, as a result, highly unstable and supports little sessile life, whereas the sandstone reefs are much less affected and therefore support a more varied fauna. The boring and undercutting characteristics of these soft rocks provide a sheltered habitat for a variety of mobile invertebrates and these areas generally support the widest species diversity in the study area.

Coastal structures and shipwrecks provide the only truly hard substrata in the area. Many of the wrecks are in areas which are largely featureless but they support large populations of a range of species, notably fishes. Although many species are abundant on wrecks, species diversity is generally poorer than on the reefs and cliffs. (Chapter 3.12 -3.13).

A total of 345 species of flora and fauna are recorded. These comprise:

Algae 97spp, Sponges 41spp, Cnidaria 41spp, 'Worms' 17spp, Bryozoa 21spp, Mollusca 30spp, Crustacea 30spp, Echinodermata 6spp, Tunicata 16spp, Fishes 48spp.

Species recorded were generally only those which it is possible to identify reliably underwater. With the exception of algae, the speices lists are not based on collected specimens and many smaller species which occur in the area are unrecorded. A number of the species which are listed have not previously been recorded from this area and the survey has served to extend their distribution. A few species appear to have a distribution limited to the western part of the study area. (Chapter 4).

The area is subject to considerable human pressures. These include sewage discharge, gravel extraction, silt dumping and litter. The source of these pressures are identified and conclusions drawn on their impact on sublittoral habitats and marine life (Chapter 5). Fishing is locally important and the shell fishery is heavily exploited. The area is an important recreational fishing area (Chapter 5.7).

Coastal conservation sites are identified and discussed. These include 5 Sites of Special Scientific Interest, 2 Local Nature Reserves as well as areas included in the more general countryside protection measures of Area of Outstanding Natural Beauty, Heritage Coast and Country Park (Chapter 6).

In the conclusions and recommendations 17 sites are selected as good representatives of the main habitat types in the area. The range of habitats is compared with sites in proposed conservation areas elsewhere in the British Isles and it is concluded that the chalk cliffs and reefs and clay cliff habitats are unrepresented elsewhere in these areas (Chapter 7.1). The numbers and diversity of species recorded are compared with similar studies in the area immediately to the west and in Dorset (Chapter 7.2). No comparable work has been carried out to the east.

In view of the pressures which are being experienced it is concluded that conservation measures are needed to protect the representative sites. Two areas are suggested, one offshore from Pagham and Bognor in the western part of the area and the other between Seaford and Beachy Head in the east. Both of these areas offer the possibility of the extension of exisitng coastal conservation sites into the marine environment to include a variety of typical Sussex habitats (Chapter 7.3).

The report recommends the Nature Conservancy Council to consider the identified sites in its forthcoming Marine Conservation Review, to notify appropriate bodies in the meantime of the conservation interest of these sites and to investigate the extension of existing coastal sites with the bodies concerned. Proposals are also made for further studies of the sites which have been identified as being of particular interest (Chapter 7.4).

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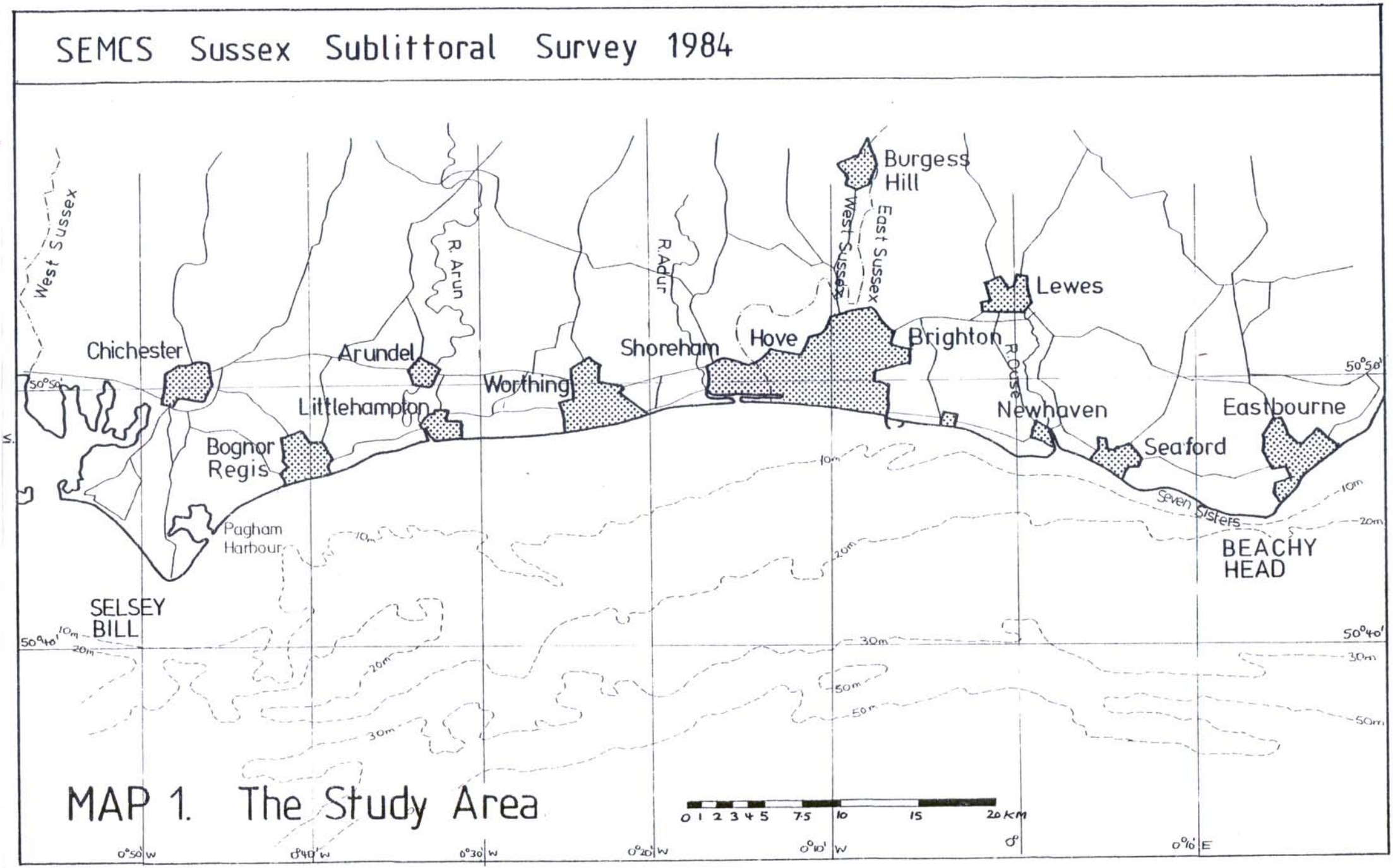

MAP 1. The Study Area

1 Introduction

1.1 BACKGROUND TO THIS STUDY

1.1.1 Between its formation in 1979 and 1981 the South-East Branch of the Underwater Conservation Society (SEUCS) initiated or assisted in a number of site specific sublittoral recording projects, principally on the two Mulberry Harbour units off Pagham in West Sussex (Stebbing 1982, Cunliffe 1981). The difficulty of relating the results of this work to the remainder of the area, which had been little studied, led the Branch to the conclusion that a more general study of sublittoral habitats, species and communities was required.

1.1.2 In 1982 the Branch initiated, as its major project for the year the "Sussex Guide" which consisted of a general survey of sublittoral habitats and species in the areas of West and East Sussex lying between Selsey Bill in the west and Beachy Head in the east (Map 1). This study area does not conform to administrative boundaries but is based on a clearly defined geographical area.

1.1.3 The area to the west is now becoming relatively well documented, principally through a parallel study of the area between Selsey Bill and the East Solent (Collins and Mallinson 1983). Marine life in Chichester Harbour has also been studied (Mugride 1983, Thomas, Culley and Withers 1978, Withers, Thomas and Culley 1978). The area to the east of Beachy Head has not been the subject of comparable work and would be a natural extension to our current survey.

1.2 PUBLICATION OF RESULTS

1.2.1 This report represents the findings of the study and is prepared in fulfillment of the Branch's contract with the Nature Conservancy Council (NCC). It is being published by the Branch with the approval of the NCC so that the information contained within it may be more widely disseminated to interested bodies and individuals.

1.2.2 The Branch is very aware that one of the most important contributions which a voluntary group can make to marine conservation is through the education of individuals who make use of marine resources to encourage them to appreciate the value (both aesthetically and economically) of marine life and to assess and lessen their own impact upon the marine environment. Two other publications, therefore, are being prepared to complement this report. These are: a guide to Sussex marine life, aimed principally at the SCUBA diving community and a 35mm slide programme.

1.2.3 The guide will include generalised descriptions of the habitats and species associations detailed in succeeding chapters of this report. It will also include diving information to enable divers to visit and appreciate the sites included.

1.2.4 The 35mm slide programme will be aimed at a wider audience. In addition to divers, the intention is that it should be available to local natural history and coastal interest groups as well as schools and other educational establishments. Again the aim will be to stimulate interest and appreciation of marine life. This part of the project is supported by the Sussex Trust for Nature Conservation.

1.3 PREPARATION OF THIS REPORT

1.3.1 Chapter 2 emphasises that this project was designed and operated as a group exercise. Records have been collected by some 30 members of the Branch and 3 diving clubs have also adopted the project and provided records from their own activities.

1.3.2 This report has been prepared by a small working group of branch members whose principal responsibilities have been as follows:-

Graham Ackers	- habitats, sponges, crustacea and echinoderms
Alison Brunstrom	- molluscs, tunicates, coastal conservation
Stella Jones	- pressures on marine resources
Dick Manuel	- sessile invertebrates
Sally Rogers	- algae
Elizabeth Wood	- habitats
Chris Wood	- project leader and general editor, methods, basic species, fishes, recommendations.

A number of these members have also contributed information and comments to other sections of the report than those listed as their responsibility above.

1.3.3 The illustrations have been prepared by Evan Jones (cover), Chris Wood (maps), Elizabeth Wood (profiles) and Peter Stebbing (outer Mulbery).

1.4 ACKNOWLEDGEMENTS

1.4.1 The principal thanks of the working group are to those members of the branch and other divers who have provided record cards and other information upon which this report is based. They are:-

Len Deeley, Fred Dow, Bill Farnham, Lucy Gilkes, Peter Harvey, Bill and Peter Hewitt, Jane Humphries, Jo Jamieson, Karen Kirk, Chris Lee, Jenny Mallinson, John McKie, Andrew Park, Pam Roth, Jacky Southwood, James Sutherland, Keith Viney, Lesley Williams and members of Billericay, Holborn Argonauts and Islington Sub Aqua Clubs.

1.4.2 We would like to thank the Nature Conservancy Council whose financial support by way of a contract has allowed this study to appear in its present form. In particular, Dr Roger Mitchell (Chief Scientist's Team, Huntingdon) and David Harvey (A.R.O. East Sussex) have assisted with advice and local information and arrangements.

1.4.3 Other valuable discussions on conservation measures and further information has been received from Ann Skinner (Sussex Trust for Nature Conservation) and Paul Millmore (East Sussex County Council), and we are grateful for their advice and encouragement.

1.4.4 Our diving activities have been assisted by the use of boats belonging to Brighton BSAC and Exul Sub Aqua Club.

1.4.5 In the preparation of the species information the assistance of the following has proved invaluable: Dr W. Farnham (Portsmouth Polytechnic), Miss S. Stone (British Museum N.H.), Mr B Picton (Ulster Museum), Dr J. Price (British Museum N.H.).

2 Methods and Results

2.1 PROJECT DESIGN

2.1.1 An essential element in this survey has been diversity. On the one hand our aim has been to survey as many sites within our study area as possible and on the other the work has been carried out by a changing group of people over two diving seasons. This is unlike an expedition, where the results are obtained using the same group of people over a relatively short period. This was a prime element in the design of the project and necessitated a clear system of forms for the recording of data in order to ensure comparability of records made by difference people on different occasions.

2.1.2 A second element in the design of the project was to enable as many members of the Branch to take part as possible, and consequently to allow members with different levels of expertise in underwater survey work to make worthwhile contributions. The third design criterion was to make the survey recording scheme sufficiently flexible so that, in addition to dives organised by the Branch specifically for survey work, individual members could contribute whilst taking part in other diving activities in the area organised by their own clubs.

2.1.3 The recording cards and forms used during the survey are reproduced in Appendix 1.

2.2. SITES COVERED

2.2.1 The group's own dives were arranged to cover as wide a range of types of site within the study area as possible. No attempt was made to direct individuals to specific sites when they were not diving with the Branch.

2.2.2 Shore access and dive site recording forms were used to record basic diving details. The information gathered on these forms is principally of interest to divers wishing to visit the area and will form a major part of the project's other publication, the Sussex Guide. Results from these forms are not, therefore, included within this report.

2.3 HABITAT RECORDING

2.3.1 The project package provided to participants requested that habitat information be recorded from all sites visited. The recording form used during 1982 was based on one prepared by the Underwater Conservation Society for use throughout the British Isles with the intention of enabling comparisons to be made with sites outside the Sussex area. The completion of this form does not require a high level of detailed knowledge and is a task which could be undertaken by less experienced members with suitable guidance. One amendment to the basic UCS form was the inclusion of marine litter as an aspect to be recorded.

2.3.2 We were disappointed with both the quantity and completeness of the habitat forms completed during 1982, particularly as we recognised the importance of this type of information to a general study. For the 1983 season we, therefore, completely redesigned the form to make best use of the space available, clarify the information required and allow adequate space for descriptive analysis, which, in view of the relatively low number of cards, would not give rise to any problems of data handling.

2.4 SPECIES RECORDING

2.4.1 Species occurring in the study area were recorded in two ways. A 'basic' list of 33 species was drawn up to include representatives of all of the major groups of marine life. These were species which could be easily identified underwater, with little chance of confusion and without the necessity for the collection of samples. The 'basic' list was designed to enable all participants to record species on a comparative basis and additional descriptive and illustrative information was available to aid the less experienced members. No changes to the 'basic' species recording scheme were made for 1983, in order to retain comparability, but a special session was held at our project workshop in April 1983 to ensure reliable identification.

2.4.2 An additional 'full' species recording card was available to enable more experienced members to record additional species. These records tend to reflect individual members' interests and are principally valuable in drawing up the overall species list. They are not intended to be used as a comparison between sites. Participants were assisted in 1982 by the inclusion in the project package of a checklist of species recorded from earlier projects. In 1983 the project package included further information and drew attention to groups and species of particular interest.

2.4.3 In the case of both recording cards species are recorded as either present or common in occurrence and the depth and substrate is also noted.

2.5 ADDITIONAL INFORMATION

2.5.1 In addition to information obtained in the field during 1982 and 1983, further species and habitat information has been incorporated from earlier work with which the branch or its members have been associated. The areas covered by this information are Mixon Hole (Site 2) (Ackers 1977), Inner Mulberry (Site 5) (Cunliffe 1981), Outer Mulberry (Site 6) (unpublished results of branch project and Stebbing (1982)) and various sites in West Sussex (branch record sheets - mostly completed by R G Ackers).

2.5.2 A collection of underwater photographs was made which have acted as an additional identification tool and will form the basis of the slide set referred to in Chapter 1.

2.5.3 Further information on coastal activities and conservation measures has been collected from a variety of sources which are acknowledged as appropriate.

2.6 SUMMARY OF FIELD RESULTS

2.6.1 Results are incorporated into this report from 60 sites within the study area. Details of the location, habitat/substrate type, depth and records made for each site are included in Appendix 2.

2.6.2 The table below provides a summary of the volume and distribution of records. These records form the field results of the study and are discussed in detail in the following two chapters.

	pre 82	1982		1983		Total	
	sites	cards	sites	cards	sites	cards	sites
Habitat Records	3	20	15	58	33	78	46
'Basic' species records	-	33	18	90	39	123	51
'Additional' species records	20+	33	17	67	35	100	53
Total	20+	86	19*	215	42*	301	60*

+ all pre 1982 species records are placed in this category
* total sites is not a summation of the column above as more than one type of information was commonly recorded from each site.

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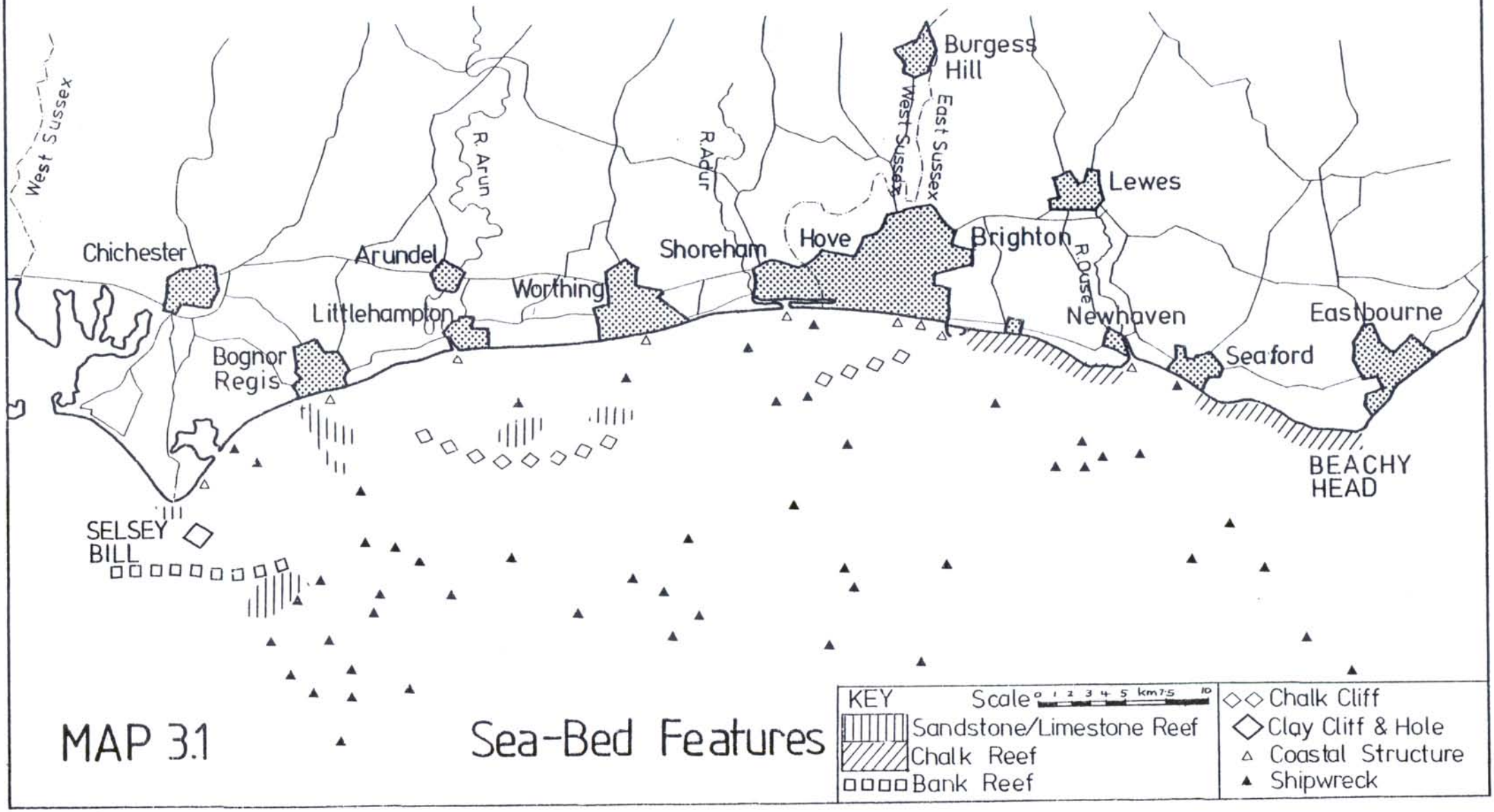

MAP 3.1 Sea-Bed Features

3 Sublittoral Habitats

3.1 THE COASTLINE

3.1.1 The study area is geographically defined by Selsey Bill in the west and Beachy Head in the east. Between these two extremities the coastline forms a gentle arc without any significant indentations. Facing generally southwards, the coast line is an almost totally exposed one with little shelter from prevailing winds, heavy seas and coastal currents. All the harbours along this stretch are artifically created, either at river mouths (Littlehampton, Shoreham, Newhaven) or behind sea defences (Brighton Marina).

3.1.2 The exposure to heavy seas, nature of the coastline and predominantly easterly current drift all combine to produce a potentially changing coastline with areas of fast erosion, particularly related to the chalk cliffs in the eastern part of the area, and areas of sediment deposition. The latter areas are associated with rivers, and minor spits have formed at Pagham Harbour, the mouth of the Adur at Shoreham and the mouth of the Ouse. This was formerly at Seaford but is now stabilised by harbour works at Newhaven (Jones 1981).

3.1.3 Structurally the coastline falls into two distinct areas, the coastal plain west of Brighton and the chalk cliffs to the east.

3.1.4 The Sussex coastal plain is underlain by clearly developed raised beaches, probably at two levels. The raised platform is mainly developed on Paleogene deposits but also planes across the chalk of the Littlehampton fold. The strath is extensively overlain with beach deposits which include a small percentage of far-travelled erratic blocks (Jones 1981).

3.1.5 The shorelines along this stretch of coast consist mostly of pebble beaches with some sandy stretches. At the extremities the beaches slope quite steeply but the central section, between Bognor and Worthing has very shallowly shelving beaches with extensive sand and mud flats at low tide. The tendency for coastal erosion along these stretches is only arrested by the erection of groynes which are a feature along the whole length of the coast.

3.1.6 The cliffs east of Brighton represent the eroding coastal end of the South Downs. This stretch of coast is typified by precipitous chalk cliffs significantly broken only by the alluvial plain of the Ouse between Newhaven and Seaford and the Cuckmere Valley. These cliffs characteristically have an extensive chalk shore platform between high and low water.

3.2. SEA BED TOPOGRAPHY

3.2.1 The Sussex sea bed slopes fairly gently to a depth of 50 metres approximately 20 km offshore. The 20m contour is about 12km from Bognor Regis (West Sussex), but approaches within 1km of Beachy Head (East Sussex). Even so, steep rocky areas are not a feature of the Sussex sub-littoral. The only precipitious site is at the Mixon Hole off Selsey Bill (Site 2) where a clay cliff drops almost vertically from the surface to a depth of 25 metres.

3.2.2 Chalk cliffs with vertical faces up to 4m are also found in several locations, generally running parallel with the coast and with a landward facing scarp. The westerly series of such cliffs running from Winter Reef (Site 26), through the Chalks (Site 29) to Worthing Lumps (Site 32) may represent a marine exposure of the Littlehampton anticline. Similarly the Newhaven or Chyngton Chalk syncline is reported to be traceable in a westerly direction just off the coast (Jones 1981) and it is possible that chalk exposures at Kingswest Lodge (Site 44), Loe Gate (Site 43) and South-West Rocks (Site 42) may be related to this feature.

3.2.3 Chalk reefs occur in the east of the region below the chalk cliffs. A reef and gulley formation is characteristically found which may represent a denudation of the chalk shore platforms referred to above.

3.2.4 In West Sussex low reefs are also formed in calcareous sandstone in the 5m-15m depth range. These seldom exhibit vertical development exceeding 2 metres. Typical sites are Bognor Reef (site 8), the Waldrons (Site 10) and Kingmere Rocks (Site 30). The presence of erratic blocks in beach gravels has been reported terrestrially from the Selsey area (Jones 1981) and also sub-littorally in Bracklesham Bay (Buehr pers. comm.) and west of Selsey Bill (Collins and Mallinson 1983). Similar erratic blocks are recorded sublittorally in this study from the Waldrons (Site 10). The occurrence of these erratics in the Selsey area is a matter of some controversy. They are generally considered to have been emplaced by drifting ice although their presence has recently been used to support the idea of direct glaciation of the channel (Jones 1981). A third theory is that they are ballast stones from early shipping in the area.

3.2.5 South of Selsey Bill is an area of exposed limestone reefs and banks which include the Pullar Bank (Site 1), the Mixon (Site 2) and extends to the Outer Owers (Site 14). In the case of the Mixon the limestone caps a clay bed which is exposed as the cliff face of the Mixon Hole (Ackers 1977).

3.2.6 Outside the relatively limited areas of hard substrata described above most of the seabed in the study area is covered with unstable deposited material ranging from small boulders and cobble (mostly flint) to finer sediments such as sand and mud. Substrata consisting of shells, shell debris and accumulated pseudo-faeces are also common.

3.2.7 There are probably as many as 60 shipwrecks off this stretch of the Sussex coast, lying in water from a few metres to 50 metres in depth. These provide solid substrata for a variety of sessile organisms and vantage points for fish and other animals in areas which are often uniformly flat and unstable. This is particularly true of the deep water wrecks. Pier struts and harbour walls provide comparable habitats in the shallow sublittoral. Map 3.1 shows a generalised picture of the main substratum types and they are considered individually in Sections 3.4 to 3.14 below.

3.3 TIDES AND TIDAL STREAMS

3.3.1 The tidal range (HWOST-LWOST) within the study area varies from 4.7m at Selsey to 6.1m at Newhaven. The range increases steadily from west to east due to the narrowing of the Channel towards the Straits of Dover.

3.3.2 Tidal streams within the study area vary considerably. In general stronger streams are experienced at offshore sites (2.9 knots near the Basil, Site 15), whilst the coastal sites experience less strong tides and longer slack water periods. (Outer Mulberry (site 6) max 1.1 knots, 3 miles of Shoreham : max 1.3 knots).

Two areas which experience locally strong tides at Selsey Bill and Beachy Head. Strong tidal currents are experienced in the Mixon Hole (Site 2) (Ackers 1977) and tidal overfalls occur off Beachy Head.

3.3.3 The tidal streams move in an easterly direction during the flowing tide. High water slack is about 1 hour before high water Dover in the west of the study area grading to the same as HW Dover at Beachy Head. Tidal streams then flow westerly to low water slack which ranges from five hours after HW Dover in the west, to 6 hours after H W Dover in the central section and 5-6 hours before HW Dover close to Beachy Head.

3.3.4 Water clarity and light penetration in the area generally is relatively poor. A combination of tidal streams, depositition of fine riverine material, channel and gravel dredging, foul and surface water outfalls and the exposed nature of the coastline all combine to limit water clarity. There is a distinct grading from west to east and whilst horizontal visibility of 6 metres is quite common in inshore sites in the western part of the area in summer, visibility of 3 metres off Seaford at the same time would be considered exceptional. Offshore sites, particularly the deeper wrecks in the western part of the study area, may have a horizontal visibility of up to 10 metres in good periods in the summer. Visibility is quickly reduced to almost nil in coastal regions after storms.

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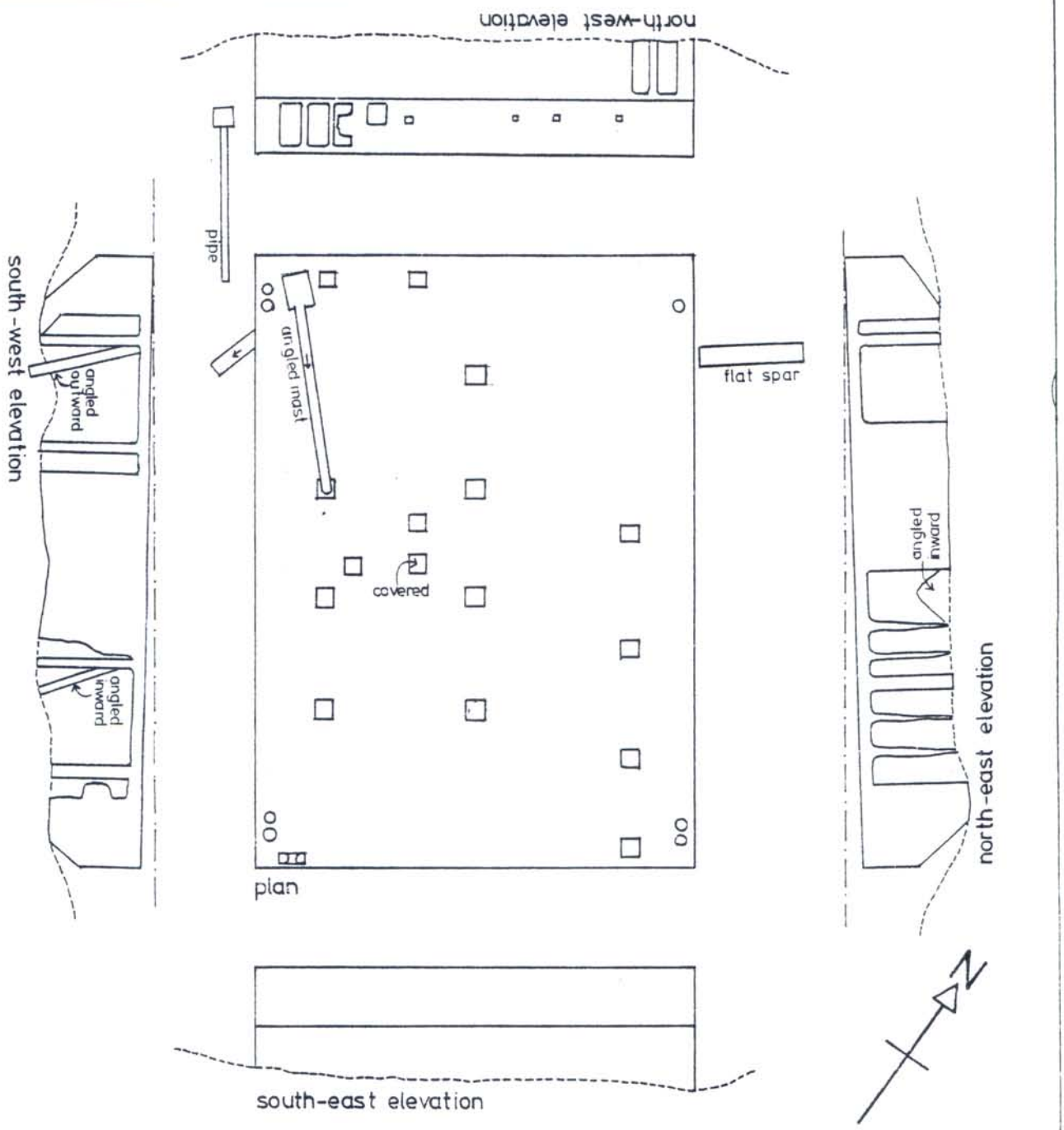


Inner Mulberry Pagham

South-east Branch
Underwater Conservation Society

May 1980

Scale
0 1 2 4 6 8 10m

Fig. 3.2

3.4 UPPER INFRALITTORAL 0 - 5 metres

3.4.1 Hard, stable substrata in the upper infralittoral are provided by a variety of artificial structures and by outcrops of bedrock and boulders. Hard, but unstable substrata are provided by cobbles and pebbles, and soft substrata by sand and some finer deposits.

Artificial Structures

3.4.2 The major artificial structures are, from west to east, Selsey Lifeboat Station (metal piles), Inner Mulberry Pagham (Concrete wreck), Bognor Pier (Metal piles), Littlehampton Harbour (concrete walls and wooden piles), Worthing Pier (metal piles), Shoreham Breakwaters (concrete walls), West Pier and Palace Pier Brighton (metal piles), Brighton Marina (concrete walls), Newhaven Breakwater (concrete walls) and a small wreck (The Gannet) at Seaford. In addition there are numerous groynes spread along the entire coastline.

3.4.3 Artificial structures in the upper infralittoral consist mostly of vertical surfaces. Those investigated along the shoreline (Shoreham Harbour Wall (Site 39), Brighton Marina (Site 47) and the wreck of the Gannet (Site 54) are typically heavily colonised by Mytilus edulis, Balanus balanoides and animal turf consisting of hydroids, bryozoans and ascidians. Alcyonium digitatum is also present, together with Metridium senile and various other anemones. Filamentous and foliaceous green and red algae are common, but kelp is absent. Amongst the mobile fauna, crabs are universally common (especially Carnicus maenas), and small blennies and scorpion fish were recorded. The Inner Mulberry (Site 5), fig. 3.2, lying 1km offshore, is similar in many respects to the shore sites, except for the presence of substantial growths of kelp (mostly Laminaria hyperborea, some L. saccharina) growing on the upper, horizontal surfaces. A total of 28 species of algae and 69 species of invertebrates have been recorded from this site (Cunliffe, 1981).

Bedrock and Boulder Substrata

3.4.4 Bedrock and boulder outcrops are found at Bognor (calcareous sandstone) and from Brighton eastwards to Beachy Head (Chalk).

3.4.5 Bognor rocks (Site 7),are widely spaced outcrops, surrounded by sand (fig. 3.3). Secondary habitats include vertical and horizontal surfaces as well as overhangs and caves created by faster erosion at the bases of the rocks. Algae (Laminaria hyperborea and foliaceous algae) dominate horizontal, sloping and the upper parts of vertical surfaces. Other vertical surfaces are dominated by sponges (especially Halichondria panicea and H. bowerbanki and ascidians (especially Molgula sp, Dendrodoa grossularia and Botryllus schlosseri). Crevices are sometimes occupied by crabs (Liocarcinus puber and Cancer pagurus) and the corkwing wrasse (Crenilabrus melops) is present wherever there is suitable cover.

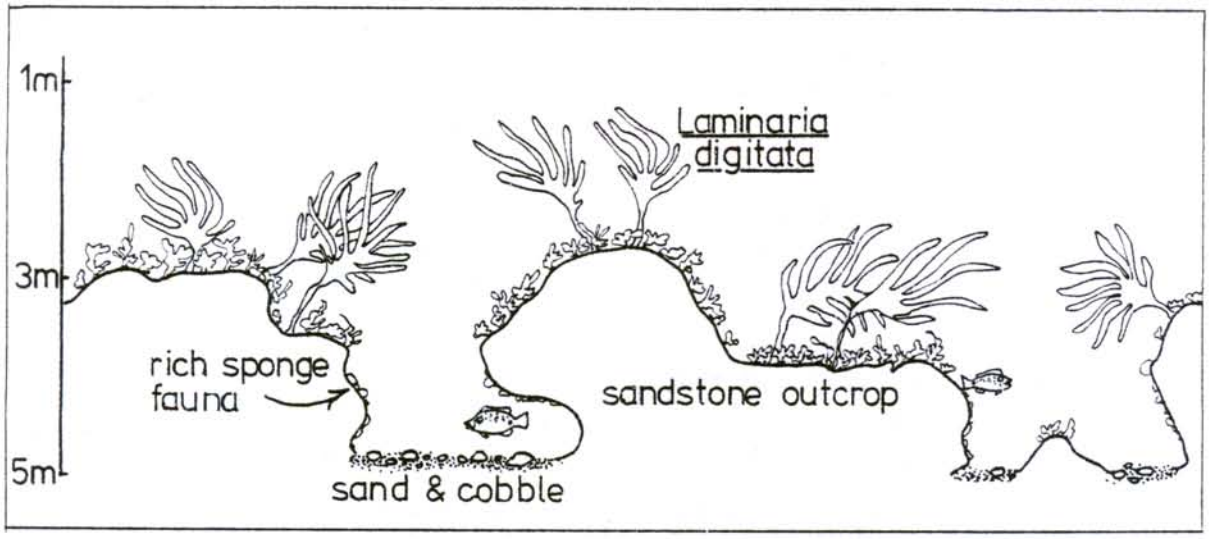


Fig 3.3. Bognor Rocks

3.4.6 Black rocks Brighton (site 48) consists of scattered chalk outcrops and boulders amongst sand. Kelp (mostly Laminaria saccharina) and foliaceious algae dominate most surfaces. Mytilus edulis, Pholas dactylus colonial tunicates and a variety of crabs are associated with the hard substrata.

3.4.7 At Rottingdean (site 49) the upper infralittoral is characterised by extensive areas of chalk, bedrock and boulders, with coarse to medium grade sand in the gullies between the outcrops. There are also patches where the substratum consists mainly of pebble and cobble. Laminaria saccharina, foliaceous red and green algae and large colonies of the sponge Halichondria panicea dominate the hard substrata. Crabs are the most obvious of the mobile animals.

3.4.8 Immediately offshore from Seaford (sites 55 and 56) are a series of flat chalk outcrops running parallel to the shore (fig. 3.5). Shallow gullies between the rocks contain coarse sand, mud and shell remains. Sediment is deposited fairly thickly in all areas. Foliaceous red and green algae dominate hard substrata, and Laminaria saccharina and L. hyperborea are also present. The chalk is often pitted with holes made by Pholas dactylus. Crabs, again, are relatively common.

Unstable and Soft Substrata

3.4.9 Most of the upper infralittoral consists of flint pebbles and sand, and the diversity of visible marine species is low. Organisms found included anemones (Actinothoe sphyrodeta and Urticina felina), worms (Arenicola marina and Lanice conchilega) and crabs (Carcinus maenas and Pagurus bernhardus) together with foliaceous algae on coarser substrata.

3.5 FLATTISH GROUND 5-10 metres

3.5.1 Shallow cobble is the major habitat type in West Sussex (Shelley Rocks, (site 11) off winter reef (site 26), off Littlehampton (site 28), near Mlown (site 38), Jenny Ground (site 40), near South-West Rocks (site 42). The seabed is flat and covered predominantly with pebbles and cobbles. There is also some gravel, sand, shell sand and finer deposits, and occasional boulders and flat patches of bedrock. Small crevices may be found associated with the cobbles and boulders, but in general there is a smaller range of microhabitats than in reef areas. These shallow regions are relatively exposed to swell and wave surge, while tidal currents are slight to moderate.

3.5.2 In general, algal cover is moderately high; Chorda filum is often dominant, and foliaceous red, green and brown algae are universally common. Laminaria saccharina is the only kelp to inhabit cobble ground, and in strong currents has been observed moving with the tide, the holdfast still attached to a cobble. L. digitata was observed only on flat bedrock (in the area of Shelley Rocks (site 11)).

3.5.3 A fairly wide range of sessile and mobile invertebrates can be found. Urticina (Taelia) felina, Lanice conchilega, encrusting and solitary ascidians, Buccinum undatum, Eupagurus bernhardus and Henricia oculata all typify pebble/cobble habitat. Crepidula fornicata often occurs in large numbers attached to cobbles and small boulders. Mytilus edulis is common and sometimes dominant on finer deposits, and Asterias rubens is often found preying on these mussel beds. Some areas are covered with shell debris (Crepidula, Ostrea, Pecten, Mytilus) which provide an additional microhabitat.

3.5.4 Fish recorded in the pebble/cobble habitat are predominantly small bottom dwellers. Gobies are particularly common and diverse (at least 4 species); the great pipefish Syqnathus acus and gunnel Pholis qunnellus regularly recorded. Flatfish (plaice and sole) and the dragonet Callionymus lyra are locally common, especially on finer deposits.

3.5.5 Chalk and flint cobble occurs in a few areas (e.g. Worthing Lumps (site 32) and Winter reef (site 26)) and tends to hae a sparser fauna and flora than other cobble areas.

3.5.6 Flattish areas of clay occur in some areas (e.g. at the top of the Mixon Hole cliff (site 2)). These provide some microhabitats (see Section 3.11), but tend to be sparsely colonised owing to erosion.

3.6 FLATTISH GROUND 10-20 metres

3.6.1 A large proportion of the Sussex sublittoral in the 10-20m depth range consists of flattish ground covered with a variety of inorganic, deposited material. Cobbles and pebbles are typical and widespread, with coarse sand and shell gravel in tide swept sites (e.g. Scallop grounds (site 9), Mussel grounds (site 29)). Most of the cobble and pebble is flint but at some sites (e.g. Scallop grounds) clay cobbles are also found. Deeper, or more sheltered sites have varying degrees of finer substrata (e.g. off South West rocks (site 42), off Anchor Lump (site 45), off Seaford (site 55)). At deeper sites empty shells of Pecten, Mytilus and Crepidula may be present.

3.6.2 Living animals also form an important substratum in many areas. Chains of live Crepidula fornicata are common at some sites, particularly the Mixon Hole (site 2), where a fine mud is formed by their pseudofaeces. Banks of Mytilus edulis occur in some areas (e.g. Mussel grounds (site 29)) and provide a microhabitat for other organisms.

3.6.3 Algae are absent from all but the shallower sites, where foliaceous reds occur. This lack of competition has resulted in a relatively rich assemblage of sessile animals and associated grazers and carnivores. Mytilus edulis and Crepidula fornicata are universally common. Other typical animals are Flustra foliacea, small ascidians, Pecten maximus (locally common), Buccinum undatum, Bugula spp, Pagurus bernhardus, Asterias rubens, Urticina felina and other anemones. Clay cobble supports little life but is extensively bored by piddocks.

3.6.4 Fish are nowhere abundant, but species diversity is reasonable Pleuronectes platessa and Callionymus lyra occur on fine deposits while Ctenolabrus rupestris is probably the commonest species overall.

3.7 FLATTISH GROUND 20-30 metres

3.7.1 Most of the deeper seabed off Sussex is flat, featureless and covered with cobbles, pebbles and finer deposits (Outer Owers, site 14). Boulder outcrops occur sporadically (e.g. off the Pullar Bank, site 1). Shell debris is widespread and usually consists of a combination of Crepidula, Ostrea, Mytilus and Pecten shells, with others occurring in smaller quantities. Sometimes these shells are concentrated into low "dunes" (off Pullar Bank, site 1).

A flat, but convoluted bed of clay was seen off the Mira (site 57). This was honeycombed, but appeared to be uncolonised by sessile organisms. Flat bedrock outcrops off the Pullar Bank (site 1) were similarly bare.

3.7.2 Strong currents occur in these deeper areas, but there is reduced disturbance from waves. This increased stablity generally enables a variety of organisms to occur, despite the paucity of microhabitats.

3.7.3 The commonest sessile animals on coarser substrata are Flustra foliacea, and the hydroid Hydrallmania sulcata. The anemones Urticina felina and Cerianthus lloydii are also common on various grades of substrate - the latter occurs at densities of about 10 per m^2 at the Outer Owers (site 14). Off the Pullar Bank (site 1) the cemented tubes of the polychaete Sabellaria spinulosa forms a hard substratum, occurring in patches level with the seabed. Crepidula fornicata is locally abundant and may form a "living" substratum which other small animals colonies. Other typical, common animals on cobble are Nemertesia, Alcyonidium gelatinosum and Ciona intestinalis. Amongst mobile animals Asterias rubens, Buccinum undatum and Pagurus bernhardus are fairly common. Solea solea and Pleuronectes platessa were recorded from finer substrata, while Ctenolabrus rupestris, Labrus bergylta and Scyliorhinus canicula are typical of cobble areas. Overall, however, fish are few in number and diversity.

3.8 SHALLOW REEFS 5-10 metres

3.8.1 Bedrock is exposed in various regions in the 5-10m depth zone and sometimes forms distinct reefs and ledges. Bognor reef (site 8) and Littlehampton rocks (site 28) are formed of calcareous sandstone, while reefs in the east of the region (Black Rocks, Brighton (site 48), Newhaven gullies (site 50) and Seaford gullies (site 56) consist of chalk. Chalk bedrock is also exposed at 8-10m at winter reef, off Littlehampton (site 26) where it represents the western end of a distinct submarine chalk cliff, running parallel to the shore. This is described in detail in Section 3.10.

Sandstone Reefs

3.8.2 These reefs are relatively flat and low lying, but some rocks and ledges stand as much as 2m above the seabed. These especially tend to be heavily undercut, with the formation of crevices, gullies, overhangs and small caves. In addition to these microhabitats and the inclined and horizontal surfaces there is cobble and pebble between and around the bedrock (Fig. 3.4).

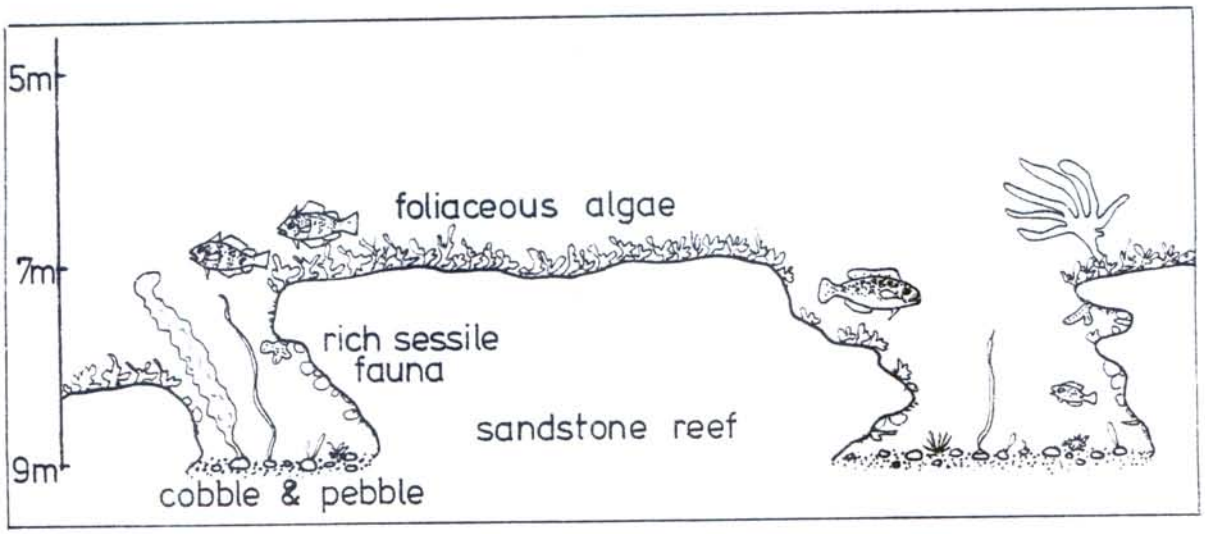


Fig. 3.4 Bognor Reef

3.8.3 Horizontal and inclined surfaces are dominated by foliaceous red and brown algae and kelp is sometimes present (mostly Laminaria digitata, some L. saccharina). Sessile fauna is sparse. In contrast, algae are generally absent on vertical surfaces, overhangs and crevices, and these microhabitats are often fairly richly colonised by animals. Sponges are usually dominant, with Halichondria panicea, H. bowerbankii, Amphilectus fucorum and Dysidea fragilis particularly well represented. Small hydroids, erect bryozoans and ascidians, (especially encrusting types such as Diplosoma listeronium) constitute much of the remaining fauna. Alcyonium digitatum occurs in underhangs but anthozoans are generally not well represented. Amongst the mobile invertebrates, molluscs, such as Calliostoma zizyphinum and crabs, particularly Macropipus puper (in crevices) and small Pagurus bernhardus are relatively common. Fish diversity and abundance is reasonably good, with Trisopterus luscus, Ctenolabrus rupestris, Labrus bergylta and Gobisculus flavescens typical of open water, and Parablennius gattorugine and Thorogobius ephippiatus associated with crevices and holes on the bottom.

3.8.4 Chalk Reefs

To the east of the region, the reefs consist of irregular chalk ridges and gullies normally running out from the shore (e.g. Newhaven Gullies (site 50), Seaford Head (site 56)). At Seaford Head the relative dimensions of the ridges and gullies change from the shore to deeper waters (fig. 3.5). The gullies become progressively smaller further from the shore and the chalk outcrops tend to have a lower profile. At a depth of 6-8m the gullies are typically 1-2 metres high, and 2-3 metres wide. The ridges are somewhat wider and more variable, in some parts extending into flat bedrock platforms. The sides of the gullies tend to be vertical, with some undercutting in places - this however is not so pronounced as in the western reefs, where the calcareous sandstone can support a greater degree of undercutting. Muddy sand predominates on the floor of the gullies, where litter (iron wreckage, tyres etc.) can be seen occasionally. Some flint is in evidence in the area, both as cobbles and bedrock. Chalk boulders also occur.

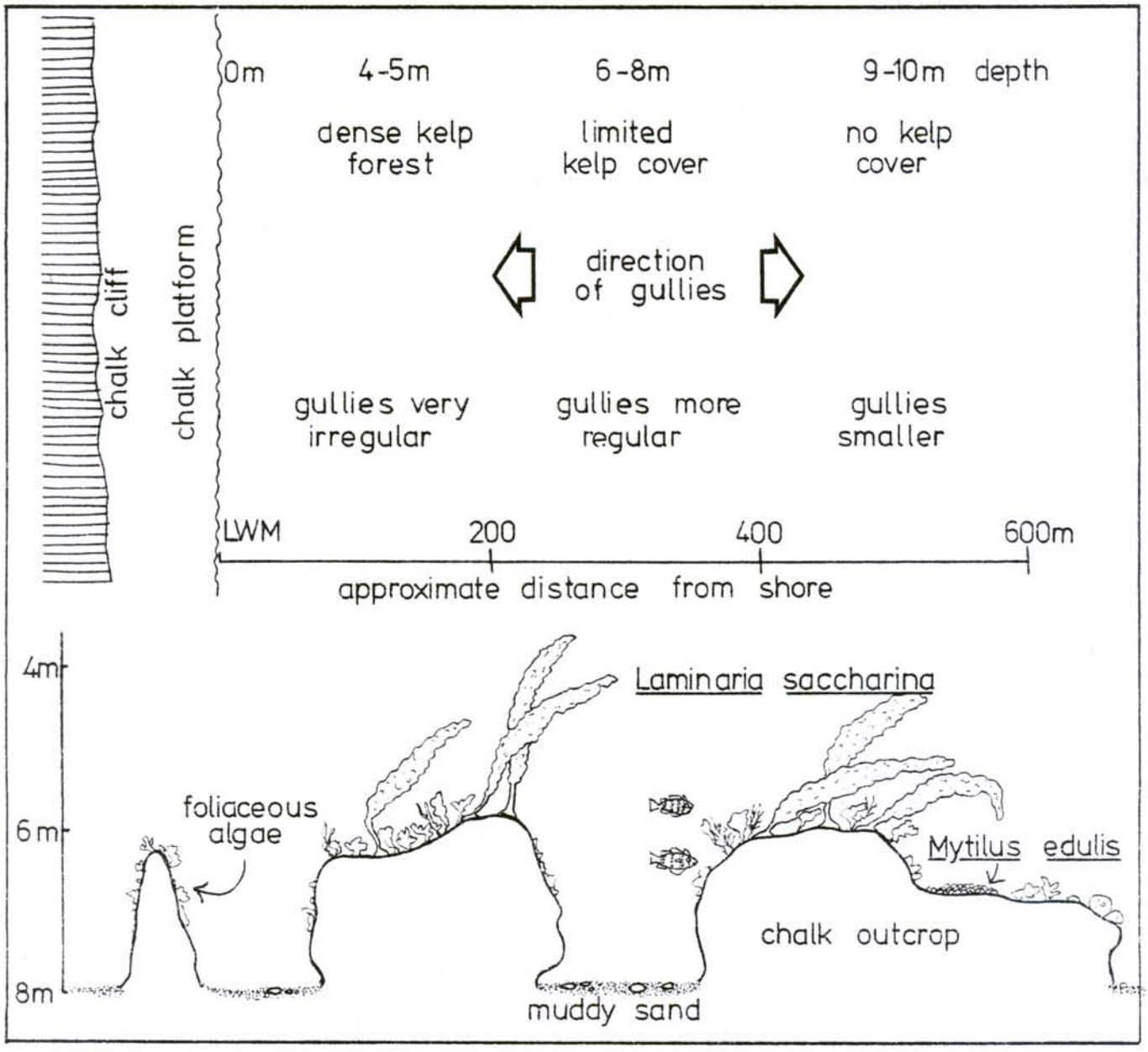


Fig. 3.5 Plan and Profile at Seaford Head.

3.8.5 Considerably more siltation occurs in the eastern reefs and this, coupled with the chalk substrate, produces a different mix of species. Upper surfaces are dominated, but not exclusively colonised, by algae. Foliaceous red algae are dominant, but kelp is also present. The commonest kelp is Laminaria saccharina whereas in the western reefs other Laminaria species dominate the upper bedrock surfaces. L. saccharina is typical of cobble substrata in Sussex, but is able to exploit bedrock surfaces when not in competition with other laminarians. The lower depth limit of foliaceous algae is not known but there is evidence to suggest that the lower limit of kelp is about 9m.

3.8.6 Sponges are less in evidence than on western reefs. However, large colonies of Halichondria panicea are common, and Suberites domuncula is much more in evidence than in other areas. Crabs, such as Liocarcinus puber, small Cancer pagurus, and Maia squinado common. There is a variety of sessile animals - phoronoids, bryozoans, and ascidians, dominant of which is Molgula manhattensis. This solitary ascidian, although cryptically coated in sand grains, carpets large areas of the rock. Mytilus edulis is also locally abundant, forming mounds on the ridges - whenever this occurs they are grazed by large populations of Asterias rubens. However, perhaps the most significant faunal components of these reefs are the piddock, Pholas dactylus, and the worm Polydora sp. Both bore extensively into the chalk, and must contribute greatly to erosion.

3.8.7 Fish are not particularly abundant on the eastern chalk reefs although a reasonable variety of species can be found. Trisopterus luscus, Ctenolabrus rupestris and other wrasse occur around the reefs, and crevice dwellers include Parablennius gattorugine Pholis gunnellus and Thorogobius ephippiatus.

3.9 REEFS 10-20 metres

3.9.1 In the west of the region Bognor reef extends into the 20-20m depth range as the Waldron's (site 10). Further offshore lies the Pullar Bank (site 1), which is a flat, sandstone reef. The Worthing Lumps (site 32) and South West rocks (site 42) are examples of chalk reefs. These are described in Section 3.10. Other deeper chalk reefs occur at Kingswest Ledge (site 44) off South West Rocks (site 42) and at Seaford Head (site 56).

The Waldrons

3.9.2 Part of the Waldrons (site 10) consists of bedrock areas with a topography identical to that of shallow reefs in the western part of the region. However, in deeper areas, there are more large sandstone boulders between the bedrock outcrops, and some of these boulders are rounded, 2-3m in diameter, with undercut bases forming small cave-like habitats. Some boulders were observed to be cracked. In some parts these boulders are strung out in a line. Also embedded in the coarse sediments are flattened boulders, 2-3m in diameter, and resembling millstones (Fig. 3.6).

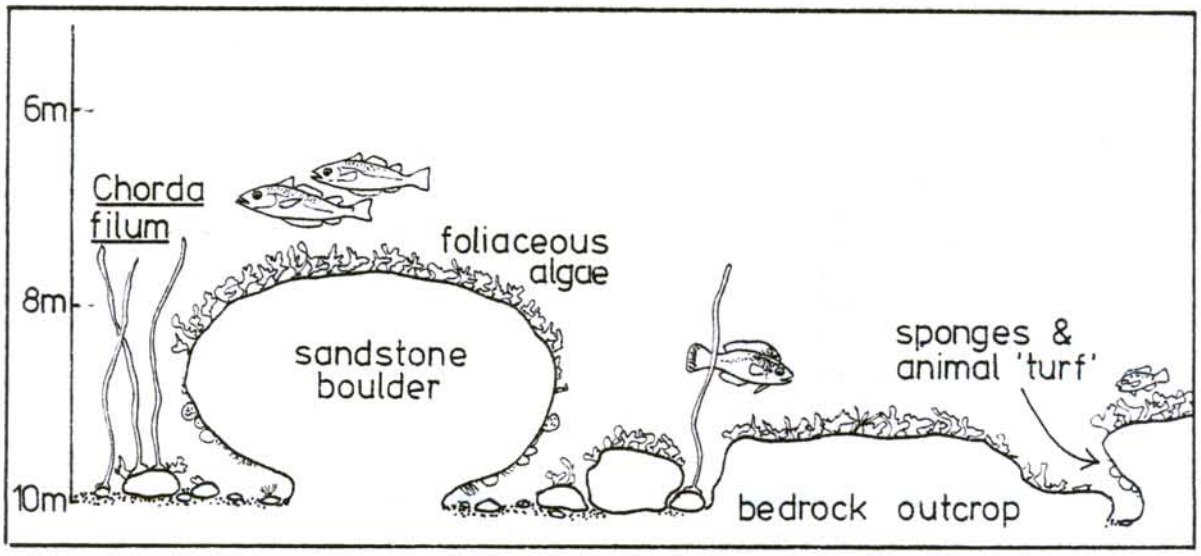


Fig. 3.6 The Waldrons

3.9.3 The site is dominated by foliaceous algae on upwardly inclined surfaces, but no kelp was observed on this reef. Chorda filum is conspicuous on flat, low lying areas. Sponges are the dominant faunal component in shaded areas. Tubularia 'turf', Bispira volutacornis, Henricia oculata and some crustaceans are recorded, but the number and variety of invertebrates other than sponges is generally poor.

3.9.4 Goldsinny, Ctenolabrus rupestris are relatively widespread, but other fish, such as Trisopterus luscus and Pollachius pollachius are restricted in their distribution and only congregate around the larger outcrops. Both male and female cuckoo wrasse were seen in unusually high numbers at this site.

Pullar Bank

3.9.5 The Pullar Bank (site 1) consists of flat, sandstone bedrock with ledges, fissures and other irregularities. Sand and shell gravel are also present in variable quantities and this sediment is prone to move and scour the bedrock. There is considerable exposure to wave surge and tidal currents, and dunes are often formed.

3.9.6 Algae are absent. Mytilus edulis, and Molgula manhattensis are locally abundant. Also common and typical are Cancer pagurus, Homarus gammarus, Urticina (Tealia) felina, Buccinum undatum and Nucella lapillus.

Seaford Head

3.9.7 The chalk reef at Seaford Head (site 56) extends to at least 18m, but the bedrock at this depth is relatively flat and featureless, in contrast to the gullies and outcrops in shallower areas. The reef is overlain with a 5cm thick layer of mud, probably of both organic and inorganic components. Occasional small boulders, cobbles and pebbles lie on the surface; these are mainly chalk, but some are flint.

3.9.8 The variety and abundance of visible marine life is restricted, presumably because of the thick layer of unstable silt which covers the reef. Alcyonium digitatum, Urticina (Tealia) felina and Actinothoe sphyrodeta occur on exposed bedrock, and amongst mobile invertebrates Pagurus bernhardus, Liocarcinus puber and Asterias rubens were recorded.

3.9.9 The seabed off the Seven Sisters (site 58) is probably similar to Seaford Head, but adverse conditions prevented a detailed study being carried out.

3.10 CHALK CLIFF

3.10.1 Three sites in the study area consist of clearly defined chalk cliffs with vertical faces up to 4m. These are the Worthing Lumps (site 32), South West Rocks (site 42) and the Winter Reef (site 26). The first two sites have cliffs facing north, towards the shore. The orientation of Winter reef is less clear for, although parts face north, the cliff as a whole appears to be more convoluted than at the other sites.

3.10.2 At each site are three definite regions (Fig 3.7).

a) Flat cliff top. The cliff top consists of flat chalk bedrock lying in depths of around 7-11m, and substantially overlain with pebbles, cobbles and sand. The cliffs concentrate water flow, resulting in considerable currents. Despite this, the substrata have achieved a degree of stability and support significant populations of foliaceous red, and some green, algae, with calcareous reds ("Lithothamnion") covering some rock surfaces.

b) Cliff face. In places, the cliffs are heavily indented vertically, forming curved sweeps, gullies and deep crevices. Horizontal indentations create crevices, caves, ledges and overhangs. The cliff faces are bored by piddocks, Pholas dactylus, but many of the holes are empty. This boring activity, together with the relative fragility of the chalk, and water turbulence, presumably causes their jagged appearance and instability. This results in limited colonisation by sessile organisms, and large parts of the cliff faces are bare. Animal turf is, however, present in places. The groups of most significance are sponges and bryozoans (mainly Bugula), with some ascidians being present. In contrast, mobile animals are relatively abundant and diverse because of the many and varied crevices present on the cliff face. Homarus gammarus, Cancer pagurus, Conger conger, Thorogobius ephippiatus and Parablennius gattorugine are all relatively common.

c) Cliff base. At the base of the cliffs are plains of chalk pebbles and cobbles (with some flint). In addition, at South West Rocks, chalk boulders, sand and mud are present, presumably reflecting the increasing siltation to the east of the region. Although not studied in detail, these areas appeared bereft of marine life.

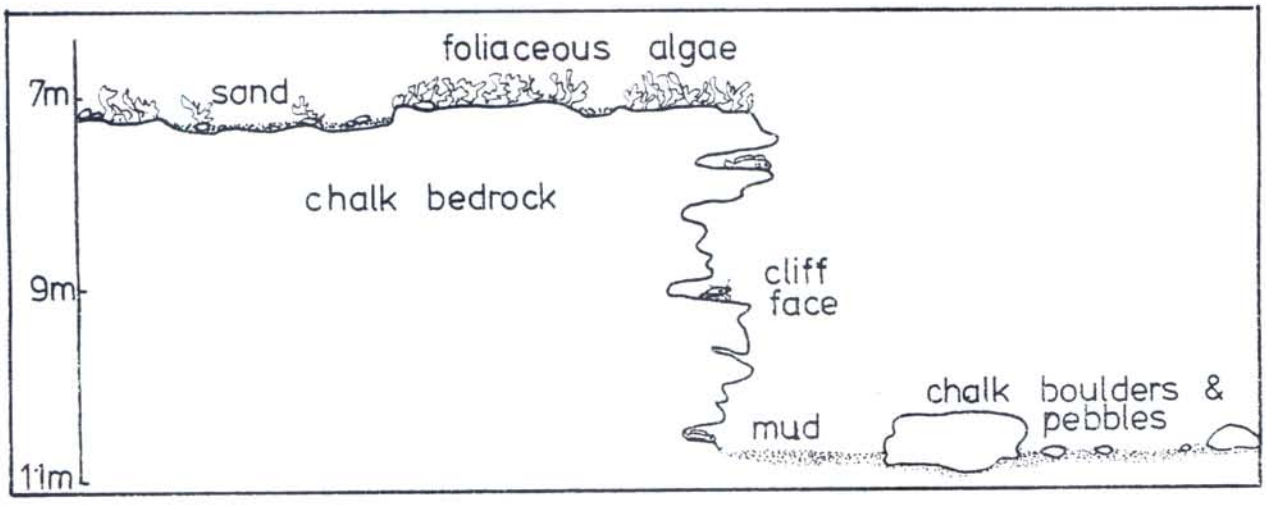


Fig. 3.7 Profile of typical chalk cliff habitat

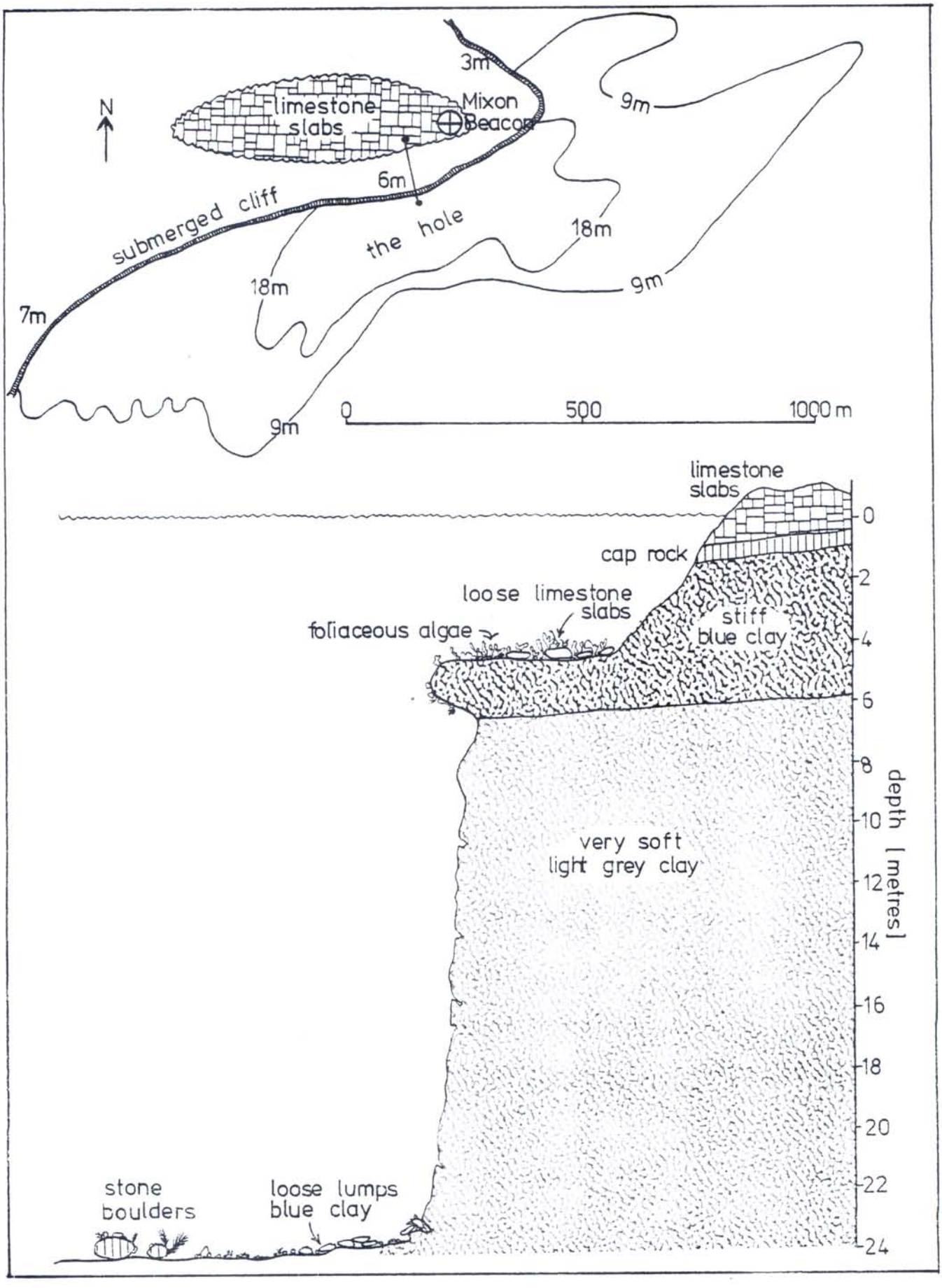


Fig. 3.8 Plan (top) and profile of the Mixon Hole.
(after Ackers 1977)

3.11 CLAY CLIFFS

3.11.1 Clay substrata occur sporadically in the Sussex area, and may form low ledges. However, the clay cliff on the north-west boundary of the Mixon Hole (site 2) is a unique feature and was the subject of a detailed study by the Aldershot Dolphins Sub-Aqua Club (Ackers, 1977). A summary of the main habitats is given below, and also shown in Fig. 3.8.

a) Cliff Top. (5m) This is a platform of clay, on which lies limestone slabs, sand and shell gravel. Algae dominate the area, with laminarians, and a heavy covering of foliaceous reds.

b) Cliff Face. (5m-10m) At the top of the cliff is an overhang caused by stiff blue clay (which erodes slowly) overlaying much softer, light gray clay (which erodes quickly). In general terms erosion results in an unstable substratum, and large patches of the cliff face are bare, and uncolonised. The more stable, stiff clay, supports more sessile organisms, both on the cliff face and under the overhang. Encrusting and foliaceous bryozoans occur (mainly Bugula), together with some hydroids and encrusting ascidians. The cliff face is extensively bored by piddocks (Pholas dactylus), but, as with chalk cliffs, many of the holes are empty. The physical and biological erosion creates many microhabitats of holes, crevices, and narrow platforms. These are occupied by the crustaceans Galathea squamifera, Liocarcius puber and Cancer pagurus and fishes Parablennius gattorugine and Thorogobius ephippiatus.

c) Cliff Slope. (10m-20m) The base of the cliff gives way to a steep clay slope covered with clay cobbles and boulders that have fallen from the cliff. No sessile organisms are found on the free clay surfaces, but cover is afforded to the crustaceans Homarus gammarus, Liocarcinus puber and Cancer pagurus.

d) Cliff Base. (20-25m) The seabed of the Hole is a slipper limpet bed, mainly consisting of living chains of Crepidula fornicata, large pieces of shell (mainly Crepidula, but some Ostrea) and pebbles, plus small quantities of particulate clay, detritus (mainly Crepidula pseudofaeces) and shell gravel. Living space within the substratum affords shelter to many small animals, in particular Pisidia longicornis. Free surfaces of the substrate are colonised by a number of sessile organisms, most common being the hydroids Hydrallmania falcata and Amphisbetia operculata, calcareous tubes of the worm Pomatoceros triqueter and the ascidian Dendrodoa grossularia. Pagurus bernhardus is the most frequently encountered mobile species. Occasional stone boulders on the seabed support a variety of sessile and mobile organisms.

3.12 SHALLOW WRECKS AND STRUCTURES 5-10m

3.12.1 Amongst the coastal structures, only Palace Pier Brighton extends into the 5-10m depth range. There are, however, a number of wrecks in shallow water including the outer Mulberry (site 6), the Frode (site 31), Indiana (site 33), Miown (site 38) and Dredger (site 40). The Mulberry is concrete and is relatively intact, whilst the others are metal and are mostly fairly broken up. All the sites are exposed to wave action and moderately exposed to tidal currents. The outer Mulberry, however, has vertical and irregular surfaces that are sheltered within the wreck (Fig. 3.9). The most important feature of the wrecks and structures is that they provide a hard and relatively stable substratum which contrasts with the substration of the surrounding seabed. This is mostly cobble and pebble, but a range of coarser and finer substrata can be found.

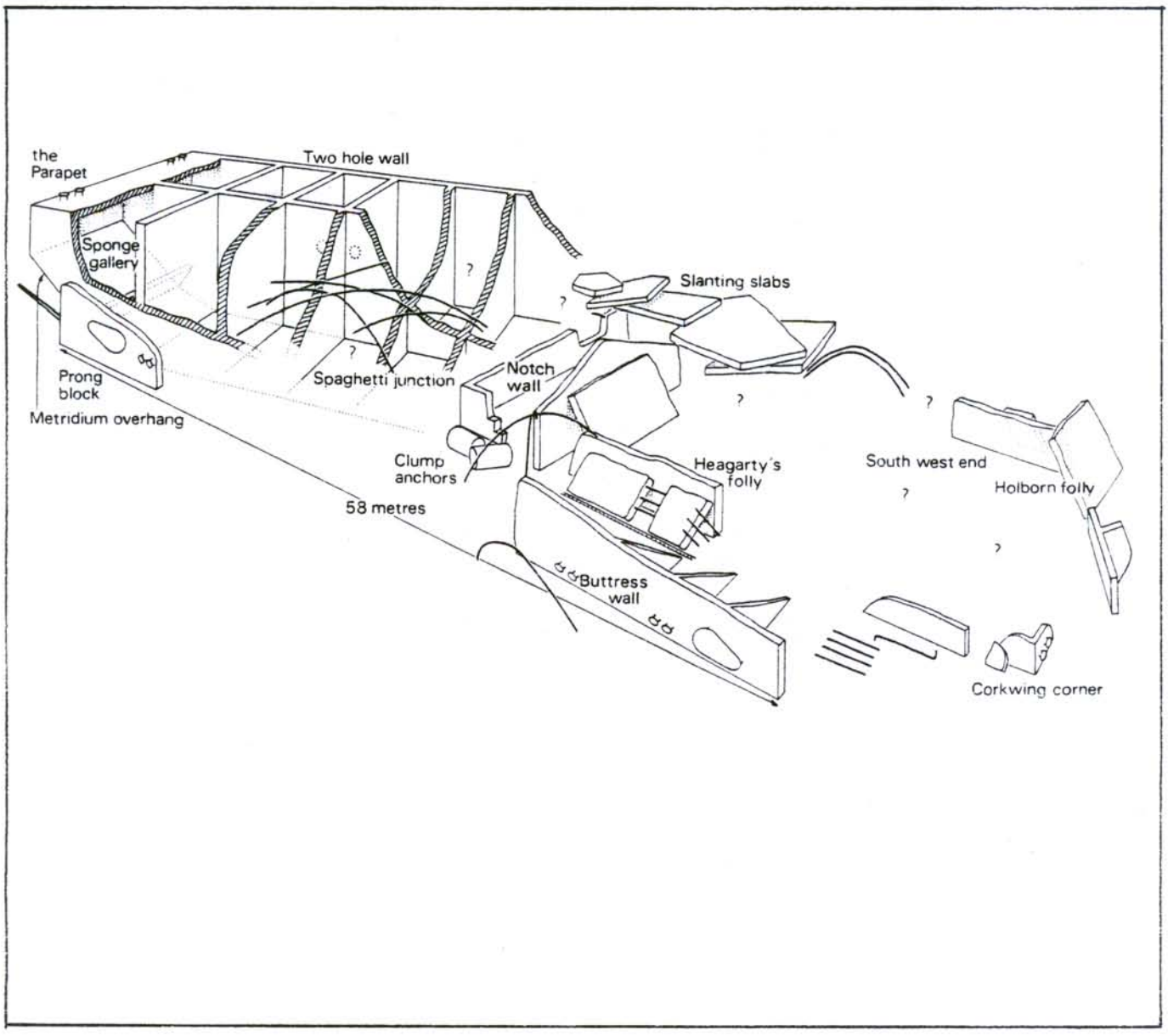


Fig. 3.9 Outer Mulberry

3.12.2 In general these habitats support a relatively rich and varied flora and fauna. Foliaceous red algae tend to dominate horizontal, unshaded surfaces, but also present are some green algae and kelp plants (mostly Laminaria saccharina). On the outer Mulberry kelp is particularly abundant and includes L. hyperborea and L. digitata as well as L. saccharina.

3.12.3 Vertical and shaded surfaces are usually heavily colonised by sessile organisms, with the noticeable exception of some of the inward facing Mulberry walls which are very silty and virtually bare. Some sites or surfaces are characterised by certain species. For example, dense patches of Corynactis viridis, Metridium senile and Alcyonium digitatum are found on parts of the Outer Mulberry. In contrast, the outer struts of the Palace Pier, Brighton are dominated by Mytilus edulis. Elsewhere, however, are a range of animals including hydroids, bryozoans, sponges and encrusting and solitary ascidians. Often a dense animal 'turf' covers the substratum. Amongst the mobile invertebrates crabs are present at all sites, with Carcinus maenas and Maia squinado particularly common. Beneath the Palace Pier, Brighton, were enormous populations of M. squinado, with individuals heaped on top of each other. Large numbers of Asterias rubens were also seen at this site, feeding on Mytilus edulis.

3.12.4 Fish are attracted to both wrecks and man made structures and are generally abundant, provided the structures are not too small or fragmented. Both substrate associated species and more open water types are well represented. In the former category Parablennius gattorugine and Taurulus bubalis were most common, and in the latter Trisopterus luscus and Ctenolabrus rupestris. Large shoals of Pollachius pollachius can also be found around the Outer Mulberry.

3.13 WRECKS 10-20 metres

3.13.1 Only two wrecks are known from this depth. These are the 'Ore Wreck' (site 24) and the Pine (site 12). Only the latter was examined in detail. The wreckage lies low on the seabed, being flat or slightly sloping, but there are also erect sections of 2-3m height. The usual wreck microhabitats of underhangs, "caves" and holes are present.

3.13.2 The site differs from deeper wreck sites in the presence of conspicuous foliaceous algae. Also of note was the presence of small specimens of Laminaria saccharina (at 14m) probably representing the lowest limit of kelp plants in this vicinity.

3.13.3 The fauna is not untypical of wreck sites, being relatively rich and varied. Alcyonidium and Nemertesia (2 spp.) are unusually common on horizontal surfaces. Also common are Bugula, Flustra and Tubularia, especially on struts and vertical surfaces and a variety of sponges and ascidians are present. Alcyonium digitatum is common, although there are noticeably few anemones (Actinothoe, and one Metridium being the exception). Gastropods and crustaceans were seen on the wreck, but in general mobile invertebrates were restricted both in variety of species and numbers of individuals.

3.13.4 As usual, fish life is good, with an abundance of Trisopterus luscus and T. minutus, plus a variety of crevice dwelling gobies and blennies.

3.14 OFFSHORE WRECKS 20 metres+

3.14.1 There are at least 50 wrecks lying in depths between 20 and 30m. They provide a reef-type habitat in areas of seabed otherwise covered with cobbles, pebbles, shells and shell debris, or finer deposits. The condition of the wrecks is variable. Some (e.g. the Basil (site 15), City of Brisbane (site 52) and Jaffa (site 23) have reasonably intact structures which stand as much as 8m above the seabed. Others (e.g. Lightfoot (site 16), "Bottle wreck" (site 20) are more broken up and low lying. All the wrecks have secondary habitats, including vertical, inclined and horizontal surfaces, underhangs, crevices, holes and caverns. The "Bottle wreck" (site 20) is unusual in consisting of a mound (6m x 10m) of pipes (0.4m diameter) which are remnants of the cargo. Wooden planks between the pipes are all that remain of the boat itself, which sank some 200 years ago.

3.14.2 Tidal currents offshore are strong and create scour holes in soft deposits around the base of the wrecks. Sediment tends to accummulate within the framework of the wrecks, where the effect of currents is less persistent, and some degree of siltation occurs on all upward facing surfaces. Siltation appears to increase towards the east of the region.

3.14.3 Diversity of sessile organisms is often relatively low, with extensive areas dominated by one or a few common species, but cover may be reasonably high (e.g. on the Basil (site 15), Jaffa (site 23) and City of Brisbane (site 52)). In other places or on other wrecks (e.g. Lightfoot (site 16), Bottle wreck (site 20)), surfaces are uncolonised or almost bare. This low diversity and poor cover probably results both from siltation and from instability of the wreck surfaces. Algae are absent, and their place is typically taken by bryozoan turf (including Flustra foliacea), Tubularia indivisa, Scypha ciliata, Dysidea fragilis (particularly on the ("Bottle wreck"), Nemertesia antenina, Pomatoceros triqueter, Filograna implexa and Diadumene cincta. Alcyonium digitatum and Metridium senile are associated in particular with underhanging structures, and small Corynactis viridis were found on a number of wrecks. Mytilus edulis is locally abundant on horizontal surfaces, as is the tube dwelling amplupod Jassa falcata. Amongst mobile invertebrates Asterias rubens is generally common, and Crossaster papposus occasionally seen. The crabs Liocarcinus puber and Cancer pagurus are always present.

3.14.4 Fish are generally abundant in terms of overall numbers, especially Trisopterus luscus, Pollachius pollachius, Ctenolabrus rupestris and Parablennius gattorugine. However, species diversity is limited in comparison with shallow wreck and reef sites, although individuals tend to be larger than average in some species. Large bass, Dicentrarchus labrax, were seen at some of these sites.

4 Flora and Fauna

4.1 BASIC SPECIES RECORDS

4.1.1 Basic species recording cards were completed for 51 of the 60 sites surveyed during the study. The locations of the sites concerned are shown in Appendix 2 and represent a complete range of habitat types within the area. The details of the information on each basic species card, arranged by site and in generalised habitat groups, are contained in Appendix 3. These results have also been included in the species group by group analyses and lists which follow.

4.1.2 The basic species records offer the possibility of making comparisons between individual sites or types of site on the basis of the species found there. They also offer a ready comparison of the occurrence and distribution of a limited number of species throughout the study area. This preliminary section is concerned only with the first of these comparisons, the second being covered in the subsequent sections of this chapter.

4.1.3 Some caution is necessary in drawing too many conclusions from this information in relation to habitats since the list of species concerned is necessarily selective and limited to easily identifiable species. The list was not drawn up with the intention of including 'indicator' species for different habitats and many of the organisms included were known to have a wide habitat tolerance and might therefore be expected to be widely recorded.

4.1.4 A comparison between the 3 broad habitat types of flattish ground, reefs (includes cliffs) and wrecks (includes piers and other structures) produces the following table:

	No of Records		All basic species		Common species	
	cards	sites	av per card	max on one card	av per card	max on one card
Flattish Ground	30	18	7.0	12	2.6	6
Reefs	41	16	10.0	18	4.5	11
Wrecks	51	26	10.6	19	4.4	9

4.15 The table shows a clear correlation between reefs and wrecks in terms of the number and commoness of the basic species. This is to be expected in that wrecks provide a hard substratum in many ways similar to natural reef habitats. Both are quite different from the flattish ground category and significantly lower records in terms of number of species and common species per card are recorded from these latter areas. It is interesting to note that the gap is greater in terms of common species than all species. On average cards from flattish ground record 58% of the number of species recorded as common in the other two categories, as opposed to

68% where all of the basic species are concerned. In terms of occurrence of the basic species, therefore, the flattish ground areas are significantly sparser than others.

4.16 The second variable which may be used as a basis for comparison is depth as demonstrated in the following table:

	No of Records		All basic species		Common species	
	cards	sites	av per card	max on one card	av per card	max on one card
Depth 0-5m	12	8	9.3	15	4.1	7
5-10m	50	19	10.6	19	4.3	13
10-20m	27	15	8.4	14	3.6	8
20m+	33	20	10.0	16	4.0	8

4.17 sites in the depth range 5-10m appear to record, on average, the greatest number of basic species as well as the greatest number of these species found to be common. The reduction in numbers recorded in the 10-20m depth range is not continued in the deeper 20m+ range. This column is probably misleading because of the preponderance of records from wrecks in the 20m+ depth category. If wrecks are split from other habitat types in the 20m+ category the following table results.

	No of Records		All basic species		Common species	
	cards	sites	av per card	max on one card	av per card	max on one card
Depth 20m+ wrecks	27	16	10.4	16	4.2	8
other sites	6	5	8.0	12	3.3	5

4.1.8 The importance of the deeper wrecks in terms of the life they support is clear from this table. A generally downward trend in terms of numbers of basic species from a peak in the 5-10m range is confirmed by the 'other sites' figure, but the wrecks at this depth exhibit numbers and commoness of basic species which match the naturally more productive shallower regions. The importance of these unnatural features in contributing to the marine fauna of the Sussex area should not therefore be overlooked.

4.1.9 The basic species records can be further analysed to see whether the 5-10m peak is a constant feature among the different broad habitat categories. This produces the following table.

	No of Records		All basic species		Common species	
	cards	sites	av per card	max on one card	av per card	max on one card
A.Flattish Ground						
Depth 0-5m	3	3	7.7	10	1.3	3
5-10m	11	7	6.2	10	2.2	6
10-20m	12	9	7.2	12	3.3	6
20m+	4	4	8.5	12	3.0	4
B. Reefs						
Depth 0-5m	3	3	10.7	12	4.7	6
5-10m	23	8	10.8	18	5.2	11
10-20m	13	7	8.8	14	3.2	8
20m+	2	1	7.0	8	4.0	5
C. Wrecks						
Depth 0-5m	6	3	9.3	15	5.2	7
5-10m	16	6	11.1	19	5.6	9
10-20m	2	1	13.0	13	4.0	4
20m+	27	16	10.4	16	4.2	8

4.1.10 The drawing of any firm conclusions from this table would be inadvisable as a number of the categories, because of the sub-division, result from very low numbers of records. However, a general trend of reducing numbers and commoness of basic species with depth below 10m can be inferred from the reef sites. The wreck sites show little variation with depth although some reduction in the numbers of basic species recorded as common is apparent. On the other hand results in the flattish ground category show the 5-10m depth range as the least well populated with basic species and a marginal increase in species per card with increasing depth.

4.2 ALGAE

4.2.1 This is the first comprehensive survey of the sublittoral algae off the Sussex Coast. In addition to the two Laminaria species on the Basic Species List the Survey records 95 species from 18 sites, well distributed along the coastline. Previous County records can be obtained from the bibliography prepared by Dixon, Irvine and Price (1966). A previous diving survey has been carried out to investigate the 'seaweed problem' at Worthing (Twonsend 1956). Some 50 species were recorded, most of which have been found in the present survey. Tittley and Price (1978) also report briefly on the inter-tidal algae of East Sussex. A number of species have been found in the present survey which they did not record from East Sussex but did report from elsewhere in the eastern English Channel. These include Cladophora pellucida, Cutleria and Dudresnaya. We have also confirmed their record of Arthrocladia from Sussex which they had queried.

4.2.2 Four of the species are new records for Sussex. These are, from the Waldrons off Littlehampton (Site 10),

Falkenbergia rufolanosa - not recorded by Farnham (1980)
Kallymenia reniformis - not recorded by Irvine (1983)

from the South West Rocks off Hove (Site 42),

Audouinella rosulata - not recorded by Dixon & Irvine (1977)
Gloisiphonia capillaris - not recorded by Irvine (1983)

A possible fifth new record from this site is
Daysa ? corymbifera but the identification has not yet finally been confirmed.

4.2.3 The relative numbers of species of Chlorophyta, Phaeophyta and Rhodophyta found in an area may be used to determine an index of floristic affinities. In warmer waters the variety of red algae is expected to increase while the browns decrease. In our survey the numbers of species recorded were:

Greens 9 species; Browns 23 species; Reds 65 species.

This gives a value of the ratio (R + C ÷ P of 3.2. This is high compared with surveys of adjacent areas. (Farnham, pers. comm.) It may reflect the fact that records were only collected by diving so that many littoral species are not recorded. The value for the British Isles as a whole is 2.2.

4.2.4 34 species were found in the Sussex Survey which were not recorded in the mainly shore based survey of the seaweeds of Kent (Tittley & Price 1977). One would expect a decrease in the total number of algae species from West to East as the waters become cooler. Being largely shore based, the Kent Survey necessarily includes drift species - a problem overcome by a diving survey. It is not known how far different species can drift or what their rate of disintegration might be and so the origin of drift specimens is very uncertain.

4.2.5 It is of interest to mention that drift species of Codium bursa were recorded from Bognor at the end of the last century (Guermontrez 1892) but this species was not found during our diving survey.

4.2.6 Two other factors should be taken into account when examining the variety and distribution of algae along the coast:

(i) The survey dives were restricted to four summer months so that seasonal differences in algal growth are ignored.

(ii) Many divers have little knowledge of algae so records and collections from a particular site are enormously increased by the presence of an expert or enthusiast.

However examination of the individual site records show that although 15 of the 18 sites recorded for algae were shallower than 10m, the 3 deeper sites still had a good variety of species. Substrate is expected to be a determining factor and indeed a high proportion of the species are found on rocks, flattish ground with cobble and rock like man-made structures. Wrecks appear a less favourable habitat with a lower variety of species.

4.2.7 One species conspicuous by its absence is Sargassum muticum. Although this notorious "japweed" has successfully invaded coastlines to the East and West of Sussex (Farnham 1980), growing plants were not recorded in our area. This species has, however, been recorded intertidally in Pagham Harbour (WSCC 1983) and is known to be growing inside Shoreham Harbour and Brighton Marina (D.H. Harvey pers. comm.).

4.2.8 SPECIES LIST - ALGAE

The species below were recorded at the sites given on the following dates:

Site Reference Number	Date of Dive	Site Reference Number	Date of Dive
2	6.83	40	5.82
6	6.83	41	5.82
7	7.82	42	8.83
8	7.82, 7.83	46	7.82
10	7.83	47	8.82
12	7.83	49	7.82
13	7.83	50	7.83
26	6.83	54	8.83
38	5.82	56	7.83

NOTATION

Abundance when recorded: 'p = present.
'c' = common.

'*' = tetrasporangial plants (Rhodophyta).

'X' indicates species not recorded in Kent (Tittley & Price 1977).

Authorities used as in Parke & Dixon CheckList (1976).

CHLOROPHYTA

Bryopsis plumosa 2, 6c, 10, 40c, 46p, 47p.

Chaetomorpha melagonium 2.
Cladophora sp. (46p, 49p).
C.pellucida (6).
Codium fragile ssp tomentosoides (2).
Derbesia marina (2, 26, 42, 47) X.

Enteromorpha intestinalis (12, 46, 47, 49, 54c, 56).
Phaeophilia viridis, endophytic in various red algae, (10).
Ulva lactuca (2, 26, 46p, 47p, 49p, 54c).

PHAEOPHYTA

'Aglaozonia parvula' phase of Cutleria multifidia (26) X.
Arthrocladia villosa (12,42).
Chorda filum (8c, 10c, 42, 46)
Cladostephus spongiosus (2, 6, 8p)
C. verticillatus (ip, 10, 26)
Desmarestia aculeata (6, 12, 13, 42, 47)
D. ligulata (8c, 26)
D. viridis (26, 46c)
Dictyota dichotoma (2, 6p, 8 c, 10, 12, 26 42, 46, 47)
Ectocarpus sp. (6p, 8c, 46)
Griffordia granulosa (26) Plurilocular sporangia
G. secunda (47p) Unilocular sporangia
Halidrys siliquosa (2, 6c, 8p, 12, 13c, 26, 47.)
Halopteris scoparia (6)
Himanthalia elongata (7c)
Laminaria digitata (6, 8c)
B. L. hyperborea (2c, 5c, 6c, 7p, 8c, 31p, 33c, 48c, 56c)
B. L. saccharina (1c, 2c, 5c, 6c, 8p, 11p, 14p, 26c, 28p, 31p, 33c, 38c, 40c, 41c, 46c, 47p, 48c, 49c, 50c, 56c)
Punctaria latifolia (2)
Sphacelaria cirrhosa on Gracilaria (2) X
Sporochnus pedunculatus (12, 26, 42). X
Taoria atomaria (8, 12, 26, 42, 46, 47)
Tilopteris mertensii (26).X

RHODOPHYTA

Ahnfeltia plicata (2, 13, 26, 47)
Antithamnion sp. (47)
A. plumula (12*, 42)
A. spirographidis (26). X
Apoglossum ruscifolium (on Crepidula 26, 2*)
Audouinella bonnemaisoniae (26)X
A. daviesii on hydroid (26)
A. endophytica on Heterosiphonia (26) X
A. rosulata on Sporochnus (26, 42). X
Bonnemaisonia asparagoides (2, 26mf)
Brongniartella byssoides (2, 8p, 10, 12, 26, 42*, 47)
Calliblepharis ciliata (2, 6, 8c, 13p, 26, 38c)
Callithamnion corymbosum (26*, 42, 46p, 47p)
Ceramium rubrum (2, 26*, 42, 46, 47)
C. strictum epiphytic (26, 42, 47)
Chondria dasyphylla (8, 10, 26, 42, 46, 47)
Chondrus crispus (2, 6p, 10p, 13p, 26, 42, 50c)
Chyclocladia verticillata (12*, 26, 42*). X
"Conchocelis rosea" in Pomatoceros lamarkii (42) X
Corallina officinalis (2, 6, 8, 26)
Cordylecladia erecta (2, 26)
Corynospora pedicellata fertile (42).X
Cryptopleura ramosa (2, 6, 26*, 42, 47, 56)
Cystoclonium purpureum (2, 6, 12, 26, 42)
Dasya ? corymbifera (42f*) X
Delesseria sanguinea (2, 6c, 8c, 10, 15p, 38c)

Dermatolithon hapalioides (2) X
Dilsea carnosa (2, 6, 8p, 13, 38, 41c, 56)
Dudresnaya verticillata (10*, 42f*) X.
Erythrotrichia carnea (10,26, 46, 47).
"Falkenbergia rufolanosa" tetrasporangial phase of Asparagopsis armata (10) X.
Fosliella farinosa on P.crispa (26). X
Gloiosiphonia capillaris (42f).
Gracilaria verrucosa (2,26, 42).
Griffithsia corallinoides (42, 47).
G. flosculosa (2, 6, 8c, 12, 26, 46c, 47).
Halarachnion ligulatum (8p, 26, 42f, 46p). X
Halopitys incurvus (6). X.
Halurus equisetifolius (2)
Heterosiphonia plumosa (2, 8c, 26, 42).
Hildenbrandia rubra (26).
Hypoglossum woodwardii (2*, 26, 38, 40, 47).
Kallymenia reniformis (10). X.
Lithophyllum incrustans (2)
Lomentaria clavellosa (2, 26f*, 47).
L. orcadensis (2*, 26, 47). X
Membranoptera alata (2, 8)
Naccaria wigghii (2, 10, 26, 42). X.
Palmaia palmata (2, 6).
Peyssonnelia sp. (2). X.
Phyllophora crispa (2, 10, 26, 42)
P. pseudoceranoides (2, 6, 10, 26, 42).
Phymatolithon polymorphum (26). X.
Plocamium cartilagineum (2, 6c, 8c, 12, 13c, 26, 40c, 41c, 42, 46, 47, 49c, 56)
Polysiphonia elongata (6, 8, 10, 42, 46, 47)
P. nigrescens (12, 26, 56)
P. urceolata (2*, 47)
Rhodophysema elegans (47)X
Rhodomela confervoides (2, 10, 12, 26)
Rhodophyllis divaricata (10*)X
Rhodymenia ? delicatula (42, 47)
R. pseudopalmata (13p, 47)
Scinaia forcellata (42, 47)
Sphaerococcus coronopifolius (8c, 10, 38c)X
Spondylothamnion multifidum (2)X
Spyridia filamentosa (2, 6, 26*, 42)X

4.3 SPONGES

4.3.1 Although nowhere prolific, sponges are distributed in moderate numbers on the shallower reefs and wrecks. In this environment, sessile invertebrates experience severe competition from algae, and sponges are more common in microhabitats away from direct light, such as cliffs, overhangs or caves. However, Tethya aurantium Halichondria panicea, Amphilectus fucorum and Dysidea fragilis appear to withstand algal competition to some extent, and can be found on horizontal surfaces. Despite this competition, shallower sites providing hard substrates show a reasonable species diversity, the richest being the Waldrons (site 10-24 species), the (outer) Mulberry harbour (site 6-20 species), Bognor Reef (site 8-21 species), and Littlehampton (site 28-18 species).

4.3.2 The other major hard substrate habitat types in Sussex are the deeper, offshore wrecks, where algae is absent. However, they exhibit a poor sponge fauna, with an average of 4 species per wreck, where sponges were recorded. The maximum was the Armed Trawler (Site 19-11 species). Only two species, Dysidea fragilis and Hemimycale columella are frequent and typical components of the offshore wreck fauna.

4.3.3 Nowhere in the Sussex sublittoral do the tides produce excessive currents. However, many sponges have a preference for water movement, and this can be quite strong under certain localised conditions. Halichondria panicea has colonised the two holes in the vertical wall of the (outer) Mulberry Harbour (Site 6), almost excluding all other organisms. Considerable water surges occur through these tunnels, and the growth form of H. panicea here is robust enough to withstand the water movement.

4.3.4 Oscarella lobularis has only been recorded twice, on high cliffs. One forms the NW side of the Mixon Hole (Site 2), and is composed of a stiff clay. The other is the N facing chalk cliff of the Worthing Lumps (Site 32). In both situations, the seabed topography causes considerable currents along the cliff faces, which are extensively bored by piddocks (Pholas dactylus), and subject to some erosion. This erosion causes patchy colonisation by sessile animals, with large areas of the cliff faces being bare. It is also interesting to note that one of the records of Apysilla rosea results from a substantial colony on the Worthing Lumps cliff. The other 3 Aplysilla sp. records represent very small, more "typical", encrustations in cryptic microhabitats.

4.3.5 It is likely that most of the species, all being attached to a hard substate, benefit from topography causing local increases in water movement. However, one species, Polymastia boletiforme appears to prefer the base of silty caves, or the inside of wrecks, where water movement is more restricted. Such habitats are not particularly common, and this species is fairly rare in Sussex.

4.3.6 Within the limits implied by previous comments, most species appear to be found across the whole of the diving depth range. It is not possible of course to generalise where only a few records exist. However, there are indications that five species prefer shallower depths in the 0-12 metre range. These are Stelligera rigida, Halichondria panicea, Hymeniacidon perleve, Amphilectus fucorum and Hiliclona fistulosa. Depth as such is unlikely to be the limiting factor for these species, however. Depending on the species, it is more likely to be low light intensity, increased siltation with depth, or a settlement preference for bedrock rather than a wreck.

4.3.7 In terms of abundance, many species are only found in ones and twos when encountered. Species which have been recoded as common at more than one site are, Scypha ciliata, Leuconia nivea, Pachymatisma johnstonia, Tethya aurantium,

Suberites domuncula, Halichondria panicea, H. bowerbanki, Hymeniacidon perleve, Hemimycale columella, Amphilectus fucorum and Dysidea fragilis. The last named is by far the dominant sponge in Sussex, and is present at virtually every site and in most habitat conditions. Indeed, in relative terms it is probably the most successful animal colonizer of the region.

4.3.8 The rarities are Oscarella lobularis, Dercitus bucklandi, Myxilla incrustans, M. rosacea, Stylostichon dives, S. plumosum, Microciona armata, Aplysilla rosea, A. sulfurea and Halisarca dujardini.

4.3.9 The rarity of Oscarella may be a result of a lack of suitable habitats, as described above. One Dercitus record, from the top of the Worthing Lumps (Site 32), resulted from one small specimen on the side of a mini chalk outdrop. The other record was a single, but more substantial specimen, almost hidden from view in a small cave at the Waldrons, (Site 10). Indeed, all the records for these rarities in the species list result from single specimens only, with the exception of Myxilla rosacea on the (outer) Mulberry Harbour (Site 6), where two specimens were found. A single specimen of Ciocalypta penicillus was dubiously recorded by sight at the (outer) Mulberry Habour (Site 6) in 1979. The specimen could not be found in the same location when re-visited in 1983 and has not been recorded during our survey dives. It is, however, known to occur at South-West Rocks (site 43) and Loe Gate (site 44) (D.H. Harvey pers. comm.).

4.3.10 Several of the rare species - Suberites 1 and 2, Stylostichon spp, Microciona, Aplysilla spp. and Halisarca - are encrusting. Suberites 1 was on the valves of a living Chlamys opercularis, and Suberites 2 is a bright, orange species, encrusing a large cobble. In general terms, encrusing species appear to be very uncommon in Sussex, and are virtually absent from non-cryptic habitats. More specimens may eventually be found by close inspection of stable shell and cobble substrates, not an exercise within the terms of reference of the present study.

4.3.11 Haplosclerid (Haliclona) sponges are difficult to differentiate as entities and, at present, almost impossible to name as species. This results from considerable taxonomic confusion, a problem currently being addressed by workers in Holland. For the purposes of this report, Haliclona oculata and Haliclona fistulosa are named. The latter is a fairly distinctive and frequently found species in the region. It is whitish, sometimes with a tingle of grey or pink, crisp in texture, having large but sparse osculae and often gives off tassels. The remaining Haliclonas are tentatively separated into 9 species from specimens and numbered 1-9 in the species list. Externally, they range in form from repent branching (nos. 1 to 4), to massive purple forms with "volcano" osculi (no. 6), to crusts (nos. 8 and 9). Visual records, under Haliclona spp., refer mainly to the repent branching forms, which are fairly common on reefs and shallow wrecks. Ecologically, Haliclona sponges are quite important in Sussex, but further work on their status will require the acquisition of more specimens and clarification of their taxonomy.

4.3.12 Cliona celata has only been found in its boring phase, with just the yellow papillae showing on the substate.

Halichondria panicea can be either cream-yellow, or green, and is very polymorphic. It is found encrusting the holdfasts of laminarians, at the base of Tubularia stalks, as massive crusts in current exposed locations (see above, on Mulberry), or in shallow water (e.g. Rottingdean, Site 49) where it closely resembles the classic shore form. At the Rottingdean site, which is adjacent to the shore, it is abundant, and virtually the only sponge present. It is also abundant on the shallow (inner) Mulberry (Site 5), where it is extensively grazed by Archidoris pseudoargus.

4.3.13 Dysidea fragilis ranges in size from small patches 2-3 cm across, up to massive specimens of 12 cms or more across (specimens of this size were encountered on the Bottle Wreck, Site 20). Normally whitish in colour, some specimens exhibit a purple colour.

4.3.14 Within the species list, only Pachymatisma johnstonia was on the Basic Record Card. A few of the other records, of the more easily recognisable species, were supplied by other project participants. However, the majority of the records are those of R G Ackers and include sight records, plus 100 specimens collected for authentication. Where appropriate, the names used are in the sense intended in the UCS Sponge Guide (Moss & Ackers, 1982). Where species are not in the Sponge Guide, a reference follows the name to show the sense within which the name is used.

4.3.15 Within the sublittoral region under consideration, 41 species have so far been differentiated. This compares unfavourably with the Plymouth Marine Fauna, which lists 93. However, that list was compiled by many workers, over a long period of time, and includes records from deep water as well as the shore. Nevertheless, there would appear to be a significant reduction in species moving eastwards along the Channel.

4.3.16 By contrast, there is a close match between the sponges recorded here, and in Dorset by the Dorset Underwater Survey. Those not recorded in Sussex include Stelletta grubii, Stelligera stuposa, Raspailia hispida, Axinella polypoides and Scypha compressa. The latter species was included in the preliminary report of the Sussex Sublittoral Survey, on the basis of sight records alone. However subsequent examination of collected specimens of Leuconia nivea have revealed their growth forms to resemble Scypha compressa in some intances. As no specimens of Scypha compressa itself were collected during 1983, it is removed from the Sussex list, but it's status in the area is uncertain.

4.3.17 Juniper and Steele recorded 20 species intertidally in the Portsmouth area. As expected, a number of sponges in the Sussex area are strictly sublittoral, and were not found by Juniper and Steele. However 6 named species found by them have apparently not as yet turned up sublittorally in Sussex. These are Leuconia barbata, Suberites epiphytum, Haliclona limbata, H. macandrewi, Mycale macilenta and Microciona atrasanguinea. However, apart from Mycale macilenta, it could be that these differences are nomenclatural, rather than actual.

4.3.18 Collins & Mallinson (1983) recorded 17 species of sponges from the eastern Solent, a region immediately to the west of the present study area. Two species recorded by them were not recorded in the present study - Axinella polypoides, and Scypha compressa. For comments on the latter, see 4.3.16 above. Axinella polypoides is a typical SW Britain species, and its inclusion in Collins & Mallinson resulted from a single specimen, of uncertain growth form, observed on a limestone boulder in Bullock Patch in 1982. They also possess a previous record from the old beach line south of Chichester Habour, but as the substrate there is clay and sand, this may have been a drift specimen (Collins & Mallinson, pers. comm.)

4.3.19 It is tempting to suggest that some of the species, apparently rare are at the eastern extremity of their distribution in Sussex. Limiting factors could be increased cold, turbidity, and pollution. Strong water movement is favourable to sponges, and tidal currents increase eastwards to the Straits of Dover, which could therefore have a rich sponge fauna. For the present, therefore, the records must be taken at their face value. Overall, there is a mediocre diversity of species; some indications of depth and water current preferences; indications of algal competition; considerable variations in abundance; evidence that 3 species reach their eastern limit of distribution in Dorset (Stelletta grubii, Stelligera stuposa, and Raspailia hispida) and 1 in E. Solent (Axinella polypoides).

4.3.20 SPECIES LIST - SPONGES

In this, and following Lists, the species name is followed by the sites from which it was recorded and, in brackets after each site reference number, the date of the record and whether the species was noted as 'present' = p or 'common' = c.

PORIFERA

CALCAREA

LEUCOSOLENIDAE

Leucosolenia botryoides (Ellis & Solander, 1786). Sensu Burton 1963. 1 (5/81p), 6 (7/83p), 8(5/75p), 19 (6/81p), 26 (6/83p), 28 (6/82p), 52 (7/83p), 56 (7/83p).

SYCETTIDAE

Scypha ciliata (Fabricius, 1780). Sensu Burton 1963. 1 (5/81p), 2(8/77p), 4(6/78p), 5 (8/80p), 6 (8/80p, 6/83p, 7/83p), 8(5/75p, 7/81p), 10 (6/83c), 14 (7/81c), 15 (7/83c), 16 (7/83c), 19 (6/81c, 8/81p), 23 (7/82p), 28 (6/82p), 38 (5/82c), 40 (5/82c), 53 (7/83p).

GRANTIIDAE

Leuconia nivea (Grant, 1826). 1 (5/81p), 4(5/78c), 5 (9/80c), 6(9/79c, 8/80c, 7/83p), 7 (7/83p), 8(10/79p), 9(6/81c), 10 (8/83p), 19 (8/81p), 52 (7/83p).

DEMOSPONGIAE

OSCARELLIDAE

Oscarella lobularis (Schmidt, 1862). 2 (7/82p), 32 (7/82p).

PACHASTRELLIDAE

Dercitus bucklandi (Bowerbank, 1857). 10 (8/83p), 32 (7/82p).

GEODIIDAE

B Pachymatisma johnstonia (Bowerbank in Johnston, 1842). 6 (6/83c), 8 (10/79p, 7/82p), 10 (6/83c, 7/83p, 8/83p), 11 (7/81c), 14 (9/81p), 21 (5/82p), 26 (6/83p), 28 (6/82c), 30 (7/83p), 31 (7/83p), 38 (7/83p), 42 (8/83p), 48 (7/83c), 55 (7/83p).

TETHYIDAE

Tethya aurantium (Pallas, 1766). 6 (9/79p), 8(7/74p, 4/75p, 10/79p, 7/81c), 9 (11/79p, 6/81p), 10 (6/83p, 8/83p), 12 (7/83p), 14 (7/81c), 19 (6/81c, 8/81p), 22 (9/79p), 28 (6/82p), 30 (9/79p), 32 (7/82p), 50 (7/83p).

SUBERITIDAE

Suberites domuncula (Olivi, 1792). 1 (5/81p, 8/83p), 2 (8/75p), 5 (8/80p), 8 (7/82p), 42 (7/82c), 49 (7/82p), 50 (7/83c), 56 (7/83p).

Suberites 1. 10 (7/83p).

Suberites 2. 10 (8/83p).

POLYMASTIIDAE

Polymastia boletiforme (Lamarck, 1815). 6 (9/80p, 7/83p), 8 (7/74p, 10/79p), 21 (11/79p), 28 (6/82p).

Polymastia mamillaris (O.F. Muller, 1806). 6 (9/79p, 9/80p, 7/83p), 8 (8/75p, 7/82p), 9 (11/79p, 6/81p), 10 (8/83p), 14 (7/81p), 19 (6/81p), 28 (8/81p).

THOOSIDAE

Cliona celata (Grant, 1826). 1 (7/83p), 2 (7/82p), 6 (8/80p), 7 (7/83p), 26 (7/83p), 42 (7/82p), 50 (7/83p).

HEMIASTERELLIDAE

Stelligera rigida (Montagu, 1818). 6 (9/79p, 7/83p), 7 (7/83p), 8 (9/78p, 10/79p, 7/82p), 9 (11/79p, 6/81p), 10 (7/83p, 8/83c), 20 (10/83p), 21 (11/79p), 28 (8/81p), 30 (9/79p), 55 (2/80p).

RASPAILIIDAE

Raspailia ramosa (Montagu, 1818). 6 (7/83p), 8 (10/79p), 10 (7/83p, 8/83c), 12 (7/83p), 19 (6/81p), 20 (10/83p), 24 (9/79p), 28 (6/82p), 30 (9/79p), 48 (8/83p).

HALICHONDRIIDAE

Halichondria panicea (Pallas, 1766). 1 (5/81p, 7/83p), 2 (5/74p), 3 (8/79p), 4 (6/78c, 11/79p, 8/81c), 5 (9/80c), 6 (9/79c, 8/80p, 9/80p, 7/83p), 7 (4/79p, 7/83c), 8 (8/75p, 10/79p, 7/82p), 11 (7/81p), 19 (6/81p), 26 (6/83p), 28 (6/82p), 30 (9/79c), 31 (7/83c), 38 (5/80p), 40 (5/82c), 41 (5/82p), 47 (8/82p), 48 (8/83c), 49 (7/82c), 50 (7/83c), 52 (7/83c), 54 (8/83c), 55 (7/83p), 56 (7/83c).

Halichondria bowerbanki (Burton, 1930). 1 (5/81p), 2 (6/83c), 5 (9/80c), 6 (8/80p, 9/80p, 7/83p), 7 (7/83c), 8 (7/82p), 10 (8/83p), 28 (8/81p, 6/82p), 30 (7/83p), 48 (8/83c), 50 (7/83p).

Ciocalypta penicillus Bowerbank, 1874. 42c, 43c (records by D.H. Harvey pers. comm.).

HYMENIACIDONIDAE

Hymeniacidon perleve (Montagu, 1818). 1 (5/81p, 4 (8/81p), 5 (9/80p), 6 (9/80p, 7/83p), 7 (7/83p), 8 (10/79 c, 7/82p), 10 (8/83c), 11 (6/82p), 12 (7/83p), 28 (8/81p, 6 82c), 32 (7/82c), 50 (7/83p), 52 (7/83p).

MYCALIDAE

Hemimycale columella (Bowerbank, 1874). 8 (9/78c), 9 (11/79p, 6 81c), 10 (7/83p, 8/83p), 11 (7/81p), 12 (6/83p, 7/83p), 14 (7/81p), 19 (8/83p), 20 (10/83p), 21 (11/79p), 22 (9/79p), 23 (7/82p), 25 (8/82p), 28 (8/81p, 6/82p), 30 (9/79p).

Amphilectus fucorum (Esper, 1794). 1 (5/81p), 2 (5/74p, 7 82p), 5 (9/80p), 6 (9/79p, 8 80p, 9/80p, 7(83p), 7 (7/83pp), 8 (7/74c, 5/75c, 9 78c, 10/79p, 7/82c), 10 (7/83p, 8/83c), 11 (7/81c, 6/82p), 12 (7/83p), 22 (9/79p), 24 (9/79p), 26 (6/83p), 28 (8/81p, 6/82c), 30 (9/79c, 7/83p), 31 (7/83p), 32 (7/82p), 38 (5/80p, 7/83p), 42 (8/83c), 49 (7/82p), 50 (7/83c), 56 (7/83p).

MYXILLIDAE

Myxilla incrustans (Johnston, 1842). 8 (7/82p), 30 (9/79p).

Myxilla rosacea (Lieberkuhn, 1859). 6 (7/83p).

Stylostichon dives (Topsent, 1891). Sensu van Soest and Weinberg, 1980. 14 (7/81p).

Stylostichon plumosum (Montagu, 1818). 10 (8/83p).

MICROCIONIDAE

Microciona armata Bowerbank, 1862. Sensu Levi, 1960. 6 (7/83p), 10 (8/83p).

HALICLONIDAE

Haliclona oculata (Pallas, 1766). 6 (9/80p), 8 (7/82p), 9 (6/81p), 14 (7/81p), 19 (6/81p).

Haliclona fistulosa (Bowerbank, 1866). Sensu Haliclona E/H, Moss and Ackers, 1982. 1 (6/79p), 6 (9/79p, 9/80p, 7/83p), 8 (8/75p), 9 (6/81p), 10 (7/83p, 8/83c), 11 (7/81p), 12 (7/83p), 19 (8/81p), 28 (8/81p, 6/82p), 32 (7/82p)

Haliclona 1. 8 (9/78c), 10 (7/83p), 22 (9/79p).

Haliclona 2. 6 (7/83p), 28 (6/82p).

Haliclona 3. 10 (8/83c).

Haliclona 4. 28 (6/82p)

Haliclona 5. 6 (7/83p)

Haliclona 6. 8 (7/81p), 28 (6/82p).

Haliclona 7. 10 (7/83p).

Haliclona 8. 2 (7/82p).

Haliclona 9. 2 (10/79p, 7/82p).

Haliclona spp. 2 (8/77p), 4 (11/79p), 6 (9/79c, 8/80p), 7 (7/83p), 9 (11/79p, 6/81p,7/83p), 11 (6/82p), 28 (8/81p, 6/82p), 30 (9/79p), 32 (7/82p).

DYSIDEIDAE

Dysidea fragilis Montagu, 1818. 1 (6/79p, 5/81p, 7/83p), 2 (5/74p, 8/77c, 8/79p, 10/79p, 7/82p), 4 (5/78p, 6/78p, 11/79p), 5 (9/80p), 6 (9/79c, 7/83p), 7 (7/83p), 8 (7/74p, 5/75p, 8/75p, 9/78c, 10/79p, 7/81c, 7/82c), 9 (11/79p, 6/81c), 10 (7/83p, 8/83c), 11 (7/81c, 6/82p), 12 (7/83p), 14 (7/81p, 9/81p), 19 (6/81c, 8/81c), 20 (10/83c), 21 (11/79p), 22 (9/79c), 23 (7/82c), 24 (9/79c), 25 (8/82p), 26 (6/83p), 28 (8/81c, 6/82c), 30 (9/79c, 7/83p), 34 (7/82c), 38 (5/80p, 5/82p), 40 (5/82c), 42 (8/83c), 48 (8/83c), 50 (7/83p), 52 (7/83p), 56 (7/83p).

APLYSILLIDAE

Aplysilla rosea Schulze, 1878. Sensu Arndt, 1935. 10 (8/83p), 32 (7/82p).

Aplysilla sulfurea Schulze, 1878. Sensu Arndt, 1935. 7 (7/83p), 10 (7/83p).

HALISARCIDAE

Halisarca dujardini Johnston, 1842. Sensu Borojevic, Cabioch and Levi, 1968. 10 (7/83p).

4.4 SESSILE INVERTEBRATES

4.4.1 Included under this heading are the phyla Cnidaria (hydroids, corals, and sea anemones), Bryozoa (moss animals), various 'worm' phyla, and the subphylum Tunicata (sea squirts).

4.4.2 The majority of sessile invertebrates live attached to any suitable stable 'hard' substrate. In adequately lit situations they face severe competition from algae, resulting in reduced species - diversity of animals; and in some localities the deposition of silt is too great for the tolerance of many species. In the Sussex area, unlike many localities in Britain, there is no pressure from grazing by the large sea urchin Echinus, which can dramatically affect species diversity, as this animal does not occur in the area.

4.4.3 Nearly all sessile animals are filter-feeders - employing various devices to strain food particles out of suspension in the water - and many species form colonies of numerous individuals as this often permits greater efficiency in filter-feeding. Such colonial forms often resemble plants more than animals and are easily overlooked by sport divers. Filter-feeding works best in a situation where the individual or colony can project into a water current, thus intercepting a continuous supply of food. Hence prominent features such as wrecks, piers, and other man made objects are greatly favoured as living-sites by filter-feeding animals as are natural cliff faces, islets and isolated rock pinnacles, etc., which sadly are lacking in Sussex.

4.4.4 As described in Chapter 3 the underwater environment off Sussex consists largely of soft sediments or loose, semi-stable deposits of larger particles punctuated by a large number of wrecks which provide what is probably the habitat of major importance to sessile animals. 'Natural' hard substrates - reefs and cliff faces - are relatively uncommon and it seems likely that without the 'stepping-stones' provided by the numerous wrecks (and the increased bio-mass of sessile animals they support) many species could not maintain viable populations and would not exist here.

4.4.5 Some animals, Byrozoans in particular, are able to colonise the semi-stable substrates (e.g. cobbles, or larger shell material such as Crepidula) but it is likely that these habitats, unless very deep, suffer considerable damage from winter storms; hence many of the animals they support are 'annuals'.

4.4.6 In practice the sessile invertebrates can be divided loosely into two groups: 1) The larger, relatively conspicuous, relatively easily identified animals such as Alcyonium (dead mens fingers), Metridium (plumose anemone), various sea squirts (Tunicata), Horn wrack (Flustra) and Tube worms (Bispira and Sabella); and 2) The great multitude of small or tiny, relatively inconspicuous and difficult-to-identify forms which include most hydroids and bryozoans, many worms, and some colonial sea squirts and anthozoans. These two divisions can be roughly discerned in our records. The small forms are easily overlooked, even by the experienced eye, and their identification is largely a specialist task requiring access to good microscopes and 'the literature'. Therefore our records of this group are sparse and no inference other than simple occurrence should be drawn from them. On the other hand many of the larger forms were very well recorded and their distribution in the area can be accurately defined.

Phylum CNIDARIA (COELENTERATA)

Class HYDROZOA

4.4.7 Twenty-one species of hydroids were recorded but only Tubularia indivisa (58 records), Hydrallmania falcata (14), and Nemertesia antennina (11), all large and conspicuous species, were recorded on more than ten occasions. Such numbers compare very favourably with the findings of the Dorset Underwater Surveys 1 & 2. (Brachi, Collins, and Roberts 1977, Dixon, Harrison, Hodder and Roberts 1978) which recorded 25 species, although only 12 of these are common to both lists These are the only recent surveys of a reasonably nearby sea area of comparable size. Surveys 1 and 2 cover the Dorset coast east of Portland; Survey 3 covers the coast west of Portland and is not considered here. Perhaps the most striking difference is the absence from the Dorset surveys of the athecates Sarsia and Eudendrium spp. and the large, easily recognised Nemertesia ramosa (which we recorded 6 times). Tubularia was rarely recorded in Dorset presumably because their sampling was restricted to natural substrates. In Sussex this species was reported 45 times on wrecks and other man-made structures, but only 13 times from natural habitats.

Subphylum ANTHOZOA

4.4.8 Several anthozoans are typical members of the animal communities found on wrecks. Alcyonium digitatum and Metridium senile are particularly conspicuous, being large and usually occurring on prominent structures such as spars, masts, railings, etc. The small anemone Actinothoe is also commonly found on wrecks and is widely distributed in Sussex although apparently rare in Dorset (Dixon, Harrison, Hodder and Roberts, 1978). The Dahlia anemone Urticina (Tealia) felina, although sometimes found in the deeper recesses of wrecks, is more at home on broken ground where it can bury itself amongst cobbles or gravel, or squeeze into some cosy crevice between rocks. These four species are all common and widely distributed throughout the area.

4.4.9 Another anemone, Anemonia viridis, prefers firm substrates in shallow water (usually less than 10m deep). This habitat is uncommon in Sussex which may account for the sparseness of our records of this species, but it may also be reaching the eastern limit of its range here, as is Cereus pedunculatus. The latter anemone's most easterly occurrence in natural conditions (it is otherwise known from a warm water outfall in Essex) appear to be our records from Shoreham dredger (site 40) and around the Mira Wreck offshore from Seaford (site 57). Our survey has produced extensions to the known eastward ranges of several other species: Corynactis viridis (jewel anemone) at six sites as far east as 'City of London', South of Shoreham (site 37); Anthopleura ballii, two sites, Shelley Rocks (site 11), Shoreham dredger (site 40) (this species was also reported from Selsey by Stephenson, 1935); Actinia fragacea, at Seaford Head (site 56).

4.4.10 Of the other anthozoans the burrowing, tube-dwelling anemone Cerianthus lloydii is common in soft substrates throughout the area but as these sediments have not yet been thoroughly sampled our records of this species are rather few. Cereus pedunculatus and Sagartia troglodytes are also found burying in soft substrates but may also occur in rock crevices; the latter was common in the chalk ledges off Newhaven (site 50). Diadumene cincta, a widespread but rather local species in Britain, was found on several wrecks as well as the harbour wall at Shoreham (site 39). On the 'City of Brisbane' (site 52) a large aggregation of D. cincta was found, many of which bore catch-tentacles - elongated tentacles used in aggressive acts towards other anemones.

4.4.11 The most interesting record from 1983 was a photographic record of the curious anemone Aureliania heterocera taken on the Outer Owers (site 14). This is a species which a few years ago was considered rare (Manuel, 1981) but has been recorded in increasing numbers recently. Our record of Sarcodictyon roseum (Bognor Rocks site 7, 2 colonies) is also a 'first' for Sussex. Sarodictyon is an inconspicuous octocoral which is seldom noticed although in fact quite common and widely distributed in British waters.

4.4.12 One day in June 1982, when diving was impossible due to the weather, a small group visited Pagham lagoon (O.S. ref SZ884970) and confirmed the continued existence of a population of Nematostella vectensis, a rare brackish-water anemone first discovered here in 1974 by R Manuel (see Williams, 1976). Another lagunar species from Sussex is Edwardsia ivelli Manuel, 1975. This species was discovered in Widewater lagoon, between Lancing and Shoreham, in 1973, but was not recorded again, despite several searches, until December 1983 when found in the same location by Dr. M. Sheader (D.H. Harvey pers. comm.). E. ivelli and N.vectensis are both tiny burrowing anemones that live in fine soft mud; they are unlikely to be found unless deliberately sought. Little is known of E.ivelli - Widewater is the type and only known locality - but the few remaining refuges in this country of N.vectensis are threatened by pollution, rubbish dumping or in-filling, and drainage. The latter is probably the only seriously endangered anthozoan species in this country (see Wells, Pyle, and Collins, 1983, for further details).

'WORMS'

4.4.13 Most worms are inconspicuous animals and our records reflect just how easy it is to overlook them. For instance, nemertines (proboscis worms) do occur in Sussex, even though absent from our records!

4.4.14 Of the polychaetes Lanice conchilega and Bispira volutacornis are the most recorded species, presumably because they are on the Basic List; but one would expect Arenicola, Sabellaria, Spirorbis, etc., to be at least as common.

4.4.15 The two tiny serpulids Filograna and Salmacina have both been recorded but may have been confused. The major difference between these genera - Filograna has an operculum which is lacking in Salmacina - is unlikely to be discernible underwater. Both genera are entered as reported, but it might be a worthwhile future project to collect specimens to determine whether both genera occur in our area and if so, what their ecological requirements are. Specimens collected from the Shirala (site 21) in 1979 proved to be Salmacina (R G Ackers pers. comm.).

4.4.16 Phoronis hippocrepia proved to be abundant in the chalk ledges of the Newhaven and Seaford areas. This species can be identified underwater by its comparitively large size (C. 4mm across the tentacles) and the whitish, paired brood pouches at the base of the tentacles (Emig, 1979). Specimens collected in July 1983 produced numerous 'actinotrocha' larvae in the aquarium.

Phylum BRYOZOA

4.4.17 Alcyonidium spp. and Flustra foliacea are both large and conspicuous bryozoans, common in the Sussex area. Alcyonidium was very abundant on coarse shell material (Crepidula, Mytilus) and other semi-stable substrates, and may be characteristic of such a habitat. Flustra also occurs on semi-stable substrates but may also form substantial beds on reefs or even wrecks.

4.4.18 Two species of Bugula, B. turbinata and B. plumosa cannot be reliably distinguished underwater and so are lumped together in our list. They both have a distinctive spiral growth form and are common beneath overhangs on reefs or wrecks.

4.4.19 According to Ryland & Hayward (1977) and Hayward & Ryland (1979) all the species of bryozoans we recorded are to be expected in the area, with the possible exception of Pentapora foliacea ('ross coral') which appears to reach its eastern limit at the western end of our survey area, on deep wrecks well offshore.

4.4.20 As an exercise a single small stone about 6 cm long was picked up on Bognor reef and the encrusting bryozoans identified; the resulting eight species are marked * on our list.

4.4.21 SPECIES LIST - SESSILE INVERTEBRATES

CNIDARIA (COELENTERATA)

MEDUSOZOA

HYDROZOA

TUBULARIIDAE

B. Tubularia indivisa L. 4(78), 5(81,6/83p), 6(79, 80, 6/83ccc), 7(79), 10 (6/83c, 7/83p), 12 (6/83p, 7/83c), 14 (6/83p), 15 (6/83c, 7/83c), 16 (7/83c), 17 (6/83c), 18 (6/83c, 7/83c), 19 (81c, 8/83p), 20 (10/83c), 21 (79, 4/83c), 22 (79), 23 (7/82c), 24 (79), 25 (8/82c), 28 '6/82p), 30 (7/83p), 31 (6/83c), 32 (7/82p), 35 (7/83p), 36 (80, 5/83c), 37 (7/83p), 38 (5/82ccc, 7/83p), 40 (5/82c), 44 (5/83c), 50 (7/83pp), 51 (6/83p), 52 (7/83ccccp), 53 (7/83p), 56 (4/83cppp, 7/83c, 8/83c), 57 (5/83ccc).

Sarsia (Syncoryne) eximia (Allman) 40 (5/82c)

EUDENDRIIDAE

Eudendrium rameum (Pallas). 38 (5/82c)

Eudendrium sp, 'Xmas-tree hydroid'. 14 (6/83c), 38 (5/82p)

CAMPANULARIIDAE

Clytia johnstoni (Alder) 40 (5/82p).

Obelia dichotoma (L) 4 (81).

Obelia geniculata (L) 1 (81), 2 (77), 5 (82p), 6 (79), 38 (5/82c), 40 (5/82c), 49 (7/82c).

Obelia sp. 50 (7/83p).

Laomedia flexuosa Hincks 5 (81), 39 (5/82p).

SERTULARIIDAE

Diphasia attenuata (Hincks) 2 (7/82p), 23 (7/82p).

Dynamena pumila (L) 5 (81).

Hydrallmania falcata (L) 1 (79, 7/83c), 2 (77, 79), 4 (78, 79), 5 (81), 6 (79), 12 (7/83p), 14 (6/83c), 14A (81), 20 (10/83p), 29 (10/83p), 52 (7/83p).

Sertularia cupressina (L) 2 (79), 4 (78), 5 (81).

Sertularia operculata (L) 2 (77).

Sertularella polyzonias (L) 48 (8/83p), 56 (5/83p).

PLUMULARIIDAE

Aglaeophaenia pluma (L) 2 (79), 4 (78), 5 (81), 6 (78, 79, 80).

Kirchenpaueria pinnata (L) 57 (5/83c).

Nemertesia antennina (L) 1 (8/83p), 12 (7/83c), 14 (6/83p), 15 (7/83p), 20 (10/83p), 22 (79), 24 (79), 5 (8/82p), 28 (81), 29 (79), 57 (5/83c).

Nemertesia ramosa (Lamouroux). 9 (7/83p), 12 (7/83c), 23 (7/82p), 28 (6/82p), 52 (7/83pp).

Plumularia setacea (Ellis & Solander). 40 (5/82c).

Plumularia sp. 14 (6/83c).

ANTHOZOA

OCTOCORALLIA

CLAVULARIIDAE

Sarcodictyon roseum (Philippi) 7 (7/82p)

ALCYONIIDAE

B Alcyonium digitatum L, dead mens fingers. Pre 77, 1 (78, 79), 2 (77), 4 (78), 5 (6/83c), 6 (79, 80c, 6/83cc, 7/83c), 8 (78, 79, 81, 7/82cpppp, 7/83c), 9 (81), 10 (6/83c, 7/83p, 8/83p), 11 (81), 12 (6/83p, 7/83c), 15 (6/83p, 7/83c), 16 (7/83p), 17 (6/83p), 18 (6/83p, 19 (81cc, 8/83c), 21 (79, 5/82p, 4/83p), 22 (79), 23 (7/82p, 7/83c), 24 (79), 25 (8/82p), 26 (6/83p), 27 (4/83p), 28 (6/82p), 30 (79, 7/83pp), 31 (6/83p, 7/83pp), 32 (7/82p), 33 (5/83p), 35 (7/83c), 36 (80, 5/83c), 37 (7/82c, 7/83c), 38 (80, 5/82ppp, 7/83p), 42 (7/82p, 8/83c), 44 (5/83c), 45 (8/82pp), 46 (7/82pp, 8/82p), 50 (7/83cpp), 51 (6/83c), 52 (7/83ccccc), 53 (7/83p), 54 (8/83p), 55 (7/83c), 56(4/83c, 7/83pp), 57 (5/83cpp)

HEXACORALLIA

CERIANTHIDAE

Cerianthus lloydii Gosse 1 (8/83p), 2 (7/82p), 9 (81), 14 (6/83cc), 20 (10/83c), 28 (6/82p), 29 (10/83p), 36 (5/83p), 40 (5/82p), 42 (8/83p), 46 (7/82p), 51 (6/83p), 57 (5/83p)

ACTINIIDAE

Actinia equina (L), beadlet anemone. 7 (7/83p), 39 (5/82p), 49 (7/82p)

Actinia fragacea Tugwell, strawberry beadlet-anemone. 56 (7/83p)

Anthopleura ballii (Cocks) 11 (6/82p), 40 (5/82p)

B Anemonia viridis (Forskal), snakelocks anemone. 2 (79, 7/82p), 3 (79), 4 (78), 6 (77, 78, 79, 80, 6/83cpp, 7/83c), 8 (7/82pppp, 7/83p), 30 (79, 7/83p), 32 (7/82p), 33 (5/83p), 38 (5/82p)

Urticina (Tealia) eques (Gosse) 5 (81) In Cunliffe, 1981, very dubious record requires confirmation.

B Urticina (Tealia) felina (L), dahlia anemone. 1 (79, 7/83c, 8/83p), 2 (77, 79, 6/83pp), 3 (79), 4 (78, 81), 5 (6/83p), 6 (77, 78, 6/83cp, 7/83p), 9 (79), 11 (6/82p), 12 (6/83p), 13 (7/83p), 14 (6/83ccp), 17 (6/83p), 20 (10/83p), 21 (5/82p), 23 (7/82pp), 26 (6/83p, 7/83p), 28 (8/82p), 29 (79, 10/83p), 30 (7/83cp), 31 (6/83p, 7/83pp), 33 (5/83p), 35 (7/83p), 36 (5/83p), 37 (7/83p), 40 (5/82p), 41 (5/82cppp), 45 (8/82pp), 46 (8/82p), 47 (7/83c, 8/83c), 49 (7/82p), 50 (7/82cp), 52 (7/83p), 54 (8/83ccp), 55 (7/83cc), 56 (4/83c, 5/83p, 7/83ccccpp, 8/83cp), 57 (5/83p), 58 (8/83cc)

AURELIANIIDAE

Aureliania heterocera (Thompson) 14 (6/83p)

DIADUMENIDAE

Diadumene cincta Stephenson 6 (6/83p), 31 (7/83pp, 39 (5/82p), 40 (5/82c), 51 (6/83c), 52 (7/83ccc)

METRIDIIDAE

B Metridium senile (L), plumose anemone. 4 (78), 5 (81c, 6/83c), 6 (79, 80, 6/83ccp, 7/83p), 7 (7/83p), 12 (7/83p), 14 (9/81), 15 (6/83c), 17 (6/83p), 19 (81), 36 (5/83c), 37 (7/82p, 7/83p), 39 (5/82cc), 40 5/82p), 46 (7/82cp, 8/82pp),47 (8/82p), 50 (7/83ccp), 51 (6/83c), 52 (7/83cccp), 54 (8/83cc), 55 (7/83pp), 56 (4/83cp, 5/83p, 7 83ccppp, 8/83p), 57 (5/83cp), 58/8/83c).

SAGARTIIDAE

B Actinothoe sphyrodeta (Gosse) 1 (78, 7/83p, 8/83p), 2 (7/82p, 6/83p), 5 (81c), 7 (81), 9 (79, 81c, 7/83p), 11 (81), 12 (6/83, 7/83p), 13 (7/83p), 14 (6/83pp), 15 (6/83p, 7/83p), 16 (7/83p), 18 (6/83pp, 7/83c), 19 (81c), 20 (10/83p), 23 (7/82p), 26 (6/83p), 8 (6/82p), 29 (10/83p), 31 (6/83c, 7/83p), 35 (7/83c), 36 (5/83c), 37 (7/82p), 45 (8/82p), 46 (7/82pp), 52 (7/83ccpp), 53 (7/83p), 54 (8/83p), 55 (7/83cp), 56 (4/83ccp, 7/83ccpp, 8/83p), 57 (5/83pp), 58 (8/83p)

Cereus pedunculatus (Pennant), daisy anemone. 2 (7/82p), 4 (81), 6 (77,78,80), 10 (6/83p), 14 (6/83cp, 26 (6/83c), 28 (81c, 7/83p), 29 (79), 30 (7/83c), 31 (7/83p), 40 (5/82p), 57 (5/83c)

Sagartia elegans (Dalyell) 2 (7/82p), 14 (6/83p), 54 (8/83p), 56 (7/83p)

Sagartia troglodytes (Price) 1 (8/83p), 2 (7/82pp, 14 (6/83p), 26 (6/83p), 39 (5/82p), 40 (5/82p), 42 (8/83p), 50 (7/83cp), 55 (7/83c), 56 (7/83p)

Sagartiogeton undatus (O.F. Muller) 52 (7/83p)

EDWARDSIIDAE

Edwardsia ivelli Manuel, Widewater lagoon, nr Shoreham, type and sole locality.

Nematostella vectensis Stephenson, Pagham lagoon, 1974-82

CORALLIMORPHIDAE

Corynactis viridis Allman, jewel anemone. 6 (79p, 6/83p), 14A (7/81p), 16 (7/83p), 19 (6/81p, 8/81p), 20 (10/83p), 37 (7/83p)

PLATYHELMINTHES

EURYLEPTIDAE

Prostheceraeus vittatus (Montagu) 12 (6/83p, 7/83p), 28 (7/83p), 39 (75p), 42 (7/82p)

ANNELIDA

POLYCHAETA

SPIONIDAE

Polydora sp. 50 (7/83cc)

ARENICOLIDAE

Arenicola marina (L). 3 (79), 7 (79, 7/83c), 50 (7/83c)

SABELLARIIDAE

Sabellaria spinulosa Leuckart 1 (79, 7/83c), 7 (7/82p)

Sabellaria sp. 50 (7/83c)

TEREBELLIDAE

B Lanice conchilega (Pallas), sand mason worm. 1 (7/83p), 2 (83p), 4 (78, 79, 81), 6 (77, 78), 7 (79), 8 (7/83p), 11 (6/82p), 29 (79, 10/83p), 30 (7/83p), 38 (5/82p), 39 (5/82c), 41 (5/82c), 48 (7/83p, 8/83c), 49 7/82c), 50 7/83p), 52 (7/83p), 54 (8/83cpp), 56 (8/83c)

SABELLIDAE

B Bispira volutacornis (Montagu) 5 (80, 81), 8 (7/82p, 7/83p), 9 (7/83p), 10 (7/83p, 6/83c), 11 (81, 6/82cpp), 26 (6/83c), 28(6/82p), 30 (79), 31 (6/83p), 32 (7/82p), 42 (8/83p), 48 (8/83p), 51 (6/83p), 56 (7/83c, 8/83p)

Myxicola infundibulum (Renier) 10 (6/83p)

Pomatoceras triqueter (L) 1 (79), 2 (77, 79), 7 (79), 9 (79,81), 14A (81c), 20 (10/83p), 38 (5/82), 49 (7/82c), 50 (7/83p), 56 (5/83p, 7/83p), 57 (5/83c)

Potamilla reniformis (O.F. Muller) 7 (7/82p)

Potamilla torelli Malmgren 7 (7/82p)

Sabella penicillus (S. pavonina) 11 (81), 55 (7/83p)

Spirorbis borealis Daudin 5 (81)

Filograna implexa Berkeley 2 (7/82), 9 (7/83), 12 (7/83p), 26 (6/83cpp), 28 (7/83p), 31 (7/83p)

Salmacina dysteri (Huxley) 2 (77, 79), 6 (80), 9 (79, 81), 11 (81), 14A (81c), 19 (81), 21 (79), 22 (79), 30 (79)

PHORONIDA

PHORONIDAE

Phoronis hippocrepia Wright 50 (7/83ccp)

Phoronis sp. 26 (6/83p), 42 (7/82p, 8/83c), 56 (7/83p) (Probably same sp. as above)

BRYOZOA

CTENOSTOMATA

ALCYONIDIIDAE

Alcyonidium gelatinosum (L) 1 (7/83c), 2 (81, 7/82c), 5 (81), 6 (79, 80), 7 (7/82p), 9 (81), 12 (7/83p), 19 (81), 20 (10/83p), 23 (7/82p)

Alcyonidium hirsutum (Fleming) 14 (6/83c)

Alcyonidium sp. 10 (6/83c), 14 (6/83c)

CYCLOSTOMATA

CRISIIDAE

Crisia eburnea (L) 11 (6/82c)

TUBULIPORIDAE

Tubulipora lobulata Hassall 7 (7/82p)*

CHEILOSTOMATA

MEMBRANIPORIDAE

Membranipora membranacea (L) 5 (81), 49 (7/82c), 50 (7/83p)

ELECTRIDAE

Electra pilosa (L) 2 (79), 5 (81), 6 (79), 7 (79, 7/82p*), 13 (7/83p), 22 (79)

FLUSTRIDAE

Chartella papyracea (Ellis & Solander) 48 (8/83p)

B Flustra foliacea (L), hornwrack. 1 (79, 7/83c, 8/83c), 2 (77,79), 5 (81, 6/83p), 6 (79,80,6/83ccc), 7 (81,7/83), 9 (79), 10 (6/83p, 7/83p), 12 (6/83c, 7/83c), 13 (7/83c), 14 (9/81p, 6/83ccc), 16 (7/83p), 17 (6/83p), 19 (81, 8/83p), 20 (10/83p), 21 (79, 4/83p), 22 (79), 23 (7/82cc, 7/83p), 24 (79), 25 (8/82c), 26 (6/83cpp), 28 (81, 6/82p), 29 (79), 30 (79, 7/83p), 31 (6/83p, 7/83pp), 36 (80), 38 (5/82pp), 45 (8/82p), 48 (8/83c), 55 (7/83p), 56 (4/83c), 57 (5/83ppc), 58 (8/83p)

CELLARIIDAE

Cellaria sp. 23 (7/82c)

SCRUPOCELLARIIDAE

Scrupocellaria reptans (L) 48 (8/83p)

Scrupocellaria scruposa (L) 7 (7/82p*), 23 (7/82c)

BICELLARIIDAE

Bicellariella ciliata (L) 2 (78), 4 (78), 6 (78)

BUGULIDAE

(Bugula plumosa (Pallas) 2 (7/82c, 6/83cp), 3 (79), 4 (78), 5 (81),6 (79, 6/83c), (Bugula turbinata Alder 7 (7/82p*, 7/83p), 15 (7/83p), 23 (7/82c), 26 (6/83cc), (28 (7/83p), 48 (8/83pp), 49 (7/82p), 50 (7/83cp), 52 (7/83p), 55 (7/ 83p)

Bugula spp. (Other than above) 1 (7/83p), 8/83c), 5 (81), 6 (79, 80), 9 (81, 7/83c), 12 (7/83c), 14 (81c), 16 (7/83p), 19 (81), 23 (7/82c), 26 (6/83p), 31 (7/83c), 42 (8/83c), 50 (7/83c), 52 (7/83p), 56 (7/83p)

EXOCHELLIDAE

Escharoides coccinea (Abildgaard) 7 (7/82p*)

HIPPOPORINIDAE

Pentapora foliacea (Ellis & Solander) 16 (7/83p), 23 (7/82p), 25 (8/82p)

SCHIZOPORELLIDAE

Schizomavella discoida (Busk) 7 (7/82p*)

HIPPOTHOIDAE

Hippothoa flagellum Manzoni 7 (7/82p*)

CELLEPORIDAE

Cellepora pumicosa (L) 2 (77), 6 (79), 7 (7/82p*), 48 (8/83p)

Omalosecosa ramulosa (L) 14 (81c), 19 (81c), 22 (79)

4.5 MOLLUSCS

A total of 28 species of molluscs were recorded during the study from 50 of the 60 sites visited. Since molluscs comprise the second largest Phylum in the animal kingdom this number is unexpectedly low. Molluscs were recorded from nearly all the sites visited, but rocky outcrops and small reefs, (especially the Pullar Bank (site 1), Mixon Hole (site 2), the Frode (site 31) and the Winter Reef (site 12) appear to support the most varied molluscan fauna.

4.5.2 Most reocrds are from depths of 5-10 metres; the deeper wrecks in 20m+ gave few records as did the shingle and pebble substrates which are widespread in the area.

4.5.3 The most commonly recorded molluscs from rocky outcrops and small reefs are the common topshell Calliostoma zizyphinum, slipper limpet Crepidula fornicata, grey topshell Gibbula cineraria, common whelk Buccinum undatum, common piddock Pholas dactylus and the common mussel Mytilus edulis. The deeper wrecks at 20m+ support only a few species, notably Mytilus edulis, great scallop Pecten maximus and the common topshell Calliostoma zizyphinum.

4.5.4 The grooved top shell Canthoridus striatus is reported to be present off Bognor reef and rocks, also at the Mixon Hole. This was previously thought to be found only in the Western English Channel.

4.5.5 There are four sightings of the blue rayed limpet Patina pellucida at the Frode (site 31), Seaford Head, (site 56), Rottingdean rocks (site 49) and the Mixon Hole (site 2). This figure is lower than might be expected and may be due to genuine scarcity (Patina preferring clearer water) or merely the difficulty in recording the species due to its habit of living in Laminaria holdfasts. Patina is also known to occur at Newhaven Gullies (site 50) (D.H. Harvey pers. comm.).

4.5.6 The cuttlefish Sepia officinalis is seen around some of the wrecks and also at the Palace Pier, Brighton. This cuttlefish is bottom-living, hiding in the sand, and, like flatfish, is probably more common that the records suggest.

4.5.7 There were only three sightings of the common oyster Ostrea edulis, found at three sites between Brighton and Seaford Head. This is most probably due to the distribution and abundance of the slipper limpet Crepidula fornicata (originally an import from America) now a serious predator to the common oyster.

4.5.8 SPECIES LIST - MOLLUSCS

GASTROPODA

PROSOBRANCHIA

ARCHAEOGASTROPODA

Patella vulgata L, limpet. 3 (81p), 5 (80p), 34 (82c)

B Patella pellucida L, blue-rayed limpet. 2 (82p), 6 (80p), 31 (6/83p), 49 (7/82c), 56 (7/86p)

Gibbula cineraria (L), grey topshell. 1 (79), 2 (7/82p), 4 (79p), 6 (80p), 7 (7/83c), 8 (7/82pp, 7 /83p), 11 (6/82c), 14 (9/81p), 19 (81c), 20 (10/83p), 26 (6/83p, 7/83p), 29 (79p), 31 (7/83p), 42 (8/83p), 49 (7/82c), 60 (81p)

Cantharidus striatus (L), grooved topshell. 8 (7/82p)

Calliostoma zizyphinum (L), common topshell. 1 (79c, 7/83p), 2 (7/82p, 6/83p), 5 (80p), 6 (80p), 7 (7/82c, 7/83c), 11 (6/82p), 12 (6/83p, 7/83p), 12 (6/83p, 7/83p), 14 (9/81p), 16 (7/83p), 19 (81c), 22 (79p), 23 (7/82p), 25 (8/82p), 26 (6/83p, 7/83p), 28 (6/82p), 30 (7/83c), 31 (7/83c), 60 (81p)

MESOGOASTROPODA

Lacuna vincta (Montagu), banded chink shell. 47 (82p), 49 (7/82p).

Littorina saxatilis (Olivi), rough periwindkle. 5 (80p)

Littorina littorea (L), edible periwinkle. 5 (80p).

B Crepidula fornicata (L), slipper limpet. 1 (8/83c), 2 (5/82c, 7/82c), 3 (81c), 4 (79p), 5 (80p), 6 (80c), 8 (7/82p, 7/83c), 9 (81c, 7/83c), 11 (6/82p), 14 (6/83c), 19 (81c), 23 (7/82cc), 26 (6/83ccp, 7/83c), 28 (81p, 8/82p), 29 (10/83p), 30 (7/83c), 31 (7/83p), 39 (5/82c), 41 (5/82pp), 42 (7/82c, 8/83cp), 45 (8/82cp), 46 (7/82p), 47 (8/82c), 48 (7/83c, 8/83c), 49 (7/82c), 56 (7/83p).

Trivia monarcha (da Costa), european cowrie. 3 (81p), 8 (7/82p), 9 (81p), 26 (6/83p), 41 (5/82p).
Trivia arctica (Montagu). 1 (79p, 8/83p), 2 (7/82pp), 5 (80p), 7 (7/83p), 9 (81p), 26 (6/83p, 7/83p), 29 (81p), 30 (7/83p), 31 (7/83p), 42 (8/83p).

NEOGASTROPODA

Nucella lapillus (L), dogwhelk. 1 (79c, 7/83p), 5 (80c), 14 (6/83p), 26 (6/83p), 29 (79p, 10/83p).

Ocenebra erinacea (L), oysterdrill. 1 (7/83p), 6(80p), 28 (81p, 6/82p), 49 (7/82c), eggs 14 (6/83p).

Buccinum undatum (L), common whelk. 1 (79c, 7/83p, 8/83p), 2 (7/82c, 6/83p), 3 (81c), 4 (79p), 6 (80p), 9 (81c), 14 (6/83p), 19 (81p), 26 (6/83p, 7/83p), 28 (81p, 8/82p, 10/83c), 31 (7/83p), 38 (5/82p), 39 (5/82p), 42 (7/82p), 57 (5/83c).

Nassarius reticulatus (L) netted dogwhelk. 1 (79), 6 (80p), 9 (81p), 12 (7/83p), 14 (81p), 26 (7/83p), 31 (7/83p), 42 (8/83p).

Nassarius incrassatus (Strom), thick-lipped dog whelk. 1 (79, 7/83p), 14 (9/81p), 28 (81p, 6/82p), 49 (7/82p).

OPISTHOBRANCIA

TECTIBRANCHIA

Aplysia punctata Cuvier, sea hare. 6 (80p), 9 (81p).

NUDIBRANCHIA

Archidoris pseudoargus (Rapp), sea lemon. 5 (80c), 6 (80c), 9 (81p), 19 (81p), 28 (81p, 6/82p), 29 (79p), 31 (7/83p), 41 (5/82p)

Facelina auriculata (O.F. Muller). 41 (5/82p)

Coryphella pedata 6 (6/83p), 8 (7/82p), 33 (5/83p)

Coryphella browni 57 (5/83p)

BIVALVIA

PRIONODESMACEA

FILIBRANCHIA

B Mytilus edulis L, common mussel. 1 (79, 7/83p), 2 (5/82c, 6/83p), 3 (81c), 4 (79p), 5 (80p, 6/83p), 6 (80p), 12 (6/83p), 14 (6/83cccc), 15 (7/83c), 18 (6/83cc, 7/83c), 19 (81c, 8/83c), 23 (7/83ccc), 28 (81c, 6/82p), 29 (10/83cp), 31 (6/83c), 35 (7/83c), 36 (5/83c), 37 (7/82c, 7/83c), 39 (5/82cc), 41 (5/82p), 44 (5/83p), 45 (8/82cp), 46 (7/82c, 8/82cc), 47 (8/82c), 48 (7/83pc, 8/83c), 50 (7/83pp), 51 (6/83c), 52 (7/83cccc), 55 (7/83c), 56 (7/83p), 57 (5/83cc)

PSEUDOLAMELLIBRANCHIA

Ostrea edulis (L), common European oyster. (3 (81p), 5 (80p), 6 (80p), 47 (8/82p), 50 (7/83p), 52 (7/83p), 60 (81p).

B Pecten maximus (L), great scallop. 8 (7/83p), 9 (81, 7/83p), 19 (81p), 23 (7/82cc), 35 (7/83p), 36 (5/83p), 37 (7/83p), 44 (5/83p), 51 (6/83p), 52 (7/83p), 53 (7/83p)

TELEODESMACEA

Venerupis rhomboides (Pennant), banded carpet shell. 2 (7/82p)

Ensis ensis (L), razorshell 38 (7/82p)

Hiatella arctica (L) 14 (9/81p).

Pholas dactylus L, common piddock. 2 (7/82c, 6/83cc), 10 (6/83c), 15 (7/83p), 26 (6/83c), 32 (7/82c), 42 (8/83c), 48 (7/83c, 8/83c), 49 (7/82c), 50 (7/83ccc), 54 (7/83cc), 56 (7/83c)

CEPHALOPODA

DECAPODA

Sepia officinalis L, cuttlefish. 12 (8/83), 38 (5/82p, 7/83p), 46 (8/82), 54 (8/83), eggs 12 (7/83).

4.6 CRUSTACEA

4.6.1 The phylum crustacea contains a large number of representatives in British seas. The vast majority are small, wither planktonic or benthic, and cover a wide range of taxa. Within a survey of this kind, it was only possible to consider the larger crustaceans, most of which are confined to the Suborder Reptantia (lobsters, hermit crabs and true crabs).

4.6.2 The edible crab, Cancer pagurus was the most commonly recorded, being unrecorded from only 8 sites. It is widespread across the area, sometimes occurring in ones and twos, sometimes in large numbers (e.g. Mixon Hole Cliff). It seeks cover, as provided by wreck habitats, crevices in cliffs, the base of boulders and miniature caves in bedrock. Only occasionally is it found partially buried in soft substrata. The vast majority of specimens encountered are within the size range 7-14cms across the carapace. With a Sussex legal landing size of 14cms, the relative scarcity of larger specimens can only be attributed to the widespread crab potting in the area. Both Selsey and Littlehampton are in the top ten England and Wales crab ports (Edwards, 1979).

4.6.3 Recorded only slighltly less frequently was the other edible crab, the spiney spider crab, Maia squinado. It is a larger animal than Cancer, less dependant on cover and occurs on all substrata. Aggregations were recorded at the Palace Pier Brighton in August 1982. A fishery exists, apparently only for the claws. One fisherman was observed at Newhaven Gullies removing spider crabs from pots, ripping off the claws, smashing the carapace with a hammer and throwing the specimens back in the sea.

4.6.4 The lobster, Homarus gammarus is also widespread, but recorded less frequently, and in lower numbers than either Cancer or Maia. It does not occur in open water (at least in daylight) and is normally observed in caves within bedrock or wrecks. Again, few specimens observed were above the legal landing size (8cms carapace length), and many were considerably smaller. Selsey is an important lobster fishing port.

4.6.5 The fourth heavily recorded species was the Velvet swimming crab, Liocarcinus puber. Again this is widespread, occurring only on rough ground (reefs or wrecks). In contrast, the shore crab, Carcinus maenas, is typically found on flattish, sediment ground, but undoubtedly seeks cover on occasions. It occurs all across the region, but only in very shallow water. It does not appear to be restricted by the virtual absence of suitable shore habitats.

4.6.6 Hermit crabs probably exist in higher numbers than any other macro crustaceans in the area, despite being recorded less than the large crabs. This underecording results partly from their exclusion from the basic recording card, and partly from uncertainties over identification. Larger hermit crabs were always Pagurus bernhardus, and identification underwater is relatively easy. Small hermit crabs occur in large numbers, and cannot be identified underwater. However, a number of samples collected in 1983 were all P. bernhardus. On the other hand, a specimen of P. cuanensis was identified from the Mixon Hole in 1977. Thus,although the vast majority of hermit crabs sighted were probably P. bernhardus, other species can obviously occur. One reason for the large numbers of hermit crabs in the region is that their preferred habitat - coarse sediments - is dominant.

4.6.7 A similar recording problem exists with barnacles. Again, they are common and underecorded. Specimens collected for identification invariably turned out to be Semibalnus balanoides (membranous base), which is slightly surpirising. One might have predicted Balanus crenatus as being the most likely, common, sublittoral species.

4.6.8 The squat lobster, Galathea squamifera, the hairy crab Pilumnus hirtellus and the long-clawed porcelain crab Pisidia longicornis were definitely underecorded. They are cryptic species, living under cobbles, pebbles, empty shells, in Crepidula and Mytilus beds, etc. The infauna of these habitat types was not investigated in detail.

4.6.9 Atelecyclus rotundatus prefers gravelly, uneven, sediments and Corystes cassivelaunus, soft sediments into which it buries. Both species were recorded only once, a reflection of the lack of diving on such habitats, rather than their true frequency.

4.6.10 Spider crabs of the genera Hyas, Inachus, Macropodia and Pisa were recorded occasionally. Their preferred substrataare foliaceous algae, bryozoans and hydroids, and they can be very cryptic in such habitats. Even if seen, these crabs cannot be identified by the non-specialist underwater and collection is required.

4.6.11 Carpets of tubes of the amphipod Jassa falcata cover and dominate the surface of the "City of Brisbane" wreck (site 52). Although this animal does occur in vast aggregations, the drab appearance of its tubes has probably resulted in its being largely unnoticed in the region.

4.6.12 This survey has successfully demonstrated the abundance, distribution and habitat preferences of the larger crustaceans occuring in the area. However, records of smaller species are largely fortuitous, and cannot be taken as a true indication of their status in the region. For example, Ingle 1980 records 34 (Brachyuran) crabs occurring in East Channel, and/or Wight, whereas only 13 are recorded in this report.

4.6.13 SPECIES LIST - CRUSTACEA

CIRRIPEDIA

Elminus modestus Darwin. 2 (5/77p, 7/77pp)

Semibalanus balanoides (L) acorn barnacle. 1 (6/79p), 2 (5/77p), 6 (5/77c, 8 (8/80p), 8 (4/79p), 12 (7/83c), 23 (7/82p), 49 (7/82c), 56 (5/83p)

Barnacles. 1 (8/83c), 4 (8/81c), 5 (9/80c), 19 (8/81p), 25 (8/82p),52 (7/83c), 57 (5/83c)

MYSIDACEA 50 (7/83c)

AMPHIPODA

Jassa falcata (Montagu) 52 (7/83c)

DECAPODA

Atecyclus rotundatus (Olivi) 20 (10/83p)

B Cancer pagurus L, edible crab. 1 (6/78c, 6/79cp, 5/81c, 7/81p), 2 (5/77c, 7/77p, 8/77cc, 8/79c, 5/82p, 7/82cp, 6/83ppp), 4 (5/78p, 8/81p), 6 (9/79p, 6/83p), 7 (7/83p), 8 (5/77p, 9/78p, 7/82pppp, 7/83p), 9 (11/79p, 6/81p), 10 (7/83p), 11 (7/81p), 12 (7/83pp), 13 (7/83c), 14 (6/83pp), 15 (6/83p), 17 (6/83p), 18 (6/83p), 19 (8/81p), 20 (10/83p), 21 (11/79p 5/82p), 23 (7/82pp, 7/83p), 24 (9/79p, 8/81p), 25 (8/82p), 26 (6/83pp), 27 (4/83p), 28 (8/82p), 29 (10/83p), 30 (7/83c), 31 (7/83pp), 32 (7/82p), 33 (5/83p), 35 (7/83p), 36 (5/83p), 37 (7/83p), 38 (5/82p, 5/82cpp, 7/83p), 39 (5/82p), 40 (5/82p), 41 (5/82cccc), 42 (7/82p, 8/83p), 44 (5/83p), 45 (8/82cp), 46 (7/82pc, 8/82p, 47 (8/82c), 48 (7/83c, 8/83c), 49 (7/82p), 50 (7/83cccp), 51 (6/83p), 52 (7/83ppc), 53 (7/83c), 54 (8/83ccc), 55 (7/83cpp, 56 (4/83p, 7/83ccccpppp, 8/83ccp).

B Carcinus maenas (L) Shore crab. 3 (8/79c), 4 (5/78p, 8/81c), 38 (5/82p), 39 (5/82cc), 40 (5/82p), 46 (7/82pp, 8/82pc), 47 (8/82c), 48 (7/83pp), 49 (7/82p), 54 (8/83p), 55 (7/83p), 56 (7/83p, 8/83c)

Corystes cassivelaunus (Pennant), masked crab. 2 (6/83 dead), 38 (5/82p)

Crangon crangon (L) 41 (5/82p)

Galathea squamifera Leach. 1 (8/83p), 2 (5/74p, 5/77c, 8/77c), 9 (11/79p), 11 (6/82), 14 (6/83p), 29 (10/83c), 42 (7/82p), 49 (7/82c)

B Homarus gammarus (L) common lobster. 1 (6/78c, 6/79pp, 5/81p, 7/81c), 2 (5/77p, 7/77p,8/77p,8/79p,7/82p), 6 (7/83p), 8 (7/82pp), 10 (7/83p, 8/83p), 11 (12/82p), 12 (16/83p, 52/83p), 13 (7/83p), 14 (7/81p, 9/81p), 15 (20/83p), 16 (6/83p), 18 (6/83p), 20 (10/83p), 21 (5/82p), 23 (7/83p), 24 (9/79p), 25 (8/82p), 26 (6/83p, 7/83p), 28 (8/82p), 30 (7/83p), 31 (6/83p), 32 (7/82p), 33 (5/83p), 35 (7/83p), 36 (5/83p), 37 (7/82pp), 38 (7/83p), 41 (5/82pp), 42 (8/83p), 44 (5/83p), 47 (8/82p), 50 (7/83p), 51 (6/83p), 52 (7/83ppp), 53 (7/83c), 54 (8/83p), 55 (7/83p, 8/83p), 56 (7/83ppp), 57 (5/83p)

Hyas coarctatus Leach. 57 (5/83p)

Inachus phalangium (Fabricius). 1 (6/79p), 2 (8/79p), 5 (9/73p)

Inachus sp. 1 (8/83c), 28 (8/82p), 50 (7/83p), 56 (7/83p)

Leander sp. 5 (80p)

B Liocarcinus (Macropipus) puber (L), Velvet swimming crab. 1 (6/79pp, 5/81p), 2 (5/77c, 7/77c, 8/77cc, 8/79p, 5/82p, 6/83cc), 5 (6/83p), 6 (9/79p), 7 (7/83p), 8 (5/77p, 9/78p, 10/79p, 7/82ccpp), 9 (11/79p, 6/81p), 10 (7/81p, 7/83p), 11 (7/81p), 12 (6/83p, 7/83p), 13 (7/83p), 14 (7/81p, 9/81p), 18 (6/83p, 7/83p), 19 (8/81p, 8/83p), 20 (10/83p), 21 (4/83p), 23 (7/82pp, 7/83p), 24 (8/81p), 25 (8/82c), 26 (6/83p), 28 (8/82p), 31 (7/83p), 36 (5/80p, 5/83p), 37 (7/83p), 40 (5/82p), 41 (5/82ccp), 42 (8/83p), 45 (8/82c), 46 (7/82cp, 8/82c), 47 (8/82c), 48 (7/83c, 8/83c), 49 (7/82p), 50 (7/83cccc), 51 (6/83p), 52 (7/83 cppp), 54 (8/83ccc), 55 (7/83ccccp), 56 (4/83cp, 7/83ccccccccpp), 57 (5/83pp), 58 (8/83c)

Macropodia rostrata (L) 2 (7/82p), 3 (6/78p), 29 (9/79p), 48 (7/83p)

Macropodia tenuiostris (Leach) 46 (7/82p)

Macropodia sp. 14 (6/83p)

B Maia squinado (Herbst), spiny spider crab. 1 (6/79p, 7/83p), 2 (5/77p, 7/77p, 8/79p, 7/82c, 7/82c, 6/83ppp), 8 (7/82ppp, 7/83p), 9 (11/79p), 11 (6/82p), 12 (6/83p, 7/83p), 14 (7/81p, 6/83p), 15 (6/83p), 16 (7/83p), 17 (6/83p), 18 (6/83pp, 7/83p), 19 (8/81p, 8/83p), 22 (9/79p), 23 (7/82p, 7/83p), 24 (9/79p), 26 (6/83p), 28 (6/82p, 8/82p), 29 (9/79p, 10/83p), 30 (7/83c), 31 (6/83p, 7/83p), 35 (7/83p), 36 (7/83p), 37 (7/82p, 7/83p), 38 (5/82pppp, 7/83p), 39 (5/82p), 41 (5/82cp), 42 (7/82p, 8/83p), 44 (5/83c), 45 (8/82pp), 46 (7/82cc, 8/82cc), 47 (8/82c), 48 (7/83c, 8/83c), 49 (7/82c), 50 (7/83pppp), 51 (6/83p), 52 (7/83ppp), 53 (7/83p), 54 (8/83ppp), 55 (7/83ccp), 56 (7/83ccccc, 8/83pp), 57 (5/83ppp)

Pagurus bernhardus (L) 1 (6/79cc, 7/83p), 2 (5/77p, 7/77c, 7/82c), 3 (8/79p), 4 (6/78p, 8/81p), 6 (5/77p), 9 (11/79p), 14 (6/83p), 20 (10/83p), 24 (8/81p), 28 (8/82p), 29 (9/79p, 10/83p), 38 (5/82p), 39 (5/82p), 41 (5/82c), 49 (7/82p), 56 (7/83c), 57 (5/83c)

Pagurus cuanensis Thompson. 2 (8/77p)

Pagurus sp. 1 (5/81p), 2 (6/83p), 7(7/83c), 11 (6/82p), 14 (6/83pc), 26 (6/83pp, 7/83p), 42 (7/82p, 8/83pp), 46 (7/82p), 50 (7/83p), 55 (7/83c), 56 (7/83p)

Pilumnus hirtellus, (L), hairy crab. 2 (5/74p), 8 (4/79p), 10 (8/83p), 11 (6/82p)

Pisa tetraodon (Pennant). 3 (8/79p), 5 (9/73p), 29 (9/79p)

Pisidia longicornis (L) 1 (6/79p), 2 (5/74p, 7/77c, 7/82c), 5 (9/80p), 9 (11/79p, 6/81p), 23 (7/82c), 52 (7/83p)

CHELICERATA

PYCNOGONIDA

Achelia sp. 4 (6/74p)

Nymphon gracile Leach 4 (11/79p)

Nymphon sp. 4 (6/74p), 13 (7/83p)

Phoxichilidium tubulariae Lebour 2 (5/74p)

4.7 ECHINODERMS

4.7.1 Three species of starfish occur in the area. Asterias rubens was the most frequently recorded, being widespread and common. Although not present at every site, when recorded it's abundance could vary from an occasional specimen to large aggregations. In the latter case, it would typically be found feeding on mussels. It's preferred substrata are flattish areas, mainly cobbles and pebbles, but it also occurs on wrecks or reefs. It occurs at all depths.

4.7.2 Crossaster papposus prefers similar substrata, but is restricted to deeper waters. It was not commonly recorded, and normally only found in small numbers.

4.7.3 Henricia oculata also typically only occurs in ones and twos, but was recorded fairly frequently. It's preferred substratum is reef areas, possibly a reflection of its breeding habits rather than a specialised food preference - see Mortensen (1927), p. 119.

4.7.4 Neither Crossaster nor Henricia were recorded east of Worthing. Indeed, because the cut-off is so marked for both species, they may have reached a distribution limit at this point. A limiting factor could be the increasing turbidity and siltation to the east of the region. Crossaster is at its most southerly distribution in the Channel (Mortensen 1927, p. 114), and could thus be expected to occur patchily at its limit of distribution. On the other hand, Henricias's absence from the eastern part of the region may be caused partially by the lack of sandstone reefs - its favourite habitat, which supports the greatest abundance and diversity of sponges, it's main food. It is known to occur off Rye (Evan Jones, pers. comm).

4.7.5 The only brittle stars recorded, Amphipholis squamata and Ophiothrix fragilis were found amongst shell material and under stones. They may occur more frequently in these cryptic habitats than the records suggest. Ophiothrix does not appear to occur at its normal adult size, and there were no records of brittle star beds. Ophiura texturata was recorded as common off Rye in 1979 (G. Ackers, pers. comm) and should occur on deeper sandy bottoms within the region.

4.7.6 The two records of the sea-urchin Psammechinus miliaris were represented by single specimens of the living animal (1976), and an empty test (1982) found amongst shell material. Heron-Allen (1911) reports this species as being "rare" in the Selsey Bill area. It is possible that populations do exist but they are occupying habitats not investigated by divers and are likely to be only seen out in the open at night.

4.7.7 No holothuria were found, although Heron-Allen (1911) rather surprisingly reported the presence of Leptosynapta inhaerens and Holothuria forskali in the Selsey Bill area.

4.7.8 The most notable feature of the echinoderm fauna in the area is the extreme paucity of species. Given the presence of suitable habitats, this area must be approaching the lowest echinoderm diversity in the British Isles. The contrast between the 6 species recorded and the 47 in the Plymouth area (Marine Biological Association, 1957) is most marked. Furthermore, echinoderm fauna becomes even richer further west and north off the west coasts of Ireland and Scotland.

4.7.9 SPECIES LIST - ECHINODERMATA

ASTEROIDEA

B Asterias rubens L, common starfish. 1 (5/81c, 7/81c, 7/83p, 8/83c), 2 (5/82p, 7/82p), 8 (5/77p), 11 (6/82p), 12 (6/83p), 14 (6/83p), 15 (7/83p), 18 (6/83cc, 7/83p), 19 (6/81p, 8/81p), 23 (7/82cc, 7/83p), 25 (8/82c), 26 (6/83p), 27 (4/83p), 28 (6/82p), 30 (9/79p, 7/83p), 31 (7/83p), 32 (7/82c), 35 (7/83p), 36 (5/83c), 37 (7/82c, 7/83c), 38 (5/80p, 5/82cpppp, 7/83p), 41 (5/82cccp), 42 (7/82p, 8/83cp), 44 (5/83c), 45 (8/82cc), 46 (7/82cp, 8/83cc), 48 (8/83c), 50 (7/83ccp), 51 (6/83c), 52 (7/83ccccc), 53 (7/83p), 54 (8/83ccp), 55 (7/83ccpp), 56 (4/83ccc, 5/83c, 7/83ccc, 8/83cc), 57 (5/83cccp), 58 (8/83ccc).

B Crossaster papposus (L), common sun star. 1 (7/81c, 7/83p, 8/83c), 2 (9/76p, 7/77p), 14 (6/83ppp), 18 (6/83pp), 20 (10/83p), 23 (7/82cc), 25 (8/82p).

B Henricia oculata (Pennant). 6 (9/79p, 6/83pp, 7/83p), 8 (5/77p, 9/78p, 10 (79p, 7/82cpp, 7/83p), 9 (6/81c, 7/83p), 10 (6/83p, 7/83p, 8/83p), 11 (7/81c), 13 (7/83p), 14 (6/83p), 15 (6/83p), 16 (7/83p), 18 (6/83p, 7/83p), 19 (6/81p, 8/81p), 21 (11/79p), 22 (9/79p), 23 (7/82cc, 7/83p), 26 (6/83p), 27 (4/83p), 28 (6/82p).

OPHIUROIDEA

Amphipholis squamata (Delle Chiaje). 2 (7/77p), 4 (6/78p).

Ophiothrix fragilis (Abildgaard), common brittle-star. 23 (7/82p), 41 (5/82p).

ECHINOIDEA

Psammechinus miliaris (Gmelin), green sea-urchin. 23 (7/82p-test only), 31 (7/76p).

4.8 TUNICATES

4.8.1 In spite of the difficulty of identifying sea squirts, both underwater and in the hand, a high number of species (16) was recorded in the survey. Clavellina lepadiformis, the light bulb tunicate, was the most abundant being reported from 26 sites along the whole length of the coast from Selsey Bill to Beachy Head. This species has a westerly distribution in the British Isles and must be near its easterly limits in this area.

4.8.2 Ciona intestinalis was recorded from only 3 sites in 1982, but in 1983 it was found at 15, and was common at most of these. Diplosoma listerianum is also very common, but was more commonly recorded in 1982 than 1983.

4.8.3 This is a group in which considerable changes in distribution can be expected over a short period due to the brevity of their life span in the adult stage. The difference between results in the two years trends to bear this fact out. The greatest variety of species of tunicates is found on rocky outcrops at a depth of 5-10m, Bognor Rocks (site 8), 9 species and Winter Reef (site 26), 10 species, being the best recorded sites. Some species also colonise stony or sandy/muddy sea beds where they are loosley attached or partially embedded. Molgula manhattensis is one such species and forms a thick carpet over the sea bed in sandy areas. It is very common around Newhaven and Seaford (sites 50, 54 and 56).

4.8.4 Archidistoma aggregata, apparently an uncommon species (Millar 1970), was abundant on Bognor Reef but owing to its habit of covering itself with gravel it was not easy to find. Styela clava proved to be quite common and widespread in the area, but was less recorded in 1983 than 1982. This is an introduced species, possibly from the Far East, which is now established in the English Channel (Millar 1970).

4.8.5 The systematic status of the species of didemnids found in the Channel is complicated, Lafarque 1968, described a large number of species from West France, including several new species, and it would seem likely that at least some of these penetrate the Channel as far as our area. It would be worth a serious study of these in future years.

4.8.6 SPECIES LIST - TUNICATES

TUNICATA

CLAVELLINIDAE

B Clavellina lepadiformis (O F Muller), light bulb tunicate. 2 (77, 79), 4 (79), 5 (81, 6/83p), 6 (79, 80), 7 (7/83p), 8 (7/82pppp, 7/83p), 10 (6/83p), 12 (6/83p), 15 6/83c, 7/83p), 16 (7/83p), 18 (6/83p), 23 (7/82pp), 25 (8/82p), 26 (6/83cc), 28 (6/82p), 32 (7/82p), 37 (7/83p), 40 (5/82p), 41 (5/82pp), 42 (7/82p, 8/83p), 46 7/82p, 8/82c), 48 (7/83p, 8/83c), 49 (7/82p), 50 (7/83cccp), 52 (7/83pp), 54 (8/83cp), 55 (7/83cp), 56 (7/83ccp, 8/83c), 58 (8/83p)

Archidistoma aggregatum Garstang. 8 (7/82c).

POLYCLINIDAE

Morchellium argus (Milne-Edwards). 2 (77), 3 (78, 81), 4 (79), 5 (81), 6 (78, 79, 80), 7 (7/82p), 11 (6/82p), 19 (81), 28 (6/82c), 31 (7/83p), 40 (5/82c), 48 (7/83c), 49 (7/82p), 50 (7/83ccp), 54 (8/83pp), 56 (7/83c)

Aplidium sp. 26 (6/83c), 42 (8/83p)

Aplidium proliferum (Milne-Edwards). 26 (7/83p), 28 (7/83p), 47 (8/82c)

Aplidium cf punctum 6 (6/83c), 31 (7/83p), 38 (5/82c), 40 (5/82c), 50 (7/83c)

DIDEMNIDAE

Didemnum candidum Savigny. 5 (81), 14 (6/83p), 26 (6/83p), 40 (5/82p).

Diplosoma listerianum (Milne-Edwards). 2 (77, 79, 7/82c), 3 (79, 81), 5 (81c), 6 (79, 80c), 7 (7/83p), 8 (79, 7/82pc, 7/83p), 9 (79), 10 (7/83p), 11 (6/82p), 12 (7/83p), 26 (6/83), 30 (79), 31 (7/83p), 40 (5/82p), 48 (7/83c, 8/83p), 49 (7/82p), 50 (7/83ccp), 54 (8/83pp).

CIONIDAE

B Ciona intestinalis (L). 2 (77), 3 (78, 81), 4 (79), 5 (81c), 6 (79,80), 7 (7/83p), 8 (79), 9 (79), 20 (10/83p), 26 (6/83c), 29 (79), 30 (79, 7/83p), 31 (6/83p, 7/83pp), 38 (5/82pp), 45 (8/82p), 46 (8/82c), 48 (8/83c), 54 (8/83pp), 55 (7/83cp), 56 (7/83pp, 8/83c), 58 (8/83cc).

ASCIDIIDAE

Ascidiella aspersa (O F Muller) 1 (8/83), 2 (79, 81), 3 (79), 5 (81c), 6 (79, 80c), 8 (79, 7/82p), 19 (81), 29 (79), 48 (7/83c), 49 (7/82p)

Ascidia mentula O F Muller. 4 (79), 5 (81), 6 (79), 8 (79), 9 (79, 81), 11 (6/82p), 12 (7/83cc), 19 (81), 20 (10/83p), 26 (6/83pp), 42 (8/83p).

STYLEIDAE

Styela clava Herdman. 2 (77, 7/82p), 3 (78, 81), 4 (79), 6 (78, 79), 7 (7/83p), 8 (79, 29 (79, 10/83p)

Dendrodoa grossularia (Van Beneden). 1 (7/83p, 8/83p), 2 (77, 79, 7/82cc), 3 (78), 4 (79), 5 (81), 6 (80), 7 (7/83c), 8 (78, 79, 7/82c), 9 (7/83p), 11 (6/82p), 23 (7/82p), 26 (6/83cc), 31 (7/83c), 39 (5/82c), 54 (8/83c)

Distomus variolosus Gaertner. 2 (77, 3 (78, 79, 81), 4 (79), 26 (7/83).

Botryllus schlosseri (Pallas), star ascidian. 2 (77), 3 (78, 81), 5 (81c), 6 (79, 81, 6/83p), 7 (7/83c), 8 (79), 9 (81, 7/83p), 26 (6/83c), 28 (81, 6/82p, 7/83c), 31 (7/83p), 49 (7/82p).

Botryllus leachi (Savigny). 2 (6/83p), 3 (78), 5 (81), 40 (5/82c)

MOLGULIDAE

Molgula manhattensis (de Kay). 1 (78, 79, 7/83pp), 2 (79), 7 (7/83c), 8 (79), 9 (79), 29 (79), 30 (79, 7/83pp), 48 (8/83p), 49 (7/82pp), 50 (7/83ccc), 54 (8/83cc), 56 (7/83c).

4.9 FISHES

4.9.1 A total of 42 species of fishes were recorded during the survey together with 6 additional species recorded by D.H. Harvey (pers. comm.). No specimens were taken although a number of the visual identifications have been checked by reference to photographs.

4.9.2 Fishes were recorded from 53 sites and those seen at 10 or more these were:-

Trisopterus luscus	41 sites
Labrus bergylta	34 sites
Parablennius gattorugine	24 sites
Ctenolabrus rupestris	22 sites
Crenilabrus melops	17 sites
Pollachius pollachius	16 sites
Trisopterus minutus	15 sites
Callionymus lyra	13 sites
Conger conger	11 sites
Thorogobius ephippiatus	10 sites
Labrus mixtus	10 sites

4.9.3 The bib, Trisopterus luscus, is clearly the most widely occurring species within the sites studied and, additionally, was usually recorded a common as it is normally a shoaling species. By contrast the ballan wrasse, Labrus bergylta, a solitary species, was widely recorded but rarely reported as common. It is noteworthy that seven of the eleven fish species listed above fall within two families, the Gadidae (cod fishes) and Labridae (wrasses).

4.9.4 In contrast to the widely recorded species, 22 of the 48 species listed were recorded from only one site. The maximum number of species recorded from one site is 13 (Brighton Pier - Site 46).

4.9.5 It is possible to make some comparisons with other published works which include lists of fishes. Two local historical works, Merrifield (1864), which relates to Brighton and Heron-Allen (1911), which relates to Selsey Bill, list some 80 and 37 species respectively, though both rely heavily on commercial landings and therefore gather from a wider area than that of our survey. Some species referred to as common by Merrifield (1864) and which we have not recorded are monkfish, whiting, herring and mackerel, the latter two, at that time, supporting substantial local fisheries. A very much greater occurrence and variety of flat fishes are recorded by both authors, but our low records of these species may reflect an inherent bias in diving surveys. Personal records by D.H. Harvey (pers. comm.) from South-West Rocks (site 42) include 6 species which we did not record, including 3 flatfish. These are included in the species list and notated accordingly.

4.9.6 This part of the English Channel may represent the most easterly occurrence for a number of fish species common in south-west Britain and it is therefore interesting to compare our species list with those in the three Dorset Underwater Survey reports (Brachi, Collins and Roberts 1977, Dixon, Harrison, Hodder and Roberts 1978 and Dixon, Pears, Attfield and Carter). These together list 36 species (excluding those only recorded from rock pools). Those listed which we have not recorded are:-

Belone belone garfish, Diplecogaster binaculata and Apletodon microcephalus clingfishes, Galeorhinus galeus tope, Raja microcellata small-eyed ray.

Of these species the clingfish is a south-western species. The other species are all listed by Merrifield and probably occur in Sussex. 18 species were recorded during our survey which do not appear in the three Dorset reports. Most of these are uncommonly recorded species in Sussex with the exception of the poor cod, Trisopterus minutus which we recorded from 15 sites in Sussex but is apparently absent from Dorset.

4.9.7 The Gadidae, cod, family is well represented in the study area. In addition to Trisopterus luscus and Trisopterus minutus, both mentioned above, 3 other species are recorded. Pollachius pollachius is a common fish on wrecks in the area, but it little recorded from reefs or flattish ground. It is notable that the Dorset reports record this as the most common species of the gadidae and personal observations also suggest that it is much more common in occurrence in Dorset and elsewhere in south-west Britain.

4.9.8 Two further gadoids Merlangius merlangus, whiting, and Trisopterus esmarkii norway pout, are recorded from the Inner Mulberry (site 5) (Cunliffe 1981). Visits during our survey have failed to confirm the presence of either species. The whiting almost certainly occurs off Sussex but is not often seen by divers, preferring open sandy habitats. On the other hand T. esmarkii is a northern species mainly found offshore and in deeper water than that of our study (Wheeler 1968 and 1978). Cunliffe's record must, therefore, be considered doubtful.

4.9.10 The Labridae, wrasse, family comprises five species regularly found in British waters and all of these were recorded during this study. Four of these five species are regularly seen in the area and are in the table of wide-spread species in para. 4.9.2 above. The fifth species Centrolabrus exoletus is included on the basis of a single siting at a reef off Littlehampton (Site 28). This species is recorded in one of the Dorset surveys (Dixon, Harrison, Hodder and Roberts 1978) but was not thought to occur east of Dorset (Wheeler 1969). This single siting is insufficient to record a permanent population in Sussex, but it is clearly a species worthy of further investigation.

4.9.11 The blennies (Blenniidae and Pholidae) are not well represented in the study species list in terms of diversity. However, Parablennius gattorugine, the tompot blenny, was commonly recorded from wrecks and reefs at all depths except less than 5 metres. Pholis gunnellus, the butterfish or gunnel, is a regular inhabitant of cobble and small boulder substrates.

4.9.12 The gobies (family Gobiidae) were more widely recorded and five species are listed although this group is a difficult one to identify reliably by sight. One goby which is unmistakable and also of interest in distribution terms is Thorogobius ephippiatus, the leopard-spotted goby. The occurrence and distribution of this species, owing to its cave and crevice habitat and extreme shyness, is known almost entirely from records by divers (Wheeler 1969 - as Gobius forsteri). It is likely that our Sussex sightings represent the most easterly records of this species in the English Channel and it may be significant that they are mostly from the western end of the study area. Off Bognor and Littlehampton this species was regularly recorded from reefs at all depths between 5m and 20m. There are only two records east of Littlehampton, from South-West Rocks (Site 42) and the Newhaven Gullies (Site 50).

4.9.13 A number of fish species have been recorded which are probably seasonal migrants to the area from the south and west. These include Spondyliosoma cantharus black sea bream and Mullus surmuletus red mullet. On the other hand Cyclopterus lumpus, the lumpsucker, is essentially a northern species and

its occurrence in the English Channel may reflect the wide distribution of the planktonic larvae and young stages and the bathypelagic existance of non-breeding males (Wheeler 1969 and 1978).

4.9.14 In terms of species relative to habitat, reefs and wrecks in the 5-20m depth range appear to support the greatest diversity. The two tables below show the sites from which the greatest diversity of fish species was recorded and individual and average numbers of species recorded from sites within each habitat category.

Number of fish species recorded	Site name and Reference No.	Habitat Type
13	Brighton Pier (46)	5-10m wreck
12	Pine (12)	10-20m wreck
11	Bognor Reef (8)	5-10m reef
11	Rocks of Littlehampton (28)	5-10m reef
11	Frode (31)	5-10m wreck
11	Newhaven Gullies (50)	5-10m reef
10	Outer Mulberry (6)	5-10m wreck
10	Waldrons (10)	10-20m reef
10	Miown (38)	5-10m wreck
10	Seaford Head (56)	9-15m reef

Habitat type		Number of Species recorded (Site ref. No.)	Average
Flattish Ground	5-10m	0 (2), 1 (11), 6 (12), 6 (28), 6 (41), 1 (42), 2 (55).	3
	10-20m	5 (1), 3 (9), 1 (29), 4 (30), 5 (42), 5 (45), 1 (56)	3.5
	20m+	2 (1), 5 (1-4), 2 (57)	3
Reefs & Cliff	0-5m	3 (7), 3 (48), 9 (49)	5
	5-10m	11 (8), 11 (28), 4 (47), 1 (48), 11 (50), 10 (56)	8
	10-20m	10 (10), 5 (12), 8 (14), 6 (32), 7 (42)	7
	20m+	2 (2)	2
Wrecks	0-5m	9 (5), 2 (54)	5.5
	5-10m	10 (6), 11 (31), 4 (33), 10 (38), 4 (40), 13 (46	8.5
	10-20m	12 (12)	12
	20m+	6 (15), 6 (16), 6 (18), 3 (19), 6 (20), 0 (21), 7 (23), 5 (25), 2 (36), 2 (37), 2 (51), 8 (52), 2 (57)	

4.9.15 The reef sites typically support small populations of most of the wrasse species. Of the cods, bib and poor cod are often present, but not in great numbers. The bib in these areas are invariably juveniles or small adults. The species which live in crevices or caves on the reef itself include Conger conger conger eel, Taurulus bubalis long spined sea-scorpion, Parablennius gattorugine tompot blenny, and Thorogobius ephippiatus leopard-spotted goby.

4.9.16 The wreck sites, whether inshore or offshore, support large numbers of fishes and in these terms are certainly the most productive parts of the study area. The shallower wrecks (5-15m) have a species diversity which matches the reefs. On the other hand deeper wrecks (20m+), though supporting enormous fish populations, are noticeably poorer in species diversity. Trisopterus luscus, bib, is the dominant species on all of the wrecks visited except the shallow Inner Mulberry (Site 5) and Shirala (Site 21). (The latter is quite inexplicable and doubted by the author although two contributors have dived this wreck and

failed to record its presence). Poor cod, T. minutus, is often associated with the shaols of bib though numbers and size of individuals are always smaller. Both species are found close to the bottom of wrecks and amongst wreckage. Pollachius pollachius, pollack, is found in the higher parts of wrecks and in mid-water just above them.

4.9.17 Labrus bergylta is the most common wrasse on all wrecks in all depths. The shallow wrecks may also have Crenilabrus melops though this species appears to be absent from deeper ones. On the other hand Ctenolabrus rupestris, though present at all depths is more frequently seen on the deeper wrecks.

4.9.18 The other prominent features of the wreck fish populations are Parablennius gattorugine, which was often recorded as common, despite its crevice habitat, and Conger conger which, for the same reason may be under-recorded.

4.9.19 The extensive areas of flattish sand and cobble, regardless of depth, support only limited fish populations with both numbers and species diversity being the lowest in the study area. The species most commonly recorded were small, bottom dwelling, species. Four species of goby, the great pipefish Syngnathus acus, and gunnel Pholis gunnellus were regularly recorded, whilst the dragonet Callionymus lyra was occasionally present in larger numbers.

4.9.20 The table below compares the records of the most widely distributed fish species (from para 4.9.2) in terms of the number of sites within each habitat category from which they are recorded.

	Habitat Type									Number of Sites from which recorded
	0-5m	5-10m			10-20m			20m+		
		Flat	Reef	Wreck	Flat	Reef	Wreck*	Flat	Cliff*	Wreck
Trisopterus luscus	4	0	8	5	2	4	1	1	0	16	41
Labrus bergylta	3	0	6	6	3	4	1	2	0	9	34
Parablennius gattorugine	0	0	4	4	2	3	1	1	0	9	24
Ctenolabrus rupestris	2	0	4	1	3	5	1	1	0	5	22
Crenilabrus melops	3	2	3	3	1	3	1	1	0	0	17
Pollachius pollachius	2	0	1	2	0	1	1	1	0	8	16
Trisopterus minutus	1	1	3	4	1	1	1	0	0	3	15
Callionymus lyra	3	1	3	2	3	0	1	0	0	0	13
Conger conger	0	0	3	2	0		1	0	0	3	11
Thorogobius ephippiatus	0	0	4	0	0	2	1	1	1	1	10
Labrus mixtus	1	0	2	2	0	3	0	0	0	2	10

* only one site in this category.

4.9.21 FISH SPECIES LIST

Nomenclature in the following list follows Wheeler (1978).

SELACHII

CETORHINIDAE

Cetorhinus maximus (Gunnerus), basking shark. 12 (6/83p).

SCYLIORHINIDAE

B Scyliorhinus canicula (L), lesser spotted dogfish. 1 (7/83p), 2 (5/82c), 8 (7/83c), 9 (81), 14 (6/83p), 18 (7/83p).

TRIAKIDAE

Mustelus sp., smooth hound. 28 (8/82p).

SQUALIDAE

Squalus acanthias (L), spurdog. 42p (D. Harvey pers. comm.)

RAJIDAE

Raja clavata L, thornback ray. 28 (8/82p), 42p (D. Harvey pers. comm.).

Raja batis L, skate. 56 (5/83p).

PISCES

ANGUILLIDAE

Anguilla anguilla (L), eel. 49 (7/82p).

CONGRIDAE

Conger conger (L), conger eel. 12 (6/83p), 16 (7/83p), 19 (8/83p), 23 (7/82p), 28 (6/82p), 32 (7/82p), 33 (5/83p), 38 (5/82p), 42 (8/82p), 48 (7/83), 56 (7/83p).

LOPHIIDAE

Lophius piscatorius L, angler fish. 11 (81), 42p (D. Harvey pers. comm.).

GADIDAE

Gadus morhua L, cod. 57 (5/83p).

Trisopterus minutus (L), poor cod. 5 (81), 6 (80, 6/83cc), 10 (7/83p), 12 (7/83c), 18 (7/83p), 19 (8/83p), 26 (6/83p), 28 (6/82p), 29 (10/83p), 31 (7/83p), 40 (5/82p), 41 (5/82p), 46 (7/82p), 50 (7/83p), 52 (7/83cp), 42c (D. Harvey pers. comm.).

B Trisopterus luscus (L), bib/pouting. 6 (79, 80, 6/83ccc, 7/83c), 8 (7/82cccpp, 7/83c), 10 (6/83cc, 7/83p, 8/83p), 12 (6/83c, 7/83c), 14 (9/81c), 15 (6/83c, 7/83c), 16 (7/83c), 17 (6/83c), 18 (6/83ccc), 19 (81, 8/83c), 20 (10/83c), 23 (7/82c, 7/83c), 25 (8/82c), 26 (7/83p), 27 (4/83c), 28 (81, 6/82c, 8/82p), 30 (7/83c), 31 (6/83c, 7/83cp), 33 (5/83c), 35 (7/83c), 36 (5/83c), 37 (7/82c, 7/83c), 38 (5/82ccc, 7/83c), 40 (5/82c), 42 (8/83pp), 44 (5/83c), 45 (8/82p), 46 (7/82ccp, 8/82c), 47 (8/82c), 48 (7/83c, 8/83c), 49 (7/82p), 50 (7/83cccp), 51 (6/83c), 52 (7/83ccccc), 53 (7/83p), 54 (8/83ccc), 55 (7/83cp), 56 (7/83p), 57 (5/83cc), 58 (8/83c), 60 (81c).

Pollachius pollachius (L), pollack. 5 (81), 6 (79, 81, 6/83p), 8 (7/82cpp, 7/83c), 10 (6/83p, 7/83c), 12 (6/83c, 7/83p), 14 (9/81p), 15 (7/83c), 16 (7/83c), 18 (7/83p), 19 (81), 23 (7/82c), 25 (8/82p), 46 (7/82p, 8/82p), 49 (7/82p), 52 (7/83ccp), 60 (81), 42c (D. Harvey pers. comm.).

Molva molva (L), ling. 25 (8/82p), 42p (D. Harvey pers. comm.).

ATHERINIDAE

Atherina presbyter Valenciennes, sand smelt. 49 (7/82p).

ZEIDAE

Zeus faber L. John Dory. 42p (D. Harvey pers. comm.).

SYNGNATHIDAE

Syngnathus acus L, greater pipefish. 41 (5/82pp), 46 (7/82p), 50 (7/83p), 56 (7/83p), 42p (D. Harvey pers. comm.).

COTTIDAE

Myoxocephalus scorpius (L), bull rout/fatherlasher. 1 (8/83), 38 (5/82p).

Taurulus bubalis (L), long spined sea scorpion. 6 (6/83p), 10 (6/83p), 28 (6/82p), 31 (7/83p), 46 (8/83p), 50 (7/83p), 56 (7/83p).

AGONIDAE

Agonus cataphractus (L), hooknose. 38 (5/82p).

CYCLOPTERIDAE

Cyclopterus lumpus L, lumpsucker. 3 (5/83p), 42p (D. Harvey pers. comm.).

Liparis sp., sea snail. 1 (8/83p).

PERCICHTHYDAE

Dicentrarchus labrax (L), bass. 52 (7/83pp), 56 (7/83p), 42p (D. Harvey pers. comm.).

SPARIDAE

Spondyliosoma cantharus (L), black sea bream. 46 (8/82c).

MULLIDAE

Mullus surmuletus L, red mullet. 31 (7/83p), 50 (7/83p), 56 (7/83p), 42p (D. Harvey pers. comm.).

MUGILIDAE

Chelon labrosus (Risso), thick lipped mullet. 31 (7/83c), 46 (7/82p), 49 (7/83p), 42c (D. Harvey pers. comm.).

LABRIDAE

B Labrus mixtus L, cuckoo wrasse. 6 (6/83c), 8 (7/82ppp), 10 (6/83c, 7/83p, 87/83p), 15 (7/83p), 16 (7/83p), 28 (6/82p), 30 (7/83p), 31 (6/83c, 7/83p), 42 (8/83p), 49 (8/83c).

B Labrus bergylta Ascanius, ballan wrasse. 5 (81), 6 (6/83ccp), 7 (7/83p), 8 (81, 7/82ccpp, 7/83p), 9 (7/83p), 10 (6/83c, 7/83p), 12 (6/83c, 7/83pp), 13 (7/83c), 14 (9/81c, 6/83p), 15 (7/83p), 18 (7/83p), 20 (10/83p), 23 (7/82p), 26 (6/83, 7/83p), 27 (4/83p), 28 (81, 6/82p), 30 (7/83c), 31 (6/83p, 7/83pp), 32 (7/82c), 33 (5/83p), 35 (7/83p), 37 (7/83p), 38 (5/82cccp), 40 (5/83c), 42 (8/83p), 44 (5/83c), 46 (7/82pp), 48 (7/83p), 50 (7/83pp), 51 (6/83c), 52 (7/83ppp), 53 (7/83p), 54 (8/83ppp), 56 (7/83pp).

Centrolabrus exoletus (L), rock cook. 28 (6/82p)

Ctenolabrus rupestris (L), goldsinny. 5 (81), 6 (79, 6/83cc), 7 (7/83p), 8 (7/82cccc, 7/83cp), 9 (7/83p), 10 (6/83c, 7/83c), 12 (7/83c), 14 (9/81p, 6/83p), 15 (7/83p), 16 (7/83p), 23 (7/82c), 25 (8/82c), 26 (6/83c), 28 (81, 6/83c), 29 (10/83p), 30 (7/83c), 32 (7/82p), 42 (8/83pp), 45 (8/82p), 50 (7/83pp), 52 (7/83p), 56 (7/83c).

Crenilabrus melops (L), corkwing wrasse. 5 (81), 6 (79, 81, 6/83pp), 7 (7/83c), 8 (7/82cpp), 9 (7/83p), 10 (8/83c), 11 (6/82p), 12 (6/83p), 14 (9/81p), 26 (6/83p, 7/83p), 28 (6/82p), 31 (7/83c), 32 (7/82p, 7/83p), 41 (5/82p), 42 (8/83p), 46 (7/82p), 49 (7/82p).

BLENNIIDAE

Parablennius gattorugine (L), tompot blenny. 6 (79, 81, 6/83p), 8 (7/82p), 9 (81), 10 (6/83p), 12 (7/83p), 14 (9/81p, 6/83p), 15 (7/83p), 16 (7/83c), 18 (7/83c), 19 (81), 23 (7/82c), 25 (8/82c), 26 (6/83c), 28 (81, 6/82c), 29 (10/83c), 31 (7/83p), 32 (7/82c), 38 (5/82cp), 42 (8/83c), 46 (7/82p), 50 (7/83cc), 52 (7/83cpp), 57 (5/83p), 60 (81).

Lipophrys (Blennius) pholis (L), shanny. 49 (7/82p)

PHOLIDAE

B Pholis gunnellus (L), butterfish/gunnel. 4 (81), 38 (5/82p), 40 (5/82p), 41 (5/82pp), 47 (8/82p), 49 (7/82p), 50 (7/83cpp), 55 (7/83p), 56 (4/83c, 7/83pp, 8/83c)

AMMODYTIDAE

Ammodytes tobianus L, sand eel. 36 (5/83p).

CALLIONYMIIDAE

Callionymus lyra L, dragonet. 2 (7/82p), 4 (81), 5 (81), 6 (6/83p), 8 (81), 12 (7/83p), 28 (6/82p, 8/82p), 31 (7/83p), 41 (5/83pp), 42 (8/83c), 45 (8/82c), 46 (7/82p), 49 (7/82p).

GOBIIDAE

Gobius niger L, black goby. 12 (7/83p), 41 (5/82p), 57 (7/83p)

B Thorogobius ephippiatus (Lowe), leopard-spotted goby. 2 (7/82p), 8 (7/82p, 7/83p), 10 (8/83p), 12 (7/83pp), 14 (9/81p), 18 (6/83p), 26 (6/83c), 28 (6/82p), 31 (6/83p), 42 (8/83c), 50 (7/83pp)

Gobiusculus flavescens (Fabricus), two-spot goby. 5 (81), 8 (7/82c), 26 (7/83p), 32 (7/82p), 39 (5/82p).

Pomatoschistus pictus (Malm), painted goby. 12 (7/83p), 42 (7/82c), 50 (7/83p)

Pomatoschistus minutus (Pallas), sand goby. 26 (7/83p), 38 (5/82p), 45 (8/82c).

SCOMBRIDAE

Scomber scombrus L, mackerel. 42p (D. Harvey pers. comm.)

SCOPHTHALMIDAE

Scophthalmus rhombus (L), brill. 42p (D. Harvey pers. comm.)

Zeugopterus punctatus (Bloch), topknot. 23 (7/82p).

PLEURONECTIDAE

Pleuronectes platessa L, plaice. 5 (7/83p), 28 (8/82p), 29 (10/83c), 38 (5/82p), 42 (8/83p), 53 (7/83c)

Platichthys flesus (L), flounder. 42c (D. Harvey pers. comm.)

Microstomus kitt (Walbaum), lemon sole. 42p (D. Harvey pers. comm.)

SOLEIDAE

Solea solea (L), sole/dover sole. 28 (8/82p), 45 (8/82p), 53 (7/83c), 42c (D. Harvey pers. comm.).

5 Pressures on the Marine Environment

5.1 INTRODUCTION

5.1.1 The West Sussex coastline is highly developed with a string of coastal towns, broken only by Pagham Harbour, between Selsey and Brighton. Further east are longer stretches of natural cliff coastline, but even here are considerable coastal settlements and a substantial population close inland. London too is within an hour or two's drive. These factors clearly combine to put considerable pressures on the marine environment both in terms of its exploitation to serve coastal populations and to provide opportunities for recreation for a much wider area.

5.1.2 The study area is also important in sea transport terms with 3 ports, including a cross-channel ferry service, and a major shipping lane passing through it. Again this must bring pressure to bear on marine life and habitats.

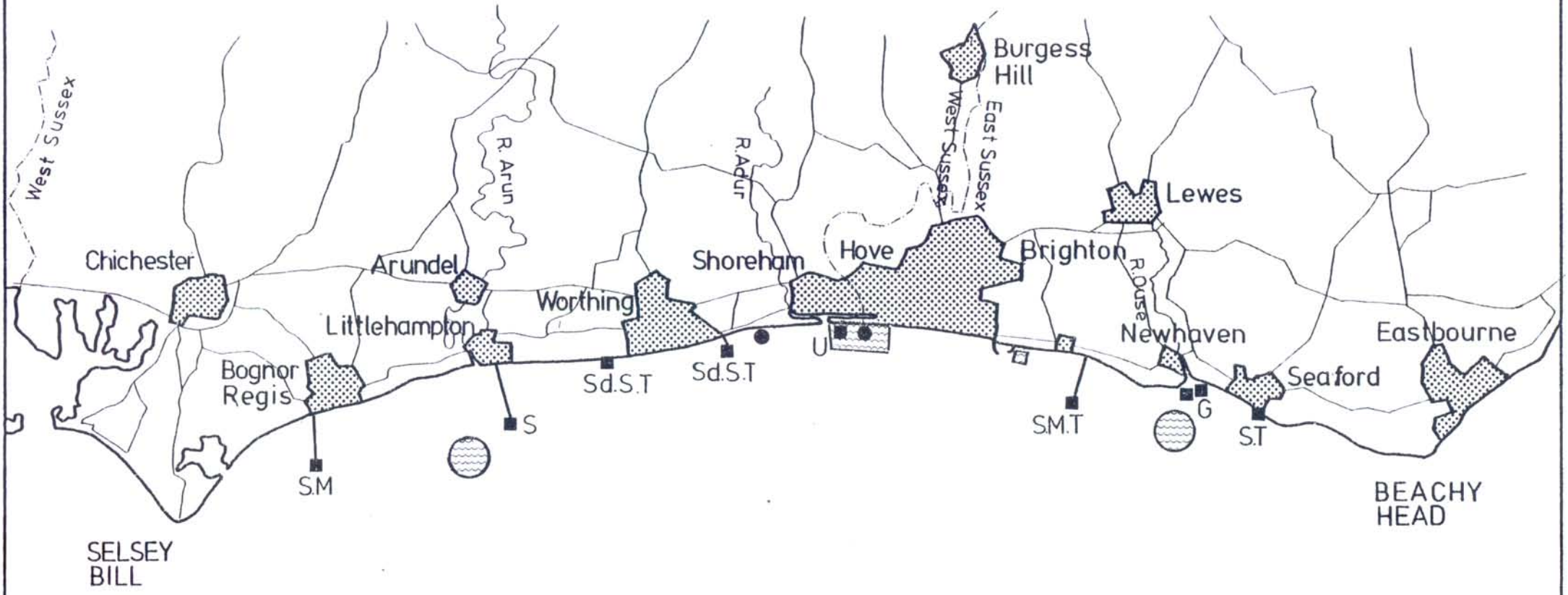
5.1.3 The pressures on marine life in the area may be divided into direct pressures from exploitation by capture and indirect pressures on habitats and species living in them. The latter include sewage disposal, industrial effluents, dredging and spoil dumping and marine litter, and certainly constitute the major threat. They are therefore considered first.

5.2 SEWAGE DISPOSAL

5.2.1 Almost all sewage disposal in this country involves discharges into rivers, estuaries or the sea. Sewage from inland towns must be fully treated before it is discharged to a watercourse. On the other hand many coastal towns discharge sewage into the sea in an untreated state. Sewage discharge to sea is generally considered acceptable only if it is first mechanically treated (screened or macerated) to prevent the discharge of solids and then discharged far enough out from the shore to prevent any sewage getting to bathing areas. This means building a long sea outfall or discharging via a storage tank so that sewage is only released into the water on the ebb tide. Long outfalls help to keep beaches clear of sewage and may encourage dispersal as they will often be in areas of greater tidal streams. They are not otherwise any advantage from the point of view of marine life and might, if placed in a productive area because sewage encourages entrophication, be positively harmful.

5.2.2 It is generally believed that, given sufficient dilution, organic material, which is the main constituent of sewage, is effectively treated by the natural purifying action of the sea. This includes bacterial processes and the effect of salinity and exposure to U.V. light from the sun on harmful bacteria present in sewage. However, some recent work suggests that considerable hazards to bathers may remain. It is beyond the scope of this report to present an overview of this aspect of sewage pollution and the following information is thus a purely factual statement of local sewage discharges.

SEMCS Sussex Sublittoral Survey 1984



MAP 5.1 Disposal of Wastes

5.2.3 The following table and Map 5.1 show the location and nature of sewage disposal from the coastal towns of Sussex.

Location of outfall	Sewage Effluents discharged to Tidal Waters: Grid Reference of discharge point	Dry Weather Flow m^3/day: Winter	Dry Weather Flow m^3/day: Summer	Maximum Population	Length of outfall below LWM (metres)	Type of Treatment
Bognor Regis	SU922900	10,190	12,900	91,400	2,820	screens and macerators
Littlehampton	TQ019013	18,200	24,100	53,000	2,500	screens, diffusers along the length of the outfall
Worthing (East)	TQ168036	22,730		83,000	330	)screens, grit removal,)sedimentation tidal storage)sludge digested and/or)tankered away
Worthing (West) (Goring by Sea)	TQ115031	6,800		32,000	At LWM	
Portslade	TQ241049	12,500	17,000	74,900	50	Tidal tank
Portobello (Saltdean)	TQ393015	49,000	50,800	270,000	2,250	screens, grit removal, tidal tank, macerators, diffusers at end of outfall
Seaford	TV489982	4,000	5,200	22,860	45	screens, tidal tank

Source: Coastal Anti-Pollution League updated by Southern Water Authority Statistics

5.2.4 The quality of discharges from sea outfalls exceeding 500m^3/day are shown in the following table. For comparative purposes a typical Biochemical Oxygen Demand (BOD) for treated sewage discharged into an inland watercourse would be 20. These discharges are to coastal waters which are not controlled for pollution prevention purposes, pending the implementation of Part II of the Control of Pollution Act 1974.

Outfall	Flow Code	Number of Samples	Average results for period Jan-Dec		
			Suspended Solids	BOD	Ammonia (as N)
1980					
Bognor	C	50	203	154	26
Littlehampton	C	48	353	236	34
Worthing East	B	47	91	132	28
Worthing West	C	57	97	122	31
Portobello (Brighton)	C	61	222	198	33
1981					
Bognor	C	46	206	139	24
Littlehampton	C	45	305	226	33
Worthing East	B	44	101	134	27
Worthing West	C	51	95	106	27
Portobello (Brighton)	C	14	170	167	32

Source: Southern Water Authority

Flow Codes:

A - 500-2,000 m^3/day
B - 2000-20,000 m^3/day
C - more than 10,000 m^3/day

Some additional information on sewage discharge effluents is available:-

5.2.5 Sewage from the whole of BRIGHTON is piped to Saltdean. There are five outfalls along the beach at Brighton but these are all stormwater overflows. The PORTOBELLO outfall has recently been improved and extended from 1,700m to 2,250m below low water mark.

5.2.6 The tidal tank at SEAFORD allows effluent to be discharged only on a falling tide. This helps to minimise the deposition of objectionable material on the beach. A longer outfall is proposed for 1986.

5.2.7 NEWHAVEN has two sewage treatment works; East and West, consisting of covered sedimentation tanks. The separated sludge is pumped out to sea through pipes within both breakwaters of Newhaven harbour. These outfalls do not appear in the Coastal Anti-Pollution League List or S.W.A. tables, presumably because the settled sewage effluent, as opposed to the sludge, is discharged into the River Ouse and not directly to the Sea.

5.2.8 Work is nearing completion to connect Arundel town to LITTLEHAMPTON sewers to enable discharges of crude sewage to the tidal river Arun to be stopped.

5.2.9. Unlike many other coastal counties the SEWAGE SLUDGE produced in Sussex from inland treatment works is not dumped at sea. It is disposed of by spreading on farm land or tipping. The only sewage sludge dumped at sea along this coast originates from Southampton and is dumped off the Isle of Wight.

5.2.10 It is clear that considerable variation in sewage treatment and discharge exists in the study area. The Portslade outfall does not appear to be treated in any way and is only controlled by discharge related to tide. In addition the Littlehampton and Seaford outfalls are only screened. Of these outfalls the only one which we have dived close to during the study is at Seaford. The amount of paper and other material floating in the water at this site leads us to seriously doubt the efficiency of the screens employed.

5.3 INDUSTRIAL EFFLUENTS

5.3.1 The only industrial effluent discharged to sea is from the Beechams factory at Broadwater trading estate in Lancing. This company manufactures drugs, and their effluent, which has very high coliform counts is known to contain antibiotics, solvents and various biological materials. Although the effluent has been described as smelling of 'tom cats' it is generally acknowledged that fishing is very good around the outfall. Beechams do have a licence to discharge low-level radioactive waste - this is the only known discharge of this type in this area.

5.3.2 There is a hot water outfall from the power station at Portslade.

5.4 COASTAL WATER POLLUTION

5.4.1 Until April 1984 the Southern Water Authority's responsibility for controlling pollution in tidal waters is very limited. The Government intends to implement the first phase of Part II of the Control of Pollution Act 1974 from that date. This will mean that SWA will have responsibility for the control of pollution in coastal waters up to the three mile limit.

5.4.2 Water authorities are also responsible for the quality of water at beaches officially designated as 'Eurobeaches' under the EEC directive concerning the quality of bathing water 1975. The directive sets limits on various parameters with emphasis on the microbiological quality of the water.

5.4.3 There are no beaches in Sussex designated under these provisions since the number of swimmers is relatively low. However, the bacteriological quality of the water is monitored at fourteen points along the coast between Seaford and East Wittering. Only two parameters are determined instead of the 19 required by the EEC directive for designated beaches. Results of these tests are shown in the table on the following page.

5.4.4 These two tests detect the numbers of coliform bacteria from a 100ml sample, capable of growing on a specific nutrient medium, and the numbers of Escherichia coli colonies which will grow. They are the two most important tests in the microbiological examination of water and the results for the study area are shown in the following table.

5.4.5 The EEC directive states two values for each parameter, a guide level and a mandatory level. For the number of total coliforms per 100ml the guide

	E.coli colonies per 100ml	Total coliforms per 100ml	E.coli colonies per 100ml	Total coliforms per 100ml	E.coli colonies per 100ml	Total coliforms per 100ml	E.coli colonies per 100ml	Total coliforms per 100ml
SITE NAME	BOGNOR REGIS south of gardens Marine Drive West		ATHERINGTON south of NCP car park		LITTLEHAMPTON south of outfall pumping station		ANGMERING ON SEA south of Sea Lane	
GRID REF.	SZ 923985		TQ007007		TQ040013		TQ068014	
NO. OF SAMPLES	23		24		24		23	
MINIMUM	5	5	1	5	5	5	0	5
MAXIMUM	40600	48150	1420	1260	850	1350	460	1240
MEAN	1952	2229	78	87	140	374	64	154
BATHERS/KM*	13		5		4		3	
SITE NAME	WORTHING south of Eardley Hotel, Mar. Parade		SOUTH LANCING south of garage & beach cafe		SHOREHAM south of beach huts Beach Road		HOVE south of Medina Terrace	
GRID REF.	TQ153023		TQ183036		TQ214044		TQ288043	
NO. OF SAMPLES	23		24		23		24	
MINIMUM	5	5	10	20	5	5	10	40
MAXIMUM	1400	7380	3700	5600	2750	3600	3100	9900
MEAN	275	919	464	884	168	215	461	1407
BATHERS/KM*	7		13		9		9	
SITE NAME	BRIGHTON south of Metropole Hotel		SALTDEAN south of Lido through underpass		NEWHAVEN south of beach outside breakwater		NEWHAVEN south of beach inside breakwater	
GRID REF.	TQ306038		TQ381018		TV446997		TV449988	
NO. OF SAMPLES	41		48		44		45	
MINIMUM	5	10	10	10	10	50	10	10
MAXIMUM	4400	16000	10000	11100	30500	51000	21000	50500
MEAN	382	1268	721	1151	1911	4026	1787	4249
BATHERS/KM*	43		7		2		9	
SITE NAME	SEAFORD EAST south of sea outfall							
GRID REF.	TV488982							
NO. OF SAMPLES	44							
MINIMUM	50	50						
MAXIMUM	200000	280000						
MEAN	31555	50717						
BATHERS/KM*	1							

NOTES: Sampling carried out in summer months, (May - September) from May 1978 - Sept 1982

* BATHERS/KM represents the average number of bathers per kilometer at times of sampling

Source of data: Southern Water Authority

level is 500 and the mandatory level is 10000. For the number of E.coli colonies per 100ml the guide level is 100 and the mandatory level 2000. It, therefore, appears, from the mean levels, that all of the beaches except Seaford would comply with these 2 out of the 19 parameters in of the directive and the results for Angmering, and Atherington being lower than the guide level, are particularly good. The Seaford Beach, however, shows mean levels of 5.7 times the mandatory level for total coliforms and 15.7 times the mandatory level for E. coli colonies.

5.4.6 This study did not attempt to identify specifically any effects of water pollution on marine life. However, some of the species results include species which are known to be pollution tolerant. For example species of several genera of attached macroalgae are known to thrive in sewage polluted water. These include Enteromorpha intestinalis and Ulva lactuca the growth of which has been studied in Chichester Harbour. It is notable that both of these species are recorded as common from the Gannet (site 54) which is close to the Seaford sewer outfall. The increased growth rates of these plants is probably due to the utilization of nitrogen in the form of ammonia, or urea and possibly vitamins B6 and B12 from sewage, (Agg, Stanfield and Gould 1978).

5.4.7 More use has been made of invertebrate fauna than other groups of organisms as indicators of pollution in the marine environment. The Southern Water Authority have recently carried out a survey of invertebrate fauna in Seaford Bay which has shown evidence of organic enrichment especially close to the sewage sludge outfalls at Newhaven Harbour. However, they conclude that the area is not seriously polluted as diversity indices for all nine sampling points were high and that the water quality is good enough to support a large number of different species. We believe that comparative studies of similar areas with different levels of water pollution would provide a more valuable guide, and recommend that independant studies of this sort should be undertaken in the area.

5.5 MARINE DREDGING AND DUMPING

5.5.1 Sand and gravel extraction for the construction industry is carried out in the study area. Licences to extract are required, and these are issued by the Crown Estate Commissioners. The licensing authority has to take into account any possible interference with fisheries or navigation routes before giving a licence to dredge.

5.5.2 None of the dives during the study were carried out in gravel extraction areas. However, Collins and Mallinson (1983) describe the results of such activities as observed in the Solent. They report the formation of pits several metres deep and generally devoid of life. Our species and habitat information reveals a generally less diverse fauna in these areas which are to to some extent naturally unstable in any event. Of greater concern would be the extraction of gravel close to areas of greater diversity such as reefs and wrecks where the increased sedimentation and turbidity might have severe consequences.

5.5.3 The dumping of dredge spoils at sea is also licenced, in this case by the Ministry of Agriculture Fisheries and Food. This activity may only be carried out in designated dumping grounds and amounts are controlled by the Dumping at Sea Act 1974. The main consideration in considering licence applications is the effect on fisheries. All the material regularly dumped off Sussex is silt, sand or gravel from the maintenance dredging of channels and harbours. Spoil from excavation work for new harbours,

docks etc., which may include rocks and compacted clays is normally directed to the larger dumping grounds off the Isle of Wight.

5.5.4 In 1983 the amount of spoil licensed for dumping at sea off the Sussex coast between Beachy Head and Sesley Bill was 602000 wet tonnes. The amounts and locations of licences were as follows:-

Origin	Annual Amount	Location of dumping ground	Note
Littlehampton	15,000 tonnes	Area of 5 cables radius centred on 50°44.5'N, 00°34.5'W.3 miles 00°34.5'W off-shore, depth 9 metres.	Licence expired 10/83
Shoreham	182,000 tonnes	east of harbour for a distance of about 1 mile along coast between H.Wmark and 1,000 yds offshore.	same area as sewage outfall and hot water outfall from power station.
Brighton	5,000 tonnes	east of marina from shoreline to about 0.1mile offshore.	
Newhaven	400,000 tonnes	circle of ½mile radius centred on 50°45'36"N, 00°3'18"E, 1 mile off-shore, depth 13m.	

5.5.5 As with gravel dredging, there are two potential effects of spoil dumping. Clearly deposition of substantial amounts of spoil will have a dramatic effect on life in the area in which it is dumped. It will also increase water turbidity in a much wider area and in view of its content is likely to have more serious effects in this respect, than gravel extraction.

5.5.6 The location of the designated dumping areas gives some cause for concern. The Littlehampton area, though small in amount and well offshore in an area with considerable tidal streams, is close to four of the sites dived: 26 Winter Reef, 27 the Chalks, 28 Littlehampton Rocks and 29 Mussel Beds. Unexpected levels of siltation were not encountered at any of these sites but it is significant that two visits to the Pine (site 12) some 2 miles south-west of the dumping ground found completely different conditions, on one occasion the wreck surfaces being totally covered in silt.

5.5.7 Both Shoreham and Brighton dumping grounds are adjacent to the shoreline and in areas protected from tidal movements by harbour walls. It is doubtful whether dispersal in those areas is very great.

5.5.8 The Newhaven dumping ground accommodated two thirds of the total amount of dumping in the study area. The site itself is in an area of flattish ground but there are interesting sites in the immediate vicinity. Inshore is Newhaven Gullies (site 50), south are five wrecks, Clodmore (site 51), City of Brisbane (site 52), Celtic (site 53), Clan Macmillan and Lancer (not studied) and to the east are sites at Seaford (Seaford Beach site 54, Gannett site 55 and Seaford Head site 56). The substantial amount of dumping must contribute to the high levels of sedimentation in these areas.

5.6 MARINE LITTER

5.6.1 Attention has been drawn to the problems of marine litter chiefly by studies sponsored by the 'Sunday Times' and the Keep Britain Tidy Group (Dixon and Hawksley 1980). These surveys have been concerned with floating litter and litter on beaches. Some information on the incidence of marine litter on the sea bed is available from our habitat forms.

5.6.2 Strictly speaking the great number of wrecks in the area could be described as human debris. However, as noted earlier, these in practice provide valuable habitats and are extensively colonised by mobile and invertebrate fauna. They are also the prime locations for recreational diving and fishing in the study area and cannot be considered anything but a beneficial feature.

5.6.3 The wrecks aside, the sites where the greatest amounts of litter are found are all coastal. Predominent materials are plastic bags and bottles, tin cans and car tyres. Those sites where rubbish can be thrown directly into the sea are generally the most polluted and these include Shoreham Harbour, (site 39), Brighton Marina (site 47) and Palace Pier (site 46). Litter seen at the latter site on a single dive comprised:

> pram frame, lager cans, newspapers, plastic and glass bottles, fishing lines and weights, paper plates, wood, wellington boot, plastic tubing, electric flex, heavy duty battery, aluminium moulding.

5.6.4 The other coastal site from which considerable amounts of litter were recorded was Seaford Head (site 56). This included plastic cups, bottles and bags, car tyres and wood. Significant at this site was the amount of paper debris being carried by currents in midwater. This presumably emanates from the foul sewer outfall.

5.6.5 On deeper sites the marine litter recorded was mostly related to fishing activities. Many of the wrecks have tangled and broken fishing nets and lines hanging from them and these remain a potential danger to the resident fish populations. Abandoned crab and lobster pots were also encountered.

5.6.6 From the results of our observations marine litter on the sea bed does not appear to be a serious threat and is usually present in quantity only at sites with direct access such as piers and harbour walls. The amount of litter at Seaford Head is a cause for greater concern and can only be explained in part by the adjacent sewer outfall.

5.7 FISHING

5.7.1 The study area supports a substantial inshore commercial fishery and is important for recreational angling. Local fishing regulations are administered by the Sussex Sea Fisheries Committee and as a result of concern about overfishing the Committee is currently taking steps to conserve stocks by controlling the amount of netting and, more importantly, crab and lobster potting, in the area.

5.7.2 The major fishing port in the area is Newhaven and the annual catch of fish landed here is valued at between £100,000 and £500,000 which is similar to that landed at the other major ports of the South Coast, for example, Hastings, Portsmouth and Plymouth. Catches are generally taken in shallow water by small boats ranging from 4-5m rowing boats to 15m trawlers. Many fishermen are part-timers.

5.7.3 There are three types of fishing carried out; demersal fishing for bottom dwelling species, pelagic fishing for surface feeding fish and shell fishing.

5.7.4 The main bottom dwelling species caught inshore are lemon and dover sole, plaice, dabs and skate. Deeper water fish caught are cod and whiting. The best area for demersal fishing is between Seaford Head and Brighton which is worked by trawlers from Newhaven. Further westward some demersal fishing is carried out in winter from the small ports between Brighton and Bognor Regis, but this is secondary to shellfishing.

5.7.5 Dover sole is an important species to fishermen. It can be caught using an otter trawl and in this part of the channel gill nets are used too. However the most effective method is a heavily chained twin-beam trawl. Like scallop dredging this must have a detrimental effect on the sea bed.

5.7.6 Another common flatfish, plaice, is abundant in the area. Plaice attract fishermen because the stocks can be fished throughout most of the year using trawls, beam trawls, seine nets and set nets.

5.7.7 The pelagic species fished are herring, mackerel and sprats, usually with drift nets, although feathered hooks and hand-lines are often used for mackerel. Herring fishing is now confined to boats from only two or three Sussex ports during the period October-December and many fishermen are finding herring uneconomical. The mackerel season extends from May to July, but the high cost of nets and mediocre catches obtained means that it is a comparatively small fishery attracting only a limited number of boats. However, mackerel fishing from the beaches of Sussex is a popular sport during the summer months.

5.7.8 The majority of crabs, lobsters and prawns are caught on the rocky terrain between Littlehampton and Selsey using baited moored pots. Crabs are fished every other day in winter and daily in summer when yields can reach 1 ton per day. More brown edible crabs are caught than spider crabs and the majority of both species are exported live to France and Spain. Generally the whole area is good for lobster fishing but the best area is off Selsey Bill where there are often as many as 26 lobster boats working. 1-1½ hundredweight of lobsters can be landed daily at the peak of the season.

5.7.9 Although our species records for edible crabs and lobsters show both species to be widespread in distribution and common in occurrence it is notable that the average size of individuals seen is rarely large. Most appear to be about or less than the minimum exploitable size and this may reflect the fact that the fishing of these species has reached its maximum potential and that there is danger of over exploitation.

5.7.10 Another very important species to local fishermen is scallops. They are fished using a towed dredge with a net attached. The majority of scallop dredgers work from the port of Newhaven. The beds are located several miles offshore in relatively deep water. Although small they can yield 160 bags of scallops per day, each bag containing 10 dozen shells.

5.7.11 The importance of the area for recreational angling should not be overlooked. This consists of beach and boat angling and principal bases for the latter are Littlehampton, Brighton Marina and Newhaven. There is also at least one well established spear fishing club in the area.

6 Coastal Conservation Sites

6.1 INTRODUCTION

6.1.1 At the present time there are no sublittoral areas in Sussex which receive conservation protection and no sites in the area are currently being suggested by the Nature Conservancy Council for designation as Marine Nature Reserves under Section 36 of the Wildlife and Countryside Act 1981.

6.1.2 On the other hand some parts of the Sussex coastline are of great scenic beauty or scientific interest and these have been recognised by their designation as sites of Special Scientific Interest, Local Nature Reserves, Country Parks or Heritage Coast.

6.1.3 In the following chapter we put forward recommendations which include the identification of sublittoral areas for future protection. In doing so we have taken note of the advantages which can be gained in terms of public identity and management from the location of marine conservation sites as extensions to land based conservation sites (Ray 1976, NCC/NERC 1979 para 4.42). We pay particular attention to the Heritage Coast concept which has been put forward as an advantage in providing a buffer zone through control over access, pollution and undesirable developments (Mitchell 1977).

6.1.4 The existing sites are considered under the type of protection they receive and their location is shown in Map 6.1. The descriptions are taken from SSSI notification maps and leaflets produced by the appropriate authorities. All of the coastal SSSI boundaries are open ended on the seaward side. However NCC responsibility ends at the low water mark of medium tides.

6.2 SITES OF SPECIAL SCIENTIFIC INTEREST

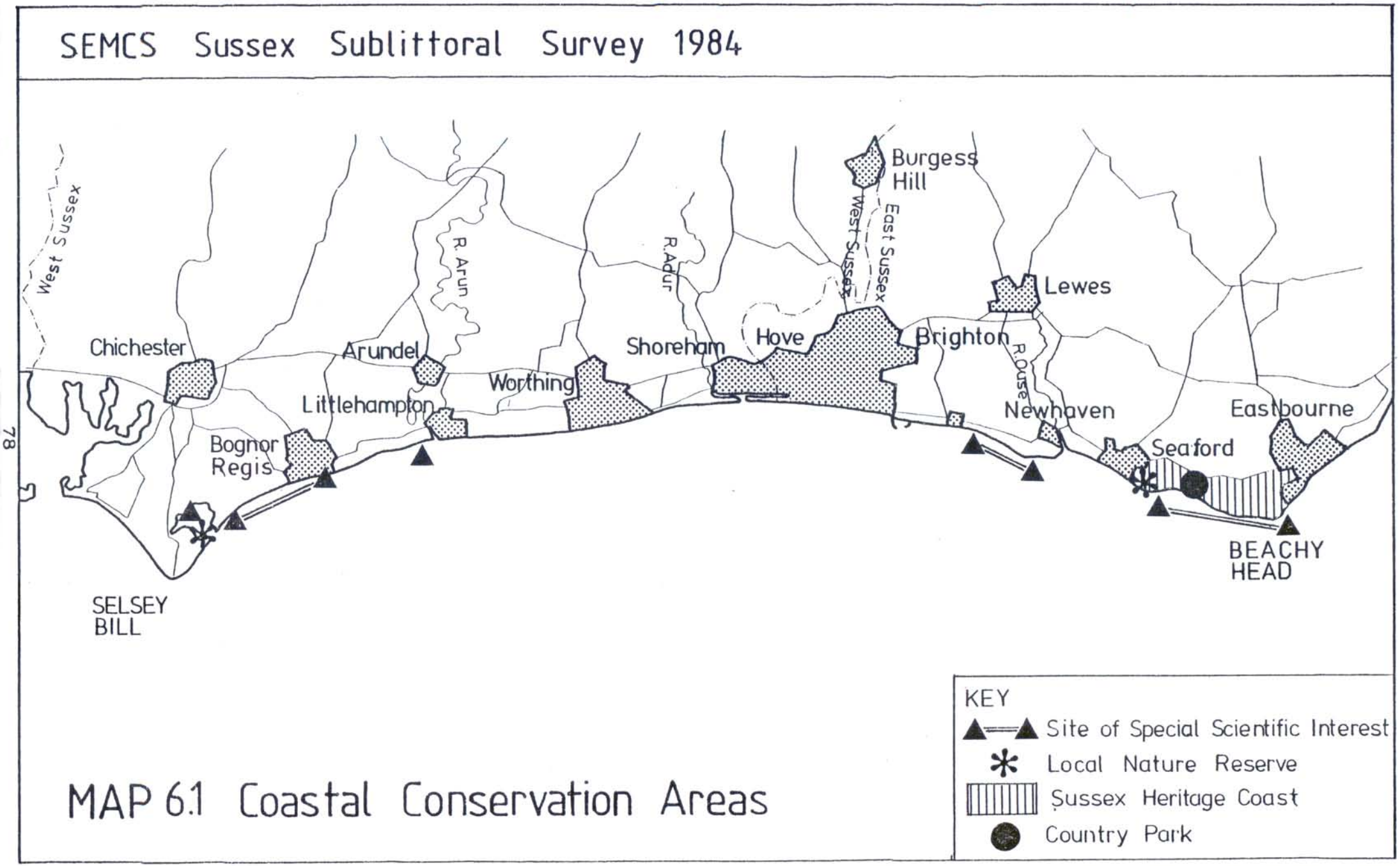
6.2.1 1. PAGHAM HARBOUR (Map 6.2)

Area - 86.5 ha - 214 acres
First notified - 1954, Revised 1980
Local Planning Authority - Chichester District Council

The SSSI is almost entirely incorporated within the Pagham Harbour Local Nature Reserve (para 6.3.1 below). One of the parts which is not so incorporated is the area of beach between HWMMT and LWMMT since the Southern Water Authority ownership does not extend to this area and the LNR agreement here is between the SWA and the West Sussex County Council.

6.2.2 2. BOGNOR REEF (Map 6.3) X
Area 79.6 ha - 197 acres (to LWMMT)
First notified 1980
Local Planning Authority - Arun District Council

This long stretch of beach (6.8 km approx) is almost adjacent to the Pagham Harbour SSSI at its western end (there is a gap of about 150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West Sussex
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West Sussex
East Sussex
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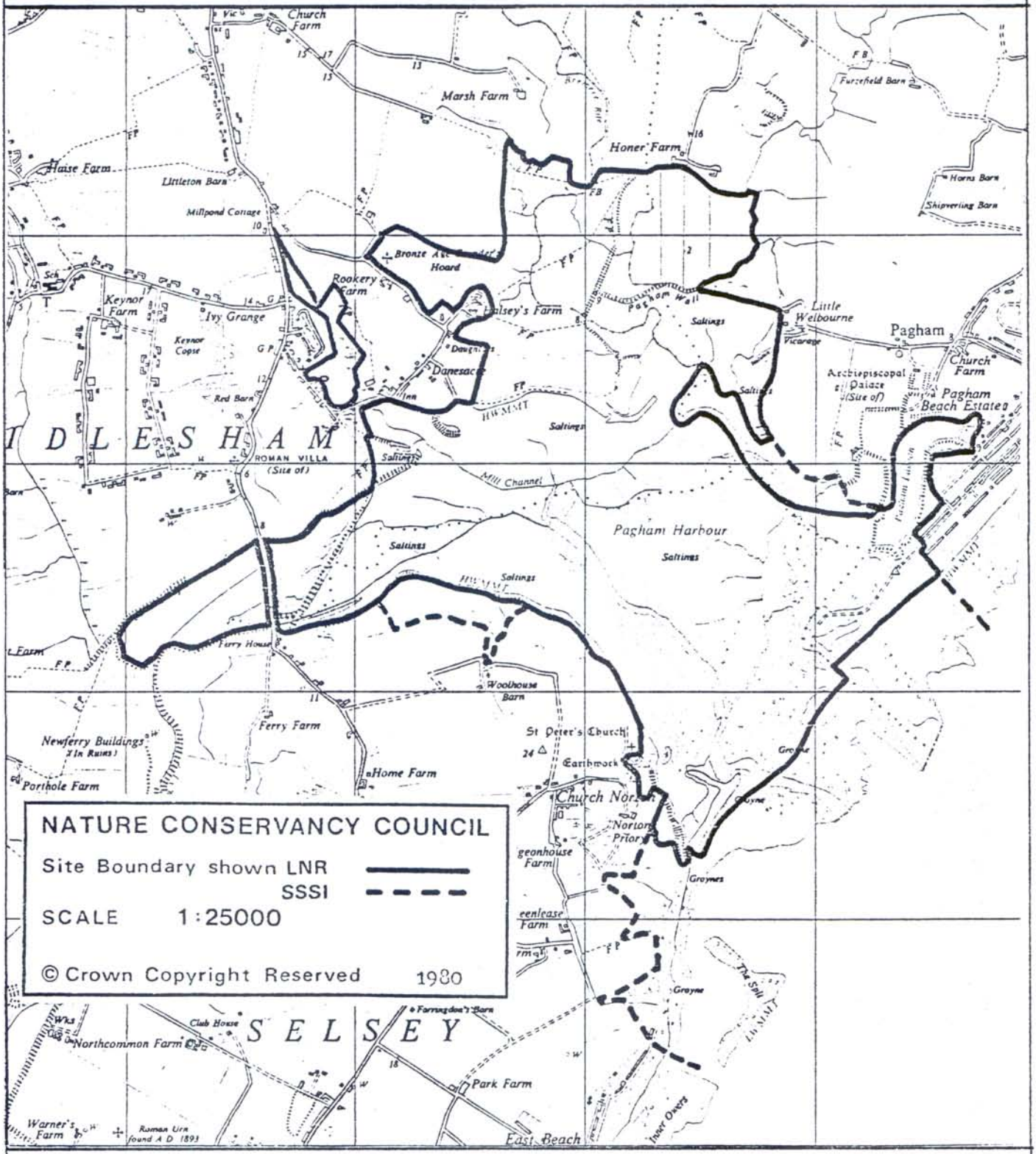
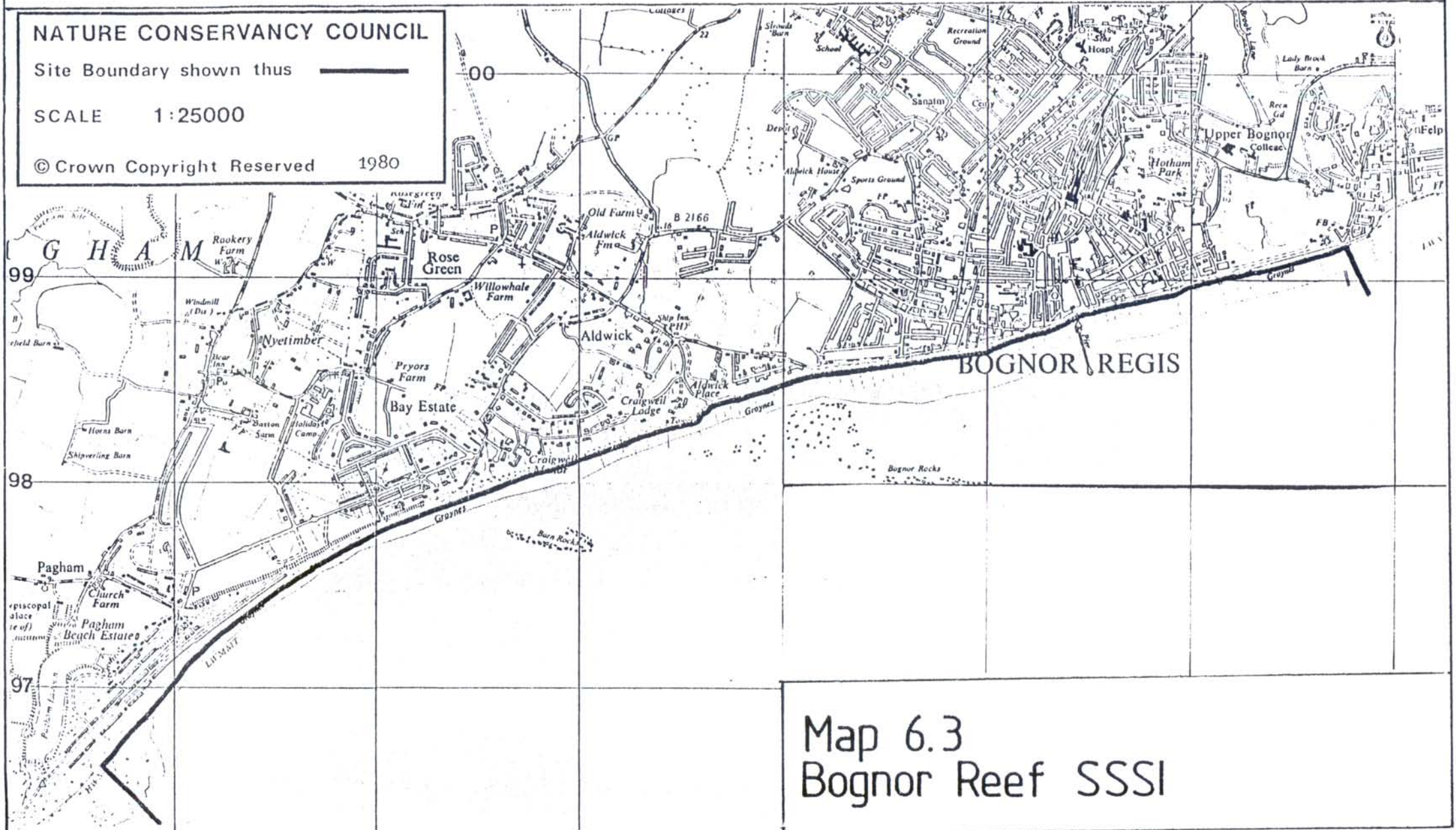
Lewes
Chichester
Arundel
Shoreham
Hove
Brighton
R. Ouse
Worthing
Littlehampton
Newhaven
Eastbourne
Bognor Regis
Seaford
BEACHY HEAD
SELSEY BILL
KEY
Site of Special Scientific Interest
Local Nature Reserve
Sussex Heritage Coast
Country Park
MAP 6.1 Coastal Conservation Areas

SEMCS Sussex Sublittoral Survey 1984



MAP 6.2 Pagham Harbour

SEMCS Sussex Sublittoral Survey 1984



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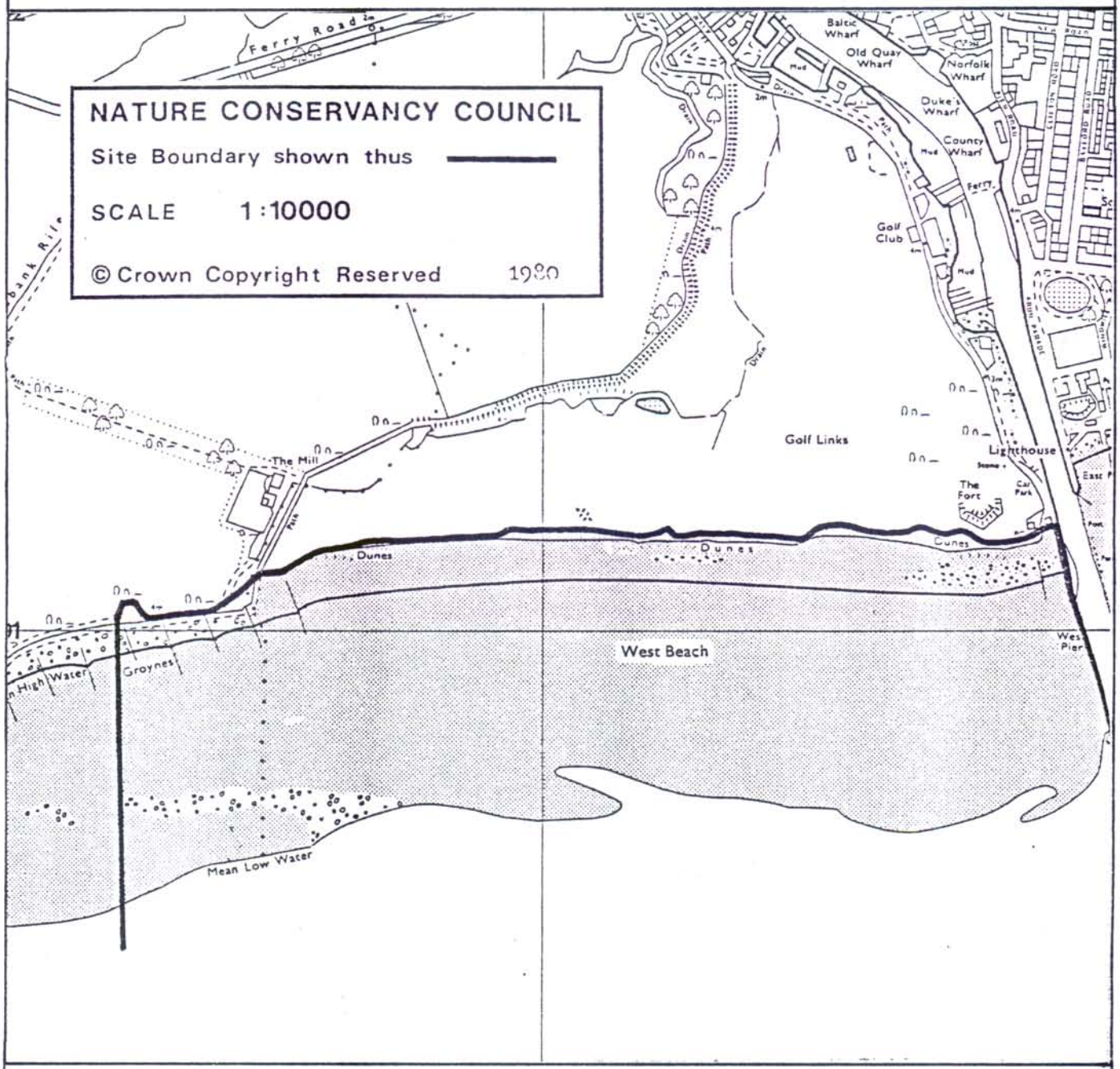
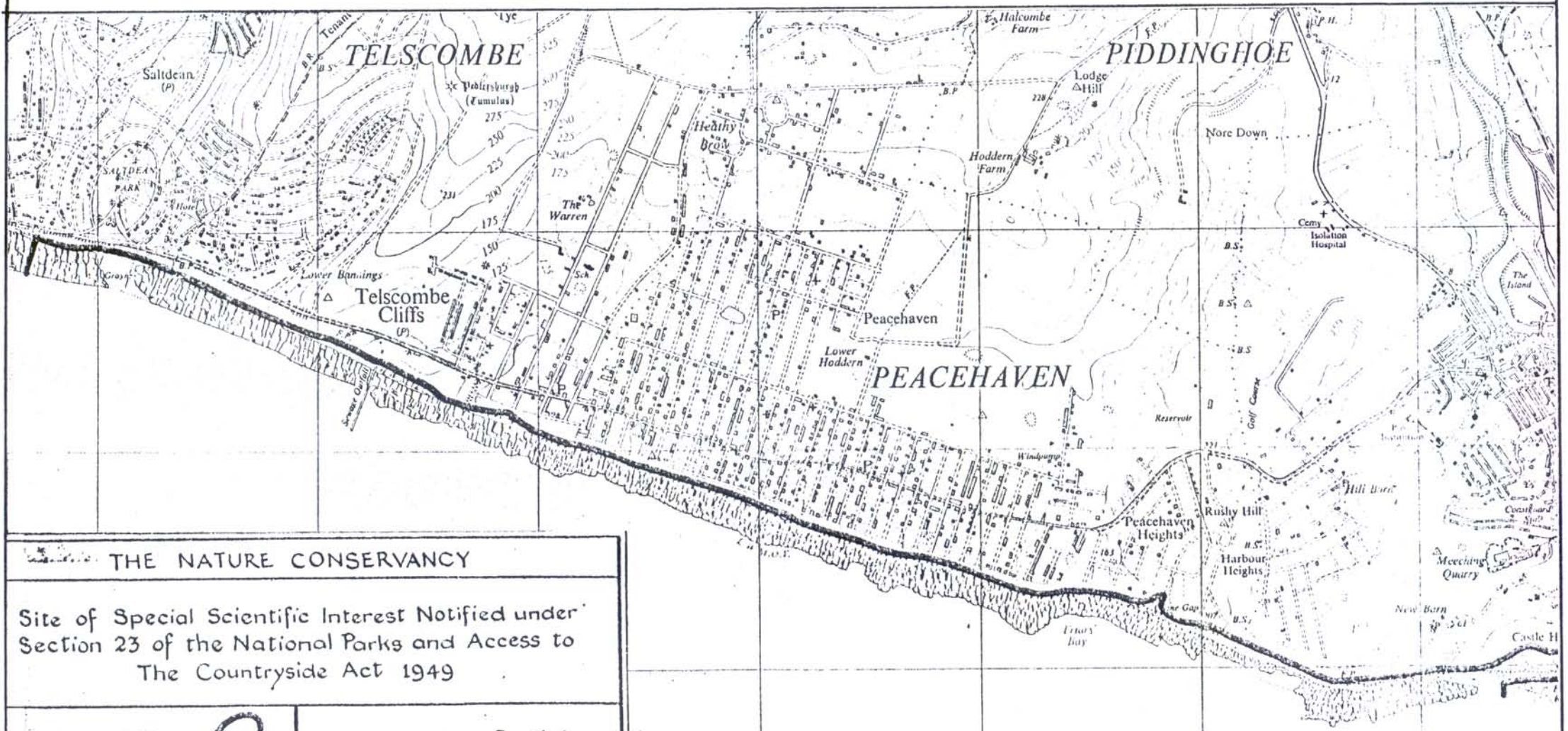


MAP 6.4 Climping Beach SSSI

SEMCS Sussex Sublittoral Survey 1984



THE NATURE CONSERVANCY

Site of Special Scientific Interest Notified under Section 23 of the National Parks and Access to The Countryside Act 1949

Site Shown Thus O	Drawn By S. H. I.
Grid Ref. TQ(51)408 007	File Number
Scale 2½" to 1 Mile Date 8. 12. 1965 Checked By R. F.	

MAP 6.5
Peacehaven Cliffs – Castle Hill SSSI

metres) and includes the whole of the beach at Bognor Regis seafront. The beach shows an almost complete section of the London Clay and includes very important insect fossils.

6.2.3 3. CLIMPING BEACH (Map 6.4)
Area 69.5 ha - 172 acres
First notified - 1980
Local Planning Authority - Arun District Council

This is a short stretch of coast backed by a golf course and includes a line of sand dunes which still retain a good sand dune flora. At the western end a shingle beach also retains a good flora with Crambe maritima and Glaucium flavam. The littoral zone is used by feeding waders.

6.2.4 4. PEACEHAVEN CLIFFS - CASTLE HILL

Area 117 ha - 288 acres (Map 6.5)
First notified - 1953
Local Planning Authority - Lewes District Council

This site covers 7.5km of cliff coastline which is of geological value with the most important exposures of the Offaster pilula zone in Britain, and at Castle Hill the only fossiliferous exposure of the Woolwich and Reading Beds (Eocene) in Sussex. The scenic attributes of this cliff coastline have been recently recognised by the designation of part of the area, at Castle Hill as a coastal park. Two of the dive sites identified in this study are close to this SSSI; site 49, Rottingdean Rocks, is the shallow sublittoral area just west of the SSSI and site 50, Newhaven Gullies is immediately seaward of the SSSI towards its eastern end. The foul sewage outfalls at Telscombe Cliffs referred to in Chapter 5 cross the SSSI.

6.2.5 5. CUCKMERE HAVEN - BEACHY HEAD (Map 6.6)

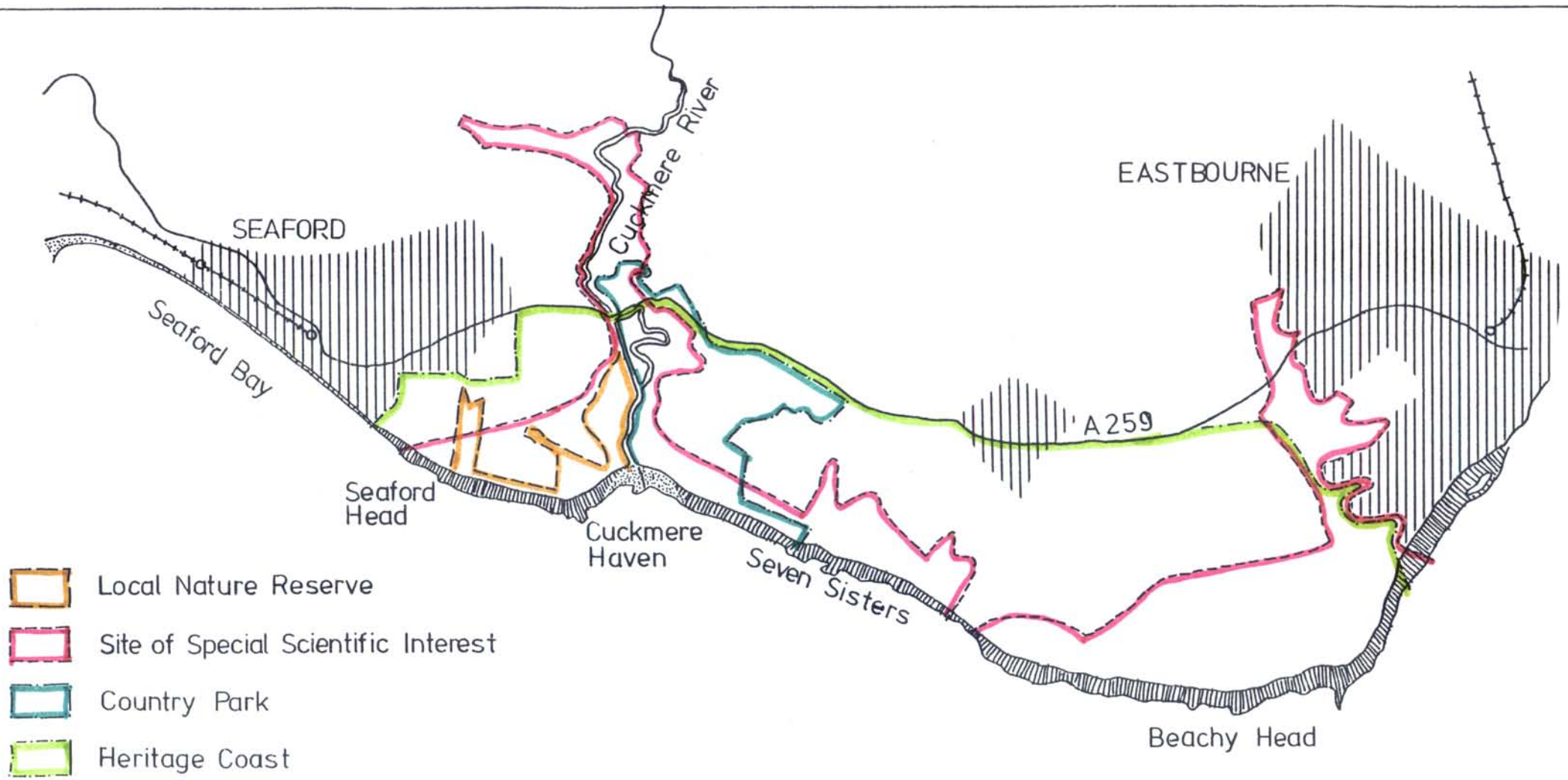
Area 1344 ha - 3,319 acres
First notified - 1953
Local Planning Authority - Lewes and Wealden District Councils and Eastbourne Borough Council

This site covers approximately 12.5 kilometres of coastline extending to, and just beyond, the easterly extent of our study area. Parts of the SSSI are also included in the Seaford Head Nature Reserve (para 6.3.2 below), the Seven Sisters Country Park (para 6.4.1 below) and the Heritage Coast (para 6.5.1 below).

6.2.6 From the scientific point of view the area is of exceptional interest with a variety of habitats including fresh and brackish water, shingle beach, saltmarsh, alluvial meadows, chalk grassland and chalk cliff; all having a rich and characteristic fauna. A number of rare plants occur. Bird populations, especially those over-wintering and on migration, are also of interest. The cliffs and foreshore are of geological value with an important fossiliferous exposure in the Chloritic Marl.

6.2.7 None of these SSSIs have yet been re-notified under the Wildlife and Countryside Act (1981).

SEMCS Sussex Sublittoral Survey 1984



MAP 6.6 Coastal Conservation Sites - Seaford to Beachy Head

6.3 LOCAL NATURE RESERVES

6.3.1 1. PAGHAM HARBOUR

Most of Pagham Harbour is owned by the Southern Water Authority and since 1964, it has been managed by West Sussex County Council (WSCC) as a Local Nature Reserve. A management plan for the reserve was approved in 1972 and has subsequently been reviewed twice (WSCC 1983). The Nature Reserve now consists of some 700 acres of mud flats and about 500 acres of surrounding land.

6.3.2 Pagham Harbour is one of the few undeveloped areas on the Sussex Coast and such a large area of undisturbed and unpolluted mud flats is of great importance to wildlife; the birdlife and flora of the Reserve is of national importance. The management of the Reserve is the responsibility of the Coast and Countryside Committee of the County Council and they are advised by a Sub-Committee which includes representatives of the local District and Parish Councils, the Southern Water Authority and conservation and recreational interests. There is a full-time Warden and a number of voluntary wardens.

6.3.3 The Management Plan (WSCC 1983) sets out four management principles as follows:-

(a) To conserve the natural flora and fauna of the Nature Reserve and its geological and physiographical features and to maintain the habitat conditions necessary for the species characteristic of the Reserve. This is the prime object of management.

(b) To encourage and provide opportunities for the study and research into the ecology of the Reserve.

(c) To encourage recreational, educational and other uses of Pagham Harbour insofar as they are compatible with a Nature Reserve and to regulate the pressures on the Harbour so as to achieve an acceptable balance.

(d) To extend the boundaries of the Nature Reserve to include adjacent areas of interest including those which are complementary to the Harbour in providing the birdlife with roosting and nesting areas.

6.3.4 The fourth principle is of particular interest in the context of this study and will be considered further in Chapter 7.

6.3.5 2. SEAFORD HEAD (Map 6.6)

The Reserve covers an area of 308 acres and was established in 1969. The land is in the ownership of the Lewes District Council and a local farm owner and is managed by the Seaford Head Nature Reserve Management Committee.

6.3.6 The reserve has three main components: chalk downland, part of the Cuckmere River valley and the foreshore. The foreshore is already acknowledged as a part of the reserve area, is subject to certain bye-laws (e.g. collection of periwinkles at certain periods) and information on seashore life is included in a publicity leaftlet (Seaford Head Nature Reserve Management Committee 1981).

6.4 COUNTRYSIDE AND RECREATION DESIGNATIONS

6.4.1 The scenic beauty of the coastal cliffs and their hinterland in the eastern part of our study area, between Brighton and Beachy Head have been recognised for their national importance in countryside terms and the opportunities they offer for countryside recreation. These designations are not therefore primarily wildlife or habitat conservation measures although in all cases they are designed to maintain, and where appropriate enhance, the natural qualities of the area. With the exception of the Newhaven Coastal Park which has been referred to earlier in para 6.2.4, all of the designations apply in the area between Seaford and Beachy Head and whilst they overlap, as they do with the strictly conservation measures already described, the aims are complementary rather than competitive.

6.4.2 1. SUSSEX HERITAGE COAST (Map 6.6)

The undeveloped stretch of coastline between Seaford and Eastbourne has long been recognised for its magnificent cliff and downland scenery, and steps were taken as long ago as the early 1930's to protect it from the sort of development which has disfigured the similar stretch of coastline between Brighton and Newhaven. In 1966 the South Downs were designated as an Area of Outstanding Natural Beauty and subsequently the area between the coast and the Seaford-Eastbourne road (A259) has been defined by the Countryside Commission as a Heritage Coast (ESCC 1973 and 1976).

6.4.3 The Heritage Coast is not a purely preservation concept but recognises the competing demands on the area and seeks to strike a balance through positive management activities. The five objectives of the Heritage Coast Policies are (ESCC 1976):

1. To maintain the valued character of the landscape; in particular, its variety of scene, and its rural atmosphere.

2. To safeguard the interests of farming, forestry, water supply, nature conservation, and residents.

3. To provide for recreation activities that are based on the resources of the area, and do not damage them.

4. To provide for a variety of tastes in type of recreation activity, and in degree of solitude.

5. To ensure that recreation activities do not conflict with each other, and that the enjoyment of visitors is not spoilt by the numbers of others present.

6.4.4 The general management policies do not include any policies strictly related to the marine environment although clearly many of the concepts are equally applicable.

6.4.5 Management activities within the area are co-ordinated by the East Sussex County Council and there is a full-time South Downs Conservation Officer based in the County Planning Department at Lewes.

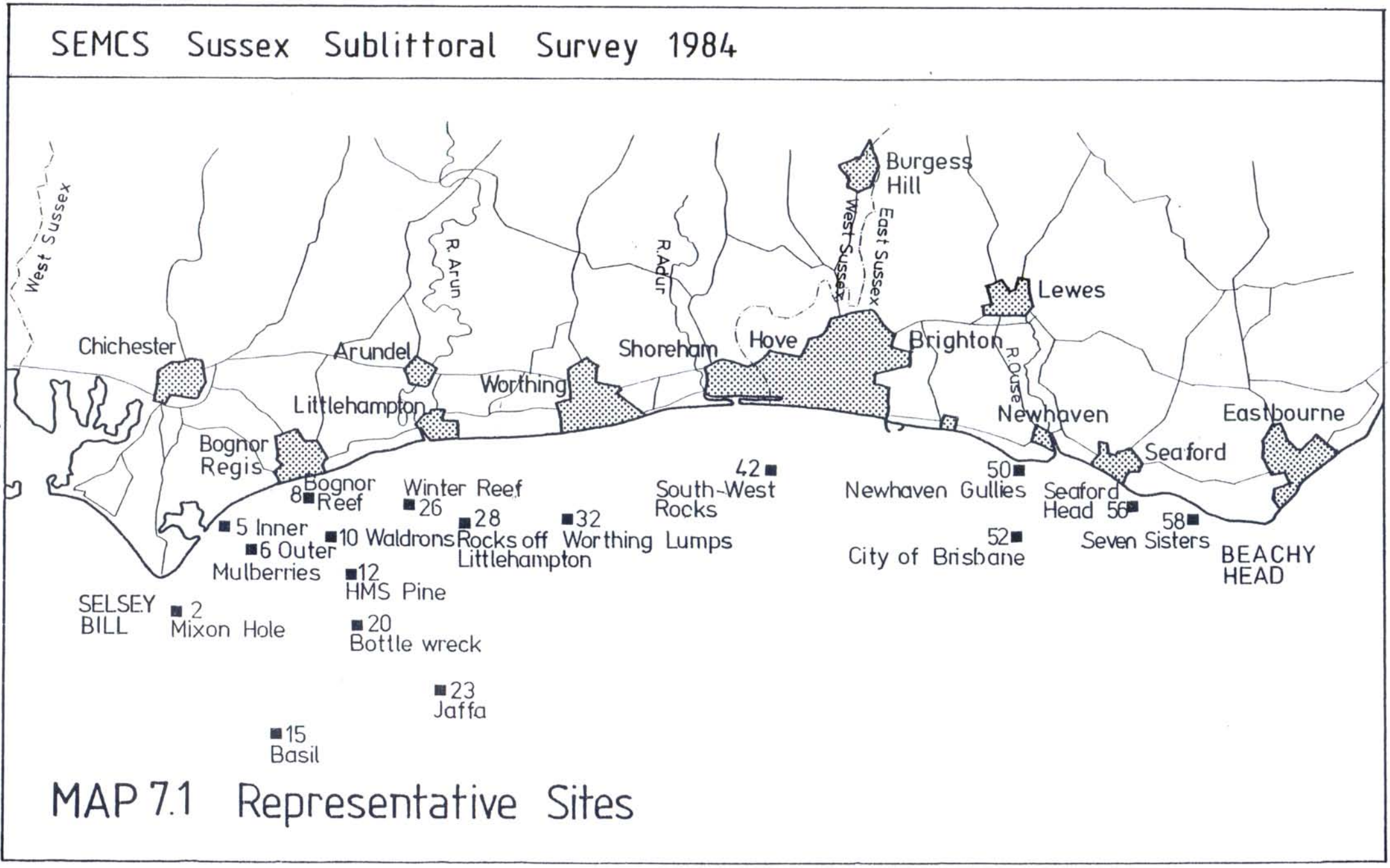
6.4.6 2. SEVEN SISTERS COUNTRY PARK (Map 6.6)

The Seven Sisters Country Park lies within the Sussex Heritage Coast, but differs in that it is owned by the East Sussex County Council. Purchased in 1971, the park covers 692 acres on the east side of the Cuckmere River and includes the famous Seven Sisters Cliffs. The objectives in managing the park are (ESCC 1980):-

1. To conserve the scenic beauty, relative remoteness and wildife;

2. To provide opportunities for people to enjoy and appreciate its qualities.

6.4.7 There is a Park Centre with interpretation facilities within the Park at Exceat and associated with it a privately operated natural history exhibition which includes marine exhibits (Symington 1983).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West Sussex
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Burgess Hill
Lewes
Chichester
Arundel
Shoreham
Hove
Brighton
R. Ouse
Worthing
Littlehampton
Newhaven
Eastbourne
Seaford
Bognor Regis
8 Bognor Reef
Winter Reef 26
42
South-West Rocks
50
Newhaven Gullies
Seaford Head 56
58
5 Inner
10 Waldrons
28 Rocks off Littlehampton
32 Worthing Lumps
52
City of Brisbane
Seven Sisters
BEACHY HEAD
6 Outer Mulberries
12 HMS Pine
SELSEY BILL
2 Mixon Hole
20 Bottle wreck
23 Jaffa
15 Basil
MAP 7.1 Representative Sites

7 Conclusions & Recommendations

7.1 RANGE OF HABITATS IN THE STUDY AREA

7.1.1 The great majority of the sea bed within the study area is flat or gently sloping and covered with a mixture of sand, pebbles and cobble. Harder substrata comprise sedimentary rocks and divide into, (a) limestone and sandstone ledges and reefs, (b) chalk reefs and cliffs and (c) clay cliff. The chalk and clay outcrops are relatively soft and subject to erosion. The only really hard substrata in the area are artificial and provided by the extensive number of shipwrecks and coastal structures.

7.1.2 The sites within each habitat category are described in Chapter 3. For the purposes of identifying representative sites to be given further consideration, we have made comparisons of the different sites within each habitat type. To some extent this comparison has been subjective but we believe that the following sites are all good examples of their type within the study area and should be prime sites for further investigation.

a.	Sandstone Reefs	Bognor reef (site8) The Waldrons (site 10) Rocks off Littlehampton (site 28)
b.	Chalk Reefs	Newhaven Gullies (site 50) Seaford Head (site 56) Seven Sisters (site 58)
c.	Chalk Cliffs	Winter Reef (site 26) Worthing Lumps (site 32) South-West Rocks (site 42)
d.	Clay Cliff	Mixon Hole (site 2)
e.	Shallow wrecks (0-10m)	Inner Mulberry (site 5) Outer Mulberry (site 6)
f.	Wreck 10-20m	Pine (site 12)
g.	Deep Wrecks (20m+)	Basil (site 15) Bottle Wreck (site 20) Jaffa (site 23) City of Brisbane (site 52)

7.1.3 No sites have been selected within the large areas of flattish ground since this habitat surrounds the great majority of the sites in the other categories and its wide occurrence does not lend itself easily to the identification of specific areas. In general terms the flattish ground surrounding the shallow sites (0-10m depth) is mixed and has a cover of foliaceous algae, whilst that around the deeper sites is less varied and has no algal cover. Any further studies of the specific sites above should include the areas immediately around them.

7.1.4 The selection of deep wreck sites could well be the subject of further investigation since we have not received comprehensive habitat information on many of the known wrecks in the area. The four deep wrecks listed have been selected as having varied characteristics which may be summarised:

Basil - the deepest and furthest offshore site studied, wreck reasonably intact.

Bottle Wreck - remains of cargo only - unusual and interesting.

Jaffa - recorded as having the richest and most diverse marine life, well broken up.

City of Brisbane - geographically distinct from other three.

7.1.5 In order to assess the importance of these habitats in national terms a thorough review is required which is not within the scope of this study. At this stage it is possible, however, to make some general comparisons with areas which are known to be of marine conservation interest, are already voluntary marine reserves, or are suggested for Marine Nature Reserve (MNR) status. Many of these nationally recognised sites are in exposed hard rock areas and comprise mainly rocky substrata (Bardsey (Jones, Jones and Hughes 1981), Skomer (Crump 1981), Lundy (Hiscock 1981), Wembury (Holme 1981) and St. Abbs (Earll and Wood 1981)). Others have more specialised habitats such as land locked Loughs (Lough Hyne (Wilson 1981), Strangford Lough (Erwin 1981)) or are estuarine (Roseland (Burrows 1981)). The closest voluntary reserve to the study area is the Purbeck Marine Wildlife Reserve in Dorset. In this area the shores and seabed consist predominently of cementstone ledges with shale between them (Hawthorne and Welton 1981).,

7.1.6 From this brief summary it is clear that the study area has completely different characteristics from any of the above sites. Significant habitats which do not appear to occur within the areas above are chalk reefs, chalk cliffs and clay cliffs. We, therefore, believe that good examples of these habitats are of national importance and deserve consideration for Marine Nature Reserve status.

7.1.7 The shipwrecks are a significant feature of the Sussex marine environment. In rocky areas the presence of wrecks is of minor biological importance and they may in fact support a less rich fauna and flora than their surroundings. Wrecks in flat and relatively bare areas, such as much of the study area, have an 'oasis' effect and are important and productive habitats. We are unaware of any wrecks of this type within recognised conservation areas, with the exception of the 'Robert' in Lundy, and this is a consideration which should be borne in mind in the forthcoming Marine Conservation Review.

7.1.8 Threats to the habitats described have been discussed in Chapter 5. Whilst a number of potential threats have been identified, the only one of the listed sites which seems to be suffering damage at the present time from human activities is Seaford Head. The major impact here is from foul sewage although sludge dumping and marine litter are contributory concerns. We considered that the situation warrants immediate action.

7.2. MARINE FLORA AND FAUNA

7.2.1 The survey has identified a wide range of the visible flora and fauna in the study area with a total of 345 species recorded on the species lists. As a very rough guide to the diversity of marine life it is possible to make comparisons with two other diving surveys on the south coast. These are in the area from Selsey Bill to the East Solent (Collins and Mallinson 1983) and in Dorset east of Portland Bill (Brachi, Collins and Roberts 1977 and Dixon, Harrison, Hodder and Roberts 1978).

The following table shows the Sussex area as having a wider range of recorded species than the Selsey Bill - East Solent area but that Dorset is considerably richer than either. Considerable caution should be used in interpreting these figures since the Selsey Bill - East Solent survey was much more limited in extent than this study and, on the other hand, the Dorset surveys include a substantial number of intertidal species and also rely to a greater extent on collections.

Table. Comparison of numbers of species recorded

	Sussex	Selsey-Solent	Dorset
Algae: Green	9	2	40
Brown	13	13	56
Red	65	20	109
Sponges	41	17	19
Cnidaria	41	22	41
'Worms'	17	12	29
Bryozoa	21	8	46
Mollusca	30	36	99
Crustacea	30	19	93
Echinodermata	6	7	10
Tunicata	16	21	22
Fishes	48	27	34
Total	345	204	598

7.2.2 In general terms species diversity would be expected to decrease as one moves further east along the English Channel because of the nature of the seabed, the turbidity and clarity of the water and the patterns of water movement. A number of species which occur in Dorset are not recorded in this study and they may therefore have reached the easterly extent of their distribution west of Sussex. Such species include the sponges Stelletta grubii, Steligera stuposa, Raspailia hispida and Axinella polypoides.

7.2.3 A few species which are recorded in Sussex appear to have a distribution restricted to the western part of the study area and thus the easterly

extent of their distribution may be found here. Examples are:

Anthozoa - Corynactis viridis, Anthopleura ballii
Echinodermata - Crossaster papposus, Henricia oculata
Fishes - Centrolabrus exoletus

7.2.4 The survey has also served to extend the known distribution of a number of species. Some of these were recorded in the eastern part of the study area and thus may also occur further east, beyond Beachy Head. Examples are:

Algae - Falkenbergia rufolanosa, Kallymenia reniformis, Audouinella rosulata, Gloisiphonia capillaris
Anthozoa - Cereus pedunculatus, Actinia fragacea, Aureliania heterocera
Fishes - Thorogobius ephippiatus

7.2.5 There are few species common in Sussex which do not occur in other areas which are existing or proposed marine conservation areas. The semi-soft clay and chalk reefs support a limited but specialised fauna which may not be common elsewhere. The most significant single species in these habitats is Pholas dactylus which bores extensively into the soft rocks.

7.2.6 Our studies of human pressures in the study area do not include any information wich would suggest that collecting or fishing is having an unduly adverse effect on populations of any species. We are, however concerned that the Outer Mulberry, as by far the most popular diving site in the area, is exposed to depredation of certain species by divers. Clearly this is only of local concern but it would be unfortunate if uncontrolled collecting were allowed to affect the diversity of species present.

7.3 NEEDS AND OPPORTUNITIES FOR MARINE CONSERVATION

7.3.1 The study has demonstrated the considerable extent of exploitation of the marine environment in the study area for human needs - food, waste disposal, transport and recreation. Some of these create conditions which are already damaging potentially interesting marine habitats e.g. Seaford Head. Others, such as gravel dredging, have the potential to do considerable damage if they were to be licenced to take place in areas of rich or interesting marine life.

7.3.2 We believe it is, therefore, important to identify areas of interest and to make these known to the relevant authorities as soon as possible so that they make take them into account in their decision making. We urge the Nature Conservancy Council to consider all of these areas in the forthcoming Marine Conservation Review. In particular we believe that the chalk and clay cliff and reef communities are important as they are habitats poorly represented elsewhere. We note that the identification and safeguarding of sites representing all major marine ecosystems is a specific aim of the Marine Conservation Review (Mitchell 1981). However, we are aware that this Review has been subject to delay and that it is not now proposed to commence work until 1985. Even then it will take some years to complete and, therefore, areas already subject to damaging activities may have been irrevocably affected by the time they can be objectively considered through the MCR process.

7.3.3 In the meantime, we believe that sites of interest should be given some protection, though we are aware that the current legislation offers no opportunity for statutory controls. A number of measures, other than the

designation of a Marine Nature Reserve, might be adopted to provide limited conservation status. These are:

a. the notification of sites of interest to decision-making bodies,
b. direct approaches to controllers of potentially damaging activities,
c. the encouragement of publicity and education as a basis for informed public opinion on local marine conservation issues,
d. the extension of the areas of interest of existing coastal conservation, recreation and countryside sites,
e. the establishment of voluntary marine nature reserves.

7.3.4 The courses of action in a, b and c above could be taken in repsect of all of the sites identified in paragraph 7.1.2 As far as d. is concerned the advantages of a direct relationship between terrestrial and marine conservation sites is officially recognised (NCC/NERC 1979) and many of the voluntary reserves operate in this fashion. The Purbeck reserve adjoins an Area of Outstanding Natural Beauty (AONB) and a Site of Special Scientific Interest (SSSI) (Hawthorne and Welton 1981), Skomer Island is a National Nature Reserve (NNR) (Crump 1981), Bardsey Island is a private Nature Reserve (Jones, Jones and Hughes 1981) and St. Abbs is partly a Local Nature Reserve (LNR) and partly SSSI (Earl and Wood 1981). The value of coastal sites as a buffer to marine reserves is also well recognised and Mitchell (1977) refers specifically to the value of a seaward extension of the Heritage Coast scheme.

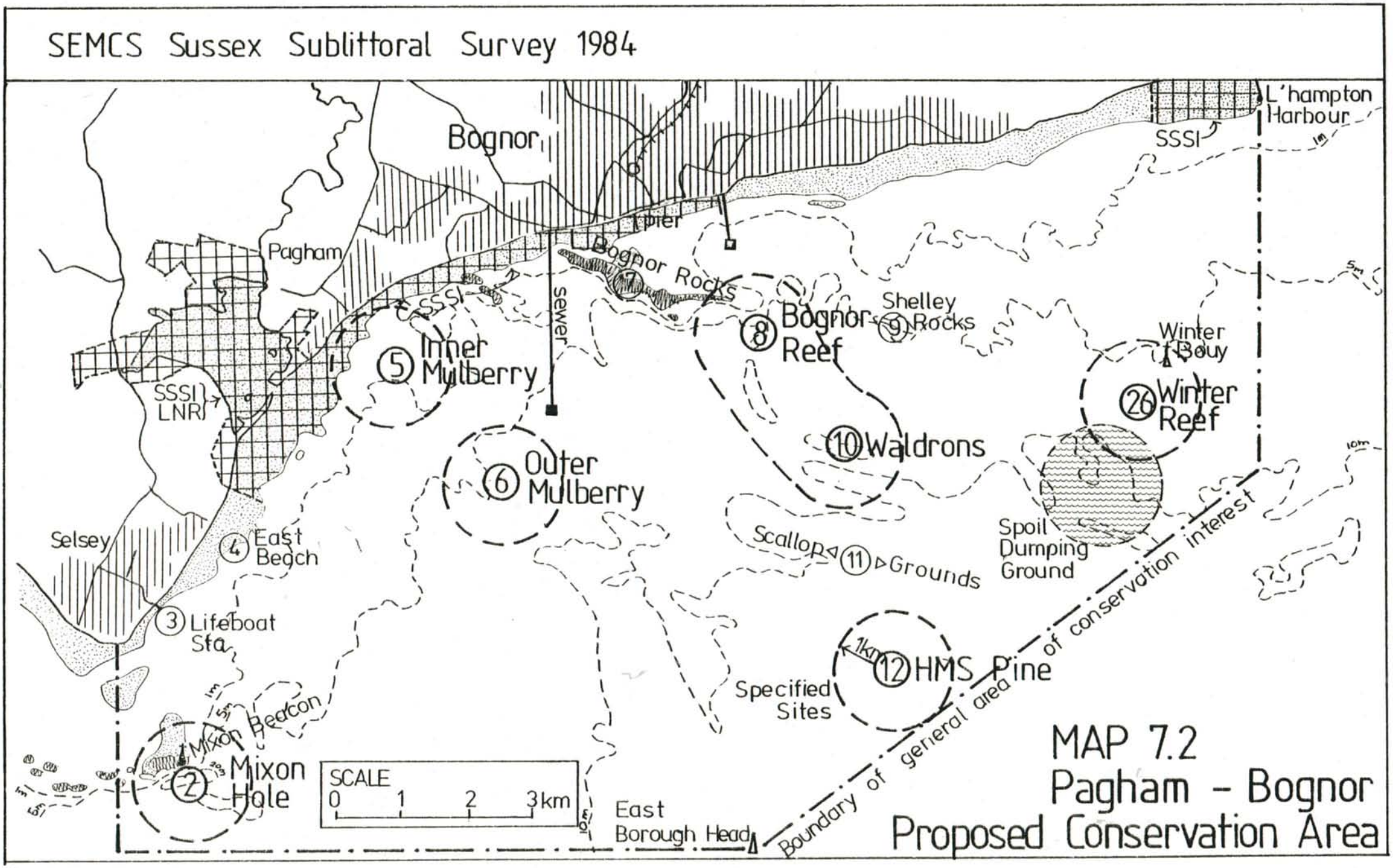
7.3.5 The educational role of marine sites should not be overlooked. We believe this is an area where organisations already involved in countryside education and interpretation could play a valuable role. The marine side of the 'Living World' exhibition at Exceat is a step in this direction but we believe organisations like the Sussex Trust for Nature Conservation could bring marine issues into their excellent education packs and thus to schools and other groups. The joint NCC/NERC report, Conservation in the Marine Environment (NCC/NERC 1979), in this context, refers both to the possible role of Naturalist Trusts in marine conservation and also to the need for sites with an important educational role to be close to centres of population and adjacent to terrestrial sites.

7.3.6 The coastal conservation areas have been discussed in Chapter 6 and two areas offer distinct possibilities for extension to include marine sites. These are the Pagham Harbour Local Nature Reserve in the west of our study area and the Sussex Heritage Coast in the east.

Pagham Harbour - Bognor Reef (Map 7.2)

7.3.6 The Pagham Harbour LNR and two SSSIs cover the whole of the coastline from the outskirts of Selsey to Bognor seafront. Five of the sites we identify as of particular interest in paragraph 7.1.2 are situated in this area. They are the Inner and Outer Mulberries (sites 5 and 6), Bognor Reef (site 8), the Waldrons (site 10) and the Pine (site 12). In addition two other sites, of quite different character, lie close by. They are the Mixon Hole (site 2) and Winter Reef (site 26). The inclusion of all of these sites in a single area would represent an excellent cross section of habitats in the study area and would include:

sandstone reefs - Bognor Reef and the Waldrons
chalk reef - Winter Reef
clay cliff - Mixon Hole


SEMCS Sussex Sublittoral Survey 1984
Bognor
Pier
Pagham
Bognor Rocks
sewer
SSSI
L'hampton Harbour
SSSI
LNR
Inner Mulberry
Outer Mulberry
Bognor Reef
Shelley Rocks
Winter Buoy
Winter Reef
Waldrons
Selsey
East Beach
Lifeboat Sta
Scallop Grounds
Spoil Dumping Ground
Mixon Beacon
Mixon Hole
HMS Pine
Specified Sites
Boundary of general area of conservation interest
East Borough Head
SCALE
0 1 2 3km
MAP 7.2
Pagham - Bognor
Proposed Conservation Area

inshore wreck - Inner Mulberry
shallow wreck - Outer Mulberry
shallow wreck - Outer Mulberry
10-20m wreck - Pine

The only typical Sussex habitats unrepresented would be chalk coastal reefs and deep wrecks.

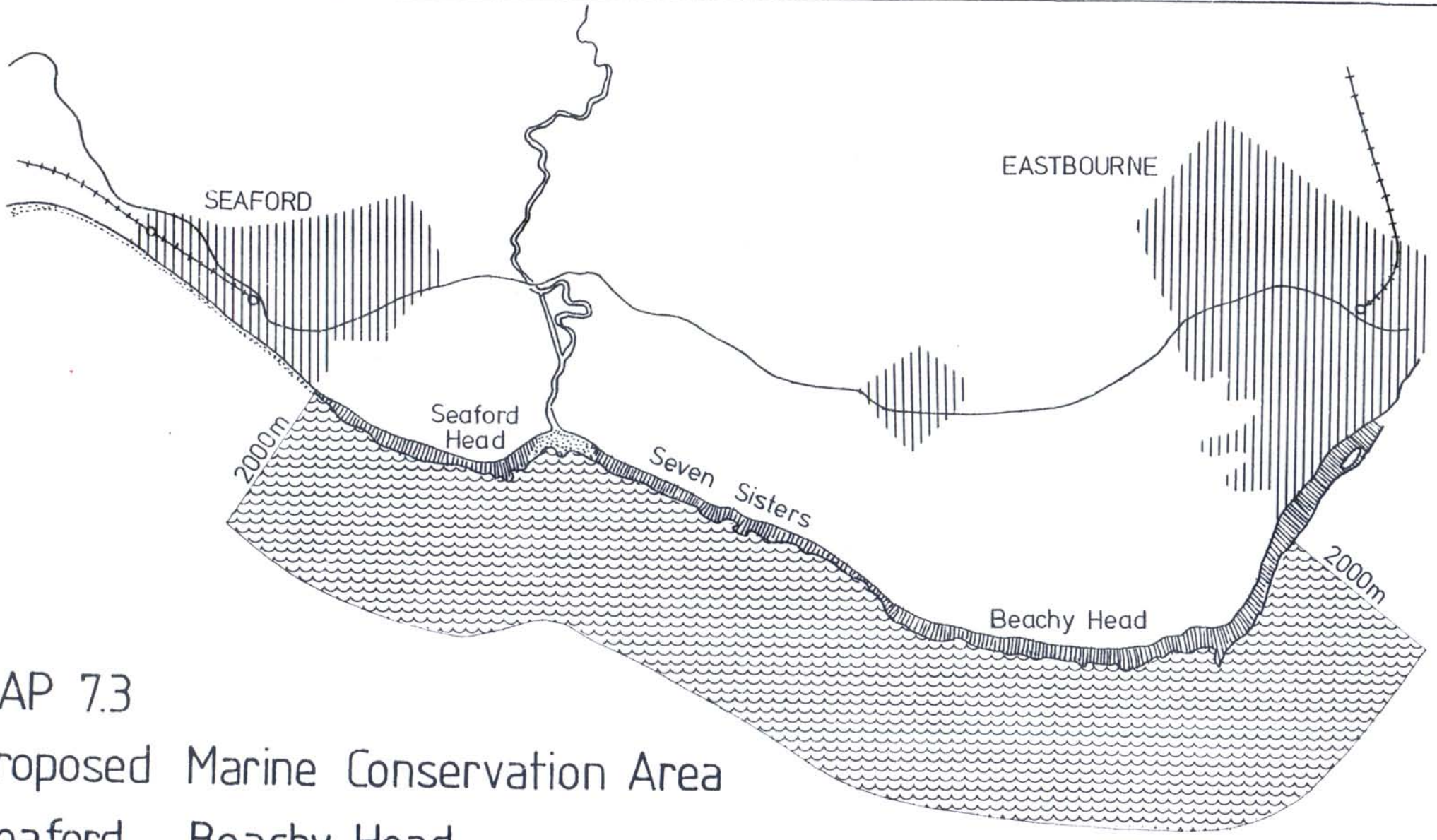
7.3.8 The area encompassing these sites is quite large (Map 7.2) and for this reason would probably be unsuitable as a reserve in the sense implied in the current British legislation (Wildlife and Countryside Act 1981). However, as an area of interest within which specific policies could be applied to the sites of particular value, this would represent a varied and typical area. The range of habitats would make it particularly valuable in educational terms. Apart from the marine life interest, it is worth noting that the Mulberry Harbour units are also of considerable historical interest as they represent the best preserved relics of the World War II Normandy landings on this side of the Channel.

Seaford Head - Beachy Head (Map 7.3)

7.3.9 The whole of this length of the Sussex coastline is protected by a variety of means (AONB, SSSI, LNR, Country Park and Heritage Coast). The main marine habitat is the coastal chalk reef which is not present in the Pagham area described above nor, as we have seen, in proposed marine conservation areas elsewhere in the country. This area is also the one which appears to be the most threatened by man's activities. The problems in the Seaford Head area which we have identified are largely in the hands of public authorities. The major one is sedimentation, in which natural levels are increased by dredge spoil dumping off Newhaven and an untreated inshore foul sewage outfall adjacent to the chalk reef. The sewage outfall also contributes to a marine litter problem in the area and we have seen evidence that the screening which takes place before dischage is inefficient.

7.3.10 These problems could be tackled without the necessity for MNR status provided the area is identified as being of marine conservation interest by its adoption as an informal extension of the terrestrial conservation areas by the responsible authorities and with the support of the NCC.

SEMCS Sussex Sublittoral Survey 1984



MAP 7.3

Proposed Marine Conservation Area

Seaford - Beachy Head

7.4 RECOMMENDATIONS

A. RECOMMENDATIONS TO THE NATURE CONSERVANCY COUNCIL

7.4.1 We recommend that the following sites, which represent good examples of the range of habitats present in the study area be the subject of further consideration as to their suitability as Marine Nature Reserves in the forthcoming Marine Conservation Review. The sites are shown in Map 7.1.

Mixon Hole, Inner Mulberry, Outer Mulberry, Bognor Reef, The Waldrons, HMS Pine, Basil, Bottle wreck, Jaffa, Winter Reef, Rocks off Littlehampton, Worthing Lumps, South-West Rocks, Newhaven Gullies, City of Brisbane, Seaford Head, Seven Sisters.

7.4.2 Pending the Marine Conservation Review we recommend that the following bodies be notified of the marine conservation interest of all of the above sites and be urged to consult the NCC over any proposals which might affect the sublittoral habitats and marine life in the area:

Ministry of Agriculture, Fishereis and Food - in respect of their fisheries interests and responsibilities under the Dumping at Sea Act (1974).

Southern Water Authority - in respect of water pollution and sewage disposal.

Crown Estates Commissioners - in respect of sand and gravel exploitation.

West and East Sussex County Councils and appropriate District Councils.

7.4.3 We recommend that the attention of the following bodies is drawn to our concern over current activities which appear to be having a detrimental effect on interesting sublittoral habitats and marine life in the area:

Southern Water Authority - Seaford Sewer outfall

Ministry of Agriculture Fishereis and Food - location of dredge spoil dumping areas from the following ports:

Littlehampton - effects on wrecks and reefs in area,
Brighton - effects of discharge close to shoreline on chalk reef,
Newhaven - effects of the discharge of large volumes on coastal reefs between Newhaven and Seaford.

7.4.4 We recommend that the West Sussex County Council be approached to investigate, jointly with the NCC, the extension of the Pagham Harbour Nature Reserve and Bognor Reef SSSI to encompass the range of marine habitats shown in Map 7.2.

7.4.5 We recommend that the Countryside Commission, the East Sussex County Council and Seaford Head Nature Reserve Management Committee be approached to investigate, jointly with the NCC, the extension of the Sussex Heritage Coast to include the marine area shown in Map 7.3 which contains coastal chalk reef formations which are rare in occurrence elsewhere in the British Isles.

B. RECOMMENDATIONS TO THE MARINE CONSERVATION SOCIETY

7.4.5 We recommend that the Conservation Committee adopts and supports the recommendations in this report and publicises the marine conservation interest of the area amongst members of the Society and with other conservation groups with which the society is associated.

7.4.7 At the local level, we recommend the South-East Branch to publicise the marine conservation interest of the area to the diving, natural history and conservation societies of the area as well as to members of the general public.

7.4.8 We recommend that further sublittoral studies are undertaken in the area and that support is sought for the following projects:

a. detailed studies of the identified sites in the Pagham area, apart from those already carried out at the Mixon Hole and the Inner and Outer Mulberries.
b. detailed studies in the Seaford Head - Beachy Head area.
c. comparative studies of a wider range of offshore wrecks in deep water to identify with more certainty those of the greatest diversity and interest.

7.4.9 We recommend that the South-East Branch ensure the publication of the results of studies undertaken on the Outer Mulberry so that the information collected is made readily available.

Appendix 1. Survey Forms

Each participant in the project and each dive that was organised was provided with a 'Project Package' to guide them in participating in the survey. The explanatory information consisted of:

1. Explanatory information (revised for 1983)

2. Basic species list - a brief description of the 33 basic species together with information on recording methods.

3. Basic species illustrated guide - a recognition guide for less experienced participants.

4. Additional Species List - issued 1982 and substantially revised for 1983 to include recognition guide to interesting species and preservation information.

The recording forms and cards are reproduced on the following pages. They are:

1. Habitat recording form (1982) - this form was closely modelled on the UCS habitat form in use at the time with minor modifications (colour code yellow)

2. Habitat recording form (1983) - the form was substantially revised for 1983 to exclude information irrelevant to the study area and to encourage better descriptive techniques.

3. Basic Species Recording Card (colour code blue)

4. Additional species recording card (colour code green)

In addition diving information was collected by the completion of access and dive site forms. These have not been used in drawing up this report and are not therefore reproduced.

All of the material distributed was colour coded for ease of reference. In addition the two species cards were printed on card rather than paper. All are reproduced here in black and white only for ease of printing.

the Sussex Guide habitat form

corders Name
dress

one
te of observation Time

Site Name
Area/nearest town

OS Grid Ref. ..... Sheet number ....
Lat/Long
Duration of study

STRUCTIONS: Tick and score as appropriate using the following notations; 1 =<10%
2 = 10%to 30%, 3 = 30%+

PTHS STUDIED (recorded depth)

0-5m	5-10m	10-15m	15-20m	20-30m	30+m

EA OF SURVEY		COMMENTS
xtensive(site)		
mall(station)		
hore dive		
oat dive		
POSURE TO WAVE ACTION		
ery sheltered		
heltered		
od. exposed		
xposed		
ery exposed		
POSURE TO TIDAL CURRENTS		
one		
ome, noticable		
trong		
ISIBILITY(in metres)		

EA BED TYPE (score as indicated above)		
Bedrock		
Boulder (50 cm+)		
Boulder (15-50 cm)		
Cobble (5-15 cm)		
Pebble (2.5-5 cm)		
Gravel		
Coarse sand		
Medium fine sand		
Muddy sand		
Mud		

OVER - PLANT (score as indicated above)		
Kelp		
Foliaceous red		
Foliaceou green		
Foliaceous brown		
Calcareous encrusting reds		
Diatom 'planktonic origin'		

OVER - ANIMAL (score as indicated above)		
Dominant species		
Hydroid 'turf'		
Bryozoan 'turf'		
Ascidian 'turf'		
Other		

OVER - INANIMATE		
Mud on rock: None		
Some		
100%		
'Bare' rock		
'Bare' sediment plain		
Shell remains		
Human debris (note outfalls or other pollution sources)		

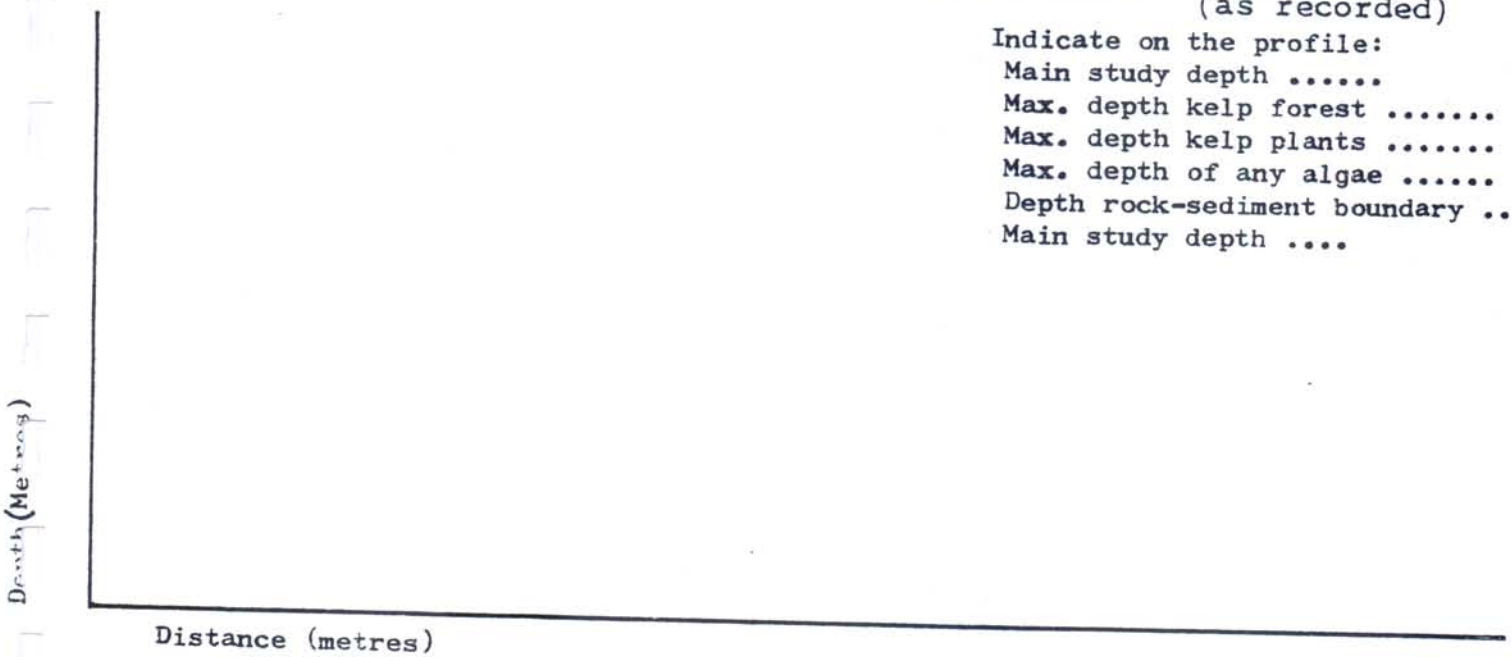
FEATURES - ROCK		COMMENTS
Gullies (size)		
Cliffs (size)		
Caves (size)		
Crevices (size)		
Wreck		
Other		
Rock type (eg calcareous)		
FEATURES - SOFT SEDIMENT		
Of one uniform type		
A mixture (eg sand & mud)		
Burrows		
Mounds or worm casts		
Crab excavations		
Shell remains		
'Worked' surface with obvious species		
Other comments		

Describe the site briefly. What features stand out in your mind about the site?

Draw an aerial view - map of the site. Give distances in metres & the direction of North

Draw a cross section (transect) of the site. Give distances in metres and depth (as recorded)

Indicate on the profile:
Main study depth .....
Max. depth kelp forest .....
Max. depth kelp plants .....
Max. depth of any algae .....
Depth rock-sediment boundary ..
Main study depth ....



Other comments
Does anything make this site like or unlike other sites you have visited in this or other areas?

The Sussex Guide HABITAT RECORD FORM H83/

Recorders name Address/telephone	Date & time of study Duration of study Main study depth Upper limit study Lower limit study Lower limit kelp* Lower limit foliaceous algae*
SITE NAME	
OS Grid ref. Lat/Long	(*If flat site state if present or absent)

EXPOSURE TO WATER MOVEMENT	very sheltered	sheltered	mod exposed	exposed	very exposed
Wave action					
Tidal currents					

SEA BED TYPE/HABITAT: Score as follows 1 (minor), 2 (secondary), 3 (dominant).

Bedrock	
Boulder 50 cm+	
Boulder 15-50 cm	
Cobble 5-15 cm	
Pebble 2.5-5 cm	
Gravel	
Coarse sand	
Med fine sand	
Muddy sand	
Mud	
Shell remains	
Piers/harbour walls	
Wreck	

DESCRIBE the main features of the habitat(s). What microhabitats (eg. gullies, caves, crevices, inclined surfaces etc) are present?

Continue overleaf..

CROSS SECTION (PROFILE) OF SITE or WRECK. Please draw a sketch overleaf, even if the site is flat. Include a scale, and in the case of a wreck estimate its overall dimensions. Show microhabitats on the sketch.

ROCK TYPE: Score as follows 1 (minor), 2 (secondary), 3 (dominant)

(Take sample if unsure) sandstone ☐ flint ☐ clay ☐ chalk ☐ other (specify) ☐

COVER: Score 1,2, or 3 as above.

Kelp (attached)	
Foliaceous algae	
Animal 'turf' (hydroid, ascidian, bryozoan).	
Other animals	
Bare surfaces: sediment	
" " no sediment	
Human debris (specify)	

DESCRIBE what you saw as the main features of the marine life (eg. dominant spp or types, characteristic spp, typical associations, unusual/rare spp).

OVERALL SITE ASSESSMENT

	Poor	Average	Good	Excellent
Variety habitats/microhabitats				
Abundance of fish				
Abundance of other marine life				
Variety of species (fish & others)				

Is this site like/unlike other sites you have visited in this or other areas?

SEUCS SUSSEX GUIDE PROJECT 1982 — SPECIES RECORDING CARD - BASIC SPECIES

SITE NAME	RECORDED DEPTH (METRES) (ONE ONLY PER CARD)	0-5m	5-10m	10-15m	15-20m	20-30m		
GRID REF OR LAT/LONG								
DATE & TIME OF DIVE	SUBSTRATE PERCENTAGE COVER ESTIMATE	BED ROCK	BOULDER (26cm+)	COBBLE (6.5 - 25 cm)	PEBBLE (0.5 - 6.5cm)	COARSE SAND	MEDIUM FINE SAND	MUD
RECORDER'S NAME								
ADDRESS								

SPECIES Tick present or common and add which substrate they were attached to

	Present	Common	Substrate
1 LAMINARIA HYPERBOREA Kelp			
2 LAMINARIA SACCHARINA Sea Belt			
3 PACHYMATISMA JOHNSTONIA Elephants Ear Sponge			
4 TUBULARIA INDIVISA Sea Fir			
5 ALCYONIUM DIGITATUM Dead Mens Finger			
6 ANEMONIA SULCATA Snakelocks Anemone			
7 TEALIA FELINA Dahlia Anemone			
8 METRIDIUM SENILE Plumose Anemone			
9 ACTINOTHOE SPHYRODETA -			
10 LANICE CONCHILEGA Sand Mason Worm			
11 BISPIRA VOLUTACORNIS Fan Worm			
12 HOMARUS GRAMMARUS Lobster			
13 MACROPIPUS PUBER Velvet Swimming Crab			
14 CARCINUS MAENAS Shore Crab			
15 CANCER PAGURUS Edible crab			
16 MAIA SQUINADO Spider Crab			
17 PATINA PELLUCIDA Blue Rayed Limpet			
18 CREPIDULA FORNICATA Slipper Limpet			
19 MYTILUS EDULIS Common Mussel			
20 PECTEN MAXIMUS Great Scallop			
21 PHOLAS DACTYLUS Piddock			
22 FLUSTRA FOLIACEA Hornwrack			
23 CROSSASTER PAPPOSUS Common Sun Star			
24 HENRICIA OCULATA -			
25 ASTERIAS RUBENS Common Starfish			
26 CLAVELINA LEPADIFORMIS Light Bulb Tunicate			
27 CIONA INTESTINALIS -			
28 SCYLIORHINUS CANICULA Lesser Spotted Dogfish			
29 TRISTOPTERUS LUSCUS Bib			
30 LABRUS BERGYLTA Ballan Wrasse			
31 LABRUS MIXTUS Cuckoo Wrasse			
32 PHOLIS GUNNELLUS Gunnel			
33 THOROGOBIUS EPHIPPIATUS Leopard Spotted Goby			

SEUCS SUSSEX GUIDE PROJECT 1982 — SPECIES RECORDING CARD - 'FULL' SPECIES

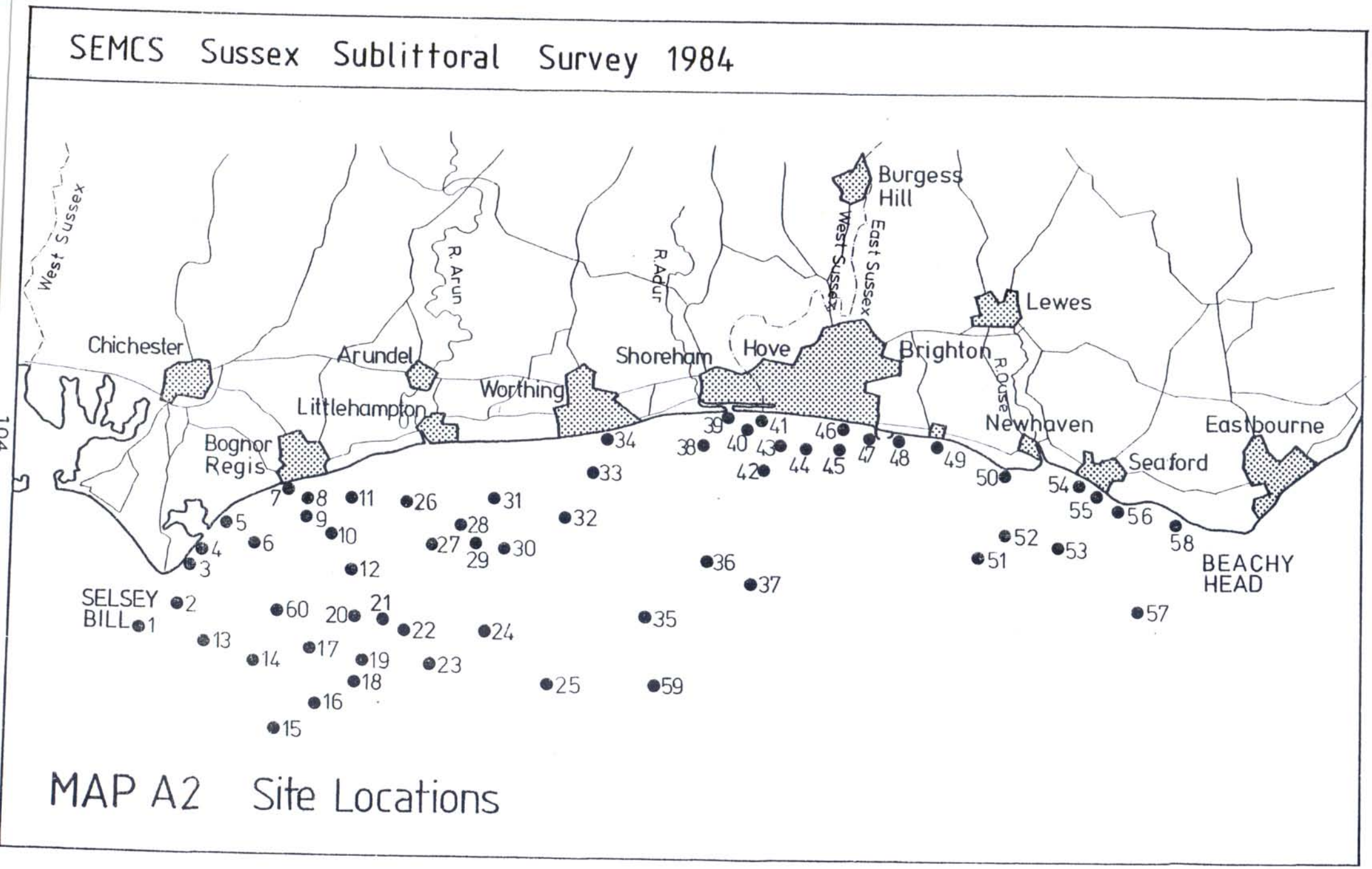
SITE NAME	RECORDED DEPTH (METRES) (ONE ONLY PER CARD)	0-5m	5-10m	10-15m	15-20m	20-30m		
GRID REF OR LAT/LONG								
DATE & TIME OF DIVE	SUBSTRATE PERCENTAGE COVER ESTIMATE	BED ROCK	BOULDER (26cm+)	COBBLE (6.5 - 25cm)	PEBBLE (0.5 - 6.5cm)	COARSE SAND	MEDIUM FINE SAND	MUD
RECORDER'S NAME								
ADDRESS								

SPECIES Tick present or common and add which substrate they were attached to

	Present	Common	Substrate
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

GROUPS List Groups/Families observed

	Present	Common	Substrate
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			


SEMCS Sussex Sublittoral Survey 1984
West Sussex
R. Arun
R. Adur
West Sussex
East Sussex
Burgess Hill
Lewes
Chichester
Arundel
Shoreham
Hove
Brighton
R. Ouse
Worthing
Littlehampton
Bognor Regis
Newhaven
Eastbourne
Seaford
BEACHY HEAD
SELSEY BILL
1
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MAP A2 Site Locations

Appendix 2. Site Details

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	SPECIES RECORDS ADDITIONAL
1	Pullar Bank	50°40.5'N 0°48'W	Flattish cobble/ pebble	10-25	78,79	83/14	83/15,73	83/10,54
2	Mixon Hole	50°52.2'N 0°46.1'W	Shallow clayreef clay cliff	0-25	77,78,79	83/7	82/19,29 83/8,33	82/17,26 83/22,95
3	Selsey East Beach	50°44.3'N 0°46'W	Littoral, pebble/cobble	0-3	79	-	-	-
4	Selsey Lifeboat Station	50°43.5'N 0°46.9'W	Pier/pebble	0-3	78,79,81	-	-	-
5	Inner Mulberry	50°45.6'N 0°45.5'W	Concrete wreck	0-4	80,81	-	83/23	-
6	Outer Mulberry	50°44.6'N 0°42'W	Concrete wreck	0-9	77,78,79, 80,81	83/9	83/6,11,31, 39	83/4,5,20, 94
7	Bognor Rocks	50°46.5'N 0°41.2'W	Littoral reef and sand	0-3	79	83/21	83/27	83/18
8	Bognor Reef (extension of site 7)	50°45.3'N 0°39'W	Low reef	6-10	77,78,79, 81	82/9,10	82/14,15, 17,21 83/70	82/12,13,15, 18,19,20,29, 83/54
9	Scallop Grounds	50°45.5'N 0°38.5'W	Flattish cobble/pebble	10-12	79,81	83/12	83/13	83/7
10	Waldrons	50°45'N 0°38'W	Low reef	10-14	-	83/22,34, 41	83/26,51,59	83/15,35,43, 99

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	SPECIES RECORDS ADDITIONAL
11	Shelley Rocks	50°45.8'N 0°36.5'W	Mixed flattish ground	5-6	81	82/6	82/12	82/11
12	H.M.S Pine	50°43.1'N 0°37.2'W	Broken up wreck	14-18	-	83/15,35	83/16,52	83/11,36,48, 98
13	Middle Ground	50°40'N 0°44'W	Mixed flattish ground	15-20	-	83/39	-	83/42
14	Outer Owers	50°39.1'N 0°41.3'W	Reef and flat cobble	10-20+	-	83/10,23	83/9	82/31 83/17,24,25, 37
15	Basil	50°35'N 0°41'W	Wreck	25-35	-	83/19	83/20/25	83/13
16	Lightfoot	50°36.3'N 0°39.5'W	Scattered wreck	25-30	-	83/11	83/12	83/6
17	Gascony	50°39.5'N 0'39.5'W	Wreck	20+	-	83/18	83/19	-
18	War Helmet	50°37.5'N 0°36.5'W	Wreck	20+	-	83/16	83/17,24,64	83/46
19	Armed Trawler	50°39.7'N 0°35.3'W	Wreck	20-25	81	83/44	83/65	83/47
20	'Bottle' Wreck	50°40.9'N 0°36.5'W	Wreck	20-25	-	83/54	83/85	83/58
21	Shirala	50°40.9'N 0°35.2'W	Wreck	20+	79	83/1	82/18 83/1	83/49

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	SPECIES RECORDS ADDITIONAL
22	Glenlee	50°40.4'N 0°34'W	Wreck	20+	79	-	-	-
23	Jaffa	50°39'N 0°27'W	Wreck	20-24	-	82/18 83/42	82/20,30 83/61	82/27
24	'Ore' Wreck	50°40.5'N 0°28.9'W	Wreck	20+	79	-	-	-
25	Cairn dhu	50°39'N 0°26'W	Wreck	23-25	-	82/16	82/27	82/23
26	Winter Reef	50°45.1'N 0°33.5'W	Chalk reef and flattish cobble	8-10	-	83/8,20	83/10,21	83/14,16,26, 27,38,96
27	Chalks	50°44.1'N 0°31.3'W	Low reef	15	-	83/3	83/3	83/3
28	Rocks off Littlehampton	50°44.5'N 0°30'W	Low reef and flattish pebble	10-12	81	82/5,17	82/11,28	82/10,24
29	Mussel Beds (near Meteor aircraft)	50°44.5'N 0°30.3'W	Flat pebble ground	12	79	83/55	83/86	83/59
30	Kingmere Rocks	50°44'N 0°28'W	Flattish pebble ground with low reef	10-15	79	83/43	83/62,69	83/53
31	Frode	50°46.2'N 0°28.7'W	Scattered wreck on pebble ground	6-9	-	83/17,37	83/18,28,63	83/12,39,45
32	Worthing Lumps	50°44'N 0°25'W	Low chalk cliff	10-12	-	82/19	82/31	82/28

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	SPECIES RECORDS ADDITIONAL
33	Indiana	50°47'N 0°22.2'W	Scattered wreck	5-10	-	83/2	83/2	83/1
34	Worthing Pier	50°48.5'N 0°22'W	Littoral - struts and sand	0-3	-	82/12	-	-
35	Ikeda	50°41'N 0°19.8'W	Wreck	26	-	-	83/67	-
36	Pentrych	50°43.5'N 0°15.7'W	Wreck	23	80	-	83/29	83/19
37	City of London	50°42'N 0°14.3'W	Wreck	24-28	-	-	82/13 83/34	83/28
38	Miown	50°48.3'N 0°15.3'W	Wreck	8-10	80	82/7	82/5,6,7 83/60	82/4,5,6,7 83/44
39	Shoreham Harbour	50°49.6'N 0°14.9'W	Harbour wall	0-3	-	82/3,4	82/3,4	82/2,3
40	Dredger	50°49'N 0°12'W	Small wreck	8	-	82/8	82/10	82/9
41	Jenny Grounds	50°49'N 0°12.5'W	Flat cobble ground	7-8	-	82/1,2	82/1,2,8,9	82/1,8
42	South-West Rocks	50°48'N 0°12'W	Flat pebble/sand and low chalk cliff	10-13	-	82/20 83/38	82/32 83/56,57	82/32 83/40,41,100
43	Loe Gate	50°48.5'N 0°10'W	Low chalk cliff	9-12	-	-	-	-

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	ADDITIONAL
44	Kingswest Ledge	50°48.5'N 0°9.5'W	Low chalk reef	15	-	-	83/30	-
45	Anchor Lump	50°48.6'N 0°08.2'W	Flattish cobble ground	10-12	-	-	82/24,25	83/30
46	Palace Pier	50°48.9'N 0°08.3'W	Metal piles and wreckage on flat sand	4-8	-	82/11,14	82/16,23,33	82/14,21,33
47	Brighton Marina (west side)	50°48.6'N 0°06.5'W	Concrete harbour wall	0-5	-	82/15	82/26	82/22,25
48	Black Rock	50°48'N 0°05'W	Low reef	0-12	-	83/57	83/36,82,88	83/29,55
49	Rottingdean Rocks	50°48'N 0°03'W	Chalk reef	0-3	-	82/13	82/22	82/16
50	Newhaven Gullies	50°46.6'N 0°2'E	Chalk reef	4-9	-	83/31,33	83/38,50,72	83/31,34,52
51	Clodmore	50°43.2'N 0°0.9'E	Wreck	26	-	-	83/66	83/23
52	City of Brisbane	50°44.5'N 0°0.8'E	Wreck	20-26	-	83/24,32	83/35,37,49, 71	83/30,33,51
53	Celtic	50°43.6'N 0°4'E	Wreck	22	-	-	83/68	83/50
54	Gannet	50°46'N 0°6.2'E	Scattered wreck	2-4	-	83/58	83/83,84,90	83/56,57

No.	SITE NAME	LAT/LONG	HABITAT TYPE	DEPTH	PRE 1982	HABITAT RECORD	SPECIES RECORDS BASIC	SPECIES RECORDS ADDITIONAL
55	Seaford Beach	50°46.5'N 0°5.5'E	Littoral mixed pebble,sand; chalk reef exposed deeper	0-15	-	83/36,56	83/54,55,87, 89	83/60
56	Seaford Head	50°45.3'N 0°6.8'E	Chalk reef and flat sand/mud	3-20	-	83/4,5, 25-30	83/4,40-48, 53,58,74-78	83/8,32,97
57	Mira	50°41.1'N 0°8.3'E	Wreck on mixed flattish ground	27-31	-	83/6,13	83/5,14,22	83/2,9
58	Seven Sisters	50°44.5'N 0°10.5'E	Chalk reef, sand/mud deeper	5-20	-	83/51-53	83/79-81	-
59	Standwold (= Easingwold)	50°37.7'N 0°20'W	Wreck	20+	-	83/45	-	-
60	Zaanstrom	(50°41'N 0°41'W)	Wreck	20+	81	-	-	-

Note: Depths quoted above are recorded depths and have not been adjusted to chart datum. If related to chart datum depths quoted would be a maximum of 5.2 metres and a minimum of 1.9 metres less at neap tides (when most diving was done) or a maximum of 6.6 metres and a minimum of 0.5 metres less at spring tides.

Appendix 3 Basic Species Records

The following three tables are a compilation of all of the Basic Species recording cards completed during the study. The records have been divided into the three broad habitat categories of flattish ground, reefs and wrecks which are used elsewhere in this report. Within each category the cards are arranged into 0-5m, 5-10m, 20-20m and 20m+ depth bands and within each depth band the sites are arranged from west to east. The abundance of each species is signified by P for present and C for common. Where an individual record is shown in brackets there is doubt as to its validity.

BASIC SPECIES RECORDS — FLATTISH GROUND

	DEPTH	0-5m			5-10m											10-20m												>20m			
	SITE NUMBER	7	48	55	2		11	26	28	41				42	55	1	9	79	30		42	45		55	56		58	1	14	57	58
	SITE NAME	Bognor Rocks	Black Rock	Seaford Beach	Mixon Hole		Shelley Rocks	Winter Reef	Rocks of L'hampton	Tanny Grounds				South-West Rocks	Seaford Beach	Pullar Bank	Scallop Grounds	Mussel Beds	Kingmere Rocks		South-West Rocks	Anchor Lump		Seaford Beach	Seaford Head		Seven Sisters	Pullar Bank	Outer Owers	Mira	Seven Sisters
	CARD NO.	83/27	83/88	83/55	83/7	83/32	82/12	83/21	82/28	82/1	82/2	82/8	82/9	82/32	83/54	83/73	83/13	83/86	83/62	83/69	83/56	82/24	82/25	83/89	83/14	83/77	83/80	83/15	83/9	83/14	83/81
	MONTH	7	7	7	6	6	6	7	8	5	5	5	5	7	7	8	7	10	7	7	8	8	8	7	5	8	8	7	6	5	8
1	Laminaria hyperborea	P			C	C																									
2	Laminaria saccharina		C		C	P	P			C	C	P	C						P			P	P					C			
3	Pachymatisma johnstonia																		P					P							
4	Tubularia indivisa																		P											C	
5	Alcyonium digitatum													P					P	P		P	P	C						C	
6	Anemonia viridis																		P												
7	Urticina felina						P	P	P	P	P	C	P	P	C	P		P	C	P		P	P	C	P	C		C	C		C
8	Metridium senile	P		P																				P	P		C				
9	Actinothoe sphyrodeta			P												P	P	P					P	C				P		P	P
10	Lanice conchilega		P				P					C						P		C								P			
11	Bispira volutacornis						P										P														
12	Homarus grammarus						P	P				P	P						P					P				P		P	
13	Liocarcinus puber	P		P						P		C	C		C							C	P	C							
14	Carcinus maenas		P												P																
15	Cancer pagurus	P		C	P				P	C	C	C	C	P	C	P		P	C			C	P				P	P			P
16	Maja squinado			P	P		P		P			C	P	P	P			P	C			P	P					P	P	P	
17	Patina pellucida																														
18	Crepidula fornicata		P				P	C	P	P			P	C		C	C	P		C	P	C	P								
19	Mytilus edulis		P						C				P					C				C	P					P			
20	Pecten maximus																P														
21	Pholas dactylus		P																					C							
22	Flustra foliacea															C	C			C			P	P				C	C	C	P
23	Crossaster papposus															C												P	P		
24	Henricia oculata																P												P		
25	Asterias rubens			C			P			P	C	C	C	P	P	C				P	C	C	C	C	C	C	C	P	P	C	C
26	Clavelina lepadiformis	P		C								P		P										P			P				
27	Ciona intestinalis			P																P			P			C					C
28	Scyliorhinus canicula																											P	P		
29	Trisopterus luscus			P				P	P										C		P	P								P	
30	Labrus bergylta	P	P					P									P		C										P		
31	Labrus mixtus																		P												
32	Pholis gunnellus			P								P	P																		
33	Thorogobius ephippiatus																														
	SPECIES PRESENT	6	6	7	2	1	8	4	5	4	1	4	6	6	3	3	5	1	7	4	2	5	11	5	2	0	2	9	6	4	3
	SPECIES COMMON	0	1	3	2	1	0	1	1	2	3	6	4	1	3	4	2	6	5	3	1	5	1	6	1	3	2	3	2	4	3
	TOTAL SPECIES	6	7	10	4	2	8	5	6	6	4	10	10	7	6	7	7	7	12	7	3	10	12	11	3	3	4	12	8	8	6

BASIC SPECIES RECORDS — REEFS AND CLIFFS

SITE NUMBER / SITE NAME	49 Rottingdean Rks	55 Seaford Beach	56 Seaford Head	7 Bognor Rocks					26 Winter Reef	28 Rocks off L'hampton	47 Brighton Marina	48 Black Rock		50 Newhaven Gullies			56 Seaford Head									58 Seven Sisters	2 Mixon Hole		10 The Waldrons			27 The Chalks	32 Worthing Lumps	42 South-West Rocks	44 Kingswest Lodge	56 Seaford Head				2 Mixon Hole	
DEPTH	0-5m			5 — 10m																							10 – 20m													>20m	
CARD NO.	83/22	83/87	83/40	82/14	82/15	82/17	82/21	83/70	83/10	82/11	82/26	83/36	83/82	83/38	83/50	83/72	83/44	83/45	83/46	83/47	83/48	83/58	83/74	83/75	83/76	83/77	83/8	83/33	83/26	83/51	83/59	83/3	82/31	83/57	83/30	83/42	83/43	83/44	83/53	82/19	82/29
MONTH	7	7	7	7	7	7	7	7	6	6	8	7	8	7	7	7	7	4	7	7	7	7	8	8	8	8	6	6	6	7	8	4	7	8	5	4	4	4	7	5	7
1 Laminaria hyperborea			C			C	C	C				C												C	C	C	P	P							P						
2 Laminaria saccharina	C	P	C	P	P	P			C	P	P	C		P	P	C	C				P			C	C	C	P								P						
3 Pachymatisma johnstonia						P			P	C		C																	C	P	P			P			C				
4 Tubularia indivisa										P				P	P			P		C					C				C	P			P		C	P	P	C			
5 Alcyonium digitatum				C	P	P		C	P	P				P	P	C	P			P									C	P	P	P	P	C	C			C			
6 Anemonia viridis				P	P			P																									P								
7 Urticina felina	P	C										C	C		P	C	P		C	P		C					P	P										C	C		
8 Metridium senile											P			C	P	C	P	C	C		P	C			P	C											P		P		
9 Actinothoe sphyrodeta										P							P	P	C	C	P				P			P									C	C	P		P
10 Lanice conchilega	C							P					C			P							C				P														
11 Bispira volutacornis						P		P	C	P			P						C						P				C	P			P	P							
12 Homarus grammarus		P		P			P		P	P	P						P		P		P									P	P		P	P	P				P		P
13 Liocarcinus puber	C	C	P	P	C				P	P	C	C	C	C	C	C	C		C	P	C		C	C	C	C	C	C		P				P			P	C	C	P	
14 Carcinus maenas	C	P	P								C	P					P							C												(C)					
15 Cancer pagurus	C	P	P	P	P			P	P	P	C	C	C	C	P	C	C		C	C	C	P	C	P	C	C	P	P			P	P	P	P	P		P		P	P	C
16 Maja squinado	P	C	P	P	P			P	P	P	C	C	C	P	P	P	C		C	C	C		P	P			P	P						P	C				C		C
17 Patina pellucida			P																							C															
18 Crepidula fornicata	P				P			C	P		C	C	C				P																							C	C
19 Mytilus edulis		C									C	C	C	P	P		P			C								P							P	P				C	
20 Pecten maximus								P																											P						
21 Pholas dactylus	C	C	P					P	C			C	C	C	C	C	C										C	C	C				C	C							C
22 Flustra foliacea									P	P			C																P	P							C				C
23 Crossaster papposus																																									
24 Henricia oculata				C	P			P	P	P																			P	P	P	P	P								
25 Asterias rubens		P							P	P			C	P	C	C				C												P	C	P	C	C	C	C	C	P	
26 Clavelina lepadiformis	P			P	P	P	P	P	C	P		P	C	C	P	C	P		C	C					C				P				P	P							
27 Ciona intestinalis													C				P		C	P																					
28 Scyliorhinus canicula								C																																C	
29 Trisopterus luscus	P	C		C	P	C		C			C	C	C	C	P	C	P						P			C			C	P	P	C		P	C						
30 Labrus bergylta			P	C	C	P	P	P				P		P	P		P												C	P		P	C	P	C						
31 Labrus mixtus				P		P	P			P	C																		C	P	P			P							
32 Pholis gunnellus	P										P			P	P	C	P		P					C													C				
33 Thorogobius ephippiatus				P				P	C	P				P	P																P			C							P
SPECIES PRESENT	6	5	7	9	9	7	4	11	10	15	4	3	1	9	13	2	13	2	2	4	4	1	2	2	3	0	6	6	3	11	8	5	8	11	6	2	4	0	4	3	3
SPECIES COMMON	6	6	2	4	2	2	1	5	5	1	8	11	13	6	3	11	5	1	9	7	3	2	3	5	6	7	2	2	8	0	0	1	3	3	6	1	5	6	4	3	5
TOTAL SPECIES	12	11	9	13	11	9	5	16	15	16	12	14	14	15	16	13	18	3	11	11	7	3	5	7	9	7	8	8	11	11	8	6	11	14	12	3	9	6	8	6	8

BASIC SPECIES RECORDS

WRECKS

DEPTH	0-5m						5-10m							10-20	>20m																
SITE NUMBER	5	39	54	6	31	33	38	40	46	12	15	16	17	18	19	20	21	23	25	35	36	37	51	52	53	57
SITE NAME	Inner Mulberry	Shoreham Harb.	Gannet	Outer Mulberry	Froode	Indiana	Miown	Dredger	Brighton Pier	Pine	Basil	Lightfoot	Gascony	War Helmet	Armed Trawler	Bottle wreck	Shirala	Jaffa	Calm Dhu	Ikeda	Pentrych	City of London	Clodmore	City of Brisbane	Celtic	Mira
CARD NO	83/23	82/04	83/90	83/39	83/63	83/2	83/60	82/10	82/33	83/52	83/25	83/12	83/19	83/64	83/65	83/85	83/1	83/61	82/27	83/67	83/29	83/34	83/66	83/71	83/68	83/22
MONTH	6	5	8	7	7	5	7	5	8	7	6	7	6	7	8	10	4	7	8	7	5	7	6	7	7	5
1 Laminaria hyperborea	C			C	P	C																				
2 Laminaria saccharina	C		P	C	P	C	C	C	P																	
3 Pachymatisma johnstonia							P	P	P	P	(P)															
4 Tubularia indivisa	P			C	C	P	C			P							P									
5 Alcyonium digitatum	C		P	C	P	P	P			P	C															
6 Anemonia viridis				C	P	P	P	P	P	P	C															
7 Urticina felina	P		C	C	P	P	P			P	C															
8 Metridium senile	C		C	C	P	P	P			P	C															
9 Actinothoe sphyrodeta				P	C	P	P	C	P	P	C															
10 Lanice conchilega		C			C	P		P	P	C	P															
11 Bispira volutacornis						P	P																			
12 Hommaras grammarus			P		P		P			P	P			P				P								
13 Liocarcinus puber			C	C	P		P	C	C	P				P	P			P	P	P	P	P				
14 Carcinus maenas	C	C	P		P		P	P	P	P				P	P		P	P	C	P	P	P			C	
15 Cancer pagurus	P	C	C	C	P		P	C	P	P	P		P	P	P		P	P	P	P	P	P				P	P
16 Maja squinado	P	P	P	P	P		P	P	P	P	P		P	P	P		P	P	P	P	P	P				P	C
17 Atina pellucida				P	P		P	C	C	P	P		P	P	P		P	P	P	P	P	P				P	P
18 Crapidula fornicata					P			P						P													
19 Mytilus edulis	P	C		C	P			P	C					C	P											
20 Pecten maximus					C			C	C	C				C												
21 Pholas dactylus				P						C				C	C			C	C	C	C	C				C
22 Flustra foliacea		C																			P	P				
23 Crossaster papposus	P			C	C	P	P			C				P	P			P	C	P	C	C				P
24 Henricia oculata			P	P							P	P	P	P												
25 Asterias rubens			C	P		P	P			P	P	P	P	P												
26 Clavelina lepadiformis	P		C	P		P	P	C	C	P	P	C	P	C	P			P	C	P	C	C				P
27 Ciona intestinalis		P	C	P		P	P	P	C	P	P	P	P	P	P			P	C	P	C	C				P
28 Sajorhinus canicula		P	P	P	P	P	P	C	C	P	P	P	P	P	P			P	P	P	P	P				P
29 Trisopterus luscus				C																						
30 Labrus bergylta		C	C	C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C				P
31 Labrus mixtus		P	P	P	P	P	C	C	C	C	C	C	C	C	C			C	C	C	C	C				C
32 Pholis gunnellus				C	C	P	P	C	P	P	P	P	P	P	P			P	P	P	P	P				P
33 Thorogobius ephippiatus										P				P												
SPECIES PRESENT	5	2	0	8	3	7	4	2	3	5	13	9	12	8	5	9	6	7	7	8	6	1	9	9	6	5
SPECIES COMMON	4	5	3	7	7	5	9	7	7	6	6	10	3	5	2	4	2	4	6	6	5	4	4	4	2	2
TOTAL SPECIES	9	7	3	15	10	12	13	9	10	11	19	10	12	11	10	9	10	11	13	14	12	6	13	13	10	9

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