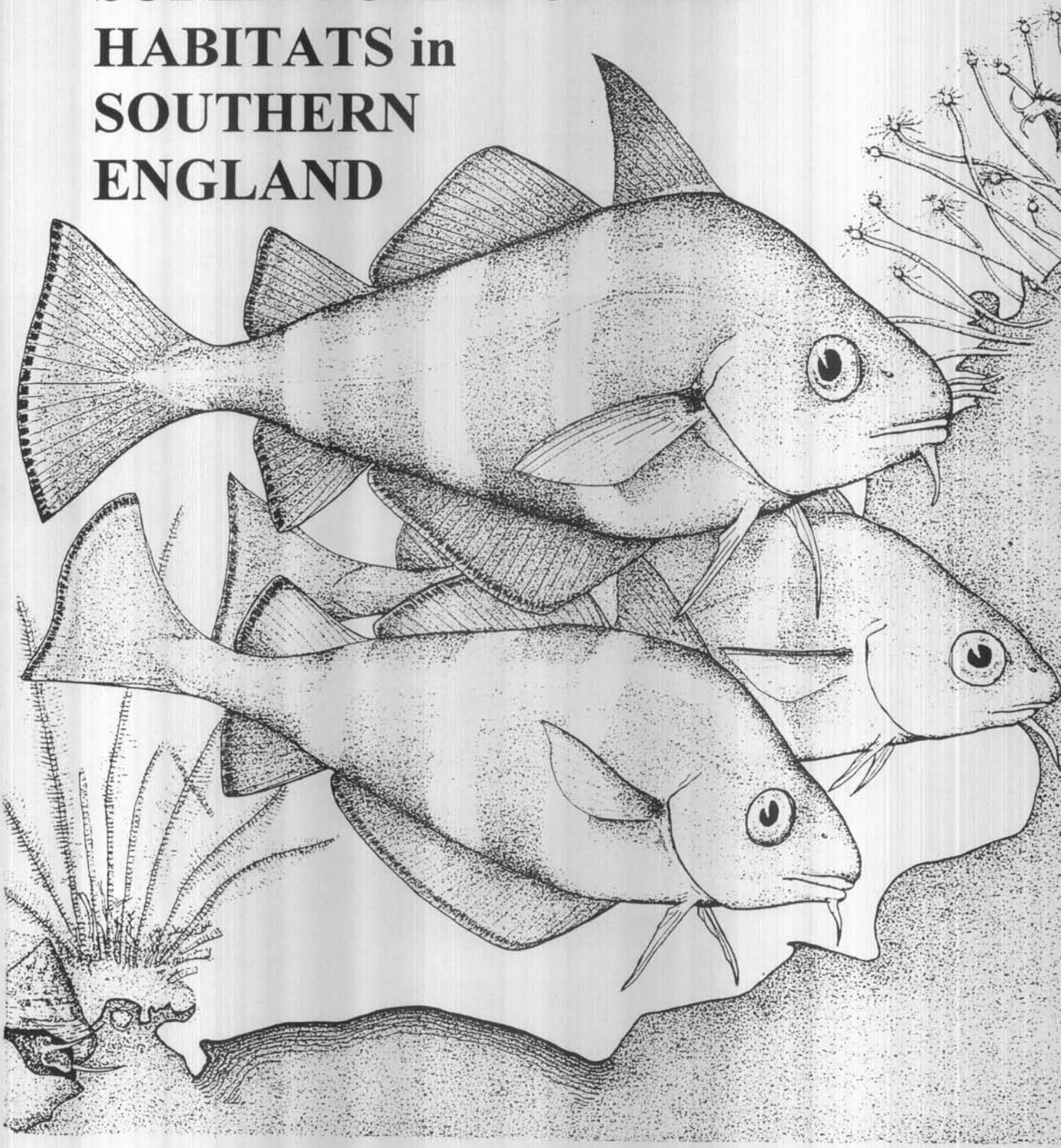
SUBLITTORAL CHALK HABITATS in SOUTHERN ENGLAND



MARINE CONSERVATION SOCIETY

South-East Region

Chalk Cliffs Project

SUBLITTORAL CHALK HABITATS IN SOUTHERN ENGLAND

report of the
Marine Conservation Society, South East Group
Chalk Cliffs project
1985-1991

by

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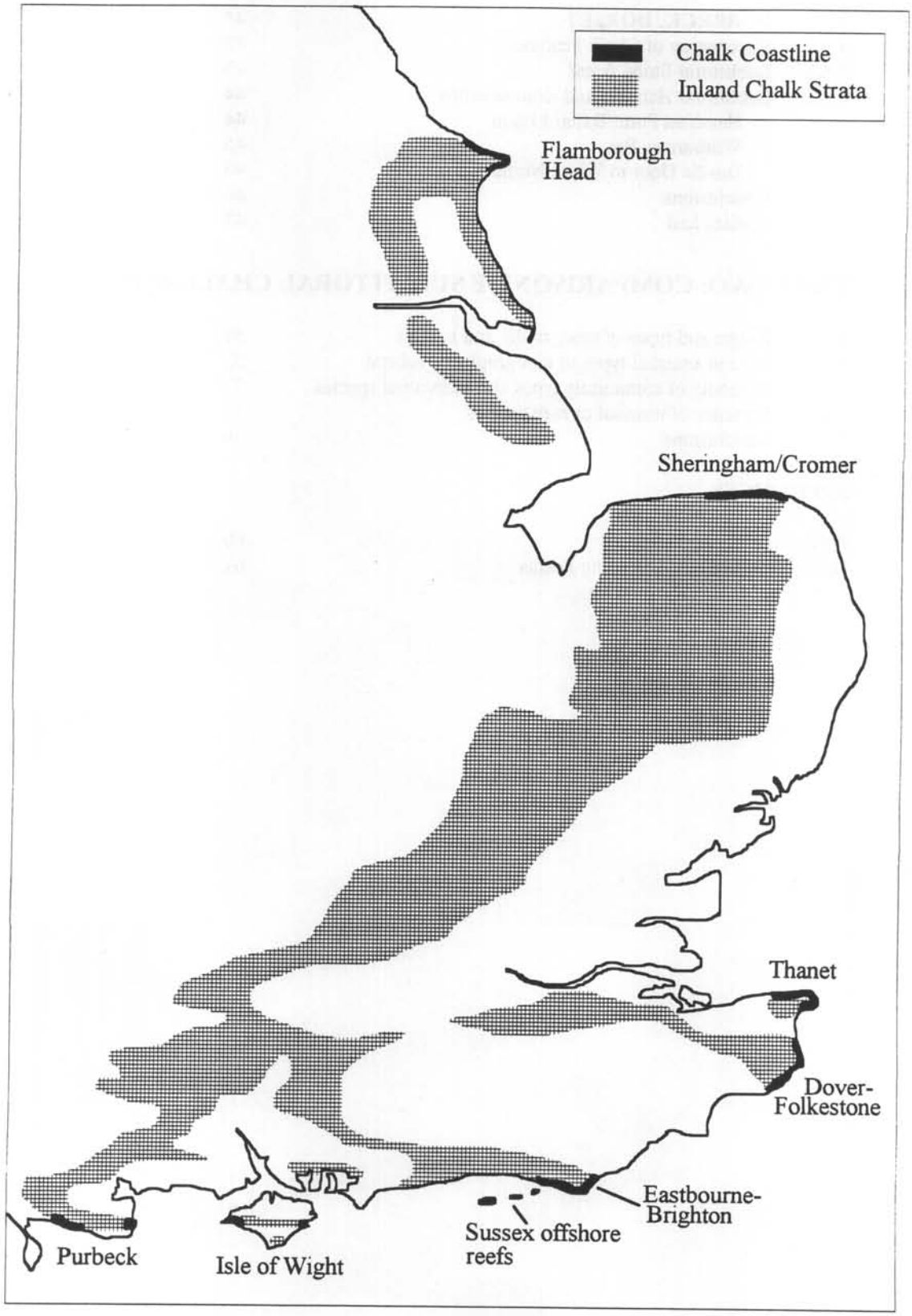

Figure 1 - Coastal Chalk exposures in England

INTRODUCTION

Following sublittoral surveys carried out by the Marine Conservation Society (MCS) in Sussex, a report was produced in 1984 (Wood 1984) which provides a general description of the natural and man-made habitats and the variety of marine life to be found underwater in the area between Selsey Bill and Beachy Head. It was clear from this work that chalk is an important rock type in the sublittoral in this area, and that the flora and fauna it supported was both diverse and distinctive.

The Society has, therefore, widened its sublittoral studies in this Chalk Cliffs Project to look at as wide a range of sublittoral chalk sites throughout southern England as possible and to compare and contrast them. The major part of the recording was carried out during 1985 with gaps being filled in by dives during the summers of 1986, 1987, 1990 and 1991.

Concurrently with this project a number of other groups have become interested in chalk as a sublittoral habitat and have taken part in or commissioned studies, many of which have involved the MCS. These are:

- Seven Sisters Marine Surveys, (Wood & Jones, 1986) - littoral and sublittoral surveys of the area between Seaford and Eastbourne carried out by MCS with the Nature Conservancy Council (NCC) with financial support from the East Sussex County Council and the NCC. Has led to the subsequent declaration of the area as the Seven Sisters Voluntary Marine Conservation Area (June 1987).
- Channel Tunnel Sublittoral Survey, (Wood & Wood, 1986) - sublittoral survey commissioned by NCC to study the area between Folkestone and Dover which would be affected by the construction of the Channel Tunnel.
- Flamborough Headland Sublittoral Survey, (Wood, E.M. 1988) - sublittoral survey commissioned by NCC and Flamborough Headland Heritage Coast Project of the most northerly coastal chalk headland in England.
- The sub-littoral chalk reefs of North Norfolk, (Frid, CLJ n.d.) - sublittoral survey on a similar basis to the MCS Chalk Cliffs survey with financial support from the NCC.

Work on a number of these studies and difficulties in reaching some locations in suitable diving conditions have resulted in the work being extended over a longer period than originally anticipated. However, the raw data has enabled MCS to:

- give advice to local authorities on the importance of some areas (Worthing),
- comment on major planning applications (Shepway, Lewes),
- give evidence at a public inquiry (Thanet),
- contribute to the JNCC Marine Nature Conservation Review Chalk Theme Report,
- contrast with non-chalk habitats in the MNCR/MCS SEASEARCH programme.

This report is divided into two parts. In the first the sublittoral habitats and plant and animal communities are described that occur in five chalk areas not covered in the other reports These are:

1. Isle of Thanet
2. Offshore reefs in Sussex
3. Coastal fringing reefs in Sussex
4. Isle of Wight
5. Purbeck, Dorset.

In the second part a preliminary comparison is made, on the basis of the information currently available, of the sublittoral chalk exposures in southern England. This comprises an assessment of their similarities and distinctive features, both in terms of topography and habitiat and the living communities within them.

METHODS

All of the data on which the first part of this report is based were collected underwater by amateur divers. Most of the dives were organised by the South-East Region of the Marine Conservation Society, but some were also run by individual diving clubs. At each site data were collected on three forms. The Site Log/Habitat Record form was developed in conjunction with an overhaul of the MCS Site Log form. This form was designed to encourage free descriptions of habitat and communities and the preparation of site sketches rather than using the 'tick box' type of form which is required where large amounts of data are to be handled by computer. This type of form has subsequently been developed by MCS and the Joint Nature Conservation Committee for nation-wide use in the SEASEARCH project.

Two species recording forms were used. The Basic Species form was designed to be used by all divers and included 30 easily recognised species. The species were chosen with the intention of answering questions about the distribution of certain species (such as Leopard Spotted Goby and burrowing sea cucumbers) as well as giving an idea of the relative densities of widespread species in areas of different habitat. The second species recording form, the Extra Species Record, allowed more experienced participants to include fuller species lists and it is these that form the basis of the species lists at the end of each section. In the Species Lists which follow the descriptions of each area the species included on the Basic Species record are identified by an asterisk. Species names and reference numbers follow Howson (1987). The abundance of each species is recorded as present (P) or common (C) and the number of records given in each case. Copies of the recording forms are included in the Appendix.

73 Site Log/Habitat Records, 78 Basic Species Records and 78 Extra Species Records were completed, a total of 229 forms. The underwater measurements on which the various maps are based were undertaken using 30m nylon tapes and folding 1m rules. Reference points for survey purposes were established on some reefs using concrete blocks.

ACKNOWLEDGEMENTS

My main thanks goes to all of those who attended project dives and completed the recording forms. Their names are listed in each section. Amongst others who helped special mention must be made of Brighton BSAC for the use of Brighton Diver for surveys and to Fred Dow in particular for his concrete blocks! The early stages and administration of the project were both greatly assisted by a grant from the British Sub Aqua Jubilee Trust. Bob Earll, Carolyn Heeps, Ian Tittley, Robert irving and Vicky Billings all made useful comments on the text at different stages.

1.1 ISLE OF THANET, KENT

1.1.1 DESCRIPTION OF CHALK FEATURES

The Isle of Thanet has a coastline of chalk cliffs about 21km in length. About half of that length faces north into the Thames Estuary and the remainder East into the southern North Sea. The site chosen for study, Botany Bay, is situated at the point where the coastline changes direction and is thus one of the most exposed sites in the area. It is also one of the few lengths of the coastline which remains in a natural state and has not been protected by sea defences.

The shore is backed by chalk cliffs and has an extensive chalk wave-cut platform extending from the headlands with a fine sand beach between. The chalk platform extends into the sublittoral before being covered by sand. Levels of turbidity in the area are generally high and low underwater visibility is a severe limitation to sublittoral studies in the area. The extent of the chalk coastline and the location of the study sites at Botany Bay are shown in Figure 1.1.1.

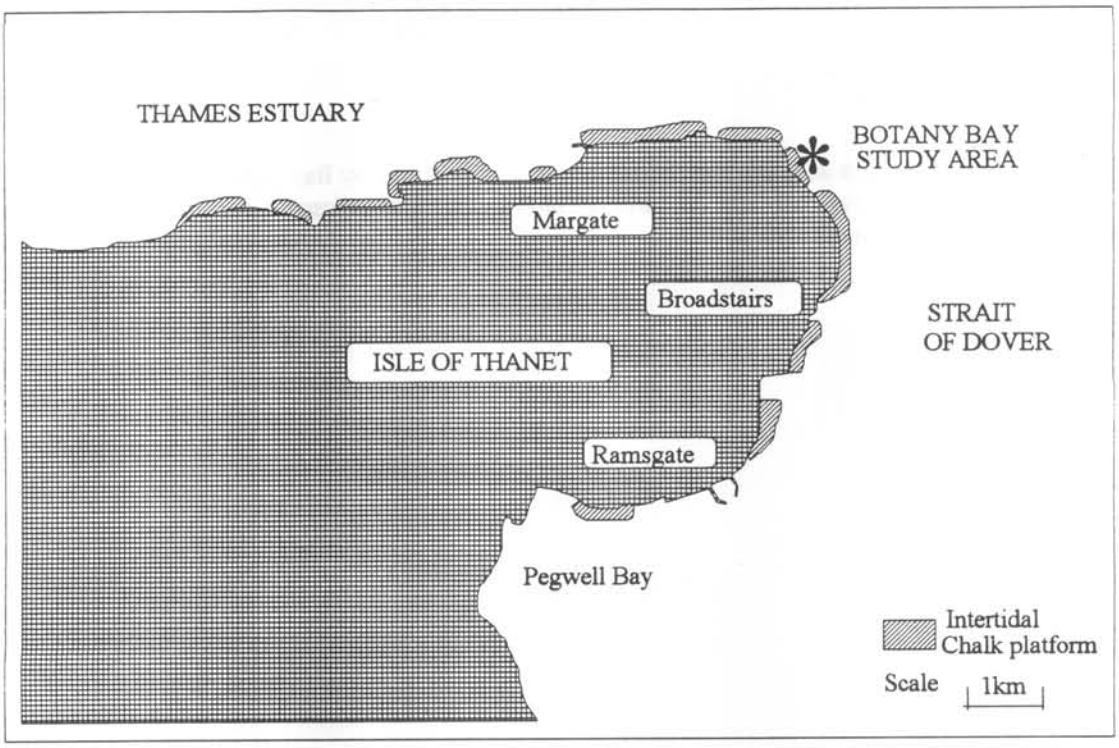

Figure 1.1.1 Isle of Thanet - Chalk coast and study site.

1.1.2 SUBLITTORAL STUDY AREAS

Underwater surveys were carried out at two sites in the vicinity of Botany Bay as follows:
2 Dives on 19/5/85 and 30/6/85
Site Log Nos. 6,21
Basic Species Record Nos. 7,29
Extra Species Record No. 25

Underwater visibility on both occasions was very poor and only a limited impression of the habitats and communities could be obtained. The records are not, therefore, comparable with those from other sites and, consequently, no conclusions are drawn from them in Part Two. The records on which the following habitat and community descriptions and the species list are based were compiled by Harry Ryall, assisted by members of the Northfleet & Strood Sub Aqua Club.

1.1.3 SUBLITTORAL HABITATS AND COMMUNITIES

The sea bed offshore in a recorded depth of 8-10m comprised gently sloping chalk bedrock with shallow gullies about 30cm deep and 1.5m wide. The gully bottoms were flat with circular holes and rounded depressions. The holes are evidence of the activity of piddocks. The circular depressions are caused by the movement of flint cobbles. The gullies run at right angles to the shore and are presumed to have been caused by wave surge.

The upper horizontal surface of the chalk between the gullies was covered by a mixture of animal turf and fine sand. A little algae was present but plants were small and appeared stunted in growth. There was no attached life in the gully bottoms and pockets of silt and sand were present. In a few areas there were mounds of broken chalk and in one spot a raised area of reef 1m in height.

Generally animal life was limited. Mobile life noted included common starfish, shore crabs, edible crabs and lobster. Only one species of fish was recorded and that, the Dab, is associated with flat sandy areas rather than rock reefs. However, the poor visibility (not more than 1m) hampered observations.

1.1.4 CONCLUSION

The brief study undertaken suggests that the sublittoral chalk off Botany Bay provides only a limited variety of habitats. This, together with the turbidity of the water and exposed conditions, means that the variety of sublittoral marine life is limited.

1.1.5 SPECIES LIST - ISLE OF THANET (BOTANY BAY)

The following species list is based on records from two dives and in poor visibility. It is consequently limited to a few of the most obvious species present and should not be considered representative. The letter and numeric codes for phyla and species follow Howson (1987). Species included in the Basic Species list are denoted by an asterisk. The abundance of species is recorded as present (P) or common (C) and the number of records in each category given when more than one.

PORIFERA (C)		
596 *Amphilectus fucorum*	*	P
HYDROZOA (D)		
144 *Tubularia indivisa*		P
597 *Nemertesia antenina*		P
ANTHOZOA (D)		
1024 *Alcyonium digitatum*		C
1158 *Anemonia viridis*	*	C
1225 *Metridium senile*		P
1237 *Cereus pedunculatus*		P
ANNELIDA (P)		
2031 *Lanice conchilega*		P
CRUSTACEA (S)		
2360 *Homarus gammarus*	*	2P
Hermit crab sp.		CP
2553 *Maja squinado*	*	P
2646 *Cancer pagurus*	*	P
2690 *Carcinus maenas*	*	CP
MOLLUSCA (W)		
1650 *Mytilus edulis*		P
2229 *Mya arenaria*		P
BRYOZOA (Y)		
694 *Flustra foliacea*	*	C
ECHINODERMATA (ZB)		
190 *Asterias rubens*		2C
PISCES - OSTEICHTHYES (ZG)		
891 *Limanda limanda*		P
ALGAE - CHLOROPHYCEAE (ZS)		
245 *Ulva lactuca*		P

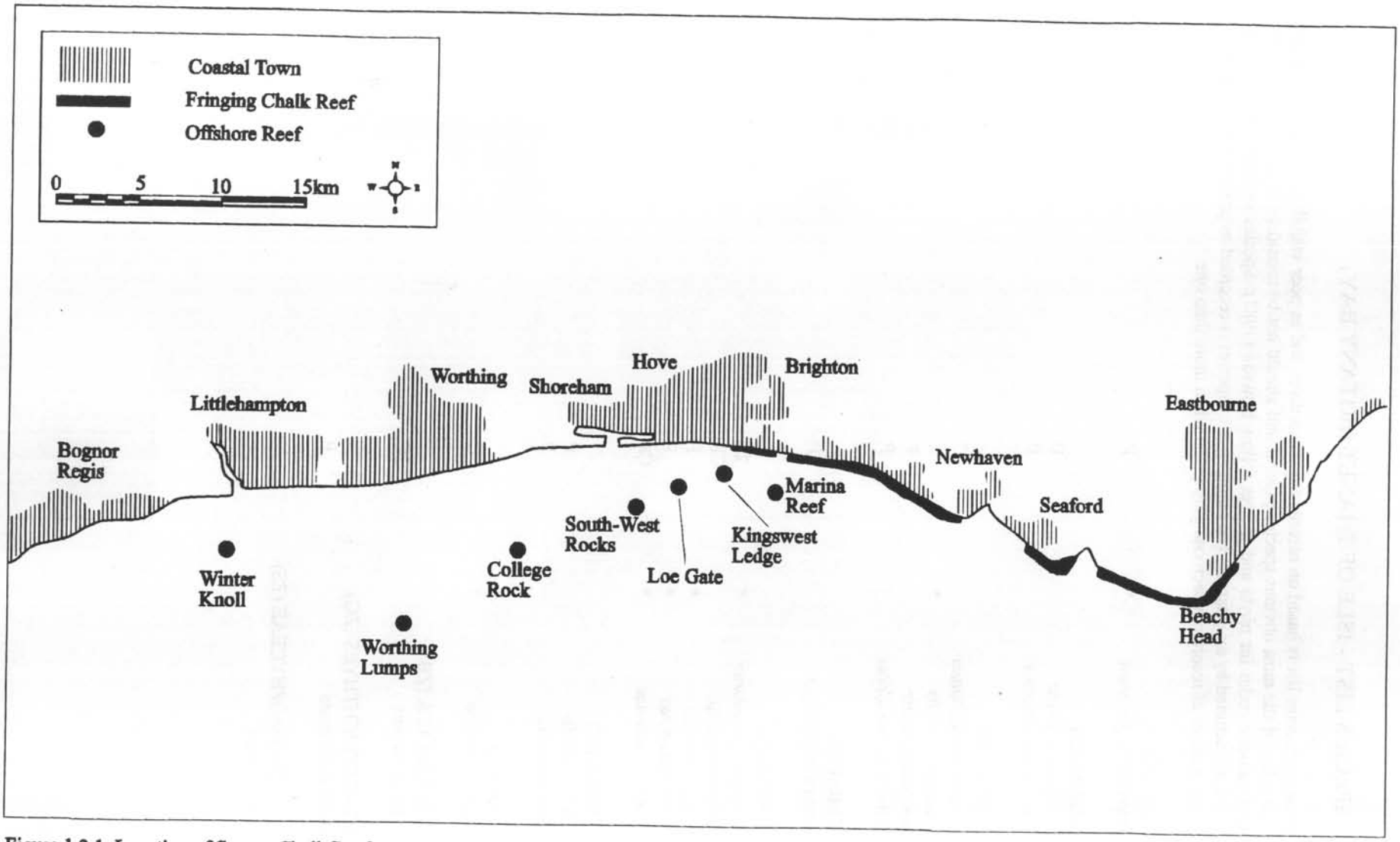

Figure 1.2.1 Location of Sussex Chalk Reefs

1.2 OFFSHORE REEFS IN SUSSEX

1.2.1 DESCRIPTION OF CHALK FEATURES

The reefs described in this chapter are unlike those we have studied elsewhere in that they do not fringe coastal chalk features and are separated from the coast by softer substrata. Chalk underlies much of West Sussex where most of these reefs are situated, although on the coast, as underwater, much of the bedrock is overlain with other more recent deposits. Three of the sites below (South-West Rocks, Worthing Lumps and Winter Knoll) were visited during the Sussex Sublittoral Survey (Wood 1984) and a common feature was the northward orientation of the chalk face at each site. We visited four additional reefs with apparently similar profiles during this survey, as well as the known sites, and three of them (Marina Reef, Kingswest Ledge and Looe Gate) were also found to be of chalk. The fourth site (near College Rocks) is a ledge of soft clay. The location of the sites is shown in Figure 1.2.1 opposite this page.

The reefs all consist of vertical chalk faces ranging in height from 0.5m to 3m. The faces are not straight but meander in and out to varying degrees. Winter Reef is the most convoluted of all and it is difficult to appreciate the overall orientation. On the other hand the face at Worthing Lumps is in the form of a gentle curve with only minor indentations. Below the vertical face are chalk boulders, and in some cases flat chalk bedrock. In all instances these become overlain with sand and gravel within a very short distance. Above the cliff face, on what may be considered as the dip slope of the feature, chalk bedrock is exposed for some distance, in some cases for as much as 100m, before again becoming covered with sand and gravel. Figure 1.2.2. is a notional cross section through one of the sites.

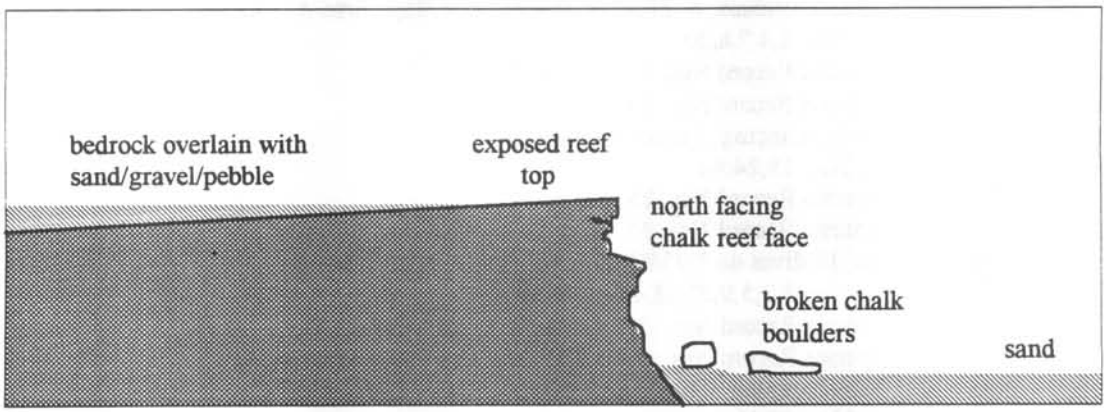

Figure 1.2.2 Typical cross-section through offshore reef.

The amounts of chalk exposed and the height of the ledges or cliffs increases generally with distance from the shore. This is presumably because the further offshore sites have stronger tides and thus the scouring effect is more pronounced and prevents sand and gravel being deposited which would obscure the face. The different sites are compared in Figure 1.2.3 below.

	Distance Offshore	Length Exposed	General Height	Maximum Height
Marina Reef	1.8km	?	0.5m	1.0m
Kingswest Ledge	2.0km	107m	0.5m	1.0m
Looe Gate	3.0km	200m	0.5m	1.5m
South-West Rocks	3.8km	270m	1.0m	2.0m
Worthing Lumps East	8.0km	190m+	2.5m	3.0m
Worthing Lumps West	8.0km	350m+	3.0m	3.0m
Winter Knoll	3.0km	?	1.0m	1.5m +

Figure 1.2.3 Extent of Chalk Cliff faces.

The three most easterly sites (Kingswest Ledge, Looe Gate and South-West Rocks) are relatively close together and this, together with their consistent orientation, suggests that they are the exposed portions of a continuous chalk feature which has the intervening sections covered by sand and gravel. Worthing Lumps consists of two separate chalk cliff faces separated by an area of sand. The two parts of this site are clearly part of the same stratum of chalk and this may or may not be a continuation of the more easterly group of sites. The most westerly site, Winter Knoll, is a much more convoluted reef and although its general orientation is northwards it is less clearly the result of chalk strata running parallel with the coast than the other sites.

1.2.2 SUBLITTORAL STUDY AREAS

Underwater surveys were carried out in the following locations:

Marina Reef, Brighton, 1 dive on 5/8/90
- Site Log No. 66
- Basic Species Record No. 73
- Extra Species Record No. 72

Kingswest Ledge, Brighton, 2 dives on 28/4/85
- Basic Species Record No. 4
- Extra Species Record No. 1

Looe Gate, Hove, 3 dives on 16/8/86
- Site Log Nos. 52,55.
- Basic Species Record Nos. 57,58,61.
- Extra Species Record Nos. 56,57,60

South-West Rocks, Shoreham, 8 dives on 27/4/85, 25/5/85, 1/6/86 & 29/7/90
- Site Log Nos. 1,4,7,8,20
- Basic Species Record Nos. 1,3,9,10,30,71
- Extra Species Record Nos. 3,6,7,26,70

Near College Rocks, Lancing, 3 dives on 13/7/85
- Site Log Nos. 19,24,42.
- Basic Species Record Nos. 25,31,35.
- Extra Species Record Nos. 20,30,44

Worthing Lumps, 13 dives on 11/5/85, 8/6/85, 13/7/85 & 20/7/86
- Site Log Nos. 2,3,5,9,22,23,41,45,46,49
- Basic Species Record Nos. 2,5,6,8,11,22,23,24,34,48,52,53,55
- Extra Species Record Nos. 2,4,5,8,19,21,22,29,39,40,43,47,48,53

Winter Knoll, Littlehampton, 2 dives on 20/7/86
- Site Log Nos. 47,50
- Basic Species Record Nos. 54,56.
- Extra Species Record Nos. 49,50,54

The records on which the following habitat and community descriptions and the species list are based were compiled by; Graham Ackers, Teresa Bennett, Len Deeley, Ponnie Dudley, Bill & Peter Hewitt, Robert Irving, Dick Manuel, Sally Rogers, Chris Spurrier, Chris Terrell, Lesley Williams and Chris Wood. The survey work was assisted by members of the Downs and Orpington Sub Aqua Clubs.

1.2.3 SUBLITTORAL HABITATS AND COMMUNITIES

MARINA REEF

This is a chalk reef about one mile south of the Brighton Marina lying in a recorded depth of 15-18 metres below chart datum). It is said to be up to 500m long but only about 100m was investigated during the survey. The maximum height of the reef is 3m. Marina Reef follows the general description of Sussex offshore reefs given above, but appears to comprise a relatively narrow stratum of chalk, only about 30cm wide, with a softer grey clay beneath it. The clay is being eroded more

quickly than the chalk and the lower part of the reef consists of chalk slabs and boulders which have broken off from the chalk stratum following erosion of the clay base.

Two profiles are shown in Figure 1.2.4. In one case (Fig. 1.2.4b) the eroding clay is visible, whilst in the other (Fig. 1.2.4a) the collapsed slabs have obscured the lower surface. The vertical chalk face of the reef is thus restricted to 30-50cm but, unlike other sites, there is a significant band of sloping slabs and boulders about 10m wide below it.

The section of the reef investigated has a characteristically convoluted profile but its overall orientation is in a curve, at the western end oriented 280°-100° and at the eastern end 0°-180°. No algae were present on the reef and the richest animal cover, a hydroid and bryozoan turf, was found at the top edge of the exposed stratum and on the vertical faces. Main components were *Hydrallmania falcata*, *Sertularia cupressina* and *Bugula* spp.. The sloping chalk surfaces were silted and more sparsely covered but included a number of silt tolerant species which do not appear to be common at other chalk sites. Prominent were the sponges *Ciocalypta penicillus* and *Polymastia mamilliaris*. The Horseshoe Worm *Phoronis hippocrepia* was also common on these upwardly facing surfaces, unlike some other areas (e.g. Seven Sisters [Wood & Jones 1986]), where a vertical orientation is more common. There was a good variety and abundance of fishes at the site.

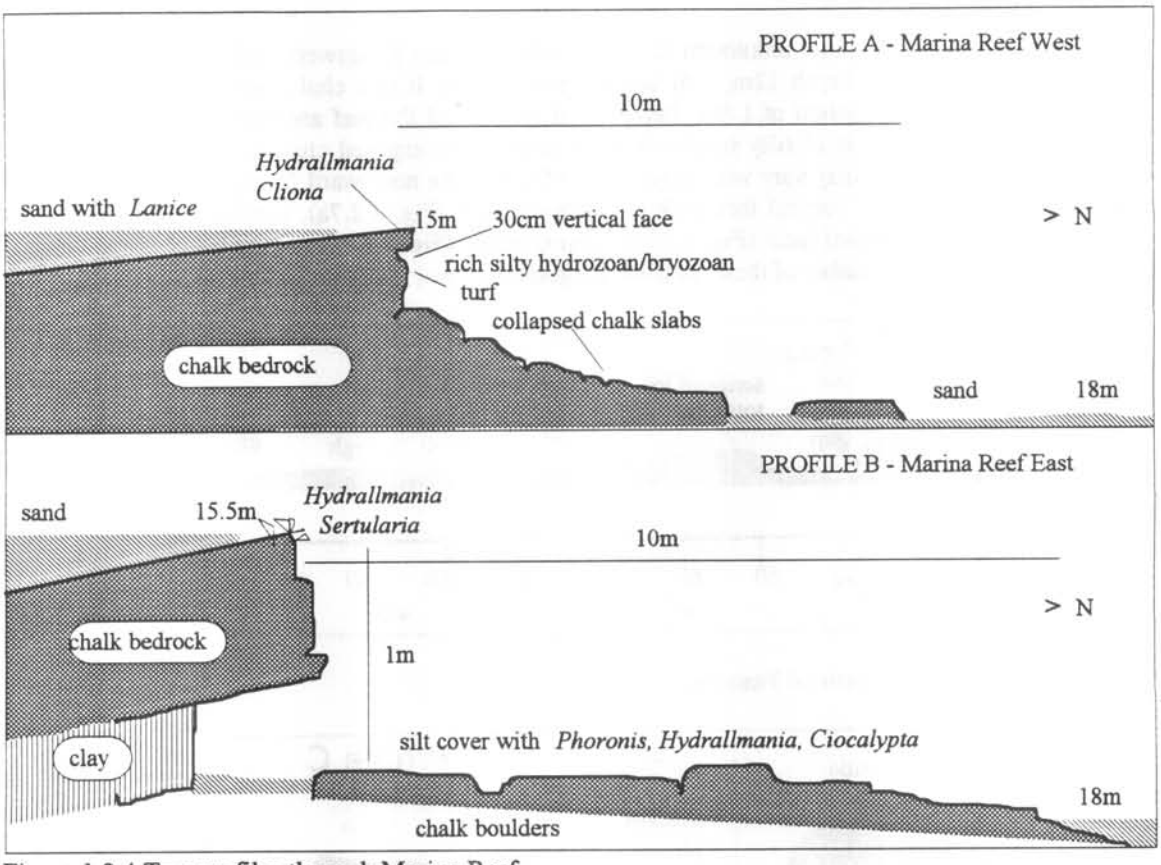

Figure 1.2.4 Two profiles through Marina Reef.

KINGSWEST LEDGE

This is a low ledge (named after the seafront development it is opposite) generally 0.5m high but with two short sections reaching 1m. The length of ledge exposed was 107m but this may vary over time with movement of the surrounding silty sand sea bed. The ledge has a convoluted outline as shown by a 50m length recorded in Figure 1.2.5. There was a considerable amount of silt cover at the time of our visit and this may be a regular feature of the area since there were almost no red algae growing on the exposed chalk. Recorded depth was 12m (below chart datum).

The main animal cover consisted of hydroids and bryozoans, prominent species being *Tubularia indivisa* and *Flustra foliacea*. The ledge supported a mobile fauna which included the Lobster *Homarus gammarus* and Velvet Swimming Crab *Liocarcinus puber* as well as Ballan Wrasse, Goldsinny and Bib.

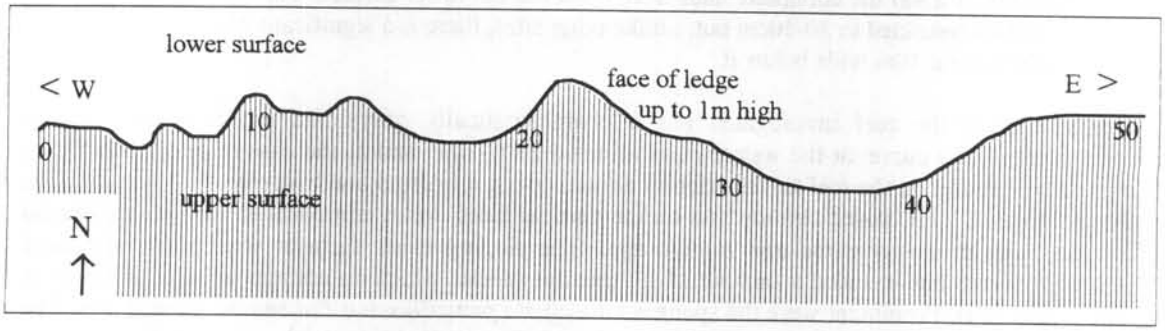

Figure 1.2.5 Plan of 50 metre length of Kingswest Ledge.

LOOE GATE

Looe Gate (reasons for name unknown) is further offshore than Kingswest Ledge but in a similar depth of water (recorded depth 12m, m below chart datum). It is a chalk reef of about 220m in length with a maximum height of 1.5m. The general features of the reef are shown in Figure 1.2.6. The surrounding sea bed is of silty sand with shell debris. The exposed chalk reef has a maximum width of 5m, though this may vary with movements of sand. The northward facing reef face is varied in profile varying from a vertical face with an undercut base (Fig. 1.2.7a), through a series of low terraces (Fig. 1.2.7b), angled faces (Fig. 1.2.7c), smooth slope (Fig. 1.2.7d) to jumbled chalk boulders and broken bedrock. A number of these profiles suggest an angled underlying chalk stratum.

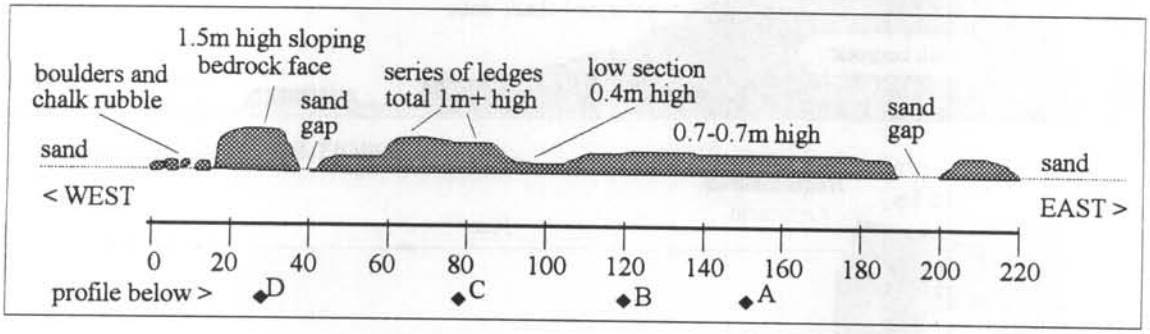

Figure 1.2.6 Looe Gate - General Features.

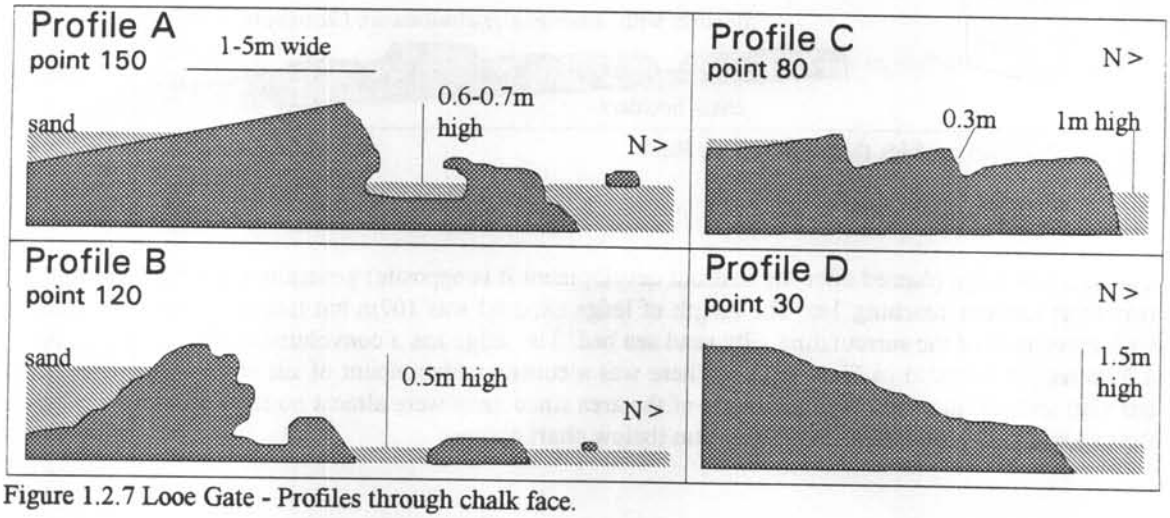

Figure 1.2.7 Looe Gate - Profiles through chalk face.

The upper chalk surfaces supported a light foliose red algal turf. Sessile fauna was varied and densely packed, except on the broken surfaces. Major elements of the cover were sponges and bryozoans. Eleven species of sponges were recorded with *Cliona celata* (boring form), *Amphilectus fucorum* and *Dysidea fragilis* the most common. Amongst the smaller sessile groups tunicates were particularly varied, with 12 different species recorded, seven of which were common. Considerable numbers of fishes were seen, both Bib *Trisopterus luscus* and Poor Cod *Trisopterus minutus* being common.

SOUTH-WEST ROCKS

South-West Rocks is a 270m length of vertical chalk face with a maximum height of 2m. It lies 3.75km offshore between Hove and Shoreham and runs approximately 240°/60°. The recorded depth is 13-15m (- m below chart datum). A general topographical survey was undertaken of the whole length of the cliff and more detailed surveys of the chalk formations and animal communities were carried out at various points.

Figure 1.2.9 (over page) shows a plan of the cliff with a section along it demonstrating the variation in height at different points. The highest sections of the cliff are all to the east of the central point. At the western end the cliff becomes gradually covered by sand. At the east it degenerates into an area of broken boulders. Profiles through the cliff face at three points are shown in Figure 1.2.8 and a detailed plan of a significant peninsular of chalk which juts some 7m out from the general line of the cliff is shown in Figure 1.2.10.

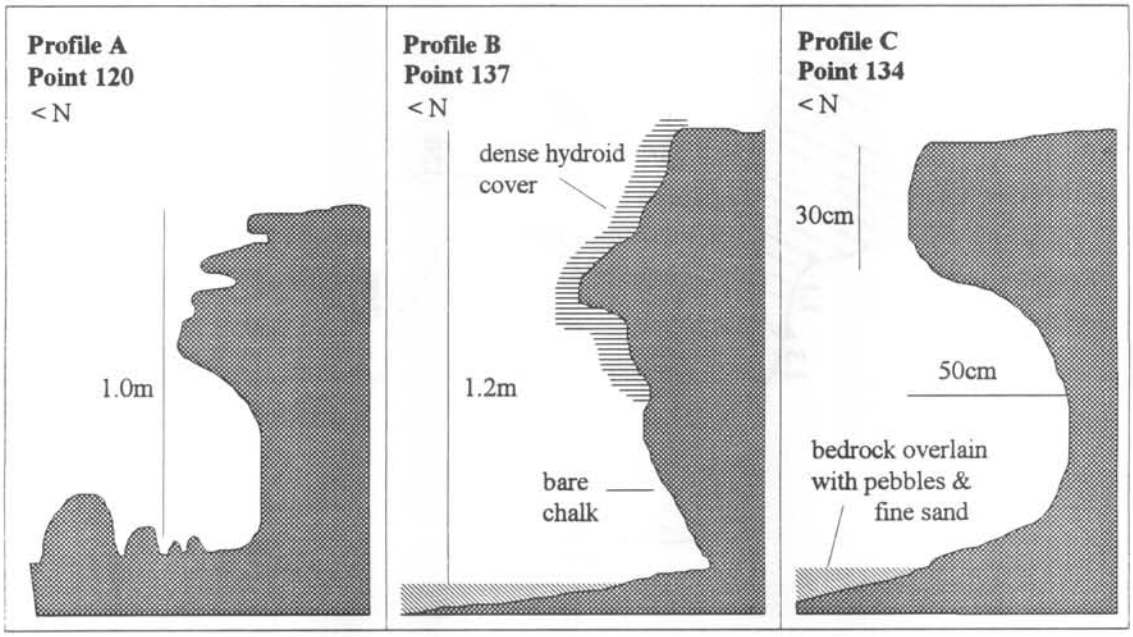

Figure 1.2.8 South-West Rocks - Three profiles through cliff face.

The profiles show that the cliff is often undercut at its base and that bedrock slopes gently away below, quickly becoming obscured by a covering of pebbles and fine sand. Above the face the horizontal upper surface forms a plateau, usually relatively flat and smooth and again soon becoming overlain with sands and pebbles. In some areas a gently undulating surface is found which has its low rounded ridges at right angles to the cliff face. Elsewhere there are occasional flint cobbles lying in depressions in the bedrock which have presumably been created by their movement in rough conditions.

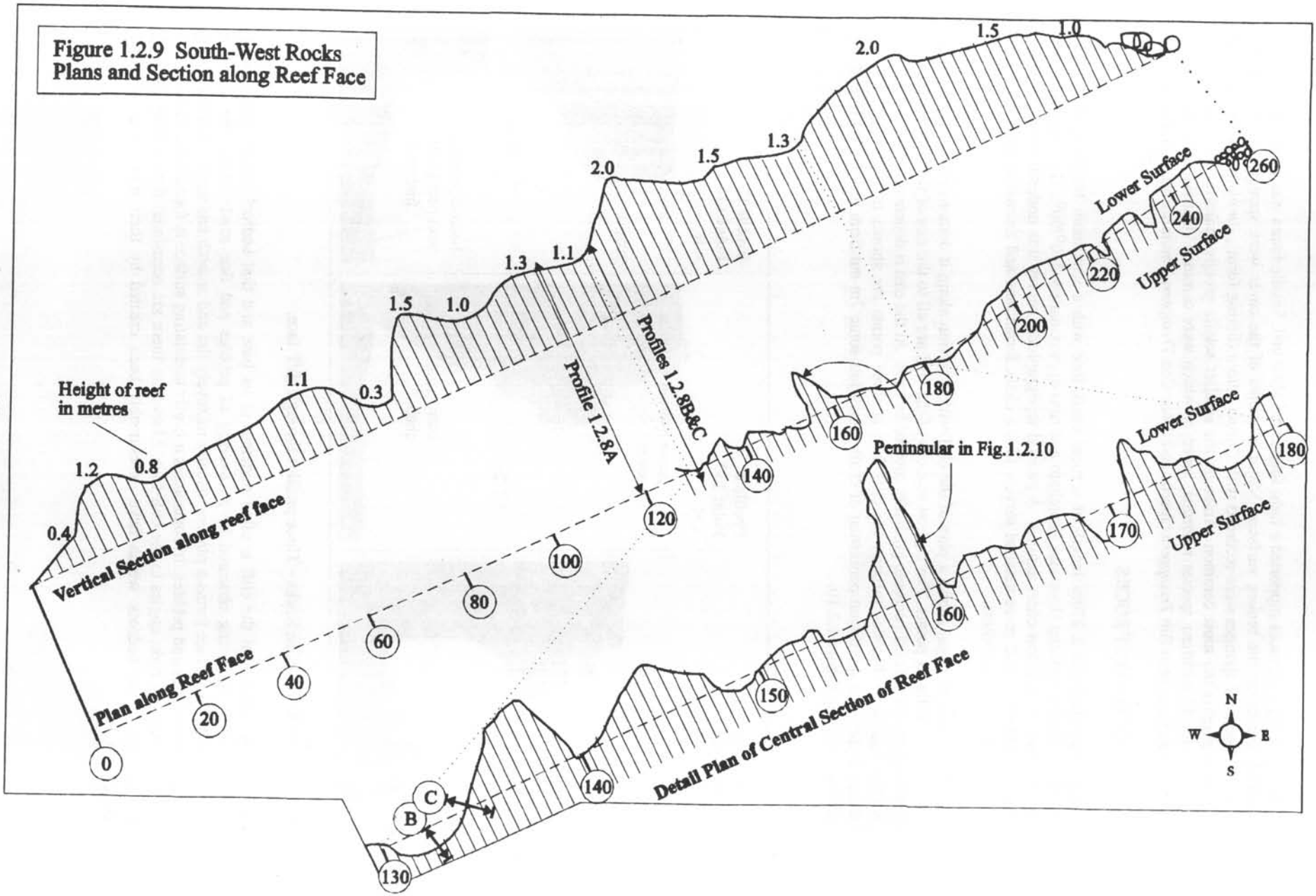
Figure 1.2.9 South-West Rocks
Plans and Section along Reef Face
Height of reef in metres
Vertical Section along reef face
Plan along Reef Face
Profile 1.2.8A
Profiles 1.2.8B&C
Peninsular in Fig.1.2.10
Lower Surface
Upper Surface
Detail Plan of Central Section of Reef Face
0.4
1.2
0.8
1.1
0.3
1.5
1.0
1.3
1.1
2.0
1.5
1.3
2.0
1.5
1.0
0
20
40
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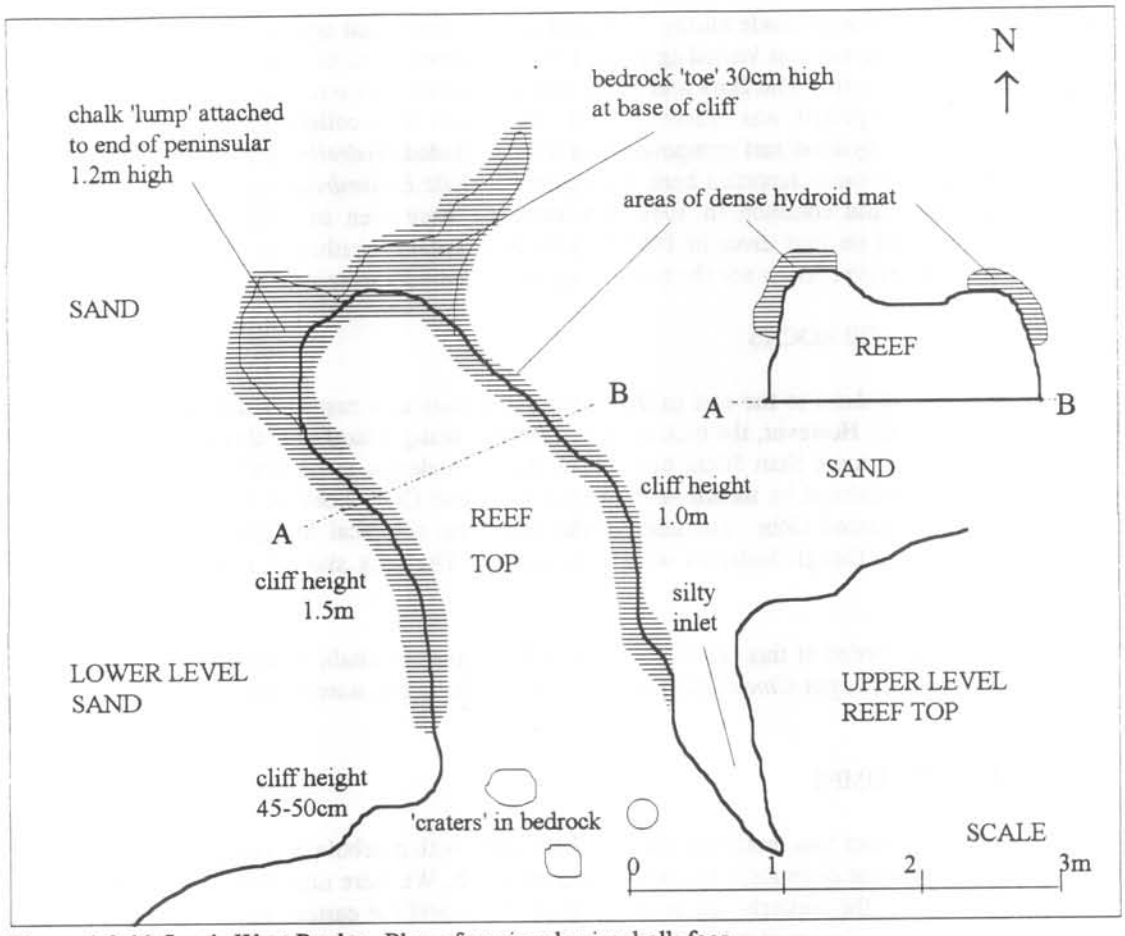

Figure 1.2.10 South-West Rocks - Plan of peninsular in chalk face.

The areas most densely covered in marine life were the upper part of the vertical cliff surface and extended onto the upper horizontal bedrock surface. The main component of a dense animal 'turf' were hyriods. The dominant species was *Eudendrium ramosum* with *Sertularia cupressina* and *Tubularia indivisa* also common. Foliaceous red algae were present on the upper horizontal surface but plants were small and silt-covered. Green algae were also present in small numbers, *Bryopsis plumosa* being the most common species.

Other faunal components of the 'turf' were sponges, principally *Amphilectus fucorum* and *Dysidea fragilis*, and bryozoans including *Flustra foliacea*. In some areas dead men's fingers, *Alcyonium digitatum* were common, but their occurrence was sporadic. The most surprising species observed was a small group of burrowing sea cucumbers occupying abandoned vertical piddock holes in the upper horizontal bedrock surface. On the basis of the tentacles alone these may well have been *Aslia lefeveri* but this could not be confirmed without damaging both the chalk and the cucumbers by removing them. This is believed to be the only record of burrowing sea cucumbers in the eastern part of the English Channel.

Piddocks were present in the chalk bedrock, particularly in the vertical face, though their holes were often obscured by the thick hydroid turf. Where chalk was broken open the dense network of burrows could be seen. The other common mollusc was the cowrie *Trivia arctica* which was seen on both horizontal and vertical surfaces, sometimes feeding on colonial sea-squirts, *Aplidium* sp.

The crustacean life was not particularly varied or abundant in the light of the suitable habitat provided by the creviced chalk face. On the other hand fishes were common, principally two representatives of the cod family, Bib *Trisopterus luscus* and Poor Cod *Trisopterus minutus*, and two wrasses, Ballan Wrasse *Labrus bergylta* and Goldsinny *Ctenolabrus rupestris*.

Most records of this site were made during 1985 and an extensive algal species list is available from 1984 (Wood, 1984). The site was visited again in 1990 and appeared to be significantly more heavily silted than on previous visits. The flora and fauna was significantly different to that recorded during the earlier visits. Algal growth was sparse and only six species were collected as opposed to the 47 recorded in 1984. The hydriod turf composition in 1990 included *Hydrallmania falcata* and *Obelia dichotoma*, neither previously recorded here, but did not include *Eudendrium ramosum* or *Sertularia cupressina*, abundant and common in 1986. No anthozoa were seen in 1990 though *Alcyonium digitatum* was recorded on four dives in 1985/6, once as common. Neither the sponge *Amphilectus fucorum*, the cowrie *Trivia arctica* nor the burrowing sea cucumbers were seen in 1990.

NEAR COLLEGE ROCKS

This ledge is similar to those to the east in that it runs generally in a east-west direction and has its vertical face to the north. However, the rock is quite different, being a hard grey clay rather than white chalk. The ledge is not more than 50cm high but is deeply undercut at its base. This creates deep crannies which were inhabited by mobile species such as Edible Crab, Lobster, Conger Eel, Tompot Blenny and Leopard-Spotted Goby. The edge of the ledge had a typical animal turf dominated by sponges and bryozoans, though hydroids were also present. The rock showed evidence of piddock borings.

Species which were recorded at this site which were absent from the chalk sites in Sussex except for Marina Reef were the sponges *Ciocalypta penicillus* and *Polymastia mamilliaris*, both seen on the upper flat clay surface.

WORTHING LUMPS

Worthing Lumps comprises two, northerly facing, chalk cliffs with a pebble/gravel gap between them and a considerable expanse of exposed flat bedrock to the south. We were unable to measure the total length of either face but the westerly one is longer than 350m and the eastern longer than 190m. In each case divers reached the point where the two cliffs are closest and the pebble/gravel area cuts through. The distance between the two cliffs at this point is estimated at 200-300metres. In each case there is a distinct change of angle in the cliff face with a reducing height of exposed chalk runnning at right angles to the main cliff for a distance of about 30m gradually reducing in height as the gravel/pebble seabed rises. It is assumed that both cliffs are part of the same feature and that the gap has been caused by erosion. The recorded depth of the reef is 13-16m (8-11 m below chart datum).

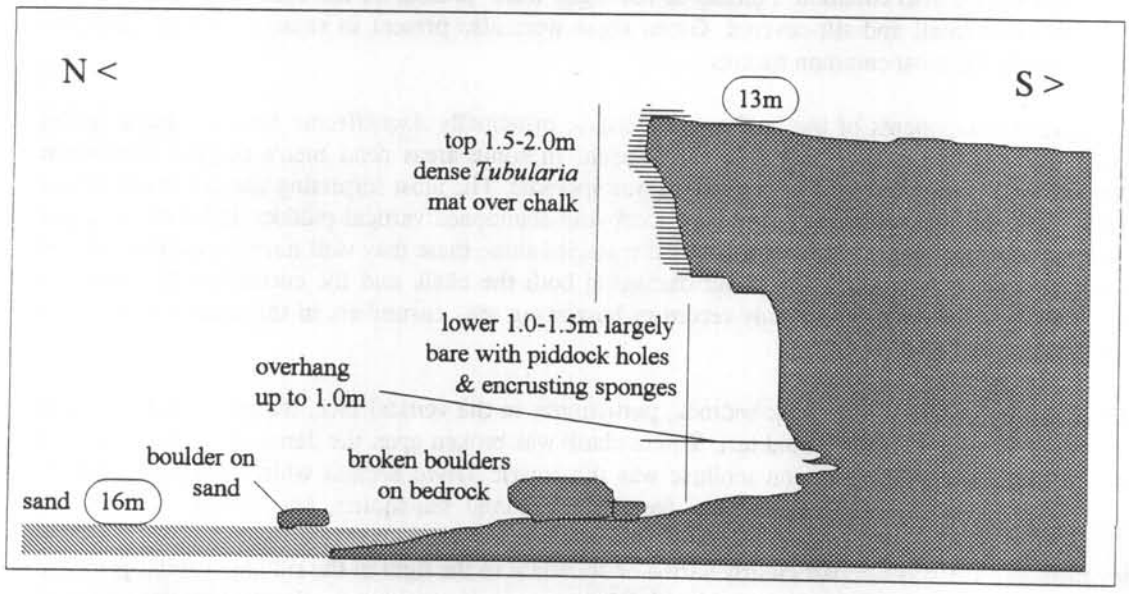

Figure 1.2.11 Worthing Lumps - Typical Profile.

The eastern cliff runs generally east-west (90°-270°) and has an irregular outline. The cliff height ranges between 2m and 3m and has a fairly consistent profile which is shown in Figure 1.2.11. The western cliff has a more curved plan form, a length of which is shown in Figure 1.2.12. The height is similar to the eastern cliff but the profile is generally more vertical and lacks the pronounced overhang found all along the eastern cliff.

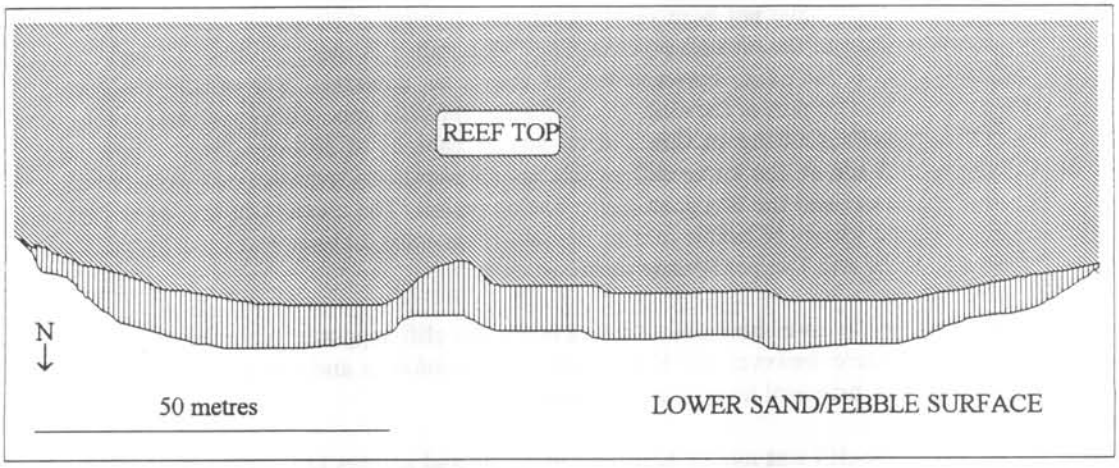

Figure 1.2.12 Worthing Lumps - Plan of western cliff face.

Worthing Lumps lies 8km offshore and is subject to tidal streams of up to 1.6kt which run parallel with the cliff face. These two factors mean that the level of siltation on the cliff face is very low compared to the other chalk sites in the area. Below the cliff face there is in both cases an area of exposed chalk bedrock with broken boulders fallen from the cliff face. In some parts close to the base of the cliff there is considerable siltation. The upper surface of the reef comprises a horizontal chalk platform with rock mills between 0.5m and 2m in diameter, and channels. These are presumed to have been created by scouring action and some have a characteristic outline as shown in Figure 1.2.13.

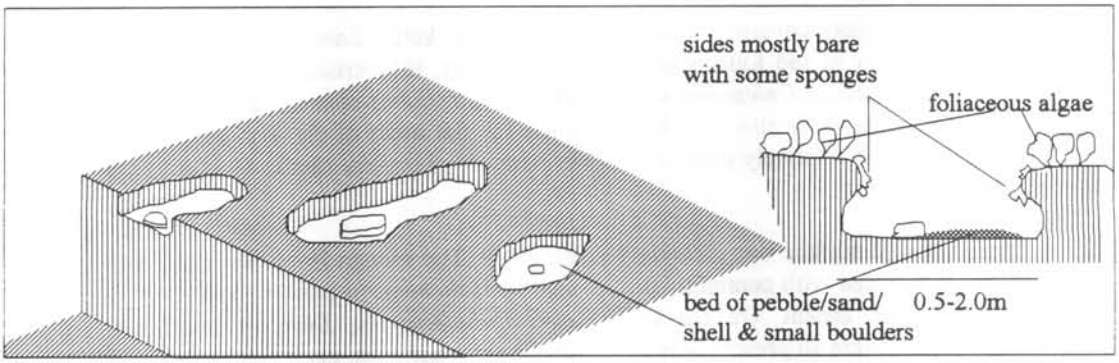

Figure 1.2.13 Worthing Lumps - Outline of rock mill on upper surface.

Generally the cliff and reef formation provides a wide range of microhabitats and this is reflected in the diversity of the marine life. Foliaceous red algae dominated the upper horizontal chalk surfaces. A few individual kelp plants were also present close to the top of the cliff face. Sponges were also common here. Some areas of chalk were covered by encrusting algae. The craters and channels in the upper surface had large parts of their walls bare though elsewhere there was a reasonably rich, sponge dominated, fauna. Tompot Blennies were found in the craters and channels and wrasses, Corkwing and Goldsinny, were common.

Vertical faces were dominated by a faunal turf of which the largest component was the hydroid *Tubularia indivisa*. This was dominant on the top half of the cliff face, forming a densely matted turf which allowed little space for other attached fauna. The upper parts of the cliff were extensively bored

by the White Piddock, *Barnea candida* and the Small Piddock, *Barnea parva*, although the siphons were difficult to distinguish amongst the *Tubularia* mat. Other attached life which did manage to get a footing here included bryozoans, *Bugula* spp. and the tube worm *Filograna implexa*.

The lower half of the cliff face was less densely colonised and there were also areas of bare chalk. The chalk which forms the cliff is quite soft and easily broken and the bare surfaces probably represent recently broken areas which have not been recolonised. The borings of piddocks were very obvious here and are clearly a force in the erosion process. Their size indicates that they were formed by the Common Piddock, *Pholas dactylus*, however few of the holes contained live shells. Encrusting sponges were common on this part of the cliff. Notable were *Aplysilla* spp. (both *rosea* and *sulfurea*), and *Hemimycale columella* growing in thin sheets. Small cushions of *Dysidea fragilis* were also common. Other attached life on the lower cliff which has an encrusting growth form were tunicates such as *Botryllus schlosseri* and the bryozoan *Cellepora pumicosa*. The crevices in the lower part of the cliff supported a good variety of mobile marine life including crabs, Lobster and small fishes. Both the Leopard-Spotted Goby and Tompot Blenny were common.

Many of the boulders on the lower horizontal surface below the cliff supported a similar range of life to that of the cliff itself. Here, however, the Hornwrack, *Flustra foliacea* and bryozoans, *Bugula* spp. replaced *Tubularia* as the principal form of animal cover.

The flat bedrock below the cliff was mainly bare with some silt and patches of mobile gravel and shell debris which inhibit the establishement of attached marine life. The shell remains were principally of the Slipper Limpet, *Crepidula fornicata*. Further away from the cliff the bedrock surface became completely covered with sand, gravel and shell remains. Occasional patches of bare exposed chalk were seen, and these showed evidence of past boring by piddocks in the presence of vertical holes.

WINTER KNOLL

The parts of the reef which were investigated faced north and east. The extent and overall orientation of the reef is not clear but we were told by one boat skipper that it is circular. The edge of the reef is formed by a cliff 1-1.5m high with a steep or vertical profile. The recorded depth at the top of the reef was 9m (4.5m below chart datum).

The upper surface was algal covered. Species included the kelps *Laminaria hyperborea* and *L. saccharina* and a variety of red foliaceous species. Unusually, the vertical faces were also algal covered. Here red algae such as *Delessaria sanguinea, Heterosiphonia plumosa* and *Calliblepharis ciliata* were common. Algae were also established on the the flat areas of chalk exposed below the cliff. The cliff face itself was relatively stable with little evidence of broken chalk. Much was covered in encrusting coralline algae.

The animal life on the cliff surface was secondary to the algae. The sponge fauna was quite different to the sites further to the east with common species such as *Halichondria panicea* and *Amphilectus fucorum* being completely absent. On the other hand *Haliclona* sp., *Dercitus bucklandi* and *Pachymatisma johnstonia* were all present here and absent from other sites, apart from small numbers at Worthing Lumps. Other components of the attached animal life were the bryozoans *Bugula* spp. and tunicates such as *Morchellium argus, Ascidia mentula* and *Clavelina lepadiformis*.

1.2.4 CONCLUSIONS

Kingswest Ledge, Looe Gate and South-West Rocks are all northward facing chalk reefs which appear to be a part of the same underlying feature. The amount of exposed chalk increases with distance from the shore and South-West Rocks has both the longest chalk face exposed and the greatest height, reaching 2metres. The profile of the face of the reef also varies between the sites and South-West Rocks has the most consistently cliff-like formation. All three sites are relatively close to the shore and show considerable evidence of siltation.

Marina Reef is a little deeper that the other three easterly reefs and may be a part of the same stratum of chalk found closer inshore, and shallower, at Kingswest Ledge. The profile of the reef is different to the other ledges in that it includes an area of collapsed chalk in the form of large slabs or eroded boulders below the main face.

Worthing Lumps is both further offshore and higher than any of the more easterly sites. It has a pronounced cliff formation, again facing northwards, throughout the length of the two exposed sections. The cliff face and upper surfaces are relatively clean as a result of the strong tidal currents and separation from coastal influences.

Winter Knoll lies in shallower water than Worthing Lumps. Its formation is different to all of the other sites in that it appears to be, as its name suggests, a knoll of chalk rather than a long face. The marine wildlife associated with it is also a contrast to the other sites in that the upper surfaces are covered with kelp forest.

1.2.5 OFFSHORE SUSSEX CHALK REEFS - SPECIES LIST

The letter and numeric codes for phyla and species follow Howson (1987). Species included in the Basic Species list are denoted by an asterisk. The abundance of species is recorded as present (P), common (C) or abundant (A) and the number of records in each category given when more than one.

		MARINA REEF	KINGS-WEST	LOOE GATE	S-W ROCKS	COLLEGE ROCKS	WORTHING LUMPS	WINTER KNOLL
PORIFERA (C)								
25	*Leucosolenia botryoides*						P	
35	*Scypha ciliata*				P	CP	3P	P
95	*Oscarella lobularis*						P	P
125	*Dercitus bucklandi*						P	3P
167	*Pachymatisma johnstonia*						P	2P
215	*Tethya aurantium*						2P	
220	*Suberites carnosus*						P	
221	*Suberites domuncula*	P		2P	P		2P	
258	*Polymastia boletiformis*						P	
261	*Polymastia mamillaris*	P				2P		
302	*Cliona celata* *	C		2CP	4P	PC	5P	3P
429	*Raspailia ramosa*	P		2P				P
407	*Stelligera rigida*		P		P			P
481	*Halichondria bowerbanki*			CP		P	C	
484	*Halichondria panicea* *			P	P		2CP	
492	*Ciocalypta penicillus*	C				2P		
523	*Hymeniacidon perleve*	P		2P	P	P	2C2P	P
596	*Amphilectus fucorum* *			2CP	C	P	8C5P	
642	*Myxilla sp.*						P	
770	*Stylostichon plumosum*				P		P	
775	*Hemimycale columella*				P	P	3C3P	
854	*Haliclona* sp.						C2P	P
858	*Haliclona fistulosa*			2P			P	P
860	*Haliclona oculata*	P		3P			2P	
890	*Dysidea fragilis*	P	P	2CP	4CP	2P	6C3P	P
903	*Aplysilla rosea*						CP	
904	*Aplysilla sulfurea*						P	
HYDROZOA (D)								
121	*Corymorpha nutans*					P	C	
144	*Tubularia indivisa* *	C	C	P	4C4P	2P	3A6C6P	P
156	*Coryne* sp.						P	
238	*Eudendrium ramosum*				A			
597	*Nemertesia antennina*		P	P	2P		P	
599	*Nemertesia ramosa*	P						
653	*Hydrallmania falcata*	C			P			
675	*Sertularia* sp.				2P		C	
677	*Sertularia cupressina*	C			C			
730	*Obelia dichotoma*				P			
ANTHOZOA (D)								
1017	*Sarcodictyon roseum*			P				
1024	*Alcyonium digitatum*	P	P	CP	C3P	3P	C8P	2P
1075	*Cerianthus lloydii*						2C	
1158	*Anemonia viridis* *					P	C12P	
1168	*Urticina felina*		P		P	P	C4P	P
1225	*Metridium senile*	P						
1232	*Sagartia troglodytes*			C			C	
1237	*Cereus pedunculatus*					P	C	
1241	*Actinothoe sphyrodeta*	C					P	P

	MARINA REEF	KINGS-WEST	LOOE GATE	S-W ROCKS	COLLEGE ROCKS	WORTHING LUMPS	WINTER KNOLL
PLATYHELMINTHES (F)							
162 *Prostheceraeus vittatus*					2P	3P	
NEMERTEA (G)							
40 *Tubulanus annulatus*						P	
ANNELIDA (P)							
1874 *Sabellaria spinulosa*			CP				
2031 *Lanice conchilega*	C					P	P
2157 *Bispira volutacornis* *		P	C2P	2P		5C7P	C2P
2255 *Pseudopotamilla reniformis*						P	
2259 *Sabella* sp.						C	C2P
2304 *Pomatoceros triqueter*				C2P			
2326 *Filograna implexa* or *					3P	5C4P	C2P
2351 *Salmacina dysteri*							
CRUSTACEA (S)							
Barnacles sp.						3C	
Prawns						P	
2360 *Homarus gammarus* *	P	P	2P	2P	2P	C5P	2P
Squat lobster sp. *			P	P		5P	3P
Hermit crab sp.	P		P			CP	
2468 *Pagurus cuanensis*				P			
2553 *Maja squinado* *			2P			6P	2P
small spider crab sp.				P	P		
2646 *Cancer pagurus* *			2P	C2P	2P	4C5P	CP
2672 *Liocarcinus puber*	C	P		P		2P	
MOLLUSCA (W)							
193 *Gibbula cineraria*						2P	P
200 *Calliostoma zizyphinum*			P	3P		3C4P	2C
726 *Crepidula fornicata*				P			
737 *Trivia arctica*		P	P	2C		P	P
777 *Natica poliana* (eggs)						P	
829 *Ocenebra erinacea*				P		2P	P
844 *Buccinum undatum*					P	2P	
887 *Hinia incrassata*			C				
889 *Hinia reticulata*			P	CP		3P	
1361 *Polycera* sp.						P	
1403 *Archidoris pseudoargus*					P	C3P	C
1418 *Jorunna tomentosa*						C5P	
1431 *Janolus cristatus*			P				
1448 *Coryphella* sp.				C		2P	P
1451 *Coryphella gracilis*				P			
1460 *Flabellina pedata*			P	2P			P
1524 *Facelina* sp.				P			
1769 *Ostrea edulis*	P			P			
2027 *Ensis siliqua*					P		
Piddocks spp. *	P		CP	4C2P	3P	4C2P	P
2251 *Hiatella arctica*			C	C			
2266 *Pholas dactylus*			C			2C	P
2271 *Barnea candida*	P					C	
2273 *Barnea parva*						C	
2393 *Sepia officinalis*	P					P	

	MARINA REEF	KINGS WEST	LOOE GATE	S-W ROCKS	COLLEGE ROCKS	WORTHING LUMPS	WINTER KNOLL
BRYOZOA (Y)							
351 *Pentapora foliacea*						3P	P
606 *Cellepora pumicosa*	P		C2P	2P	P	C2P	
694 *Flustra foliacea* *		C	P	C3P	C2P	4C10P	P
705 *Chartella papyracea*			2C	P			
710 *Securiflustra securifrons*				C			
869 *Bugula* spp.	C		A2C		P	3C3P	AC
872 *Bugula flabellata*							P
875 *Bulgula plumosa*				C		C	
879 *Bugula turbinata*	P			C	C	P	
Eucrusting bryozoans						CP	
PHORONIDA (ZA)							
4 *Phoronis hippocrepia* *	C		2CP	P	3P	C2P	C2P
ECHINODERMATA (ZB)							
149 *Crossaster papposus*						CP	
165 *Henricia oculata* *						4P	
190 *Asterias rubens*		P	2P	2C3P	P	9P	P
Cucumarian *				2P			
TUNICATA (ZD)							
6 *Clavelina lepadiformis* *	P		3P	P	P	7P	CP
12 *Pycnoclavella aurilucens*			C				
17 *Distaplia rosea*			P				
46 *Morchellium argus*			C			C	C
57 *Aplidium* sp.		P	C		P	C4P	C
63 *Aplidium poriferum*			C			P	
64 *Aplidium punctum*			C	2C			
96 *Diplosoma* sp.	P		P			C	
97 *Diplosoma listeranium*				P			
117 *Ciona intestinalis* *			P			3P	P
129 *?Perophora listeri*			P				
143 *Ascidiella scabra*			C				
150 *Ascidia mentula*							C
172 *Styela clava*							P
209 *Botryllus schlosseri*						C3P	C
256 *Molgula manhattensis*			C				
Aggregating grey squirts *			CP	2P		2CP	
PISCES - CHONDRICHTHYES (ZF)							
40 *Syliorhinus canicula*						3P	
PISCES - OSTEICHTHYES (ZG)							
22 *Conger conger*			P		2P		
196 *Molva molva*						P	
218 *Trisopterus luscus*	C	P	3C	3C2P		3P	CP
219 *Trisopterus minutus*	C		3C	C2P	C	3P	CP
376 *Syngnathus acus*		P					
408 *Eutrigla gurnardus*							P
438 *Taurulus bubalis* *				P	2P	2P	
453 *Cyclopterus lumpus*						P	
601 *Crenilabrus melops*			P	2P		2C2P	
605 *Ctenolabrus rupestris*	P	P	3P	2C2P	P	2C5P	P

		MARINA REEF	KINGS-WEST	LOOE GATE	S-W ROCKS	COLLEGE ROCKS	WORTHING LUMPS	WINTER KNOLL
PISCES - OSTEICHTHYES (continued)								
636	*Parablennius gattorugine* *	P			2P	2P	5C3P	
684	*Ammodytes* sp.						C	
700	*Callionymus lyra*	P			P	P		P
718	*Gobius* sp.			P		P		
724	*Gobius paganellus*			P				
742	*Pomatoschistus minutus*			2CP		C		
748	*Thorogobius ephippiatus* *	P			P	3P	6C2P	P
859	*Psetta maxima*				P			
867	*Zeugopterus punctatus*						P	
903	*Pleuronectes platessa*		P					
ALGAE - RHODOPHYCEAE (ZM)								
250	*Dilsea carnosa*						P	
404	*Corallina officinalis*						P	
584	*Phyllophora crispa*						2C	
586	*Phyllophora pseudoceranoides*						2CP	
611	*Chondrus crispus*						P	
631	*Plocamium cartilagineum*						P	
648	*Halarachnion ligulatum*						P	
682	*Calliblepharis ciliata*		P		P		3C3P	C
693	*Rhodophyllis divaricata*						P	
740	*Chylocladia verticillata*						P	
	Callithamnion/Antithamnion?						P	
844	*Griffithsia corallinoides*						P	
950	*Cryptopleura ramosa*						P	
955	*Delesseria sanguinea*						2C2P	C
985	*Hypoglossum hypoglossiodes*						2C	
1105	*Polysiphonia elongata*						P	
1039	*Heterosiphonia plumosa*						2P	C
1117	*Polysiphonia nigrsecens*						2P	
	Red foliaceous algae spp. *			C2P	C42P	3P	8C4P	C
	Encrusting pink/purple						P	CP C
ALGAE - PHAEOPHYCEAE (ZR)								
457	*Dictyota dichotoma*						2P	
496	*Desmarestia* sp.						2P	
497	*Desmarestia aculeata*						P	
632	*Laminaria digitata*							P
633	*Laminaria hyperborea* *						3P	C
636	*Laminaria saccharina*							C
ALGAE - CHLOROPHYCEAE (ZS)								
245	*Ulva lactuca*				P			
392	*Bryopsis plumosa*				C		2C	
	Green algae spp.				P		C	

1.3 COASTAL FRINGING REEFS IN SUSSEX

1.3.1 DESCRIPTION OF CHALK FEATURES

Chalk inter-tidal platforms extending into the sublittoral are found in Sussex between Brighton and Eastbourne. The main areas of sublittoral reefs are off Seaford Head and the Seven Sisters and have been described in a Marine Conservation Society/Nature Conservancy Council report (Wood & Jones, 1986). The reefs at Burrow Head, just west of Newhaven and at Rottingdean are described briefly in the Sussex Sublittoral Survey (Wood, 1984). The areas not described in these reports are those to the west of the Rottingdean site towards Brighton and to the east towards Newhaven. We did not manage to visit either area during the current survey in sufficiently good diving conditions to obtain any meaningful records. Beyond the westerly extent of the coastal cliffs at Brighton chalk is exposed in the sublittoral within an area generally covered by soft sediments. The dive on this area was immediately adjacent to Palace Pier and both the habitat and species present are clearly modified by the presence of the metal structures.

1.3.2 SUBLITTORAL STUDY AREAS

A single dive was carried out at Palace Pier, Brighton as follows: 1 Dive on 29/7/90
Site Log No. 64
Basic Species Record No. 71
Extra Species Record No. 70
The records were made by Chris Wood.

1.3.3 SUBLITTORAL HABITATS AND COMMUNITIES

The areas of chalk exposed beneath and adjacent to the base of the pier are limited in extent and the amount of chalk exposed may well vary with the movement of soft sediments. The chalk outcrops are generally flat with only occasional raised areas. Vertical faces and the range of chalk habitats are thus very limited. The presence of much metal debris provides a considerable range of additional habitats and there is a good range of marine animals present, particularly fishes. Species found on the chalk areas were affected by the high level of siltation and included 'mats' of the sea squirt *Molgula manhattensis* and large numbers of the Horseshoe Worm *Phoronis hippocrepia*. The rock is heavily bored by piddocks. No algae were present (recorded depth 9m, m below chart datum).

1.3.4 CONCLUSION

The Palace Pier site is not typical of the inshore chalk exposures in the area but the mixture of hard and soft substrata gives rise to a varied fauna.

1.3.4 SPECIES LIST - COASTAL FRINGING REEFS, SUSSEX

The letter and numeric codes for phyla and species follow Howson (1987). Species included in the Basic Species list are denoted by an asterisk.The abundance of species is recorded as present (P), common (C) or abundant (A) and the number of records in each category given when more than one.

The records for Rottingdean and Newhaven are from the Sussex Sublittoral Survey (Wood, 1984) and for Seven Sisters from the Seven Sisters Surveys (Wood & Jones, 1986 - chalk sites only). Records from Palace Pier are those from the mixed chalk/sand/metal habitats and exclude species occuring only on the metal structures of the pier.

	PALACE PIER	ROTTING-DEAN	NEWHAVEN	SEVEN SISTERS
PORIFERA (C)				
25 *Leucosolenia botryoides*				P
167 *Pachymatisma johnstonia*				P
215 *Tethya aurantium*			P	
221 *Suberites domuncula*	P	P	P	P
302 *Cliona celata* *			P	P
407 *Stelligera rigida*				P
481 *Halichondria bowerbanki*			P	C
484 *Halichondria panicea* *		C	C	C
890 *Dysidea fragilis*			P	P
HYDROZOA (D)				
144 *Tubularia indivisa* *	C		P	P
597 *Nemertesia antennina*				P
653 *Hydrallmania falcata*				P
669 *Sertularella polyzonias*				P
728 *Obelia* sp.			P	
731 *Obelia geniculata*		C		
ANTHOZOA (D)				
1024 *Alcyonium digitatum*	P		P	C
1075 *Cerianthus lloydii*				P
1151 *Actinia equina*		P		P
1152 *Actinia fragacea*		P	P	P
1168 *Urticina felina*		P	P	P
1214 *Diadumene cincta*				P
1225 *Metridium senile*	P		C	P
1231 *Sagartia elegans*				P
1232 *Sagartia troglodytes*	P		P	P
1237 *Cereus pedunculatus*				C
1241 *Actinothoe sphyrodeta*	P			C
PLATYHELMINTHES (F)				
162 *Prostheceraeus vittatus*				P
NEMERTEA (G)				
40 *Tubulanus annulatus*				
78 *Lineus longissimus*				P

	PALACE PIER	ROTTING-DEAN	NEWHAVEN	SEVEN SISTERS
ANNELIDA (P)				
256 *Anaitides maculata*				P
1274 *Polydora* sp.			C	
1576 *Arenicola marina*				P
1874 *Sabellaria* sp.			C	C
1876 *Sabellaria spinulosa*				C
2031 *Lanice conchilega*	P	C	P	C
2157 *Bispira volutacornis* *				P
2255 *Pseudopotamilla reniformis*				P
2261 *Sabella pavonina*				P
2304 *Pomatoceros triqueter*		C	P	P
2326 *Filograna implexa* or *				P
2351 *Salmacina dysteri*				
CRUSTACEA (R/S)				
R 108 *Balanus balanoides*		C		P
S Prawns				P
S2360 *Homarus gammarus* *	P	P	P	P
S Hermit crab sp.			P	
S2465 *Pagurus bernhadus*		P		P
S2489 *Galathea squamifera*		C		P
S2490 *Galathea strigosa*				P
S2553 *Maja squinado* *	P	C	P	P
S2559 *Hyas araneus*				P
S small spider crab sp.			P	P
S2577 *Inachus leptochirus*				P
S2646 *Cancer pagurus* *	P	P	C	C
S2672 *Liocarcinus puber*		P	C	C
S2690 *Carcinus maenas*	P	P		P
S2735 *Pilumnus hirtellus*				P
MOLLUSCA (W)				
139 *Helcion pellucidum*		C		P
193 *Gibbula cineraria*		C		P
244 *Lacuna vincta*		P		
726 *Crepidula fornicata*		C		P
737 *Trivia arctica*				P
829 *Ocenebra erinacea*		C		
887 *Hinia incrassata*		P		
1332 *Onchidoris bilamellata*				C
1403 *Archidoris pseudoargus*				P
1431 *Janolus cristatus*				P
1448 *Coryphella* sp.				P
1460 *Flabellina pedata*				P
1650 *Mytilus edulis*	C		P	P
1769 *Ostrea edulis*			P	
1991 *Cerastoderma edule*				P
2184 *Venerupis* sp.				P
Piddocks spp. *	P			C
2251 *Hiatella arctica*	C			P
2266 *Pholas dactylus*		C	C	
2393 *Sepia officinalis*				P(eggs)
2430 *Loligo* sp.				P(eggs)

		PALACE PIER	ROTTING-DEAN	NEWHAVEN	SEVEN SISTERS
BRYOZOA (Y)					
137	*Alcyonidium diaphanum*				P
606	*Cellepora pumicosa*				P
664	*Membranipora membranacea*		C	P	
694	*Flustra foliacea* *				P
869	*Bugula* spp.		P	C	C
879	*Bugula turbinata*	P			
PHORONIDA (ZA)					
4	*Phoronis hippocrepia* *	C		C	C
ECHINODERMATA (ZB)					
190	*Asterias rubens*	P		C	C
	Brittle Star sp.				P
TUNICATA (ZD)					
6	*Clavelina lepadiformis* *	P	P	C	C
46	*Morchellium argus*		P	C	C
64	*Aplidium punctum*			C	
	Didemnid tunicate				P
97	*Diplosoma listeranium*		P	C	
117	*Ciona intestinalis* *				P
141	*Ascidiella aspersa*		P		
209	*Botryllus schlosseri*		P		P
256	*Molgula manhattensis*	C	P	C	C
PISCES - CHONDRICHTHYES (ZF)					
134	*Raja batis*				P
PISCES - OSTEICHTHYES (ZG)					
12	*Anguilla anguilla*	P	P		
22	*Conger conger*				P
160	*Ciliata mustela*				P
218	*Trisopterus luscus*	P	P	C	P
219	*Trisopterus minutus*			P	P
280	*Pollachius pollachius*	P	P		P
293	*Atherina presbyter*		P		
376	*Syngnathus acus*			P	P
438	*Taurulus bubalis* *			P	P
448	*Agonus cataphractus*				P
473	*Dicentrachus labrax*				P
554	*Spondyliosoma cantharus*	P			
568	*Mullus surmuletus*	P		P	P
578	*Chelon labrosus*		P		P
601	*Crenilabrus melops*	P	P		P
605	*Ctenolabrus rupestris*	P		P	P
609	*Labrus bergylta* *			P	P
610	*Labrus mixtus*		C		
632	*Lipophrys pholis*		P		
636	*Parablennius gattorugine* *	P		C	P
680	*Pholis gunnellus*	P	P	P	P
700	*Callionymus lyra*	P	P		P
724	*Gobius paganellus*				P
728	*Gobiosculus flavescens*				P

		PALACE PIER	ROTTING-DEAN	NEWHAVEN	SEVEN SISTERS
PISCES - OSTEICHTHYES (ZG) (continued)					
742	*Pomatoschistus minutus*				C
744	*Pomatoschistus pictus*		P		
748	*Thorogobius ephippiatus* *			P	P
859	*Psetta maxima*	P			
903	*Pleuronectes platessa*				P
929	*Solea solea*				P
ALGAE - RHODOPHYCEAE (ZM)					
106	*Audouinella chylocladiae*				P
184	*Sciniaia forcellata*				P
250	*Dilsea carnosa*				P
450	*Lithophyllum incrustans*				P
548	*Gracilaria verrucosa*				P
566	*Anfeltia plicata*				P
576	*Gymnogongrus crenulatus*				P
586	*Phyllophora pseudoceranoides*				P
611	*Chondrus crispus*			C	P
631	*Plocamium cartilagineum*		C		P
682	*Calliblepharis ciliata*				P
688	*Cystoclonium prupureum*				P
726	*Rhodymenia holmesii*				P
766	*Antithamnion cruciatum*				P
775	*Antithamnionella spirographidis*				P
823	*Ceramium rubrum*				P
844	*Griffithsia corallinoides*				P
846	*Griffithsia flosculosa*				P
856	*Halurus equisetifolius*				P
950	*Cryptopleura ramosa*				P
985	*Hypoglossum hypoglossiodes*				P
995	*Nyriogramme ?bonnemaisonii*				P
1024	*Radicilingua thysanorhizans*				P
1056	*Chondria dasyphylla*				P
1116	*Polysiphonia nigra*				P
1117	*Polysiphonia nigrescens*				P
ALGAE - PHAEOPHYCEAE (ZR)					
457	*Dictyota dichotoma*				P
632	*Laminaria digitata*				C
633	*Laminaria hyperborea* *				C
636	*Laminaria saccharina*		C	C	C
ALGAE - CHLOROPHYCEAE (ZS)					
219	*Enteromorpha intestinalis*		P		P
245	*Ulva lactuca*		P		P
338	*Cladophora* sp.		P		
389	*Bryopsis ?hypnoides*				P
392	*Bryopsis plumosa*				P

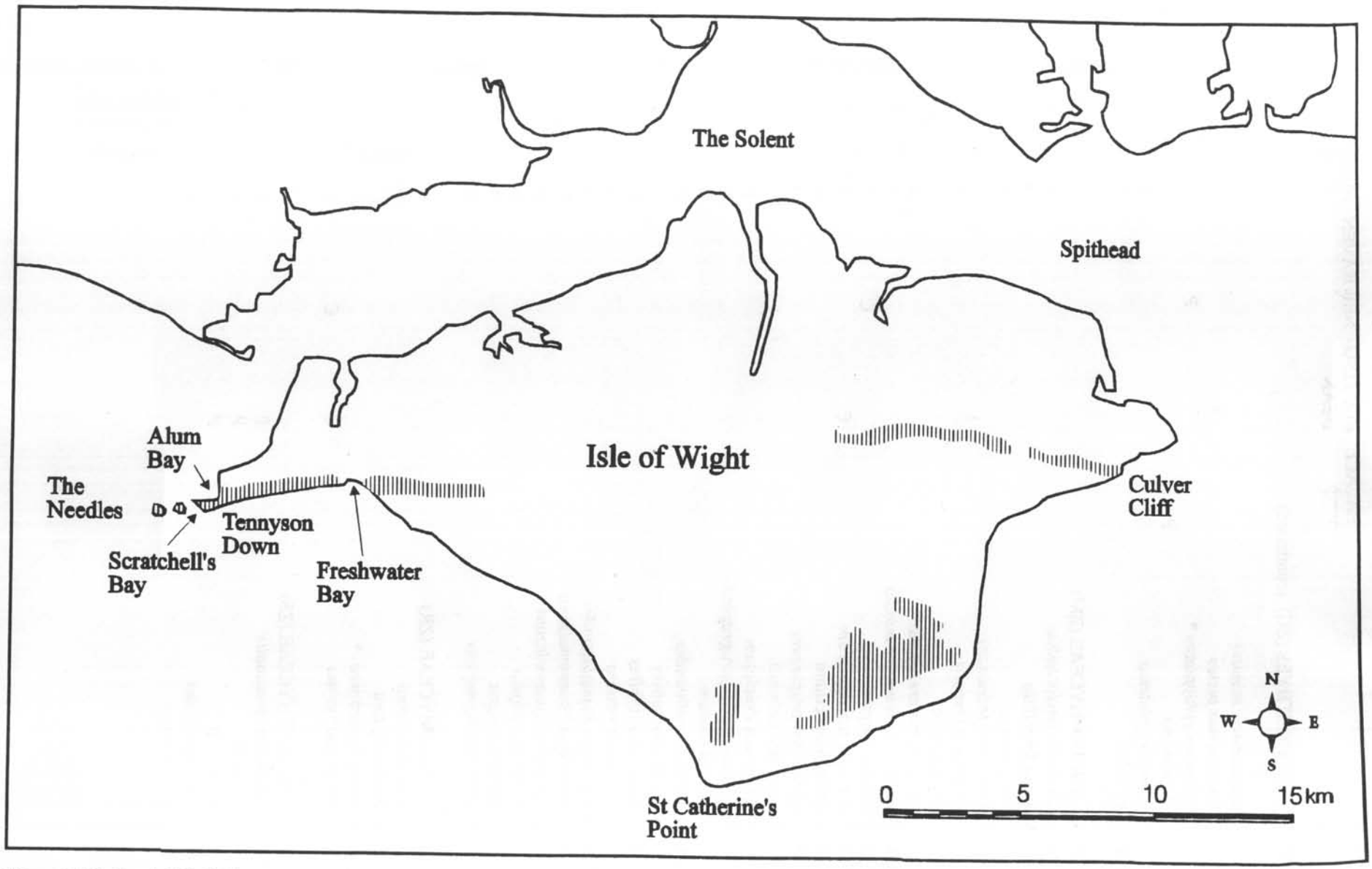

Figure 1.4.1 Coastal Chalk Exposures on the Isle of Wight.

1.4 ISLE OF WIGHT

1.4.1 DESCRIPTION OF CHALK FEATURES

The chalk strata on the Isle of Wight mainly comprise a narrow band running across the island from west to east. The strata are vertically bedded and younger rocks, mostly clays and sands, are found to the north of the chalk backbone of the island, with older rocks, greensand and gault, to the south. The chalk ridge reaches the sea at The Needles in the west and Culver Cliff in the east (Figure 1.4.1).

In the west the high ridge of Tennyson Down runs from Freshwater Bay to The Needles. It reaches a height of 147m and its southern side is formed by a chalk coastal cliff some 5km in length. At Freshwater the sea has broken through the chalk and to the east only about a further 1km of chalk forms the coast, before the ridge continues inland across the island.

South of The Needles point there is a small bay known as Scratchells Bay which has a south-westward protruding bluff forming its eastern side. The Needles themselves are chalk stacks which follow the line of the underlying strata. On the northern side of the headland is Alum Bay and a chalk cliff, about 1km in length, forms its southern side. The lower cliffs at the back of Alum Bay, and Hatherwood Point which forms its northern side, are both formed by younger rocks.

The total length of chalk cliff coastline at the western end of the Isle of Wight is thus about 8km, most of which is exposed to the prevailing south western wind and swell. There are strong tidal currents, reaching ..kts around the Needles. Figure 1.4.2. is a more detailed map of the chalk sites at the western end of the island.

The chalk cliff coastline at the eastern end of the island is more limited in extent, with only about 1km length of Culver Cliff comprising chalk. To the north of the headland is the sand edged Whitecliff Bay and to the south west, towards Sandown, the lower cliffs are formed of upper and lower greensand.

Chalk is also exposed inland in the south of the island near St Catherines Point. Here, however, there is no pure chalk cliff line and the coast consists of landslipped rocks.

1.4.2 SUBLITTORAL STUDY AREAS

Underwater surveys were carried out in the following locations.

Alum Bay (south side), 5 dives on 7/9/85
- Site Log Nos. 29,30,31,39
- Basic Species Record Nos. 36,37,42,46
- Extra Species Record Nos. 31,32,33,34,37,41

The Needles (north side), 2 dives on 7/9/85
- Site Log Nos. 32,33
- Basic Species Record Nos. 38,47
- Extra Species Record Nos. 35,37

The Needles (end) 2 dives, 9/8/86 & 11/8/86
- Site Log Nos. 56,57
- Basic Species Record Nos. 62,63

The Needles (south side), 2 dives, 7/9/85 & 8/9/85
- Site Log Nos. 34,40
- Basic Species Record Nos. 39,44,45,47
- Extra Species Record Nos. 36,42

Scratchells Bay/Sun Corner, 3 dives on 8/9/85 & 6/7/91
- Site Log Nos. 35,36,72,73
- Basic Species Record Nos. 40,41,77,78
- Extra Species Record Nos. 38,77,78

Tennyson Down, 5 dives on 30/6/90 & 6/7/91
Site Log Nos. 61,62,63,68,69,70,71
Basic Species Record Nos. 67,68,69,74,75,76
Extra Species Record Nos. 74,75,76
Freshwater, 1 dive on 6/9/86
Site Log No. 51
Extra Species Record No. 55
Culver Cliff, 3 dives on 18/7/87
Site Log Nos. 59,60,61
Basic Species Record Nos. 65,66,67
Extra Species Record Nos. 64,65,66

The records on which the following habitat and community descriptions and the species list are based were compiled by; Graham Ackers, Paul & Ponnie Dudley, Bill & Peter Hewitt, Tony Hunt, Dick Manuel, James Nokes, Sally Rogers, Chris Spurrier & Chris Wood. The survey team were assisted by members of Billericay Sub Aqua Club in the dives around The Needles and by Wight Dolphins in the dives at Culver Cliff. Additional species information from Culver Cliff was supplied by Jenny Mallinson and Ken Collins based on two dives carried out on 13/6/87.

1.4.3 SUBLITTORAL HABITATS AND COMMUNITIES

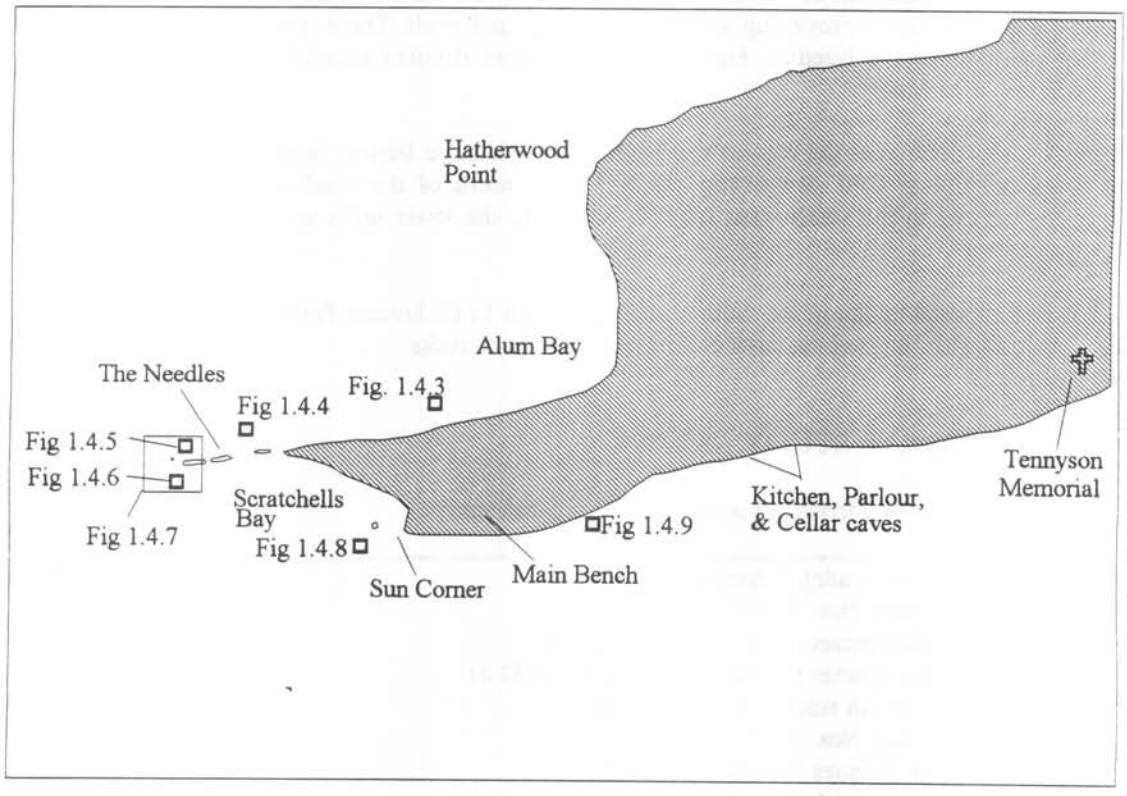

Figure 1.4.2 Location of study sites in the Needles area

ALUM BAY

The vertical chalk cliff which forms the southern side of Alum Bay does not extend significantly below low water level. There is a horizontal platform about 50m in width which extends out from the cliff base at or just below the low water mark. The outer edge of the platform is formed by a sublittoral chalk cliff about 3m in height. The upper part is vertical but the lower half is undercut by wave action and in many places forms crevices, overhangs and caves. This provides a variety of shaded and open rock surfaces and the full range of sloping, overhanging and cave-roof orientations.

Below the chalk cliff the sea-bed is comprised of a mixture of flint cobbles and chalk boulders clearly recruited from the chalk platform and cliffs. This is soon replaced by a sand and pebble sea-bed with occasional boulders both of chalk and other rocks. The boulders become less frequent further from the base of the cliff. Further offshore and again parallel with the main cliff in a depth of about 7m there is a second area of exposed chalk forming a low reef. This does not exceed 1m in height and is replaced in some areas by exposed grey clay partially covered by mobile ridges of gravel.

The shore platform was dominated by kelp forest consisting of both *Laminaria hyperborea* and *L. digitata*. The upper vertical chalk cliff was covered by a variety of red and brown foliaceous algae. Few areas of bare rock were present and those not covered by foliaceous algae or an animal 'turf' had a hard exterior coating of encrusting pink algae. Though the rocks beneath were extensively bored by piddocks the encrusting algae probably has a stabilising effect and limits the erosion process. Lower vertical surfaces and caves had a varied sponge fauna (15 spp. recorded) and a range of mobile life including large squat lobsters (*Galathea strigosa*), crabs and a number of rock and crevice dwelling species of fishes. The Leopard - Spotted Goby, *Thorogobius ephippiatus* was common.

The boulder and cobble areas below the cliff had a similar range of the smaller algae and attached animal life to the cliff itself. Notable amongst the mobile species here were large numbers of the smaller squat lobster, *Galathea squamifera*.

The sand and pebble areas and low reef further offshore were notable for the number of molluscs (7 spp.) and worms. On the exposed chalk were large numbers of the tiny horseshoe worm *Phoronis hippocrepia*.

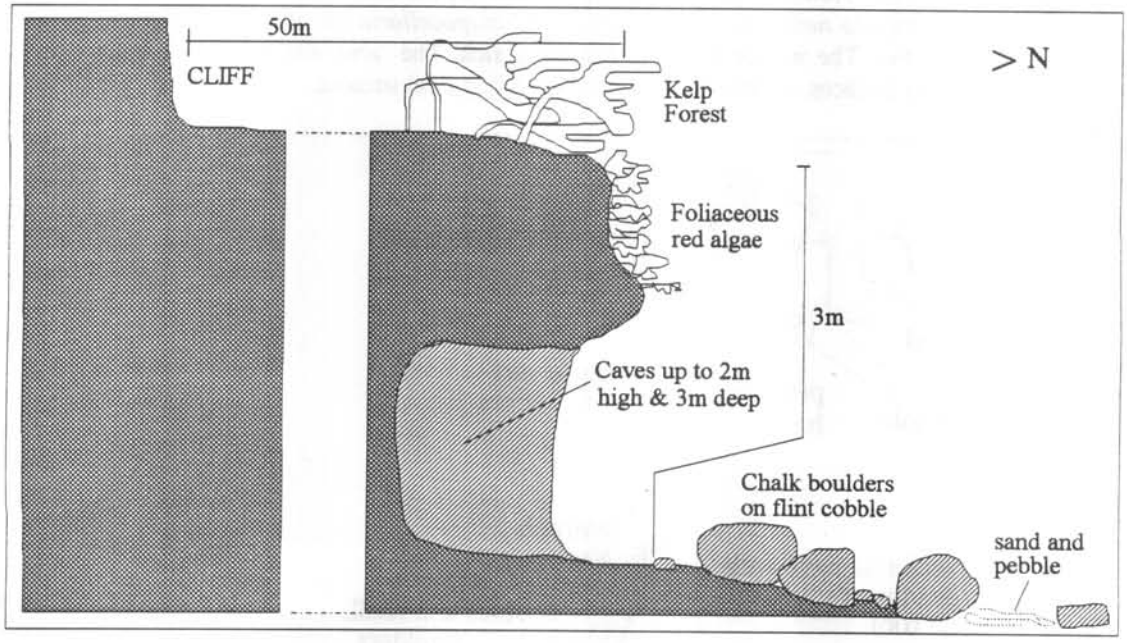

Figure 1.4.3 Alum Bay - profile.

THE NEEDLES

The sea-bed on the northern and southern sides of The Needles is quite different. The extent of exposed chalk on the northern side is limited to about 50m from the stacks and the sea-bed drops quite quickly to a gravel plain. On the south side there is an extensive shallow chalk reef system. On the north side there is a continuation of the underwater cliff found on the south side of Alum Bay, again 2-3m in height (Figure 1.4.4B). In places the cliff is replaced by a series of shallow gullies running parallel with the line of the stacks and by a boulder slope (Figure 1.4.4A). The upper surfaces were kelp covered (*Laminaria hyperborea*) with a rich understorey of red and brown seaweeds. Animal turf on the lower rocky sides was limited to sturdy encrusting species reflecting the strong currents which are experienced here and its exposed situation.

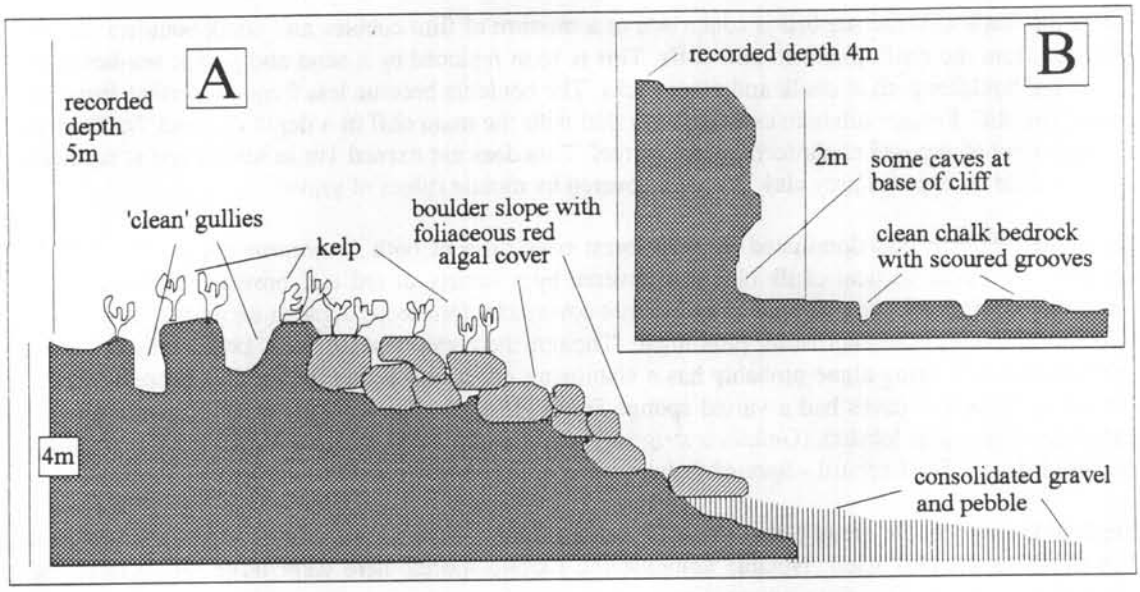

Figure 1.4.4 The Needles - Two typical profiles on the north side.

A measured transect was surveyed on the northward facing slope beyond the lighthouse and is shown in Figure 1.4.5. The cliff at this point is 6m in height. The variety of life associated with it was similar to the more easterly cliff. However, the animal 'turf' cover on the cliff was richer with a range of bryozoans including *Bugula turbinata, B. flabellata* and *Scrupocellaria* sp. as well as hydroids such as *Nemertesia antennina*. The mobile life was reasonably rich. The area was noticeably clean with virtually no silt on any surfaces, again a reflection of the strong tidal streams.

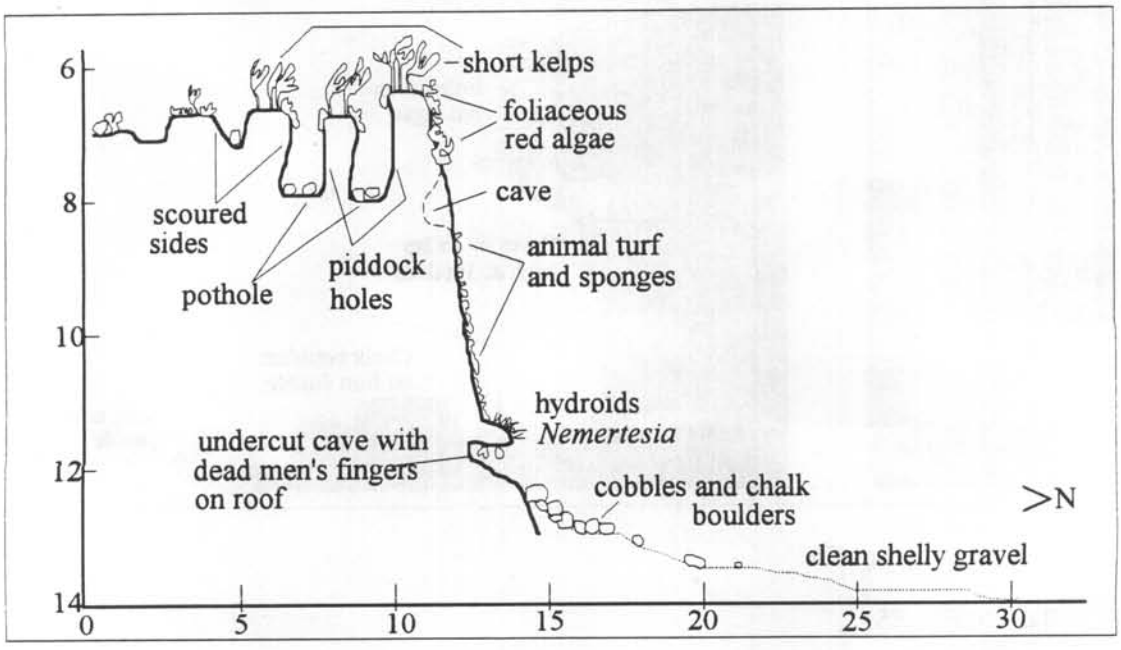

Figure 1.4.5 The Needles - Profile of drop off on north side (location on Figure 1.4.7).

On the south-west side of the lighthouse there is an underwater cliff about 3m high very close to the rock. Below this is an extensive area of chalk bedrock in contrast to the northern side where the sea-bed below the cliff is of consolidated pebbles and gravel with some boulders on the surface (Figure 1.4.6).

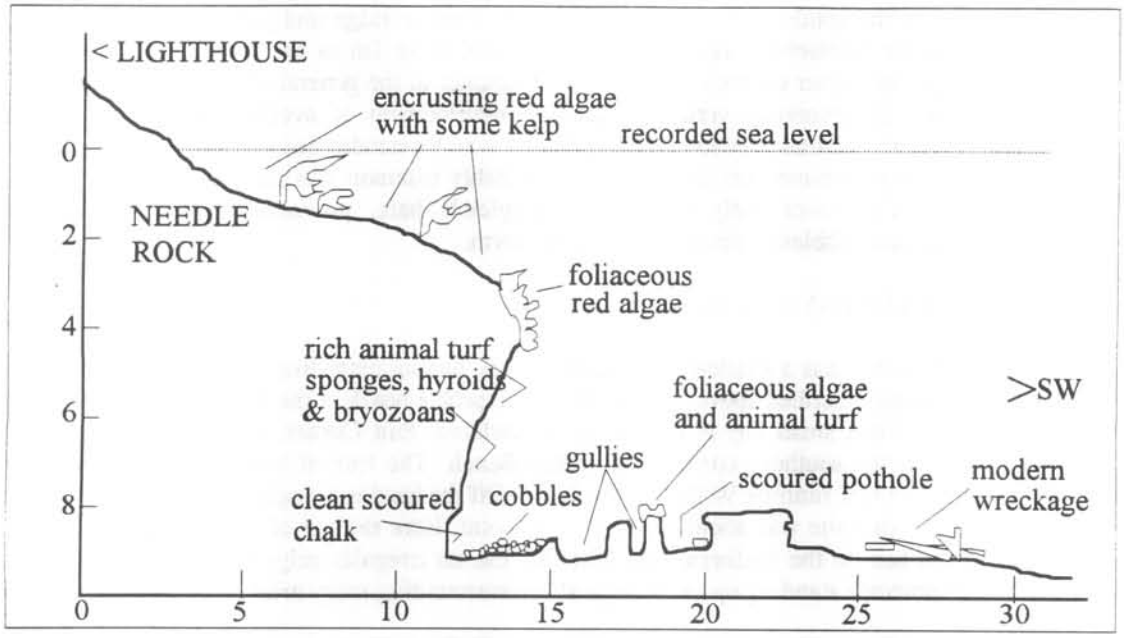

Figure 1.4.6 The Needles - Profile of Needle Rock, south-west side (location on Figure 1.4.7).

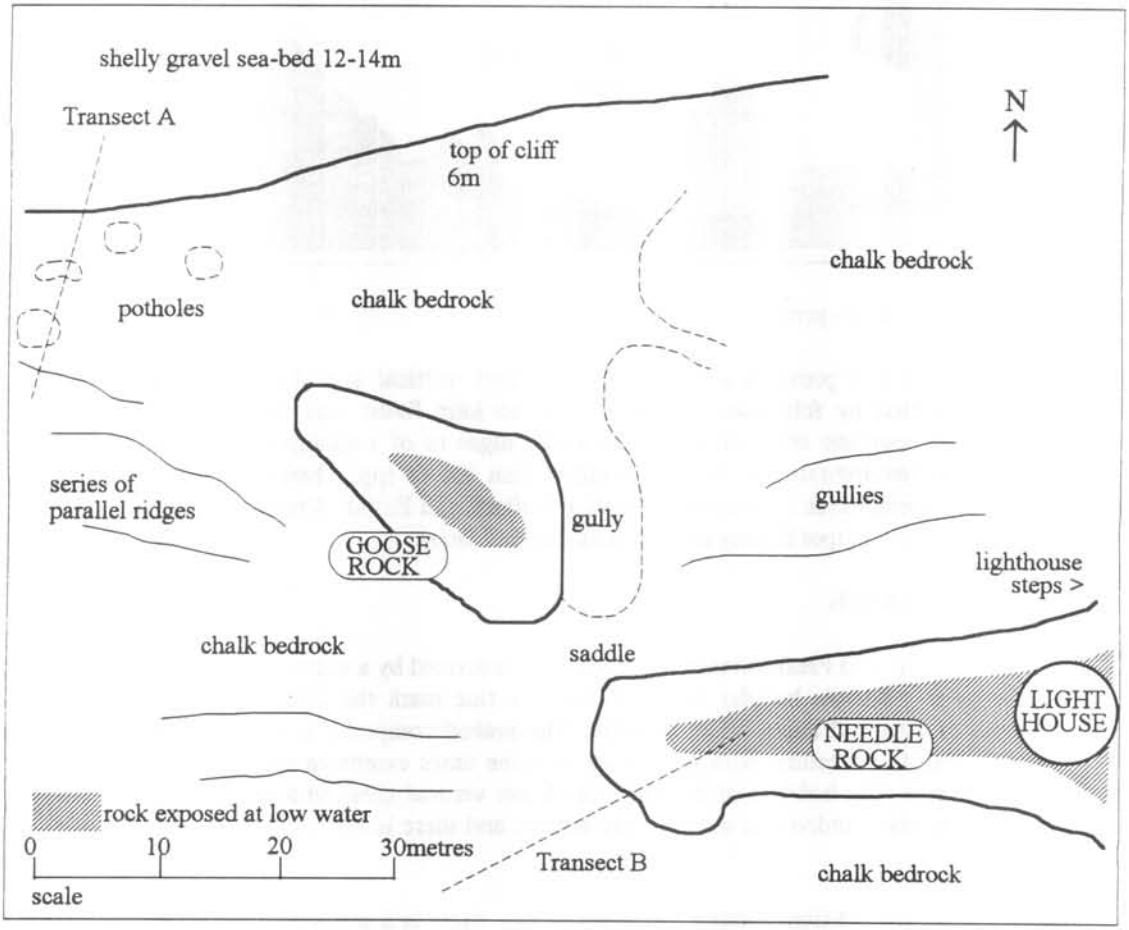

Figure 1.4.7 The Needles - Sublittoral map of lighthouse area.

The chalk bedrock to the south of the stacks has a fairly regular ridge and gully pattern running parallel with the stacks themselves. The ridges are generally up to 1m in height but there are also occasional large areas of higher bedrock with sides both counter to the general line and higher, up to 2m. The gully sides are generally vertical with little development of overhangs or caves. The horizontal surfaces were dominated by folicaeous red algae which extended onto the upper gully sides. Encrusting sponges were common on the gully sides. Notably common was the Black Tar Sponge, *Dercitus bucklandi*. The lower gully sides were completely bare, presumably affected by the movement of pebbles and cobbles in times of surge and storm.

SCRATCHELLS BAY/SUN CORNER

The central part of the bay has a shallow chalk and bedrock bottom extending east from the area to the south of The Needles described above. Inshore there is a pebble beach at the foot of the chalk cliff. The easterly extent of this small bay is formed by a headland, Sun Corner, which represents the westernmost extent of the southern coastal cliff, Main Bench. The line of Main Bench continues underwater as a distinct reef running WSE (approx 250°). Off the head is a single rock exposed at low water and our dive at this site was about 100m off this point. Here the top of the chalk reef is 5m above the gravel sea-bed on the southern side. The reef has an irregular ridge and gully formation with random large outcrops standing up to 2m high above surrounding rocky areas.

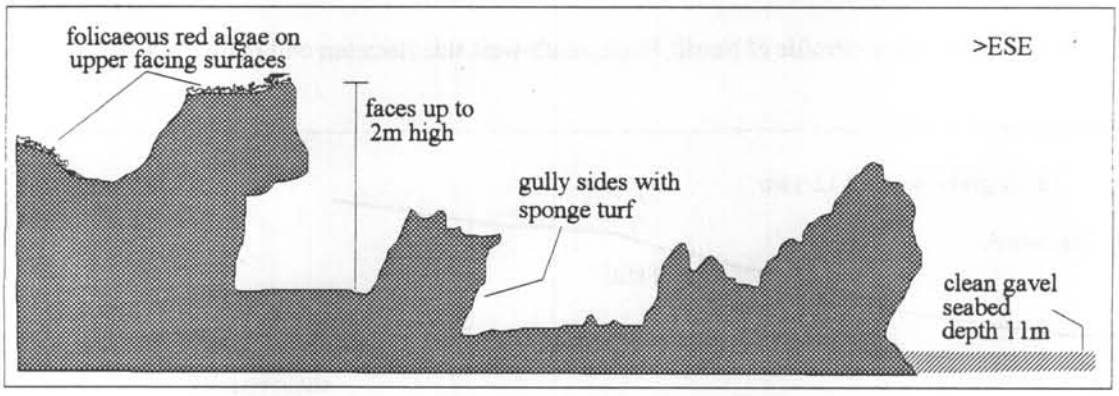

Figure 1.4.8 Scratchells Bay - profile.

The topography of the reef provides a variety of horizontal, vertical and sloping surfaces. Upper surfaces were dominated by foliaceous red algae, but no kelp forest was observed. Gully sides appeared stable with complete cover either of encrusting algae or of a sponge dominated (11 spp.) animal 'turf'. Mobile invertebrate life was not prolific. Fish life (8 spp.), however, was reasonably varied and included species seen in open water such as Pollack and Ballan Wrasse, as well as crevice dwelling species such as Tompot Blenny and Leopard-Spotted Goby.

TENNYSON DOWN

Between Scratchell's Bay and Freshwater Bay the coastline is formed by a continuous chalk cliff about 140m high. There is a narrow boulder beach. Below low tide mark the seabed shelves gradually, reaching a depth of 20m bcd about 500m offshore. The seabed comprises a series of rocky ridges running parallel with the coastline with gullies, or in some cases extensive areas of gravel or flat bedrock, between them. The bedding of the rocks is almost vertical creating a jagged profile to the tops of the ridges. Bands of individual outcrops are narrow and there is a succession of different rock types.

In the western part of this section of coast, off Main Bench, there is a series of chalk ridges parallel with the shore for a distance of about 100m from the boulder beach. The rock here is believed to be Middle Chalk and contains a high proportion of impurities. The ridges are generally about 1.5m high, but reach 3m in parts, and have kelp forest on their upper surfaces. The recorded depth is 4-6m generally but as deep as 10m opposite the coastal caves the Kitchen, Parlour and Cellar. Beyond the chalk is a gently sloping seabed with chalk boulders and gravel overlying a soft grey bedrock.

We found a second, separate, rock ridge about 200m offshore consisting of black shale angled at about 20^{o} from the vertical towards the shore. This contrastsd with the other ridges, all of which face away from the shore by a similar amount. The smooth outer face is between 8m and 12m recorded depth and dominated by sponges. We recorded nine species of sponge two of which, *Amphilectus fucorum* and *Halichondria bowerbanki*, were abundant.

Below this slope the seabed comprises flat grey clay at 12m depth, the surface extensively bored by the common piddock *Pholas dactylus*. By 300m from the shore the seabed is covered with fine silty sand. A typical profile across the area is shown in Figure 1.4.9.

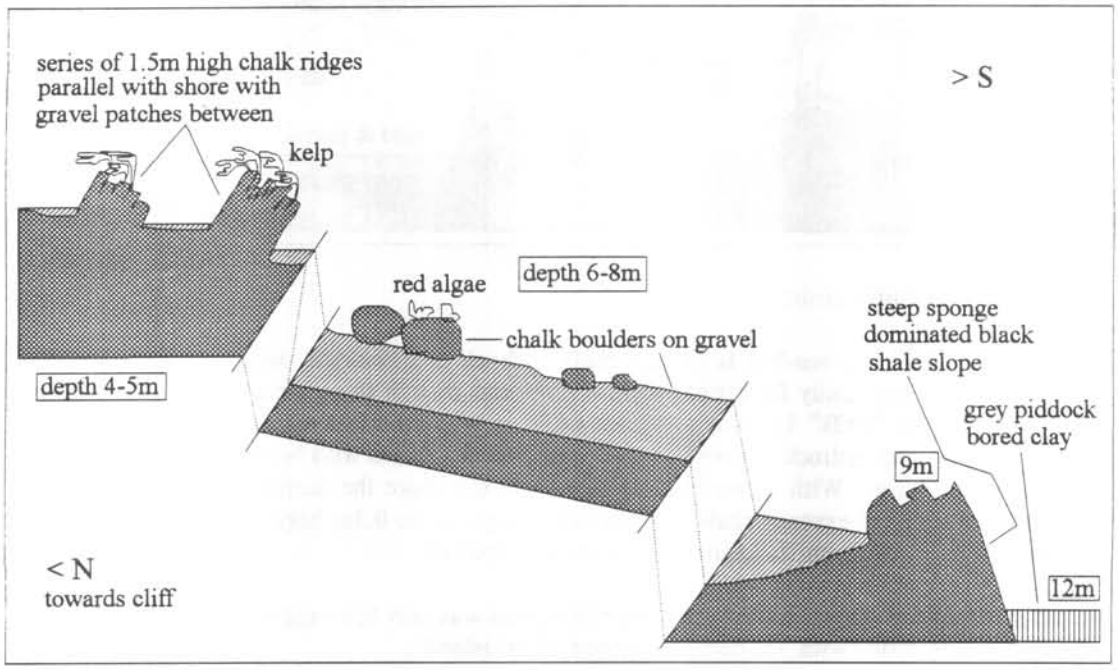

Figure 1.4.9 Profile off Main Bench, Tennyson Down

In the eastern part of this section of coast, immediately south of the Tennyson Memorial on the cliff top, chalk is only found on the foreshore and very shallow sublittoral. Within 100m of the cliff the seabed comprises a series of soft sandstone ledges running parallel with the shore. These ledges are up to 3m in height and there is a consistent 60^{o} angle of bedding towards the south. Since this faces into the prevailing swell it is clearly a reflection of the underlying structure and not the result of erosion. The range of sessile marine life on the sandstone is limited and there are many bare or silt covered areas. There is no kelp cover (recorded depth 8-14m) and only a sparse folicaeous algal cover on the highest points.

FRESHWATER

The southern facing chalk cliff coastline immediately west and east of Freshwater Bay was not explored due to poor weather conditions on our visits to the area. A single dive, in poor visibility, was undertaken off Freshwater Bay. Here chalk gullies were seen at a recorded depth of 11-15m. Considerable amounts of broken chalk rock were seen, apparently caused by the high density of piddock borings, though the area is also lobster potted. The site supported a good range of attached animals with anemones, sponges and worms all well represented. Mobile life was less prolific.

CULVER CLIFF

The end of the Culver Cliff, Whitecliffe Ledge, is a south-easterly facing head of pure white Upper Chalk with thin lines of flint along the bedding planes. The three dives were made in this area, one 100m from the cliff, and the other two drifting between 200m and 1km offshore. A strong current

running in ENE direction was experienced, thus following the line of the chalk strata. Chalk bedrock is present as far as 1km offshore.

Inshore the sea-bed comprises chalk bedrock arranged generally as low ridges up to 1m in height, though more usually 0.5m, and running parallel with the shore (Figure 1.4.10). The ridges are interspersed with lower areas of chalk with pebble, cobble and sand covering. The chalk is stabilised by the presence of encrusting pink algae. The current runs along the line of the gullies and ensures that, despite the turbid nature of the water, the rock surfaces have little silt deposited on them.

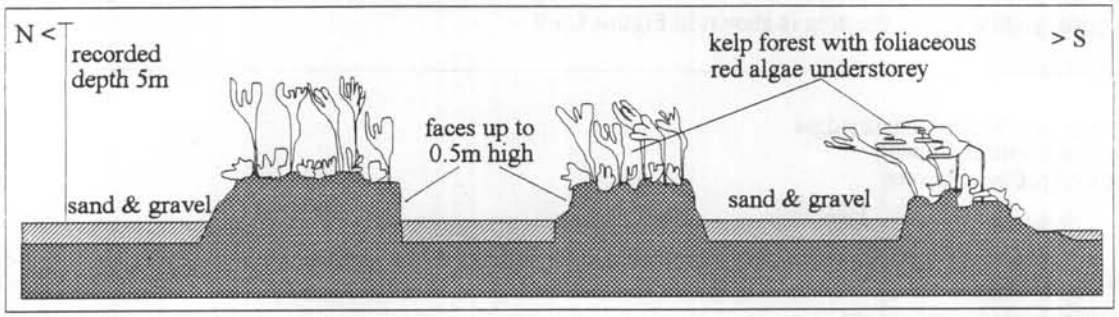

Figure 1.4.10 Culver Cliff - profile.

A little further offshore the sea-bed is largely chalk bedrock and boulders, with small patches of coarse gravel and pebble. Gully formations were not obvious though there are occasional randomly arranged 1m high short "cliffs". Upwardly inclined surfaces, with luxuriant algal cover, predominate. Most of the boulders and bedrock outcrops are low and shaded habitats with bryozoan turf secondary to the algal covered faces. With increasing distance from the shore the number of chalk boulders decrease. Here the areas of exposed chalk bedrock form ledges up to 0.5m high and have gravel and sandy areas mixed in with them. Sandstone ledges are also present.

The recorded depth over 1km offshore to the east of the point was only 8m suggesting a ridge of chalk extending eastwards in line with the chalk 'backbone' of the island.

Horizontal bedrock surfaces were all algal dominated. The kelp forest comprised mostly *Laminaria hyperborea* but *Halidrys silquosa* was an equally common brown seaweed at the shallowest site. A rich understorey of foliaceous red algae was present, prominent species including *Delessaria sanguinea, Ceramium* sp. and *Heterosiphonia plumosa.*

The limited vertical and sloping surfaces, together with any upper surfaces not covered by folicaceous plants, had a hard crust of pink algae. Animal cover was consequently limited with bryozoans such as *Bugula turbinata* the most prominent component. The sponge fauna appeared less diverse than at the sites on the western side of the island.

The chalk bedrock was extensively bored by the Red-Nose, *Hiatella artica*. Small gastropod molluscs were common as were small crustacea. Larger mobile life was limited although a number of lobsters were seen at the furthest offshore site. Pots are set in the area. Fish life was limited and few crevice related species were observed.

1.4.4 CONCLUSION

Most of the sublittoral chalk sites on the Isle of Wight were visited during the study with the exception of the south facing cliff immediately adjacent to Freshwater Bay. Because of the very steep bedding of the chalk strata through the centre of the island exposed chalk in the sublittoral is quite limited. The most varied underwater chalk topography was found on the northern side of The Needles and in Alum Bay. These areas, because of the variety of habitats, also appear to support the greatest range of animal life.

1.4.5 ISLE OF WIGHT CHALK REEFS - SPECIES LIST

The letter and numeric codes for phyla and species follow Howson (1987). Species included in the Basic Species list are denoted by an asterisk.The abundance of species is recorded as present (P) or common (C) and the number of records in each category given when more than one.

	CULVER CLIFF	FRESHWATER/ TENNYSON/ SCRATCHELLS	NEEDLES	ALUM BAY
PORIFERA (C)				
24 *Leucosolenia* sp.		4P		
26 *Leucosolenia complicata*		P2C		
35 *Scypha ciliata*	2P	4P		
58 *Leuconia nivea*			P	
125 *Dercitus bucklandi*	PC	5PC	P2C	3P
150 *Stelletta grubii*		P		
220 *Suberites carnosus*		C		
221 *Suberites domuncula*	P	6PC	2P	2P
240 *Pseudosuberites sulphureus*			P	P
261 *Polymastia mamillaris*	P	3P		P
302 *Cliona celata* *	PC	2P	2P	P
407 *Stelligera rigida*		2C	2P	PC
425 *Raspailia hispida*	P			2P
481 *Halichondria bowerbanki*		2P3C	P	2P
484 *Halichondria panicea* *	3P	6PC	2P3C	4PC
523 *Hymeniacidon perleve*	2P	3P2C	2P	P
596 *Amphilectus fucorum* *	4PC	2P6C	4P	3P
647 cf. *Myxilla rosacea*	P			
775 *Hemimycale columella*		5P	P	
854 *Haliclona* sp.		P	P	
856 *Haliclona cinerea*	P			P
858 *Haliclona fistulosa*	2P		P	P
860 *Haliclona oculata*	P	2P	2P	
862 *Haliclona* cf. *rosea*	P			
863 *Haliclona simulans*	P		P	
890 *Dysidea fragilis*	3PC	5PC	4C	3C
910 *Halisarca dujardini*				P
Red encrusting spp.			2P	C
HYDROZOA (D)				
144 *Tubularia indivisa* *	2P	5C	PC	P
306 *Bougainvillia ramosa*		PC		
526 *Halecium halecium*	P	2P2C		
554 *Aglaophenia pluma*	2PC			
586 *Kirchenpaueria pinnata*		P		
597 *Nemertesia antennina*	P	2P4C	P	
599 *Nemertesia ramosa*	P	2C		
653 *Hydrallmania falcata*		2P		
731 *Obelia geniculata*	P		P	

	CULVER CLIFF	FRESHWATER/ TENNYSON/ SCRATCHELLS	NEEDLES	ALUM BAY
ANTHOZOA (D)				
1017 *Sarcodictyon roseum*				C
1024 *Alcyonium digitatum*	3P	5P2C	5P	2P
1121 *Isozoanthus sulcatus*				2P
1151 *Actinia equina*		C		
1152 *Actinia fragacea*		2P		
1158 *Anemonia viridis* *	3P2C	4PC		4P
1168 *Urticina felina*	3P2C	3P	P	
1230 *Sagartia* sp.	2P		2P	
1231 *Sagartia elegans*	P	P		
1237 *Cereus pedunculatus*	3PC	5P	P	P
1241 *Actinothoe sphyrodeta*	C	5P	P	
1246 *Sagartiogeton* sp.	3P			
PLATYHELMINTHES (F)				
162 *Prostheceraeus vittatus*		P		
NEMERTEA (G)				
378 *Lineus longissimus*		P		
ANNELIDA (P)				
2000 Terebellid	PC			
2002 *Amphitrite* sp.			P	
2031 *Lanice conchilega*	PC	P	P	P
2157 *Bispira volutacornis* *	2P	3P4C	P	3PC
2227 *Myxicola infundibulum*	P			
2259 *Sabella* sp.	P			
2261 *Sabella pavonina*				P
2304 *Pomatoceros triqueter*	2PC	4C	P	2C
2326 *Filograna implexa* or *		5P	4P	2PC
2351 *Salmacina dysteri*				
2401 *Spirorbis* sp.	P			
CHELICERATA (Q)				
6 *Nymphon gracile*		P		
75 *Pycnogonum littorale*?		P		
CRUSTACEA (S)				
Barnacles sp.	2P	3C	2P2C	
Prawns			2P	P
2208 cf. *Palaemon elegans*	P			
2300 *Homarus gammarus* *	PC	2P3C	3PC	P
2462 *Pagurus* sp.	P			
2465 *Pagurus bernhardus*	2P			
2468 *Pagurus cuanensis*	P			
Squat lobster sp. *	2C	2PC	3P	PC
2489 *Galathea squamifera*	2PC	P		C
2490 *Galathea strigosa*				P
2507 *Porcellana platycheles*		P		P
2553 *Maja squinado* *		3P	3P	

		CULVER CLIFF	FRESHWATER/ TENNYSON/ SCRATCHELLS	NEEDLES	ALUM BAY
CRUSTACEA (S) continued					
2559	*Hyas araneus*	2P			
2578	*Inachus phalangium*	2P			
2584	*Macropodia linaresi*	P			
2585	*Macropodia rostrata*	P			
	other small spider crabs	P			
2599	*Pisa tetrodon*	P			
2646	*Cancer pagurus* *	5P	5PC	4P	2PC
2667	*Liocarcinus arcuatus*	P			
2672	*Liocarcinus puber*	P	3PC	4P	2PC
2690	*Carcinus maenas* *	P			
2735	*Pilumnus hirtellus*	PC	P		P
MOLLUSCA (W)					
130	*Patella* sp.	P		P	
139	*Helcion pellucidum*	C		P2C	
174	*Monodonta lineata*				P
193	*Gibbula cineraria*	2PC	3P	P	P
195	*Gibbula umbilicalis*		P		
200	*Calliostoma zizyphinum*	3P	8PC		
231	*Tricolia pullus*	P			
726	*Crepidula fornicata*	3P2C	P	P	2PC
736	*Trivia* sp.			P	
737	*Trivia arctica*		2P		
817	*Nucella lapillus*	P			
829	*Ocenebra erinacea*	P			
844	*Buccinum undatum*		P		C
887	*Hinia incrassata*	2P			
889	*Hinia reticulata*	2PC	3P		C
1243	*Tritonia lineata*				P
1403	*Archidoris pseudoargus*	3P		2P	
1431	*Janolus cristatus*		P		
1515	*Eubranchus tricolor*		2P		
1591	*Anatalis entalis*				C
1650	*Mytilus edulis* *	P			P
1769	*Ostrea edulis*		6PC		P
1800	*Chlamys varia*		P		
2251	*Hiatella arctica*	C	2P3C		
	Piddocks *	PC	3P5C	3C	P3C
2261	*Pholas dactylus*		4C		
2271	*Barnea candida*		2P		
2393	*Sepia officinalis*		P		
BRYOZOA (Y)					
137	*Alcyonidium diaphanum*		PC		
606	*Cellepora pumicosa*			P	
664	*Membranipora membranacea*	C			
678	*Electra pilosa*	P			
694	*Flustra foliacea* *	2P	4P2C	PC	P

		CULVER CLIFF	FRESHWATER/ TENNYSON/ SCRATCHELLS	NEEDLES	ALUM BAY
BRYOZOA (Y) continued					
705	*Chartella papyracea*		2P2C		P
710	*Securiflustra securifrons*		P	C	
820	*Epistomia bursaria*	P			
836	*Scrupocellaria* sp.			C	
869	*Bugula* spp.	3C	P4C		2P
872	*Bugula flabellata*		2C	2C	
879	*Bugula turbinata*		P3C	C	P
PHORONIDA (ZA)					
4	*Phoronis hippocrepia* *	2C	4PC	4P	P2C
ECHINODERMATA (ZB)					
149	*Crossaster papposus*	P			
165	*Henricia oculata* *	P		P	
190	*Asterias rubens*	P			
TUNICATA (ZD)					
6	*Clavelina lepadiformis* *	3P	6PC	2P	
34	*Polyclinum aurantium*	P			
46	*Morchellium argus*	P	4P		
57	*Aplidium* sp.	C	P		
64	*Aplidium punctum*		P3C		
117	*Ciona intestinalis* *		P		P
141	*Ascidiella aspersa*			P	
150	*Ascidia mentula*				P
209	*Botryllus schlosseri*	2PC	2P		
256	*Molgula manhattensis*	P			
PISCES - CHONDRICHTHYES (ZF)					
40	*Scyliorhinus canicula*			P	
PISCES - OSTEICHTHYES (ZG)					
118	Gobiesocidae sp.		P		
208	*Pollachius pollachius*	P	CP	P	P
218	*Trisopterus luscus*	P	2P	P	3P
376	*Syngnathus acus*	P			
438	*Taurulus bubalis* *	P	2P		2P
578	*Chelon labrosus*			P	
601	*Crenilabrus melops*	2	3P2C	2P	2P
605	*Ctenolabrus rupestris*	P	3PC	2P	2P
609	*Labrus bergylta* *		4P3C	5P	2P
632	*Lipophrys pholis*		P		
636	*Parablennius gattorugine* *		5PC		
700	*Callionymus lyra*	P	2PC		P
724	*Gobius paganellus*				2P
728	*Gobiosculus flavescens* *	2P	2P	P	P
742	*Pomatoschistus minutus*				P
748	*Thorogobius ephippiatus* *		6P3C	P	P2C
863	*Scophtalmus rhombus*	P			

		CULVER CLIFF	FRESHWATER/ TENNYSON/ SCRATCHELLS	NEEDLES	ALUM BAY
ALGAE - RHODOPHYCEAE (ZM)			2P3C species not recorded on some dives	7C species not recorded	P3C
256	*Dilsea carnosa*	C			
401	*Corallina* sp.	PC			
404	*Corallina officinalis*	P			
450	*Lithophyllum incrustans*		P		
459	*Lithothamnion* sp.	2C	4C		2C
584	*Phyllophora crispa*	C			
611	*Chondrus crispus*	C	2P		C
631	*Plocamium cartilagineum*	P	2C		2C
682	*Calliblepharis ciliata*	2P	2C		C
823	*Ceramium rubrum*	C			C
846	*Griffithsia flosculosa*	C			C
856	*Halurus equisetifolius*	PC	2P		
928	*Spyridea filamentosa*	P			
955	*Delessaria sanguinea*	3C	2C		P
985	*Hyploglossum hypoglossoides*	P			
1012	*Phycodrys rubens*				P
1039	*Heterosiphonia plumosa*	2C			
1050	*Brongniartella byssoides*	2P			
1105	*Polysiphonia* cf. *elongata*	P			
1145	*Rhodomela confervoides*		2P		
ALGAE - PHAEOPHYCEAE (ZR)					
439	*Cladostephus spongiosus*	P			
457	*Dictyota dichotoma*				C
632	*Laminaria digitata*	2C		2C	C
633	*Laminaria hyperborea* *	P2C	5C	3C2P	PC
694	*Sargassum muticum*		P		
716	*Halidrys siliquosa*	3C	2C		
ALGAE - CHLOROPHYCEAE (ZS)					
245	*Ulva lactuca*	P			P
338	*Cladophora* sp.	P			2C

1.4 PURBECK, DORSET

1.4.1 DESCRIPTION OF CHALK FEATURES

Chalk forms the coastline at three points in eastern Dorset. The most easterly is at Ballard Point/Handfast Point north of Swanage, where an easterly facing chalk cliff is part of the same system which runs east to west across the centre of the Isle of Wight. The end of Handfast Point is formed by two stacks, Old Harry and Old Harry's Wife. The rapid physical changes which have occurred in this area since a single major block of chalk broke away from the mainland in 1920/21 are described by May and Heeps (1985).

Chalk strata run across the Isle of Purbeck from Handfast Point as a high ridge which reaches the coast again at Worbarrow Bay. Thereafter the chalk runs parallel with the sea, but between Mupe Bay and St Oswald's Bay and again at Durdle Door, there is a narrow line of harder Portland stone forming the cliffline. The sea has broken through in a number of places to form bays in the softer chalk behind (for example at Lulworth Cove). West of Durdle Door there is a 3km. length of coastal chalk cliff stretching to White Nothe.

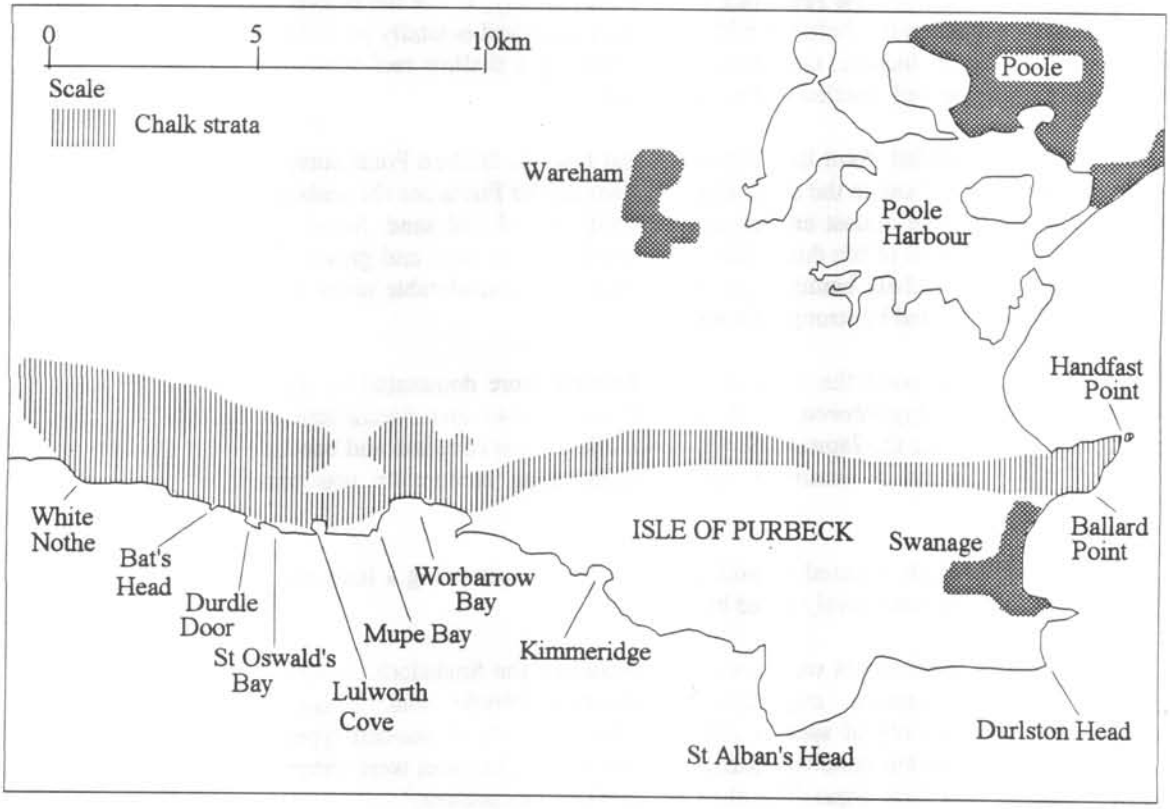

Figure 1.4.1 Location of sites described.

1.4.2 SUBLITTORAL STUDY AREAS

Underwater surveys were carried out in the following locations:

Handfast Point/Old Harry (inshore), 4 dives, 29/6/85, 30/6/85 & 24/5/86
Site Log Nos. 13,17
Basic Species Record Nos. 15,16,18,20
Extra Species Record Nos. 11,12,15,16,52
Handfast Point/Old Harry (offshore), 7 dives, 29/6/85 & 30/6/85.
Site Log Nos. 10,11,12,14,15,16,18
Basic Species Record Nos. 12,13,14,17,19,21

Extra Species Record Nos. 9,10,13,14,17,18
Worbarrow Bay, 1 dive 28/7/84
Site Log No. 44
Basic Species Record No. 51
Extra Species Record No. 46
Bat's Head/White Nothe, 3 dives 27/9/86
Site Log Nos. 53,54,58.
Basic Species Record Nos. 59,60,64.
Extra Species Record Nos. 58,59,63

The records on which the following habitat and community descriptions and the species list are based were compiled by Graham Ackers, John Clegg, Bill & Peter Hewitt, Tony Hunt, Jo Jamieson, Evan Jones, Dick Manuel, Alice Nunn, Chris Wood & Elizabeth Wood.

1.4.3 SUBLITTORAL HABITATS AND COMMUNITIES

HANDFAST POINT/BALLARD POINT

The northern side of Handfast Point faces in to Studland Bay, where the seabed consists of fine clean sand. The area is generally sheltered with little open fetch and is totally protected from the prevailing south-westerly winds. Inshore, close to the point, there is a shallow reef consisting of irregular chalk bedrock interspersed with patches of fine clean sand.

To the south of Handfast Point the stretch of coast towards Ballard Point comprises high chalk cliff with little foreshore. Close to the small stacks known as The Pinnacles the seabed consists of a flattish chalk bedrock platform almost entirely overlain with gravel and sand. Some areas of bedrock were clean but largely devoid of life due to the mobile nature of the sand and gravel. However, close to the cliff were substantial chalk boulders up to 2m high with considerable areas of vertical and sloping faces. The site is affected by strong tidal streams.

On both sides of the point the areas of chalk bedrock were dominated by algae. Four kelps were recorded, *Laminaria hyperborea, L. digitata, L. saccharina* and *Saccorhiza polyschides*. On the sheltered, northern side the Japweed *Sargassum muticum* was common and bootlace weed *Chorda* sp. occurred in both areas. A luxuriant red foliaceous algal community was present on horizontal surfaces.

Chalk faces were largely covered by pink encrusting algae providing a hard exterior and preventing erosion. The rock was extensively bored by piddocks.

Other common sessile animals were anemones, including the Snakelocks (*Anemonia viridis*), Dahlia (*Urticina felina*), *Sagartia troglodytes, Cerianthus lloydii* and Daisy anemones (*Cereus pedunculatus*), the variety of species reflecting the variation of sea-bed types. A good variety of sponges were observed but none was particularly common. Tunicates were common, the most notable species being *Morchellium argus*. The alien *Styela clava* was present.

Offshore is a flat, current swept, sea-bed with chalk bedrock exposed on the surface in many areas. Dives were made up to 2km offshore and in recorded depths of 10-14m, all on this form of terrain. In many areas the bedrock is flat, but low raised reefs also occur, without any consistent orientation, and never exceeding 1m in height. In many areas the chalk is overlain with a thin layer of gravel, shelly gravel, pebbles and cobbles. At one site empty shells of the Slipper Limpet, *Crepidula fornicata* formed 50% of the sea-bed cover.

In view of the strong currents and mobile nature of much of the sea-bed it is not surprising that mobile life dominates the species list. Crustacea ranged from the large Edible Crab *Cancer pagurus* and Velvet Swimming Crab, *Liocarcinus puber*, through the smaller squat lobsters, *Galathea* sp. and hermit crabs, to the small spider crabs, Porcelain Crab and tiny Pea Crab. Barnacles were common on many of the hard surfaces, cobbles and boulders.

Molluscs recorded included the Common Whelk, *Buccinum undatum*, the cowrie, *Trivia arctica* and large numbers of Slipper Limpets, *Crepidula fornicata*.

One group of sessile animals which is characteristic of unstable areas is the tunicates. Here they included *Clavelina lepadiformis, Botryllus schlosseri, Molgula manhattensis*, and *Morchellium argus*. The alien tunicate *Styela clava* was also present.

Hydroids and bryozoa were also varied and common, especially on the upraised bedrock areas. *Flustra foliacea* was the most prominent species.

WORBARROW BAY

Chalk strata are visible in the cliffs at the rear of the central part of Worbarrow Bay. There is a pebble beach below them and no inter-tidal chalk platform. Chalk bedrock was not recorded in the sublittoral on the one dive off this area nor is there any previous record of chalk here in the Dorset Sublittoral Survey (Brachi et al 1977 and Dixon et al 1978).

DURDLE DOOR TO WHITE NOTHE

Like Worbarrow Bay the chalk strata along this 3.5km stretch of coastline run parallel with the coastline and are steeply inclined. There is a parallel line of Portland Limestone to the south of the chalk visible at Durdle Door and as a reef running parallel with the shore which breaks surface at a number of points across the bay, known as the Bull, the Blind Cow, the Cow and the Calf. It therefore follows that there is unlikely to be any substantial extent of chalk exposed sublittorally and this proved to be the case from our dives.

Bats Head is of vertically inclined chalk but the rocky sea bed immediately to the south and the reef just offshore are of the harder Portland Limestone. There is a chalk stack and platform in shallow water to the east. A sublittoral species list is provided for this site, although it is not chalk, to act as a comparison with White Nothe, where chalk was present at a similar depth.

At White Nothe there is a boulder field apron at the base of the chalk cliff which is covered at high tide. The chalk strata are angled at about 20^{o} from the horizontal and this is reflected in the sublittoral. At about 50m off the head the sea-bed consists of chalk bedrock, angled to produce a series of ledges running at right angles to the coast. The vertical or undercut faces are to the west and are not more than 0.5m high. The features are shown in Figure 1.4.2.

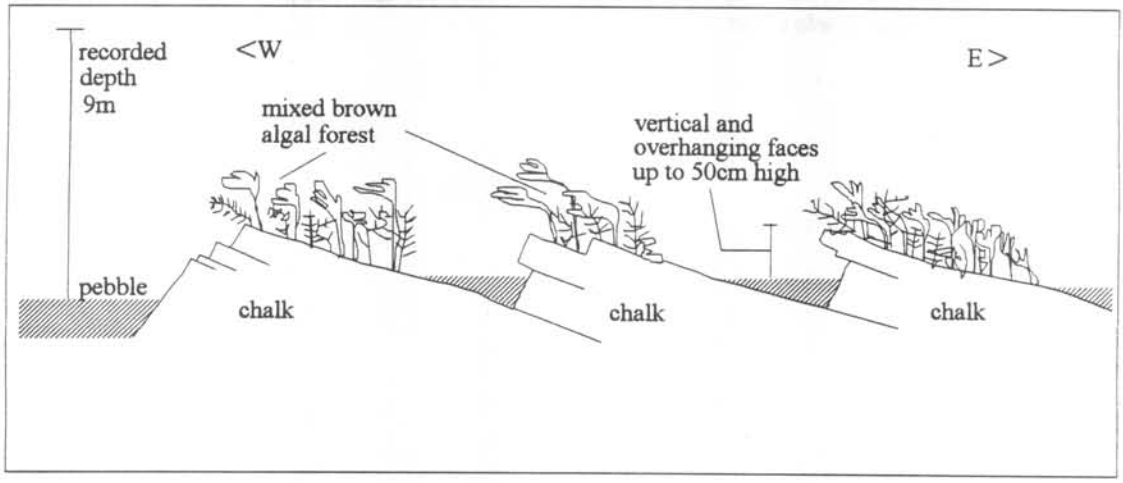

Figure 1.4.2. Profile at White Nothe.

Further offshore, about 100m, the sea-bed comprises chalk boulders lying on uneven bedrock. Pebbles and cobbles gather in lower areas. The bedrock is replaced by clean rippled sand to the south.

At both Bats Head and White Nothe the shallow reefs (recorded depths not exceeding 9m) were algal dominated. Kelps predominated, species being *Laminaria hyperborea, L. saccharina* and *Saccorhiza polyschides*. The other abundant brown alga was the Sea Oak, *Halidrys silquosa*. On the upward facing surfaces which were not kelp covered, and on pebbles and cobbles, there was an abundant covering of foliose red seaweeds. Bare rock surfaces had a calcareous red algal crust. Vertical surfaces and shaded crevices and underhangs were limited in occurrence, but those that there were supported small patches of encrusting sponges as well as small hydriods, tunicates and anemones.

The vertical faces were extensively bored by piddocks. Most common was *Barnea candida*, with the Red Nose, *Hiatella arctica*, less so. The outer 2cm of most rock surfaces was honeycombed by the tiny borings of spionid worms. However, despite these potentially destructive activities, the hardness of the chalk and the stabilising effect of the calcareous algae prevent natural erosion and no broken chalk was observed.

The composition of the algal communities at the chalk site of White Nothe and the Limestone one of Bats Head appeared to be basically similar. However the sessile animal fauna showed some differences. This was most noticable amongst the sponges. At Bats Head these were limited to *Dysidea fragilis* and small encrusting species. At Bats Head there were four large additional species, *Pachymatisma johnstonia, Hemimycale columella, Amphilectus fucorum* and *Dercitus bucklandi*. The latter, the Black Tar sponge, was recorded as common. The other difference was the common presence of piddock burrows at White Nothe whilst they were almost absent at Bats Head.

1.4.4 CONCLUSION

Only limited amounts of chalk are exposed in the sublittoral off Dorset. On the southerly facing coast, though there are fairly extensive chalk cliffs, only at White Nothe was any chalk found underwater. Although there are reefs in the area most are formed of Portland Limestone.

The one area on the Isle of Purbeck where large areas of chalk were found is off Handfast Point and Ballard Down. Here the extensive bedrock comprises a relatively flat and featureless plain with mobile pebble and shelly gravel cover. The lack of variety of habitat and strong tidal streams affect the composition of the algal and faunal communities. Inshore, below the cliffs, are large chalk boulders recruited from the cliffs and these provide considerable variety.

The species found in the area include a number of alien species, typical of the central part of the English Channel. These are the Japweed, *Sargassum muticum*, the Slipper Limpet, *Crepidula fornicata* and the tunicate *Styela clava*.

1.5.5. DORSET CHALK REEFS - SPECIES LIST

The letter and numeric codes for phyla and species follow Howson (1987). Species included in the Basic Species list are denoted by an asterisk. The abundance of species is recorded as present (P) or common (C) and the number of records in each category given when more than one.

		OLD HARRY	WHITE NOTHE	BATS HEAD (limestone)
PORIFERA (C)				
125	*Dercitus bucklandi*			C
167	*Pachymatisma johnstonia*			P
221	*Suberites domuncula*	P		
261	*Polymastia mamillaris*	P		
302	*Cliona celata* *	5P		
481	*Halichondria bowerbanki*	P		
484	*Halichondria panicea* *	5PC	C	
492	*Ciocalypta penicillus*	P		
523	*Hymeniacidon perleve*	2P		
596	*Amphilectus fucorum* *	5P		P
775	*Hemimycale columella*	P		P
854	*Haliclona* sp.			C
890	*Dysidea fragilis*	4P	P	C
	small encrusting spp.		2C	
HYDROZOA (D)				
229	*Eudendrium* sp.	P		
526	*Halecium halecium*	C		
550	*Aglaophenia* sp.	C		
597	*Nemertesia antennina*	2C		
605	*Plumularia setacea*	C		
731	*Obelia geniculata*	C		
	other small spp.			P
ANTHOZOA (D)				
1024	*Alcyonium digitatum*	3P2C		P
1075	*Cerianthus lloydii*	3P		
1158	*Anemonia viridis* *	4P4C	2P	P
1168	*Urticina felina*	2P6C		
1186	*Aureliania heterocera*	P		
1225	*Metridium senile* *	P		
1231	*Sagartia elegans*	3P	P	
1232	*Sagartia troglodytes*	4P2C		
1237	*Cereus pedunculatus*	2P5C		
1241	*Actinothoe sphyrodeta*	3P		
1287	*Calliactis parasitica*	P		
PLATYHELMINTHES (F)				
162	*Prostheceraeus vittatus*	P		
ANNELIDA (P)				
1225	*Spionidae*	C	A	
2000	Terebellids	2P		
2031	*Lanice conchilega*	P		
2157	*Bispira volutacornis* *	7PC	2P	P
2259	*Sabella* sp.	P		
2261	*Sabella pavonina*	P		
2304	*Pomatoceros triqueter*	3P		
2326	*Filograna implexa* or *	P	P	
2351	*Salmacina dysteri*			

		OLD HARRY	WHITE NOTHE	BATS HEAD (limestone)
CRUSTACEA (S)				
	Barnacles sp.	4C		
2360	*Homarus gammarus* *	5P		
2462	*Pagurus* sp.	4C		
2465	*Pagurus bernhardus*	C		
2489	*Galathea squamifera*	C		
	Squat lobster sp. *	3P6C	C	
2508	*Pisidia longicornis*	C		
2553	*Maja squinado* *	6P		
2559	*Hyas araneus*	2P		
	small spider crabs spp.	2P3C		
2646	*Cancer pagurus* *	9P2C		
2669	*Liocarcinus* cf. *depurator*	2PC		
2672	*Liocarcinus puber*	4PC	P	P
2690	*Carcinus maenas* *	2P		
MOLLUSCA (W)				
139	*Helcion pellucidum*	P		
174	*Monodonta lineata*	C		
193	*Gibbula cineraria*	3C	2P	
200	*Calliostoma zizyphinum*	2P2C	P	P
726	*Crepidula fornicata*	3PC		
737	*Trivia arctica*	PC		
738	*Trivia monacha*	PC		
817	*Nucella lapillus*	P		
844	*Buccinum undatum*	P2C		
889	*Hinia reticulata*	P3C		
1062	*Eylsia viridis*	P		
1362	*Polycera faeroensis*	P		
1403	*Archidoris pseudoargus*	3P		
1551	*Aeolidia papillosa*	P		
1769	*Ostrea edulis*	3P		
1800	*Chlamys varia*	C		
2251	*Hiatella arctica*		2P	
2271	*Barnea candida*		C	
	Piddocks *	5P2C	C	P
2393	*Sepia officinalis* (eggs)	3P		
2430	*Loligo* sp. (eggs)	2P		
BRYOZOA (Y)				
664	*Membranipora membranacea*	C		
694	*Flustra foliacea* *	P4C		
869	*Bugula* spp.	3P		
PHORONIDA (ZA)				
4	*Phoronis hippocrepia* *	5P		
ECHINODERMATA (ZB)				
149	*Crossaster papposus*	2P		
165	*Henricia oculata* *	4P		
	Cucumarians *	8P		
TUNICATA (ZD)				
6	*Clavelina lepadiformis* *	5P4C		
17	*Distaplia rosea*	C		
46	*Morchellium argus*	P5C		
57	*Aplidium* sp.	P		

		OLD HARRY	WHITE NOTHE	BATS HEAD (limestone)
TUNICATA (ZD) continued				
	Didemnid tunicates	PC	P	
97	*Diplosoma listeranium*	2PC	P	
99	*Diplosoma spongiforme*		C	P
109	*Lissoclinum perforatum*	C	P	
117	*Ciona intestinalis* *	C		
150	*Ascidia mentula*	2P		
153	*Ascidia virginea*	P		
172	*Styela clava*	4P2C		
199	*Distomus variolosus*	PC		
209	*Botryllus schlosseri*	2P2C		P
214	*Botrylloides leachii*	2P		
256	*Molgula manhattensis* *	3P5C		
	other spp.	PC		
PISCES (ZG)				
22	*Conger conger*	P		
118	Gobiesocidae	P		
208	*Pollachius pollachius*	P	C	C
218	*Trisopterus luscus*	2P	P	P
376	*Syngnathus acus*	2P		
434	*Myoxcephalus scorpius*	C		
438	*Taurulus bubalis* *	5PC		
448	*Agonus cataphractus*	P		
578	*Chelon labrosus*			P
592	*Centrolabrus exoletus*			P
601	*Crenilabrus melops*	2P	P	P
605	*Ctenolabrus rupestris*		P	P
609	*Labrus bergylta* *	3PC	2P	P
610	*Labrus mixtus*			P
636	*Parablennius gattorugine* *	2P		
680	*Pholis gunnellus*	3PC		
686	*Ammodytes tobianus*	P		
728	*Gobiosculus flavescens* *	PC	2P	P
748	*Thorogobius ephippiatus* *			P
ALGAE - RHODOPHYCEAE (ZM)				
	all species *	5P4C	2C	C
		common spp. only listed	common spp. only listed	species not recorded
401	*Corallina* sp.	C		
459	*Lithothamnion* sp.	3C	C	
611	*Chondrus crispus*	C	C	
682	*Calliblepharis ciliata*	C	C	
823	*Ceramium rubrum*		C	
1039	*Heterosiphonia plumosa*		C	
ALGAE - PHAEOPHYCEAE (ZR)				
452	*Dictyopteris membranacea*		C	
499	*Desmarestia lingulata*		C	
625	*Chorda filum*	2P		
632	*Laminaria digitata*	PC		
633	*Laminaria hyperborea* *	3C	2C	C
636	*Laminaria saccharina*	2PC	PC	C
646	*Saccorhiza polyschides*	P	PC	P
694	*Sargassum muticum*	P2C		
716	*Halidrys siliquosa*		2C	C

	Dorset	Isle of Wight	Offshore Sussex	Brighton/ Newhaven	Seven Sisters	Dover/ Folkestone	Thanet (Botany Bay)
OVERALL TOPOGRAPHY							
Coastal Fringe Reefs	*	*		*	**	*	*
Chalk platforms extending offshore	**	*		**	*	**	*
Offshore Reefs			**				
REEF FEATURES							
Substantial chalk outcrops with gullies and cliffs Vertical faces 2-6m high		*	*				
Ridges, gullies and cliffs Vertical faces up to 2m		*	**		**		
Chalk reef platform with ridges and gullies Vertical faces up to 1m	*	*		*	**	*	
Terraced bedrock - faces 1m or more high					*		
Terraced bedrock - faces less than 1m	*						
Large Boulders	*	*	*			**	
FLAT BEDROCK							
Flattish bedrock	**	**	*		*	**	*
Flattish bedrock overlain with boulders, cobbles, pebbles and sand	**	**			*	*	**
Boulders, cobbles, pebbles and sand - virtually no bedrock visible	*	**	*			**	*

Extensive occurrences	**
Minor occurrences	*

Figure 2.1 Sea bed topography and features at sublittoral chalk sites. [adapted and expanded from Wood, E.M. (1988)]

PART TWO - A COMPARISON OF SUBLITTORAL CHALK SITES IN SOUTHERN ENGLAND

The purpose of this part is to undertake a comparison of the areas of sublittoral chalk described in Part One of this report with each other and with other sublittoral chalk exposures in southern England. In compiling this section information has been taken from the following reports which, for brevity, are not referred to at each point in the text:

Sussex - Brighton to Newhaven	Wood, C.R. 1984
Sussex - Seven Sisters	Wood, C.R. & Jones, 1986
Kent - Dover to Folkestone	Wood, E.M. & Wood C.R. 1986

It is convenient to divide this comparison into four factors which are amongst those which contribute to an assessment of the biological interest of an area. They are:

1 Range and types of topography and habitats,
2 Presence of rare or unusual topography and habitats,
3 Diversity of communities,
4 Presence of rare or unusual species.

It is beyond the scope of this report to make comparisons between the sublittoral chalk habitats and communities and others in the same geographical area. Information is available from a number of sources including the following:

Sovereign Shoals, East Sussex	Wood, C. 1990
Sussex - Selsey Bill to Beachy Head	Wood, C.R. 1984
Hampshire - Selsey Bill to East Solent	Collins & Mallinson 1983
Isle of Wight	Collins & Mallinson 1988
Dorset	Brachi et al 1977, Dixon et al 1978, Dixon et al 1979.

Whilst wider consideration would be essential to any assessment of the local importance of the sites described, this report should enable a broad comparison of the chalk sites to be made and the relative importance of the sites described as examples of sublittoral chalk in southern England.

2.1 RANGE AND TYPES OF TOPOGRAPHY AND HABITAT

A number of habitats are associated with sublittoral chalk, but these are not necessarily developed to the same degree in each area. This is because of local differences in features such as seabed topography, rock type and bedding, light penetration, exposure to wave action and tidal streams, degree of scour and amount of silt present. The range of topographic types and major habitiats are shown in summary form in Figure 2.1.

OVERALL TOPOGRAPHIC FEATURES

In terms of overall topography there are three categories of sublittoral chalk areas. These are:

1 reef formations extending out from coastal chalk exposures,
2 extensive flattish chalk platforms found beyond the more variable inshore reefs,
3 offshore reefs which are separated from coastal chalk features by areas of other forms of sea bed.

The first two categories of sublittoral chalk exposures are shown to be widespread in chalk areas. However of all of the areas studied only Sussex has offshore reefs. With one exception these follow a similar form being long thin reefs running parallel with the shore with a vertical northward facing face and an area of flattish chalk bedrock to the south. Where these sites vary is in the height of the exposed vertical face. Generally the height increases from east to west with Kingswest Ledge off Brighton not exceeding 1m whilst Worthing Lumps is 3m in height.

REEF FEATURES

The range of type and extent of reef features on the coastal fringing sites is very varied. In many areas a characteristic ridge and gully system occurs. The gullies generally run at right angles to the shore and have been created by wave action in the shallow water. This feature is most clearly seen in the Seven Sisters area at sites off Seaford Head and Hope Gap. South of The Needles, Isle of Wight the ridges and gullies are parallel with the coast. This is because of the strike of the chalk strata and the prevailing wave motion.

Terraced reef features are unusual. At White Nothe, Dorset the orientation of the terraces is at right angles to the coast. That this is caused by the underlying strike of the rock strata is clear from the strata exposed above water level in the cliff. Significant vertical faces also occur where there is a strongly formed edge to the sublittoral extension of the coastal chalk platform. This is most clearly seen on the Isle of Wight where a northward facing cliff up to 6m in height is found on the north side of Alum Bay and The Needles.

Chalk boulders are present at most sites and reflect the brittle nature of the chalk which leads to their creation either by being broken off from the bedrock underwater or by recruitment from cliff falls. The area where this form of habitat is the most common is between Dover and Folkstone where the soft Lower Chalk, merging into gault clay, is subject to considerable frâgmentation. Large boulders found close inshore at Ballard Down, Dorset are most probably the result of substantial cliff falls as there is little intervening beach. In contrast the area between Dover and Folkestone has a wide beach and most of the large cliff fall boulders remain on it.

FLAT BEDROCK

Areas of flattish bedrock are generally found in deeper water and are extensive at Dover/Folkestone, Culver Cliff on the Isle of Wight and off Ballard Down, Dorset. In many areas they are partially or wholly overlain with mobile deposits of flint cobbles washed out of the chalk or gravel, pebbles, sand or mud. On many of these flattish plains there are signficant features such as areas of upraised chalk bedrock, low terraces or chalk boulders.

MICROHABITATS

The relative softness of chalk bedrock compared to other limestones (such as the Portland Stone in Dorset) is favourable to the creation of a variety of microhabitats. Erosion, whether by water movement and scouring by flints, or by the boring activites of the bivalve piddocks, has created significant crevice and cave habitats, particularly on the vertical surfaces. These range from caves, such as those at Alum Bay, Isle of Wight which are up to 2m high and 3m deep; through deep clefts, to small ledges, crevices and holes which are found at most sites. These features combine to provide a variety of horizontal, vertical, shaded, exposed and sheltered surfaces which are suitable for different forms of marine life.

Piddock holes are found both in vertical and horizontal bedrock and weaken the rock and hasten erosion. The empty holes they leave also provide a significant microhabitat for marine life.

2.2 RARE OR UNUSUAL TOPOGRAPHY AND HABITATS

Sublittoral chalk bedrock is itself relatively uncommon in the context of the British Isles and Ireland. Figure 2.2 shows that the total length of chalk coastline and offshore reefs is 106.5km or about 2% of the 15,000km. coastline of England, Wales and Scotland. The great majority of rocky seabeds are formed in harder rocks than chalk, chiefly in the older rocks of the western part of the islands. Chalk is one of the softest rocks which is sufficiently stable to form permanent sublittoral reefs. The few examples of softer rocky areas which there are, such as the clay of the Mixon Hole, Sussex, are characterised by extreme instability and this has a great effect on the variety of life found on them.

COUNTY	SITE	LENGTH OF CHALK COASTLINE/REEFS
Dorset	White Nothe-Worbarrow	4.5 km
	Ballard Down	3.0
Isle of Wight	Needles-Freshwater	9.5
	Culver Cliff	1.5
Sussex	offshore reefs	1.5
	Brighton-Newhaven	12.0
	Seven Sisters	13.5
Kent	Folkestone-Dover-Deal	15.5
	Isle of Thanet	21.5
North Norfolk	Sheringham-West Runton	8.0
Yorkshire	Flamborough Headland	16.0

Figure 2.2 Extent of Chalk coastline and reefs.

Within the general description of chalk there are variations in the stablity of the rock in different areas. This is partly due to the nature of the chalk itself and partly due to animal cover. The chalk exposed in the sublittorral in Kent and Sussex is soft and is thus liable to breakage from wave surge in shallow areas or from potting and anchoring of boats. Evidence of recently broken rock can be seen on many dives in the Seven Sisters area. The chalk in Dorset and the Isle of Wight is mostly covered with a tough outer coating of calcareous algae which results in a resistant bedrock surface which is not easily broken or eroded. Indeed in the area between White Nothe and Durdle Door, where chalk and Portland Limestone are found in close proximity, it is difficult to distinguish the two underwater.

Rocky seabeds and coastline are uncommon in South-eastern England. In most areas where there is a coastline of rock other than chalk the seabed becomes overlain with mobile sediments within a short distance from the shore. Examples are at Hastings, where there is no sublittoral rock below the coastal cliffs (Wood, C 1986) and Copt Point, Folkestone, where the low rocky point does not extend far underwater (Wood & Wood, 1986). The extent of the sublittoral chalk platforms and fringing reefs is thus unusual in this area. Offshore reefs are also uncommon. There are extensive sandstone reefs off Eastbourne (Wood, C 1990) but otherwise only chalk offshore reefs occur east of Worthing. Off the remainder of West Sussex, Hampshire and Dorset the offshore reefs are a mixture of sedimentary rock types of which chalk is only one.

Chalk provides a range of microhabitats which are uncommon in harder rocks. The abandoned holes of piddock and other borers create a honeycomb of small protected habitats, and the varying extent of erosion means that there is a variety of sizes which provides protection for a range of mobile fauna. Softer rocks, such as the clay of the Mixon Hole (Wood,C 1984), are relatively uncolonised because of their extreme fragility, whilst the smoother sandstones which occur in the English Channel provide less opportunity for cryptic species.

2.3 DIVERSITY OF COMMUNITY TYPES AND INDIVIDUAL SPECIES

This comparison comprises two elements. These are, firstly, the presence and diversity of community types and, secondly, the variety of individual species and groups.

COMMUNITY TYPES

Five different community types have been selected for comparison as those most likely to demonstrate the differences between the various sublittoral chalk sites. These are:

1. boring species,
2. algal community,
3. communities associated with vertical and overhanging surfaces,
4. communities associated with caves, crevices and holes,
5. communities on tide exposed and sand/pebble scoured bedrock.

1. BORING SPECIES

The importance of boring species to the stability and rate of erosion of chalk reefs has already been stressed. This community is well developed in each of the main areas, and comprises piddocks, the boring bivalves which are the most significant component, together with the non-massive form of the sponge *Cliona celata* and two similar worm-type animals, the spionid polychaete *Polydora ciliata* and the Horseshoe Worm *Phoronis hippocrepia*. The two latter species are small in comparison with the piddocks and their burrows are a matter of millimetres deep compared to the piddock burrows which may be 15cm in length.

The relative hardness of the chalk at the Isle of Wight and Purbeck, in comparison with outcroppings at Dover and in Sussex, makes the substratum less easily penetrated by boring animals and less prone to erosion. The density of piddocks and other boring bivalves at Dover has been shown to be very high with figures equivalent to 2272 and 733 individuals of the Red-Nose, *Hiatella arctica*, per square metre of surface area of bedrock. Population densities of the larger Common Piddock, *Pholas dactylus*, in this area are believed to be similar. At least 5 species of boring bivalves are present at Dover; fewer species have been reported from the other areas (Figure 2.3).

The common piddock, *Pholas dactylus* is common in all areas and normally found boring vertically into horizontal bedrock. The piddock species usually found on upraised areas of rock and frequently boring horizontally is *Hiatella arctica*. The other 'borers', *Polydora ciliata, Phoronis hippocrepia* and *Cliona celata* (non-massive form) are also widespread and common in most areas, though their occurrence seems to reduce towards the south-west.

	DORSET	ISLE OF WIGHT	OFFSHORE SUSSEX	SEVEN SISTERS	DOVER
PIDDOCKS					
all Piddocks (species not identified)	C	C			
Pholas dactylus		C	C	C	A
Zirfaea crispata					P
Barnea candida	C	P	P		
Barnea parva			P	C	
Hiatella arctica	P	C	P	C	A
OTHER 'BORERS'					
Cliona celata	P	P	C	P	R
Polydora ciliata	A			P	P
Phoronis hippocrepia	P	C	C	C	P

KEY
A=abundant
C=common
P=present
R=rare

Figure 2.3 Comparison of occurrence of boring species

2. ALGAL COMMUNITY

Kelp, *Laminaria hyperborea* forests are well developed on stable substrata in Dorset, the Isle of Wight and at Winter Knoll (the shallowest of the offshore reefs in Sussex); moderately well developed at Dover and the Worthing Lumps (offshore Sussex), very limited at Seven Sisters, and absent from the other Sussex offshore reefs (Marina Reef, Kingswest Ledge, Looe Gate and South-West Rocks). Apart from *Laminaria digitata* and other large brown alga that are characteristic of very shallow water, the other species which makes up a significant part of the kelp forest is *Saccorhiza polyschides*. This kelp was found at all of the sites in Dorset but at no other site and its presence is presumably related to its westerly geographic distribution (Norton, 1985).

There is a rich undergrowth of foliose red algae and sessile animals in the areas where kelp forests are well developed. In the less well developed areas, which are either wave exposed situations or areas of high turbidity, the richness of the understorey is correspondingly diminished.

Another noticeable difference between areas is the rarity of Ballan Wrasse and Goldsinny at Dover. These fishes are common amongst the kelp plants in Dorset, the Isle of Wight and Sussex (and elsewhere around the British Isles).

Apart from the kelp forests each of the chalk areas, with the exception of Marina Reef, also have well developed algal-dominated communities in shallow water. These occur on a variety of substrata, ranging from bedrock outcrops to cobbles. Many of the species present are common to all sites, and some (for example *Laminaria saccharina*) are found over wide areas of the seabed. This species is particularly common at the Seven Sisters but less so on the offshore Sussex reefs. It was not recorded from the Isle of Wight.

3. COMMUNITIES ASSOCIATED WITH VERTICAL AND OVERHANGING SURFACES.

The areas where steep and vertical surfaces are best represented are the Isle of Wight (Alum Bay and The Needles) and the offshore Sussex reefs (especially Worthing Lumps). Other areas with lower vertical surfaces are Seven Sisters and Dover/Folkestone.

A feature of the communities on these surfaces is a distinct difference between the upper and lower sections. Typically the densest flora and fauna occurs at the very top of the vertical face and this may be dominated by a single species, often a hydroid such as *Tubularia indivsa* or *Eudendrium ramosum*. Immediately below this is a more diverse, normally fauna dominated, mixture forming a dense 'turf'. The main components of this are sponges, bryozoans and tunicates.

The lower vertical surfaces are often the subject of scouring action and may have a characteristically concave profile. The fauna which can survive in these situations is limited and tends to consist entirely of either low growing encrusting species, such as the sponges *Aplysilla* spp., or quick growing and short lived species.

There is considerable variety in the composition of the 'turf' on vertical faces between the different areas. Flora dominated surfaces are limited, though they do occur at Winter Knoll (Sussex) and Alum Bay (Isle of Wight).

Hydroids are a prominent feature of the animal turf. In the more silty areas such as Dover and South-West Rocks the common species are *Eudendrium* sp. (identified at *E. ramosum* at South-West Rocks) and *Halecium halecium* (Dover only). Other hydroids which are dominant at certain sites are *Sertularia cupressina* (South-West Rocks), *Tubularia indivisa* (Worthing Lumps) and *Hydrallmania falcata* (Marina Reef).

Sponges are a particularly important component on vertical surfaces. *Halichondria panicea*, though widespread in distribution, is particularly common at the Seven Sisters where it forms extensive sheets around the top of the vertical faces and onto the horizontal surfaces. In the same area, and elsewhere in Sussex, the distinctive orange *Amphilectus fucorum* is particularly common. On the lower faces encrusting sponges such as *Aplysilla* and, further to the west, *Dercitus bucklandi* are to be found. One ubiquitous species is *Dysidea fragilis*.

The most common bryozoans amongst the faunal turf are *Bugula* spp. and these are widespread in distribution. Other 31common species include *Crisia eburnea* (Dover), *Scrupocellaria* sp. (Needles) and the hard encrusting *Cellepora pumicosa* (Sussex and Isle of Wight).

Colonial tunicates such as *Aplidium* spp. and *Morchellium argus* are widely distributed. The most widespread of the encrusting *Botryllus* species is *B. schlosseri* (common at Worthing Lumps, Winter Knoll), but the other species, *Botrylloides leachii* is much more common than *B. schlosseri* at Dover.

4. COMMUNITIES ASSOCIATED WITH CAVES, CREVICES AND HOLES.

Underwater caves and larger crevices in chalk are only recorded from Alum Bay and the north side of The Needles (caves up to 3m deep and 2m high). Smaller horizontal crevices are widespread on chalk reefs and, in addition to the above areas, are common at Worthing Lumps and other offshore Sussex reefs and at the Seven Sisters. Another specialised community takes advantage of piddock holes after the death of the bivalve concerned. Intertidal caves are more widespread.

There is a considerable degree of homogeneity in the communities exploiting these habitats in the various areas. Mobile species common wherever large enough crevices are found include Lobster *Homarus gammarus*, Edible Crab *Cancer pagurus* and squat lobster *Galathea strigosa*. Other larger crabs are found in some areas such as the Velvet Swimming Crab *Liocarcinus puber* and Spiny Spider Crab *Maja squinado* (both Seven Sisters).

Two fishes are typical of this community; Leopard-Spotted Goby *Thorogobius ephippiatus* and Tompot Blenny, *Parablennius gattorugine*. Both fishes are relatively common from Sussex westwards, but rare off Dover. At Dover the Gunnel *Pholis gunnellus* exploits the same habitat, effectively replacing the two species which are more common elsewhere.

The smaller crevices and piddock holes attract smaller mobile species such as hermit crabs, Hairy Crab *Pilumnus hirtellus* and small spider crabs *Inachus* and *Macropodia* spp.

Sessile forms are secondary in this community. In the larger caves and crevices a number of sponge species, chiefly encrusting forms, are found. Dead Men's Fingers *Alcyonium digitaum* may grow from the ceiling (Needles - Isle of Wight). *Sagartia troglodytes* was also observed at Dover growing in old piddock holes.

5. COMMUNITIES ON TIDE EXPOSED AND SAND/PEBBLE SCOURED BEDROCK.

In each of the sublittoral chalk areas a certain amount of low-lying chalk bedrock is present in deeper water, but the most extensive exposures below the algal-dominated zone appear to be off Ballard Down, Dorset. Other significant locations are at Culver Cliff and Seven Sisters. Below the offshore Sussex Chalk reefs and at Dover the flat bedrock quickly becomes overlain with a permanent cover of soft sediments.

The current-swept area off Ballard Down, Dorset, is subject to sediment scour and, except on areas of raised chalk bedrock, the community is dominated by moblie fauna. On the upraised areas the Hornwrack *Flustra foliacea* is a common component of the fauna. Off Culver Cliff, Isle of Wight, rock surfaces in deeper water are still densely covered by red algae and the flat reef tops on the offshore Sussex reefs are similar.

RANGE OF SPECIES

Comparisons of species totals can be misleading when surveys are carried out to different levels of detail and for varying lengths of time. However, the totals in Figure 2.4 result from broadly similar diving surveys carried out over short periods during the summer months, and provide a reasonable basis for discussion. The studies at Seven Sisters and Dover were more intensive than those reported in Part One of this report. They should be interpreted accordingly. Groups consisting entirely or predominantly of small, often cryptic, animals (e.g. polychaetes, amphipods, isopods and pycnogonids) which cannot be identified *in-situ* have been omitted from the table.

The number of sponge species is highest from the Isle of Wight and the Sussex offshore reefs, and noticeably higher than all the other areas. This generally confirms the pattern given by Earll and Farnham (1983) and is a reflection of geographic location. The low Dorset figure is misleading since a considerable number of other species have been recorded from this area on substrata other than chalk (Earll & Farnham, 1983; Brachi *et al*, 1977 and Dixon *et al*, 1988).

The range of fish species recorded varies considerably with the adjacent offshore Sussex and Seven Sisters areas showing the greatest diversity.

The drop in algal species diversity at the eastern end of the English Channel is to be expected, due partly to the increased turbidity of the water. More intensive sampling from the Dorset and Isle of Wight sites would almost certainly produce more diverse algal assemblages than for any of the other sites. Again a much greater number of species have been recorded on other substrata in the area (Brachi *et al*, 1977 and Dixon *et al*, 1988).

	Dorset	Isle of Wight	Offshore Sussex	Seven Sisters	Dover
Algae	15*	28*	31*+46=74	39	43
Porifera	14	28	27+1=28	15	16
Hydrozoa	7	9	10	4	12
Anthozoa	11	12	9	12	10
Decapoda	13	22	9+1=10	26	16
Gastropoda	10	15	9+3=12	9	8
Opisthobranchia	4	4	8	8	13
Bivalvia	4	6	6+1=7	6	7
Bryozoa	3	11	9	5	13
Echinodermata	3	3	4	2	6
Tunicata	17	10	16+3=19	11	10
Pisces	19	18	21+14=35	24	20

Notes:
These totals result from diving surveys carried out over short periods during the summer months, but cannot be considered as definitive.
* Conspicuous species only - no collections made.
Sources of information: Dorset, Isle of Wight & Sussex offshore (first column): Part One of this report;
Sussex (additional species - second column): Wood,C (1984);
7 Sisters: Wood,C & Jones (1986);
Dover: Wood,E and Wood,C (1986);

Figure 2.4 Numbers of species recorded from chalk habitats:
[adapted and expanded from Wood, E.M. (1988)]*

2.4 PRESENCE OF RARE OR UNUSUAL SPECIES

Species recorded during the surveys may be considered rare or unusual for two reasons:

1. because they are limited to chalk and similar substrata and unlikely to be found elsewhere,
2. because of the location of particular sites in relation to the geographical distribution of the species concerned.

SPECIES CHARACTERISTIC OF CHALK

The species which are characteristic of chalk substrata are those which depend upon the softness of the rock either for boring into or for the crevice and hole microhabitiats which it provides.

The piddocks are the most characteristic group and are found throughout the British Isles boring into sand, peat, marl, wood, shale, slate, red sandstone and schists (Tebble, 1966), as well as into chalk. Of the four members of the Family Pholadidae recorded two, *Zirfaea crispata* and *Barnea candida*, are widely distributed around the British Isles. The other two species, *Pholas dactylus* and *Barnea parva*

both have a southerly distribution and are confined to the south and south-west coast of Great Britain (Tebble, 1966). The fifth species, *Hiatella arctica*, is a member of the Family Hiatellidae and is said to be the only member of the family which bores into soft rock. Again it has a wide distribution.

The only area from which all five species have been recorded is at Dover and in this area all five were present at one site, Shakespeare Cliff. It must, however, be noted that the softness of chalk in this area makes the collection and identification of piddocks an easier exercise than at some other sites.

The other boring species, though characteristic, are also not specific to chalk bedrock. The sponge *Cliona celata*, in its boring form is recorded on limestone, shells and calcareous algae (Ackers *et al*, 1985), as well as on chalk. The massive form was not seen at any site in these surveys.

The crevice dwelling species that are characteristic of chalk are also found in similar habitats elsewhere. Two examples are the Tompot Blenny, *Parablennius gattorugine* and the Leopard-Spotted Goby, *Thorogobius ephippiatus*. The Tompot Blenny has a southerly and westerly distribution in the British Isles (Dipper, 1987).

The Leopard-Spotted Goby was once thought to be extremely rare in British waters and have a restricted, southerly distribution. However, diver observations have since shown it to be widespread (Dipper, 1987). It is recorded from most chalk sites as far east as Dover, where it is rare.

GEOGRAPHIC DISTRIBUTION OF SPECIES

Western and southern parts of the British Isles lie within the Lusitanian province of the warm-temperate (Mediterranean-Atlantic) region and are endowed with many 'warm-water' species. The transitional zone between the warm-temperate and cold-temperate regions is considered to be from east Dorset in the south to the Orkneys in the north, This area includes all of the chalk sites. These sites may thus be expected to contain marine species with different affinities.

The other biogeographical interest of the chalk sites is that many of them are in areas where little sublittoral recording has taken place. It is not, therefore, surprising that the recorded distribution of a number of species has been extended by these surveys. Examples have been mentioned above.

The chalk records offer an opportunity to compare the geographic distribution of various groups. Two examples are given in Figures 2.5 and 2.6. The first comparison, which is of a number of typically southerly or westerly sponge species (Figure 2.5), shows that some, like *Dercitus bucklandi*, are limited to the most westerly sites whilst others, like *Hymeniacidon perleve*, though reducing in occurrence are found in all of the chalk areas. The Elephant-hide Sponge *Pachymatisma johnstonia* is interesting in that whilst it is not found on chalk substrata in Sussex it does occur on harder sandstone reefs in the area at Beachy Head (Wood and Jones, 1986) and the off Eastbourne (Wood, 1990). The second comparison (Figure 2.6) is of a group of characteristic reef fishes, the wrasses. This shows a reduction in the number of species and individuals from the south-west to the easterly sites. Similar comparisons could be made for a number of other groups.

	DORSET	ISLE OF WIGHT	OFFSHORE SUSSEX	SEVEN SISTERS	DOVER
Dercitus bucklandi	(P)	C	P	-	-
Polymastia mamillaris	P	P	P	-	-
Hymeniacidon perleve	P	C	C	C	P
Amphilectus fucorum	C	C	C	C	C
Hemimycale columella	P	C	C	-	R
Raspailia ramosa	-	-	P	-	P

" Key; C=common, P=present, R=rare

Figure 2.5 Distribution of selected 'southerly and westerly' sponge species.

	DORSET	ISLE OF WIGHT	OFFSHORE SUSSEX	SEVEN SISTERS	DOVER
Goldsinny *Ctenolabrus rupestris*	P	C	C	C	C
Ballan Wrasse *Labrus bergylta*	C	C	C	C	R
Corkwing *Crenilabrus melops*	C	C	C	P	-
Rock Cook *Centrolabrus exoletus*	P	-	-	-	-
Cuckoo Wrasse *Labrus mixtus*	P	-	-	-	-

Key; C=common, P=present, R=rare

Figure 2.6 Occurrence of Wrasses at chalk sites.

One southern species which appears to be very much at the extremity of its range on the chalk sites in southern England is a burrowing sea-cucumber, assumed from the colour of its tentacles and habitat alone to be *Aslia lefevrei*. The most easterly record is of a single animal at South-West Rocks. In view of the suitability of the habitat for this crevice-dwelling species it must be assumed that its rarity reflects the most easterly extent of its distribution.

A number of species with a generally northern distribution nevertheless occur on the more southerly sites. Two examples are the nudibranch *Cadlina laevis* and the whip forming amphipod *Dyopedos porrectus*. *Cadlina laevis* is reported by Thomspon and Brown (1976) as being most common on the north-east of the British Isles but is recorded in chalk from Dover. The whip amphipod is also recorded here but neither species has been seen in the more westerly chalk sites.

Another species which, though not confined to northern waters, is most common there, is the spider crab *Hyas araneus*. In the south west it is largely replaced by the Spiny Spider Crab *Maja squinado*. On the chalk sites *Hyas* is the only large spider crab recorded from Dover whilst either it and *Maja* or the latter alone are found at the other sites.

2.5 CONCLUSIONS

Whilst there are similarities in the topography, habitats and species found on sublittoral chalk, there are also significant differences which mean that no one site can be considered characteristic. Amongst the differences are geographical position and stability of bedrock, both of which lead to some significant variations in species composition.

The greatest variety of sublittoral topography is found at The Needles/Alum Bay on the Isle of Wight. Here are the tallest chalk faces recorded (6m) and there are also extensive areas of horizontal bedrock. However, there are significant sublittoral chalk features which do not occur in this area such as offshore chalk reefs, which are found only off the Sussex coast. Wave surge ridge and gully systems are best developed at the Seven Sisters.

Chalk sites in general are significant for the presence of burrowing and crevice-dwelling animals. The combination of these species is varied and includes both species with a northerly and southerly distribution within the British Isles. There is evidence of an overlap of such species in the Dover area.

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M.C.S CHALK CLIFFS SITE LOG

CARD NO

LOCATION

COUNTY	NEAREST TOWN
SITE NAME	SURVEY REF

LAT ° ' " N LONG ° ' " W/E

GRID REF

NORTH POINT

LOCATION SKETCH

INSERT SCALE

DIVE DETAILS

RECORDERS NAME

ADDRESS

DATE	D	M	Y	
TIME	IN	OUT	DUR	GMT/BST

DIVE TYPE: SHORE ☐ BOAT ☐ DRIFT ☐ SNORKEL ☐

ESTIMATE AREA/DISTANCE COVERED

RECORDED DEPTH RANGE

MAIN ☐ UPPER ☐ LOWER ☐

HORIZONTAL VIS EST ☐ MEASURED ☐

TEMPERATURE EST ☐ MEASURED ☐

THERMOCLINE YES NO DEPTH ☐

FRESH WATER AT SURFACE YES NO

SITE ASSESSMENT

SITE TYPE

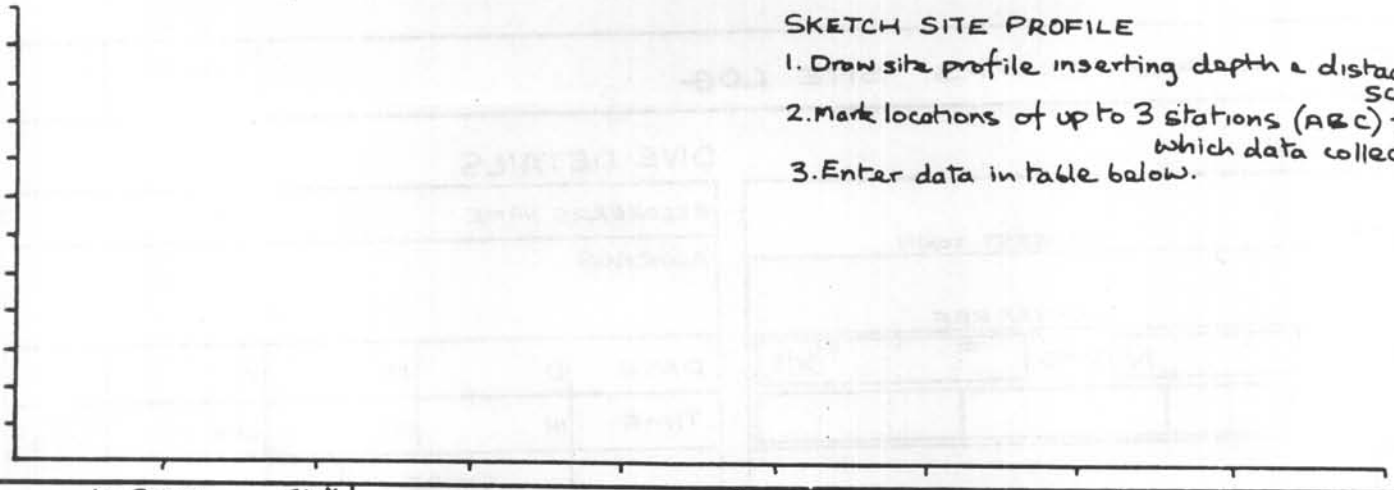
ROCK TYPE

EXPOSURE TO WATER MOVEMENT [RING ONE IN EACH ROW OR TWO IN LAST]

WAVE ACTION	V SHELTERED	SHELTERED	SEMI-EXPOSED	EXPOSED	V EXPOSED
TIDAL STREAMS	V WEAK	WEAK [<1KT]	MODERATE [1-3KT]	STRONG [3-6KT]	V STRONG
UNDERWATER	NO CURRENT	SOME CURRENT	STRONG CURRENT	NO WAVE SURGE	WAVE SURGE

DESCRIBE THE MAIN FEATURES OF THE UNDERWATER SCENERY AND HABITATS

OVERALL SITE ASSESSMENT	POOR	AVERAGE	GOOD	EXCELLENT
UNDERWATER SCENERY				
VARIETY OF HABITATS				
ABUNDANCE OF FISH LIFE				
ABUNDANCE OF OTHER MOBILE LIFE				
ABUNDANCE OF ATTACHED LIFE				



SKETCH SITE PROFILE

1. Draw site profile inserting depth & distance scales.
2. Mark locations of up to 3 stations (A B C) from which data collected.
3. Enter data in table below.

SCORING 1 = RARE <10% 2 = SECONDARY 10–40% 3 = PREDOMINANT >40%	STATION A SCORE	STATION A COMMENT	STATION B SCORE	STATION B COMMENT	STATION C SCORE	STATION C COMMENT
SEA-BED TYPE						
CHALK BEDROCK						
OTHER BEDROCK						
CHALK BOULDER						
CHALK RUBBLE						
FLINT COBBLE						
GRAVEL						
SHELLY GRAVEL						
COARSE SAND						
FINE SAND						
MUD						
METAL/WOOD/CONCRETE						
OTHER (specify)						
FEATURES						
UPPER HORIZONTAL SURFACE						
SLOPING SURFACES – GRADUAL						
SLOPING SURFACES – STEEP						
SLOPING SURFACES – VERTICAL						
SLOPING SURFACES – OVERHANGING						
LOWER HORIZONTAL SURFACE						
GULLEY						
SEA-BED COVER						
KELP FOREST						
RED FOLIACEOUS ALGAE						
ENCRUSTING PINK ALGAE						
ANIMAL TURF						
BARE SURFACES						
SILTATION						
SAND ON ROCKS						
THIN SILT COVER						
HEAVY SILT COVER						

DESCRIBE THE MAIN FEATURES OF THE MARINE LIFE AT THE SITE. ARE THERE ANY HUMAN PRESSURES EVIDENT?

MCS CHALK CLIFFS BASIC SPECIES RECORD											NO				
SITE NAME											RECORDER'S NAME				
SURVEY REF/SITE LOG STATION											ADDRESS				
LAT	°	'	"	N	LONG	°	'	"	E/W		DATE	D	M	Y	
GRID REF											TIME	IN	OUT	DUR	GMT/BST

		UPPER HORIZONTAL SURFACE		VERTICAL SURFACE		LOWER HORIZONTAL SURFACE		OTHER	
	SEABED TYPE								
	RECORDED DEPTH								
	PRESENT/common	P	C	P	C	P	C	P	C
1. LAMINARIA HYPERBOREA	Red Kelp								
2. RED FOLIACEOUS SEAWEED									
3. ULVA LACTUCA	Sea Lettuce								
4. CLIONA CELATA	Boring Sponge								
5. HALICHONDRIA PANICEA	Breadcrumb Sponge								
6. AMPHILECTUS FUCORUM	Orange Sponge								
7. TUBULARIA INDIVISA	Sea Fir								
8. ANEMONIA VIRIDIS	Snakelocks Anemone								
9. METRIDIUM SENILE	Plumose Anemone								
10. BISPIRA VOLUTACORNIS	Fan Worm								
11. FILOGRANA IMPLEXA	Red Spot Tube worm								
12. PHORONIS HIPPOCREPIA	Horseshoe Worm								
13. FLUSTRA FOLIACEA	Hornwrack								
14. MYTILUS EDULIS	Common Mussel								
15. PIDDOCKS	H Holes. L Live. S Shell debris.								
16. CANCER PAGURUS	Edible Crab								
17. HOMARUS GAMMARUS	Lobster								
18. CARCINUS MAENAS	Shore Crab								
19. MAIA SQUINADO	Spiny Spider Crab								
20. GALATHEA SP	Squat Lobster								
21. HENRICIA OCULATA	Blood Star								
22. BURROWING SEA CUCUMBERS									
23. CLAVELINA LEPADIFORMIS	Light Bulb Squirt								
24. CIONA INTESTINALIS	Sea Squirt								
25. AGGREGATING RED/GREY SEA SQUIRTS									
26. LABRUS BERGYLTA	Ballan Wrasse								
27. TAURULUS BUBALIS	Long Spined Sea Scorpion								
28. PARABLENNIUS GATTORUGINE	Tompot Blenny								
29. THOROGOBIUS EPHIPPIATUS	Leopard-Spot Goby								
30. GOBIUSCULUS FLAVESCENS	2 Spot Goby								

MCS CHALK CLIFFS EXTRA SPECIES RECORD

MCS CHALK CLIFFS EXTRA SPECIES RECORD							NO	
SITE NAME					RECORDER'S NAME			
SURVEY REF/SITE LOG STATION					ADDRESS			
LAT ° ' " N			LONG ° ' " E/W		DATE	D	M	Y
GRID REF					TIME	IN	OUT	DUR	GMT/BST

	UPPER HORIZONTAL SURFACE		VERTICAL SURFACE		LOWER HORIZONTAL SURFACE		OTHER	
SEABED TYPE								
RECORDED DEPTH								
PRESENT/COMMON	P	C	P	C	P	C	P	C