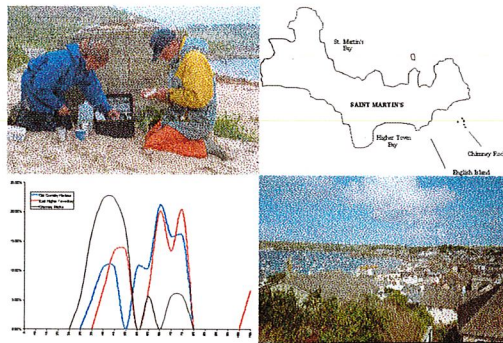


Coral Cay Conservation Sub-Aqua Club

Isles of Scilly 1994 Expedition Report



Prepared

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1. Abstract

Between 29 July and 13 August 1994 a team of 24 volunteers from the Coral Cay Conservation Sub-Aqua Club (CCC-SAC) undertook a number of marine research projects on behalf of the Isles of Scilly Marine Park Committee. This built on work started with the first Coral Cay expedition to the Isles of Scilly in 1992 which was continued in 1993. The four main projects were:

- 1) The continued assessment of the wasting disease in the sea grass beds (*Zostera marina*) around the islands. Sea grass habitats are recognised as being of significant ecological importance to marine ecosystems, supporting a diverse, productive and relatively stable environment. Sea grass populations in the north-east Atlantic have undergone episodes of decline particularly in 1930's due to infection with a slime mould that causes a wasting disease. Divers from English Nature noticed that this condition had reappeared in 1991 and that infection was reasonably widespread.
- 2) The survey of infauna species within the sea grass beds to assess the importance of these to the biodiversity of the marine environment.
- 3) The establishment of a permanent monitoring site near Penninis Head on St. Mary's for long-term habitat monitoring. A number of habitat surveys were performed here as well as at other sites.
- 4) The assessment of water quality around the sewage discharge pipe on St Mary's.

2. Introduction

Lying 40 km south-west of Lands End, the Isles of Scilly are the most westerly land mass of Great Britain, comprising an archipelago of approximately 200 granite islands and rocks separated by a shallow sea. The five main islands - St. Mary's, St. Martin's, Bryher, Treco and St. Agnes - are inhabited, and support farming, fishing and tourist industries.

The combination of physical environment and climate have dictated the very individual composition of the natural history of the Islands. Rare indigenous plants, as well as exotics characteristic of sub-tropical climates, thrive on the Islands. The almost complete absence of traffic and plentiful wind-break hedges and pines, provide ideal conditions for supporting one of Britain's most important areas for bird life.

The shallow, sheltered marine environment surrounding the Islands supports a variety of marine plant and animals that make up some of the most important marine communities to be found in Britain.

So different are the rocky shores of the western Islands that the scientific classification of shore-types had to be extended to include a special category for Scilly - the 'super-exposed'. Below the low-water mark, only those species that are able to withstand periodic inundations of the full force of the Atlantic are able to survive. On the more protected eastern seaboard by contrast, sheltered, deep-water habitats are home to colonies of various delicate species such as sea fans and branching sponges which often have southerly distributions.

At the opposite end of the scale of exposure to the battered western shores, the sea bed inside the archipelago is very sheltered. Sediments derived from the granite bedrock are carried by tides and waves into the sheltered inter-island basin and deposited there.

The relatively coarse local sediments settle rapidly and this, combined with the absence of river-born silts, leaves the water clean and clear. This encourages the growth of plants and algae which require clear waters through which adequate sunlight can pass for photosynthesis. These clear waters encourage the growth of extensive beds of eel-grass (*Zostera marina*) on sandy sediments and fast-growing kelp forests on harder substrata, and are home to some rare algal species.

Although deprived of the nutrient sources that are common to the inshore waters of mainland Britain, the waters around Scilly support a wealth of marine life, including numerous commercial species and an important colony of the Grey Seal (*Halichoerus grypus*).

More exotic visitors include the Basking Shark (*Cetorhinus maximus*), Pilot Whales (*Globicephala melaena*) and even the Killer Whale (*Orcinus orca*). The Common Dolphin (*Delphinus delphis*) and Common Porpoise (*Phocaena phocaena*) are both frequent visitors to the Islands. Records of passing Mediterranean-Atlantic 'vagrants' are not uncommon, and include the Sea Horse (*Hippocampus europaeus*), Trigger-Fish (*Ballistes capriscus*), Blue Marlin (*Makaira nigricans*) and various species of turtle. Not all such vagrants are welcome: the Japanese weed (*Sargassum muticum*) has now taken a firm hold in Scilly and may out-compete indigenous species for available space and sunlight for photosynthesis.

2.1 The Isles of Scilly Environmental Trust¹

The Isles of Scilly Environmental Trust was established in the mid-1980s for the sole purpose of "protecting the beautiful Isles of Scilly and preserving them undamaged and, as far as may be possible, unchanged for the enjoyment and appreciation of this and future generations". All the untenanted land of the Islands (including the uninhabited islands) and most of the Heritage Coast of Scilly has been leased to the Trust by the Duchy of Cornwall and the Trust is mandated to manage and conserve these areas.

¹ Source: "The Isles of Scilly: A Precious Heritage" - an Isles of Scilly Environmental Trust publication.

The archipelago of Scilly has been defined as that group of islands and rocks contained within the fifty metre depth contour (Figure 2.1). This entire area has been declared a Marine Park and has been placed under the management of the Isles of Scilly Marine Park Committee consisting of representatives of the IOS Environmental Trust, the Duchy of Cornwall, the Sea Fisheries Committee and English Nature. It aims to “conserve and protect the ecological, archaeological, historical and environmental heritage contained within the park’s boundaries and ensure its harmonious coexistence with traditional local activities to the mutual benefit of the marine environment, the local community and visitors to the islands”.

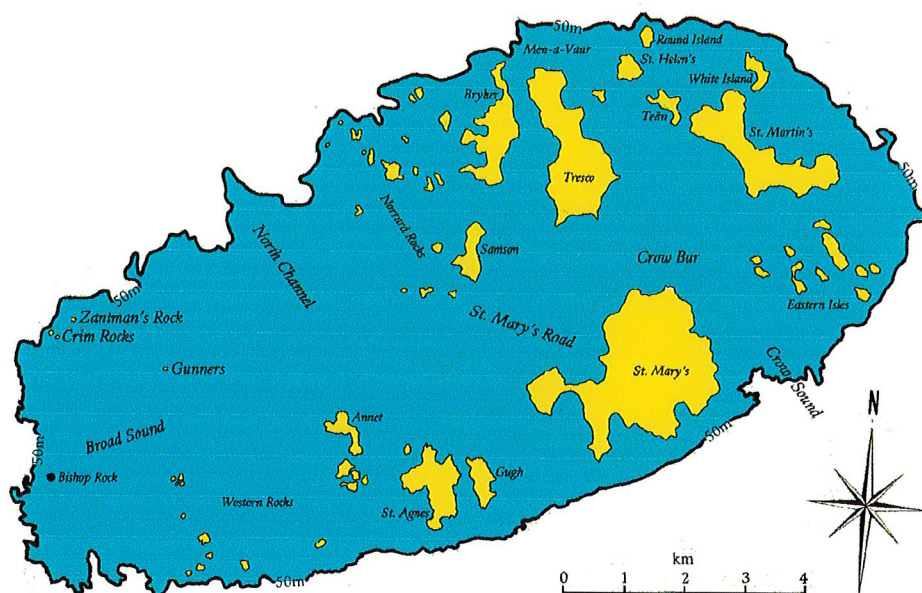


Figure 2.1 - Isles of Scilly Marine Park

The Trust also has an educational and scientific aim - “to control and co-ordinate opportunities and facilities for marine biological study and research, for the guidance, education and enjoyment of all those interested in the marine environment.”

Although Scilly has thus far escaped many anthropogenic disasters such as major oil spills or chemical pollution, an essential component of the Trust’s work is ensuring that the unique coastal resources of the Islands are protected from these potential dangers and the destruction that accompanies insensitive tourism and uncontrolled exploitation. The Trust has published a comprehensive Code of Conduct governing the management of the Marine Park and ensures that this is distributed to all users of the Island’s marine resources, including visiting tourists.

2.2 Coral Cay Conservation

Coral Cay is a UK-Based, non-profit organisation established in 1986. It has undertaken a series of surveys of the unique coastal marine resource associated with the Great Atlantic Barrier Reef of Belize¹, under a Memorandum of Understanding with the Belizian Government. The Reef has come under pressure with the increase of tourism and fishing in Belize.

In order to assist the Government of Belize with initiatives to protect its coastal resources, Coral Cay Conservation recruits teams of over 350 volunteer scientists and divers each year to participate in a systematic survey of the Reef. These volunteers are mainly from the UK and many of them have joined forces under the umbrella of the Coral Cay Conservation Sub-Aqua Club (a branch of the British Sub-Aqua Club) to continue to apply their underwater skill to conservation projects in Britain.

¹ Coral Cay Conservation is also participating in a number of projects in Southeast Asia.

3. The Expedition

Following the successful completion of the 1992 expedition and submission of the report to the Isles of Scilly Environmental Trust, the CCC-SAC was invited to return the following year to undertake further survey work. A project proposal was submitted by Brian Cleator the expedition science officer and duly accepted by both The Isles of Scilly Environmental Trust, and by English Nature for grant support under the Voluntary Marine Nature Reserves Grants Scheme. The work started by the 1992 and 1993 expeditions was continued again in 1994 when CCC-SAC was again invited to return.

3.1 Expedition Team

Many of the team members have been volunteer divers sent out by Coral Cay Conservation to Belize in Central America. There they have received training in underwater survey techniques and marine identification while surveying the Barrier Reef. These divers along with other members of the team all volunteered to give up one or two weeks of their time and finance themselves to take part in this expedition.

The Expedition Team was as follows:

Brian Cleator	Science Officer
Carolyn Tripp	
Cath Downie	
Charles Edelsten	
Charlotte Baker	
Debbie Moore	
Geoff Shaxton	
Gordon Mackenzie	Expedition Leader
Heather Sales	
Hilary Minor	
Ian Lucas	
James Taylor	

John Whittaker	
Kathy Rikards	
Kevan Cook	
Laura Sandford-Johnson	
Liz Cook	
Mark Evans	Diving Officer
Paul Wilson	
Richard Hall	
Simon Waller	
Sue Burton	
Tim Worsfold	
Vicki Billings	

The Expedition was completely self-financed with funds raised solely by fixed contributions from the participating volunteers. Office facilities were provided by the Generics Group of Cambridge and all aspects of expedition planning were co-ordinated by CCC-SAC volunteer divers. Dive boats were provided by John Whittaker of Cambridge BS-AC and by Birmingham University Sub-Aqua Club.

Items of food were kindly donated by Kellogg's Company of Great Britain Limited. The Isles of Scilly Steamship Company generously supported the Expedition by arranging subsidised transportation for equipment and personnel, and accommodation in Scilly was provided by the Board of St. Mary's School. English Nature provided the expedition with the use of an additional boat, the Melza. The Duchy of Cornwall provided mooring in St. Mary's harbour and storage facilities on St. Mary's dock.

The expedition accomplished its survey objectives to schedule and within the allocated budget and each member of the expedition carried out their tasks with enthusiasm and professionalism. With the exception of minor damage to one of the dive boats, all items of expedition equipment functioned faultlessly.

The success of the expedition was largely due to the help and support generously offered by the Duchy of Cornwall's office, Isles of Scilly Environmental Trust and English Nature, to whom we are extremely grateful. We are also indebted to the inhabitants of St. Mary's for their support, encouragement and patience, and for allowing us to share with them the natural beauty of their Isles.

It is hoped that the work presented in this report will contribute towards the continued collaboration between Coral Cay Conservation and the Isles of Scilly Environmental Trust.

4. Monitoring of *Zostera Marina* Sea Grass Beds

4.1 Introduction

Zostera marina (referred to as sea grass, eel grass or, locally, sedge) is the only sublittoral flowering plant found in the British Isles and grows in areas of shallow, wave-sheltered sands (Fowler & Pilley 1992). In the Isles of Scilly the plant grows in extensive beds on the low tide sand flats between the larger islands. These are the most extensive *Zostera marina* beds in south-west Britain and the most important in Britain as a whole in terms of their nature conservation interest, both because of their extent and the particularly rich fauna and flora, including many rarities, associated with the plants (Fowler & Pilley 1992).

Monitoring of the sea grass beds at English Island, SE St Martin's, and at Old Grimsby Harbour, E Treco began in 1984 by the Nature Conservancy Council (NCC) and continued annually (usually in September) until 1988. There was a gap of two years in 1989 and 1990 when no monitoring was undertaken, with a limited study being carried out in 1991 (Fowler & Pilley 1992).

The monitoring programme undertaken by expedition members during June 1995 was designed to continue the investigations carried out during previous CCC-SAC expeditions in 1992 (Raines *et al.* 1993) and 1993 (Cleator *et al.* 1996). From 1984 to 1988 there was no sign of any infection of leaves of individual *Zostera marina* plants. However, during the years 1988 to 1991, the health of the sea grass beds had deteriorated, apparently due to the re-appearance of a parasitic slime mould of the genus *Labyrinthula* sp. (Fowler 1992). Infection of plants by this 'wasting disease', as it is known, during the 1930's and 1940's had caused widespread loss of sea grass plants from many areas (Den Hartog 1987), including the Isles of Scilly beds and other locations in the south-west.

The wasting disease initially manifests itself as small, discrete black lesions on the leaf surface which quickly spread, causing the leaf to die within a few weeks. After two or three seasons of constant leaf loss, the rhizomes will become discoloured and perish (Den Hartog 1989). No definite causative agent has been implemented in this most recent outbreak, though adverse environmental conditions (i.e. alterations in irradiance, temperature and current flow) have been suggested as possible causes (Cleator *et al.* 1996). It is thought that stress may cause a metabolic imbalance in the plant, reducing the production of complex organic compounds which are involved in preventing infection and epiphytism (the growth of other algae on the leaves).

Following on from similar studies which had been undertaken by previous CCC-SAC expeditions to the islands, the purpose of the studies in 1994 was:

- to repeat the counts of plants within a randomly-placed 0.25 m² quadrat, in order to obtain an overall average density of plants within a particular sea grass bed;
- to measure the total number of leaves per plant and the length of each individual leaf;
- to assess the level of infection of each leaf by the *Labyrinthula* slime mould;

4.2 Methods

4.2.1 Survey Locations

A total of three sites were visited during the three weeks of the expedition. Samples had been collected from these sites in previous years - East Higher Town Bay, St Martin's; Chimney Rocks, South-East St. Martin's; and Old Grimsby Harbour, East Treco. The positions of these locations are indicated in Figure 4.1.

4.2.2 Assessment of Sea grass Condition

At each of the main collecting sites, a 0.25 m² (0.5 m x 0.5 m) quadrat made of 15 mm copper piping was placed on the sandy sea bed within the sea grass bed. The exact positioning of each quadrat (up to

a maximum of 24 repeat quadrats were undertaken at each site) was determined by randomly-generated distances (0 to 30 m) and bearings (0° to 359°) from a shot-line located at a central datum point. Pairs of divers swam away from the shot unreeling a measuring tape until the indicated distance was reached. The quadrat was then placed with its left-hand side to the right of the tape. Each quadrat had been divided into quarters by two pieces of line tied to the mid-points of the frame. Using a diving knife or a pair of scissors, plants which lay within one quarter of the quadrat were cut at sea bed level and placed into a polythene collecting bag. It was found it took about an hour for a pair of divers to collect six bags of plant samples.

A number of determinants were then measured:

- Number of plants per sample;
- Number of leaves showing infection;
- Length of the longest leaf per plant;
- Leaf infection score (see Table 4.1)
- The number of flowering stems present

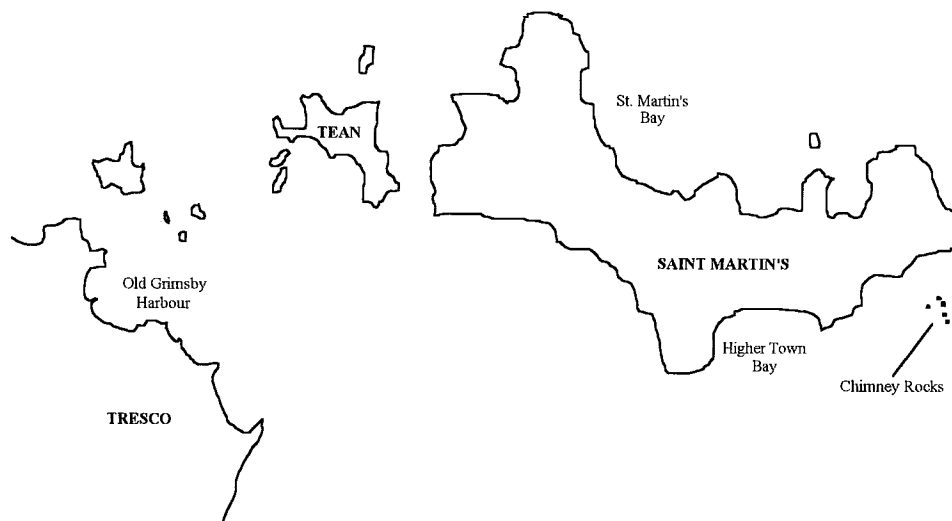


Figure 4.1 - Location of *Zostera* Sampling Sites

4.2.3 Data Analysis

The data was entered onto Excel for Windows spread sheet and analysis carried out as follows: The level of infectivity (i.e. the proportion of infected leaves) was expressed as a percentage of the total number of leaves per plant and the mean infectivity score for each plant. The density of the plants per 0.25m² was also calculated. The following statistical analyses were then undertaken.

- i) One-way ANOVAR on the percentage of infected leaves per plant and the length of the longest leaf to determine whether a significant difference exists between sites.
- ii) Correlation matrix of plant density, mean longest leaf length, and the mean infectivity score, to identify any relationship between: occurrence and extent of infection; the mean density of the plants and mean longest leaf length. The percentage of leaves infected and the infectivity score were also correlated to ascertain the extent of the agreement between the two methods of assessing the level of infection.
- iii) Frequency histograms of longest leaf length to investigate the population structure at the three sites.

In addition the means of all variables were then calculated for each quadrat and for each site.

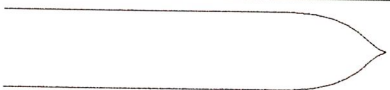
Score		Percentage	Diagrammatic representation of score
0	Uninfected	0%	
1	Some infection apparent	< 10%	
2	Up to half of leaf infected	10 - 50%	
3	Over half of leaf infected	50 - 80%	
4	Almost all of leaf infected	>80%	

Table 4.1 - Leaf infection scoring system

4.3 Results

The sampling program was carried out between July 29 and August 13, 1994. In total 564 plants were sampled from the three sites surveyed. Eighteen quadrats were sampled from Old Grimsby Harbour, fourteen from East Higher Town Bay and seventeen from Chimney Rocks. The overall appearance of the sea grass did not suggest an obvious deterioration from the previous year, although the statistical analysis of the results has indicated increased infection.

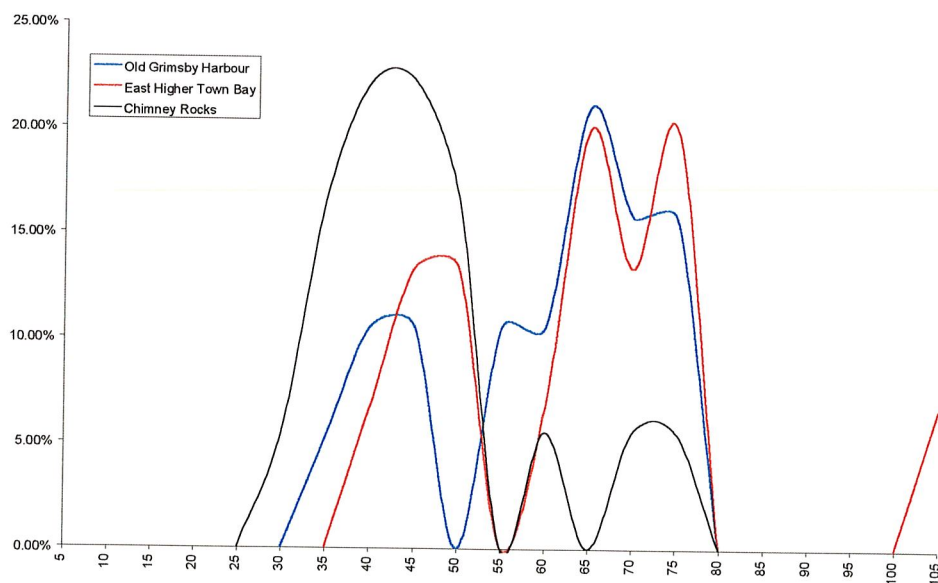


Figure 4.2 - Size Distribution of Longest Leaf

4.3.1 Size Distribution and Plant Density

The size frequency distributions for the three sites are illustrated in Figure 4.2 and together with the plant densities, summarised in Table 4.2. The summary data from each quadrat are detailed in §8.1.

	Old Grimsby Harbour	East Higher Town Bay	Chimney Rocks
Mean Leaf Infectivity Score	1.07	1.71	1.69
Mean % Leaves Infected	56.03%	78.84%	80.47%
Mean Length (and range) of Longest Leaf per Quadrat (cm)	56.84 (31.14 - 74.43)	60.99 (39.42 - 53.5)	44.55 (28.86 - 70.17)
Mean Density (and range) of Plants (per 0.25m ²)	8.83 (3 - 15)	9.64 (4 - 27)	15.00 (6 - 29)

Table 4.2 - Summary of Infection, Mean Longest Leaf Length and Mean Density per Site

The size distribution of plants (as represented by the longest leaf length) is markedly different for each site. Chimney Rocks appears to have approximately normal distribution (Figure 4.2) with a mean of 44.55 and is therefore smaller than Old Grimsby Harbour and East Higher Town Bay that have means of 56.84 and 60.99 respectively. The latter two sites have apparently non-normal distributions (Figure 4.2) with bimodal distributions, with the peak representing the greater leaf lengths being higher than that representing the lesser leaf length and also being truncated.

The results of the one-way ANOVA (Table 4.3) indicate that the Null Hypothesis: 'no significant difference existed between the leaf lengths at different sites' is not supported.

	SS	df	MS	F	P-value	F-Crit
Between Groups	2999.039	2	1499.519	8.060195	0.000941	3.186585
Within Groups	9115.963	49	186.0401			
Total	12115	51				

Table 4.3 - Results of One-Way ANOVA of Length of the Total Leaf Length Between Sites

The mean density of the plants is similar for Old Grimsby Harbour and East Higher Town Bay but differs from Chimney Rocks where the plants grow more densely. Results of the correlation analysis for the length of the longest leaf against plant density for individual sites do not indicate any direct relationship.

Determinant	Density	% Infected	Mean Leaf Length	Mean Infectivity Score
Old Grimsby Harbour				
Density	1.00			
% Infected	0.17	1.00		
Mean Leaf Length	-0.11	0.30	1.00	
Mean Infectivity	0.04	0.70	0.53	1.00
East Higher Town Bay				
Density	1.00			
% Infected	0.02	1.00		
Mean Leaf Length	-0.01	0.41	1.00	
Mean Infectivity	-0.06	0.94	0.46	1.00
Chimney Rocks				
Density	1.00			
% Infected	-0.15	1.00		
Mean Leaf Length	0.28	-0.36	1.00	
Mean Infectivity	0.31	0.73	-0.30	1.00



Significant Positive Correlation

±0.5 - significance level

Table 4.4 - Results of Correlation Analysis

4.3.2 Infectivity

The correlation analysis summarised in Table 4.4 indicates that there is a relationship between the length of the longest leaf and the mean infectivity score for Old Grimsby Harbour.

This table also summarises the correlation between the level of infectivity as measured by the mean leaf infectivity score for each plant and the percentage of each plant's leaves that were infected. This indicates that they are positively correlated for all three sites. Additionally the values for East Higher Town Bay and Chimney Rocks are very similar with values of 78.84%, 1.71 and 80.47%, 1.69 respectively.

The plants at Old Grimsby Harbour appear to be less infected with mean values of 56.03% and 1.07. These differences are apparent in the results of the ANOVAR that tests the Null Hypothesis that: 'no significant difference occurs between the level of leaf infectivity between sites' (Table 4.5). The calculated F-value indicates that the Null Hypothesis has to be rejected.

	SS	df	MS	F	P-value	F-Crit
Between Groups	0.677337	2	0.338668	12.09647	5.37E-05	3.186585
Within Groups	1.371867	49	0.027997			
Total	2.049203	51				

Table 4.5 - Results of One-Way ANOVAR of % Leaves Infected Between Sites

4.4 Discussion

4.4.1 Population Size Structure

The result suggest that plant populations from separate sea grass beds from similar locations, may have a different size structure. This reflects the results in 1993 when the results for East Higher Town Bay had an apparently normal distribution, but with the shortest leaves and range. The longest leaf data (Figure 4.2) indicate that Chimney Rocks has a similar distribution pattern.

Similarly in 1993 Chimney Rocks had a bimodal distribution with the higher peak, representing the longer leaf lengths, being truncated. The results in Figure 4.2 suggest a similar distribution for both Old Grimsby Harbour and East Higher Town Bay.

4.4.2 Infectivity

No significant relationship was found between the length of the longest leaf and the mean infectivity score. Thus it can be concluded that the cause of lesions is not related to leaf size and therefore age of the plant.

The level of infection, as measured by the two methods used, was higher than that recorded during the previous study in 1993 (Cleator *et al.* 1996). Similarly the plant density recorded was significantly less.

The positive correlation at all three sites¹ for the two methods for assessing the degree of infection as measured by the percentage of leaves infected and the mean infectivity scores indicates that they are likely to generate similar results and so in future only one method could be used.

¹ Two sites had similar correlations in 1993

5. Infaunal and Epifaunal Survey

5.1 Introduction

Previous CCC-SAC expeditions had examined the health of the sea grass itself but had not examined the animals living in the surrounding sand (the Infauna) or the animals living on the sea grass itself (the Epifauna). Such a programme of study was undertaken to examine the following:

- infauna and cryptofauna contribute a major, but sometimes overlooked, component of biodiversity of many marine habitats;
- one of the major reasons that sea grass beds are considered to be important¹ is their high productivity and infauna is likely to contribute significantly to this productivity;
- a possible effect of the sea grass wasting disease is the encroachment on the beds by other species such as *Sargassum* - a study of the associated eel grass fauna and that of neighbouring habitats will indicate the likely ecological impact of such a change.

Since this was the first survey of this type carried out by CCC-SAC, the approach taken was to perform a general study of all the above points. The information and analysis can then guide more focused studies in the future.

5.2 Methods

An area around English Island was chosen for the survey (see Figure 5.1). This site presents a good combination of sea grass beds and sand patches and is familiar to CCC-SAC from previous *Zostera* surveys.

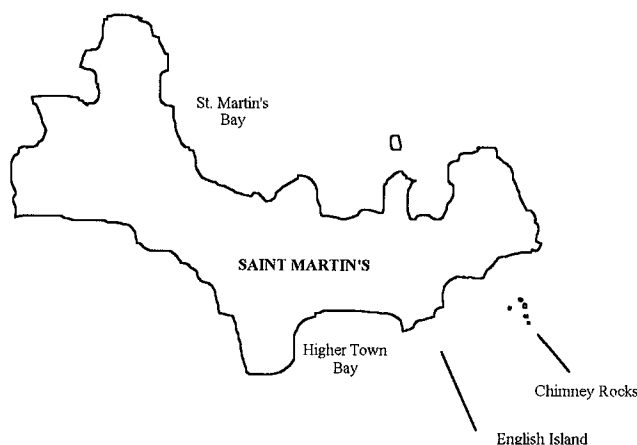


Figure 5.1 - Position of Survey Area

In order to obtain a general picture of the survey area, each sample was taken from a separate site rather than taken several samples from the same vicinity. These sites were chosen by sending divers down a shot line with instructions to swim a pre-allocated random direction and distance until they reached a site with the appropriate characteristics. These characteristics were chosen to include the following types of sample:

- areas outside the sea grass bed;
- areas where the sea grass is sparse;
- areas where the sea grass is dense;

¹ One of the reasons that has been cited in support of the importance of eel grass beds is that they act as fish nurseries - the epifauna and infauna are likely to form an important food source for these nurseries.

- sediment patches within the sea grass bed;
- where possible, habitats that may supersede the sea grass such as *Sargassum*.

The procedure used to retrieve and analyse each sample was as follows:

- the sea grass was removed at the roots from within a 0.1m² quadrat and placed in a plastic bag;
- an 0.018m² core was taken from the centre of the quadrat¹;
- the core samples were fixed as soon as practicable after sampling;
- the sea grass was washed as soon as practicable after sampling and any epifauna found preserved for further examination;
- the sea grass leaves were counted, measured, examined for disease and an overall measurement of volume taken;
- the core samples were sieved using an 0.5mm sieve and sorted and identification performed in the laboratory.

5.3 Results

Although 28 samples were taken, it was not possible to analyse all of them due to the intermittent availability of suitable laboratory facilities. Of the samples taken, half had the species picked out and identified. The results are summarised in §8.2.

5.4 Discussion

From the samples identified and from subjective examination of the other samples, the following tentative conclusions may be drawn:

- the infauna amongst the *Zostera* beds is far richer than that amongst the surrounding sands; the *Zostera* infauna is very diverse and quite numerous;
- the *Zostera* epifauna is also very rich. The epifauna may, however, be less stable than the infauna. The samples taken immediately after a storm contained little epifauna;
- there is a degree of overlap between the infaunal and epifaunal species. I would guess that after storms, the epifauna is recolonised, at least partly, from the infauna.

These results would indicate that further studies would establish a definite correlation between the sea grass beds and the biodiversity of the associated sand area. Any future studies would need to ensure that sufficient laboratory time is available for the analysis of the samples.

¹ Although designed to sample the infauna, this process is bound to collect some epifauna that may have become detached from the *Zostera*.

6. Permanent Monitoring Site

6.1 Introduction

The waters surrounding the Isles of Scilly are noted for their diversity of habitat type and are recognised as being of significant marine conservation importance. The sublittoral communities of the islands were studied by Hiscock in 1983 when 14 community types were identified. Although detailed and extensive, these surveys identified a number of locations that required further or initial investigation. CCC-SAC undertook a number of habitat surveys in 1993 and this showed that volunteer divers were able to identify biologically diverse sites and to identify the major species present.

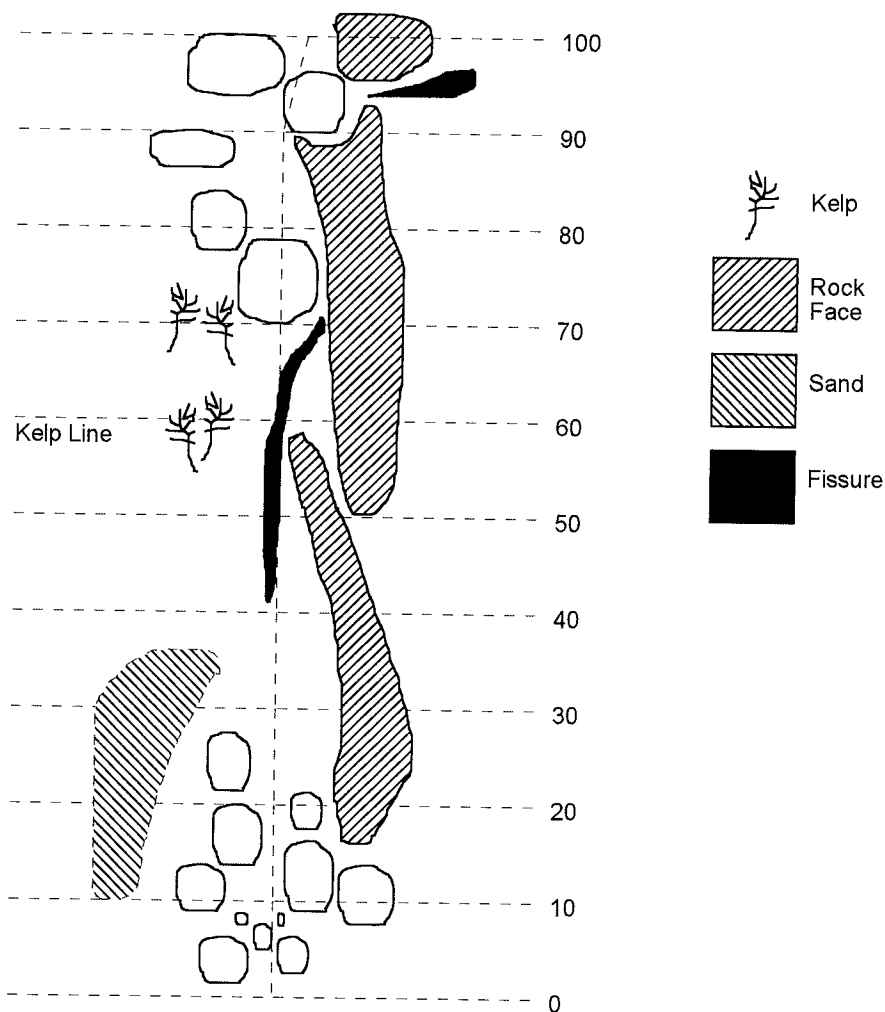


Figure 6.1 - Seabed Topology

A number of sites were surveyed in detail to determine a suitable site for the establishment of a permanent monitoring site (see §8.3). Such a site would allow a small area to be surveyed repeatedly over a period of time with the intention of detecting changes in the fauna and flora present. The surveyed sites were judged by their biological diversity, their depth range and their accessibility to divers both in terms of distance from an appropriate base and by their exposure to tides.

Distance Along Tape			Depth		Description
From	To	Distance	Measured	CD	
0	0	0	-32	-27	Large boulders with smaller ones near tape; small sand particles in between
5	6	5.5	-31	-26	Boulders; large sand gully to left with smaller boulders
7	9	8	-29	-24	Large boulder to right
9	12	10.5	-28	-23	Sand patch to left; steep slope to right and overhanging rock
13	20	16.5	-25	-20	Rock wall (approx. 8m high) to right; sand with small boulders to left
20	25	22.5	-25	-20	Sheer wall to right; large sand gully to left
25	30	27.5	-25	-20	Slight slope upwards
34	36	35	-23	-18	Scattered large boulders; wall continuing on right
36	36	36	-23	-18	Wall continuing on right; cliff on left
40	45	42.5	-23	-18	Slope up, wall on both sides
45	45	45	-22	-17	Narrow cleft below line
50	50	50	-21	-16	Rock surface, flat with covering of sand; start of kelp line
55	55	55	-20	-15	Slope up; steep face on right
60	60	60	-20	-15	Wall on right; boulders over rock surface to left. Cleft below line.
70	70	70	-19	-14	Slope up; more boulders
75	75	75	-17	-12	Sharp drop to cleft on left; wall on right.
80	80	80	-16	-11	Large boulders
85	85	85	-16	-11	Large wall on right; large boulders on left
90	90	90	-16	-11	Large wall on right; large boulders on left
95	95	95	-16	-11	Large wall on right; large boulders on left
100	100	100	-15	-10	Cleft in wall on right; large boulders on left

Table 6.1 - Topological Survey (Cath Downie and Charlotte Baker, 11 August 1994)

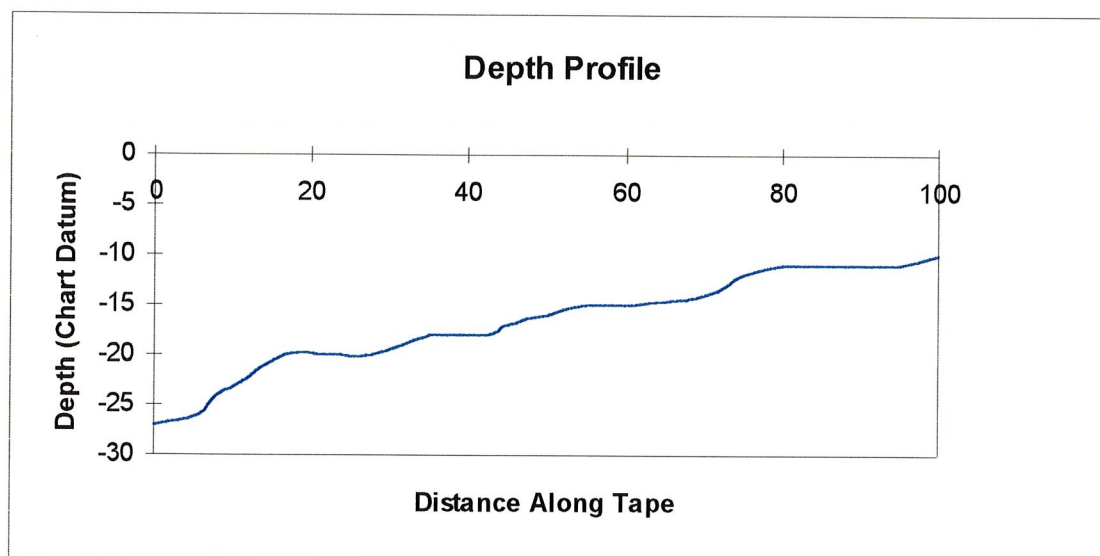


Figure 6.2 - Depth Profile

6.2 Methods

The site was surveyed both physically (Figure 6.1, Figure 6.2 and Table 6.1) and biologically (§8.3) by surveying around a 100m tape measure placed on the sea bed. The physical nature of the site was recorded by observing the substrate type and topology at regular intervals along with the depth of

water. The site was also surveyed biologically a number of times by noting the species present at various points along the tape measure.

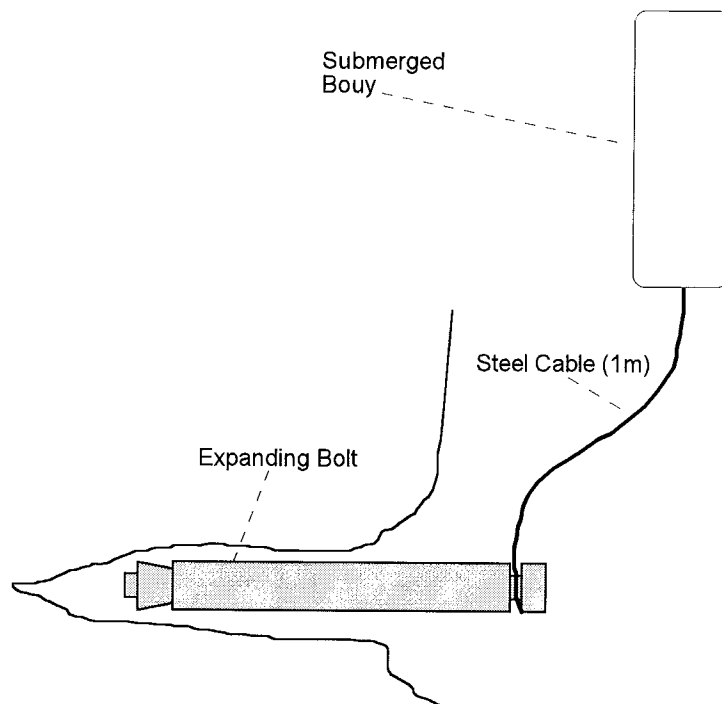


Figure 6.3 - Expanding Bolt Method

Once the surveys were complete a number of techniques were tried to establish permanent markers on the site without damaging the surrounding environment more than absolutely necessary. The first method, illustrated in Figure 6.3, relied on expanding bolts as a way of permanently fixing a small submerged buoy to points along the tape measure.

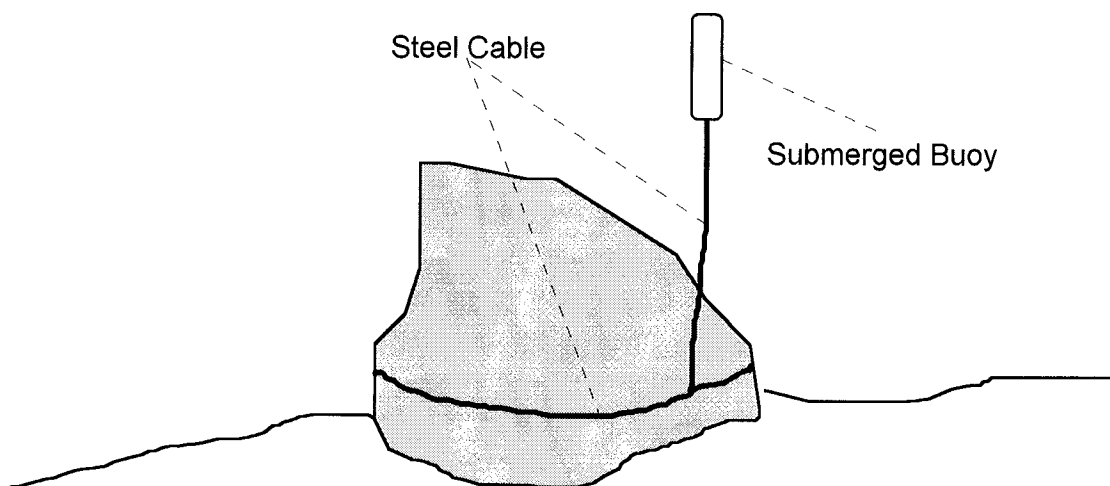


Figure 6.4 - Steel Wire Method

Although bolts of various lengths and diameters were tried, it was found that it was not possible to obtain a reliable fixture to any of the rock faces. This was due to a lack of suitably shaped crevices or holes. Even when an appropriate gap was found the expansion of the bolt tended to crack the rock face well before a good grip was established. This method of attachment was abandoned after a number of attempts.

A more successful method of attachment using wire wrapped around boulders was also tried (Figure 6.4). Wire normally used for yacht rigging and outboard steering mechanisms was used since it is

resistant to salt-water corrosion. The wire was looped around suitable rocks or boulders and attached using U-bolts. A small submersible buoy was then attached by a short length of cable to the loop to assist in relocating the points.

6.3 Results

Based on the results of the habitat surveys as summarised in paragraph 8.3, the site at Peninnis Head was chosen to establish a permanent monitoring site. This site presents a good range of depths from about 30 metres to the surface, is more easily accessible from St. Mary's compared to Gap Point and is less exposed to the tide as the Gilstone. The physical survey revealed a site with a number of different substrate types with both sand and rock being present as illustrated in Figure 6.1. In addition there were a number of vertical and horizontal rock faces with overhangs and fissures being present. Three buoys were attached to rocks as described above.

7. Bacteriological Analysis

7.1 Introduction

Bacteriological analysis of the waters around St Mary's Island was undertaken with the aim of

- a) gaining information on the water quality off bathing beaches and around the sewage outfall near to Morning Point;
- b) assessing the practicalities of using the Delagua water test kit for such surveys.

The main sewage discharge point for St Mary's is just west of Morning Point in the south-west of the island. At the time of sampling, this outfall was in need of repair. There was a large crack in it some 2m from its end. Effluent also periodically overflowed from a manhole cover over the discharge pipe approximately 5m up the beach. A number of other smaller outfalls were also observed around the island (see Figure 7.2 and Table 7.3).

7.1.1 The Oxfam - Delagua Water Test Kit

All analysis was carried out using the Oxfam - Delagua Water Test Kit, kindly lent to Coral Cay Conservation by the Robens Institute, Surrey (Figure 7.1). Using the kit, it is possible to analyse a sample for the presence of thermotolerant (faecal) coliforms. Faecal coliforms may be used as indicator bacteria to measure the amount of sewage pollution in water and to assess the safety of bathing waters. These bacteria occur in large numbers in human faeces, and hence sewage, but are not pathogens themselves. *E. coli*, one species of faecal coliforms, is reported to occur at concentrations ranging from 10^6 to 10^9 per gram of fresh human faeces and can be routinely detected down to a concentration of 1 per 100ml of water. This renders the assessment of the presence of faecal matter, and hence the potential presence of human pathogens, very sensitive indeed. The use of indicator bacteria avoids the need to carry out the many different tests for the range of pathogens that may be present and circumvents the danger involved in growing up large numbers of these pathogens.

Faecal coliforms may be recognised by their ability to produce a colour change, from red to yellow, in a specific culture medium. A known volume of water may be passed through a sterile filter which will catch any bacteria present. The filter may then be grown on a liquid growth medium which feeds coliform bacteria but inhibits other bacteria. To ensure that only faecal coliform bacteria grow, the filter is kept at 44°C. The faecal coliform bacteria then multiply many times to form colonies of bacteria which are visible to the naked eye.

7.1.2 The EC Bathing Waters Directive

The EC Bathing Waters Directive was published in 1976 and brought into UK legislation through the Bathing Waters Regulations in 1988. The Directive has two main objectives: to improve or maintain the quality of bathing waters for amenity reasons and to protect public health. The Directive lists mandatory levels for a number of parameters, the primary ones being faecal and total coliforms. Designated bathing waters must be sampled and analysed and their compliance with named parameters assessed. There are no designated Bathing Beaches within the Scilly archipelago, however, standards from the Directive serve as useful guidelines.

7.2 Methods

7.2.1 Bathing Water Sampling Sites

Samples were taken from a number of sites off Town Beach, Porthmellon Beach and Porthcressa Beach on the 9th August 1994 (Figure 7.2 and Table 7.1). Samples were collected in a sterile sample container from water at a depth of approximately 30cm. At each site, the presence of visible sewage solids was noted and observations of wind speed and direction, sea state, cloud cover and rain were recorded.

7.2.2 Outfall Sampling Sites

Samples were collected in the beach and nearshore vicinity of the outfall (as indicated in Figure 7.2 and Table 7.2) on two occasions. On the 8th August 1994, samples were taken, by foot, near to the point of discharge of the short sea outfall west of Morning Point and from the pool of liquid which had collected in the depression over the manhole cover. On the 11th August 1994, samples were taken some 100m offshore along a transect lying parallel to the shoreline and at 50m intervals from a point opposite the outfall to the west end of Porthcressa Beach. All samples were collected in a sterile sample container.

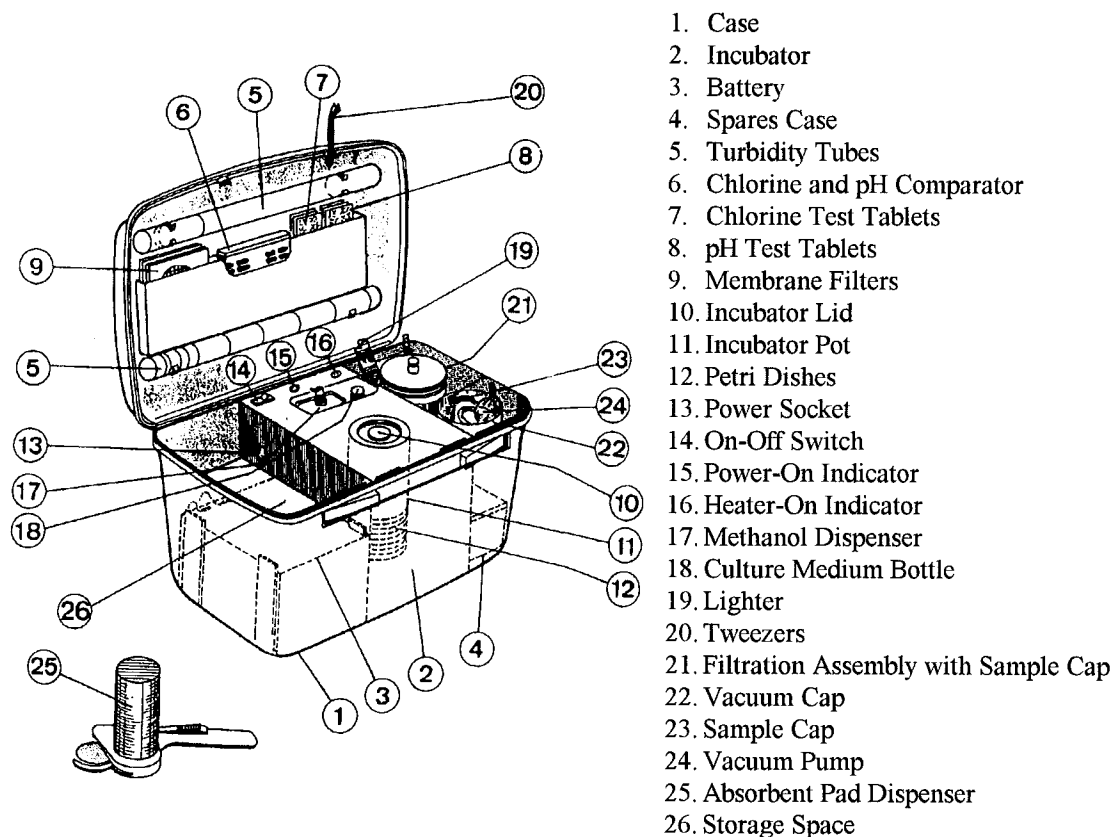


Figure 7.1 - Oxfam - Delagua Water Testing Kit¹

7.2.3 Sample Processing

7.2.3.1 Sterilisation of apparatus

Prior to analysis, all apparatus was sterilised. Both the sample cup and filtration apparatus were dried with a clean towel. The filtration funnel was then secured onto the sample cup on position 2 (see Figure 7.4). This allowed the sterilising agent, formaldehyde gas produced from burning methanol, to penetrate. The methanol was poured into the sample cup and ignited. When almost burnt, the apparatus was placed firmly over the sample cup so that a good seal was formed. The apparatus was then left for at least 15 minutes before a sample was processed.

¹ Diagram of the testing kit are reproduced from the Oxfam-Delagua Portable Water Testing Kit, Users Manual, Revised and Updated Third Edition 1993.

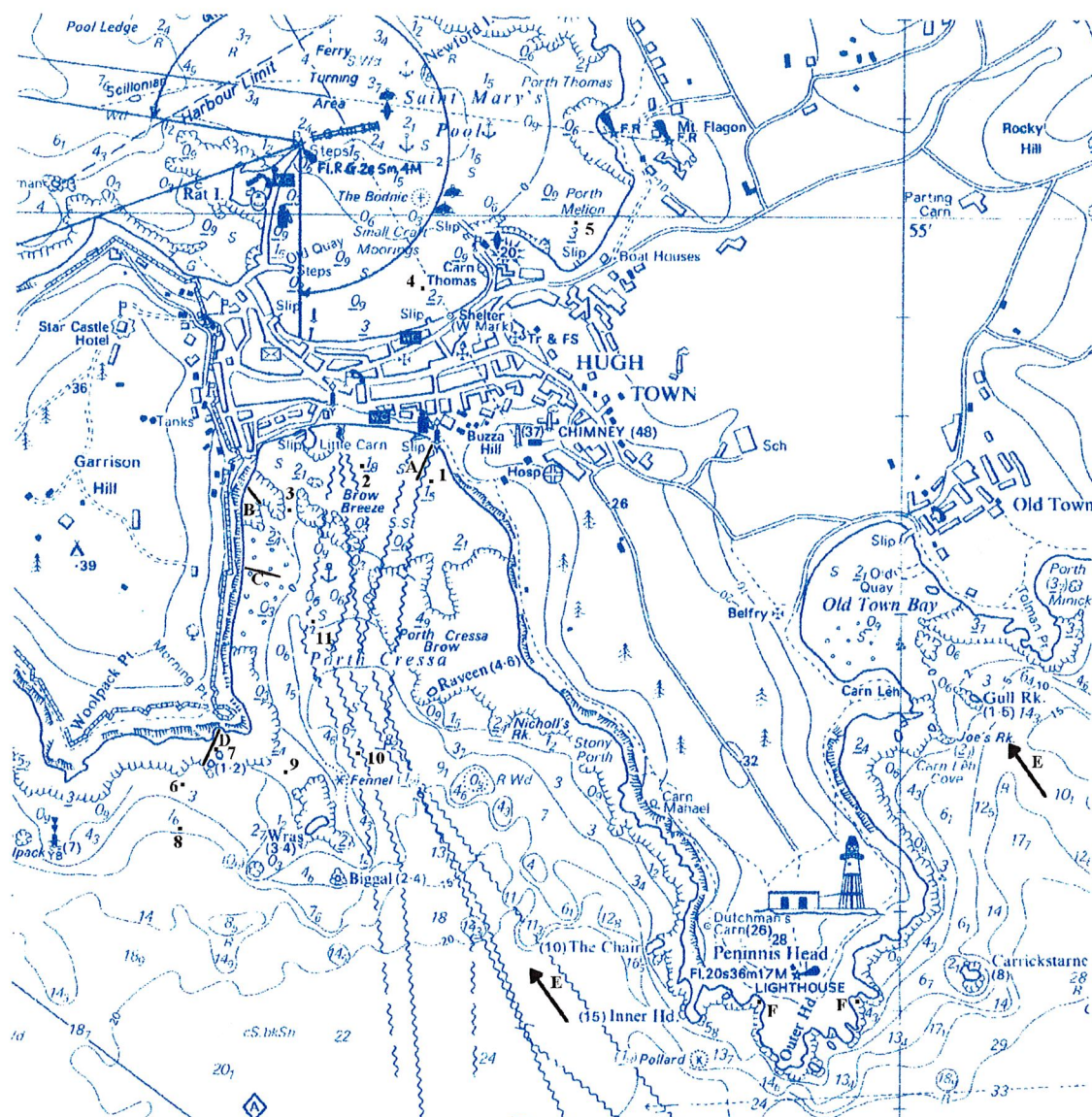


Figure 7.2 - Sample Site and Observation Locations

Sample	Site Location	Approximate Position	
0	Blank (distilled water)		
1	Porthcressa, opposite storm overflow	49°54.73'N	006°18.73'W
2	Porthcressa, by tourist information centre	49°54.75'N	006°18.83'W
3	Porthcressa, west end rocks	49°54.70'N	006°18.95'W
4	Town Beach, jetty opposite Man o' War	49°54.92'N	006°18.75'W
5	Porthmellon, opposite surfing school	49°54.99'N	006°18.51'W

Table 7.1 - Location of Bathing Water Sampling Sites

Sample	Site Location	Approximate Position	
6	Next to main sewage outfall, west of Morning Point	49°54.45'N	006°19.10'W
7	Discharge from manhole cover, main sewage outfall	49°54.48'N	006°19.05'W
8	Opposite sewage outfall, west of Morning Point	49°54.38'N	006°19.12'W
9	50m east of outfall	49°54.44'N	006°18.95'W
10	Morning Point	49°54.40'N	006°18.84'W
11	Porthcressa, west end	49°54.59'N	006°18.91'W

Table 7.2 - Location of Outfall Sampling Sites

Observation	Description
A	Storm Drainage from Filling Station and Launderette, some smell
B	Old broken pipe capped near shore
C	Concrete covered pipe (Capped) possibly with a tap inside Garrison Wall
D	Main sewage outlet
E	Wind direction
F	Two manhole covers (tap inside), almost dry. No smell.

Table 7.3 - Outfalls Observed on St. Mary's

7.2.3.2 Preparation of culture medium

Membrane Lauryl Sulphate Broth is provided in powder form. This powder was placed in a beaker and 500ml de-ionised water (available from the local chemist) was added. The mixture was heated until the powder had dissolved. The liquid was poured into polypropylene bottles provided in the kit. All bottles were sterilised in an autoclave at 121°C for 10 minutes. Bottles may be sterilised using a pressure cooker or by boiling in a pan of water. Alternatively, media may be made prior to use and stored unopened in a cool, dark place for several months.

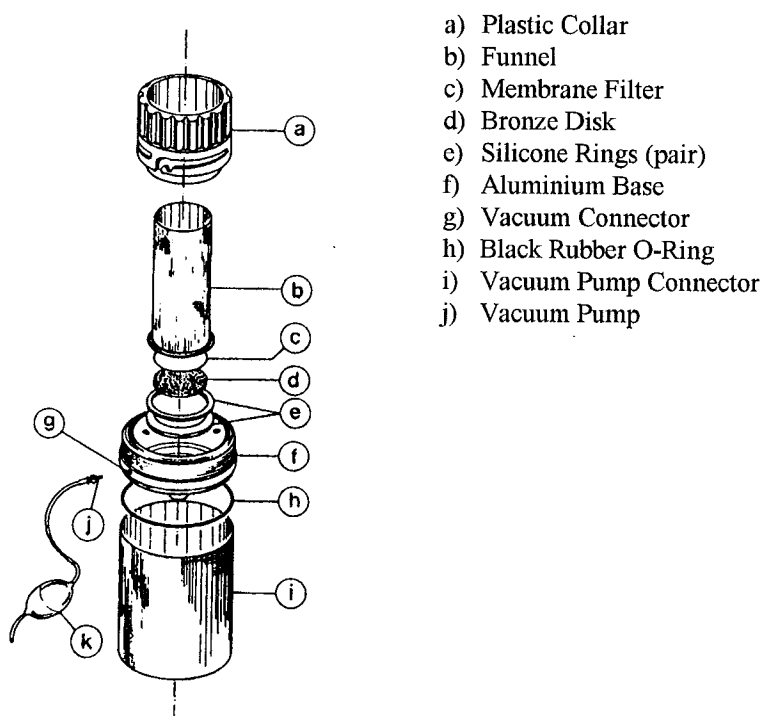


Figure 7.3 - Filtration Apparatus and Components

7.2.3.3 Preparation of petri dishes

Petri dishes were cleaned by plunging them into boiling water for 15 minutes. Water was poured from the dishes which were assembled while still hot. Once the dishes had cooled, one absorbent pad was placed in each dish using the sterile pad dispenser provided. Enough culture medium was then poured onto each pad to soak the pad and leave slight excess.

7.2.3.4 Sample analysis in the field

Firstly, the tweezers provided were sterilised using a lighter and placed in the holder in the kit. The filtration apparatus was then removed from the sterile filtration cup and placed firmly onto the vacuum cup (Figure 7.3). Using the sterile tweezers, a sterile membrane filter was placed over the bronze disc filter support within the filtration apparatus. The funnel and collar of the filtration

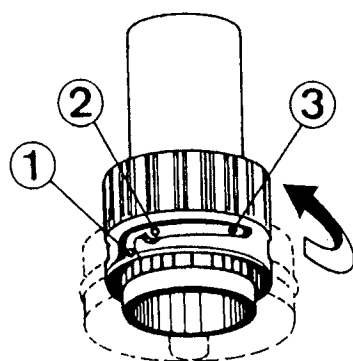
apparatus were then replaced immediately to reduce the risk of contamination, and the plastic collar screwed down to hold the membrane and provide a water tight seal. Each sample was poured into the filtration apparatus up to the appropriate mark, 10, 50 and 100ml lines were engraved on the inside of the funnel, depending on the dilution required. As samples were taken around a sewage discharge, dilutions of 1ml or less were required. One ml syringes were employed and samples were diluted by up to 100 times (*Figure 4*). The vacuum pump was then attached to the apparatus and the pump bulb squeezed several times in order to draw the sample through the membrane. When all the water had passed through the filter, the pump was disconnected, the filtration collar lifted and, using the tweezers, the membrane filter was removed and placed in one of the broth-soaked pads within a petri dish, taking care that no bubbles were trapped within the membrane. The dish was then labelled with both site and volume filtered.

All samples were incubated within the kit at 44°C +/- 0.5°C for 16-18 hours. The kit may run off the mains electricity supply, an internal or an external battery.

7.2.3.5 Counting Colonies

Once the incubation period was complete, the yellow colonies, i.e. the faecal coliforms, on each membrane were counted. The counts were then converted into counts per 100ml and recorded onto results sheets. All contaminated materials such as used membranes and pads were then disposed of by incineration.

Information on calibration of the incubator, care and maintenance of the kit and fault finding are clearly documented in the Users Manual. The kit also provides apparatus for measuring residual chlorine and pH for use on drinking water.



- 1) Completely Free - The apparatus can be dismantled when in this position.
- 2) Loose but not free - all interior surfaces are exposed to the atmosphere. This is the position used when sterilising the apparatus.
- 3) Fully tightened - the funnel forms a tight hermetic seal between the membrane support and the membrane filter. This is the position for filtration.

Figure 7.4 - Collar Positions

7.2.3.6 Sample Contamination

In order to assess the degree of contamination arising during sampling and analysis, a sample of de-ionised water was analysed by the same methods, under the same conditions and incubated along with all other bathing water samples.

7.3 Results

7.3.1 Bathing Waters

Results of analysis of the bathing waters at Town Beach, Porthmellon and Porthcressa are shown in Table 7.5. Where values for two dilutions have been obtained, the geometric mean of the values has been calculated.

Counts of faecal coliforms from the waters off Town Beach were well below mandatory standards required by the EC Bathing Water Directive (Table 7.4) whilst those from Porthmellon Beach were below both mandatory and guideline standards. There was no evidence of sewage solids on either beach

In contrast, counts from all three sites sampled off Porthcressa beach were higher, those from the west end rocks around 4 ½ times, than mandatory levels. All sites were littered with sanitary products, cotton buds, paper and other sewage related debris ().

Data on tidal state and wind strength and direction show that sampling at this beach was undertaken around high water in moderately strong ESE winds. The high counts and visible evidence of sewage pollution probably resulted from sewage released at the outfall near to Morning Point being carried inshore. Discharges from a household waste pipe noted to the east side of the beach will also have contributed to bacterial load within the bay.

No colonies were found on the plate where ionised water only had been filtered, indicating that samples were analysed without contamination.

7.3.2 Comparison of CCC analysis with that from South West Water

Water samples were taken by South West Water (SWW) and analysed for faecal coliforms some 3 weeks prior to the sampling carried out by CCC. Counts found by CCC from analysis of waters from Porthmellon Beach were similar to those found by South West Water (§8.4). In contrast, counts from Porthcressa Beach differed greatly, counts found by CCC being some 1000 times greater than those found by South West Water.

This difference may be due to sampling time. Samples taken by SWW were collected on an early ebb tide whereas those collected by CCC were taken on the late ebb, i.e. when effluent from the Morning Point outfall would be carried inshore. Weather conditions at the time of SWW's sampling are not known.

Parameter	'I' value	'G' value
Faecal coliform count per 100ml	2000	100
	T value - imperative value	
	'G' value - guideline value	

Table 7.4 - Bacteriological water quality standards - EC Bathing Waters Directive (76/160/EEC)

7.3.3 Beach sampling around the outfall

Observation revealed that the outfall west of Morning Point discharged constantly for around 6 minutes at 11 minute intervals. Such discharges were noted at all states of the tide. Sewage appeared to be macerated however sanitary products, paper and sewage solids were clearly visible both in the water around the point of discharge and in the rock pools either side of the discharge pipe.

Counts of bacteria both around the outfall and at the manhole were very high (see Table 7.6).

7.3.4 Inshore sampling around the outfall

Owing to the low number of petri dishes which may be incubated at one time (sixteen), the kit was found to be unsuitable for inshore bacteriological sampling as it stands. The results obtained (see Table 7.7) do not provide any useful information. For the plume from the outfall to be traced, a number of sites need to be sampled at different states of the tide and in varying wind conditions. Furthermore, in order to ensure readable counts on any one plate taken at a particular site, each sample must be subject to a number of dilutions. Kits which allow processing of a larger number of samples at any one time would be required for such surveys.

7.4 Discussion

7.4.1 Bacteriological analysis

Concentrations of faecal coliforms in the waters off the two beaches apparently used for recreational purposes, Porthmellon and Town Beach, were found to be well below mandatory levels laid down by the EC Bathing Waters Directive (76/160/EEC). Counts of faecal coliforms from waters sampled off

Porthcressa Beach were found to be around 4½ times above mandatory EC Standards when sampled at high water and in a ESE wind.

7.4.2 Use of the kit

The Delagua Test Kit was found to be easy to use and the instructions allowed samples to be processed by non-scientists, i.e. Coral Cay volunteers. The kit enabled credible results to be obtained where spot samples only were needed, i.e. for the analysis of bathing waters. The use of the kit in more complex outfall surveys was found to be very limited due to the fact that only 16 samples could be processed on any one occasion.

Site ¹	Time	Wind direction	Wind strength	Swell ²	Cloud cover ³	Presence of sewage solids or detritus	Faecal coliforms (presumptive)		
							Volume filtered (ml)	Count	Count/100ml
0	N/A	N/A	N/A	N/A	N/A	N/A	100	0	0
1	18:35	ESE	6-7	mod-strong	8/8 (rain)	Littered with sanitary products, cotton buds, plasters etc.	0.1	0	4400
							1	44	
							10	TNC	
2	19:05	ESE	6-7	mod-strong	8/8 (rain)	as above	0.1	0	2000
							1	20	
							10	TNC	
3	19:36	ESE	6-7	mod-strong	8/8 (rain)	as above	0.1	14	8700
							1	55	
							10	TNC	
4	21:45	ESE	2-3	slight	8/8	No sewage solids seen	1	12	730
							10	44	
							100	TNC	
5	22:15	ESE	2-3	slight	8/8	No sewage solids seen	1	0	20
							10	0	
							100	20	

Table 7.5 - Sample Sheet, Date: 9th August 1994, Samplers: CCC, HW: 19:08, LW: 13:09 (BST at St Mary's), Beach/Boat: Beach

¹ Site number are as in Table 7.1

² None, slight, moderate, strong

³ This is expressed as eighths of full cover

Site ¹	Time	Wind Direction	Wind Strength	Swell	Cloud cover	Presence of sewage solids and detritus	Faecal coliforms		
							Volume filtered (ml)	Count	Count/100m
0	N/A	N/A	N/A	N/A	N/A	N/A	100	0	0
6	15:00	E	3-4	Moderate	8/8	Rocks littered with sanitary products, cotton buds, plasters etc.	0.01	13	100000
							0.1	78	
							1	TNC	
7	15:30	E	3-4	Moderate	8/8	as above	0.01	2940	29000000
							0.1	>1000	
							1	TNC	

Table 7.6 - Sample Sheet, Date: 8th August 1994, Samplers: CCC, HW: 18:25, LW: 12:28 (BST at St. Mary's), Beach/Boat: Beach (main sewage outfall)

Site	Time	Wind Direction	Wind Strength	Swell	Cloud Cover	Faecal coliforms	
						Volume filtered (ml)	Counts/100ml
8	09:30	N	2-3	slight	8/8	10	30
9	10:27	N	2-3	slight	8/8	10	-
10	11:10	N	2-3	slight	8/8	10	20
11	11:00	N	2-3	slight	8/8	10	-
8	12:00	N	2-3	slight	8/8	1	-
9	12:55	N	2-3	slight	8/8	1	-
10	13:20	N	2-3	slight	8/8	1	-
11	13:45	N	2-3	slight	8/8	1	-

Table 7.7 - Sample Sheet, Date: 11th August 1994, Samplers: CCC, HW: 08:11, LW: 14:23 (BST at St. Mary's), Beach/Boat: Boat (Melza)

¹ Site numbers are as in Table 7.2

8. Appendices

8.1 Zostera Quadrat Summaries

8.1.1 Old Grimsby Harbour

Quadrat	No. Leaves	No. plants/0.25m	No. Infected	No. Uninfected	% Infected	Total Length	Mean Leaf Infection Scores
A	3.67	6	2.17	1.50	63.33%	39.33	1.20
B	4.14	7	2.43	1.71	59.29%	57.71	0.90
C	4.27	15	3.40	0.87	80.00%	62.60	1.52
D	3.00	11	0.64	2.09	19.70%	51.55	0.61
E	4.78	9	2.00	2.78	38.06%	37.33	0.84
F	3.57	14	1.86	1.71	54.29%	31.14	0.84
G	4.00	7	1.86	2.14	45.48%	74.43	1.40
H	4.00	6	1.67	2.33	41.11%	42.50	0.84
I	4.57	7	1.86	2.71	40.71%	41.14	0.54
J	4.33	3	2.00	2.33	45.00%	68.67	0.92
K	4.33	6	3.17	1.50	74.17%	64.83	1.60
L	3.91	11	2.45	1.45	60.76%	72.36	1.11
M	4.00	8	2.50	1.50	62.50%	64.13	1.44
N	5.43	7	3.29	2.14	59.73%	73.00	1.20
O	4.54	13	2.23	2.31	50.38%	69.08	1.23
P	3.89	9	2.22	1.67	58.52%	68.00	0.78
Q	3.85	13	2.54	1.31	69.87%	54.62	1.05
R	4.71	7	3.29	1.43	69.76%	60.14	1.19
Grand Mean	4.11	8.83	2.31	1.79	56.03%	56.84	1.07

8.1.2 East Higher Town Bay

Quadrat	No. Leaves	No. Plants/0.25m	No. Infected	No. Uninfected	% Infected	Total Length	Mean Leaf Infection Scores
A	3.78	27	2.63	1.15	73.02%	70.26	1.49
B	4.86	7	4.00	0.86	83.81%	56.71	1.83
C	4.08	12	3.75	0.33	92.92%	39.42	2.01
D	4.00	7	2.00	2.00	53.57%	63.29	0.79

Quadrat	No. Leaves	No. Plants/0.25m	No. Infected	No. Uninfected	% Infected	Total Length	Mean Leaf Infection Scores
E	4.50	4	1.75	2.75	32.08%	42.50	0.53
F	4.38	8	4.00	0.38	91.88%	69.50	2.00
G	3.45	11	2.09	1.36	72.42%	66.91	1.53
H	4.50	6	4.17	0.33	93.33%	102.00	2.55
I	4.20	10	2.90	1.30	69.17%	44.00	0.90
J	4.30	10	1.90	2.40	41.67%	47.10	0.47
K	3.11	9	3.00	0.11	96.30%	47.89	2.72
L	5.25	8	5.25	0.00	100.00%	70.63	2.14
M	4.60	5	4.60	0.00	100.00%	74.20	2.71
N	3.73	11	3.73	0.00	100.00%	61.09	2.71
Grand Mean	4.07	9.64	3.16	0.92	78.84%	60.99	1.71

8.1.3 Chimney Rocks

Quadrat	No. Leaves	No. Plants /0.25m	No. Infected	No. Uninfected	% Infected	Total Length	Mean Leaf Infection Scores
A	3.28	18	3.22	0.06	98.61%	35.11	2.06
B	3.43	7	3.43	0.00	100.00%	28.86	1.69
C	3.17	6	1.83	1.33	55.56%	39.83	0.61
D	3.67	12	2.50	1.17	67.36%	70.17	1.08
E	3.92	13	1.92	2.00	48.08%	57.77	0.89
F	3.64	25	2.88	0.76	79.20%	66.40	1.48
G	3.72	29	3.28	0.59	89.08%	49.14	1.54
H	3.93	15	3.07	0.87	80.56%	36.13	1.14
I	4.60	10	4.00	0.60	87.33%	45.60	1.67
J	3.73	11	2.82	0.91	75.15%	40.27	1.37
K	4.20	15	3.47	0.73	83.33%	41.93	1.63
L	4.77	13	3.46	1.31	72.31%	32.08	1.45
M	4.15	13	3.00	1.15	74.49%	31.23	1.71
N	3.77	22	2.64	1.36	71.06%	34.95	1.81
O	4.18	11	3.09	1.09	74.24%	43.45	1.88
P	3.94	16	3.88	0.06	98.44%	35.50	2.90
Q	4.42	19	3.89	0.53	89.12%	47.37	2.64
Grand Mean	3.91	15	3.12	0.82	80.47%	44.55	1.69

8.2 Infauna Sample Results

8.2.1 Infauna Species

Sample (CCZB-)	94-8	94-12	94-18	94-22	94-44	94-51	94-54	94-59
Pick by	TW	SB	SB	TW	SB	SB		SB
Identification by	SB	SB	SB					SB
Volume Rhizome	10			46				9
Volume Organic Debris	20		10	110	1			13
Zostera Pair	94-7	94-9	94-17	94-23				94-60

Species	Total	Total	Total	Total	Total	Total	Total	Total
<i>Ampelisca diadema</i> ?		1						
<i>Aonides</i>							8	
<i>Malacoceros</i>		1						
<i>Spio</i>			75					
<i>Amelisca</i>	1							
<i>Amphipholis squamata</i>								1
<i>Aora gracilis</i>	3							
<i>Aricidea minuta</i>	1	2	1		1			
<i>Atylus</i>								1
<i>Porcellidium</i>				32				
<i>Bodotria scorpiodes</i>	5							
<i>Capitella</i>					1			
<i>Caulleriella zetlandica</i>	1							
Copepoda+A46	1							
<i>Dexamine spinosa</i>			2					
<i>Exogone hebes</i>	9	8	24		3			6
<i>Fabulina fabula</i>			1					
<i>Helcion pellucidum</i>								1
<i>Lacuna parva</i>								1
<i>Lucinoma borealis</i>			1					
<i>Magelona filiformis</i>		1						
<i>Malacoceros fuliginosus</i>			3		1			
<i>Microdeutopus stationis</i>			2					
<i>Moerella donacina</i>			1					
Nematoda	5		46	3	48		45	4
<i>Notomastus</i>				2				
<i>Ophryotrocha</i>								1
<i>Pariambus typicus</i>	6			4				
<i>Pectinaria auricoma</i>			1					
<i>Perioculoides longimanus</i>	1	1						
<i>Phyllodoce mucosa</i>	18	2	11	10	8	1	12	7
<i>Platynereis dumerilii</i>	3		3	1	5		70	2
<i>Rissoa interrupta</i>	12							
<i>Scoloplos armiger</i>			2	1	4			
<i>Spio armata</i>	9							
<i>Spio martinensis</i>		41		154	48	51		71
<i>Streptosyllis websteri</i>	1							
<i>Tubificoides benedii</i>								
<i>Tellimya ferruginosa</i>		1						
<i>Timoclea ovata</i>			1					
<i>Tubificoides bendii</i>				13				1
<i>Tubificoides pseudogaster</i> agg.				13				1
<i>Urothoe pulchella</i>	1							

8.2.2 Zostera Species

Sample (CCZB-)	94-7	94-17	94-31	94-23	94-58	94-60
Pick by	TW		SB	SB	TW/TB	TW
Identification by	TW		TW	TW	TW	TW
Volume Zostera Leaves	10	14	20	10	10	20
Volume Zostera Plants	80	50	45	80	73	100
Length of Stalk	143	120	179	207		
Infaua Pair	94-8	94-18	94-30	94-24		94-59

Species	Total	Total	Total	Total	Total	Total
Copepoda	1					
<i>Amphithoe gammaroides</i>					4	
<i>Ampelisca</i>						1
<i>Amphithoe ramondi</i>	2				2	5
<i>Amphipholis squamata</i>		3		1		
<i>Anemonia viridis</i>				1		
<i>Abludomelita obtusata</i>						
<i>Autolytus</i>				1		
<i>Aora gracilis</i>	2	7	2			
<i>Aplysia</i>					1	
<i>Bodotria scorpioides</i>	1					
<i>Grania clavata</i>	1					
<i>Capitella</i>		1				
<i>Caprella acanthifera</i>	1	1			1	
<i>Cuthona</i>				2		
<i>Cymodoce truncata</i>	1					
<i>Dexamine spinosa</i>	9	24				
<i>Dexamine thea</i>	2		1			
<i>Eatonina fulgida</i>	4	3			1	
<i>Erichthonius difformis</i>	3				2	6
<i>Erichthonius punctatus</i>		3	2	1		
<i>Eumida bahusiensis</i>		1				
<i>Haliclystus auricula</i>		1	1	1		
<i>Harmothoe</i>		2	1			
<i>Helcion pellucidus</i>	24	1	7	10	26	7
<i>Heteranomia squamata</i>	1	1	1	2		
<i>Idotea</i>		2				
<i>Jassa falcata</i>	21	4	6		11	
<i>Lacuna parva</i>	16	6		76	16	13
<i>Limapontia capitata</i>		1		3		
<i>Lucernariopsis campanulata</i>			1			
<i>Microdeutopus stationis</i>		2				
<i>Modiolus modiolus</i>				1		
Nematoda						1
Nemertea	3	3	4	7	3	
<i>Nicolea zostericola</i>		2			2	
<i>Odontosyllis gibba</i>	1	1				
Ostracoda		1				
<i>Pionosyllis compacta ?</i>	16	2	2	27	1	
<i>Platynereis dumerilii</i>	17	14	12	13	111	8
<i>Porcellidium</i>	28	19	4		33	16
<i>Rissoella diaphana</i>	7			3		
<i>Rissoa interrupta</i>	696	203	12	1655	2	15
<i>Rissoa parva</i>	25	18	2	9		4
<i>Spio</i>		3				

<i>Stenothoe monoculoides</i>	4		2			
<i>Tricolia pullus</i>		1	1	1		
<i>Turbellaria</i>	13	7	5	13	8	1
<i>Turbellaria</i> (in eggs)					9	

? eggs		1		8		
? Epifauna	F					
Algae debris (mainly <i>Asparagopsis</i>)			R			
<i>Asparagopsis</i> (fl)		10ml				
(fl) <i>Asparagopsis armata</i>				C		
Big debris (stalks etc.)		9ml				18 ml
Calcareous Red algae		F				
<i>Celleporella hyalina</i> (on <i>Zostera</i>)	R	R		R		
Campanulariidae					P	
<i>Ceramium</i>				R		
<i>Ceramium</i> (epi)	F					
<i>Ceramium</i> (fl)	3ml					
<i>Ceramium rubrum</i> (epi)		0				
<i>Chondrus crispus</i> (fl)		3ml				
Debris			R	5ml		
Debris (in <i>Asparia</i>)	5ml					
Didemnidae (epi)	R					
Encrusting red algae				R		
Filamentous green (epi)	O					
Filamentous red algae (epi)	F					
Foliose green algae				R		
<i>Hinia reticulata</i> eggs		4	R	4		
<i>Laminaria saccharina</i>						
Fine debris (small particles)		4ml				5ml
<i>Membranipora membranacea</i> (on <i>Lam sac</i>)		5ml				5ml
Polyclinidae		1	10ml			
<i>Ulva lactuca</i> (fl)		12ml	5ml			

(fl) - floating, unattached

(epi) - epifauna, attached

8.3 Habitat Surveys

Number	Site	Date	Time	Divers	Depth	Range	From Coordinates	To Coordinates
1	Gilstone	01-Aug		Paul, Time, Geoff	20	24		
2	Gilstone	01-Aug	15:00	Kevan, Hilary		20		
3	Gilstone	01-Aug	09:40	Kevan, Hilary	25	25		
4	Gilstone	01-Aug	11:00	Simon, Richard	0	25		
5	Gap Point							
6	Gap Point	03-Aug	10:00	Charles, Vicki	6	22		
7	Gilstone	05-Aug	11:30	Heather, Vicki	6	24.5		
8	Gilstone	01-Aug	15:30	Liz, Geoff, Mark	12	20		
9	Gilstone	01-Aug	11:00	Liz, Mark	19	25		
10	Gap Point	03-Aug	11:24	Kevan, James	7	17		
11	Gilstone	04-Aug	15:00	Liz, James	16	21		
12	Peninnis Head	06-Aug		Laura, Richard	5	24		
13	Peninnis Head	06-Aug	09:45	Simon, Ian	0	27		
14	Gilstone	06-Aug	09:30	Liz, Paul	0	23		
15	Peninnis Head	07-Aug	09:55	Kevan, Carolyn	6	28		
16	Peninnis Head	07-Aug	12:00	Liz, John	8	28	49° 54.15'N 06° 18.50'W	
17	Peninnis Head, near the Chair	08-Aug	09:30	Richard, Ian, Carolyn	10	30		
18	Peninnis Head	08-Aug	12:10	Paul, Richard, Cath	20	20		
19	Peninnis Head	04-Aug		Laura, Simon	0	28		
20	Inner Gilstone	04-Aug	17:00	John, Vicki	6	22		
21	Peninnis Head, South of Lighthouse	06-Aug		Brian	6	23		
22	Peninnis Head	07-Aug	10:20	Gordon, Cath, Kathy	8	30		
23	Peninnis Head	07-Aug		Charlotte, Hilary	24	29		
24	Inner Head	07-Aug	10:20	Liz, John	14	27	49° 54.19'N 06° 18.35'W	49° 54.26'N 06° 18.33'W
25	Peninnis Head, South of Caen Mahael	08-Aug	10:45	Gordon, Simon	12	23		
26	Peninnis Head, South of Caen Mahael	08-Aug		Charlotte, Cath	21	25		
27	Peninnis Head, South of Caen Mahael	08-Aug		Laura, Kevan	10	21.5		
28	Peninnis Head	06-Aug	09:45	Gordon, Debbie	6	29		

Date and Time:	1 August	Site 1:	Gilstone Rock
Divers:	Paul, Time, Geoff	Depths:	20-24m
Position on Rockface:	South West Face		
Weather and Notes:	Rough		

Physical Description:

Vertical, smooth cliff face leading to rocky bottom, joining very smooth face on west.

Biological Description:

Mainly plumose and jewel anemones. Jewel anemones dominant on smooth face and plumose on rough face. Hydroid-bryozoan turf around anemones with fine foliose and filamentous algae. Shallow water with *Laminaria digitata* and hyperborea and echinus and foliose algae. Rocky bottom with plumose anemones and fine algae with hydroids-bryozoa.

Date and Time:	1 August, 15:00	Site 2:	Gilstone Rock
Divers:	Kevan, Hilary	Depths:	20m Maximum
Position on Rockface:	Seaward, South-westerly side		
Weather and Notes:	Slight swell - intermittent drizzle.		

Physical Description:

Rock slopes up to around 17m then deep drop-off with no shelf. Entry point close to west side of rock - slopes to near vertical drop off to 17m which then slopes deeper. Several gullies. Visibility approximately 5m.

Biological Description:

To approximately 17m large quantities of kelp with red and green seaweed growing on rocky substrate. Below this, rock face cut by gullies and crevices. Below kelp lines, vertical faces encrusted with jewel anemones.

Date and Time:	1 August, 9:40	Site 3:	Gilstone Rock
Divers:	Kevan, Hilary	Depths:	25m
Position on Rockface:	Seaward Side		
Weather and Notes:	Moderately heavy swell, Overcast sky clearing.		

Physical Description:

Gilstone rock shelves down to approximately 17-20m, then drops to 25m to a rock shelf and then a further drop of 4-5m to a large, boulder strewn area. The rock is cut by gullies. Swam from East face, eastwards, then circled North onto pillar that rose from around 20m to around 12m. Visibility approximately 10m.

Biological Description:

Down to approximately 17m there is much kelp. On the rocks where the growths of red and brown seaweed. On this dive we located a sheer, vertical rock face, dropping to 25m on to a rock ledge. The rock face was covered with jewel anemones. Some also on the rock shelf. There were some dead-man's fingers with more at greater depths. Some growths of yellow encrusting sponge were evident. Sea mat and nudibranch eggs visible on kelp. Saw a cuckoo wrasse and a few Ballan wrasse.

Date and Time:	1 August, 11:00	Site 4:	Gilstone Rock
Divers:	Simon, Richard	Depths:	0 to 25m
Position on Rockface:	Eastern Side		
Weather and Notes:	Sunny, scattered cloud, south-west 2-3		

Physical Description:

At 25m boulders and rock ledges up vertical wall to 20m. From 19m up to 16m gentle sloping ledge encountered. From 16m to 11m another ledge sloping up to 9m. Small wall up to 6m rising to surface.

Biological Description:

At 25m mainly sea urchins, a few plumose anemones, dead man's fingers. Small concentrations of jewel anemones. Ledges mainly kelp covered (thinly) with various types of red and brown seaweeds nearer surface. From 18m upward, larger areas of jewel anemones seen. 10m to surface producing mainly small areas of plumose anemones (green, white, orange and brown).

Date and Time:**Site 5:****Divers:****Depths:****Position on Rockface:****Weather and Notes:****Physical Description:****Biological Description:****Date and Time:**

3 August, 10:00

Site 6:

Gap Point

Divers:

Charles, Vicki

Depths:

6-22m

Position on Rockface:

South side of bay - North side of big point

Weather and Notes:

Overcast, drizzle. Sea state: choppy. SW wind, little current. Visibility approximately 3m.

Physical Description:

6-10m, granite boulders, piled up with gaps, holes and crevices in between. 14-18m granite boulders with silty sand and some small shell graven in between. 18-22m large granite boulders with silty sand and mud on seabed.

Biological Description:

6-12m	Dense kelp forest on top of boulders, stipes thick with read weed. Encrusting red algae on vertical faces.	Sea mat on kelp fronds., Gabbia sea cucumbers and urchins on bare rock faces. Devon cup corals, snakelock anemones and spider crabs.
12-18m	Sparse kelp, other brown weed: dictyopteris and halidrys. Scattered red weed.	Rock: Devonshire cup corals, red dead man's fingers, sponges. Mud/sand: burrowing anemones, daisy anemones, starfish and burrowing brittle stars
18-22	Sparse, stunted kelp. Some foliose red weed.	As above

Date and Time:

5 August, 11:30

Site 7:

Gilstone Rock

Divers:

Heather, Vicki

Depths:

6-24.5m

Position on Rockface:

South East Face

Weather and Notes:

Clear and Sunny, north-west 3-4, Visibility approximately 15m, Low water at 10:19, current flowing South Easterly

Physical Description:

Very large kelp ledges just below the kelp line and proceeding down to about 30m where large boulders could be seen. A few large crevices running into the rock. One ledge sloped up like a slipway. Ledges from 1-2 metres wide.

Biological Description:

Dense kelp to 14m (SMB prevented closer inspection). Jewel anemones, 50% closed, on all vertical surfaces. Devonshire cup corals, 'animal turf', small white nudibranchs with yellow tufts on all

horizontal surfaces. Fan corals on lower ledges. Many very large fish, friendly, on wide ledges under overhangs. Interesting life became sparser as the dive progressed.

Date and Time: 1 August, 15:30 **Site 8:** Gilstone Rock
Divers: Liz, Geoff, Mark **Depths:** 12-20m
Position on Rockface: South West
Weather and Notes: Sun with rain showers, wind 2 South Easterly

Physical Description:

Ledge at 12m covered with small boulders, then vertical cliff-face from 12 to 20m with vertical crevices and larger indentations. Swam East at 20m then gradually up to 12m.

Biological Description:

At 12m Kelp (0.5m tall), brown and red seaweed (less abundant). A few sea urchins, Ballan wrasse and nudibranch eggs. From 12-20m very little seaweed, jewel anemones very abundant. Plumose anemones, dead man's fingers, Devonshire cup corals, *Sagartia elegans*, few common and spiny starfish. Many edible crabs (1 or more in every crevice), dogfish and Ballan wrasse. General: very few fish and boring sponges absent.

Date and Time: 1 August, 11:00 **Site 9:** Gilstone
Divers: Liz, Mark **Depths:** 19-25m
Position on Rockface: East, south-east
Weather and Notes: Ground Swell, Wind 2 South West, Overcast with sunny spells.

Physical Description:

Vertical rock face dropping down to around 30m. Small ledges at intervals, vertical crevices. Swam East.

Biological Description:

24m - Cliff face covered with jewel anemones (mainly purple and green). Colonies of plumose anemones and patches of dead man's fingers. Encrusting algae in places. Red algae - small clumps of *Delesseria sanguinea*. Large boring sponges, rose coral, anemones (*Sagartia elegans*), sea urchins on ledges, topshells, variety of fish species - Pollack and Ballan wrasse. Two dogfish and edible grabs were observed. 22m - Sea urchins, topshells, as above, sea feathers. 20m - increase in algal cover, especially red.

Date and Time: 3 August, 11:24-11:53 **Site 10:** Gap Point
Divers: Kevan, James **Depths:** 7-17m
Position on Rockface:
Weather and Notes: Overcast, slight Swell from South West. Wind - south-south-west 3-4.

Physical Description:

Rock substrate of large boulders with soft sand, mud sediment at base. Start of dive in mud, swam South and onto ledge at range 7-9m then swam down slope in East direction to maximum depth of 17m. Visibility 4-5m at best though quickly got worse if silt stirred up.

Biological Description:

Kelp was heavily coated with hydrozoa. Typical semi-exposed flora and fauna, Laminaria dominated. Pollack and Ballan wrasse were common. Sediment in gullies contained *Sagartiogeton lacaratus* anemones and sand gobies. Common sea urchins where relatively sparse, *Anemonia viridis* were very common. Very dense bryozoan coatings.

Date and Time: 4 August, 15:00 **Site 11:** Gilstone
Divers: Liz, James **Depths:** 16-21m
Position on Rockface: South Face
Weather and Notes: Calm

Physical Description:

Vertical rock face down to 30m with ledges, large and small at intervals. Many crevices running down rock face.

Biological Description:

12-16m - kelp dominant with leafy red and green algae abundant growing closet to the rock substrate. 16-21m - jewel anemones, *Sagartia elegans*, plumose anemones, dead man's fingers. Red fingers, boring sponges, plumose anemones, *Axinella*. Topshells, Ballan wrasse, Pollack, dogfish, edible crabs. Possible spiny squat lobster observed.

Date and Time:	6 August	Site 12:	Penninis Head
Divers:	Laura, Richard	Depths:	5-24m
Position on Rockface:	220° from lighthouse		
Weather and Notes:	Sunny and clear		

Physical Description:

24m - large boulders, smooth surface. 23m - rock face 2m high. 18m - cliff started, 16m - levelled out. 13m - dropped to sand gully from 6-7m wide.

Biological Description:

24m - occasional urchins, cup coral on large boulders. 23m - minuscule brown anemones on flat rock surface. Smattering of ? - very thin. Bright orange spots - possibly ? Cracks in rock - 2 slugs - on flat surface several cotton spinners. Spiny starfish on most rocks. 23-20m Jewel anemones. Occasional *Actinothoe sphyrodeta* anemones. 20m - branching brown seaweed mixed with occasional small tufts of kelp. 18m - start of red filamentous seaweed. Small crabs in cracks. 13m - large brown seaweed thick with kelp - some dead - and surface encrusted with Crustose corallines. Thick kelp to 5m.

Date and Time:	6 August, 9:45	Site 13:	Penninis Head
Divers:	Simon, Ian	Depths:	0-27m
Position on Rockface:	Due north facing lighthouse, central pinnacle in cove.		
Weather and Notes:	Sunny and clear, no swell		

Physical Description:

Vertical drop to 12m then levels off at 16m. Slopes to 20m and then levels off again. Finally slopes down to 26m.

Biological Description:

26m - slab-like rocks covered on animal turf, dead man's fingers, jewel anemones, sea urchins, boring sponges, (all few in number), sparse red and green algae. 24m - pink encrusting Crustose corallines on boulders (small areas) red and green algae more prolific, Ballan wrasse seen. 22m - first kelp patches encountered. 20m - sea fans, finger-type sponges, more red and green algae, anemones abundant in silty mud between rocks. 18m - kelp covered boulders (Bryozoan coated), top sides have jewel anemones and dead man's fingers. 12-16m thicker kelp with increased red and green algae present. 8m - thin kelp.

Date and Time:	6 August, 9:30	Site 14:	Gilstone Rock
Divers:	Liz, Paul	Depths:	0-23m
Position on Rockface:	South-south-east facing wall		
Weather and Notes:	Flat calm.		

Physical Description:

Vertical rock face straight down to 23m, with a ledge at 6m, 16m and 20m. Ledges varied in size. On sea bed at bottom of cliff lay numerous boulders - ranging in size from 2-15m in diameter. Vertical crevices running down cliff face.

Biological Description:

22m - boulders covered with small clumps of leafy red and green algae, Devonshire cup corals, axinella, boring sponge, animal turf, Polymastia, Suberites, dead man's fingers, spiny starfish, jewel anemones, sea urchins, 7 legged starfish, ross coral, Pollack, ballan wrasse. The tops and east facing walls of boulders covered with red algae, predominantly green. Ledge at 20m covered with small kelp strands, purple encrusting algae. In gully next to wall - large boring sponges, hydroids, red fingers and Halecium. 16m - another ledge covered with kelp, red algae, two-spotted gobies, sponges, sea cucumber, sea urchins, corallina. 14m - another ledge, kelp more abundant, covered with bryozoan mats, red encrusting algae, dead man's fingers, hydroids on kelp, *Sagartia elegans*, jellyfish, ballan wrasse. 11m - Kelp dominant species, with red algae. Colonial tunicates around holdfasts. Red leafy algae. Large patches of *Sagartia elegans*. Orange sponge - *Amphilectus*.

Date and Time:	7 August, 9:55	Site 15:	Penninis Head
Divers:	Kevan, Carolyn	Depths:	6-28m
Position on Rockface:			
Weather and Notes:	Fine		

Physical Description:

Very large boulders leading to walls and crevices up to wall of small rock where dive ended.

Biological Description:

Start of kelp at around 20m and heavy kelp cover at 17m. Below that red algae more common. Sand on bottom devoid of life but boulders and rock faces covered in sponges, bryozoans and hydroids of various types. Mobile species included sea urchins, cucumbers and stars.

Date and Time:	7 August, 12:00	Site 16:	Penninis Head
Divers:	Liz, John	Depths:	8-28m
Position on Rockface:	south-south-east		
Weather and Notes:	Slightly overcast, slight swell, Wind 2-3, tide < 0.1kt, Visibility 10m.		

Physical Description:

Figures are lengths along transect. 0-12m - boulders at depth of 27m varying in size up to 3m in diameter. 12-20m - coarse sand and silt at depth of 27m. 20-28m - boulders and sand. 28-35m - sand stretch with ferrous wreckage buried in sand, tubular, 6ft long and 2ft diameter. 35m - start of gully formed by larger boulders. 49m - cliff face, narrow gully around 1ft deep and wide. Rock face up to 8m (end of transect)

Biological Description:

0-12m - boulders, sponges - Suberites, Axinella, Polymastia. Dead man's fingers. Devonshire cup corals, red fingers, seven-legged starfish, hydroids, bryozoan turf, purple starfish, colonial tunicate, individual tunicates, worm casts. Sea urchins sea fan, jewel anemones (few), fan-shaped sponge, ross coral. Star Ascidia. 12-20m sand, anemones, *Cerianthus lloydii*, Devonshire cup coral, peacock worms, sand masons, dragonets, sand gobies, common starfish. 20-28m - boulders and sand, sponge, Polymastia, *Sagartia elegans*, sea cucumber - cotton spinners lodged under boulders, brown sea cucumber. 28-35m - sand, sea anemone *Cerianthus lloydii*, small clumps of red seaweed. 35m - boulders, orange encrusting sponge (*Amphilectus*), jewel anemones, sea urchins, *Sagartia elegans*. Bring sponge. 42m - small fronds of kelp, colonial tunicates. 49m - cliff face, red and green leafy algae, crevice containing spiny starfish, red encrusting starfish, sea urchins. 61m - more kelp, sea urchins, Devonshire cup corals. 66m - large boulders - spiny starfish, jewel anemones, topshells and blue-ray limpets. Bryozoan mats and leafy red algae on kelp fronds. 74m - red and green leafy algae and feathery red algae. Large clump of red algae (thorny branches). Hydroids on kelp. 94m - cliff face, cotton spinners, red encrusting algae, two-spot gobies, jewel anemones. 95m - (8m depth) dead man's fingers, *Sagartia elegans*, colonial tunicates, orange sponge, edible crabs, velvet swimming crab in vertical crevice of rock face. From 7m onwards Ballan wrasse, 35m - shoal of female cuckoo wrasse, small cod-like fish (poor cod?) with barble under jaw seen throughout survey.

Date and Time:	8 August, 9:30	Site 17:	West Peninnis Head
Divers:	Richard, Ian, Carolyn	Depths:	10-30m
Position on Rockface:	West face		
Weather and Notes:	Cloudy, Wind East 5		

Physical Description:

Figures are lengths along transect. 30-25m - mud and sand. 25-10m - large boulders. 10-6m - cliff face.

Biological Description:

30-14m - spiny starfish, Devonshire cup corals, common urchins, Crustose Corallines, cotton spinners, red and orange encrusting algae, dead man's fingers. 25-14m - polychaete worms, *Pomatoceros*, sea fan, thin wrack-pinkish-ross. *Dictyopteris membranacea*. 22m-14m - jewel anemones, bluey sponge (possibly *Halicolona viscosa*). 14-10m Boring sponge, kelp, podweed. Kelp covered on sea mat.

Date and Time:	8 August, 12:10	Site 18:	Peninnis Head
Divers:	Paul, Richard, Cath	Depths:	0-20m
Position on Rockface:	4.8m on tape to 11m on tape		
Weather and Notes:			

Physical Description:

1) Large boulders 0.5m to 1m in diameter on rocky bottom. Occasional large rocks 3-4m to north of tape. 2) Sandy area surrounded by rock ? around 7.8m on tape about 2m ? wide. Clean scoured sand. 3) Underside of 1m diameter boulder 9.1m on tape about 0.25m to north.

Biological Description:

1) Upper surface of boulders covered with hydroid/bryozoa turf. Cup corals at about 6 per square metre. Large urchins grazing on several rocks. Various sponges dotted around rocks with abundant serrulid tubes. Cup corals, sponges and serrulids much more abundant on undersides of rocks. Small animal tubes (amphipod/polychaete) among turf. Lots of goldsinny wrasse darting around and the odd Ballan wrasse. 2) clean sand with burrowing anemones and *Lanice* tubes. Surface covered with small sand gobies. 3) bryozoan/hydroid growth. Abundant cup corals. Frequent encrusting sponges and abundant serpulid tubes. One large group of orange tunicates, classic shape, about 2cm high 20-30 individuals in group.

Date and Time:	4 August	Site 19:	Peninnis Head
Divers:	Laura, Simon	Depths:	0-28m
Position on Rockface:			
Weather and Notes:	Sunny and clear.		

Physical Description:

Rocky bed with some sand patches. Boulders rising steeply 28-22m. 22-20m ? ? forming bed with crevices but smooth surfaces. 17-12m steady rising boulders. 12m to surface - sheer rock face.

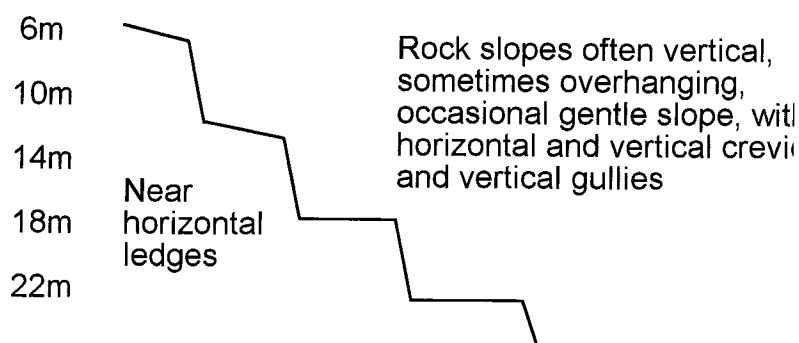
Biological Description:

28m - occasional starfish, some ? seaweed with red filamentous algae. 26m - few anemones in sand patches and cotton spinners on boulders. 22m - some kelp with brown seaweed. 20m - kelp ? but considerable coverage. Some red algae. Occasional urchins on surface. 17m - kelp thickening. Jewel anemones widespread with occasional cup corals. Crustose corallines covering rock faces. 10-5m - thick kelp covering. Few crabs in crevices. Some patches of brown and red algae mixed with kelp. Thick kelp to surface. Occasional sponges in patches on rocks.

Date and Time:	4 August, 17:00	Site 20:	Inner Gilstone
Divers:	John, Vicki	Depths:	6-22m
Position on Rockface:	Western side of Gilstone - sheltered from current		

Weather and Notes: Clear, sunny, swell, slight chop. South-west flowing current (approximately 0.5kt) HW 15:45.

Physical Description:



Biological Description:

Dense kelp to about 15m, sponges and anemones on rocks between. Horizontal ledges at approximately 18 to 22m: sparse kelp, variety of sponges, occasional sea cucumbers, seven-legged starfish, spiny starfish, Devonshire cup coral, one sea fan. Vertical walls: jewel anemones, ross coral, bryozoans, some encrusting sponges, feather stars, plumose anemones, *Sagartia spp.*, hydroid *Nemertesia antennina*, several nudibranchs. Crevices: small brown crabs, prawns. Dark corner under overhang: large white sea squirts (5" tall). *Ascidia mentula*.

Date and Time: 6 August **Site 21:** Peninnis Head
Divers: Brian **Depths:** 6-28m
Position on Rockface: South of lighthouse
Weather and Notes:

Physical Description:

Rock covered ledges down to about 25m. Boulders at 25m then wide gully. Medium sand leading to bed rock.

Biological Description:

Laminaria kelp down to about 25m. *Corynactis viridis*, bryozoan turf on rock surface and vertical surface of gully. Boulder surfaces covered with tubiforous turf. Bryozoans, red algae, antherozoans. Bedrock at mouth of gully - diverse cover of sponges, antherozoans etc. Cerianthids on sand. *Stolonica socialis* on horizontal surface.

Date and Time: 7 August **Site 22:** Peninnis Head - 1st Transect
Divers: Gordon, Cath, Kathy **Depths:** 8-30m
Position on Rockface: South of lighthouse
Weather and Notes: Fine

Physical Description:

Distance	Depth	Angle	Description
0	29.2	-	1-2m boulders with some sand
20	27.3	4°	Some horizontal and vertical faces on rocks
30	26.6	7°	Wall rising to right of line
40	25.2	8°	
50	22.1	18°	Less sand. Deep rocky crevices. Kelp line.
60	19.3	16°	
70	16.5	16°	Very large boulders with overhangs
80	13.8	16°	
90	12.0	10°	Wall area to right

100	8.4	21°	Sharp rise at end
-----	-----	-----	-------------------

Biological Description:

30m - boulders covered with silt and animal turf and *Alcyonium digitatum*. Numerous large sea urchins. Area of sponge in variety of forms and encrusting coralline algae. Some thin feathery algae. Jewel anemones more frequent at shallower depths. Devonshire cup corals at all depths. 18m-14m - kelp started appearing. Increasing numbers of ballan wrasse, goldsinny, female cuckoo wrasse. Diverse cover, kelp encrusted with sea-mat at 10-7m and *Ectocarpus Spp.*

Date and Time: 7 August **Site 23:** Peninnis Head
Divers: Ian, Charlotte, Hilary **Depths:** 24-29m
Position on Rockface: 0.2m right from transect
Weather and Notes: Sunny, slight haze, wind north east 2-3. Sea state calm, slight swell.

Physical Description:

28.8m - start of transect - large boulders with expenses of sand in between. Rocks silty. 26.1m - rocks more vertical, silty with crevices. 23.5m - Rocks shelve and small kelp appears and red and brown seaweed

Biological Description:

28.8m - boulders covered with animal turf with Devonshire cup corals frequent and suberites common. Also present were white dead man's fingers, branching sponges, black holothurians, small red sea weed, some sea urchins, some colonial sea squirts and frequent occurrences of orange tunicates. Up to 26.1m - frequent patches of white and yellow sponge siphons (*Polymastia*), also sagartia. On the sand - 'tube anemones' where frequent and also sand-mason tubes. 25.4m - red weed with a broad blade. 23.5m - small kelp on rocks - *Suberites* still present. 21.5m - *Laminaria sacharina* present with the kelp, *Suberites*, sea urchins and red and brown seaweed.

Date and Time: 8 August **Site 24:** Inner Head
Divers: Liz, John **Depths:** 14-27m
Position on Rockface: Rock faces around 220°T
Weather and Notes: Wind east 4-5, swell 1.5-2m, Low water St. Mary's 12:30. Dive profile - diagonal from Inner Head to The Chair. No tidal stream.

Physical Description:

Large boulders to 25-23m, small cliff 23m passed 20m and on to 18-15 (by vision). 18m - narrow gully running south-east to north-west. Bottom ????. Top 1.5-2m wide. Total depth of gully around 10m. Large boulders at 15m. Gully 5-10m long.

Biological Description:

25m - Cotton spinners, leopard spotted goby, dragonettes, red dead man's fingers., dead man's fingers, jewel anemones (few), few cup corals, ballan wrasse, sea urchins. 23m - many yellow boring sponges, more cup corals, dead man's fingers, few *Sagartia elegans*, ??? and velvet swimming crab, small red and green seaweed, ballan wrasse, jewel anemones, cup corals, cotton spinners, small spiny starfish, sea urchins. 20m - very sparse kelp starts, jewel anemones, cup corals, large bass ???, *Polymastia* ???, sea cucumber in sand and brown sea cucumber in crevices in rock. Ballan and cuckoo wrasse. 17m - brown sea cucumber, jewel anemones, cup corals, yellow boring sponges, cuckoo wrasse (one wrasse??? a sex change). Kelp still sparse. Ling.

Date and Time: 8 August, 10:45 **Site 25:** Peninnis Head, S of Carn Mahael
Divers: Gordon, Simon **Depths:** 12-23m
Position on Rockface: Swam 060°M on the third transect south of the carn
Weather and Notes: Force 4-5, overcast

Physical Description:

Flat sand-silt bottom, then gradually rising over boulder field. Steepening towards the shallower area but still fairly gentle gradient.

Biological Description:

— — — — — Sandy bottom with hermit crabs and Anelid worm casts stretching to rocks beds, several dragonets — — — — —
 seen and worm holes. *Sagartia elegans* and *Sagartiogeton laceratus* anemones seen. Red algae, small amounts of brown algae, dead man's fingers - red and white, several edible crabs, crustose corallines on rock surfaces. Sponges - *Axinella polypoides*, *Cliona celata* and other tub like sponges. Sea urchins (common), cotton spinners, one vase-shaped sea squirt seen (greyish in colour). Several cup corals and jewel anemones on rock faces higher up on rocks. Spiny starfish abundant, cuckoo and ballan wrasse. Kelp starts at 17m - though not very prolific even at 12m. Bryozoans and hydroids on kelp.

Date and Time: 8 August **Site 26:** E Peninnis Head, S of Carn Mahael
Divers: Charlotte, Cath **Depths:** 21-25m
Position on Rockface: Bearing of 240° towards shore
Weather and Notes: Force 4-5, east, overcast, Sea state around Peninnis head, moderate to rough. In lee of head, calm with slight swell.

Physical Description:

Initially over fine silty sand with depressions. Thereafter single big boulder followed by rocky face and boulders. Little change in depth. Increase of algae on top of rock.

Biological Description:

On sand - signs of poychaete, ??? and *Sagartia spp.* Leopard spotted gobies ??? Boulders covering of animal turf. All species described apart from those found on sand only refer to boulders.

Date and Time: 8 August **Site 26:** E Peninnis Head, S of Carn Mahael
Divers: Laura, Kevan **Depths:** 10-21.5m
Position on Rockface: 060° into rock face
Weather and Notes:

Physical Description:

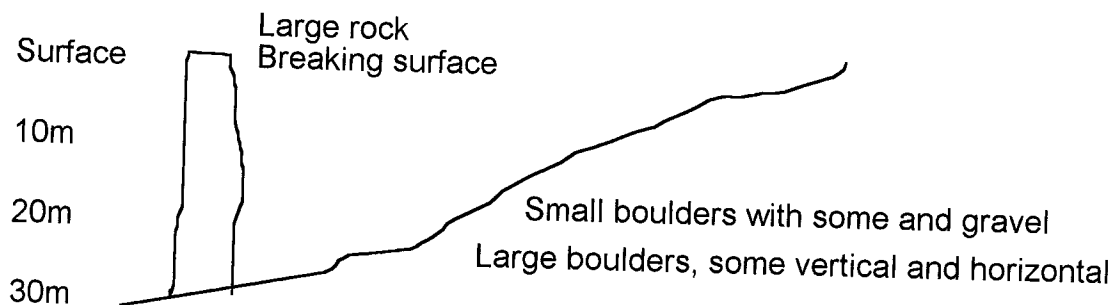
Sandy bed at 21.5m. Rocky boulders started at 20m. Smooth faced with some crevices. Rising steeply to 13m where it levelled out. Dropped down again to rocky bed with some sandy patches to 18m. Rising up to 8m and dropped back down. Most boulders smooth, good sized rocks and clusters of pebbles.

Biological Description:

Some sea pens on sandy bed. Red and brown algae on rocks, some anemones, clusters of small sponges cup corals and cucumbers on rock faces, Several spiny starfish, few urchins. At shallower depths large patches of crustose corallines on rock face. Kelp thickening to widespread cover at 16m interspersed with brown and red algae. Small patches of sea squirts, occasional dead man's fingers.

Date and Time: 6 August
Divers: Gordon, Debbie
Site 26: Peninnis Head
Depths: 6-29m
Position on Rockface:
Weather and Notes: Fine, little wind or current. Dropped in by large rock and swan toward rock face in north-north-east direction

Physical Description:



Biological Description:

Boulders at 20m where sparsely populated with life with a covering of animal turf and encrusting algae. Algae started at around 20m and thick kelp at around 10m. Dead man's fingers present in the 20-30m range. Urchins present at all depths but most prominent at depth.

Species Name	Dive Number and Frequency																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Abietinaria</i> spp.	2																											
<i>Actinaria</i> spp.									5																			
<i>Actinothoe sphyrodeta</i>				4																								
<i>Alcyonium digitatum</i>	2	3	3	2	2	2	2	4	5	5	4	4	4	4	4	2	3	1	2	4	5	3	3	1	4			
<i>Alcyonium glomeratum</i>	1				2	2	2	5	5	5	2			2	2	2			2	3	2	2	2	1	2			
<i>Amphilectus fucorum</i>												4			2													
<i>Amphilectus</i> spp.																			4									
<i>Anemonia sulcata</i>					2																							
<i>Anemonia viridis</i>				4					5					3														
<i>Antedon bifida</i>	2																		4	2								
<i>Antho inconstans</i>																	1											
<i>Ariphina</i> spp.					1																							
<i>Ascidia</i> spp.																					5							
<i>Ascidia montule</i>																1			2									
<i>Ascidella aspersa</i>																	1											
<i>Aslia lefevrei</i>																2								3				
<i>Asterias digitatum</i>	1																											
<i>Asterias rubens</i>									5						4	1	2					1					2	
<i>Astropecten irregularis</i>						1	1																					
<i>Axinella dissimilis</i>																					4							
<i>Axinella polypoides</i>					2						2			4	2					3			1		1	1		
<i>Axinella</i> spp.							2																					
<i>Betrykeides</i>																		2										
<i>Botryllodes leachi</i>																												
<i>Botryllus schlosseri</i>													4		1				2									
<i>Bryozoa</i>					4																							
<i>Bugula</i> spp.	2																			3								
<i>Calliblepharis</i>					3																							
<i>Callionymus lyra</i>																2								2				
<i>Cancer pagurus</i>								5	4		2				2							2	2	2				
<i>Caryophyllia smithii</i>	2		4		3	4	4						4	2	2	3	5				3	5	3	2	2			

Dive Number and Frequency																												
Species Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Cellaria</i> spp.	2																											
<i>Cereus peduncularis</i>					4	3																						
<i>Cerianthus lloydii</i>					4	4			5							4												
<i>Cliona celata</i>	3	2	2	1			3		4				4	2		4	2			3	4			4	4	4		
<i>Corallina officinalis</i>													1												3			
<i>Corynactis viridis</i>	4	4	5				5	5	6		5	2	2		2	4	3			5	5	4	2	4				
<i>Crisia</i> spp.	4																			2	3							
Crustacea (Prawns)																				2								
Crustose corallines					2								5		4	5						5	2		4	3		
<i>Cryptopleura ramosa</i>	2				2																							
<i>Ctenolabrus rupestris</i>					3	2												3				2			3			
<i>Cyanea lamarckii</i>													2															
<i>Cyocalyptra</i>						2														3								
<i>Delesseria sanguinea</i>							4	2	5				5		4													
<i>Desidiacidon fruticosum</i>																					4							
<i>Dictyopteris membranacea</i>						2										4	3					2						
<i>Dictyota dichotoma</i>	4			4	4								5															
<i>Dilsea cernosa</i>									5																			
<i>Drachiella spectabilis</i>									5													4	2					
<i>Echinus esculentus</i>	2	3	3		4	2			4				4	4	4	2		3			4	4	1	4	4	4		
<i>Ectocarpus</i> spp.																						4						
<i>Eunicella verrucosa</i>							2								1	1	1			1	1	1	1					
<i>Euphagurus bernhardus</i>					3	1																						
<i>Galathea strigosa</i>											1																	
<i>Gibbula</i> spp.						3			2	4	1				3					2		2						
<i>Gobiusculus flavescens</i>					3								4		1												3	
<i>Griffithsia flosculosa</i>									6																			
<i>Halecium helectinum</i>																4				2								
<i>Haliclona</i> spp.																												
<i>Halicondria panacea</i>															2													
<i>Halidrys siliquosa</i>					4	2											4											

Dive Number and Frequency																												
Species Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Halopteris flicina</i>	2				1																							
<i>Henricia oculata</i>																1												
<i>Heterosiphonia plumosa</i>	2																											
<i>Himanthalia elongata</i>					1																							
<i>Hinia reticulata</i>					2																							
<i>Holothuria forskali</i>	1		3		4	3	4							4	2	2	2			3	4	2	1	4	4	3		
<i>Inachus</i> spp.						1																						
<i>Isozoanthus</i>						2																						
<i>Labrus bergylla</i>		2	2		3		2	4	4	2	4		3	4		1	1	2	1	3	4	2		2		3	2	2
<i>Labrus mixtus</i>			2				2									1	1			2	4	2		3		3	2	2
<i>Laminaria digitatum</i>	2					2																						
<i>Laminaria hyperborea</i>	2		5		4	5		5			5			5		4	5					5						
<i>Laminaria</i> spp.									6													5		2				
<i>Lance conchilega</i>																4												
<i>Leucosolinia complicata</i>															2													
<i>Liocarcinus puber</i>							1					1				1	1							2				
<i>Luidia ciliaris</i>	1					1	1							2		4				2	4	2						
<i>Luidia sarsi</i>							1																					
<i>Marthasterias glacialis</i>		3	2		3	1	2	4	1	1				4	1	4				3	2	2	1	2	4	3		
<i>Membranipora membranacea</i>		5	5			5	4							5	5		5			5		5						
<i>Metridium senile</i>	4	4		2			2	4	5		4																	
<i>Molva molva</i>																							1			1		
<i>Monodonta</i> spp.			3																									
<i>Nemertesia antennina</i>																				1								
<i>Nemertesia</i> spp.	2																											
<i>Nudibranchia</i>		3	3				3													2								
<i>Obelia</i>						4														5								
<i>Okilia</i>																4												
<i>Onchidy</i> spp.												1																
<i>Pachymatisma johnstonia</i>				1																								
<i>Palaemon serratus</i>																	1											1

Dive Number and Frequency																												
Species Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Palmaria palmata</i>	2				2																							
<i>Parablennius gattorugine</i>																				1								
<i>Pentapora foliacea</i>	3			1			2		1				4		2					3	2		1					
<i>Phyllopora crispa</i>																					4							
<i>Pollachius pollachius</i>							2		2	2	4	1		4			1		2								2	2
<i>Polycera faeroensis</i>																			2									
<i>Polycera quadrilineata</i>	2																		2									
<i>Polymastia boletiforme</i>	1													2		4	2				4	5	1			3		
<i>Polymastia mamillaris</i>																				3	4	5	1			4		
<i>Pomatoschistus minutus</i>										6						4												
<i>Potina pellucida</i>																2												
<i>Prostheceraes vittatus</i>					1																					1		
<i>Psammechinus miliaris</i>							4	2		5							2											
<i>Rasphalia spp.</i>	1																				4							
Rhodophyceae					4	2																						
<i>Sabella paroniya</i>	2															2												
<i>Sabella penicillus</i>																												
<i>Sabella spp.</i>																				2								
<i>Sagartia elegans</i>				2			2		4		4			4	2							4	2	2	2			
<i>Sagartia spp.</i>																				4						4		
<i>Sagartia troglodytes</i>																					4							
<i>Sagartiogeton laceratus</i>										5											1	4	2		2			
<i>Scyliorhinus spp.</i>	2		1				1	1	2		2									1							1	
Serpulids																	5											
<i>Sertolaria spp.</i>																					4							
<i>Sertulia argentea</i>								2																				
<i>Steligeria spp.</i>	1									2																		
<i>Stolonica socialis</i>																												
<i>Suberites carnosus</i>						2								2		4		2			5							
<i>Taurulus bubalis</i>						1														1						2		
<i>Tethya aurantium</i>	1																											

Species Name	Dive Number and Frequency																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Thorogobius ephippiatus</i>												1				1			2					3		4	2	
<i>Trisopterus minutus</i>																1												
<i>Ulva</i>													4															
<i>Urticina felina</i>					2	2																						
<i>Phallusia mammilata</i>																										1		

Key: 1 - Rare, 2 - Occasional, 3 - Frequent, 4 - Common, 5 - Abundant, 6 - Super Abundant

8.4 Water Quality Forms



SOUTH WEST WATER

Results of Analysis

Page 1 of 1

SAMPLE FROM: Private Samples
 SAMPLE TAKEN ON 20 Jul 1994 at 1035 hours. USER REF. CODE: PRIVATE

SAMPLED BY: SOM IOSATBROOKS
 MATERIAL SAMPLED: Miscellaneous
 Type & Purpose of Sample: Single spot sample
 Charged samples

OBSERVATIONS: PORTHMELLON BEACH ST MARYS I.O.S. (NE END)
 WEATHER (previous 24 hrs.): --

ANALYSIS STARTED ON 20 Jul 1994 at TRURO Laboratories
 LAB. SAMPLE REF. TM94/18041

Result	Standard
FAECAL STREPTOCOCCI MF (PRE) as No./100ml	11.
Bacteriology	
TOTAL COLIFORMS as No/100 ml (3 dilutions)	152.
FAECAL COLIFORM MF (PRE) 3 DILUTIONS as No./100ml	16.

KEY TO ABBREVIATIONS: '>' - greater than; '<' - less than; 'trace' - detected but below reported value;
 'est' - estimated count; 'b/p' - below the reported value and not detected;
 'U' - Underestimating given under Section 70 of Water Act 1989;
 'rel' - related standard under Part III of Water Quality Regulations;
 'mg/l' - milligrams per litre or parts per million; 'µg/l' - micrograms per litre or parts per thousand million;
 'ng/l' - nanograms per litre or parts per million; 'p.p.m.' - no standard applies.

The standard reported is the maximum allowed value as specified by the Water Quality or other appropriate regulations.

C. B. Buckley

C. B. Buckley
 CHIEF SCIENTIST

940725116ant



SOUTH WEST WATER

Results of Analysis

Page 1 of 1

SAMPLE FROM: Private Samples
 SAMPLE TAKEN ON 20 Jul 1994 at 1035 hours. USER REF. CODE: PRIVATE

SAMPLED BY: SOM IOSATBROOKS
 MATERIAL SAMPLED: Miscellaneous
 Type & Purpose of Sample: Single spot sample
 Charged samples

OBSERVATIONS: PORTHMELLON BEACH ST MARYS I.O.S. (SW END)
 WEATHER (previous 24 hrs.): --

ANALYSIS STARTED ON 20 Jul 1994 at TRURO Laboratories
 LAB. SAMPLE REF. TM94/18042

Result	Standard
FAECAL STREPTOCOCCI MF (PRE) as No./100ml	14.
Bacteriology	
TOTAL COLIFORMS as No/100 ml (3 dilutions)	40.
FAECAL COLIFORM MF (PRE) 3 DILUTIONS as No./100ml	10.

KEY TO ABBREVIATIONS: '>' - greater than; '<' - less than; 'trace' - detected but below reported value;
 'est' - estimated count; 'b/p' - below the reported value and not detected;
 'U' - Underestimating given under Section 70 of Water Act 1989;
 'rel' - related standard under Part III of Water Quality Regulations;
 'mg/l' - milligrams per litre or parts per million; 'µg/l' - micrograms per litre or parts per thousand million;
 'ng/l' - nanograms per litre or parts per million; 'p.p.m.' - no standard applies.

The standard reported is the maximum allowed value as specified by the Water Quality or other appropriate regulations.

C. B. Buckley

C. B. Buckley
 CHIEF SCIENTIST

940725116ant



SOUTH WEST WATER

Results of Analysis

Page 1 of 1

SAMPLE FROM: *Private Samples*
SAMPLE TAKEN ON 20 Jul 1994 at 1045 hours. USER REF. CODE: *PRIVATE*

SAMPLED BY: *SOM LOSATBROOKS*
MATERIAL SAMPLED: *Miscellaneous*
TYPE & PURPOSE OF SAMPLE: *Single spot sample*
Charged samples

OBSERVATIONS: *PORTHCRESSA BEACH ST MARYS I.O.S. MIDDLE*
WEATHER (previous 24 hrs.): *--*

ANALYSIS STARTED ON 20 Jul 1994 at *TRURO Laboratories*
LAB. SAMPLE REF. *TM94/18043*

	Result	Standard
FAECAL STREPTOCOCCI MF (PRE) as No./100ml	1.	--
Bacteriology		
TOTAL COLIFORMS as No/100 ml (3 dilutions)	6.	--
FAECAL COLIFORM MF (PRE) 3 DILUTIONS as No./100ml	2.	--

KEY TO ABBREVIATIONS: '>' - greater than; '<' - less than; 'trace' - detected but below reported value;
'est' - estimated count; 'u/p' - below the reported value and not detected;
'U' - Underlying given under Section 20 of Water Act 1989;
'--' - related standard under Part III of Water Quality Regulations;
'mg/l' - milligrams per litre or parts per million; 'µg/l' - micrograms per litre or parts per thousand million;
'ng/l' - nanograms per litre or parts per million million; '-', '-' - no standard applies.

The standard reported is the maximum allowed value as specified by the Water Quality or other appropriate regulations.

C. B. Buckley

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SOUTH WEST WATER

Results of Analysis

Page 1 of 1

SAMPLE FROM: *Private Samples*
SAMPLE TAKEN ON 20 Jul 1994 at 1050 hours. USER REF. CODE: *PRIVATE*

SAMPLED BY: *SOM LOSATBROOKS*
MATERIAL SAMPLED: *Miscellaneous*
TYPE & PURPOSE OF SAMPLE: *Single spot sample*
Charged samples

OBSERVATIONS: *LITTLE PORTH PORTCRESSA ST MARYS I.O.S.*
WEATHER (previous 24 hrs.): *--*

ANALYSIS STARTED ON 20 Jul 1994 at *TRURO Laboratories*
LAB. SAMPLE REF. *TM94/18044*

	Result	Standard
FAECAL STREPTOCOCCI MF (PRE) as No./100ml	1.	--
Bacteriology		
TOTAL COLIFORMS as No/100 ml (3 dilutions)	g.	--
FAECAL COLIFORM MF (PRE) 3 DILUTIONS as No./100ml	g.	--

KEY TO ABBREVIATIONS: '>' - greater than; '<' - less than; 'trace' - detected but below reported value;
'est' - estimated count; 'u/p' - below the reported value and not detected;
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The standard reported is the maximum allowed value as specified by the Water Quality or other appropriate regulations.

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8.5 Budget

The following summarises the income and expenditure of the report. The remaining balance of 165.05 will be used for the production of the report.

Expedition Fees	4682.00	
Accommodation		1071.80
Breathing air		459.90
Boat expenses		1088.50
Ferry transportation		807.50
Food		310.22
Miscellaneous		112.50
Petrol		533.67
Science equipment		132.86
Total	£4682.00	£4516.95
Balance		£165.05

8.6 References

- Cleator, B. , Nunny, R and Mackenzie, G. 1996. Coral Cay Conservation Sub-Aqua Club Isles of Scilly 1993 Expedition Report.
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- Fowler, S.L. 1992. Marine monitoring in the Isles of Scilly, 1991. Report to the Nature Conservancy Council. 31 pp.
- Fowler, S.L. & Pilley, G.M. 1992. Report on the Lundy and Isles of Scilly marine monitoring programmes, 1984 to 1991. Unpublished report to English Nature. (Contractor: The Nature Conservation Bureau Ltd., Newbury).
- Raines, P., Nunny, R and Cleator, B. 1993. Coral Cay Conservation Sub-Aqua Club Isles of Scilly 1992 Expedition Report.