



# *MarLIN*

*The Marine Life Information  
Network for Britain & Ireland*

## **ENGLISH CHANNEL TOWED SLEDGE SEABED IMAGES.**

### **PHASE 2: ANALYSIS OF SELECTED TOW IMAGES.**

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Report to the Joint Nature Conservation Committee

October 2005

#### Reference:

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English Channel towed sledge seabed images.  
Phase 2: Analysis of selected tow images

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## English Channel towed sledge seabed images. Phase 1: scoping study and example analysis.

### CONTENTS

EXECUTIVE SUMMARY .....	5
1. Introduction.....	7
2. Methods.....	7
2.1 Images selected for analysis.....	7
2.2 Methods of analysis .....	7
2.4 Comparison with other studies.....	8
3. Results.....	10
4. Discussion and comparison with late 19 <sup>th</sup> and early 20 <sup>th</sup> century descriptions .....	30
4.1 Comparisons with late 19 <sup>th</sup> and early 20 <sup>th</sup> century descriptions .....	30
4.2 Comments on image analysis .....	30
4.3 Accuracy of positioning and tabulation of positions.....	30
5. Thoughts on utility of the images for identifying change .....	31
6. References .....	31
Appendix 1. Extracts from the Plymouth Marine Fauna.....	33
Appendix 2. Seabed infaunal communities sampled by Ford (1923) and matched to epifaunal towed sledge surveys.....	35



English Channel towed sledge seabed images.  
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## English Channel towed sledge seabed images. Phase 2: analysis of selected tow images.

### EXECUTIVE SUMMARY

During the 1970s and 1980s, the late Dr Norman Holme undertook extensive towed sledge surveys in the English Channel and some in the Irish Sea. Only a minority of the resulting images were analysed and reported before his death in 1989 but logbooks, video and film material has been archived in the National Marine Biological Library (NMBL) in Plymouth. A study was therefore commissioned by the Joint Nature Conservation Committee and as a part of the Mapping European Seabed Habitats (MESH) project to identify the value of the material archived and the procedure and cost to undertake further work (Phase 1 of the study reported here: Oakley & Hiscock, 2005).

Some image analysis was undertaken as a part of Phase 1. Phase 2 (this report) was to further analyse selected images. Having determined in Phase 1 that only the 35 mm photographic transparencies provided sufficient clarity to identify species and biotopes, the tows selected for analysis were ones where 35mm images had been taken. The tows selected for analysis of images were mainly in the vicinity of Plymouth and especially along the area between Rame Head and the region of the Eddystone.

The 35 mm films were viewed under a binocular microscope and the taxa that could be recognised recorded in note form. Twenty-five images were selected for inclusion in the report.

Almost all of the images were of level sediment seabed. Where rocks were included, it was usually unplanned and the sled was hauled before being caught or damaged. The main biotopes or biotope complexes identified were:

**SS.SMU.CSaMu. Circalittoral sandy mud.** Extensively present between the shore and the Eddystone Reef complex and at depths of about 48 to 52 m. At one site offshore of Plymouth Sound, the turret shell *Turritella communis* was abundant. In some areas, this biotope had dense anemones, *Mesacmaea mitchelli* and (more rarely) *Cerianthus lloydii*. Queen scallops, *Aequipecten opercularis* and king scallops, *Pecten maximus*, were sometimes present in small numbers. Hard substratum species such as hydroids, dead mens fingers *Alcyonium digitatum* and the cup coral *Caryophyllia smithii* occurred in a few places, probably attached to shells or stones beneath the surface.

South of the spoil ground off Hilsea Point at 57m depth, the sediment was muddier but is still assigned to this biotope complex. It is notable that three small sea pens, most likely *Virgularia mirabilis*, were seen here.

**SS.SMx.CMx. Circalittoral mixed sediment.** Further offshore but at about the same depth as SS.SMU.CSaMu occurred, coarse gravel with some silt was present. The sediment was characterised most conspicuously by small queen scallops, *Aequipecten opercularis*. Peculiarly, there were 'bundles' of the branching bryozoan *Cellaria* sp. – a species normally found attached to rock. It could not be seen whether these bundles of *Cellaria* had been brought-together by terebellid worms but it is notable that *Cellaria* is recorded in historical surveys. As with many other sediments, there were occasional brittle stars, *Ophiocomina nigra* and *Ophiura ophiura*. Where sediments were muddy, the burrowing anemone *Mesacmaea mitchelli* was common. Where pebbles or cobbles occurred, there were attached species such as *Alcyonium digitatum*, *Caryophyllia smithii* and the fleshy bryozoan *Alcyonidium diaphanum*.

**Undescribed biotope.** Although most likely a part of SS.SMx.CMx, the biotope visually dominated by a terebellid worm believed to be *Thelepus cincinnatua*, is worth special

attention as it may be an undescribed biotope. The biotope occurred about 22 nautical miles south of the latitude of the Eddystone and in depths in excess of 70 m.

**SS.SCS.CCS.Blan.** *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel at about 48m depth and less. This habitat was the 'classic' 'Eddystone Shell Gravel' which is sampled for *Branchiostoma lanceolatum*. However, no *Branchiostoma lanceolatum* could be seen. The gravel was almost entirely bare of epibiota. There were occasional rock outcrops or cobbles which had epibiota including encrusting calcareous algae, the sea fan *Eunicella verrucosa*, cup corals, *Caryophyllia smithii*, hydroids and a sea urchin *Echinus esculentus*.

The variety of species visible on the surface is small and therefore identification to biotope not usually possible.

Historical records from sampling surveys that used grabs and dredges at the end of the 19<sup>th</sup> century and early 20<sup>th</sup> century suggest similar species present then. Illustrations of some of the infaunal communities from work in the 1920's is included in this report to provide a context to the epifaunal photographs.

## Reference

Hiscock, K., & Oakley, J., 2005. English Channel towed sledge seabed images. Phase 2: Analysis of selected tow images. *Report to the Joint Nature Conservation Committee from the Marine Biological Association*. Plymouth: Marine Biological Association. JNCC Contract F90-01-784.

## English Channel towed sledge seabed images. Phase 2: analysis of selected tow images.

### 1. INTRODUCTION

Some image analysis was undertaken as a part of Phase 1. Phase 2 (this report) was to further analyse selected images.

Many of the rolls of 35mm film show similar bottom type for the majority of the tow. Therefore precise matching of position and frames is not necessary to characterise the seabed along the tow.

### 2. METHODS

#### 2.1 Images selected for analysis

Having determined in Phase 1 that only the 35 mm photographic transparencies provided sufficient clarity to identify species and biotopes, the tows selected for analysis were ones where 35mm images had been taken. Tows were further selected as near to the Eddystone Reef complex, where there is current activity to map seabed habitats, offshore of Rame Head, the only area where mud was expected to be present and where there is current concern about dredge spoil disposal, and other locations to give a 'spread' to the samples.

#### 2.2 Methods of analysis

The films for each of the selected areas were rapidly inspected and one example tow from similar ones was set-aside for detailed inspection. Each frame of each film of the selected tows was inspected under a binocular microscope and notes made of substratum character and species present that could be seen on the surface. Where available, log books referring to tows have been inspected. Results were tabulated.

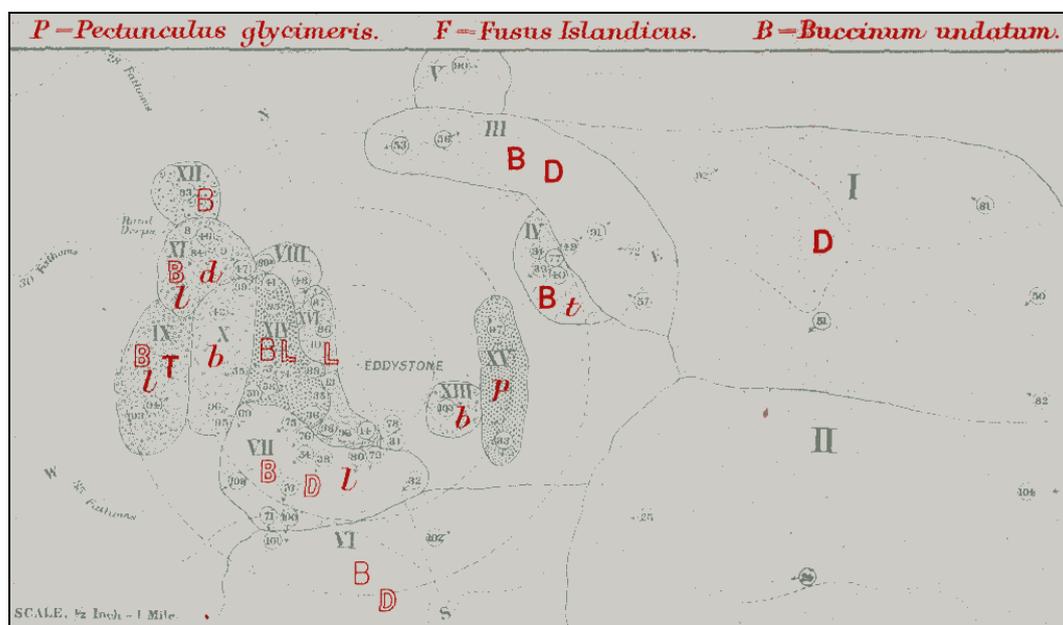


Figure 1. Part of one of 41 charts each showing bottom types and the distribution of different species in the area surveyed by Allen (1899). Bottom types I to VIII are fine sand; IX to XIII are coarse gravel with sand or mud; XIV and XV are fine gravel, and XVI is shell gravel. Only some letter codes are keyed in this extract.

Species could usually be identified by their characteristic features although many are indicated as uncertain identifications. One particular entity – a terebellid worm creating large branching structures of concreted sediment – caused difficulty in identification but was a dominant species in deep water south-east of the Eddystone. It appears most likely to be *Thelepus cincinnatus*. Holme’s notebook records ‘dense hydroids’ which, from the on-board video image, may have been a mistaken identification for *Thelepus*.

## 2.4 Comparison with other studies

The area of the Eddystone has been extensively sampled but mainly for specimen collection rather than community analysis. There are descriptions of the main collecting grounds in the Plymouth Marine Fauna (Marine Biological Association, 1957) (Appendix 2). The sampling undertaken by J.A. Allen around the 30 fm (approximately 55 m) line at the end of the 19<sup>th</sup> century and by Ford (1923) between the mainland and the Eddystone are outstanding and, as historical data sets from a time when fishing activity must have been much less than today, provide comparisons for the situation when the towed video images were collected and for new surveys. Allen (1899) illustrated bottom types and species occurrences and an example is given in Figure 1. Other notable surveys are those of Crawshaw (1912) and Mare (1942). Crawshaw reports his findings as accounts of the distribution and abundance of each species rather than as the communities found at survey stations. Mare sampled the Rame Mud area close to Fords stations and in an area not sampled by Holme – who seems to have kept his sledge clear of the area which had become a munitions dump.

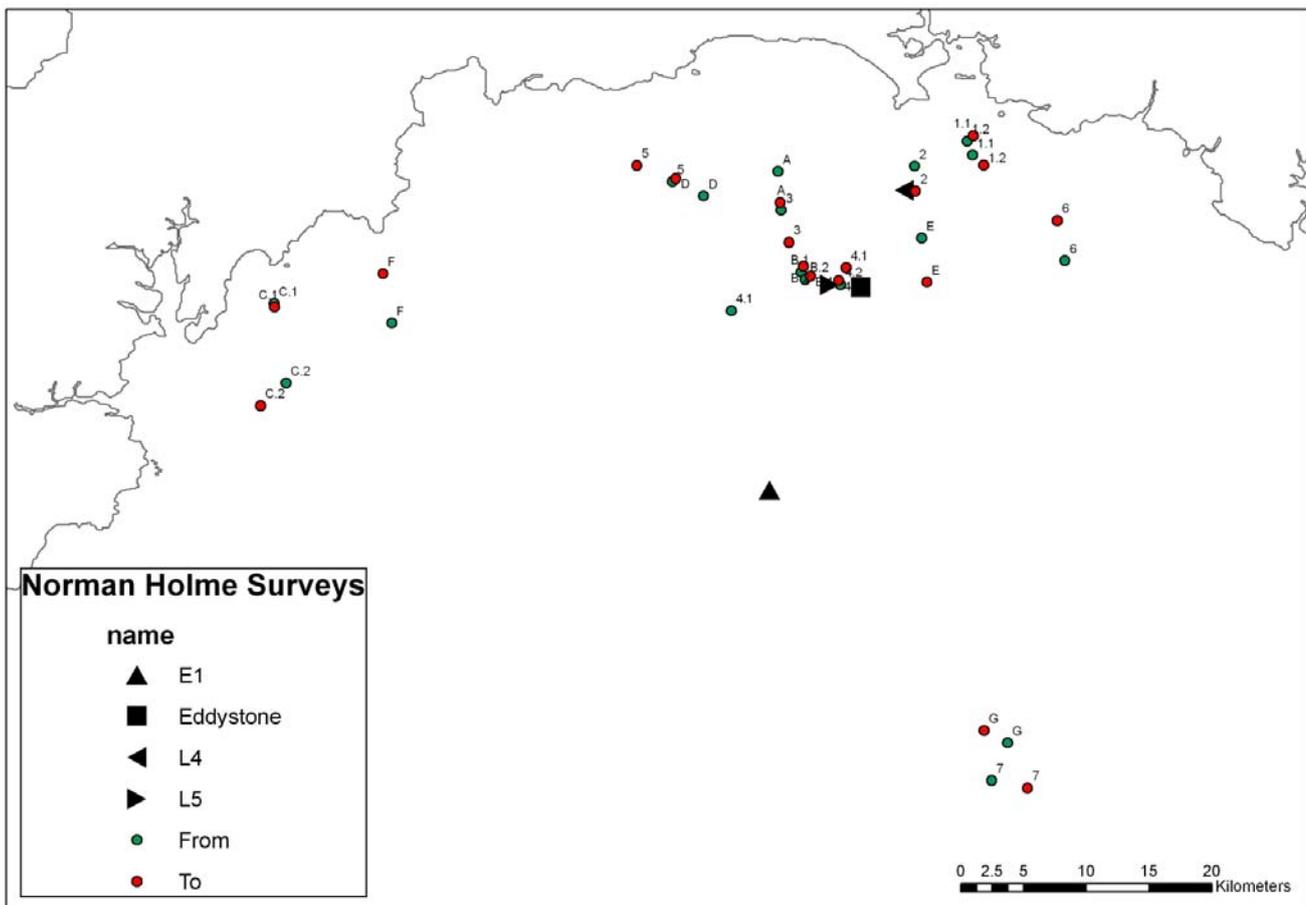


Figure 2. Location of all tows where 35 mm images have been inspected and interpreted for the Phase 2 study. Numbers and letter codes are those listed in Table 1. Sample sites for long-term observations by MBA at E1, L4 and L5 are shown.

Table 1. Location and positions for tows where 35 mm images have been inspected and interpreted. The images are ordered approximately from north to south.

<b>Number (for chart)</b>	<b>Location description</b>	<b>From latitude &amp; longitude</b>	<b>To latitude &amp; longitude</b>
1.1	Offshore Plymouth Sound (South to North)	50° 16' 32.19"N, 4° 8' 24.18"W	50° 17' 22.96"N, 4° 8' 21.88"
1.2	Offshore Plymouth Sound (West to East)	50° 17' 8.08"N, 4° 8' 46.32"W	50° 16' 46.014"N, 4° 7' 39.72"
2	South Rame Head	50° 16' 03.01"N, 4° 12' 18.06W	50° 14' 58.71"N, 4° 12' 14.08"W
3	South Rame	50° 14' 07.86"N, 4° 21' 16.16"W	50° 12' 45.08"N, 4° 20' 43.79"
4.1	NW Eddystone (Allen Station 95). First tow. Station 4.	50° 09' 46.20"N, 4° 24' 35.67"W	50° 11' 38.97"N, 4° 16' 53.90".
4.2	NW Eddystone (Allen Station 95). Second tow. Station 5.	50° 10' 55.88"N, 4° 17' 16.95"W	50° 11' 05.07"N, 4° 17' 22.21".
5	Off Looe	50° 15' 21.48"N, 4° 28' 33.40"W	50° 16' 03.96"N, 4° 30' 56.82"W
6	Outside of spoil ground offshore Hilsea	50° 11' 56.76"N, 4° 02' 12.01"W	50° 13' 41.89"N, 4° 02' 43.73"W
7	South of the Eddystone	49° 49' 25.263"N, 4° 07' 19.443"W	49° 49' 15.976"N, 4° 04' 46.406"W
A	'Just N of Hand Deeps'	50° 15' 48.74"N, 4° 21' 28.75"W	50° 14' 28.29"N, 4° 21' 18.69"W
B.1	Plymouth – Allen 42. First tow	50° 11' 27.59"N, 4° 19' 54.12"W	50° 11' 16.85"N, 4° 19' 17.44"W
B.2	Plymouth – Allen 42. Second tow	50° 11' 08.46"N, 4° 19' 38.06"	50° 11' 43.00"N, 4° 19' 45.19"W
C.1	Gerran. First tow	50° 09' 57.17"N, 4° 55' 14.56"W.	50° 09' 49.16"N, 4° 55' 12.69"W
C.2	Gerran. Second tow	50° 06' 31.28"N, 4° 54' 23.17"W	50° 05' 31.65"N, 4° 56' 04.44"W
D	'Looe Grounds'	50° 14' 44.35"N, 4° 26' 27.67"W	50° 15' 29.64"N, 4° 28' 19.50"W
E	'South Rame'	50° 12' 55.71"N, 4° 11' 50.25"W	50° 11' 01.38"N, 4° 11' 28.32"W
F	'Off Dodman'	50° 09' 09.49"N, 4° 47' 19.86"W	50° 11' 17.45"N, 4° 47' 57.52"W
G	South of Eddysone	49° 51' 02.85"N, 4° 06' 06.27"W	49° 51' 35.27"N, 4° 07' 40.20"W

### 3. RESULTS

The locations for films inspected and analysed are mapped in Figure 1 and are listed in Table 1. Figures 3 and 4 are charts with locations mapped near Falmouth and near Plymouth respectively.

Example images from the films analysed are shown in Plates 1 to 25. Image width is about 50-60 cm.

A description of the seabed features for each of the films inspected in detail is given below.

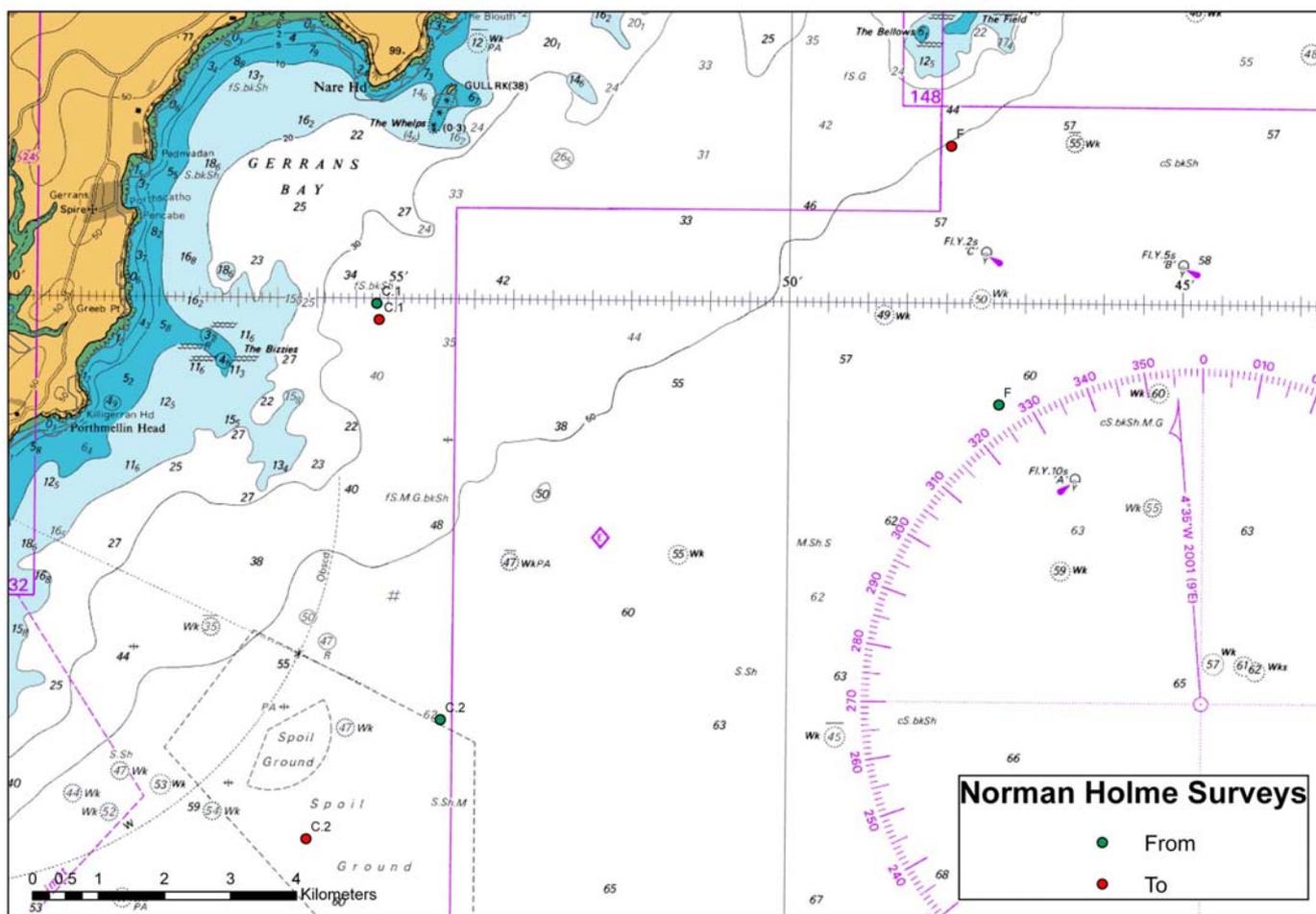


Figure 3. Location of tows where 35 mm images have been inspected and interpreted from east of Falmouth. Letter codes are those listed in Table 1.

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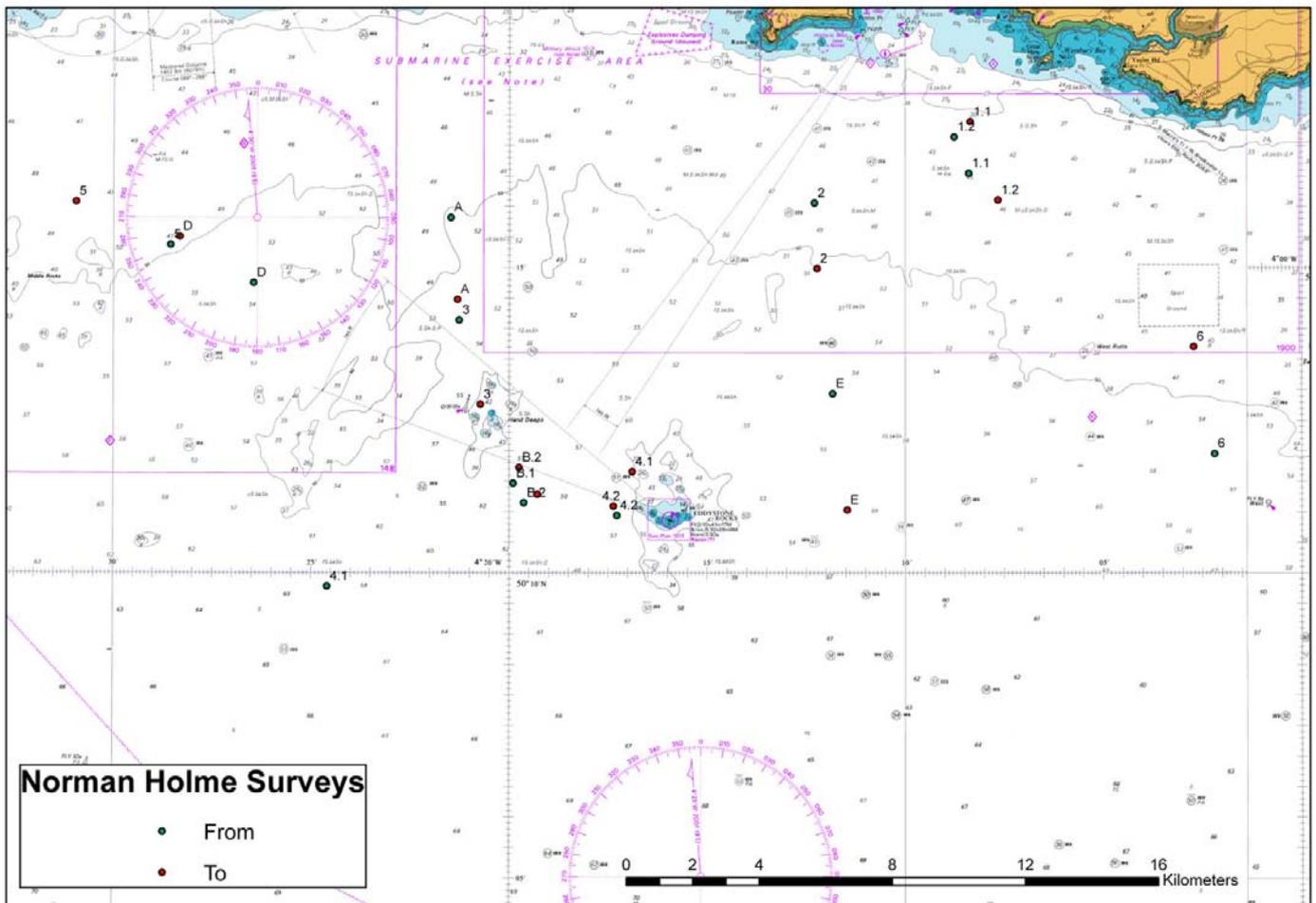


Figure 4. Location of tows where 35 mm images have been inspected and interpreted from near Plymouth. Number and letter codes are those listed in Table 1.

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## 1. Offshore Plymouth Sound

**Date:** 18 June 1975

**Film:** Film 6

**Approximate depth:** 46-49 m

**Decca co-ordinates:** **Tow 1 (S to N). Start:** Red A2.63; Green B47.60. **End:** Red A1.98; Green B47.74. **Tow 2 (W to E). Start:** Red A2.25; Green C30.52. **End:** Red A2.27; Green B46.35.

**Positions:** **Tow 1 (S to N):** 50° 16' 32.19"N, 4° 8' 24.18"W to 50° 17' 22.96"N, 4° 8' 21.88". **Tow 2 (W to E):** 50° 17' 8.08"N, 4° 8' 46.32"W to 50° 16' 46.014"N, 4° 7' 39.72"

**Biotope (complex):** SS.SMU.CSaMu Circalittoral sandy mud

**Plates:** 1-3

**Number of frames:** 167



Plate 1. Dense *Turritella communis* (shells) at about 46 m depth off Plymouth Sound.



Plate 2. Part of a muddy patch amongst otherwise muddy sand and shell south of Plymouth Sound at about 49 m depth. The hole is most likely of the angular crab *Goneplax rhomboides*.



Plate 3. Muddy sand or sandy mud south of Plymouth Sound at about 47 m depth with king scallop *Pecten maximus* and gelatinous bryozoan *Alcyonidium diaphanum*.

The seabed was of muddy sand or sandy mud with a few whole shells, especially *Aequipecten opercularis* shells in some areas. At the start of the tow, the sediment was bare but soon afterwards became covered in abundant *Turritella communis*. The number that were live could not be determined but it appeared (from inverted shells) that some were empty. There were areas without *Turritella* shells at various intervals in the tow but overwhelmingly, the seabed was visually characterised by *Turritella* shells. Many of the shells may have been occupied by pagurid crabs and several could be seen. Characteristic features of some other sediments at similar depths (such as clumps of *Cellaria* sp(p), the anemones *Mesacmaea mitchelli* and *Cerianthus lloydii* and the brittle star *Ophiura ophiura*) were only occasionally seen. There were a small number of scallops, *Aequipecten opercularis* and *Pecten maximus* seen. For a short length of the tow (in about the middle), there was mud sediment with burrows including one image of what was most likely a *Goneplax rhomboides* burrow.

Other species observed as single individuals or very small numbers were: *Alcyonium digitatum*; Hydrozoa indet. (a finely branching species); *Pagurus prideaux* with *Adamsia carciniopados*; *Alcyonidium diaphanum*; *Protula tubularia*; *Urticina felina*; *Asterias rubens*; *Aphrodite aculeata*; ?*Dasychone bombyx*; dragonet (*Callionymus lyra*).

## 2. South Rame Head [Near MBA Monitoring Station L4]

**Date:** 23 April 1975

**Film:** [1 or 2 – not numbered]

**Approximate depth:** 50m

**Decca co-ordinates: Start:** Red A4.0; Green C37.5. **End:** Red A5.06; Green C37.57.

**Positions:** 50° 16' 03.01"N, 4° 12' 18.06W to 50°14' 58.71"N, 4° 12' 14.08"W

**Biotope (complex):** SS.SMU.CSaMu Circalittoral sandy mud

**Plates:** 4-8

**Number of frames:** 169



Plate 4. Sandy mud south of Rame Head with harbour crab *Macropipus* sp. and burrowing anemones *Mesacmaea mitchelli* and *Cerianthus lloydii*.

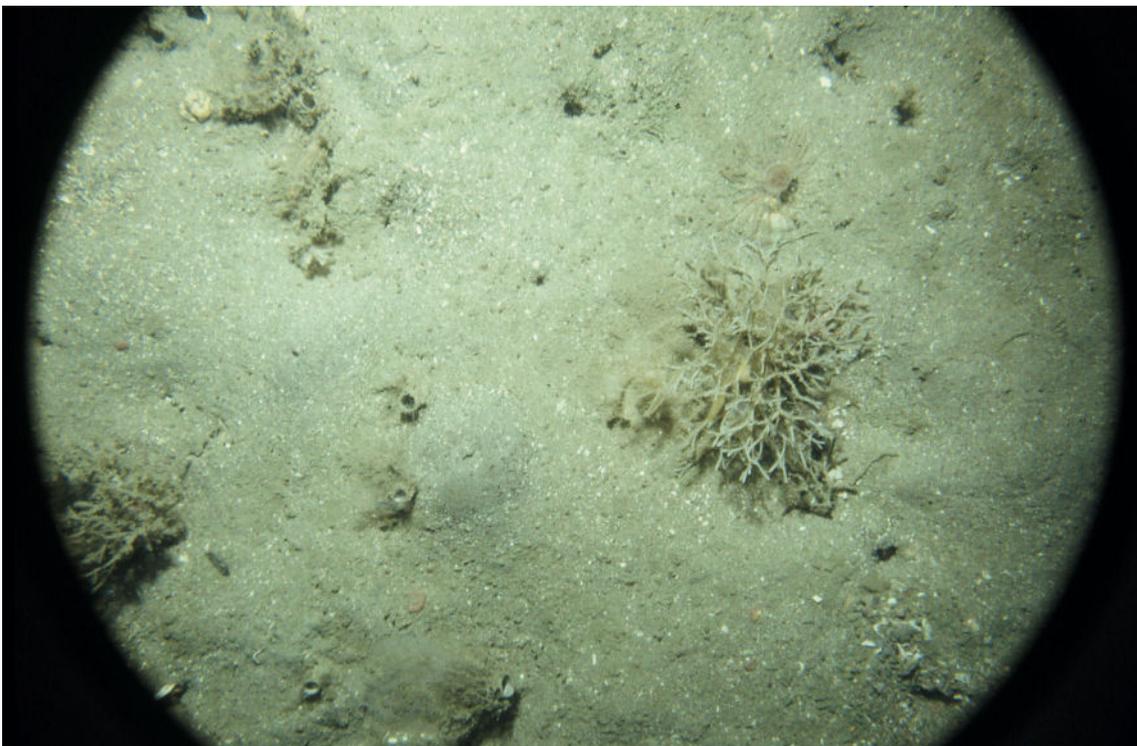


Plate 5. 'Bundle' of *Cellaria* sp(p) – possibly brought together by a terebellid worm. Two tubes of a *Chaetopterus* sp. also visible.

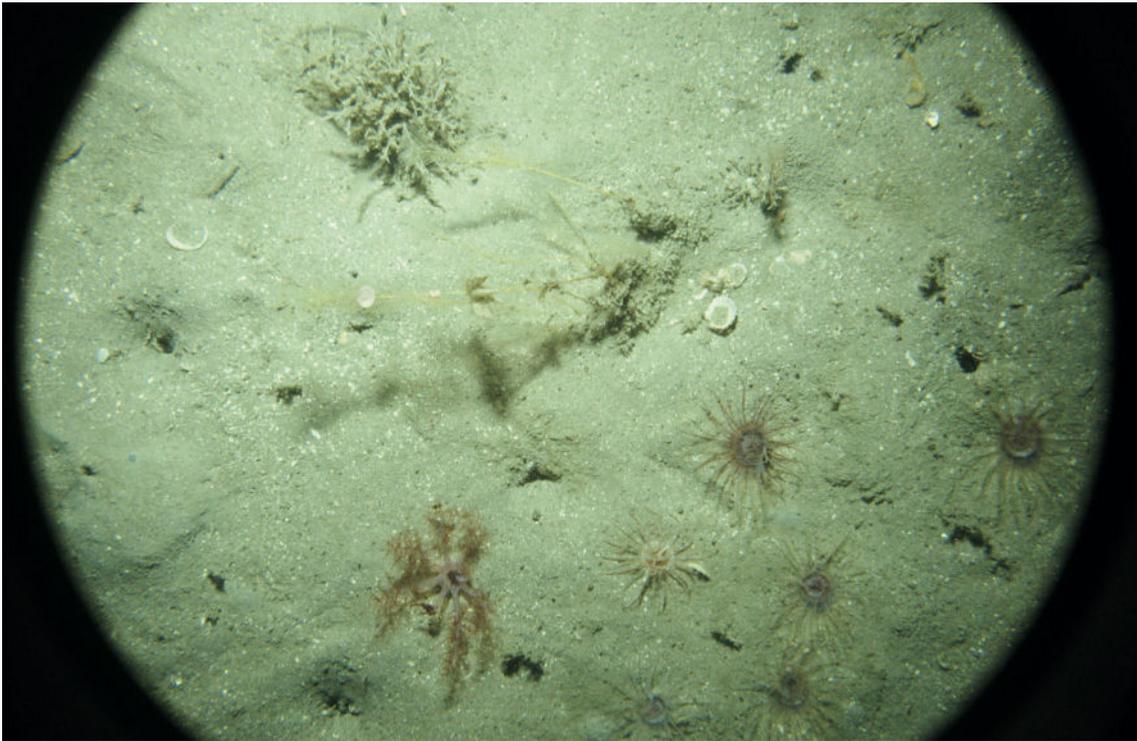


Plate 6. Unusually dense burrowing anemones *Cerianthus lloydii* and the burrowing sea cucumber *Neopentadactyla mixta*.



Plate 7. The turreted shell *Turritella communis* and typically 'bare' sediment.



Plate 8. A tusk shell, ?*Dentalium entalis* ploughing through the sediment.

Tow 2 was less than one nautical mile south of Film 8 on 19 May 1977. The seabed was of sandy mud with occasional whole shells and characterised by abundant (several / sq. m) burrowing anemones *Mesacmaea mitchelli* and frequent *Cerianthus lloydii*. There were many 'tangles' of *Cellaria* sp(p), sometimes with the antenna hydroid *Nemertesia antennina*. The brittle stars *Ophiocomina nigra* and *Ophiura ophiura* were occasional. There were rarely dead mens fingers *Alcyonium digitatum* and cup coral *Caryophyllia smithii*, presumably where shells or stones were present just below the surface. The sediment type was similar but the conspicuous fauna different with many more burrowing anemones. The tangles of *Cellaria* sp. were also noted for Film 12 on 7 July 1976 which was a further approximately 1.8 nautical miles further south – but there were no queen scallops seen here although they were abundant at the further south site.

Other species observed as single individuals or very small numbers were: Polychaeta indet. (*Myxicola*-like or *Chone*-like); *Galathea* sp. (sheltering under an *Alcyonium digitatum*); 'Arenicola' – like casts; Harbour crab *Macropipus* sp.; ?*Sagartia troglodytes* decorate; *Lanice conchilega*; *Atelycyclus rotundatus*; *Chaetopterus* sp.; ?*Schizotracha frutescens*; *Neopentadactyla mixta*; *Turritella communis*; ?*Phaxus pellucidus*; tusk shell ?*Dentalium entalis*.

### 3. South Rame

**Date:** 7 July 1976

**Film:** Film 12

**Approximate depth:** 52 m

**Decca co-ordinates: Start:** Red A7.72; Green D37.58; Purple B53.96. **End:** Red A9.50; Green D37.; Purple B50.52.

**Positions:** 50° 14' 07.861"N, 4° 21' 16.159"W to 50° 12' 45.079"N, 4°20' 43.791"

**Biotope (complex):** SS.SMx.CMx Circalittoral mixed sediment

**Plates:** 9 -12

**Number of frames:** 149



Plate 9. Brittle star *Ophiocomina nigra* and queen scallop *Aequipecten opercularis*.



Plate 10. Seabed of coarse sediment. Unpopulated at the surface and typical of the tow.

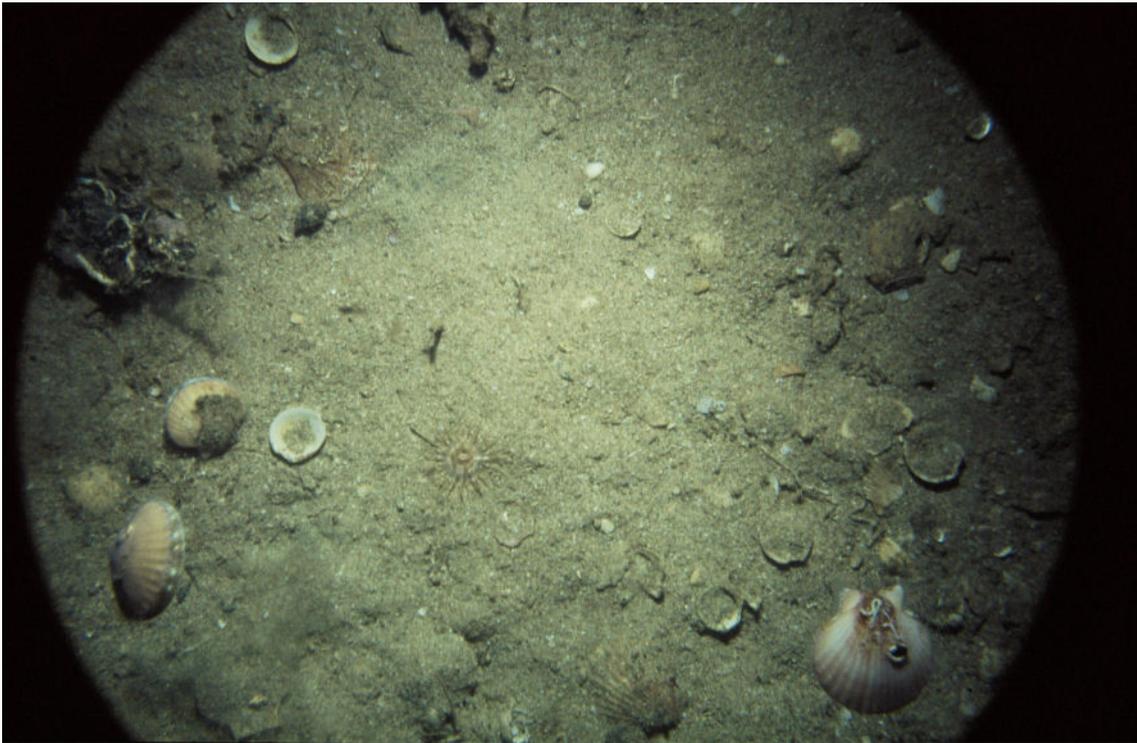


Plate 11. Burrowing anemone *Mesacmaea mitchelli* and queen scallops *Aequipecten opercularis*.



Plate 12. Group of the parchment tube worm *Chaetopterus* sp. with terebellid 'nests'.

The majority of Tow 3 was over coarse gravel with some silt although, for significant lengths of the tow, finer sediments were present with occasional *Ophiocomina nigra*. The sediment was characterised most conspicuously by small *Aequipecten opercularis* with a few brittle stars *Ophiocomina nigra* and burrowing anemones *Mesacmaea mitchellii*

present. Some *Chaetopterus* sp. were present and the erect bryozoan *Cellaria* sp. in a few pictures. The *Cellaria* were tangled and seemed to be bundles of drift rather than attached and may have been brought together by a terebellid worm. The whole length of the tow was remarkable for the significant numbers of small queen scallops *Aequipecten opercularis*, present. The biotope complex identified here is not an exact match.

Other species observed as single individuals or very small numbers were: *Macropipus* ?*depurator*, dead mens fingers *Alcyonium digitatum*, spider crab *Inachus* sp., an anemone ?*Sagartia troglodytes decorata*, and the tube worm *Protula tubularia*.

#### 4. NW Eddystone (Allen Station 95) [Near MBA Monitoring Station L5]

Date: 17 June 1975

Film: Film 4, Stns 4 & 5

Approximate depth: 47m

**Decca co-ordinates: Start: Station 4** Red A10.17; Green D47.0; Purple A73.55. **End:** Red A10.23; Green C47.92. **Start: Station 5** Red A11.35; Green D31.04 **End:** Red A11.14; Green D31.13.

**Positions: Start: Station 4** 50° 09' 46.20"N, 4° 24' 35.67"W to **End:** 50° 11' 38.97"N, 4° 16' 53.90". **Start: Station 5** 50° 10' 55.88"N, 4° 17' 16.95"W to **End:** 50° 11' 05.07"N, 4° 17' 22.21". (Log book records Radar 0.66 miles, 160° True to Eddystone for Station 4 and about "1" W of the Stone for Station 5).

Number of frames: 217

**Biotope (complex):** SS.SCS.CCS.Blan *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel [The shell gravel in the region of the tow is a sampling area for *Branchiostoma lanceolatum* although none were seen in images.]

Plates: 13 -16



Plate 13. Eddystone shell gravel.



Plate 14. *Caryophyllia smithii* in sediment most likely attached to pebbles or shells.

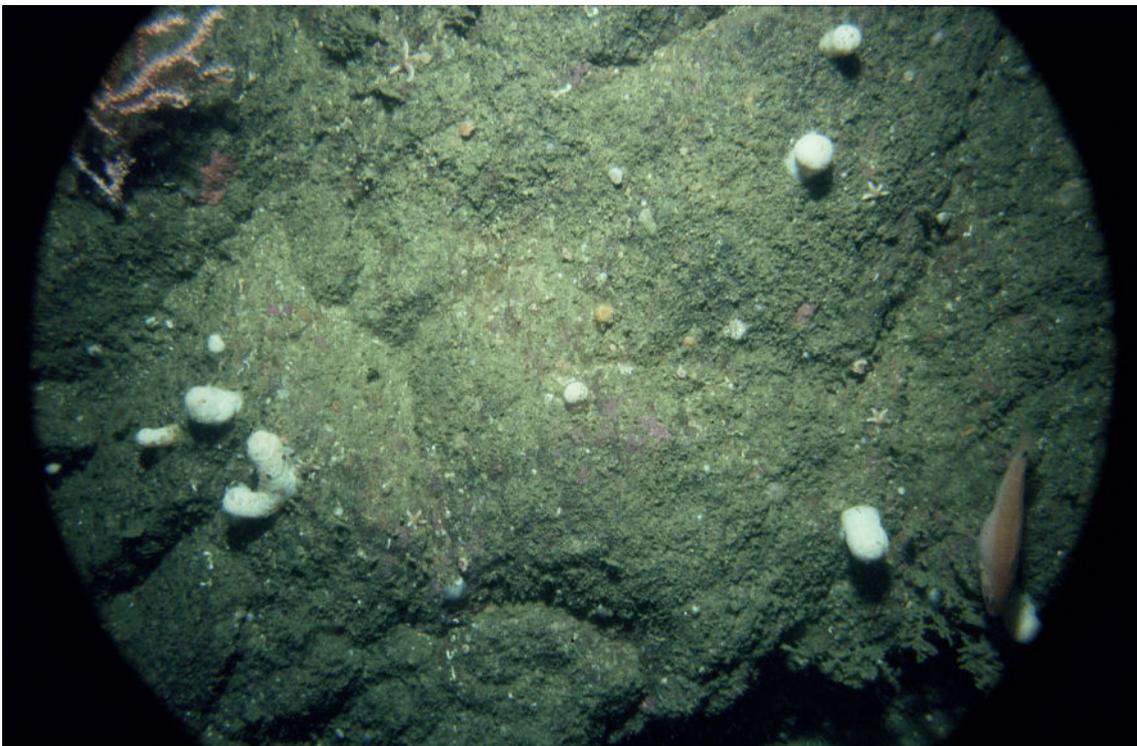


Plate 15. Rock with encrusting calcareous algae, dead mens fingers *Alcyonium digitatum*, cup corals *Caryophyllia smithii*, sea fan *Eunicella verrucosa*, small common starfish *Asterias rubens*.



Plate 16. Coarser sediments with burrowing anemone *Mesacmaea mitchelli* and gelatinous bryozoan *Alcyonidium diaphanum*.

Station 4 is "Vevers line NW of Stone". Slightly muddy shell gravel ('Eddystone gravel') throughout with patches of pebbles or flat cobbles and possibly bedrock outcrops occasionally throughout the tow. The sediment surface was largely devoid of epibiota or signs of infauna although species seen included a scallop *Pecten maximus*, the tube of a *Chaetopterus* species, *Ophiura albida*, a burrowing anemone *Mesacmaea mitchelli*, a black brittle star *Ophiocomina nigra*, and one pair of bivalve siphons. At one point there was a dense patch of a *Lanice*-like worm tube. The brittle star *Ophiura ophiura* occurred where sediments were silty. Sediment near to the hard substratum tended to have attached fast growing species such as the soft branching bryozoan *Alcyonidium diaphanum*, the antenna hydroids *Nemertesia antennina* and *Nemertesia ramosa* and the finely branched bryozoan *Bicellariella ciliata*. Where apparently more stable hard substratum occurred, there were cup corals *Caryophyllia smithii* and erect bryozoans *Cellaria* sp(p), dead mens fingers *Alcyonium digitatum*, sea fans *Eunicella verrucosa* and common starfish *Asterias rubens*. A goldsinny wrasse *Ctenolabrus rupestris*, one sea urchin *Echinus esculentus* and one patch of the hydroid *Aglaophenia* sp. were also seen. Flat cobbles or small boulders occurred for a few frames and were encrusted with Corallinacea.

Other species observed as single individuals or very small numbers were: Hydrozoa indet. (a finely branching species), *Lanice conchilega*, *Nemertesia antennina*, necklace shell (*Euspira* (= *Natica*) *catena* or *Polinices pulchellus*) eggs and the seven-armed starfish *Luidea ciliaris*

## 5. Off Looe

**Date:** 25 June 1980

**Film:** 3

**Approximate depth:** 47 m

**Decca co-ordinates: Start:** Red A8.12; Green E33.76; Purple B63.23. **End:** Red A7.94; Green E38.24; Purple B66.90.

**Positions:** 50°15' 21.48"N, 4°28' 33.40"W to 50° 16' 03.96"N, 4° 30' 56.82"W.

**Biotope (complex):** SS.SMx.CMx Circalittoral mixed sediment

**Plates:** 17-19

**Number of frames:** 198

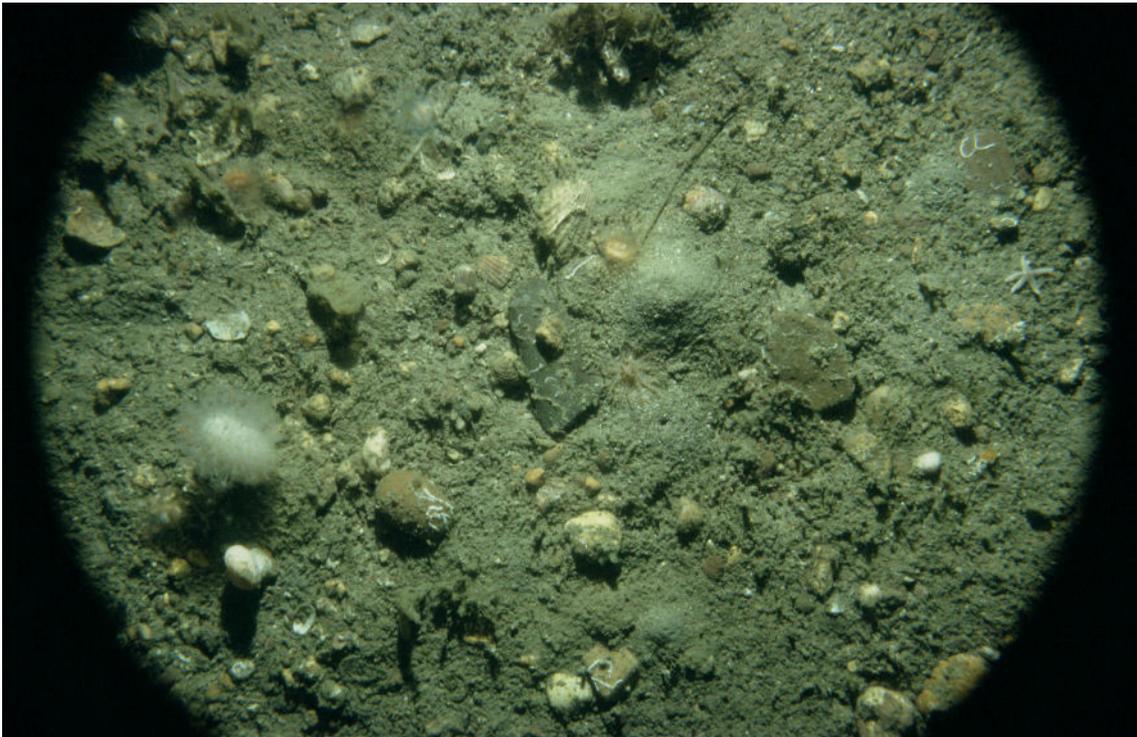


Plate 17. Muddy gravel with dead mens fingers *Alcyonium digitatum*, burrowing anemones *Mesacmaea mitchelli*, a cup coral *Caryophyllia smithii* and small common starfish *Asterias rubens*.

The start of the tow was on muddy gravel with significant numbers of visible species. The burrowing anemone *Mesacmaea mitchelli* was common, occurring in about one-in-four frames. Two small burrowing anemones – either small *Cerianthus lloydii* or *Edwardsia* sp. were seen. Larger shells or cobbles were colonised by a variety of species including the colonial anemone *Epizoanthus couchi*, the cup coral *Caryophyllia smithii*, dead mens fingers *Alcyonium digitatum* and the fleshy branching bryozoan *Alcyonidium diaphanum*. About 20 frames into the tow, the substratum became cleaner. The antenna hydroid *Nemertesia antennina* was present and one burrowing sea cucumber, *Neopentadactyla mixta* was seen. A few terebellid tentacle masses were seen in siltier sediments including the structures of concreted sand amongst which the tentacles occurred. Burrowing anemones, *Mesacmaea mitchelli*, were not seen in the cleaner sand/gravel but re-occurred together with another burrowing anemone, *Cerianthus lloydii*, towards the end of the tow where the sediment became muddy again.

Other species observed as single individuals or very small numbers were: the solitary fleshy hydroid *Corymorpha nutans*, the starfish *Astropecten irregularis*, the hermit crab *Pagurus bernhardus*, the brittle star *Ophiura ?albida* and 'quills' of the polychaete *Hyalinoecia tubicola*.

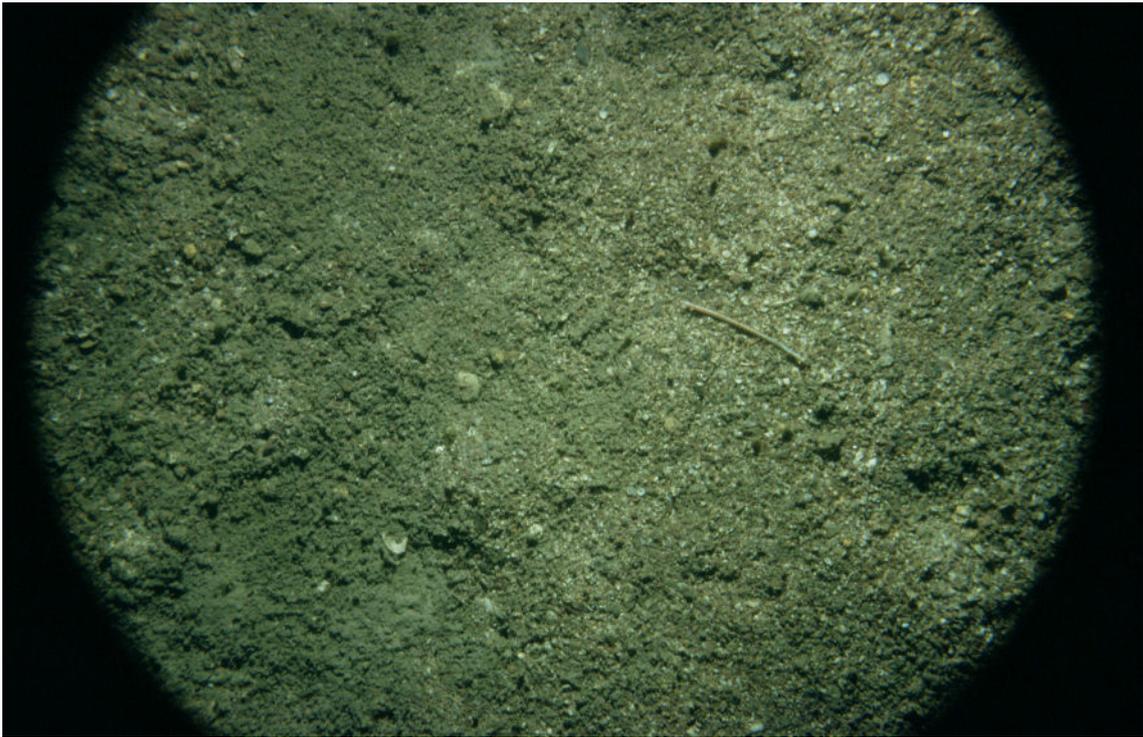


Plate 18. Muddy coarse sand with quill worm *Hyalinoecia tubicola*.

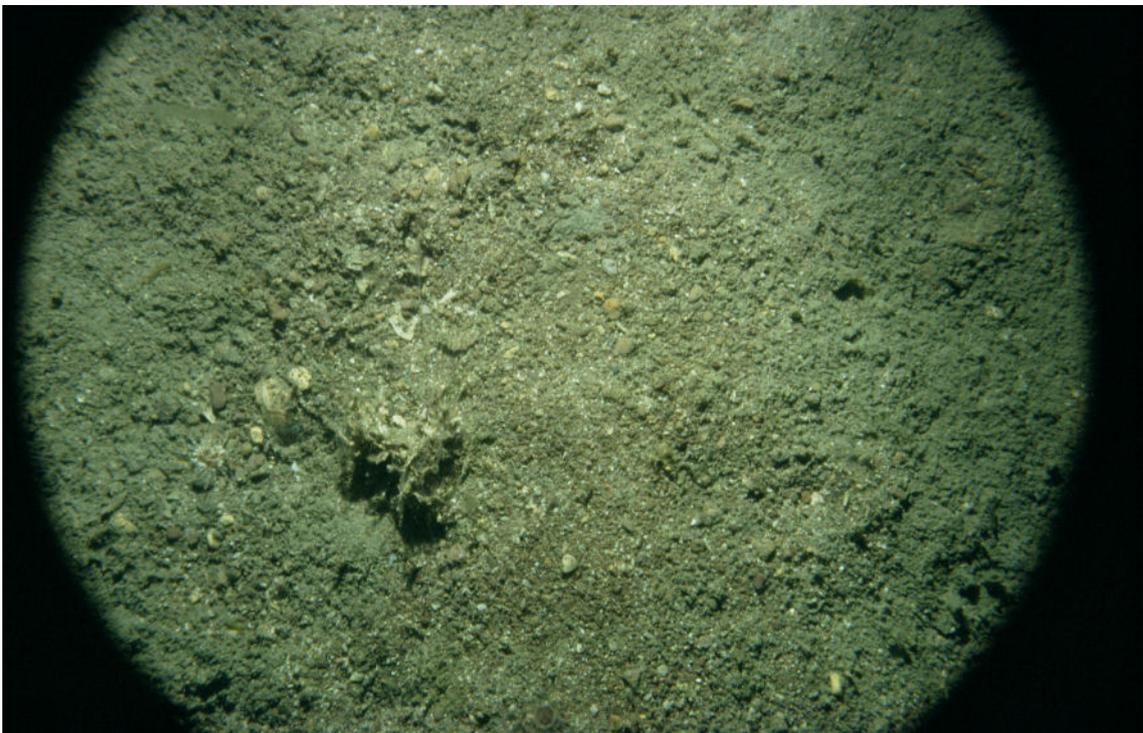


Plate 19. Coarse rock sand with the burrowing anemone *Mesacmaea mitchelli*, terebellid worm tentacles and their associated structures.

## 6. Outside of spoil ground offshore Hilsea

**Date:** 23 May 1977

**Film:** Film 8

**Approximate depth:** 57m

**Decca co-ordinates: Start:** Red A6.48; Green B36.74; Purple A59.85. **End:** Red A3.85; Green B36.90; Purple A64.13.

**Positions:** 50° 11' 56.76"N, 4° 02' 12.01"W to 50°13' 41.89"N, 4° 02' 43.73"W

**Biotope (complex):**

**Number of frames:** 191

**Biotope (complex):** SS.SMU.CSaMu Circalittoral sandy mud

**Plates:** 20 - 23

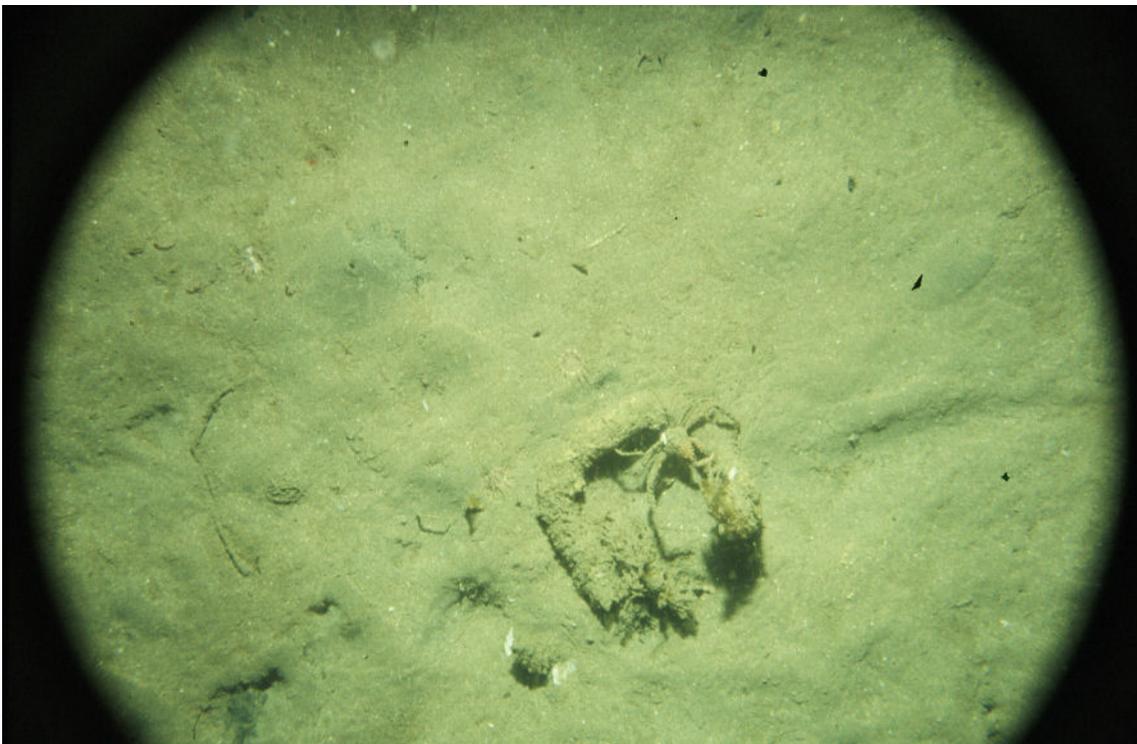


Plate 20. 'Outside spoil ground'. Anemones (most likely *Sagartia troglodytes decorata*), a spider crab (*Inachus* sp.) and debris.

It was not possible to identify the precise biotope. Sandy mud throughout with some signs of worked sediment (black sediment at surface, burrows). There was a sparse fauna visible with occasional common starfish *Asterias rubens*, and brittle stars *Ophiura ophiura* and *Ophiocomina nigra*. There were possibly the arms of burrowing brittlestars (most likely *Amphiura filiformis*) in a few frames. Anemones (most likely *Sagartia troglodytes decorata*) were present in many of the frames and there were two *Mesacmaea mitchelli* seen. Worm casts, similar to those of *Arenicola marina* were seen in several frames. *Pagurus prideux* with *Adamsia carciniopados* and *Corystes cassivilaunus* were frequent. One small piece of debris was seen. It is notable that, in the earlier report (Oakley & Hiscock 2005) it was observed that, from Video cassette 2, 4 May 1976 offshore of Rame Head that the sediment type was closest to SS.SMU.CSaMu, circalittoral sandy mud but that no sea pens, characteristic of the biotope had been seen. Three sea pens, most likely small *Virgularia mirabilis*, were seen in the film frames described here.

Other species observed as single individuals or very small numbers were: shells (2) of *Echinocardium cordatum*, spider crab *Inachus* sp., dragonet *Callionymus lyra*, sand goby *Pomatoschistus* sp. and queen scallop *Aequipecten opercularis*.



Plate 21. 'Outside spoil ground'. A sea pen (most likely small *Virgularia mirabilis*).

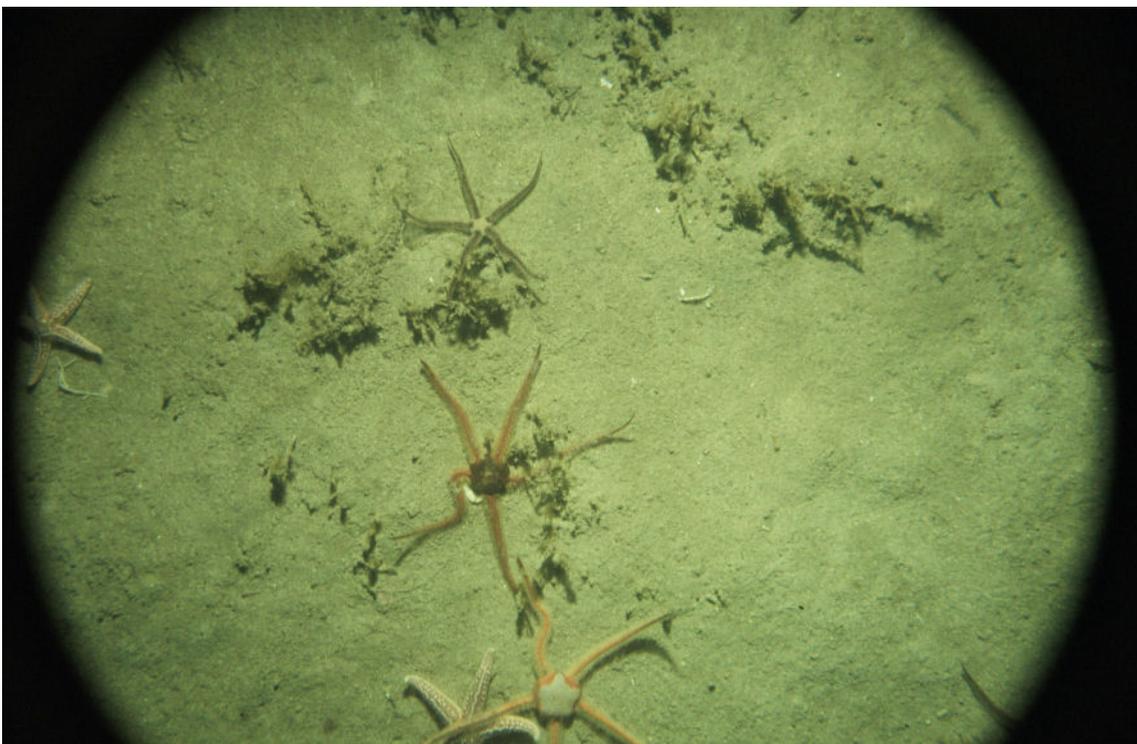


Plate 22. 'Outside spoil ground'. Brittle stars (*Ophiocomina nigra*) and common starfish (*Asterias rubens*).



Plate 23. 'Outside spoil ground'. Terebellidae tentacles, burrowing anemone, *Cerianthus lloydii* and starfish, *Ophiocomina nigra* and *Asterias rubens*.

## 7. South of the Eddystone (Tow 16)

**Date:** 20 May 1982

**Film:** Film 14

**Approximate depth:** 70m+

**Decca co-ordinates: Start:** Red C15.56; Green D36.96; Purple A50.72. **End:** Red C17.85; Green C33.61; Purple A50.25.

**Positions:** 49° 49' 25.26"N, 4° 07' 19.44"W to 49° 49' 15.97"N, 4° 04' 46.40"W.

**Biotope (complex):** Not established. Visual domination by a terebellid tube worm (? *Thelepus cincinnatus*) suggests an undescribed biotope.

**Number of frames:** 213

**Plates:** 24-25

This tow was a significant distance (about 22 nautical miles) south of the latitude of the Eddystone and south-south-east of the rock. The bottom was mainly of significant quantities of shells and pebbles embedded in sandy mud. Depth was in excess of 70m. The most conspicuous feature was the presence of high densities (7-10 per image) of a terebellid worm creating a concreted sandy network amongst which the tentacles formed a complex net. The worm was most likely *Thelepus cincinnatus* which was recorded by Crawshaw (1912) as abundant in this region at 40 to 50 fathoms depth. [Holme recorded "sand and hydroids" in the tow log.] There were burrowing anemones: *Mesacmaea mitchelli* and *Cerianthus lloydii*. Hydroids were attached to pebbles including *Abietinaria abietina* and *Nemertesia* species. There were also anemones, possible *Sagartiogeton laceratus*. There were patches of fine shell gravel/sand between the areas where



Plate 24. Sandy mud with shells and pebbles colonised by the terebellid worm ?*Thelepus cincinnatus* and with the burrowing anemone *Mesacmaea mitchelli*, cup coral *Caryophyllia smithii* and dragonet *Callionymus lyra*.



Plate 25. Consolidated shell gravel and finer sediments towards the end of the tow.

?*Thelepus cincinnatus* were absent. Several colonies including one large colony of dead mens fingers *Alcyonium digitatum* were observed, presumably attached to shells or stones. A significant number of other species were seen in images (possibly because of

hard substrata present) but none abundant or likely to be characteristic. Towards the end of the tow, there were areas of highly compacted/consolidated shell gravel.

Other species observed as single individuals or very small numbers were: dragonet *Callionymus lyra*, branching sponge indet., cup corals *Caryophyllia smithii*, queen scallops *Aequipecten opercularis*, king scallop *Pecten maximus*, brittle star *Ophiura ophiura*, the parchment tube worm *Chaetopterus* sp., the spider crab *Inachus* sp., sea urchin *Echinus esculentus*, pagurid crab *Pagurus prideaux* with cloak anemone *Adamsia carciniopados*, dahlia anemone *Urticina felina*, tube worm *Protula tubularia* and common starfish *Asterias rubens*.

## Films inspected rapidly

### A. 'Just N of Hand Deeps'. Depth: 52 m. 7 July 1976. Film 11.

**Decca co-ordinates: Start:** Red A5.98; Green D37.50; Purple B58.28. **End:** Red A7.5; Green D37.56; Purple B54.(70).

**Position: Start:** 50° 15' 48.74"N, 4° 21' 28.75"W **End:** 50° 14' 28.29"N, 4° 21' 18.69"W.

Muddy sand to muddy shell gravel later including areas dominated by whole shells. Conspicuous species were *Chaetopterus* sp. and *Mesacmaea mitchelli* and occasional *Liocarcinus ?depurator* and some terebellid worms, *Aequipecten opercularis* and *Pecten maximus* but little else.

### B. Plymouth – Allen 42. Depth 59m.16 June 1975. Film 2.

#### B.1 First tow

**Decca co-ordinates: Start:** Red A10.84; Green D36.00; Purple A76.85. **End:** Red A10.98; Green D34.88; Purple A75.92.

**Position: Start:** 50° 11' 27.59"N, 4° 19' 54.12"W **End:** 50° 11' 16.85"N, 4° 19' 17.44"W.

#### B.2 Second tow

**Decca co-ordinates: Start:** Red A11.26; Green D35.63; Purple A75.98. **End:** Red A10.44; Green D35.58; Purple A77.22.

**Position: Start:** 50° 11' 08.46"N, 4° 19' 38.06"W **End:** 50° 11' 43.00"N, 4° 19' 45.19"W.

Muddy rock and shell gravel with areas of muddy sand. *Mesacmaea mitchelli* most conspicuous on the coarser sediments and terebellid 'nests' (*Thelepus cincinnatus*) on the finer sediments. There were a few *Ophiocomina nigra* present and some *Arenicola* – like casts. There were several patches of *Lanice*-like worm tubes in finer sediments. Only a small number of *Aequipecten opercularis* were seen.

### C. Gerran. Depth 36 to 62 m. 24 May 1977. Film 10.

#### C.1 First tow

**Decca co-ordinates: Start:** Red A18.31; Green H34.91; Purple B71.72 (at 36m). **End:** Red A18.47; Green H34.92; Purple B71.47 (at 39m).

**Position: Start:** 50° 09' 57.17"N, 4° 55' 14.56"W. **End:** 50° 09' 49.16"N, 4° 55' 12.69"W

#### C.2 Second tow

**Decca co-ordinates: Start:** Red A22.28; Green H35.15; Purple B65.21. **End:** Red A23.8; Green H39.05; Purple B64.87.

**Position: Start:** 50° 06' 31.28"N, 4° 54' 23.17"W. **End:** 50° 05' 31.65"N, 4° 56' 04.44"W

“Towing south from Gerrans Bay on Decca Line H35”. The tow started in shallow water (noted as 36m) with broken rocks dominated by red algae and extended over maerl beds (mixture of live and dead maerl) then over more rocky areas where the first tow was abandoned. The tow was re-deployed in deeper (c 62m) water where the seabed was similar to that described for ‘Off Dodman’. [The red algae present at the start were more characteristic of depths of about 20m than the 36 m noted.]

**D. ‘Looe Grounds’. Depth 53-54m. 24 June 1980. Film 2.**

**Decca co-ordinates: Start:** Red A8.31; Green D47.83; Purple B59.98. **End:** Red A8.01; Green E33.25; Purple B63.41.

**Position: Start:** 50° 14’ 44.35”N, 4° 26’ 27.67”W **End:** 50° 15’ 29.64”N, 4° 28’ 19.50”W.

Start of tow only had small boulders with patches of the encrusting bryozoan *Parasmittina trispinosa* and common starfish *Asterias rubens* with sandy gravel between. Mainly coarse muddy sand with cleaner or muddier patches. There were occasional burrowing anemones *Mesacmaea mitchelli*, terebellid worms, ?*Thelepus cincinnatus* and brittle stars *Ophiura ophiura*. There were sessile species attached to stones or shells: the cup coral *Caryophyllia smithii*, dead mens fingers *Alcyonium digitatum* and the gelatinous bryozoan *Alcyonidium diaphanum*, mainly in areas of muddy sand towards the end of the tow. Other species noted as once or a very few times were: the spider crab *Inachus* sp., the antenna hydroid *Nemertesia ramosa*, the star sea squirt *Botrylloides leachii*, a queen scallop *Aequipecten opercularis* and tube worms *Chaetopterus variopedatus*.

**E. South Rame. Depth 54 m. 23 May 1977. Film 9.**

**Decca co-ordinates: Start:** Red A7.22; Green C37.51; Purple A72.05. **End:** Red A10.00; Green C37.77; Purple A67.80.

**Position: Start:** 50° 12’ 55.71”N, 4° 11’ 50.25”W. **End:** 50° 11’ 01.38”N, 4° 11’ 28.32”W .

“Towing south”. The start of the tow was sandy mud, changing about half way through to muddy gravel. In the muddy areas, there were high densities of *Mesacmaea mitchelli* and *Cerianthus lloydii* (ten *Cerianthus* in one image). As sediments became coarser, there were *Cellaria* ‘tangles’. There was little other fauna to report.

**F. ‘Off Dodman’. Depth 62 m. 6 July 1976. Film 10.**

**Decca co-ordinates: Start:** Red A18.20; Green G37.50; Purple B64.94. **End:** Red A15.76; Green G37.62; Purple B69.34.

**Position: Start:** 50° 09’ 09.49”N, 4° 47’ 19.86”W. **End:** 50° 11’ 17.45”N, 4° 47’ 57.52”W.

Muddy sand with shells with similar fauna to the finer sediments in the South Rame SS.SMx.CMx tow, including *Mesacmaea mitchelli*, *Ophiocomina nigra* and *Ophiura ophiura*. Occasional sand mason worms *Lanice conchilega* were present. There were some hard structures in the sediment as evidenced by occasional *Caryophyllia smithii*, *Alcyonium digitatum* and *Nemertesia antennina*. There were also king scallops *Pecten maximus* in addition to the large numbers of small queen scallops *Aequipecten opercularis*. There were some ?*Thelepus cincinnatus*. Other species observed in small numbers were the spider crab *Inachus* sp., the small brittle star *Ophiura albida*, the crab *Atelacyclus rotundatus*, hermit crabs, *Pagurus* sp. and *Pagurus prideaux* with the cloak anemone *Adamsia cariniopados* and the dragonet *Callionymus lyra*.

**G. South of Eddysone. 78 – 79m. 19 May 1982. Film 13, Tow 15**

**Decca co-ordinates: Start:** Red C11.95; Green D33.11; Purple A50.64. **End:** Red C9.43; Green D34.66; Purple A51.00.

**Position: Start:** 49° 51' 02.85"N, 4° 06' 06.27"W **End:** 49° 51' 35.27"N, 4° 07' 40.20"W.

This tow was noted as turning east during the tow.

(Very similar to the 20 May film 14 Tow 16 inspected and illustrated.) Muddy sand sediments conspicuously dominated by ?*Thelepus cincinnatus* for most of the tow with coarser sediments for about one fifth of the tow and about in the middle of the tow. Notebooks state "sand, hydroids" – the "hydroids" will be the ?*Thelepus cincinnatus*.

## 4. DISCUSSION AND COMPARISON WITH LATE 19<sup>TH</sup> AND EARLY 20<sup>TH</sup> CENTURY DESCRIPTIONS

### 4.1 Comparisons with late 19<sup>th</sup> and early 20<sup>th</sup> century descriptions

The work of Allen (1899) is remarkable and many of the most abundant species he recorded and likely to be visible in photographs are the same as those seen in the towed sledge images. Assemblages present and associated with different types of sediments are described in both Allen (1899) and Ford (1923) and, with further work, could be identified more precisely to biotopes. The papers by Allen and Ford are very detailed and maps are provided of the recorded distribution of species (Allen) and communities (Ford). Figure 1 shows one of the maps from Allen (1899) with species distributions overlain on the different substratum types identified. Appendix Figures 1 to 5 are from Ford (1923) and show the organisms present in the communities that he identified from areas also sampled by Holme.

The images showing areas of deep (70m+) seabed visually dominated by a terebellid worm suggest a biotope that is not in the latest sediment classification.

Inevitably, there are films that have not been inspected or analysed as a part of the exercise described here. Some of that material will be used to support research recently funded by the Aggregate Levy Sustainability Fund for locations east of Plymouth. Eventually, as funding and staff availability permit, it is hoped that all of the films will be analysed and information on biotopes and species occurrences entered to Marine Recorder.

### 4.2 Comments on image analysis

Whilst the photographic images are very clear, they reveal only epifauna and sometimes the signs (siphons, burrows) of infaunal species that characterise the biotopes.

### 4.3 Accuracy of positioning and tabulation of positions

Matching films to the tabulated information on film number and positions in the Phase 1 report (Oakley & Hiscock, 2005) revealed that there were errors in transcription between spread sheet and Word table that require correction. Also, the line numbers in the spread sheet of positions had been used to number positions plotted to figures and charts in that report but had not been included in the tables.

Problems of conversion were further encountered even after careful copying from the log books: some Decca positions converted to latitude and longitude distant from named locations.

It is, unfortunately, anticipated that such problems will continue and future analysis will need to take care, seek most recent algorithms or even revert to reading latitude and longitude from paper Decca charts.

By far the greatest amount of time taken in the work described here was translating Decca co-ordinates and trying to establish just where the tows were – although the log book records were well-maintained and clear.

## 5. THOUGHTS ON UTILITY OF THE IMAGES FOR IDENTIFYING CHANGE

Environmental conditions in the Channel have changed since the work of Allen at the end of the 19<sup>th</sup> century (Allen 1899), since the sampling undertaken by Ford (1923) and since the images described here were collected. Most notably, the intensity of fishing with mobile bottom gear has increased and the weight of the trawls has increased. Scallop dredging, which uses spiked metal dredges designed to dig into the seabed, is particularly likely to have increased over the past 20-30 years.

The results from the surveys undertaken by Allen and by Ford are very detailed and will not be dissected here. However, re-sampling and detailed comparison will be undertaken in work now commencing at the Marine Biological Association. The work of Crawshaw (1914) is also very detailed and the species listed should be compared with those seen in towed sledge images and the results from new work being undertaken. Some species, for instance the sponge *Desmacidon fruticosum*, appear to have disappeared since the old surveys and such species losses should be catalogued and explained.

The images collected by Holme show sediment type and surface-dwelling fauna and flora. The images do not reveal the infauna except for a few species that have surface structures or signs (tentacles, siphons, burrows). Nevertheless, repeat survey could be targeted at quantitative surveys of those species that live on the surface or that have surface features or signs. Those species include burrowing anemones and the structures formed by terebellid worms which would be particularly susceptible to damage by physical disturbance. Hermsen *et al.* (2003), working on the Grand Banks off Newfoundland, found that the terebellid worm *Thelepus cincinnatus*, also probably this species recorded in high densities south of the Eddystone, was an indicator of absence of trawl impacts. On some tows, the number of queen scallops was significant with, on average, more than one per frame (approximately per 0.3 m<sup>2</sup>). The precise track of the tows is recorded in the log books as Decca co-ordinates and each entry should be mapped and checked against depth and probable correction factors before any re-survey.

Notably, the area visually dominated by shells of *Turritella communis* offshore of Plymouth Sound is the same area where Allen recorded dense *Turritella* as a facies of his *Venus gallina* with *Turritella communis* community.

Unfortunately, the area now used for dredge spoil disposal off Rame Head does not feature in the areas surveyed – possibly because it was a munitions dump. Survey data available for that area is therefore restricted to samples collected by grab and dredge from over 60 years ago (Ford, 1923; Mare, 1942).

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## APPENDIX 1. EXTRACTS FROM THE PLYMOUTH MARINE FAUNA

From: Marine Biological Association (1957) and for the areas where films have been analysed. Species names are those used in 1957. It is expected that "miles" refer to nautical miles.

**The Rame-Eddystone or Middle Grounds.** This name has been used to indicate the grounds extending 3-4 miles on either side of the line from Rame to Eddystone and having depths of from 25-30 fm. Two typical classes of grounds can be recognized in this area: (1) coarse grounds with a bottom soil of muddy gravel on which a few *Chaetopterus* may sometimes be taken, and the chief hydroids are *Halecium halecinum* and *H. beani*; and (2) fine grounds with a bottom soil of fine muddy sand, characterized by a certain amount of *Cellaria sinuosa* and *C. fistulosa* and by the hydroid *Sertularella gayi*. The grounds are very patchy, and the two typical faunas are much intermingled, so that it is only occasionally and after a short haul that a fair representation of either of the two types of fauna is obtained. Either ground can profitably be worked with both the dredge and trawl. On both *occasional Chlamys opercularis* may be met with in particular spots, and *Marthasterias glacialis* and *Asterias rubens* are generally distributed over the area.

The following are typical species occurring on the two classes of grounds:

**COARSE GROUNDS.** *Hyalinoecia tubicola*, *Halecium halecinum*, and *H. beans*, *Atelecyclus septemdentatus*, *Ophiura albida*, *Ophiactis ballis*, *Venus fasciata*, *Venerupis rhomboides*, and *Ebalia tuberosa* and *E. tumefacta*.

**FINE GROUNDS.** *Cellaria sinuosa*, and *C. fistulosa*, *Ophiura texturata*, *Sertularella gayi* and *S. polyzonias*, *Echinocardium cordatum*, *Corystes cassivelaunus*, *Solecurtus chamasolen*, *Phaxas pellucidus*.

From the above description it will be seen that the fauna of the Rame-Eddystone Grounds resembles very closely that of the Eddystone-Start Point Grounds already described in Allen, 1899, p. 365 *et seq.*

The fish fauna differs from that of the Corner Ground in scarcity of rays, but rather more flatfish such as brill, turbot and lemon-soles.

**The Rame Mud**, Maximum depth about 25 fm. With Rame Head bearing, from north-east to east-north-east, distant from 2-3 miles, the sea bottom consists of soft mud and contains quite a rich and characteristic fauna. Polychaetes are abundant, *Melinna palmata*, *Notomastus latericeus*, *Glycera*, *Goniada*, and *Nephtys* being typical examples. *Cucumaria elongata* is numerous, *Goneplax rhomboides* fairly common, with *Alpheus glaber* and *Callianassa subterranea*, always present but scarce. The fish *Cepola rubescens* is invariably found on these grounds, and whiting in their season. A study of this ground was made by Mare (1942).

The **Looe-Eddystone Grounds** (25-30 fm.). This name has been applied to an extension westwards of the Rame-Eddystone Grounds. The fauna is similar in general character to that of the latter grounds, but is particularly rich—the result, probably, of the presence of much rough ground intermingled with trawling ground. *Echinus esculentus* is plentiful, together with *Pecten maximum* and *Chlamys opercularis*. *Solaster papposus* and *Porania pulvillus* are also generally present in small numbers. Half-grown thornback rays (*Raia clavata*) are generally plentiful but flatfish are scarce.

**Looe Grounds** (27-29 fm.). Looe bearing north to north-west, distant 5-7 miles. The bottom consists of fine sand and gravel with outcroppings of rock. The buried fauna is similar to that of the shell gravels and sands already described – except for the absence of *Amphioxus*. The epi-fauna is characterized by an abundance of *Echinus esculentus*. *Solaster papposus*, *Porania pulvillus* and *Palmipes membranaceus* are constantly present in small numbers. *Pecten maximum* is common and *Chlamys opercularis* generally abundant, but large variations in its numbers commonly occur. This is also a good ground for obtaining fairly consistent catches of mixed fish—especially *Scyliorhinus canicula*, *Raia* spp., various flatfishes, gadoids (including small hake), gurnards and John Dory in some restricted places *Ophiothrix fragilis* is plentiful.

**Eddystone Shell Gravel** (23-26 fm.). Extending between about 4 and 6 cables N.N.W. of the Eddystone Lighthouse is a patch of rough, clean shell gravel where *Amphioxus lanceolatus* is present in quite large numbers. Up to 75 individuals have been taken in one haul of a 3 ft dredge. Other inhabitants of this shell gravel, constantly present, but in smaller numbers, are *Acropagia crassa*,

*Venus fasciata*, *Gari tellinella*, *Solecurtus scapula*, *Conilera cylindracea*, *Ampelisca spinipes*, *Ebalia tuberosa*, *Echinocyamus pusillus*, *Lumbriconereis*, *Glycera*, and *Polygordius*. A fair number of *Gymnammodytes semisquamatus* are generally present around the periphery of this ground. For further details of this ground see Smith (1932).

**Eddystone (Inner) Channel Grounds** (32-38 fm.). Eddystone 1-8 miles distant from north-north-west to east-north-east. The bottom is fine sand. This infauna here is similar to that of the Looe-Eddystone grounds, but enriched by the presence also of *Nucula turgida*, *Lucinoma borealis*, *Cyprina islandica*, *Cardium echinatum*, *Echinocardium cordatum* and *Glossobalanus sarniensis*. *Chaetopterus variopedatus* is also present in considerable numbers. Close to the Eddystone rocks, with the lighthouse bearing east-north-east to north-east, thornback rays (*Raja clavata*) are more plentiful than further out. Further information about the fauna of this ground is given by Holme (1953).

**Eddystone (Outer) Channel Grounds** (35-43 fm.). Eddystone 12-15 miles distant bearing north-east to north-west. The bottom here also consists of fine sand and shell gravel with the usual fauna, except that ling and large hake are occasionally taken. The large lamellibranch *Pinna* is present on these grounds but is only rarely taken, generally in the trawl.

**The 30 fm. line from Eddystone to Start Point.** A detailed description of the grounds and their fauna along this line is given by Allen (1899).

**APPENDIX 2. SEABED INFAUNAL COMMUNITIES SAMPLED BY FORD (1923) AND  
MATCHED TO EPIFAUNAL TOWED SLEDGE SURVEYS.**

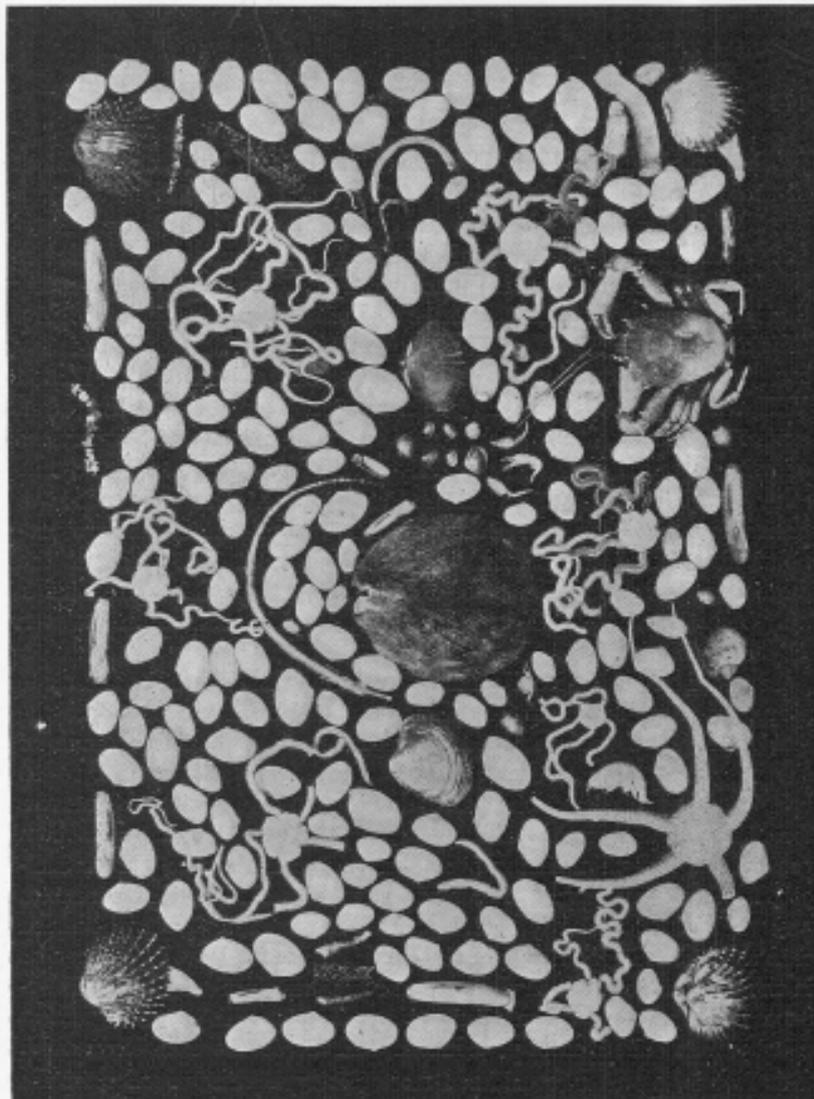


FIG. 1. EcVg COMMUNITY. b + Ec. + fil.

Number of animals per  $\frac{1}{10}$  sq. metre ( $\frac{1}{10}$  natural size).

No.		No.	
<i>Nucula nitida</i>	4	<i>Portunus</i> sp. (juv.)	1
<i>Montacuta bidentata</i>	4	<i>Schizopoda</i>	1
<i>Syndosmya alba</i>	188	<i>Nika edulis</i>	1
<i>Syndosmya prismatica</i>	1	<i>Diastylis</i> sp.	1
<i>Mactra staltorum</i>	1	<i>Ampelisca</i> sp.	1
<i>Venus gallina</i>	1	<i>Nephtys</i> sp.	1
<i>Venus ovata</i>	1	<i>Sthenelais limicola</i>	1
<i>Cardium echinatum</i>	4	<i>Owenia fusiformis</i>	1
<i>Corbula gibba</i>	1	<i>Goniada maculata</i>	1
<i>Cultellus pellucidus</i>	9	<i>Lumbriconereis</i> sp.	1
<i>Natica alderi</i>	1	<i>Amamotrypane aulogaster</i>	1
<i>Bullinella cylindracea</i>	1	<i>Pectinaria</i> sp.	3
<i>Echinocardium cordatum</i>	1	Polychaeta, sandy tubes	fragments
<i>Amphitars filiformis</i>	1	<i>Nemertinea</i>	1
<i>Ophiura ellaris</i>	1	<i>Syngnathus</i> sp. (juv.)	1
<i>Coryastes cassivelanuns</i>	1		

Station 63. Bigbury Bay { Borough Island, N.E. by E. } October 31st, 1922. Silty  
{ Bolt Tail, S.E.  $\frac{1}{2}$  S. } sand.

**Appendix Figure 1.** Samples identified to the *Echinocardium cordatum* – *Venus gallina* b association were identified for areas south of Rame Head and off the spoil grounds for the tows investigated here. From: Ford, 1923.



FIG. 3. VG + TURRITELLA COMMUNIS.

Number of animals per  $\frac{1}{16}$  sq. metre ( $\frac{1}{16}$  natural size).

No.		No.	
<i>Nucula nitida</i>	1	<i>Diastylis</i> sp.	1
<i>Lacuna spinifera</i>	1	<i>Ampeliscia</i> sp.	1
<i>Thyasira flexuosa</i>	1	<i>Melinna adriatica</i>	1
<i>Solecurtus antiquatus</i>	1	<i>Notomastus latericeus</i>	fragments
<i>Cultellus pellucidus</i>	1	<i>Nephtys</i> sp.	1
<i>Thracia convexa</i>	1	<i>Glycera</i> sp.	1
		<i>Goniada maculata</i>	1
<i>Bullinella cylindracea</i>	1	<i>Magelona papillicornis</i>	1
<i>Turritella communis</i>	60	<i>Owenia fusiformis</i>	1
		<i>Ammotrypane aulogaster</i>	1
<i>Cucumaria elongata</i>	1	Cirratulidae	1
<i>Amphizoa filiformis</i>	1	<i>Lumbriconereis</i> sp.	1
		<i>Aricia</i> sp.	fragments
<i>Gonoplax rhomboides</i>	1	Terebellidae	1
<i>Alpheus ruber</i>	1		
		Nemertinea	1

Station 96. Rame Head, N.E. by E.  $\frac{1}{2}$  E.  $1\frac{1}{2}$  miles. May 9th, 1923. Muddy coarse sand with some shell fragments.

**Appendix Figure 2.** The *Venus gallina* community with *Turritella communis* sampled by Ford (1923) off Rame Head and also recorded off Plymouth Sound was observed in Tow 1 described here. (See Plate 1.) From: Ford, 1923.

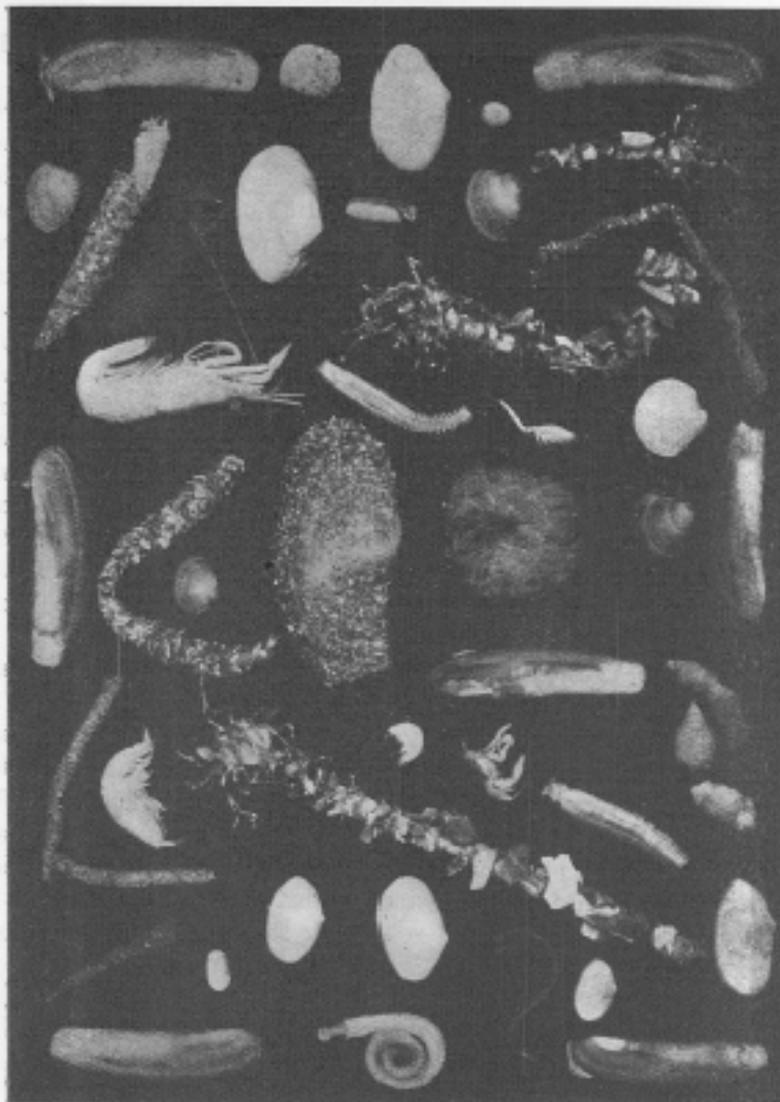


FIG. 4. EcVg COMMUNITY. b dominant over (b).

Number of animals per  $\frac{1}{16}$  sq. meter ( $\frac{11}{16}$  natural size).

	No.		No.
<i>Nucula nitida</i>	4	<i>Nika edulis</i>	1
<i>Tellinomya ferruginosa</i>	1	<i>Diastylis</i> sp.	1
<i>Syndosmya alba</i>	5	<i>Ampellicca</i> sp.	1
<i>Syndosmya prismatica</i>	1		
<i>Dosinia lupina</i>	1	<i>Nephtys</i> sp.	2
<i>Cultellus pellucidus</i>	7	<i>Sthenelais limicola</i>	1
<i>Lyonsia norvegica</i>	1	<i>Ovenia fusiformis</i>	1
		<i>Geniada maculata</i>	1
<i>Bullinella cylindracea</i>	1	<i>Pectinaria</i> sp.	1
<i>Natica alderi</i>	1	<i>Lanice conchilega</i> , tubes	frequent
<i>Echinocardium cordatum</i>	1	<i>Polychaeta</i> , tubes	frequent
<i>Echinocyamus pusillus</i>	1		
<i>Anapagurus levis</i>	1	<i>Nemertinea</i>	1

Station 104. Borough Island E., Revelstoke Point N.E. by N. June 12th, 1923. Silty sand with some flaky shell fragments.

**Appendix Figure 3.** The *Echinocardium cordatum* – *Venus gallina* b association recorded by Ford (1923) as found offshore and south of Rame Head (roughly where Tows 2 and 3 of the present analysis were located) and similar distances offshore to the west and east. From: Ford, 1923.

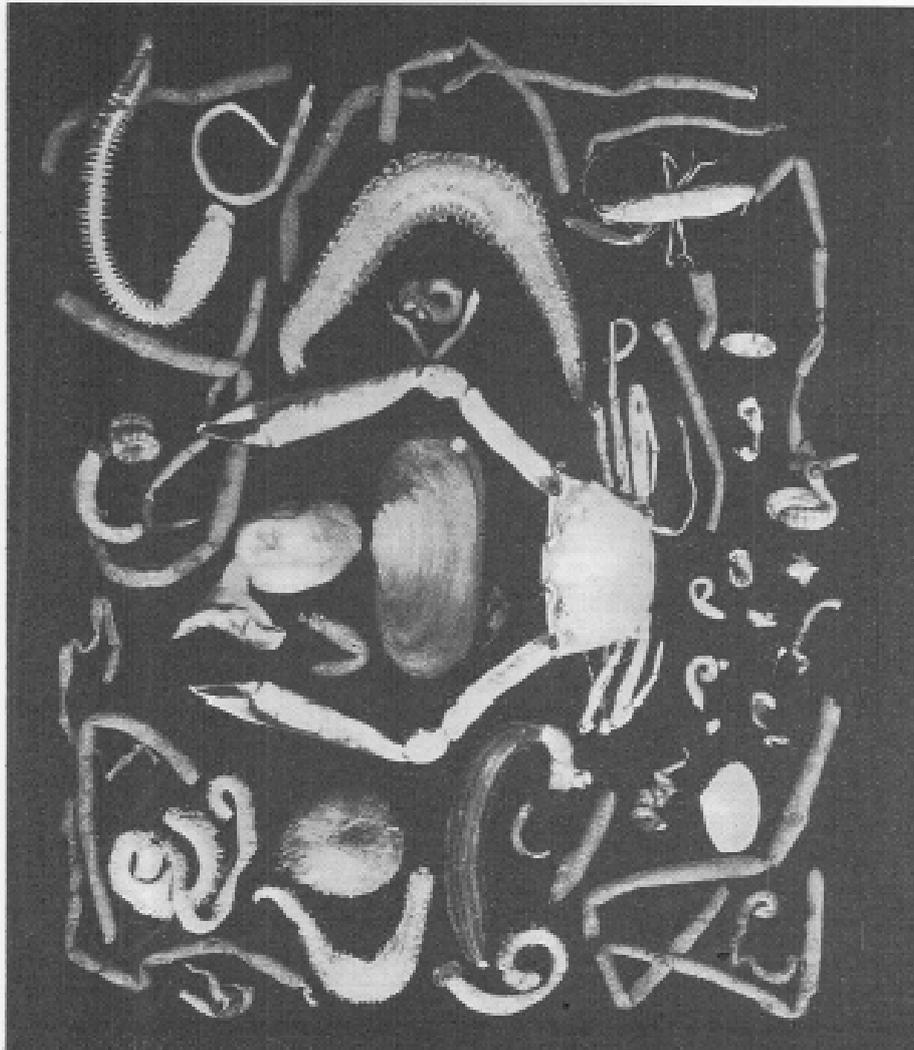


FIG. 5. *EcVg* COMMUNITY, *EcVg* MUD.

Number of animals per  $\frac{1}{16}$  sq. metre ( $\frac{1}{16}$  natural size).

No.		No.	
<i>Syndosmya alba</i>	1	<i>Melania adriatica</i>	frequent
<i>Solecurtus antiquatus</i>	1	<i>Notomastus latericus</i>	frequent
<i>Corbula gibba</i>	1	<i>Nephtys</i> sp.	2
<i>Echinocardium cordatum</i>	1	<i>Glycera</i> sp.	1
<i>Cucumaria elongata</i>	2	<i>Magelona papillicornis</i>	1
<i>Gonoplax rhomboides</i>	1	<i>Aricia</i> sp.	1
<i>Alpheus ruber</i>	1	<i>Nemertinea</i>	1
<i>Callinassa subterranea</i> (juv.)	2	<i>Sagartia</i> sp.	1
<i>Coryastes cassoelanus</i> (juv.)	1	<i>Clupea</i> sp., post-larva	1
<i>Parcellana longicornis</i> (juv.)	1	<i>Pleurocoetes limanda</i> , post-larva.	1
<i>Diastylis</i> sp.	1		

Station 5. Rame Head E.  $\frac{1}{2}$  N. 1 $\frac{1}{2}$  miles. May 31st, 1922. Black mud.

**Appendix Figure 4.** The *Echinocardium cordatum* – *Venus gallina* Mud association recorded by Ford (1923) as found south-west of Rame Head and possibly present in parts of Tow 1 described here. Rame Mud was not sampled in the towed sledge surveys. From: Ford, 1923.

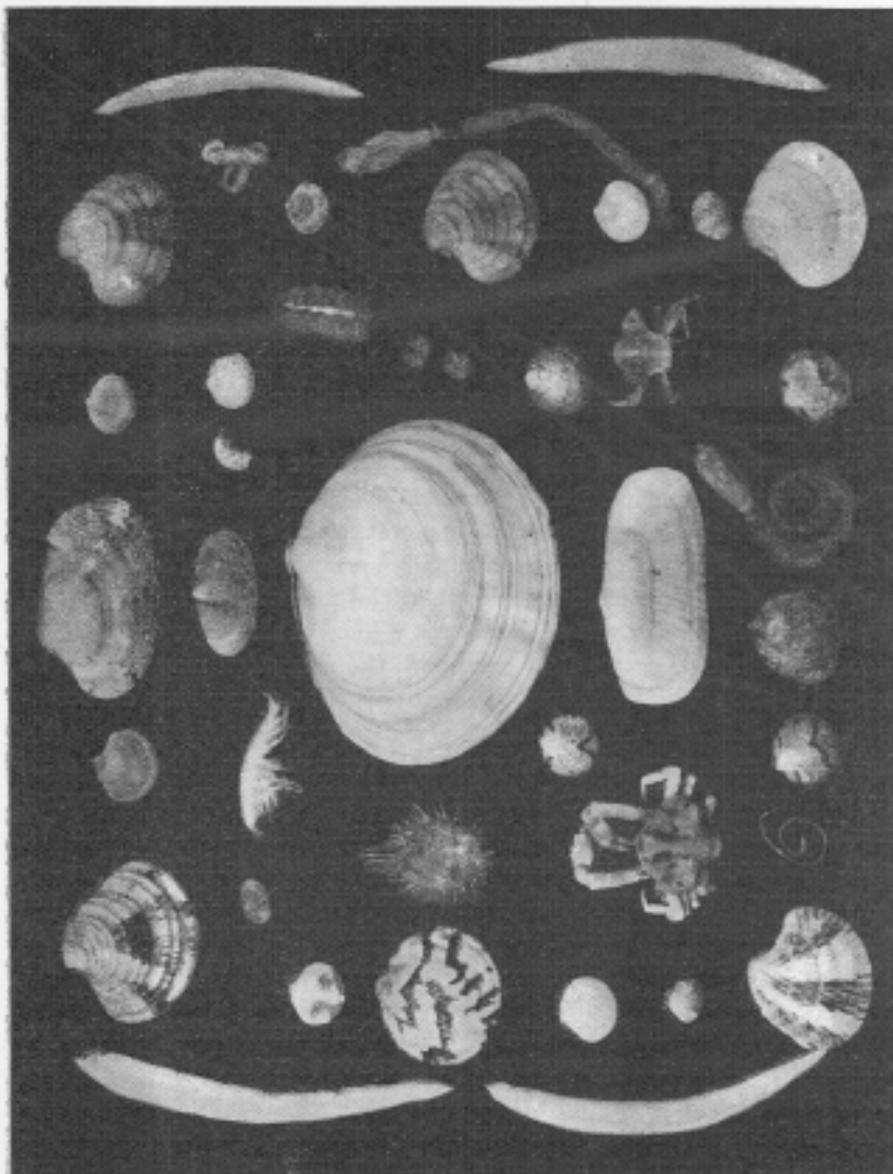


FIG. 6. SPVF COMMUNITY.

Number of animals per  $\frac{1}{10}$  sq. metre ( $\frac{11}{10}$  natural size).

	No.		No.
<i>Glycymeris glycymeris</i> . . . . .	5	<i>Echinecyamus pusillus</i> . . . . .	2
<i>Tellina crassa</i> . . . . .	1	<i>Portunus pusillus</i> . . . . .	1
<i>Tellina pusilla</i> . . . . .	1	<i>Ebalia tuberosa</i> . . . . .	1
<i>Venus fasciata</i> . . . . .	5	<i>Ampelisca typica</i> . . . . .	1
<i>Venus ovata</i> . . . . .	2	<i>Maera</i> sp. . . . .	1
<i>Tapes virginicus</i> . . . . .	1	<i>Polygordius</i> sp. . . . .	fragments
<i>Gouldia minima</i> . . . . .	6	<i>Glycera</i> sp. . . . .	2
<i>Cardium nodosum</i> . . . . .	1	<i>Polynoe</i> . . . . .	1
<i>Cardium norvegicum</i> . . . . .	1	<i>Lambriconeris</i> sp. . . . .	1
<i>Gari tellinella</i> . . . . .	1	<i>Amphioxus lanceolatus</i> . . . . .	4
<i>Echinocardium flavescens</i> (juv.) . . . . .	1		

Station 81. Eddystone S.S.E.  $\frac{1}{2}$  E.  $\frac{1}{2}$  mile. January 25th, 1923. Clean shell gravel.

**Appendix Figure 5.** The *Spatangus purpureus* – *Venus fasciata* community was recorded by Ford (1923) especially around the Eddystone (Tows 4 and 5 from the towed sledge surveys described here). From: Ford, 1923.