Proceedings of the Isle of Wight Natural History and Archaeological Society vol, pp 41-85
(published 1990)

THE MARINE FLORA & FAUNA OF BEMBRIDGE AND ST. HELENS, ISLE OF WIGHT

K.J. Collins, R.J.H. Herbert & J.J. Mallinson

Bembridge and St. Helens are situated on the eastern tip of the Isle of Wight. Historical and recent records of marine flora and fauna have been collated. Present within the region is a wide variety of marine and maritime habitats including rocky, sandy and muddy shores, brackish lagoons and of course the open sea. The sublittoral has been surveyed and reported for the first time. This survey extended between 1 and 3 km offshore at depths from 0 to 15 m below Chart Datum. The biological importance and biogeographical significance of the area, together with the impact of man's activities in the region, are reviewed and discussed.

The most notable feature of the locality is the extensive shallow lagoon system at low water accomodating a remarkable diversity of species. These include the rare red algae, *Grateloupia filicina var. luxurians*, and *Gracillaria bursa-pastoris*, and currently the most easterly population of the brown alga *Padina pavonica* on the British side of the English Channel. A trio of rare sea anemones has been recorded, namely *Anthopleura ballii* and *Aureliana heterocera*, and in the brackish lagoons, *Nematostella vectensis*. The sublittoral communities are similar to those between the eastern Solent and Selsey Bill. The shallow shelving coastline is reminiscent of the Kimmeridge area off Dorset which has been recognised for the richness of its marine flora and fauna.

Introduction

Bembridge and St. Helens have long been a favourite venue for rock-pooling, and the study of marine life. The two parishes are situated at the eastern tip of the Isle of Wight and are separated by Brading Harbour. Within close proximity is a range of marine and maritime environments; these include the exposed chalk headland of Culver Cliff with its wave cut platform; the limestone ledges and 'tidal' (eulittoral) lagoons off Bembridge Foreland; sandy shores at Whitecliff Bay, Bembridge Point, St. Helens and Priory Bay; estuarine mudflats and saltmarsh within Brading Harbour; sand dune communities on St. Helens Duver; brackish lagoons adjoining the harbour; and a wealth of marine habitat below low water mark.

The aims of this study were threefold:

a) to collate existing knowledge and records from the area
b) to survey and report for the first time the sublittoral environment
c) to interpret the ecology and review the biological importance and biogeographical significance of the region.

Literature review

Early work

Although nineteenth centuary natural historians produced descriptions of the Isle of Wight marine flora and fauna (eg Venables 1860, 1867, Doubleday 1900), they were soon superceded by Morey's (1909) guide and species notes for terrestrial and marine life of the Island. Interestingly, as far as marine animals are concerned, there is much greater reference to Whitecliff bay and the *Zostera* beds of St. Helens than to Bembridge in these early accounts. In more recent times however, it has been the ledges at Bembridge which have received the greatest attention. The first description of the seashore life specific to Bembridge was made by Barker (1923). The *Proceedings of the Isle of Wight Natural History and Archaeological Society* has provided a forum for reporting local observations since 1923.

Fauna (Nomenclature follows Howson (1987))

General observations on the marine biology were made by Marshall (1947). James & Marshall (1954) produced a marine fauna list for Bembridge and Shanklin shores and Ryde and Sandown piers, though unfortunately records for the different localities were not separated. Taylor (1961, 1962) has presented the results of rockpool surveys in this area and Prebble (1967, 1968) has described the shells. Evans (1953) discovered that, although rare, the limpet *Patella depressa* reached its easterly limit in the English Channel at Bembridge, and *Patella ulyssiponensis* (as *P. aspera*) at Culver Cliff. Crisp & Southward (1958) described in detail the distribution of the commoner intertidal animals at over 100 sites along the English Channel, 13 of which were on the Isle of Wight, including one at Lane End, Bembridge. This work led to recognition of the geographical limits in the distribution of certain species.

Many records for Bembridge are contained in Juniper's (1963) survey of intertidal fauna of the Portsmouth area. Intertidal bryozoa from Bembridge and Culver Cliff have been recorded by Crew (1970). Swatman (1984a, 1984b, 1985) has produced reports on the abundance and distribution of species on Bembridge lifeboat station pier and Black Rock, and observations on the intertidal habitats between Culver and Bembridge. Studies on the reproduction of the anemone *Actinia equina* have been carried out by Carter & Thorp (1979) of Portsmouth Polytechnic.

The variation in the dog-whelk, *Nucella lapillus* from coastal sites including Bembridge has been described by Berry & Crothers (1974), Crothers (1975), and Bantock & Cockayne (1975). Herbert (1989b) has reported the decline of the dog-whelk from the Solent south to Bembridge lifeboat station.

Bird counts within Brading Harbour and adjacent marshes are recorded by Cheverton (1971, 1979, 1985). and a comparative survey of the distribution of over-wintering shore birds around the Island including Bembridge and St. Helens was carried out by Cheverton & Stafford (1985).

Flora

The first volume of the *Proceedings of the Isle of Wight Natural History and Archaeological Society* contained a description of the Island's marine algae by Delf & Grubb (1923). This was updated by Norkett (1947).

In April and July 1955, Kain (1958) made a general survey of littoral algal zonation and diatom species around the south coast of the Isle of Wight. Two of these study sites were on Bembridge ledges, 'north' (just north of the lifeboat station) and 'south' (on Long Ledge). Of the 65 macroscopic algal species found around the Island, 54 were recorded at Bembridge.

In 1973, Farnham and co-workers from Portsmouth Polytechnic marine laboratory reported the first occurrence of the alien brown alga, *Sargassum muticum* on Bembridge ledges (Farnham *et al.*, 1973, Jones & Farnham, 1973). This is a vigorously growing species and it soon spread along the south coast of England, dominating the local flora in certain sheltered shallow sites (Jephson & Farnham 1974, Farnham 1978, Lewey & Farnham 1981, Critchley 1981, Critchley *et al.* 1983). Morell (1986) mapped the abundance of *Zostera* and 8 algal

species including *Sargassum, Laminaria* spp. and *Fucus* spp. over the whole of the Bembridge ledges. Withers *et al.* (1975) described the epifauna and associated flora, and Jephson & Gray (1977) described the epiphytes. Gray (1978) also investigated the epifauna. An account of the attempted control of the weed is made by Farnham & Jones (1974) and Critchley *et al.* (1986).

Chamberlain (1977) has reported new British records for *Pneophyllum limitatum* (as *Fosliella limitata)* and *P. lejolisii* (as *F. lejolisii*). Price *et al.* (1979), who have investigated the distribution of the brown alga *Padina pavonica*, make important reference to Bembridge and other Island shores.

Hawes & Cobb (1979), and Cobb & Williams (1987) have used Bembridge material in their investigations concerned with the symbiotic relationship between chloroplasts of *Codium fragile* and the mollusc *Elysia viridis*, and photosynthetic biochemistry of *Codium*, respectively.

The local significance of the *Zostera* beds in the Bembridge ledge lagoons is described by Tubbs & Tubbs (1983) while Shepard (1971) has listed the flora within the sand dune communities of St. Helens Duver.

Farnham (1982) has compiled a list of marine algae of the Isle of Wight and Tittley, (1988), has surveyed algal communities on Culver Cliff amongst other chalk cliffs on the Island.

Sediments

The macrofauna of the intertidal sands at Bembridge and Ryde were studied by Withers (1979). Holme & Bishop (1980) briefly describe the main communities within sediment shores present in the area of current interest. Howard *et al.* (1988), and Sheader & Sheader (1987) have investigated Brading Harbour and the brackish lagoons respectively.

Reviews

An overview of the Solent area is given briefly in Monkhouse (1960). Barnes *et al.* (1973) describe the sublittoral fauna of the east and west Solent, and later, an assessment and review of work on the Solent estuarine system was produced by the N.E.R.C. (1980). Most recently, Dixon & Moore (1987) have reported on the Solent System as part of a survey of Harbours, Rias and Estuaries of Southern Britain. This extensively describes the physical attributes of the region, reviews marine biological and related studies and describes the use of the area as well as carrying out new survey work. At Bembridge this involved a short description of the mid-tide rocky shore.

Collins & Mallinson (1983) have described the area between the East Solent and Selsey Bill which contains sublittoral records relevent to this area. Woods (1988) has examined sublittoral chalk habitats in southern England and included studies off Culver Cliff. George *et al.* (1989) have surveyed the chalk macrobenthos on the north and south face of Culver Cliff amongst other sites on the Island.

Intertidal survey methods

In the last ten years much information about the intertidal ecology of the area has been obtained by Dr W. Farnham and other research workers at Portsmouth Polytechnic. In addition, students attending field study courses at the Medina Valley Centre have contributed further records and data which has greatly enhanced our understanding of the area. Field meetings attended by members of the Isle of Wight Natural History and Archaeological Society have also yielded valuable information.

During April 1988, members of this Society carried out a transect survey 300 m south east of the lifeboat station. A tape measure was laid out across the shore and using an abundance scale (Table 1), selected species were recorded within a 0.25 square metre quadrat frame placed both sides of the tape at 2 m intervals. The total area sampled at each interval was therefore 0.5 square metres, and the mean species densities or cover values of the two quadrats

were noted. The slope of the transect was determined using a pantometer frame placed every metre. The transect finished at low water, the time of which was recorded. The height of low tide above Chart Datum at Portsmouth dockyard was then obtained from the harbour master, and using *Reed's Nautical Almanac* the equivalent height at Bembridge was calculated. The results are presented in Fig 2. The historical and recent intertidal species records listed in the Appendices were obtained between Culver Cliff and Horestone Point.

Sublittoral survey methods

Whilst there has been considerable attention directed towards the littoral zone, especially the rocky Bembridge Ledges there is no published information on the sublittoral. Some of the *Sargassum* studies extended into the shallow sublittoral, as this species is generally confined to less than 2 m below Chart Datum. Dr W Farnham has records including the occurrence of sublittoral algal species. The survey by Collins & Mallinson (1983) from the East Solent to Selsey Bill includes data from St. Helens Fort and New Grounds, some 2 miles off the Bembridge shore.

The survey area, shown in Figure 3, was from Horestone Point to Culver Cliff extending from Low Water Springs/Chart Datum to a distance of 1 km offshore, approximately the line of the 10 m contour in 1987. The survey area was extended the following year to distances of 2-3 km offshore with depths of up to 16 m below Chart Datum.

The survey work was carried out by SCUBA diving from a 10 m launch on 10 separate days between April and July 1987, and on 4 days between May and August 1988. This gave much needed time for working through the collected material after each day's fieldwork. Usually the diving team consisted of three or four members, diving in pairs, with one of the authors as a member of each dive pair to ensure consistency of reporting. The divers were marked by a surface marker buoy which was tracked on the surface by the support boat, monitoring the position by Decca (MkIII) fixes, and depth profile by recording (Ferrograph) echo sounder. Usually 3-4 survey dives of around 30-45 minutes were made each day. The time on site was constrained by the considerable distance from the boat base to the survey area, and by the tidal conditions.

The underwater routine was to swim or drift with the current, covering distances of approximately 100-400 m and noting major substrate types and associated species. Records were made in pencil underwater on a 'Formica' slate. A checklist was tried on some dives as a means of making recording easier. Another technique, which was particularly valuable when the water was cold early in the survey, was the use of an underwater tape recorder. Collections of algae and fauna were made for later identification. Gravel and sand samples were also collected in plastic bags for determining mollusc infauna. Photographs were taken to provide habitat information and records of species for later identification. Two Nikonos cameras with underwater flash units, were used. One was a Nikonos II with 35 mm lens and 2:1 extension tube for small species. The other was a Nikonos III with 28 mm lens for general habitat pictures and a removable Nikonos close-up lens giving a 24 x 16 cm field of view. Underwater visibility varied between 2 and 4 m. During the survey the water was usually turbid. This rapidly attenuates surface light, making lack of light at depth a problem, rather than simply visible distance.

On surfacing, the divers' records and observations were transferred to the standard survey record sheet. This had a check-list for the expected species and space for the addition of further records. The abundance of each of the species on the main substrates/habitats was recorded using a five point semi-quantitative scale (see Collins & Mallinson (1988).

On shore, the survey collections were transferred to separate aquaria for study. Algae were pressed for confirmation of identification by Dr W. Farnham at Hayling Island Marine Laboratory. Uncertain faunal species were preserved in alcohol. The sand and gravel samples were sieved through a 500 μm mesh and sorted for small molluscs which were passed on to J. Light and I. Killeen of the Conchological Society of Great Britain and Ireland.

The abundance and habitat data for species found during the survey dives was transferred to a data base; the Gemini Data Gem, a ROM based random access system for the BBC B micro-computer. This allowed manipulation of the data and searching for occurrences related to substrate and depth.

Description of the littoral zone

This description is mainly concerned with the rocky and sandy intertidal area along the coast. The harbour is dealt with separately.

Geology

Within Whitecliff Bay, the relatively soft Eocene sands and clays succeed the Upper Cretaceous Chalk of Culver Cliff. The rapidly receding cliffs, which have almost vertical strata, undoubtedly contribute much sediment to the beaches and attract considerable international interest owing to the variety of different exposures and their ease of accessability. Toward Black Rock, the northerly dip of the strata decreases and the distinctive cream coloured Bembridge Limestone reaches sea level. It is the Bembridge Limestone that forms the hard ledges which are of much biological interest. Between the two bands of limestone, each being 1.5 to 2.0 m thick, is a thin mudstone (Insole & Daley 1985). The lower band of limestone forms the outer reef at Long Ledge and Bembridge Ledge. The more easily weathered mudstone causes the formation of the eulittoral 'lagoons', separating these reefs from the upper Black Rock Ledge. Mudstones of the Bouldnor Formation provide the backdrop for a short distance before being replaced by lower cliffs composed of flint pebble conglomerate which are now interpreted as being a Quaternary (? Ipswichian) raised beach (Daley & Insole 1984). To the north of the harbour, the limestone ledges are again backed by mudstones, though the boulders on the shore at Horestone Point are sandstones belonging to the Seagrove Bay Member of the Headon Hill Formation.

Topography

Apart from the hard resistant nature of the limestone rock itself, perhaps the most important physical aspect of the shore which has most significantly influenced intertidal communities is the almost plateau-like topography. This may best be seen at low tide from a high elevation such as the summit of Culver Cliff, when the extensive nature of the ledges can also be appreciated. On the ebb tide these flat ledges drain relatively slowly, and even at low tide there is much standing water and large shallow connecting pools. It is this feature that enables the colonisation and growth of such a high diversity of algae and associated animal life. Sand frequently covers the bottom of these shallow pools, and where there is a certain degree of sediment stability, the brown alga *Padina pavonica* may occur. Small rocks and boulders of limestone within the pools provide a haven for many species, including the long-clawed porcelain crab *Pisidia longicornis*. At the edge of each successive ledge there is often an abrupt micro-cliff, up to 2 m high, which in places may appear uncannily man-made owing to the regularity of fissures and joints. This 'cliff' may frequently be undercut where waves have exploited the softer rocks beneath the hard limestone. At low tide, the exposed overhangs reveal an interesting fauna including the anemone *Diadumene cincta*, sponges *Halichondria panicea* and *Hymeniacidon perleve*, and the rock-boring mollusc *Hiatella arctica*. These overhangs and crevices also provide shelter at low tide for crabs, and for the shanny, *Lipophrys pholis*. Below each 'cliff', the blocks of fallen limestone provide a haven for large numbers of the broad clawed porcelain crab, *Porcellana platycheles*.

The chalk platform of Culver Cliff is also gently shelving, though topographically it is somewhat different. The east-west strike of the strata is defined by hard flint-rich bands raised above softer weathered chalk, resulting in a regular chanelled platform. Various sized boulders cover the shore, and on the north-east face the near vertical strata are undercut by waves producing a smooth concave base to the cliff.

Exposure to wave action

Generally speaking, the eastern tip of the Isle of Wight is relatively sheltered from the prevailing south-westerly winds and wave fronts, though moderate to fresh easterly and north-easterly winds may result in large breakers over the ledge despite the comparatively short fetch. The shore communities on the chalk wave cut platform at the foot of Culver Cliff are indicative of fairly exposed conditions and include a high density of limpets, barnacles and mussels. The long embracing arm of 'Long Ledge' undoubtedly confers a high degree of shelter to the shores behind, and further north. The alga *Ascophyllum nodosum*, which is usually found in sheltered conditions, is relatively rare except at Black Rock and Horestone Point where it is more evident and locally common. Various workers have attempted to classify Bembridge shore according to the much used and acclaimed 'Ballantine Scale' (Ballantine, 1961) which is based on the use of indicator species. Crothers (1975), using this scale, gives the shore a score of '5 - fairly sheltered', though difficulties are encountered in coming to a satisfactory conclusion owing either to the rarity or absence of some important indicator species such as *Pelvetia canaliculata*, *Chthamalus*, *Monodonta* and *Lichina pygmaea*. As previously indicated, the shore aspect does result in strong easterly and north easterly winds at times and the smothering of algae-covered rocks by several centimetres of shifting sand on the upper and middle shore is not uncommon.

Tides

The spring tide range varies between 3.1 m at the entrance to Brading Harbour and 3.9 m at the Nab Tower further east. Tidal currents of up to 2.7 knots exist off Long Ledge and run parallel to the shore from the end of Culver Cliff to Bembridge Ledge. Along the seaward edge of Long Ledge there appear to be overfalls at certain states of the tide, though the tidal streams are slower north of Bembridge Ledge. In common with the rest of the Solent, Bembridge experiences a significant prolonged stand at high water attributed to the double tide phenomenon characteristic of this part of the English Channel. This, combined with the time of high water springs being around midday, is beneficial to intertidal species as immersion during this period will reduce potential damage and risk of desiccation, particularly on the lower shore.

Intertidal zonation

As a result of the gradient of environmental conditions which extend across any seashore, species of plants and animals will occupy certain positions or 'zones' according to their tolerance to submergence and exposure. The upper and lower limits of a species zone may also be influenced by biological factors such as predation, grazing and competition, and may be subject to seasonal and long term fluctuations. On some steep shores, this zonation pattern may be very distinctive and, at low tide, bands of different coloured algae parallel to the shore may be obvious to the most casual observer. However, on rather flat shores such as the limestone ledges at Bembridge, where at low tide there are large areas of sand and standing water between the rocks, this pattern, although present, is not as immediately apparent. Moreover, some of the upper shore species which are so characteristic of many rocky shores are either absent or limited due to the lack of suitable substrate, whereas some lower zones are vastly extended owing to the level topography.

Much of the intertidal zone is backed by low lying, quickly receding cliffs. The supralittoral EHWS (Extreme High Water Spring) tide mark consists of shingle, sand and cobbles, and debris washed up with the tide. The fauna and flora normally associated with this tidal level on rocky shores is therefore virtually non-existant. Apart from *Arthopyrenia halodytes* on Culver Cliff and *Verrucaria* sp. on large boulders at Black Rock and Horestone Point, there are no other recorded lichens. The small periwinkle *Littorina neritoides* is occasionally found in crevices within old concrete sea defences at Forelands and on high boulders at Black Rock and Culver Cliff. The uppermost outcrops of Bembridge Limestone are somewhat vulnerable to smothering by sand, particularly after storms, but *Enteromorpha* is common and *Fucus spiralis*

varies from being locally abundant to rare. The rocky shore variety of the brown alga *Pelvetia canaliculata* is absent, though the estuarine form is frequent on the upper shore amongst saltmarsh plants within St. Helens mill pond. The sands between the upper rocky reefs are dominated by juvenile *Arenicola marina*. Withers (1979) found a moderatly rich fauna in the finer sands above MLWN (Mean Low Water Neap Tide), with *A. marina* at maximum densities of 50 per sq metre at the top. Dominant crustaceans were *Urothoe poseidonis* at maximum densities of 2340 per sq metre and *Bathyporeia sarsi*, with maximum densities at 4620 per sq metre. In crevices within the uppermost ledges, the anemone *Actinia equina* may be abundant though the general lack of deep pools at higher tidal levels prohibits the occupation of lower shore species. Sand between the mid and lower ledges frequently prevents the colonisation of mid-littoral algal species and therefore limits zone formation.

On the edge of the middle reef, breaking waves inhibit stable algal colonisation and a striking limpet-barnacle zone may occur. The dog-whelk, *Nucella lapillus*, may be locally common south of the lifeboat station feeding upon the dominant barnacle, *Balanus balanoides*.

The very extensive lower reefs are dominated by the brown alga, *Fucus serratus*. As a result of the flat topography and poor drainage, Kain (1958), found that many species of algae extend to higher tidal levels than at St. Catherines Point, where the shore is steep and drainage fast. For example, *Fucus serratus* was found to be present up to nearly 3 metres above Chart Datum at Forelands whereas at St. Catherines Point, despite being more exposed, the same species was limited to 1.7 m above Chart Datum.

In the more gravelly parts of the shore and within the lower tidal lagoons, the green alga *Codium fragile* may be abundant, and the eel-grass *Zostera* may be locally common, though it is never very extensive except in Priory Bay where the largest beds are to be found.

The fauna associated with the lower ledges is also varied. Both the edible periwinkle, *Littorina littorea*, and the flat winkle, *L. mariae/obtusata*, are extremely abundant. The snakelocks anemone, *Anemonia viridis*, may be very common within shallow pools, and boulders within the pools will frequently provide refuge for long-clawed porcelain crabs, *Pisidia longicornis*, squat lobster, *Galathea squamifera*, and shore crab, *Carcinus maenas*. Many tunicate species may be found under these rocks, including *Clavellina lepadiformis* and *Aplidium* sp.. The hermit crab, *Pagurus bernhardus*, occupies empty periwinkle and dog-whelk shells and is extraordinarily abundant here. Withers (1979), found that sand between the reefs at MLWS was poorly sorted, gravelly, and as a consequence only inhabited by 13 species, which were mainly amphipods and polychaetes.

Sheltered open lagoons and channels of shallow water extend up and between the exposed ledges. These harbour an extremely diverse algal flora including *Halydrys siliquosa, Laminaria saccharina, Chondrus crispus, Codium fragile,* and *Griffithsia flosculosa*. In summer, the lagoons have an almost complete canopy of floating Japanese seaweed *Sargassum muticum.* The rare anemone, *Anthopleura ballii* may also be found in the lagoons.

On the extreme lower shore, the ledges are dominated by *Laminaria digitata* with encrusting *Lithothamnion* sp.. The hairy crab, *Pilumnus hirtellus*, and anemones, *Urticina felina* and *Cereus pedunculatus*, are common. The blue-rayed limpet, *Helcion (= Patina) pellucidum*, may commonly be found within holdfasts and upon fronds of *Laminaria.* The limpet *Patella ulyssiponensis* is also confined to the lower shore.

Description of sublittoral environment

The surface rock features at the base of Culver Cliff and along Bembridge Ledges continue a short distance underwater before being covered by boulders of the same material, then by gravels and sands. This is shown in the sectional profiles in Figure 4.

As with the shore profile, there is a shallow gradient seaward, continuously in the north of the area and with a 6 m shelf in the south. The typical offshore substrate is a mixture of gravel, sand and flint cobbles, with varying proportions of each (Figure 5). This material virtually

entirely covers Culver Spit, the seaward extension of Culver Cliff. Only inshore are outcrops of its chalk backbone found. The most extensive area of sublittoral rock extends from the Foreland promontory, around Sharpus Rocks and off The Run. Here, there are massive slabs of Bembridge Limestone presumably derived from under-cut bedrock. This was undoubtedly the richest and most diverse habitat encountered during the survey. To the south of Culver Spit, in deeper water, there is a complex pattern of rocky ridges (1-3 m high) protruding through the seabed gravels from the Wealden beds. Clay bedrock underlies the Bembridge Limestone and was seen as patchy, horizontally bedded outcrops amongst the boulders and gravel in this general area.

To the north of Bembridge Ledge, sheltered from the full force of Channel tidal currents, siltier conditions prevail. There is a marked contrast between the clean, washed material to the south and the muddier sediments to the north. This follows the overall pattern of increasingly fine sediments towards the East Solent. St. Helens Road contains an extensive area of pure fine mud of considerable depth. Tidal currents here are slow, the region being outside the main stream of the Solent and Channel water movements. Further north, at Warner Shoal, the main source of hard substrate is the shells of the slipper limpet, *Crepidula fornicata*.

Substrates

Mud

Generally, the muds and silts of the Solent region were found to contain chains of slipper limpets (*Crepidula fornicata*) which provide attachment for other organisms. These include hydroids (*Kirchenpaueria pinnata* and *Hydrallmania falcata*), and sponges (*Halichondria* sp. and *Suberites carnosa*). A number of small crab species, (*Pisidia longicornis*, *Macropodia rostrata* and *Pagurus bernhardus*), were found in the cover provided by the slipper limpet shell epifauna. On Warner Shoal, there was a significant number of mature oysters, (*Ostrea edulis*), providing a resource for the local fishery.

St. Helen's Road, as described above, contains an extensive area of fine, deep, soft mud without any hard substrate. Here, an exciting discovery was made; a large population of the echiurid worm *Maxmuelleria lankesteri*. Densities of several per square metre were seen. Specimens were photographed with feeding proboscis extended from their burrows, across the surface mud. Attempts were made to sample these animals but only fragments could be withdrawn from the deep burrows. Samples of mud revealed large numbers of the amphipod *Ampelisca diadema* and the bivalve mollusc *Nucula nitidosa*.

Sand

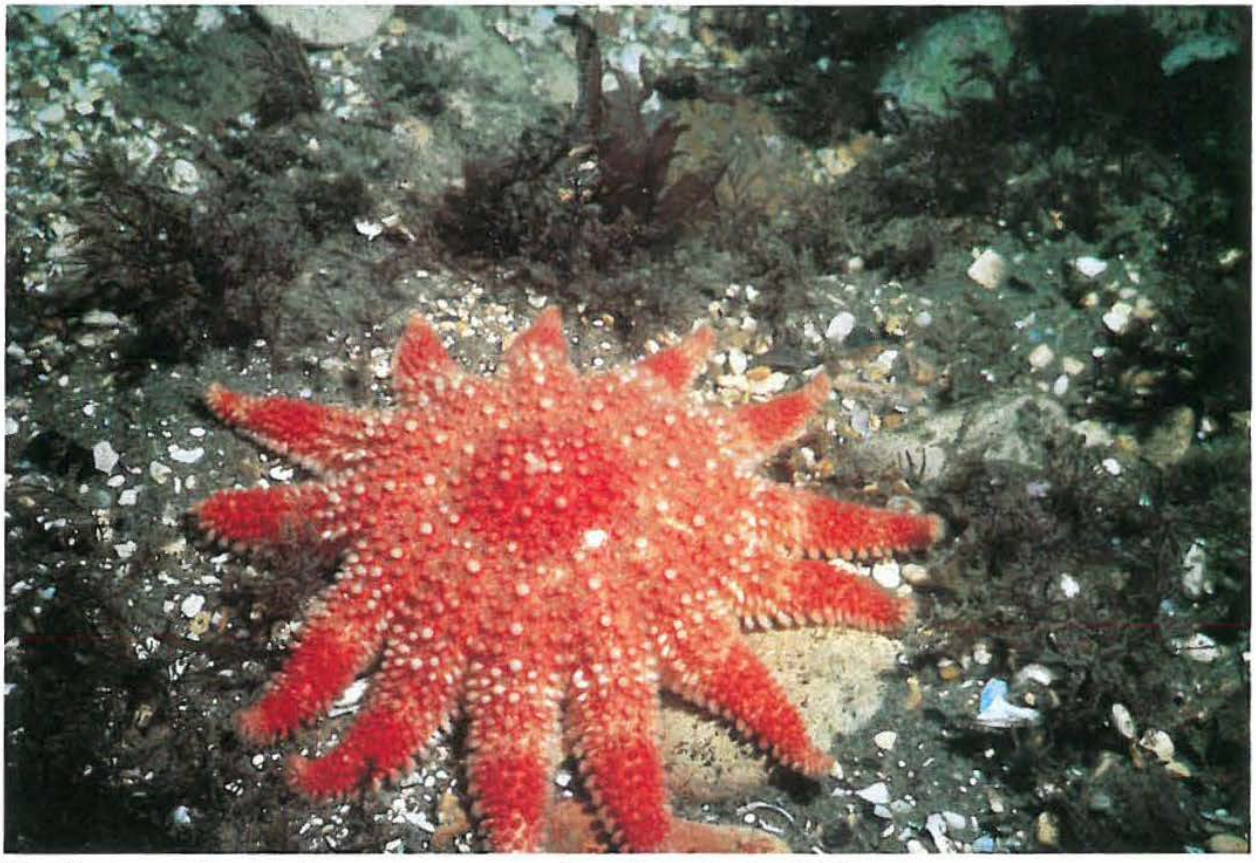
Areas of clean sand extend over 1 km from Whitecliff Bay which also has a sandy beach. This sand is very mobile with ripples inshore and deep waves in the tidal mainstream. In the more stable areas the burrowing worms *Lanice conchilega* and *Arenicola marina* are found. Mobile species typically found in such areas were *Pagurus bernhardus, Hinia reticulatus* and, occasionally, *Carcinus maenas*. A number of species are sand tolerant but require some underlying stone or hard substrate for attachment. These include the anemones *Anemonia viridis* and *Cereus pedunculatus*, and notably the red alga *Polyides rotundus*. A number of other algae were found in sand on the margins of rocky outcrops.

Gravel and Cobble

There was a variable mixture of sand, gravel and cobble over much of the area. The gravel provides a firm substrate for settlement and consequently has a richer flora and fauna than the sand. Extensive areas of pure cobble were found during the East Solent to Selsey Bill survey (Collins & Mallinson 1983) and were described as a separate habitat. In this survey, flint cobbles were found in low densities mixed with the gravel sharing much the same species.

The prominent anemones *Anemonia viridis* and *Urticina felina* were typical of the gravel

View south at low tide towards Long Ledge and chalk headland of Culver Cliff.
Photo: L. Tiller



The Common Sunstar *Crossater papposus* found at a depth of 10m.
Photo: Collins & Mallinson

areas. *Anemonia* was sometimes found in large numbers where there were cobbles as well. *Cereus pedunculatus* was also commonly found on this substrate. In the north of the area the conditions are siltier and were favoured by *Cerianthus lloydii* which was not found in the south.

Gravels containing a sand fraction were found to support the sandmason worm *Lanice conchilega*. In the north, where there were finer sediments associated with the gravel, the peacock worm *Sabella* sp. was more typical.

The slipper limpet *Crepidula fornicata* is a characteristic species of the Solent region and its shells can form the main hard substrate in areas of soft sediments. It was commonly associated with the gravel and occasionally achieved dominance.

Exposed gravel stones were often colonised by tubeworms such as *Pomatoceros triqueter*, and by barnacles (*Balanus* spp.). On the deeper areas of stable gravel and cobbles, the hydroids *Halecium halecinum, Kirchenpaueria pinnata* and *Nemertesia antennina* were found. The foliose bryozoan *Flustra foliacea* occupied a similar niche. There was a marked difference in the flora between north and south, reflecting the current conditions. In the south the algae were seldom found on the gravel presumably because of current dragging. By contrast, in the north, a substantial proportion of the algae found occurred on gravel and cobble substrates. Apart from the weaker currents here, the gravel also extends into shallower depths. The most striking area of weed growth on gravel was north of St. Helens Fort where there was total cover by fronds of *Laminaria saccharina* several metres long.

Mobile species commonly found on the gravel were the gastropods *Buccinum undatum, Gibbula cineraria* and *Hinia reticulatus*, and the crabs *Pagurus* spp. and *Liocarcinus* spp.. Where foliose cover was available there was an increased range of mobile fauna, including the spider crabs *Macropodia rostrata* and *Pisa tetraodon*. A species typical of cobble areas was *Galathea squamifera*, living on the underside of the larger rounded flint stones.

Gravel areas below 10 m were too deep for foliose algal growth although encrusting red algae of the *Lithothamnion* type were found as deep as 14 m. At one site south of Culver Spit the gravel contained live maerl.

Clay

Limited outcrops of clay bedrock were found in the centre of the survey area, often in areas of relatively mobile gravel. These were generally found to be barren. The impression was given that they had either been recently exposed or were too soft to support epibiota. There was evidence of boring by the piddock *Pholas dactylus*.

Chalk bedrock and boulders

Low ridges of chalk bedrock and scattered large (1m) boulders were found at the base of Culver Cliff. Strong currents which sweep round the headland prevent the accumulation of silts, and the intervening sediments are clean gravels. The shallow water chalk surveyed supported a heavy algal growth on upper surfaces. This was dominated by the brown algae *Laminaria digitata*, *Laminaria hyperborea* and *Halidrys siliquosa*. Within this there was a variety of smaller red algae including *Dilsea carnosa*, *Griffithsia flosculosa*, *Halurus equisetifolius* and *Phyllophora crispa*. Much of the exposed chalk surface was covered with pink encrusting algae, probably *Lithothamnion* sp.. At 9m, hydroids *Tubularia indivisa* and *Kirchenpauria pinnata* were visually dominant over the few small species of red algae such as *Phyllophora* spp. The stable current-swept surfaces provide ideal settlement sites for sponges, the most commonly found being *Dysidea fragilis*, *Halichondria panicea* and *Amphilectus fucorum*. Another sponge, *Ciocalypta penicillus*, was found in its characteristic habitat where the base of the chalk outcrop met the coarse sand. As with the cobble substrate, the anemones *Anemonia viridis, Urticina felina* and *Cereus pedunculatus* were prominent.

Limestone bedrock and boulders

The littoral Bembridge Limestone pavement does not extend far into the sublittoral, but remnants of it, as broken slabs and isolated boulders, occur all along its edge. This is

undoubtedly the most scenic area, supporting the widest diversity of species.

There was a characteristic depth related gradation of the large brown algae on upper surfaces of rocks and boulders. From the littoral zone, *Fucus serratus* gives way to the kelps, first *Laminaria digitata* and then *Laminaria hyperborea*. The latter is found with *Halidrys siliquosa* which generally extends somewhat deeper. Deeper still, red algae predominate, particularly *Heterosiphonia plumosa*, *Plocamium cartilagineum*, *Delessaria sanguinea* and *Cryptopleura ramosa*. Below this, animal species are dominant, with occasional red algae such as *Phyllophora crispa*. The shallow broken pavement areas support a greater diversity of species than the isolated boulders. The unusual brown alga, *Zanardinia prototypus*, was found in such an area.

As the algal cover diminished with depth, hydroids bryozoans and sponges became more prominent. These included *Halecium halecinum*, *Flustra foliacea* and *Bugula plumosa*. The sponge *Halichondria panicea* was the most massive, covering the upper surfaces of some small boulders. Another spreading form, though thinner, was *Amphilectus fucorum*, found in similar situations. *Polymastia mamillaris* was also found on upper surfaces in small isolated patches, often partly obscured by other organisms.

The sides of boulders, even in relatively shallow water, were fauna dominated, having a continuous cover of bryozoans, hydroids, sponges, worms and ascidians. *Bugula turbinata* was the most prominent bryozoan here. Typical sponges found were *Dysidea fragilis*, *Hemimycale columella* and occasionally branching species such as *Haliclona oculata* and *Raspailia hispida*. A number of ascidians shared this habitat including *Clavellina lepadiformis* and *Morchelium argus*.

The continuous cover on the rocks and boulders supported a wide range of mobile species, particularly molluscs and small crabs.

Deeper limestone outcrops were found at Nab and Princessa Shoals as well as components of the Wealden beds south of Culver Spit. These sites were generally below the depth for significant algal growth (10m). In its place are erect hydroids *Nemertesia antennina* and *Tubularia indivisa*, and foliose byrozoa *Flustra foliacea* and *Bugula* spp. Sponges are a characteristic component of deep rock and boulder epifauna, usually in low density but showing a wide diversity (covering some 20 species identified in this survey alone). The more frequently encountered species are *Dysidea fragilis* and *Halichondria panicea*. Another prominent charateristic species of rock fauna is the soft coral, *Alcyonium digitatum*. Sloping rock surfaces in areas of strong currents could support dense blankets of the small tunicate, *Dendrodoa grossularia* often containing specimens of *Polycarpa rustica*.

Brading Harbour (= Bembridge Harbour)

Other than that done by Howard *et al.* (1988), there has been little intensive survey work in the harbour. The harbour is fed by the eastern river Yar, though salinities are not greatly reduced. Silts and clays predominate, within which are typically estuarine communities including *Corophium volutator* and *Macoma balthica*. In the harbour entrance where the tide swept substrate includes more pebbles and cobbles, the plumose anemone *Metridium senile*, and barnacle *Balanus crenatus* occur along with *Styela clava* and *Lanice concheliga*. Outside the harbour entrance, apart from *Hinia* (= *Nassarius*), *Carcinus* and *Anemoni*a, there are relatively few animal species on the sandy and pebbly substrate, though the more uncommon alga *Chondria tennuissima* is found. The old St. Helens tide mill pond lies to the west of the harbour and, although it drains completely at low tide, it is separated from the rest of the harbour by a causeway through which sea water passes. The enclosed area has a developing saltmarsh; though of particular interest is the presence of the estuarine form of the channelled wrack *Pelvetia canaliculata*.

Brackish lagoons

To the south east of the harbour behind the embankment wall and coast road lie three brackish lagoons, two of which (Harbour Lagoon and Harbour Farm Lagoon 1) have relatively high salinities owing to percolation of sea water from the harbour through the embankment. As well as more common species such as *Sphaeroma rugicauda*, both lagoons accommodate good populations of the rare anemone *Nematostella vectensis* (Sheader & Sheader 1987; Herbert 1989a) for which the site is the species type locality (Stephenson 1935). Harbour Farm Lagoon 1 also supports a population of the rare stonewort *Lamprothamnium papulosum*. Carter (1937) has recorded 38 unicellular algal species from Harbour Lagoon (as Brading Harbour Lagoon), some being newly described.

Observations on flora & fauna

This section comments on selected groups of animals and plants including those which were either not substrate related or were too infrequent to be classified as a dominant component of a particular zone.

Sponges

Intertidal:
The green and yellow shore crust forms of *Halichondria panicea* are not uncommon under boulders submerged in pools, or in crevices with *Hymeniacidon perleve*. *Dysidea fragilis* may be found on shells and on boulders.

Many species colonise the alien brown alga *Sargassum muticum*.

Sublittoral:
Sponges were generally confined to rocks and boulders above the bottom sediments. One notable exception was *Ciocalypta penicillus* which occurred on the boundary of flat rock with clean sand or fine gravel and shell. The encrusting black sponge *Dercitus bucklandi*, found in crevices, is difficult to see under poor light conditions and therefore its abundance may have been underestimated.

The calcareous limestone and chalk rocks, as would be expected, supported occasional colonies of the boring sponge, *Cliona celata*.

The purse sponges *Grantia compressa* and *Scypha ciliata* tended to settle on other organisms, particularly algae, in areas of dense cover.

Sponges were an important component of the deep rock fauna, showing a great diversity. More species were found at the limited number of deep sites than at three times the number of shallower sites on the inshore survey. Two species found, *Pachymatisma johnstonia* and *Tethya aurantium,* are characteristic of deeper water, particularly off the Dorset coast. The most striking sponge was the massive form of *Dysidea fragilis* found in the deepest sites (14-16 m below Chart Datum) on the upper surfaces of rock outcrops. In shallower water it is typically found as small (2 cm) patches on the sides of boulders and in crevices. This sponge was identified *in situ* from its distinctive surface pattern. Whether the massive form is the same species growing without algal competition, or another species, is not certain and would be worth further investigation.

Cnidaria: Hydrozoa

Intertidal:
On the fronds of many lower shore algae *Obelia geniculata* is often abundant.

Sublittoral:
Hydroids such as *Halecium halecinum* and *Kirchenpaueria pinnata*, became more common with increasing depth, replacing algae. The large erect *Nemertesia antennina* was only found on the deeper survey dives and became more common further offshore.

Cnidaria: Anthozoa (Sea anemones)

Intertidal:
The beadlet anemone *Actinia equina* is very common within damp crevices whereas both grey and green varieties of the snakelocks anemone *Anemonia viridis* are highly abundant in pools. The small orange anemone *Diadumene cincta* may be locally common underneath the overhanging ledges of the micro-cliffs.

Sublittoral:
Most species of anemone were burrowing forms reflecting the large areas of gravel. The northern region was siltier and more stable supporting more species such as *Cereus pedunculatus* and *Anthopleura ballii* which also occur in the eulittoral lagoons. The latter has a distribution thought to be limited to this section of the eastern Channel. The presence of the small anemone *Halcampa chrysanthellum* indicates the stability of the area, as it was growing among stones of similar size to itself. An interesting find was a single specimen of the rare *Aureliania heterocera*, again in gravel. The soft coral *Alcyonium digitatum* became more common further offshore.

Anemones found on elevated surfaces of rock included *Actinia equina* and *Aiptasia mutabilis*. Some were found above this on the attached weed, for example *Anemonia viridis* which was found ubiquitously.

Annelids and Echiurids (Worms)

Intertidal:
The globular green egg masses of the polychaete *Eulalia viridis* are common on the shore in spring. The scale worm *Harmothoe imbricata* is frequent underneath boulders in pools.

Sublittoral:
Worms were found either in sediments on the seabed or on rock. *Lanice conchilega* was found in sand and sandy gravel as expected. Another worm with a distinctive sand tube, probably *Branchiomma* sp., was found in the south. *Sabella* sp. and terebellids, characteristic of silty conditions, were found in large numbers in the north. The latter were inferred from the presence of radiating feeding tentacles on the seabed.

The calcareous tubes of *Pomatoceros triqueter* were found on most hard surfaces from large stones upwards. Finer tube worms (*Filograna* sp.) were present on many deep rock faces associated with encrusting bryozoa.

The echiurid worm *Maxmuelleria lankesteri* was a most unexpected find in St. Helen's Road. This has been described as a typically northern species and has been studied in Loch Sween by Atkinson (1987). There is a record of this species from the Solent near Wootton (Wadham, 1935), and Spooner & Holme (1961) found specimens at one site in Poole Bay off Bournemouth. There is clearly a significant population of this worm in St. Helen's Road which deserves further study.

Crustaceans

Intertidal:

The common shore crab *Carcinus maenas* is frequent from early summer, whereas the squat lobster *Galathea sqaumifera* reaches its maximum abundance in the early autumn when many young may be found. The lower pools and crevices provide a refuge for young *Cancer pagurus* and velvet swimming crab *Liocarcinus puber*, although the latter has become noticably more uncommon on the shore in the last two years. The pea crab *Pinnotheres pisum* may be frequent in mussels on the shore below Culver. The crabs *Macropodia rostrata* and *Pisa tetraodon* are common on the shore in summer and early autumn.

Sublittoral:

One of the more striking features were the large areas of the tubes of the amphipod *Ampelisca diadema* found on flat open gravel or rock. These closely packed vertical tubes trap mud and silt, forming a layer up to 15 cm deep. These sometimes extended over several hundreds of square metres to the exclusion of virtually everything else. Another species, *Ampelisca tenuicornis*, was found in large numbers in samples of mud from St. Helen's Road.

Three specimens of the unusual stalked barnacle *Scalpellum scalpellum* were found at one site attached to hydroids.

Swimming crabs were very common in the shallow gravels in the north. Most were *Liocarcinus arcuatus*, but other species were also sampled; *L. depurator*, *L. holsatus*, *L. puber* and *L. pusillus*.

Crabs characteristic within the dense algal cover were *Macropodia rostrata*, *Pisa tetraodon* and *Hyas coarctatus*.

The commercial species, edible crabs (*Cancer pagurus*) and lobsters (*Homarus gammarus*), were regularly found amongst boulders. A wide range of sizes was observed.

Molluscs

Intertidal:

The common whelk *Buccinum undatum* and several nudibranch species are to be seen laying eggs on the shore between late April and mid June. These include *Facelina coronata*, *Aeolidiella alderi*, the sea lemon *Archidoris pseudoargus*, and the grey sea-slug *Aeolidia papillosa*. The sacoglossan *Elysia viridis* is frequently found amongst the green alga *Codium fragile*, particularly in the spring and early summer.

Sublittoral:

Few nudibranch species were found, probably because most of the survey dives were relatively early in the year. *Archidoris pseudoargus* was widely distributed.

The most common mollusc was the slipper limpet *Crepidula fornicata*. The Solent also has an oyster (*Ostrea edulis*) fishery, and isolated specimens were found attached to rocks. Conditions in the centre of the area would appear to favour mussels, *Mytilus edulis*, but only a few specimens were seen.

The limestone was subject to some boring by bivalves though this was not investigated by breaking open rocks. Empty shells suggested the presence of *Pholas dactylus*. Wood (1988) recorded *Hiatella arctica* in the chalk off Culver Cliff.

Larger mobile gastropods such as *Buccinum undatum* , *Gibbula* spp. and *Hinia* spp. were found on all substrates. *Trivia arctica* and *Calliostoma zizyphinum* were typical of the dense growth on boulders. Two specimens of the unusual white shelled form of the latter, *Calliostoma zizyphinum* var. *lyonsii* were found.

Mollusc infauna from sediment samples was studied by Light and Killeen with the intention of including these records in an atlas of the Isle of Wight marine molluscan fauna.

Bryozoans

Intertidal:
The most frequent species is *Electra pilosa* , both on rock and on the stipes of *Fucus serratus.*

Sublittoral:
As with the hydroids, bryozoans contribute to the continuous cover on rock surfaces, the most prominent of these being *Flustra foliacea* and *Bugula* species. Many bryozoans were found on algae including *Electra* spp., *Epistomia bursaria* and several *Crisia* species.

Hard forms such as *Disporella hispida* , *Pentapora foliacea* and *Palmicellaria skenei* were found at deeper sites offshore. Encrusting forms were widespread on deep upper rock surfaces. These appeared to be similar to those found on the under sides of limestone slabs off Bembridge and Selsey. They are difficult to identify but because they are so numerous are worthy of closer study.

Echinoderms

Intertidal:
The only common species found from this group is the tiny brittle star *Amphipholis squamata*, though the starfish *Henricia occulata* may occasionally be found. Withers, (unpub), has recorded the urchin *Psammechinus milliaris* from lower pools.

Sublittoral:
The three starfish, *Asterias rubens* , *Crossaster papposus* and *Henricia oculata* , were found in very small numbers.

A single specimen of the sea cucumber *Ocnus lactea* was found in a mixed sample from a dive on limestone boulder and gravel.

Ascidians

Intertidal:
Aplidium spp. are frequent under rocks and *Ciona intestinalis* is occasionally found. The star ascidia, *Botryllus schlosseri* and *B. leachii* , are found under rocks in pools.

Sublittoral:
Extensive sheets of the small ascidian *Dendrodoa grossularia* occurred on flat rock outcrops south of Culver Spit. These were found in areas with similar physical conditions to those supporting blankets of *Molgula* sp. on the New Ground (Collins & Mallinson, 1983). Other species, such as *Styela clava* , *Ascidiella aspersa* and *Clavelina lapadiformis* , were found in small numbers as isolated individuals or colonies.

Fish

Intertidal:
The butterfish *Pholis gunnellus* and five-bearded rockling *Ciliata mustela* are frequent in pools and under rocks, as is the sand goby *Pomatoschistus minutus* and shanny *Blennius pholis.*

The fifteen spined stickleback *Spinachia spinachia* is common amongst *Sargassum.*

Sublittoral:
A limited number of fish species were seen. These were mostly small bottom dwellers such as gobies *Pomatoschistus* spp., dragonet *Calionymus lyra* , and scorpion fish *Taurulus bubalis* . Notable observations were the red gurnard *Aspitrigla cuculus* and lesser spotted dogfish *Scyliorhinus canicula* . Visibility and light intensity were low at depth, reducing the opportunities for fish observations.

In June, several wrasse 'nests' were found between boulders. These consisted of a mass of tightly packed red weeds some 30-40 cm across. At one site a corkwing wrasse *Crenilabrus melops* , was observed collecting weed in its mouth and adding it to the 'nest'.

Birds

Species regularly seen feeding in the eulittoral lagoons include heron, cormorant and black-headed gulls. Redshank may be seen on the shore throughout the year and there are often 100 plus oystercatchers between Culver and Forelands. Purple sandpipers, sanderling and bar-tailed godwits may be seen in the region during autumn and winter as may large flocks of wigeon and mallard in Whitecliff Bay. Common, sandwich, and little terns may be seen diving for small fish and shrimps in the summer.

Algae

The richness of the littoral algae continues underwater due to the shallow shelving of the seabed.

On rocks there is a clear zonation of the large brown algae, from *Fucus serratus* in the littoral zone to *Laminaria digitata* , then *Laminaria hyperborea* and *Halidrys siliquosa* . Specimens of *Laminaria ochroleuca* were found amongst the *L. digitata* and *L. hyperborea*. *Laminaria saccharina* occurred on shallow gravels in the north. At some sites this was in such high densities that it completely blanketed the seabed. In a sheltered area inshore of St. Helens Fort there were tall stands of *Chorda filum* several metres high.

Sargassum muticum was found in smaller quantities than was expected from previous reports. Even in shallow water, only isolated plants were seen.

There was a range of smaller brown algae including *Desmarestia* spp., *Dictyota dichotoma* and *Cladostephus spongiosus* . The most unusual of these was the rare *Zanardinia prototypus* .

Red algae occurred throughout the depth range surveyed and showed the greatest diversity. Usually many species shared the same habitat. There are more detailed records for the larger, more prominent forms which could be identified underwater. These included *Caliblepharis ciliata* , *Delesseria sanguinea* , *Dilsea carnosa* and *Plocamium cartilagineum*. Several species, sampled and identified subsequently, were simply recorded as present with no habitat or abundance information. The greatest diversity of red algae was found on the shallow broken limestone pavement sites in the centre of the area. This diversity decreased with increasing depth, reduced light intensity and smaller boulders, allowing animal species to co-dominate. On the margin of rock outcrops subject to inundation by sand only a few algal species, such as *Halopitys incurvus* and *Polyides rotundus*, were seen.

Below 11 m there was essentially no foliose algal growth, it being replaced by hydroid and bryozoan cover.

Thin layers of purple calcareous encrusting algae were found as deep as 14 m below Chart Datum on most hard substrates, especially on the chalk. These were recorded as *Lithothamnion* sp. but not examined in detail. Fragments of live maerl were found in clean gravel samples from Culver Spit.

Green algae did not form a significant part of the sublittoral flora. Only *Ulva* sp. was recorded regularly in the shallower sites.

Biological importance

The intertidal limestone ledges are well known for their biological interest. Apart from representing the most eastern example of a rocky shore of any significance on the south coast of England, the shallow rocky environment provides an extremely favourable habitat encouraging the survival of a wide variety of species. This high diversity may be attributed to the coincidence of a number of factors, notably the range of available substrate (particularly shell and gravel), and differing degrees of exposure to wave action. Owing to the continual exposure of freshly weathered surfaces and the growth of cracks and crevices within the soft chalk and limestone bedrock, there occur, locally, areas which exhibit different states of colonisation and therefore have a high species diversity. Intertidally, the undercut edges of the littoral microcliffs are examples of such areas. Apart from the diversity of the region, the extensive nature of the eulittoral ledge-lagoon system enables the growth of large intertidal populations.

Recognition of the biological importance and geological interest has led to the coastline of Whitecliff Bay, Bembridge ledges, St. Helens ledges and Priory Bay, being notified as a site of special scientific interest (SSSI) by the Nature Conservancy Council.

The previously undescribed sublittoral zone has also revealed a variety of habitats. These include all those found in the East Solent to Selsey Bill survey (Collins & Mallinson 1983) plus chalk under-cliff habitats. The latter has a limited occurence nationally. This range represents, in a very small area, that of much of the Isle of Wight and adjacent sea area. The shallow limestone boulders off Foreland supported the richest and most diverse flora and fauna.

Compared to other highly regarded areas in the British Isles such as south west England, the Pembrokeshire coast, Anglesey and the Scottish lochs, the diverse algal community to be found at Bembridge is unique by any standards (Farnham pers comm.). A contributary factor here is the introduction of alien species such as *Sargassum muticum* .

Species found which have only local occurrence in the British Isles include the red algae *Grateloupia filicina* var. *luxurians* and *Gracilaria bursa-pastoris* . The uncommon coralline crustose red algae *Pneophyllum limitatum* and *P.lejolisii* are associated with *Zostera* , and the brown alga *Padina pavonica* may be found intertidally in pools. The large beds of eel grass *Zostera* are of regional importance and are host to a range of epiphytes.

The anemone *Nematostella vectensis* found within the brackish lagoons is of international rarity and is protected under the 1981 Wildlife and Countryside Act. Harbour Farm lagoon 1 (fig.1) supports the stonewort *Lamprothamnnion papulosum* , another national rarity protected by the same legislation.

The fauna of the ledges is not as exceptional as the flora, though the anemone *Anthopleura ballii* appears now to be limited to this mid section of the Channel. The sublittoral survey also revealed the Imperial anemone *Aureliania heterocera* which also has local occurrence.

The chalk cliffs of Culver are a designated bird sanctuary, and accommodate about 100 Herring gulls during the breeding season.

Cheverton & Stafford (1985) have recorded more over-wintering shorebird species at Forelands than any where else on the Isle of Wight. On the rocky ledges, up to 40 Purple Sandpipers may over-winter here. This is certainly significant locally and may be important regionally bearing in mind the lack of the preferred rocky shores further east. Over 100 Brent geese also frequent the shore during the winter and feed on a range of species particularly *Enteromorpha* and some *Zostera*. In some years, the sandy shores accomodate up to 200 Sanderling in the autumn and winter months. The status of this species should be carefully monitored, as regular counts of between 150-200 may be of national or even international interest.

Biogeographical significance

The marine biogeographical significance of the Isle of Wight first became widely apparent during a study of intertidal distributions in the English Channel by Crisp & Southward (1958). Earlier, Evans (1953) reported that on the south coast of England the limpets *Patella depressa* and *P. ulyssiponensis* (= *P. aspera*) were not found east of Culver Cliff. Moreover, there was a progressive increase in frequency of intermediate forms of *P. vulgata* , *P. depressa* and *P. ulyssiponensis* from west to east, until on the Isle of Wight they represented a large percentage of the total *Patella* population. Because of the difficulties encountered in species separation, precise identification must be carefully verified. Crisp & Southward (1958) do not record the presence of either *P. depressa* or *P. ulyssiponensis* at Lane End Bembridge, though recently M. Culley (pers.comm) has recorded *P. ulyssiponensis* from Long Ledge, and George *et al.* (1989) report *P. depressa* from Culver Cliff.

Species discovered by Crisp & Southward (1958) having extreme easterly limits on the Isle of Wight were the topshell *Gibbula umbilicalis* (Bembridge), the barnacles *Balanus perforatus* (Bembridge) and *Chthamalus stellatus* (Ventnor), and the small periwinkle *Littorina neritoides* (Sandown).

In recent years, field studies have yielded more records and these distributions can now be revised. The topshell *Gibbula umbilicalis* is still very rare at Bembridge though it has recently been recorded at Culver Cliff (George *et al.* , 1989) and along the mainland coast between Seaford and Eastbourne (Wood & Jones, 1986). Specimens from these localities are requested (J. Light pers. comm). Apart from dead 'shells' in 1965 and 1973, the barnacle *Balanus perforatus* has not been found alive at Bembridge since 1960 when 5 were found at Forelands and densities of 4 per sq.m were recorded near the lifeboat station (Southward, pers. comm). It is possible that the cold 1962-63 winter seriously damaged this population in the same way as it did the populations of *Chthamalus* spp. on the south coast of England. Crisp *et al.* (1981) update the distribution of *Chthamalus* spp, and indicate that in 1975 the most easterly extension of *C. stellatus* was Hanover Point at Brook, and that of *C. montagui* was at Bonchurch. In 1979, a search by the same authors did not reveal the presence of the latter species near Ventnor or St. Catherines Point despite being easily found in 1953-63. The soft rock and frequent landslips in the area offer a poor habitat for these species and it is possible that these factors, together with climatic cooling following the 1962-63 winter, have contributed to population instability and decline (Crisp *et al.* , 1981). However, George *et al.* (1989), have recently recorded a small number of *C. montagui* amongst *Balanus balanoides* and *Elminius modestus* on the chalk platform of Culver Cliff.

The small periwinkle *Littorina neritoides* has since been found at Culver Cliff, at Black Rock, and near the lifeboat station where it is always rare, though has been reported further east on a concrete sewer outfall at Seaford (Wood & Jones,1986) and in Sea Area 14 'East Channel' (Seaward,1982).

The snakelocks anemone *Anemonia viridis* (= *sulcata*) was recorded by Crisp & Southward (1958) as being common at Brook, Totland and Colwell Bay, frequent at Southsea, and rare at Brighton, though surprisingly none were found at Bembridge. Yet despite its complete disappearence from the Isle of Wight during the 1962-63 winter, both colour varieties have since returned to previous stations and they are now extremely abundant in pools and lagoons at Bembridge. The species has recently been recorded at nine sites between Selsey and Shoreham, though none further east (Wood, 1984).

The anemone *Cereus pedunculatus* , which appears to reach its easterly limit at Shoreham and Beachy Head, is also common on the lower shore and sublittoral at Bembridge. Likely to be associated with this anemone is the sea-slug *Aeolidiella alderi* which has recently been discovered at Bembridge and is currently its most easterly recorded station.

Crisp & Southward (1958) noted that the algae *Himanthalia elongata* and *Saccorhiza polyschides* were absent from the eastern Channel. Both these species have now been recorded at Bembridge, and *Himanthalia* from the shallow sublittoral at Bognor Regis

(Wood,1984) and the lower shore at Beachy Head (Wood & Jones, 1986). There is strong evidence that the presence of large amounts of suspended silt in the water, which reduces light intensity, is an important limiting factor upon the growth of *Himanthalia* (see Tittley & Price 1978), and this may account for its absence on the more turbid east coasts.

The brown seaweed *Padina pavonica* , commonly known as the 'peacocks-tail' or 'turkey-feather alga', reaches its current northern limits along southern British and Irish shores. Price *et al.* (1979), have demonstrated that more northerly (albeit perhaps ephemeral) populations existed considerably further north, and that a contraction of the species range in response to environmental change may have occured. The Isle of Wight is the furthest east of three major long-established south coast foci and the species is regularly found in pools at Bembridge during the summer. There are currently no records of this species growing further east.

The criticism justifiably levied at distribution maps is that they frequently represent the distribution of recorders rather than the species concerned. A greater measure of confidence can be applied to the intertidal data than the sublittoral purely because this has been better studied. Having said that, the sublittoral brown kelp *Laminaria ochroleuca* which appears to have a southwest distribution (John, 1969) was found at Bembridge for the first time during this recent survey and is currently its most easterly recorded station in the Channel.

The occurence of echiurid worms (*Maxmuelleria lankesteri*) in St. Helens Road is notable because this is more typically a northern species. Atkinson (1987) has studied a population in Loch Sween. Historically, isolated specimens have been recorded locally off Wootton by Wadham (1935) and in Poole Bay by Spooner & Holme (1961).

Crisp & Southward (1958) speculated as to why the Isle of Wight should represent such an apparent boundary between the western oceanic and eastern continental communities. Apart from the most easterly available hard rock of any significance, there could well be more subtle oceanographic and climatic influences. Sea temperature will affect all stages in a life cycle, and in the east Solent temperatures range from 7.8° C during February and March to peak at about 16.7° C in August. Severe winters do take their toll on intertidal species though the 1985-86 winter appeared to have little visible effect locally. Juniper & Steele (1969) record the sudden appearance of the sponge *Leuconia barbata* at Bembridge after the 1962-63 winter where previously it had not been discovered.

The sudden change from a southerly to a colder north easterly aspect at St. Catherines Point may be critical, and the strong currents in this locality could send larvae well out to sea, the majority thereby finding themselves unable to settle on intertidal rock.

Man's impact

The area is popular with summer visitors who enjoy the beaches and relatively sheltered waters for sailing and other boating activities. The harbour is a base for a number of small commercial fishing boats, and lobster and crab potting occurs off the Bembridge ledges and within some of the tidal lagoons. There is an oyster fishery off St.Helens, and the intertidal ledges are frequented by collectors of the edible winkle *Littorina littorea* . Ferries operate cross-channel services from Portsmouth and Southampton and sail on regular routes just off the ledge. Large naval vessels, container ships and tankers also pass relatively close inshore on their approach to the mainland ports.

Perhaps the earliest event worth recording is the reclamation of Brading Harbour completed in 1878. Formerly, the navigation was clear right up to the town of Brading. Bevis *et al.* (1978) refer to the abundance of the dwarf eelgrass, *Zostera noltii* (= *nana*), in Brading Harbour before reclamation. The only recent record of this species in the region is that of Kain (1958) on Bembridge Ledge north of the lifeboat station. In recent years the only reclamation of the foreshore has been in conjunction with coastal defence works, though the important brackish lagoons to the south of the harbour remain vulnerable.

The rise in popularity of yachting in the Solent generally has meant an increase in the number of moorings and berthing facilities in the harbour and in some sheltered bays. Although this has inevitably resulted in some associated pollution such as oil and diesel leakage there is no direct evidence that this has severely affected the ecology of adjacent seas. However, the use of tributyltin (TBT) antifouling paints on yachts and boats undoubtedly has. Herbert (1989b) found that the north easterly limit of the dog-whelk *Nucella lapillus* (an indicator species sensitive to TBT paints) in the Solent was between Brading Harbour and the lifeboat station. Moreover, the potentially fatal condition known as *imposex* caused by exposure to TBT increased significantly between Culver Cliff and Brading Harbour. It is quite likely that other species in the area have also been affected.

Some local fishermen blame sewage pollution and general degradation of the foreshore for the demise of the cockle population which once thrived at St. Helens. There are a few outfalls in the area, and of some concern is the dumping of sewage sludge and dredge spoil from Southampton Water off the Nab tower 13 km east of Bembridge. There have also been some reports from local anglers of mis-shapen fish and fish having swallowed plastic.

Angling is very popular in the area, and much useful information can be obtained from anglers about the health of stocks and unusual catches. However, intensive bait digging off St. Helens has caused local concern.

The close proximity to the busy shipping lanes of the eastern Solent and Channel ports has had a very significant impact on local marine life. Apart from isolated incidents such as the submarine *HMS Alliance* which came to grief on Bembridge Ledge in 1968 spilling diesel oil, there have, thankfully, been no major disasters. The impact of shipping is more subtle, being a vector for alien species from distant seas. In 1945 the Australian barnacle *Elminius modestus* was discovered in Chichester Harbour, from which it spread along the Channel coast and was first found at Bembridge in 1949 (Crisp, 1958).

Other alien species include the Japanese tunicate *Steyla clava* which was first recorded at Bembridge in 1963, and the slipper limpet *Crepidula fornicata*, now extremely abundant in the Solent. The anemone *Haliplanella lineata*, which was found on Bembridge Ledge in 1972 (Manuel pers comm), is another example from the western Pacific, first appearing in the Atlantic towards the end of the last century. This species has now been reported from many harbours and ports and has probably been carried on ship's hulls and/or transplanted oysters (Manuel,1981).

Farnham (1978 & 1980) has reported studies concerned with the introduction of alien marine algae into the Solent. More specifically, Farnham & Irvine (1968) record the occurence of the introduced red alga *Grateloupia filicina* var. *luxurians* .

Undoubtedly the most important alien species to come to Bembridge is the Japanese brown alga *Sargassum muticum* . This was first dicovered in British coastal waters at Bembridge in February 1973 (Farnham *et al.* 1973). Its rapid growth and reproductive strategy has led to the extension of its European range as far east as North Jutland, as far west as Cornwall, and as far south as Nantes in the Mediterranean (Morell, 1986). The species is thought to have arrived in our local waters associated with the import of Pacific oysters *Crassostrea gigas* into France from either Japan or British Columbia. The weed is presumed to have then floated to the south coast of England. During the summer months the eulittoral lagoons have almost a 100% surface cover of *Sargassum* which casts a considerable shade over other species. Although there had been no detailed mapping of algal species at Bembridge prior to the discovery of *Sargassum* , Morell (1986) found some evidence of competitive displacement of *Codium* and *Fucus serratus* germlings in marginal positions. There has also been concern about the observed decline of the eel grass (*Zostera* sp), though this could be due to damage caused by exposure of root stocks to frost at low tides during winter (Critchley, 1981). However, Morell (1986) reports that vast areas formerly colonised by *Zostera* have been grown over by *Sargassum* and that by 1983 *Zostera* had still not shown any sign of regeneration. To date there is no evidence that the introduction of *Sargassum muticum* has led to any local species extinction. What is certain is that although the large mats of floating

weed are a menace and a hazard to shipping and sea-borne recreation, the alga provides a substrate for a considerable epifauna and associated species. Gray (1978) lists 61 animal species on *S. muticum* at Bembridge and Withers *et al.* (1975) list 54 animal and 45 epiphytic plant species on specimens collected from Bembridge and St. Helens. This was significantly more than that found on native species growing in the vicinity. Associated with *Sargassum* plants were found two immigrant spirorbid worms; a single specimen of one of them, *Pileolaria berkeleyana* (= *rosepigmentata*), has been found at Bembridge. This species may well posess certain advantages over indigenous *Spirorbidae* (Gray,1978).

The area is visited regularly by research workers and school parties and although the shore is generally quick to recover from such activity, groups should be encouraged to exercise restraint from over-collecting and to observe a code of conduct as part of their educational objectives.

Conclusion

The ecological value of the shores of Bembridge and St. Helens have been stated many times, including their establishment as an SSSI. There is a range of exposure to wave action and a variety of substrates. The most notable feature is the extensive shallow lagoon system at low water accomodating an extremely wide diversity of species. Further intertidal survey work is required in Brading Harbour and on the chalk platform of Culver Cliff. Careful monitoring of the brackish lagoons is necessary to safeguard their high conservation value.

The shallow shelving coastline is reminiscent of the Kimmeridge area off Dorset, which has also been recognised for the richness of its marine flora and fauna. The large areas of the various habitat types at different depths allow the development of diverse communities. This has been recognised with the algae by Dr W. Farnham. A parallel to this in the fauna could be seen in the wide range of swimming crab (*Liocarcinus*) species found in the extensive shallow muddy gravels.

In general the findings of the sublittoral survey tie in with previous work to the north and east carried out during the Selsey Bill to East Solent Survey (Collins & Mallinson 1983).

The deep rock ridges south of Culver Spit have a particularly rich and diverse fauna. Further work is needed to identify the range of encrusting bryozoa at such sites. Additionally, this could be linked to an examination of the underside of limestone slabs such as those found off Bembridge and Selsey.

The unexpected discovery was the *Maxmuelleria* population, for which further work is recommended.

The range of sublittoral habitats, representative of the local sea area, complement the already recognised littoral zone, strengthening the case for conserving this fascinating area.

Readers are invited to submit interesting records and observations of marine life from Bembridge and St. Helens to the Marine Biological Recorder, Isle of Wight Natural History and Archaeological Society, 66 Carisbrooke Road, Newport, Isle of Wight.

Acknowledgements

The diving fieldwork was funded by the Nature Conservancy Council. We would like to thank Hume Wallace, skipper of the survey vessel 'Curlew', and the many divers who helped.

The Medina Valley Centre, Newport, provided facilities and resources for carrying out intertidal fieldwork and assimilating the historical records. Our thanks must also go to the many students who have contributed information and data whilst on field study courses at the Centre.

Jan Light and Ian Killeen, Conchological Society of Great Britain and Ireland, have given much help with sorting and identification of molluscs and supplying additional records from

the area. Dr Bill Farnham, Portsmouth Polytechnic Marine Laboratory, helped with the fieldwork, checked the algae identifications and made his algal records available. Dr Martin Sheader, Department of Oceanography, Southampton University and Dr Roger Bamber, CEGB Fawley Marine Laboratory, assisted with identification of amphipods and pycnogonids.

Our thanks are also due to Dr Bill Farnham and to Dr Roger Bamber for reading through the manuscript and making helpful suggestions. Dr Alan Insole made helpful comments with respect to the geology, and Jim Cheverton provided information and the list of birds from the area.

The publication of this paper was made possible by a grant from National Power.

National Power

References

Adams, L.E. 1929. Conchological notes. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **1** (10): 694.

Adams, L.E. 1937. Basking shark - a correction. Natural history and archaeological notes. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **2** (8): 700.

Anon. 1978. *The "British Birds" list of birds of the Western Palearctic.*

Atkinson, R.J.A. 1987. *The burrowing megafaunal communities of Loch Sween.* Report to the Nature Conservancy Council from the University Marine Biological Station, Millport.

Ballantine, W.J. 1961. A biologically defined exposure scale for the comparative description of rocky shores. *Field Studies* , **1** (3): 1-19.

Bantock, C.R. and Cockayne, C. 1975. Chromosomal polymorphism in *Nucella lapillus* . *Heredity* , **34** : 231-245.

Barker, K. 1923. Seashore life at Bembridge, *in* Whitehouse, J.H., *Bembridge, an historical and general survey by members of Bembridge school* : 1-100. Oxford.

Barnes, R.S.K., Coughlan, J. and Holmes, N.J. 1973. A preliminary survey of the macroscopic bottom fauna of the Solent, with particular reference to *Crepidula fornicata* & *Ostrea edulis* . *Proc. malac. Soc. Lond.* , **40** : 253-275.

Berry, R.J. and Crothers, J.H. 1974. Visible variation in the dog-whelk, *Nucella lapillus* . *J. Zool.* , **174** : 123-148.

Bevis, J.H, Kettell, R.E., and Shepard, B. 1978. *Flora of the Isle of Wight* . Yelf Bros. Newport.

Brough, P., Gibbons, R., and Pope, C. 1986. *The Nature of Hampshire and the Isle of Wight* . Barracuda Books.

Bunce, G. 1982. Natural History and Archaeological notes: Lumpsucker at Bembridge. *Proc. Isle Wight nat. Hist. arch. Soc.* , **7** (5) (for 1980): 355.

Carter, M.A., and Thorp, C.H. 1979. The reproduction of *Actinia equina* L. var *mesembryanthemum* . *J. mar. biol. Ass U.K.* , **59** : 975-1001.

Carter, N. 1937. New or interesting algae from brackish water. *Arch. Protistenk* , **90** : 1-68.

Chamberlain, Y.M. 1977. The occurrence of *Fosliiella limitata* (Foslie) Ganesan (a new British record) and *F. lejolisii* (Rosanoff) Howe (Rhodophyta, *Corallinaceae*) on the Isle of Wight. *Br. phycol. J.* , **12** : 67-81.

Cheverton, J.M. 1972. Bird Counts at Bembridge 1966-72. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **6** (6) (for 1971): 448-452.

Cheverton, J.M. 1979. Bird Counts at Bembridge 1972-77. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **7** (2) (for 1977): 91-99.

Cheverton, J.M. 1985. Bird Counts at Bembridge - 3. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **7** (8) (for 1983): 616-624.

Cheverton, J M. and Stafford, J. 1985. The Winter Shorebird Count 1984/5. *Isle of Wight Birds* : 31-47

Cobb, A.H. and Williams 1987. Relationship between chloroplast starch, phosphate content and season in the intertidal algae *Codium fragile* (Suringar) Harriot, *in* Biggens, J. (ed), *Progress in Photosynthesis Research, Vol 3* . Martinus Nijhoff Publishers, Dordrecht.

Collins, K.J., and Mallinson, J.J. 1983. *Sublittoral survey from Selsey Bill to the East Solent* . Report to the Nature Conservancy Council.

Collins, K.J. and Mallinson, J.J. 1988. *Marine Flora and Fauna off Bembridge, Isle of Wight - Sublittoral survey and review of existing knowledge, Horestone Point to Culver Cliff* . Report to the Nature Conservancy Council

Collins, K.J. and Mallinson, J.J. 1989. *Marine Flora and Fauna off Bembridge, Isle of Wight, Part II - Offshore sublittoral survey* . Report to the Nature Conservancy Council.

Crew, J.M, 1970. *Observations on the distribution and biology of the marine polyzoa of the south coast of England, reproduction and growth of Alcyonidium polyoum and other related species* . Ph.D. Thesis, University of London.

Crisp, D.J. 1958. The spread of *Elminius modestus* Darwin in north west Europe. *J. mar. biol. Ass. U.K.* , **37** : 483-520.

Crisp, D.J. and Southward 1958. The distribution of intertidal organisms along the coast of the English Channel. *J.mar.biol Ass. UK.* , **37** : 157-208.

Crisp, D.J. (ed.) 1964. The effects of the severe winter of 1962-63 on marine life in Britain. *J. Anim. Ecol.* , **33** : 165-210.

Crisp, D.J., Southward, A.J. and Southward, E.C. 1981. The distribution of the intertidal barnacles *Chthamalus stellatus* , *Chthamalus montagui* and *Euraphia depressa* . *J. mar. biol. Ass. U.K.* , **61** : 359-380.

Critchley, A.T. 1981. *Ecological studies on Sargassum muticum (Yendo) Fensholt* . Ph.D Thesis, Portsmouth Polytechnic.

Critchley, A.T., Farnham, W.F. and Morrell, S.L. 1983. A chronology of new European sites of attachment for the invasive brown alga *Sargassum muticum* 1973-1981. *J. mar. biol. Ass. UK* , **63** : 799-811.

Critchley, A.T., Farnham, W.F., and Morrell, S.L. 1986. An account of the attempted control of the introduced marine alga, *Sargassum muticum* in Southern Britain. *Biol. Conserv.*, **35** : 313-332.

Crothers, J.H. 1975. On variation in *Nucella lapillus* (L.): Shell shape in populations from the south coast of England. *Proc. Malac. Soc. Lond.* , **41** : 489-498.

Daley, B. and Insole, A.N. 1984. The Isle of Wight. *Geol. Assoc. Guide* **25** (Fourth edition). Geologists' Association.

Delf, E.M. and Grubb, V.M. 1923. Marine algae. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **1**: 181-185.

Doubleday, A. (ed.) 1900. *The Victoria County History of the Counties of England: A History of Hampshire and the Isle of Wight* . Constable, London.

Draper, I.J.H. 1964. Fish found in the Isle of Wight coastal waters 1956-64. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **5** (9): 406-411.

Dixon, I. and Moore, J. 1987. *Survey of harbours rias and estuaries in Southern Britain, the Solent system* Vol 1. Report to the Nature Conservancy Council.

Evans, R.G. 1953. Studies on the biology of British limpets. The genus *Patella* on the south coast of England. *Proc. zool. soc. Lond.* , **123** : 357-376.

Farnham, W.F. and Irvine, L.M. 1968. Occurence of unusually large plants of *Grateloupia* in the vicinity of Portsmouth. *Nature. Lond.* , **219** : 744-6.

Farnham, W.F., Fletcher, R.L. and Irvine, L.M. 1973. Attached *Sargassum* found in Britain. *Nature. Lond.* , **243** : 231-232.

Farnham, W.F. and Jones 1974. The eradication of the seaweed *Sargassum muticum* from Britain. *Biol. Conserv.* , **6** : 57-58.

Farnham, W.F. 1978. Introduction of marine algae into the Solent, with special referance to the genus *Grateloupia* . Ph.D. Thesis, Portsmouth Polytechnic.

Farnham, W.F. 1980. Aliens in the marine flora of southern England, *in* Price, J.H., Irvine D.E.G. and Farnham W.F. (eds.), *The Shore Environment* , Vol.2: *Ecosystems* : 875-914. Academic Press, London.

Farnham, W.F. 1982. *Species list of the benthic algae of the Isle of Wight.* Report to the Department of the Environment.

George, J.D., Tittley, I. and Price, J.H. 1989. *Macrobenthos of chalk shores in the Isle of Wight, Dorset and Devon* . A report for the NCC. British Museum (NH) London.

Goodall, J.M. 1923. Natural history notes. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **1** (4): 200.

Gray, P.W.G. 1978. *An investigation of the fauna associated with Sargassum muticum* . Ph.D. Thesis, Portsmouth Polytechnic.

Hawes, C.R. and Cobb, A.H. 1980. The effects of starvation on the symbiotic chloroplasts in *Elysia viridis* : A fine structural study. *New Phytol.* , **84** : 375-379.

Hendey, N.I. 1954. A preliminary checklist of British marine diatoms. *J. mar. biol. Ass. U.K.* ,

33 : 537-60.

Herbert, R. 1988. Marine Biological Recorders Report 1986. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **8** (2) (for 1987): 66-67.

Herbert, R.J.H. 1989a. Isle of Wight Marine biological report for 1987. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **8** (3) (for 1988): 37-42.

Herbert, R.J.H. 1989b. A survey of the Dog-whelk *Nucella lapillus* around the coast of the Isle of Wight. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **8** (3) (for 1988): 15-21.

Holme, N.A. and Bishop, G.M. 1980. *Report on the sediment shores of Dorset, Hampshire and the Isle of Wight* . Report to the Nature Conservancy Council.

Howard, S., Moore, J. and Dixon, I. 1988. *Surveys of Rias and Estuaries in Southern Britain. Newtown and Bembridge Harbours* . Report to the Nature Conservancy Council.

Howson, C.M. (ed) 1987. *Directory of the British marine fauna and flora* . Marine Conservation Society.

Insole, A. and Daley, B. 1985. A revision of the Lithostratigraphical Nomenclature of the Late Eocene and Early Oligocene Strata of the Hampshire Basin, Southern England. *Tert. Res.* , **7** (3): 67-100.

Jackson, J.F. 1925. A supplementary list of the mollusca recorded in 'A guide to the Natural History of the IoW, Frank Morey, 1909'. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **1** (6): 380-384.

James, L. and Marshall, C.R. 1954. *Isle of Wight Marine Fauna list 1947-52 Shanklin & Bembridge shores, Ryde & Sandown piers* . Colwyn Bay.

Jephson, N.A. and Farnham, W.F. 1974. The Jap-weed menace. *Triton* , **19** : 227-228.

Jephson, N.A. and Gray, P.W.G. 1977. Aspects of the ecology of *Sargassum muticum* (Yendo) Fensholt in the Solent region of the British Isles. 1 - The growth cycle and epiphytes, *in* Keegan, B.F., Ceidigh, P.O. and Boaden, P.J.S. (eds.) *Biology of Benthic organisms* : 367-375. 11th European symposium on marine biology. Pergamon, Oxford.

John, D. 1969. An ecological study on *Laminaria ochroleuca* . *J. mar. biol. Ass. U.K.* , **49**: 175-189.

Jones, E.B.G. and Farnham, W.F. 1973. Japweed: new threat to British coast. *New Scientist* , **60** : 394-395.

Juniper, A.J. 1963. *A survey of the intertidal fauna of the Portsmouth area* . MSc Thesis, University of Durham.

Juniper, A.J. and Steele, R.D. 1969. Intertidal sponges of the Portsmouth area. *J. nat. Hist.* , **3:** 153-163.

Kain, J.M. 1958. Observations on the littoral algae of the Isle of Wight. *J.mar. biol Ass. UK.* , **37** : 769-780.

Lewey, S.A. and Farnham, W.F. 1981. Observations on *Sargassum muticum* in Britain. *Proc. int. Seaweed Symp.* , **8** : 388-394.

Light, J and Killeen, I. 1990. A survey to record the marine mollusca of the Isle of Wight. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **9** : 86-90.

Manuel, R.C. 1981. *British Anthozoa. Synopsis of the British Fauna, No 18. Linn. Soc.* , Academic Press, London and New York.

Marshall, C. 1947. Marine biology. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **4** : 58.

Monkhouse, F.S. (ed.) 1964. *A survey of Southampton and its regions* . Southampton University Press **18** .

Morell, S.L. 1986. Biological investigations into the brown alga, *Sargassum muticum* . Ph.D thesis Portsmouth Polytechnic.

Morey, F. (ed). 1909. *A Guide to the Natural History of the Isle of Wight* . Newport.

N.E.R.C. 1980. *The Solent estuarine system. An assessment of present knowledge* . Natural Environment Research Council, publications series C No.22.

Norkett, A.H. 1947. Marine algae of the Isle of Wight. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **4** : 59.

Parke, N and Dixon, P.S. 1976. Checklist of British marine algae. Third revision. *J. mar. biol. Ass. U.K.* , **56** : 527-594.

Prebble, L. 1967. Seashore and shells section report. *Proc. Isle Wight nat. Hist. archaeol. Soc.*, **6** (2): 81.

Prebble, L. 1968. Seashore and shells section report. *Proc. Isle Wight nat. Hist. archaeol. Soc.* **6** (3): 139-140.

Price, J.H., Tittley, I. and Richardson, W.D. 1979. The distribution of *Padina pavonica* (L.) Lamour. (Phaeophyta:Dictyotales) on British and adjacent European shores. *Bull. Br. Mus. nat. Hist.* (Bot.), **7** (1): 1-67.

Seaward, D.R. 1982. *Sea area atlas of the marine molluscs of Britain and Ireland* . NCC, Shrewsbury.

Shepard, W. 1971. St. Helens Duver. *Proc. Isle Wight. nat. Hist. archaeol. Soc.* , **6** (5) (for 1970): 320-328.

Sheader, M. and Sheader, A. 1987. *A lagoon survey of the Isle of Wight* . Report to the Nature Conservancy Council.

Spooner, G.M. and Holme, M.A. 1961. Bottom fauna off the Dorset Coast. *Proc. Dorset Nat. Hist. Archaeol. Soc.* , **82** : 77-82.

Stephenson, T.A. 1935. *The British Sea Anemones* , vol 2. Ray Soc. London.

Stoker, H. 1962. *Sea fishing in Hampshire and the Isle of Wight* . Fifth impression 1974. Angling Times Books: Everest Benn, Tonbridge and London.

Swatman, M.C. 1984a. *An investigation of the abundance and distribution of species on both sea and land facing sides of the supports of Bembridge lifeboat pier at Ethel Point* . Internal report, Environmental Records Centre, IoW County Council.

Swatman, M.C. 1984b. *An investigation of the abundance and distribution of species at Black Rock, Bembridge* . Internal report, Environmental Records Centre, IoW County Council.

Swatman, M.C. 1985. *Observations on the intertidal habitats of the Isle of Wight* . Internal report, Environmental Records Centre, IoW County Council.

Taylor, R.H. 1961. Rockpool survey. *Biology Report* , **5** : 20-22.

Taylor, R.H. 1962. Rockpool survey. *Biology Report* , **6** : 12-14.

Tittley, I. and Price, J.H. 1978. The benthic marine algae of the eastern English Channel: a preliminary floristic and ecological account. *Botannica Marina* , **21** : 499-512.

Tittley, I. 1988. *Chalk-cliff algal communities, 2: outside southeastern England* . A report for the NCC. British Museum (NH). London.

Tubbs, C.R., and Tubbs, J.M. 1983. The distribution of *Zostera* and its exploitation by wildfowl in the Solent and Southern England. *Aquatic Botany* , **15** : 223-239.

Venables, E. 1860. *A guide to the undercliff of the Isle of Wight* . 526pp.

Venables, E. 1867. *A guide to the undercliff of the Isle of Wight* . 100pp.

Wadham, P. 1934. Notes on the fishes, reptiles and mammals of the Isle of Wight. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **2** (5): 395.

Wadham, P. 1935. Marine worm new to the south of England, Natural History notes. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **2** (6): 500.

Withers, R.G. 1979. Observations on the macrofauna of the intertidal sands at Ryde and Bembridge, I.O.W. *Proc. Isle Wight nat. Hist. archaeol. Soc.* , **7** (2) (for 1977): 81-89.

Withers, R.G., Farnham, W.F., Lewey, S., Jephson, N.A., Haythorn, J.M. and Gray, P.W.G. 1975. The epibionts of *Sargassum muticum* in British waters. *Mar. Biol Berl.* , **31** : 79-86.

Wood, C . 1984. *Sussex Sublittoral Survey* . Marine Conservation Society report to the Nature Conservancy Council

Wood, C.R. 1988. *Sublittoral chalk habitats in Southern England* . Report of Marine Conservation Society Chalk Cliffs Project.

Wood, C and Jones, E. 1986. *Severn Sisters Marine Surveys* . Marine Conservation Society report to the Nature Conservancy Council.

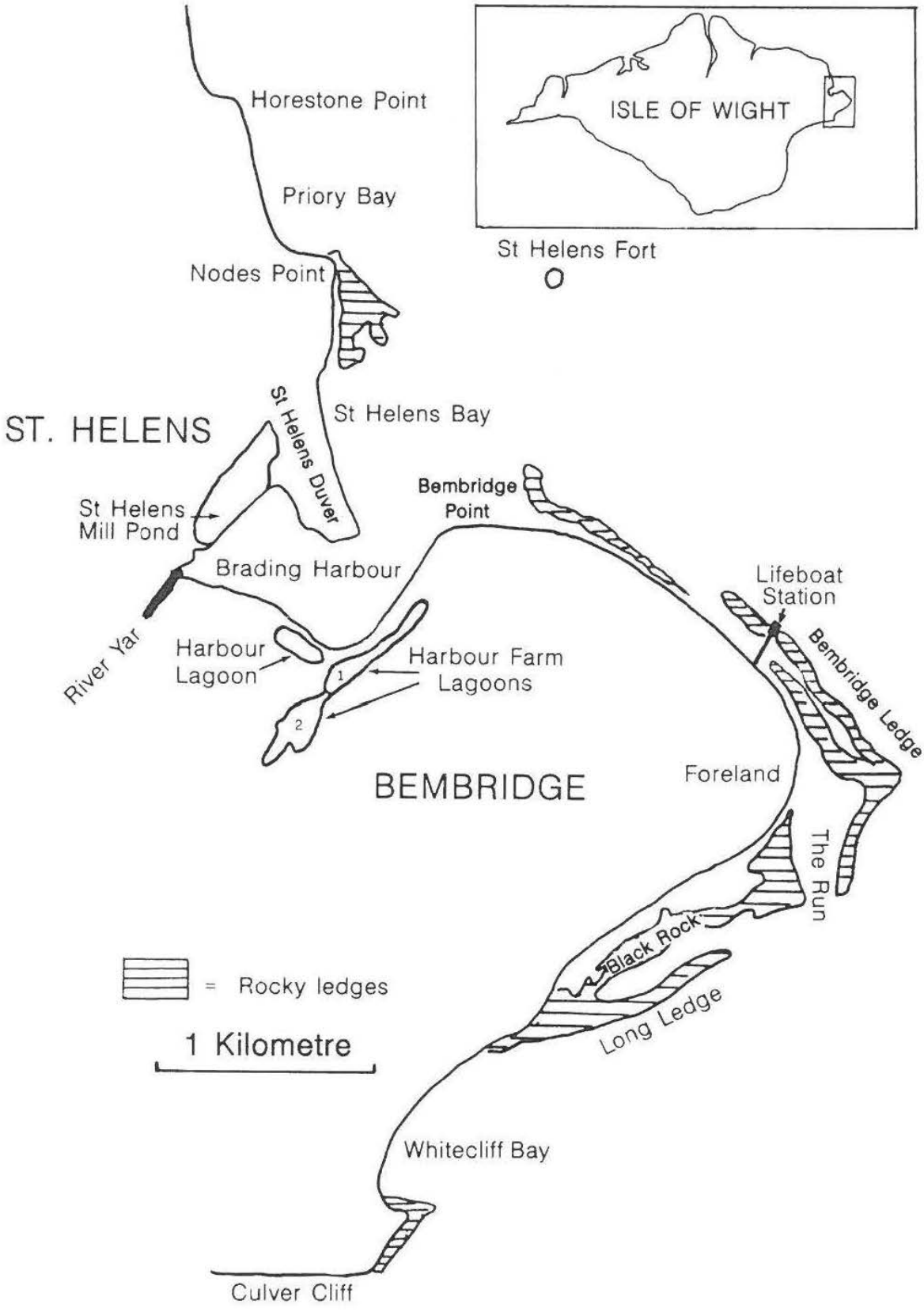


Figure 1. Location map of Bembridge and St. Helens

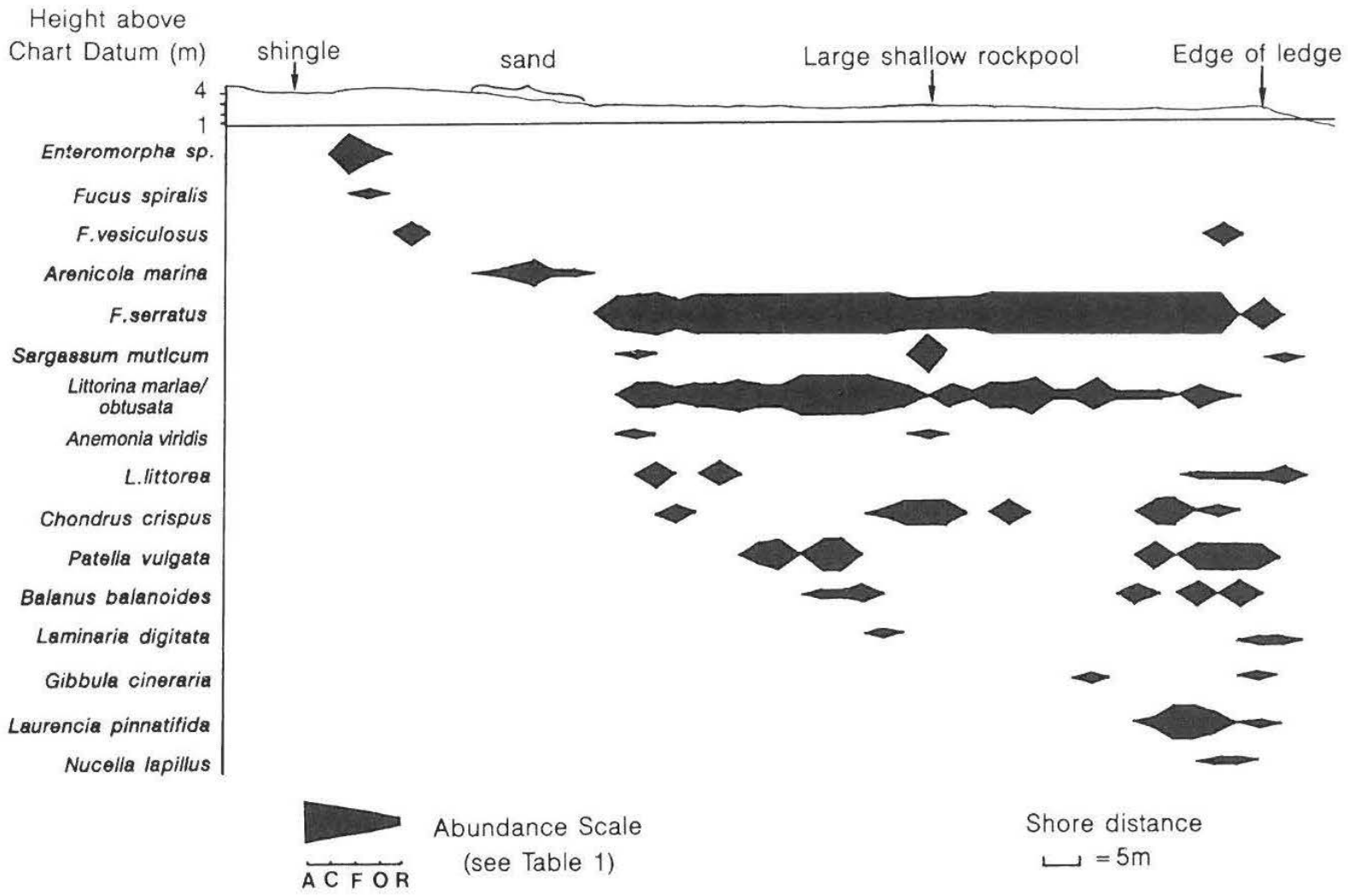


Figure 2. Kite diagram to illustrate distribution of common intertidal animals and plants. 300m SE of Bembridge Lifeboat Station.

Table 1: ABUNDANCE SCALES

ALGAE AND FLOWERING PLANTS

A: 51% - 100% cover
C: 26% - 50% cover
F: 5% - 25% cover
O: Less than 5% cover; zone still distinct
R: Only 1 or 2 small plants

LICHENS AND ENCRUSTING ALGAE

A: More than 25% cover
C: 10% - 25% cover
F: 5% - 9% cover
O: Less than 5% cover; scattered patches
R: 1 or 2 small patches

MUSSELS

A: More than 25% cover
C: Less than 25% cover; large patches
F: Small patches; scattered individuals
O: Scattered individuals; no patches
R: A few, after a general search

A – Abundant
C – Common
F – Frequent
O – Occasional
R – Rare

LIMPETS AND ALL PERIWINKLES
(except *Littorina neritoides*)

A: More than 100 per square metre
C: 50 - 100 per square metre
F: 10 - 50 per square metre
O: 1 - 10 per square metre
R: Less than 1 per square metre

TOPSHELLS, DOGWHELKS & ANEMONES

A: More than 50 per square metre
C: 10 - 50 per square metre
F: 1 - 10 per square metre
O: Less than 1 per square metre
R: Always less than 1 per square metre

SMALL PERIWINKLE (*Littorina neritoides*) AND BARNACLES (*Balanus balanoides*)

A: More than 3 per square centimetre
C: 1 - 3 per square centimetre
F: 10 - 100 per square decimetre
O: 1 - 10 per square decimetre
R: Less than 1 per square decimetre

LUGWORMS

A: 51 - 100 casts per square metre
C: 31 - 50 casts per square metre
F: 15 - 30 casts per square metre
O: 5 - 14 casts per square metre
R: 1 - 4 casts per square metre

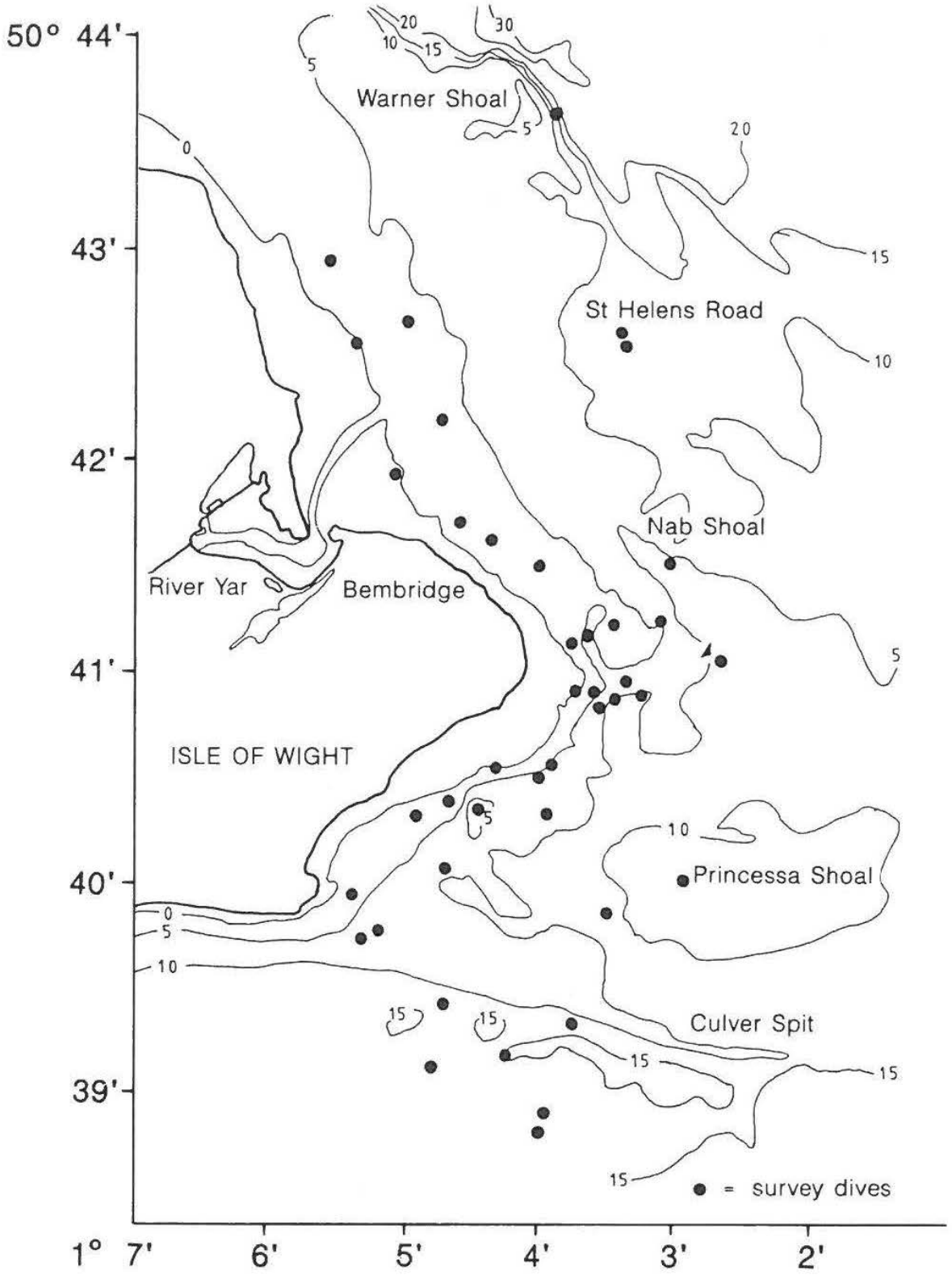


Figure 3. Chart showing survey dive sites

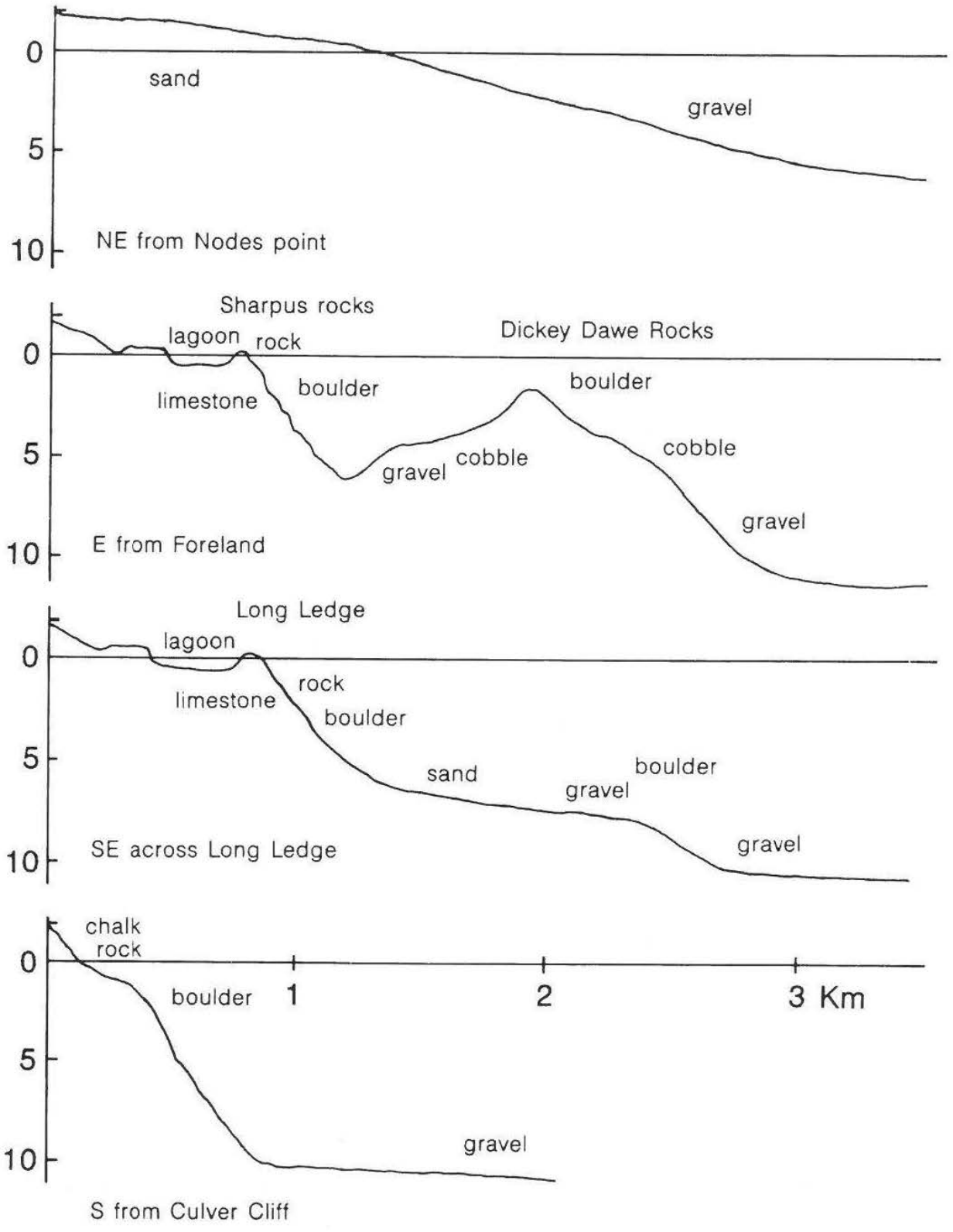


Figure 4. Cross sectional profiles from the shore. Vertical exaggeration 80x

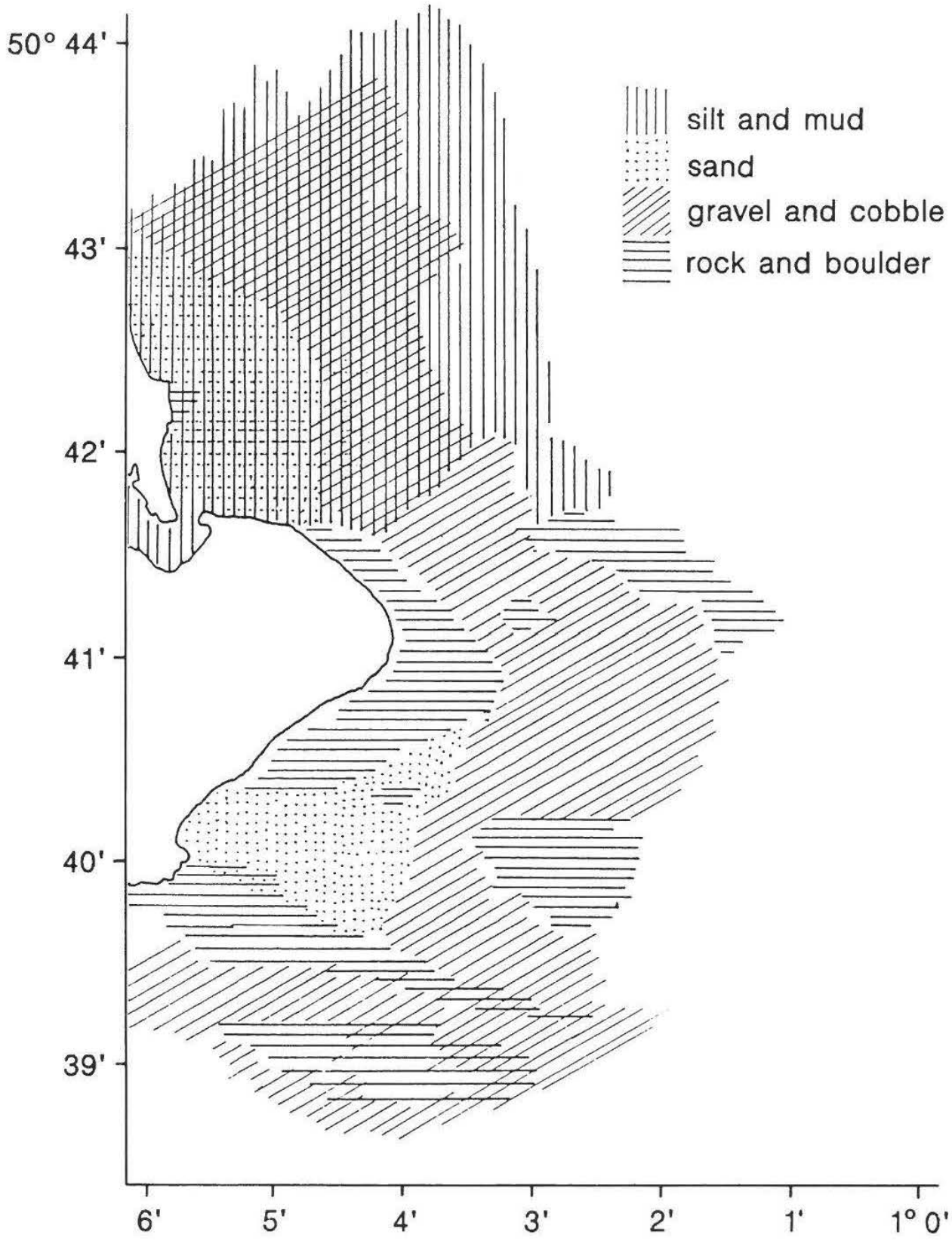


Figure 5. Simplified chart showing major substrate types

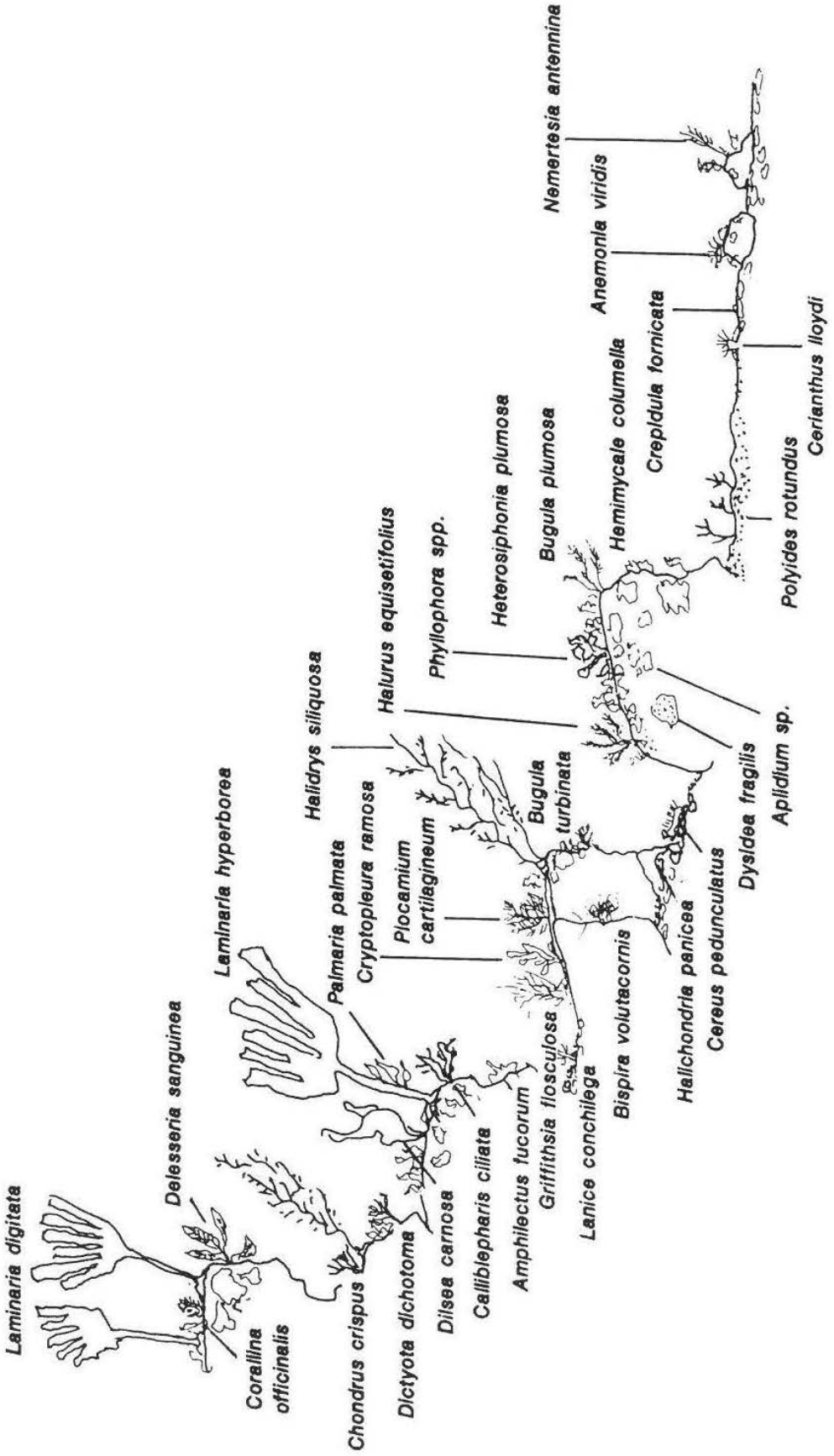


Figure 6. Diagramatic underwater section off Long Ledge showing some of the prominent flora and fauna to a depth of 10m.

APPENDIX 1

FAUNA

The following list of species from Bembridge and St. Helens follows the nomenclature according to Howson (1987). In cases where a modern synonym has not been found, the original authority is preceded by an * . Some of these species are known only outside British waters and some doubt hinges on their validity. Nevertheless, considering the frequency of alien species in the region we feel it important that these records be kept 'alive'. For further information on the abundance, habitat, and distribution of a species readers are advised to consult the appropriate source references.

Porifera

Amphilectus fucorum	KC CW
Ciocalypta penicillus	KC
Cliona celata	KC CW
Cliona sp.	Mo RW
Dercitus bucklandi	KC
Dysidea fragilis	AJ RH KC CW
Grantia compressa	VH KC
Halichondria panicea	AJ RW RH KC CW BM
Haliclona cinerea	PG CW
Haliclona fistulosa	CW
Haliclona oculata	RW KC
Haliclona simulans	CW
Halisarca dujardini	AJ
Hemimycale columella	KC
Hymeniacidon sanguinea	M47
Hymeniacidon perleve	AJ RH CW JM BM
Leuconia caminus	AJ+ RW
Leucosolenia sp.	RW+ PG KC
Microciona sp.	JM
Myxilla cf. rosacea	CW
Myxilla sp.	KC
Pachymatisma johnstonia	JM
Pachymatisma boletiformis	JM
Polymastia mamillaris	KC
Raspailia hispida	KC
Scypha ciliata	VH AJ PG KC CW BM
Scypha coronata	RW+
Stelligera rigida	KC
Suberites carnosus	KC
Suberites domuncula	KC CW
Tethya aurantium	JM

Cnidaria

Medusozoa (Scyphozoa)

Haliclystus auricula	AJ RW PG KC RH
Aurelia aurita	AJ

Medusozoa (Hydrozoa)

? *Aglaophenia* sp.	KC
Aglaophenia pluma	AJ CW
Calycella syringa	PG BM
Clava multicornis	PG
Clytia gracilis	JM
Clytia hemisphaerica	RW+
Coryne muscoides	PG
Coryne pusilla	VH AJ
Diphasia rosacea	BM
Dynamena pumila	VH PG BM
Eudendrium capillare	AJ
Eudendrium rameum	BM
Halecium halecinum	KC
Halecium labrosum	PG
Hydractinia echinata	VH RW KC
Hydrallmania falcata	KC
Kirchenpaueria pinnata	AJ RW+ CT PG JM BM
Laomedea flexuosa	RW
Monotheca obliqua	AJ
Nemertesia antennina	KC
Nemertesia ramosa	CW JM
Obelia dichotoma	RW+
Obelia geniculata	VH AJ RW RH KC CW
Plumularia setacea	PG BM
Sertularia cupressina	JM
Ventromma halecioides	PG

Anthozoa

Actinia equina	VH CS AJ RW RH KC BM
Actinia fragacea	BM
Actinothoe sphyrodeta	KC CW
Aiptasia mutabilis	KC
Alcyonium digitatum	KC CW
Anemonia viridis	VH AJ PG RH SH KC CW BM
Anthopleura ballii	VH TS AJ RH9 KC
Aureliania heterocera	KC
Cereus pedunculatus	RW RH CW KC
Cerianthus lloydii	KC
Diadumene cincta	RM RH
Halcampa chrysanthellum	KC
Haliplanella lineata	RM
Metridium senile	JM SH
Nematostella vectensis	TS MS RH9
Sagartia elegans	KC CW
Sagartia troglodytes	VH KC MS
Sagartiogeton sp.	CW
Urticina felina	Mo AJ RH KC CW BM

Ctenophora

Pleurobrachia pileus	AJ RH KC

Platyhelminthes

Leptoplana tremellaris	AJ	*Prostheceraeus vittatus*	VS

Nemertea

Amphiporus lactifloreus	RW+ PG	*Lineus* sp.	JM
Lineus longissimus	AJ RH	*Nemertea* sp.	RW9 BM
Lineus ruber	MS	*Tetrastemma* spp.	RW+ PG

Entoprocta

Brantsia gracilis	A	*Pedicellina cernua*	AJ

Sipuncula

Golfingia minuta	BM

Echiura

Maxmuelleria lankesteri	JM

Annelida

Polychaeta

Amphitrite edwardsi	AJ	*Harmothoe extenuata*	AJ
*Amphitrite scylla**Fauvel	AJ	*Harmothoe imbricata*	M47 AJ RW
Amphitritides gracilis	BM	*Harmothoe impar*	AJ
Ampharete finmarchica	SH	*Harmothoe lunulata*	AJ PG
Anaitides maculata	AJ RW PG SH	*Harmothoe* sp.	RH BM
Aphrodita aculeata	M47 CP+	*Hediste diversicolor*	RW+ RH MS SH
Arenicola marina	AJ RW9 RH KC SH BM	*Janua pagenstecheri*	AJ CT PG BM
		Janua sp.	RW+
Arenicolides ecaudata	AJ BM	*Kefersteinia cirrata*	AJ
Autolytus sp.	BM	*Lanice conchilega*	AJ RW9 RH SH KC CW BM
Boccardia polybranchia	BM		
Boccardiella ligerica	BM	*Lepidonotus squamatus*	AJ
Branchiomma bombyx	AJ KC	*Lumbrineris latreilli*	AJ
Bispira volutacornis	KC CW	*Lysidice ninetta*	AJ
Brania pusilla	BM	*Malacoceros tetracerus*	RW9
Capitella sp.	PG	*Malacoceros fuliginosus*	SH
Capitella capitata	RW9 MS SH	*Malacoceros vulgaris*	BM
Capitellides giardi	RW9 BM	*Manyunkia aestuarina*	SH
Caulleriella sp.	SH	*Marphysa sanguinea*	AJ SH
Cirratulus cirratus	M47 JRW MS BM	*Mellinna palmata*	SH
Cirriformia tentaculata	AJ RW9 SH BM	*Micromaldane ornithochaeta*	BM
Clymenura clypeata	RW9	*Myxicola infundibulum*	CW
Dodecaceria concharum	BM	*Neanthes fucata*	AJ
Eteone longa	RW+ RW9 SH	*Neanthes irrorata*	AJ
Eulalia viridis	RW RH	*Neanthes virens*	SH
Eumida sanguinea	RW9 PG	*Neoamphitrite figulus*	AJ RW
Eupolymnia nebulosa	AJ RW PG	*Nepthys caeca*	AJ RW SH
Fabricia sabella	BM	*Nepthys cirrosa*	RW9
Filograna implexa	KC	*Nepthys hombergii*	RW
Glycera tridactyla	RW9	*Nereis pelagica*	RH BM

Nicolea venustula	PG RH KC BM
Notomastus latericeus	RW
Notomastus sp.	RW9
Owenia fusiformis	JR
Petaloproctus terricola	AJ
Perinereis cultrifera	AJ RW BM
Phyllodoce laminosa	AJ
Pileolaria berkeleyana	PG
Platynereis dumerilii	RW RW+ PG BM
Polynoe scolopendrina	AJ
Polydora caeca	SH BM
Polydora ciliata	SH BM
Polydora giardi	BM
Polydora hoplura	BM
Pomatoceros lamarcki	BM
Pomatoceros triqueter	AJ RW PG RH KC CW BM
Procerastea nematodes	BM
Pseudopolydora sp.	SH
Pygospio elegans	RW9 SH
Sabella pavonina	JR
Sabella sp.	KC
Sabellaria sp.	KC
Scoloplos armiger	RW9 SH
Spio filicornis	RW9
Spio martinensis	SH
Spirorbis corallinae	CT
Spirorbis inornatus	RW+ PG BM
Spirorbis rupestris	RW
Spirorbis spirorbis	AJ RW RH BM
Spirorbis tridentatus	CT PG BM
Spirorbis sp.	KC CW MS
Sthenelais boa	AJ
Streblospio shrubsolii	MS SH
Syllis gracilis	BM
Syllis spp.	RW+ PG
Terebellidae sp.	KC
Tharyx marioni	AJ SH
Tharyx multibranchiis	SH
Trypanosyllis zebra	BM
Websterinereis glauca	BM

Oligochaeta

Tubificoides benedenii	MS BM

Chelicerata

Achelia echinata	AJ RW RW+ PG KC
Achelia laevis	PG
Achelia longipes	RW RW+ BM
Anoplodactylus angulatus	RW RW+ PG BM
Anoplodactylus pygmaeus	RW
Endeis spinosa	PG
Nymphon gracile	RH9
Phoxochilidium femoratum	RH
Pycnogonida sp.	KC

Crustacea

Cirripedia

Balanus balanoides	CS AJ RW RH KC BM
Balanus crenatus	CS KC SH
Balanus perforatus	CS
Chthamalus montagui	BM
Elminius modestus	CR8 AJ RW RH KC BM
Peltogaster paguri	AJ
Sacculina carcini	RH
Scalpellum scalpellum	JM
Verruca stroemia	CS

Leptostraca

Nebalia bipes	VH AJ RW

Mysidacea

Neomysis integer	JM
Praunus inermis	GS PG
Praunus neglectus	AJ
Siriella jaltensis	GS PG

Amphipoda

Abludomelita gladiosa	AJ
Ampelisca diadema	KC
Ampelisca tenuicornis	JM
Ampithoe gammaroides	RW+ PG
Ampithoe rubricata	AJ PG RW
Aora typica * Krøyer	PG
Apherusa bispinosa	RW
Apherusa cirrus	RW RW+ PG
Apherusa jurinei	RW PG BM
Apherusa ovalipes	RW

Atylus swammerdami	RW9 PG BM
Bathyporeia elegans	RW9
Bathyporeia guilliamsoniana	RW9
Bathyporeia nana	RW9
Bathyporeia pelagica	RW9
Bathyporeia pilosa	RW9
Bathyporeia sarsi	RW9
Calliopius laeviusculus	MS
Caprella acanthifera	AJ RW PG
Caprellidae sp.	KC RH
Corophium acutum	RW RW+ PG BM
Corophium insidiosum	PG MS
Corophium sextonae	RW
Coropium volutator	RH MS SH
Dexamine spinosa	RW KC
Dexamine thea	RW BM
Echinogammarus marinus	AJ
Echinogammarus obtusatus	RW BM
Echinogammarus pirloti	BM
Ericthonius brasiliensis	*Dana PG
Ericthonius difformis	PG
Gammarellus carinatus	RW RW+ PG
Gammarus locusta	AJ RW RW+ PG KC MS BM
Gammarus salinus	MS
Gammarus zaddachi	MS
Hyale nilssoni	RW PG BM
Hyale pontica	BM
Hyale stebbingi	BM
Iphimedia minuta	KC
Jassa falcata	RW RW+ PG BM
Maera grossimana	RW RW+ PG
Maera othonis	RW RW+ PG
Microdeutopus anomalus	PG+
Microdeutopus chelifer	BM
Microdeutopus gryllotalpa	MS
Orchestia gammarellus	Mo AJ RW
Orchestia mediterranea	BM
Phtisica marina	RW+ PG
Siriella jaltensis	PG
Stenothoe monoculoides	MS
Sunamphithoe pelagica	RW RW+ PG
Talitrus saltator	AJ RH
Urothoe brevicornis	RW9
Urothoe poseidonis	RW9

Isopoda

Cyathura carinata	RW9
Dynamene bidentata	AJ RW PG BM
Idotea baltica	AJ RW KC BM
Idotea granulosa	AJ RW PG RH BM
Idotea pelagica	BM
Idotea sp.	KC
Ligia oceanica	AJ RW RH BM
Limnoria lignorum	AJ
Sphaeroma rugicauda	AJ PG MS
Sphaeroma serratum	Mo AJ BM
Sphaeroma sp.	RW PG RH

Tanaidacea

Tanais dulongii	RW PG BM
Tanaissus lilljeborgi	RW9

Cumacea

Cumopsis goodsiri	RW9

Decapoda

Anapagurus leavis	KC
Athanus nitescens	Mo AJ RW MS
Cancer pagurus	AJ RW RH KC CW BM
Carcinus maenas	AJ RW PG RH SH KC CW BM
Crangon crangon	AJ RW RH
Eurynome aspera	PG
Galathea squamifera	AJ RW RH KC CW
Galathea sp.	KC CW
Goneplax rhomboides	CP
Hippolyte varians	GS PG
Homarus gammarus	RH KC CW
Hyas araneus	CW
Hyas coarctatus	KC
Inachus dorsettensis	PG
Inachus phalangium	KC CW
Inachus sp.	KC
Liocarcinus arcuatus	Mo KC
Liocarcinus depurator	KC
Liocarcinus holsatus	KC
Liocarcinus puber	AJ RW RH KC CW
Liocarcinus pusillus	KC
Macropodia aegyptia * M.Edwards	AJ PG
Macropodia linaresi	KC
Macropodia rostrata	RW PG+ RH8 CW
Maja squinado	AJ RH
Meiosquilla desmaresti	Mo JG
Pagurus bernhardus	AJ RW PG RH SH MS KC BM
Pagurus cuanensis	AJ KC
Pagurus pubescens	RW
Palaemonetes varians	RW PG+ MS
Palaemon adspersus	AJ
Palaemon elegans	PG CW
Palaemon serratus	AJ RW PG
Pandalus montagui	AJ
Pandalus sp.	JM
Pilumnus hirtellus	AJ RW RH KC CW BM
Pinnotheres pisum	RH9
Pirimela denticulata	RW
Pisa tetraodon	AJ RW PG RH8 KC
Pisidia longicornis	AJ RW RH KC BM
Pontophilus fasciatus	GS PG
Porcellana platycheles	Mo AJ RW RH BM

Mollusca

(Many records here are of empty shells or single valves, though have nevertheless been included.)

Polyplacophora

Acanthochitona crinitus	Mo AJ R
Acanthochitona fascicularis	AJ
Lepidochitona cinereus	Mo AJ RW PG RH K
Leptochiton scabridus	KC
Tonicella rubra	LK

Gastropoda

Akera bullata	VH Mo
Bittium reticulatum	P67
Berthella plumula	Mo RH9
Brachystomia rissoides	LK
Buccinum undatum	AJ RW RH KC
Calliostoma zizyphinum	RH KC CW
Calliostoma zizyphinum var. *lyonsii*	JM
Calyptraea chinensis	LA
Crepidula fornicata	AJ RH SH KC CW BM
Dikoleps nitens	KC
Elysia viridis	AJ RW PG RH8 KC
Epitonium clathrus	P68
Gibbula cineraria	CS AJ RW PG RH KC CW BM
Gibbula magus	VH AJ P68
Gibbula ? tumida	KC
Gibbula umbilicalis	Mo CS RW+ PG RH9 BM
Helcion pellucidum	Mo RW AJ P67 PG RH KC BM
Hinia incrassatus	RH KC CW BM
Hinia reticulatus	P68 AJ RH KC CW BM
Hydrobia ulvae	RH MS SH
Hydrobia ventrosa	MS
Lacuna pallidula	BM
Lacuna parva	RW PG RH
Lacuna vincta	P67 RW
Lamellaria latens	LK
Lamellaria perspicua	Mo AJ PG LK
Leucophytia bidentata	Mo
Limapontia senestra	LK
Littorina littorea	CS AJ RW PG RH SH KC BM
Littorina mariae	BM
Littorina neritoides	RW RH CW
Littorina obtusata	CS AJ RW PG RH KC BM
Littorina saxatilis	VH CS AJ RW RH BM
Lunatia poliana	JR
Manzonia crassa	KC
Neptunea antiqua	Mo P67
Nucella lapillus	AJ RW RH9b CW BM
Ocenebra erinacea	Mo AJ RH CW
Oenopota rufa	Mo
Onoba semicostata	RH
Paludinella litorina	Mo
Patella depressa	EV AJ MC RH BM
Patella ulyssiponensis	EV MC
Patella vulgata	EV AJ CS RW MC RH KC BM
Placida dendritica	PG+
Rissoa guerini	RH
Rissoa membranacea	Mo
Rissoa parva	Mo AJ RW RW+ PG RH KC BM
Skenea serpuloides	KC
Tectura virginea	VH
Tricolia pullus	P67 AJ KC BM
Trivia arctica	AJ KC RH
Trivia monacha	AJ
Turbonilla lactea	RH KC

Nudibranchia

Acanthodoris pilosa	Mo RW KC CW
Aeolidia papillosa	AJ RH JM
Aeolidiella alderi	RH
Ancula gibbosa	VH
Archidoris pseudoargus	RH KC
Coryphella gracilis	KC
Coryphella lineata	KC
Dendronotus sp.	JM
Facelina coronata	RW PG+ RH9
Facelina sp.	KC
Janolus cristatus	JR JM
Palio dubia	VH

Pelecypoda

Abra alba	KC
Abra tenuis	Mo
Angulus tenuis	JJ
Anomia ephippium	VH AJ
Antalis vulgaris	Mo
Arcopagia crassa	KC
Barnea candida	AJ BM
Barnea parva	AJ BM
Cerastoderma edule	Mo AJ RH RW9 SH
Chlamys varia	AJ JM
Dosinia exoleta	Mo
Ensis ensis	Mo RW
Ensis siliqua	Mo
Goodallia triangularis	KC
Hiatella arctica	AJ CW JM BM
Kellia suborbicularis	Mo
Loripes lucinalis	RW9
Lucinella divaricata	Mo
Lucinoma borealis	RW9
Macoma balthica	Mo
Martesia striata	AJ
Modiolus barbatus	Mo
Musculus discors	KC
Mya truncata	KC
Mytilus edulis	AJ RH KC CW BM
Nucula nucleus	KC

Nucula nitidosa	JM
Ostrea edulis	KC
Paphia aurea	VH
Paphia rhomboides	BM
Parvicardium exiguum	Mo AJ KC SH
Pecten maximus	Mo PG
Pholas dactylus	Mo KC BM
Pododesmus patelliformis	M47
Scrobicularia plana	SH
Solen marginatus	Mo M47
Spisula elliptica	JJ
Tapes decussatus	Mo
Venerupis senegalensis	Mo AJ RW BM
Venus verrucosa	Mo AJ

Cephalopoda	
Octopus vulgaris	JJ
Sepia officinalis	RH
Sepiola scandica *	JJ
Sepiola sp.	JM

Bryozoa

Amathia lendigera	AJ JC PG BM
Amathia sp.	KC
Amphiblestrum flemingii	Mo
Aetea anguina	AJ JC BM
Alcyonidium gelatinosum	JC KC
Alcyonidium hirsutum	AJ JC
Alcyonidium mytili	VH BM
Alcyonidium spp.	RW PG
Anguinella palmata	JC
Bicellariella ciliata	KC
Bowerbankia gracilis	AJ JC RW+ PG BM
Bowerbankia imbricata	AJ JC PG
Bugula flabellata	JM
Bugula fulva	BM
Bugula plumosa	KC
Bugula turbinata	KC BM
Bugula sp.	KC CW
Buskia nitens	JC
Callopora aurita	JC BM
Callopora dumerilii	PG
Callopora lineata	JC PG BM
Celleporella hyalina	AJ JC PG BM
Cryptosula pallasiana	JC RW+ PG BM
Cribrilina punctata	JC
Crisia aculeata	AJ JC KC
Crisia eburnea	KC
Crisia denticulata	Mo JC KC
Crisidia cornuta	Mo JC KC
Disporella hispida	JM
Electra pilosa	AJ JC RW+ PG RH KC BM
Electra sp.	KC
Epistomia bursaria	Mo JC KC
Escharella immersa	JC
Escharella ventricosa	Mo
Escharoides coccinea	AJ
Filicrisia geniculata	JC
Flustra foliacea	AJ JC RH KC CW
Flustrellidra hispida	AJ JC PG BM
Haplopoma graniferum	JC
Hippothoa divaricata	JC
Membranipora membranacea	Mo KC CW BM
Microporella ciliata	AJ JC
Nolella dilatata	Mo
Palmicellaria skenei	KC
Pedicellina cernua	JC
Pentapora foliacea	KC
Phaeostachys spinifera	Mo
Schizomavella linearis	AJ JC
Schizoporella unicornis	BM
Scruparia ambigua	JC
Scruparia chelata	AJ JC RW RW+ BM
Vesicularia spinosa	JM
Walkeria uva	JC

Phoronida

Phoronis hippocrepia	KC CW

Echinodermata

Amphipholis squamata	VH Mo AJ RW PG RH8 BM
Aslia lefevrei	JR
Asterias rubens	KC CW BM
Crossater papposus	JM
Henricia oculata	RH KC CW
Leptosynapta inhaerens	VH
Ocnus lactea	KC
Ophiothrix fragilis	JM
Psammechinus miliaris	RW
Trachythyone elongata	VH

Tunicata

Aplidium proliferum	AJ BM
? *Aplidium punctum*	KC
Aplidium sp.	CW RH BM
Ascidia conchilega	Mo
Ascidia mentula	Mo KC
Ascidiella aspersa	AJ RH JM
Ascidiella scabra	Mo AJ
Botrylloides leachi	Mo AJ RW+ PG RH
Botryllus schlosseri	Mo AJ RW+ PG RH KC CW MS BM
Ciona intestinalis	Mo AJ RH
Clavelina lepadiformis	RH KC CW
Dendrodoa grossularia	AJ KC
Didemnidea sp.	KC
Didemnum maculosum	RH BM
Didemnum sp.	Mo
Diplosoma listerianum	RW+ PG
Diplosoma sp.	Mo
Molgula manhattensis	KC
Molgula oculata	RW
Morchellium argus	RW KC BM
Polycarpa rustica	RW KC
Polyclinum sp.	CW
Styela clava	RW SH KC
Styela coriacea	KC
Tridemnum tenerum * Verrill,1871	RW+ PG

Insecta

Anurida maritima	MS BM
Chironomid spp. (larvae)	BM
Lasius fulginosus	BM

Pisces

(All historical records of species from Bembridge and St. Helens have been included here although some may have been obtained outside our survey area.)

Alopias vulpinus (thresher shark)	PW
Ammodytes tobianus (sand eel)	BC RH
Anguilla anguilla (silver eel)	ST
Apletodon microcephalus (small headed clingfish)	RW
Aspitrigla cuculus (red gurnard)	JM
Boops boops (bogue)	PW
Callionymus lyra (dragonet)	KC CW
Capros aper (boar-fish)	PW
Centrolabrus exoletus (rock cook)	RH
Ciliata mustela (five bearded rockling)	PG RH
Conger conger (conger eel)	ST
Crenilabrus melops (corkwing wrasse)	PG RH KC CW
Ctenolabrus rupestris (goldsinny wrasse)	KC CW
Cyclopterus lumpus (lumpsucker)	GB
Dicentrarchus labrax (bass)	ST KC
Gobiusculus flavescens (two spotted goby)	PG BC KC CW
Gobius niger (black goby)	AJ KC
Gobius paganellus (rock goby)	AJ KC
Labrus bergylta (ballan wrasse)	PG
Lamna nasus (porbeagle shark)	LA+
Liparis montagui (montagu's sea-snail)	AJ
Liparis sp. (sea snail)	JM
Lipophrys pholis (shanny)	AJ PG RH
Limanda limanda (dab)	AJ
Merlangius merlangus (whiting)	RH
Myoxocephalus scorpius (bull rout)	AJ
Nerophis lumbriciformis (worm pipefish)	AJ RH
Pholis gunnellus (butterfish)	AJ RH KC
Platichthys flesus (flounder)	ST
Pleuronectes platessa (plaice)	ST BC
Pollachius pollachius (pollack)	ST PG KC CW
Pomatoschistus microps (common goby)	PG RH
Pomatoschistus minutus (spotted goby)	AJ PG RH KC
Scomber scombrus (mackerel)	ST
Scophthalmus rhombus (brill)	CW
Scyliorhinus canicula (dogfish)	ST JM
Solea solea (sole)	ST JM
Spinachia spinachia (fifteen spined stickleback)	PG RH9
Spondyliosoma cantharus (black sea-bream)	DR ST PG
Syngnathus acus (greater pipefish)	CW
Taurulus bubalis (sea scorpion)	AJ BC PG RH KC CW
Thorogobius ephippiatus (leopard spotted goby)	KC
Trisopteris luscus (bib)	ST KC CW

Key to sources:

* = Obtained from record cards at Portsmouth Polytechnic Marine Laboratory, Hayling Island, Hants.

AJ - A.J. Juniper (1963)
AJ+ - Juniper & Steele (1969)
BC - Boulby-Carrington * pers. obs.
BM - George *et al.* (1989)
CT - Cliff Thorp * pers obs 1974
CP - Colin Pope (Brough *et al.* 1986)
CP+ - Colin Pope pers. obs. 1988
CR8 - Crisp (1958)
CS - Crisp & Southward (1958)
CW - C. Woods (1988)
DR - Draper (1964)
EV - Evans (1953)
GB - G. Bunce (1980)
GS - G. Smalldon * pers. obs. 1976
KC - Collins & Mallinson (1988)
LK - Light & Killeen (1990)
JC - J.M. Crew (1970)
JG - J.M. Goodall (1923)
JJ - J.F. Jackson (1925)
JM - Collins & Mallinson (1989). Additional species to those found in Collins & Mallinson (1988)
LA - L. Adams (1929)
LA+ - L. Adams (1937)
MC - M. Culley * pers obs 1978
Mo - Morey (1909)
MS - Sheader & Sheader (1987)
M47 - Marshall (1947)
PG - P. Gray (1978)
PG+ - P. Gray * pers obs 1976-79
PW - P. Wadham (1934)
P67 - L.C. Prebble (1967)
P68 - L.C. Prebble (1968)
RH - R. Herbert pers obs 1980-1989
RH8 - R. Herbert (1988)
RH9 - R. Herbert (1989a)
RH9b - R. Herbert (1989b)
RM - R. Manuel pers. obs. 1972
RW - R. Withers * pers. obs. 1976-79
RW9 - R. Withers (1979)
RW+ - R. Withers *et al.* (1975)
SH - Howard *et al.* (1988)
ST - H. Stoker (1962)
VH - Doubleday (1900)
VS - Vidya Surujballi pers. obs. 1988

Birds

The following list, compiled by J.M. Cheverton, includes those species recorded either on the shore, in Brading Harbour and St. Helens mill pond, in the brackish lagoons, or offshore between Culver Cliff and Horestone Point. The sequence and vernacular names follow *The 'British Birds' list of birds of the Western Palearctic* (Anon, 1978).

Red-throated Diver	WV	Golden Plover	WV
Black-throated Diver	WV	Grey Plover	WR
Little Grebe	R	Lapwing	R
Great Crested Grebe	WR	Knot	WV
Red-necked Grebe	WV	Sanderling	WR
Slavonian Grebe	WV	Curlew Sandpiper	P
Black-necked Grebe	WV	Purple Sandpiper	WR
Fulmar	SV	Dunlin	WR
Cormorant	R	Ruff	WV
Shag	R	Jack Snipe	WR
Grey Heron	R	Snipe	R
Bewick Swan	WV	Bar-tailed Godwit	WR
Mute Swan	R	Whimbrel	P
Canada Goose	R	Curlew	R
Brent Goose	R	Spotted Redshank	WV
Shelduck	R	Redshank	R
Wigeon	WR	Greenshank	R
Gadwall	WV	Common Sandpiper	P
Teal	R	Turnstone	WR
Mallard	R	Mediterranean Gull	OV
Pintail	WR	Black-headed Gull	R
Garganey	WV	Ring-billed Gull	OV
Shoveler	WR	Common Gull	WR
Red-crested Pochard	OV	Lesser Black-backed Gull	WR
Pochard	R	Herring Gull	R
Tufted Duck	R	Greater Black-backed Gull	R
Scaup	WV	Sandwich Tern	SV
Eider	WV	Common Tern	SV
Long-tailed Duck	OV	Arctic Tern	SV
Common Scoter	WV	Little Tern	SV
Velvet Scoter	WV	Guillemot	SV
Goldeneye	WR	Rock Pipit	R
Smew	WV	Pied Wagtail	R
Red-breasted Merganser	WR	Swallow	SV
Goosander	WV	House Martin	SV
Moorhen	R	Jackdaw	R
Coot	R	Rook	R
Oystercatcher	R	Carrion Crow	R
Avocet	OV	Starling	R
Ringed Plover	WR	Snow Bunting	OV

Key to Bird list:

OV - Occasional Visitor: very rare at any time.
P - Passage Migrant: seen most years.
R - Resident: seen in the area during most months of the year. May or may not breed. Numbers often increasing during winter months.
SV - Summer Visitor: Present in the area during summer months. May or may not breed.
WR - Winter Resident: present in the area most winters in either small or large numbers.
WV - Winter Visitor: seen periodically, usually in small numb

APPENDIX 2

FLORA
Nomenclature is according to Howson (1987) unless otherwise stated.

Rhodophycota

Acrochaetiacea sp.	RW
Ahnfeltia plicata	DG WF KC BM
Anotrichium barbatum	WF
Antithamnion cruciatum	WF
Antithamnion spirographidis	WF
Apoglossum ruscifolium	WF KC
Asparagopsis armata	WF
Audouinella bonnemaisoniae	WF
Audouinella floridula	JK RW WF BM
Audouinella pupurea	WF IT BM
Audouinella virgatula	BM
Audouinella sparsa	WF
Bangia atropurpurea	RW
Bonnemaisonia asparagoides	WF KC
Bonnemaisonia hamifera	WF
Bonnemaisonia hamifera (*Traillella intricata* phase)	KC
Brongniartella byssoides	KC
Calliblepharis ciliata	WF KC
Calliblepharis jubata	KC
Callithamnion corymbusum	WF
Callithamnion hookeri	WF BM
Callithamnion tetricum	WF
Catenella caespitosa	DG IT
Ceramium deslongchampii	N
Ceramium diaphanum	WF
Ceramium flabelligerum	BM
Ceramium rubrum	JK WF RH SH KC
Champia parvula	WF
Chondria dasyphylla	WF KC
Chondria tenuissima	WF SH
Chondrus crispus	JK WF RH SH KC BM
Choreonema thuretii	WF
Chylocladia verticillata	KC
Corallina officinalis	JK WF RH KC BM
Cordylecladia erecta	WF SH KC BM
Cruoria pellita	WF
Cryptopleura ramosa	WF KC BM
Cystoclonium purpureum	JK WF KC BM
? *Dasya* sp.	KC
Delesseria sanguinea	WF KC
Dermatolithon hapalidioides	WF
Dermatolithon litorale	WF
Dilsea carnosa	WF RH KC
Drachiella spectabilis	KC
Dudresnaya verticillata	KC
Dumontia contorta	JK WF KC BM
Erythrotrichia carnea	N RW BM
Fosliella farinosa	WF
Furcellaria lumbricalis	JK WF KC BM
Gelidium crinale	JK IT
Gelidium latifolium	JK WF RH BM
Gelidium pusillum	JK WF BM
Gracilaria bursa-pastoris	WF RH
Gracilaria verrucosa	WF KC
Grateloupia filicina var. *filicina*	WF
Grateloupia filicina var. *luxurians*	WF
Griffithsia corallinoides	WF KC
Griffithsia flosculosa	JK WF RH SH KC BM
Gymnogongrus crenulatus	WF
Gymnogongrus griffithsiae	WF
Halarachnion ligulatum	WF KC
Haliptylon squamatum	WF
Halopitys incurvus	JK WF RH KC
Halurus equisetifolius	WF KC BM
Heterosiphonia plumosa	WF KC
Hildenbrandia crouanii	WF
Hildenbrandia rubra	WF
Hildenbrandia sp.	IT
Hypoglossum hypoglossoides	WF KC
Jania rubens	JK WF
Kallymenia reniformis	WF
Laurencia hybrida	JK WF
Laurencia obtusa	WF KC
Laurencia pinnatifida	JK WF RH KC IT BM
Lithophyllum incrustans	WF
Lithothamnion sp.	JK KC
Lomentaria articulata	JK WF RH KC BM
Lomentaria clavellosa	WF
Mastocarpus stellatus	JK WF RH BM
Melobesia membranacea	WF
Membranoptera alata	DG JK WF BM
Meredithia microphylla	WF KC
Myriogramme heterocarpum	WF KC
Naccaria wiggii	WF KC
Palmaria palmata	WF RH SH KC BM
Petrocelis cruenta	WF
Peyssonnelia sp.	KC
Phyllophora crispa	DG WF KC BM
Phyllophora pseudoceranoides	DG JK WF KC
Phyllophora sicula	WF
Phyllophora traillii	WF
Phymatolithon lenormandii	WF IT BM
Phymatolithon polymorphum	WF RH
Phymatolithon purpureum	BM
Platoma sp.	KC
Plocamium cartilagineum	JK WF KC
Plumaria elegans	DG WF KC BM
Pneophyllum confervicolum	WF
Pneophyllum lejolisii	WF
Pneophyllum limitatum	WF
Polyides rotundus	JK WF KC BM
Polysiphonia denudata	JK
Polysiphonia elongata	WF KC BM
Polysiphonia lanosa	JK WF RH KC
Polysiphonia nigra	BM
Polysiphonia nigrescens	DG JK KC BM
Polysiphonia urceolata	JK WF BM
Polysiphonia violacea	KC
Porphyra leucosticta	BM
Porphyra linearis	WF IT
Porphyra purpurea	BM

Porphyra umbilicalis SH
Porphyrodiscus simulans (phase of *Ahnfeltia*) WF
Pterosiphonia capillacea BM
Pterosiphonia thuyoides JK
Rhodomela confervoides DG JK WF KC
Rhodophyllis divaricata WF
Rhodophysema elegans WF
Rhodophysema georgii WF
Rhodymenia delicatula WF
Rhodymenia holmesii KC
Rhodymenia pseudopalmata JK KC
Schmitziella endophloea KC
Scinaia forcellata WF KC
Sphaerococcus coronopifolius WF KC
Sphondylothamnion multifidum KC
Spyridia filamentosa JK KC
Stylonema alsidii RW
Titanoderma corallinae WF
Titanoderma pustulatum WF

Chromophycota

Arthrocladia villosa WF
Ascophyllum nodosum JK WF RH SH KC
Asperococcus fistulosus JK WF BM
Asperococcus turneri WF
Chorda filum N JK WF RH KC BM
Cladostephus spongiosus DG JK WF KC BM
Cladostephus spongiosus f. *verticellatus* KC
Colpomenia peregrina JK WF RH KC BM
Cutleria multifida WF
Cylindrocarpus microscopicus WF
Cystoseira baccata WF
Cystoseira foeniculaceus WF
Cystoseira nodicaulis CR WF
Cystoseira tamariscifolia WF BM
Desmarestia aculeata WF KC BM
Desmarestia ligulata KC
Desmarestia viridis WF KC BM
Dictyota dichotoma JK WF KC
Ectocarpus fasciculatus WF BM
Ectocarpus siliculosus WF KC BM
Elachista flaccida N WF
Elachista fucicola WF BM
Eudesme virescens WF BM
Fucus serratus JK WF RH KC BM
Fucus spiralis WF RH IT BM
Fucus vesiculosus WF RH SH BM
Giffordia granulosa WF RW
Giffordia mitchelliae WF KC
Halidrys siliquosa V JK WF RH KC BM
Halopteris filicina JK WF RH
Halopteris scoparia N WF BM
Hecatonema maculans (Coll.) Sauv. (life history stage of various brown algae) N WF
Himanthalia elongata V Mo WF RH
Laminaria digitata DG JK WF RH KC BM
Laminaria hyperborea WF RH KC BM
Laminaria ochroleuca KC
Laminaria saccharina DG JK WF RH SH KC
Leathesia difformis JK WF BM
Mesogloia vermiculata WF
Myrionema strangulans WF BM
Myriactula clandestina WF
Myriactula rivulariae RW WF
Myrionema magnusii WF
Padina pavonica V PR RH9 WF
Pelvetia canaliculata V WF RH
Petalonia fascia V JK WF
Petroderma maculiforme WF
Pilayella littoralis JK WF BM
Pseudolithoderma extensum WF
Pseudolithoderma roscoffensis WF
Punctaria latifolia WF KC BM
Punctaria plantaginea (Ruth.) Crev. WF BM
Punctaria tennuissima BM
Ralfsia clavata (Harv.) Crouan. frat. WF
Ralfsia verrucosa WF IT BM
Saccorhiza polyschides WF
Sargassum muticum WF RH SH KC BM
Sauvageaugloia chordariaeformis WF
Scytosiphon lomentaria RW WF BM
Sphacelaria cirrosa WF
Sphacelaria fusca JK WF
Sphacelaria radicans JK
Spongonema tomentosum BM
Sporochnus pedunculatus WF KC
Stictyosiphon griffithsianus WF
Stilophora rhizodes WF
Striaria attenuata WF
Taonia atomaria WF KC
Tilopteris mertensii WF
Zanardinia prototypus WF KC

Chlorophycota

Blidingia marginata IT
Blidingia minima JK WF BM
Bryopsis hypnoides WF
Bryopsis plumosa DG KC WF RH
Chaetomorpha capillaris WF
Chaetomorpha melagonium BM
Cladophora albida WF
Cladophora dalmatica WF
Cladophora laetevirens WF KC
Cladophora pellucida WF KC
Cladophora rupestris WF KC IT BM
Cladophora sericea WF
Codium fragile ssp. *tomentosoides* WF RH KC BM
Codium tomentosum JK
Derbesia marina WF KC
Enteromorpha compressa BM
Enteromorpha flexuosa WF KC BM
Enteromorpha intestinalis Mo WF RH
Enteromorpha linza DG WF RH BM

Enteromorpha prolifera	WF IT BM	*Spongomorpha arcta*	WF
Eugomontia sacculata	IT	*Ulothrix flacca*	JK WF
Monostroma grevillei	WF	*Ulva lactuca*	N JK WF RH KC BM
Pseudenoclonium submarinum	IT	*Ulva rigida*	WF
Spongomorpha aeruginosa	WF BM	*Ulva* sp.	SH

Cyanophyta (for nomenclature see source reference)

Calothrix sp.	WF	*Schizothrix calcicola*	IT
Calothrix crustacea	IT	*Entophysalis deusta*	N
Schizothrix arenaria	WF	? *Hyella* sp.	IT

Bacillariophyceae (for nomenclature see source reference)

Amphipleura rutilans	RW	*Navicula ramossima*	JK
Navicula grevillei	JK	*Nitzchia sigma* var. *rigidula*	JK
Navicula mollis	JK		

Chrysophycae (Nomenclature: Parke & Dixon, 1976)

? *Entodesmis littoralis* IT

Haptophycae (Nomenclature: Parke & Dixon, 1976)

? *Chrysonema litorale*	IT
Chrysotila lamellosa	IT

Algae recorded in Brading Harbour lagoon:
(as Harbour lagoon, fig 1.) Carter (1937)

Nomenclature is updated to Parke & Dixon (1976). Original nomenclature is given in brackets. The order is that followed by Carter.

* = not in Parke & Dixon (1976)

Chlamydomonas quadrilobata
Pyramichlamys excavata (as *Carteria excavata*)
Tetraselmis contracta (as *Platymonas contracta*)
Pyramimonas olivacea
Pyramimonas angulata
Pyramimonas octociliata
Bipedinomonas pyriformis
Heteromastix rotunda (as *Bipedinomonas rotunda*)
Nephroselmis minuta (as *Heteromastix minuta*)
Chloromeson parvum
Pavlova salina (as *Nephrochloris salina*)
Olisthodiscus luteus
Rhizochloris arachnoides
Chromulina lunaris
Pseudopedinella pyriformis
Syracosphaera brandti *
Ochromonas oblonga
Prymnesium parvum
Prymnesium minutum
Platychrysis pigra
Nematochrysis sessilis var. *vectensis*
Chrysomeris ramosa
Chrysomeris articulata
Cryptomonas stigmatica
Cryptomonas salina *
Rhodomonas baltica *
Chroomonas baltica
Chroomonas vectensis
Procentrum lima (as *Exuviella marina*)
Procentrum cassubicum (as *Exuviella cassubica*)
Amphidinium klebsii
Catodinium assymetricum (as *Massartia asymmetrica*)
Euglena viridis *
Euglena acusformis *
Euglena vermiformis *
Trachelomonas hispida var. *punctata* *

Charaphycae (Nomenclature: Parke & Dixon, 1976)

Lamprothamnion papulosum WF RH

Lichens

Arthropyrenia halodites (Nyl.) Arnold.	IT BM
Verrucaria Schrader nom. cons. sp.	RH IT

Angiospermae

Ruppia maritima L.	NC RH
Zostera marina L.	WF RH
Zostera nana Roth.	JK

Key to sources:

BM - George *et al.* (1989)
CR - Crisp (ed) (1964)
DG - Delf & Grubb (1923)
IT - Tittley (1988)
JK - Kain (1958)
KC - K. Collins & J. Mallinson (1988)
Mo - Morey (1909)
N - Norket (1947)
NC - N. Carter (1937)
PR - Price *et al.* (1979)
RH - R. Herbert pers. obs. 1980-89
RH9 -Herbert (1989a)
RW - Withers *et al.* (1975)
SH - Howard *et al.* (1988)
V - Venables (1860)
WF - Bill Farnham pers. obs., & (1982)

Authors: K.J. Collins & J.J. Mallinson, Dept. of Oceanography, University of Southampton, Southampton SO9 5NH.
R.J.H. Herbert, Medina Valley Centre, Dodnor Lane, Newport, Isle of Wight PO30 5TE.