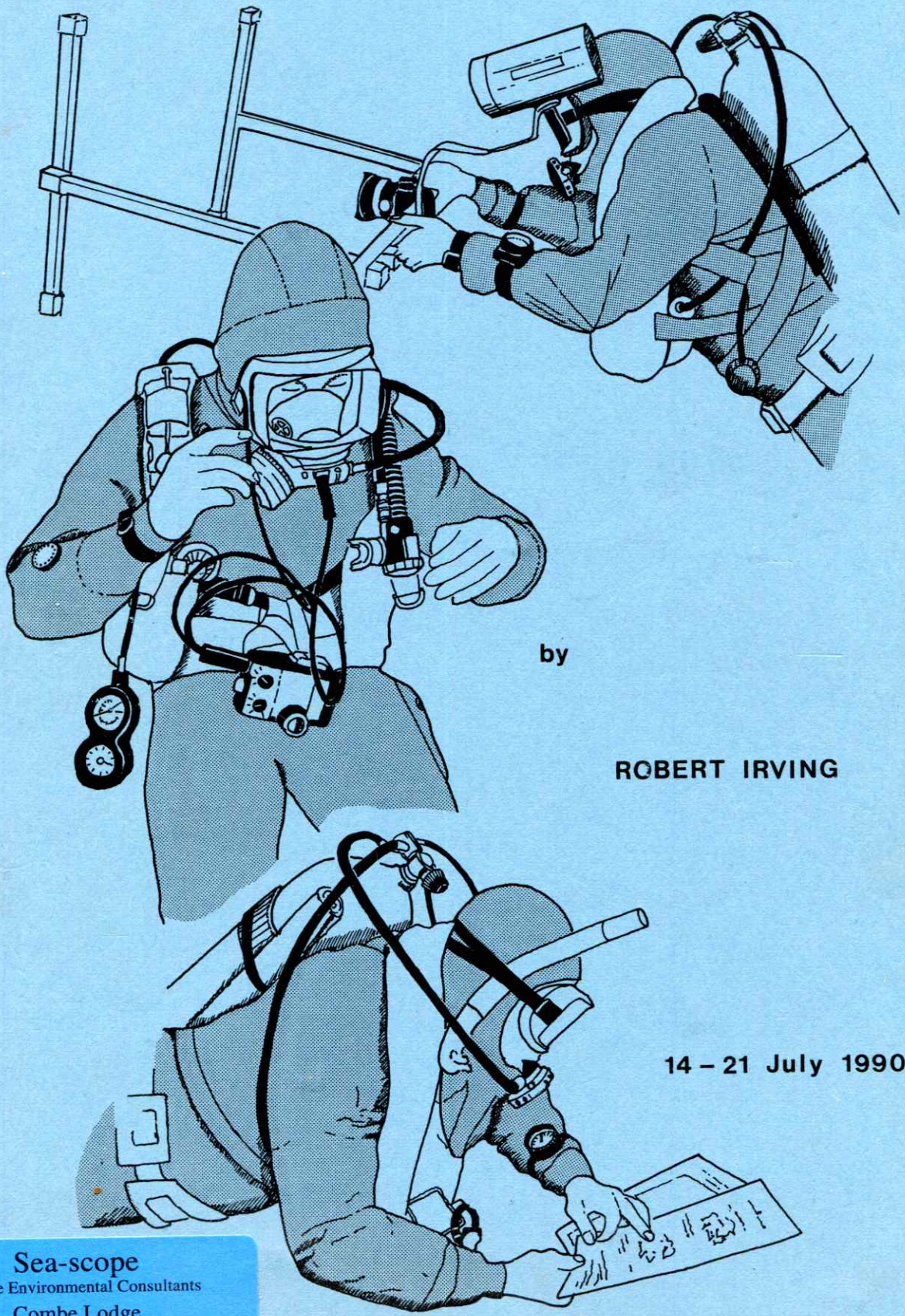
SUBLITTORAL MONITORING

WITHIN THE LUNDY MARINE NATURE RESERVE



by

ROBERT IRVING

14 – 21 July 1990

Sea-scope
Marine Environmental Consultants
Combe Lodge
Bampton, nr. Tiverton
Devon EX16 9LB
Tel. 01398 332267

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Survey Team:

Robert Irving	Freelance Consultant, London.
Stephen Bolt	Nature Conservancy Council,Peterborough.
Jon Davies	Nature Conservancy Council, Peterborough.
Stephen Warman	Nature Conservancy Council, Cornwall.
Clare Eno	Cook and volunteer diver.

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101 Abingdon Road, London W8 6QU

CONTENTS

1. Introduction and Objectives

The programme of sublittoral monitoring studies at Lundy was initiated in 1984 by K.Hiscock, and return visits have been made annually (with the exception of 1989) since then. The week long studies usually take place in July, though in 1987 they occurred in September.

The studies are designed to tell us more about the longevity and growth rates of certain species of nature conservation interest, and to indicate long term changes in community structure. A full account of the establishment of these studies is given in Hiscock (1984).

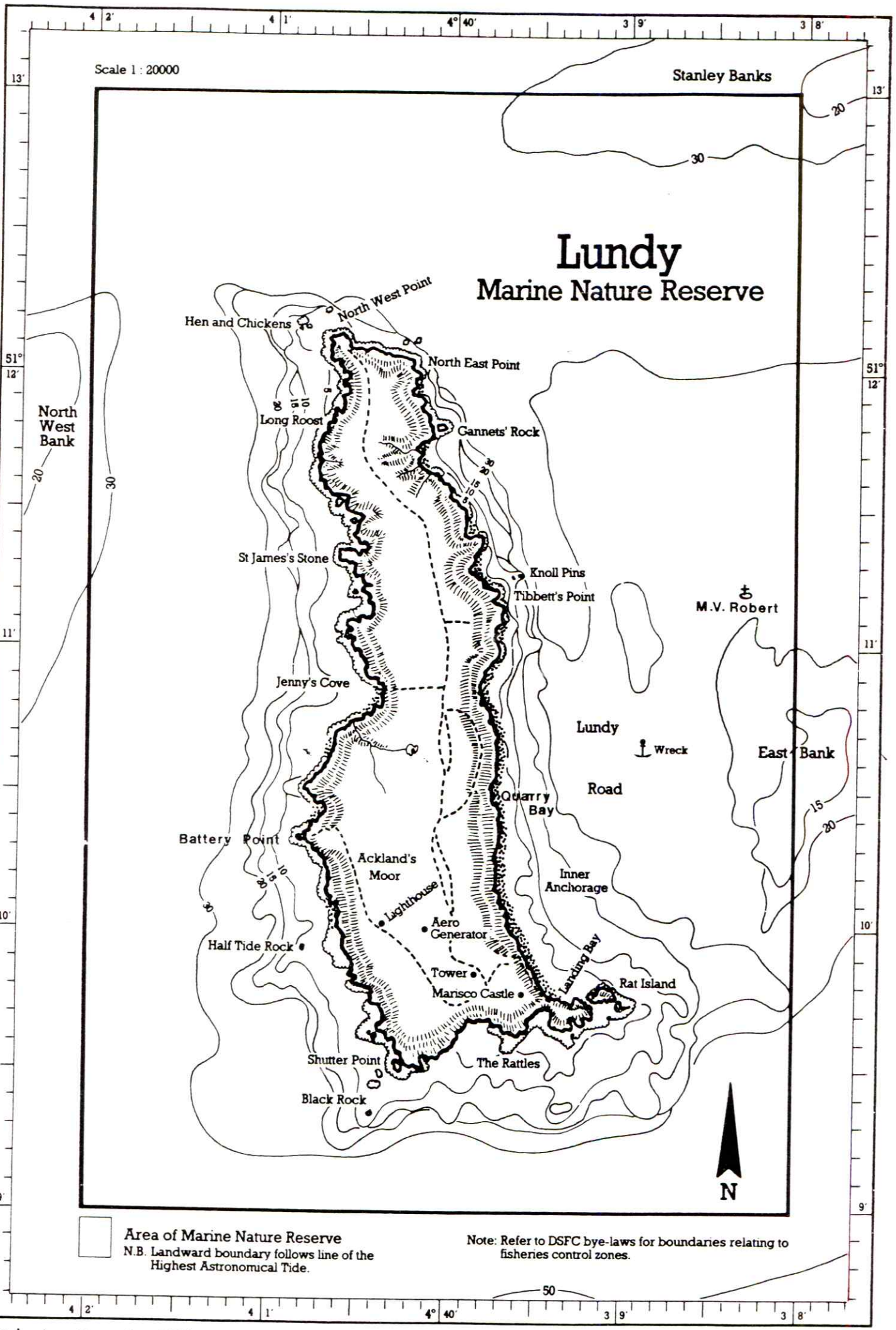
As mentioned above, no visit was made to Lundy during the summer of 1989 to continue the sublittoral monitoring work. This has meant that there is now a gap in the annual records for that year, but it also meant that, if the annual visits were to be continued, a visit during the summer of 1990 was essential.

The objectives of the 1990 work were to undertake the following tasks (in order of priority):-

1. Photography of Knoll Pins transect.
2. Photography of Gannets' Rock transect.
3. Photography of Quarry Bay transect.
4. Check marker tags on branching sponges and sea fans.
5. Searches for the red band fish Cepola rubescens.
6. Establish a new monitoring site off the west coast.*
7. Algal limit transect monitoring at the Knoll Pins.
8. Maintenance of monitoring sites.
9. Establish new monitoring site on the M.V.Robert.*
10. Counts of Tritonia odhneri on sea fans.

These objectives were subject to modification within the constraints of time and weather. Items starred were to be carried out time permitting.

Largely as a result of excellent weather conditions (very light breezes, flat calm seas and the bonus of sunshine too) all of the aforementioned tasks were carried out, though, despite a reconnoitre of likely monitoring sites on the west coast, no new site was actually established here. The location of the sites where monitoring studies take place is given in Fig. 1 overleaf.


Scale 1 : 20000
Stanley Banks
Lundy
Marine Nature Reserve
North West Point
Hen and Chickens
North East Point
Long Roost
Gannets' Rock
North West Bank
St James's Stone
Knoll Pins
Tibbett's Point
M.V. Robert
Jenny's Cove
Lundy
Wreck
East Bank
Road
Quarry Bay
Battery Point
Ackland's Moor
Inner Anchorage
Lighthouse
Aero Generator
Half Tide Rock
Tower
Landing Bay
Rat Island
Marisco Castle
Shutter Point
The Rattles
Black Rock
N
Area of Marine Nature Reserve
N.B. Landward boundary follows line of the Highest Astronomical Tide.
Note: Refer to DSFC bye-laws for boundaries relating to fisheries control zones.

2. Maintenance of east coast monitoring sites

2.1 Introduction and Methods

Each of the three monitoring sites (at Quarry Bay, the Knoll Pins and Gannets' Rock) are marked either by cast iron mountaineering pitons hammered into rock crevices, or by zinc-coated anodised steel ring bolts with expandable seats screwed into holes drilled into the rock. Both of these metal types suffer from rust corrosion (Fig. 2). Few of the original pitons or ring bolts remain, having been replaced by others over the years. Growth of encrusting organisms on the metal surfaces tends to obscure them and makes relocation difficult, even with the aid of location photographs and diagrams.

Relocation of sites was carried out using surface transit marks and the author's personal knowledge of local topographical features under water. A surface marker buoy was attached to either a sacrificial "marker" ringbolt/piton or to a nearby boulder while studies were carried out at that particular site.

Several pitons and ringbolts required replacing this year. The preferred method was to replace those which were loose or badly corroded with new ringbolts as these can be fixed in place more firmly than pitons. (However, pitons were used at the Gannets' Rock site as suitable cracks are present here). For fixing ringbolts, a small underwater air drill was used, connected to a 90 cu.ft. cylinder by a high pressure hose about 2 m long, firstly with a 6 mm tungsten carbide bit, and then with a 12 mm bit.

2.2 Quarry Bay

The boulder at the north end of this transect, with two ringbolts in it, was located relatively easily. The ringbolt at the southern end took longer to find, primarily because the sub-surface marker buoy which had been left on it in 1988 was missing. Once this ringbolt had been located, a new sub-surface marker buoy was attached to it. The "middle" ringbolt required replacing, as it had totally rusted through (see Fig. 2). A new hole was drilled adjacent to the original hole and a new ringbolt screwed into place. The other two ringbolts at each end of the transect were cleaned and found to be firm and in good condition.

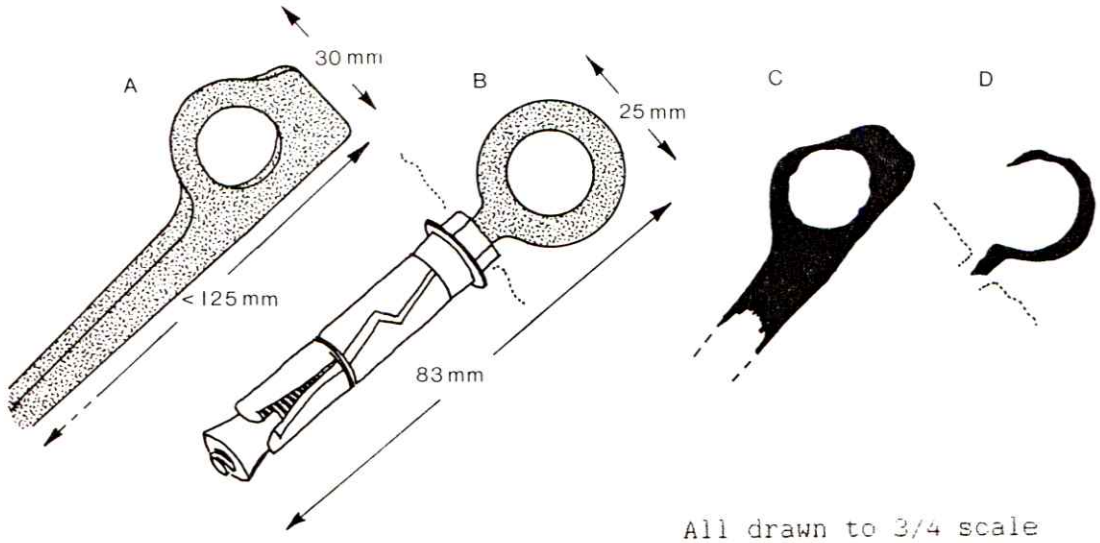


Fig. 2

A. Illustration of new piton.
B. Illustration of new ringbolt.
C. Illustration of corroded piton (1984-1988).
D. Illustration of corroded ringbolt (1984-1990) from Quarry Bay.

2.3 Knoll Pins

This site was relocated by diving on the northern side of the Outer Pin (the top of which is visible at low water) and swimming round into the canyon between the Outer Pin and the Submerged Pin. By using the relocation photographs and diagrams embedded in plastic sheets, most of the ringbolts were located with relative ease. However, after careful and thorough searching, it was concluded that the two at the western end (including the terminal one) were missing. A new hole was drilled for the terminal piton as close as possible to where photographs showed the original to have been, and a new ringbolt put in its place. Several photographs were taken to show the position of this new ringbolt. The adjacent missing bolt was not replaced. The other ringbolts were considered sufficiently robust to not require replacing for another year.

2.4 Gannets' Rock

This site was relocated by diving on the transit marks and swimming southwards until the north facing wall of the pinnacle was encountered. By then swimming eastwards, the ledge at the bottom end of the vertical transect was found, and the bottom piton relocated without too much difficulty. The transect line was attached to this and then gradually let out whilst the divers moved upwards. The line was tied to each piton in turn as these were found, using smaller pieces of string. The piton to the right of the clump of Alcyonium

glomeratum was accidentally missed. All pitons were badly rusted, and after the monitoring photographs were taken, new ones were hammered in beside them into the same cracks in the rock (this appears to be the one site where pitons can be used successfully). The sub-surface marker buoy was missing from the "marker" piton at the top of the transect, though the ring of the piton was still intact. This means that the buoy line had become untied, either as a result of natural causes or with someone's help.

3. Photographic recording along fixed transects

3.1 Methods

The same methods devised by Keith Hiscock in 1984 (together with their subsequent modification in succeeding years), were employed during the 1990 studies.

A 10m transect rope, marked at 0.5 m intervals, was threaded through the ringbolts/pitons and attached at each end. Sequential overlapping 50 cm x 50 cm photographs were then taken either side of this line, using a Nikonos camera mounted on the hollow section aluminium frame as described in the 1985 Lundy report. A Nikonos V camera body was used with a NikKor 15 mm lens and an SB102 flash gun fitted with a diffuser. Film stock was Fuji 50 ASA colour transparency film used at an aperture of f9 at a fixed lens distance of 45 cm. The system was used on Auto with TTL flash. On some occasions, there appeared to be insufficient light entering the lens for a full exposure, as the red light on the flash gun flashed after firing. However, once the film had been developed, it was found to be adequately exposed at the above settings.

For the wide angle photographs of the cave at the Knoll Pins, the same camera system was used with the addition of a Nikkor 15 mm viewfinder, but without the aluminium frame. The cave close-up photographs were taken with a Nikonos V camera body, Nikkor 28 mm lens (set at f16 and infinity), Nikonos close-up supplementary lens and an SB103 flash gun. Again, the system was used on Auto with TTL flash.

As agreed by NCC, only one complete set of photographs was taken for each of the transects.

3.2 Quarry Bay

Photographs were taken starting at the south end, proceeding up the east side to the north end, and back along the west side (LSM/005/90 - LSM/034/90).

3.3 Knoll Pins

Photographs were taken starting from the east end and then proceeded westwards, taking alternate frames above and below the transect line (LSM/093/90 - LSM/126/90). The line was not connected to the ringbolt **next** to the west end terminal one as this was missing and it was not replaced.

Close-up photographs of the "cave" were taken on 2 films on separate days, the first film giving overlapping coverage of the left side (LSM/148/90 - LSM/183/90) and the second film of the right side (LSM/184/90 - LSM/220/90). Wide angle photographs were also taken of the cave area for reference purposes if required when piecing together the mosaic of close-up photos (LSM/135/90 - LSM/147/90).

3.4 Gannets' Rock

This transect runs vertically from 19 m to 26 m (below chart datum). Photographs were started at the bottom and alternated from side to side while progressing to the top. Accidentally, the frame was used with the long side parallel to the transect line, whereas in previous years it had been used with the long side at right angles to the line. This means that the area of coverage of photographs is about 25% smaller than in previous years. Unfortunately, there was insufficient time to repeat this sequence once the mistake had been realised.

3.5 Knoll Pins algal limits transect

A site was identified in 1985 on the north-eastern side of the Knoll Pins Outer Pin which would allow for monitoring the deepest levels at which certain species of alga could grow. Light penetration is the major factor which would determine this, which is inversely proportional to the degree of water turbidity. It was intended that this study would provide some measurable indication of changes in turbidity occuring off the east side of the island over a period of years.

Considerable difficulty was encountered this year in accurately locating the start and finish of ALT4, the deepest of the 4 continuous transect positions set up in 1985. The top end of ALT4 and the bottom end of ALT3 are marked by a set of 4 large boulders at 20.5 m bcd. ALT4 runs from here on a bearing of 55° to a depth of 23.5 m bcd, over gradually shelving bedrock. In 1988, the lower end of ALT4 was marked by a large concrete block with a ringbolt embedded in it. Beyond this, the seabed is of sand with occasional boulders.

The four boulders were located and positively identified as being the ones in question after careful searching of the surrounding area of seabed. However, the topography of the seabed on a bearing of 55° from this point bore little resemblance to the relocation photographs

and diagrams taken under water. It appeared as though a large quantity of sand had been shifted, smothering the lower 1.5 m of ALT4, thereby altering the expected scene. (This could have happened when easterly gale force winds battered the island in February 1989 or in February 1990). The concrete block was not seen at all.

Though the exact position of the transect was in doubt, a line was laid out and a series of photographs taken along it (LSM/221/90 - LSM/244/90). No algae were seen growing on either side of the line however, a layer of sand being present over much of the bedrock. Later, the line was taken up and relaid as ALT3, though again the exact position of the transect was in doubt. A series of photographs was taken along this transect too (LSM/247/90 - LSM/272/90). A collection was made of the deepest occuring algae away from the immediate area of ALT3, being pressed for later identification.

? Rhodophyllis sp.	21.5 m bcd	: occasional
? Heterosiphonia plumosa	14.5 m bcd	: frequent
? Dictyota dichotoma	14.5 m bcd	: frequent
? Dictyopteris membranacea	14.5 m bcd	: frequent

The greatest recorded depth for red algae is 21.5 m bcd, which is only slightly less than the 22.0 m recorded in 1986 and 1987, and the 22.6 m recorded in 1988. The difference does not appear to be significant at this stage of the monitoring study, it being impossible to say whether it is a direct result of increased turbidity or whether it is linked to the smothering and abrasion effects of gross sand movements.

4. Viewpoint photographs

4.1 Tagging studies of Eunicella and Axinella specimens

In September 1988, an experiment was undertaken at the Quarries monitoring site in order to see if individual tagging of sea fans and sponges would assist in their future identification for photographic purposes. Initially, a number of "sacrificial" specimens were selected and tagged to determine whether, over a period of time, the tags had any deliterious effect on their growth and general well-being. Five specimens of the sea fan Eunicella verrucosa and five specimens of small branching sponges (mostly Axinella polypoides) were tagged around the base of their stalks by plastic garden tags marked with a number (a full description is given in Howard, 1988). All of the sponges were attached to the one boulder close to the southern end of the Quarry Bay transect, with the sea fans in the same area but on different boulders.

After an interval of two years, the specimens were relocated, notes made on their condition and close-up photographs taken where appropriate. The results are set out in Table 1, overleaf.

From the results it will be seen that only one of the five tags was still present on the sponges, and that one appeared to have caused a constriction around the base of the stalk. Of the five sea fans, all tags were present and had not appeared to have harmed the individuals in any way. The numbers, though written using black waterproof ink on the white plastic tags, had all disappeared. (On the new tags, numbers have been scratched on and then written over). It was therefore decided to tag the sea fans under study on Boulders 1 & 2 at the Quarry Bay site, but not the sponges.

The following sea fans were tagged:

	Tag No.	Sea fan
Boulder 1		
	1	1a
	2	1b
Boulder 2		
	3	2a
	4	2g *
	5	2h

* Sea fan 2g appeared completely dead, with 100% drift weed cover.

When tagging organisms in this way was originally discussed, one of the concerns expressed was that the tags may attract the attention of sports divers who, on closer inspection of the tags, may damage the organisms. It has been found, however, that the tags soon lose their brightness and become covered in silt and small algal growth, thereby blending themselves with their background. They can therefore safely be used to confirm positive identification of individual sea fans.

TABLE 1

Tag No.	Description in 1988	Description in 1990
Sponges		
1	*Axinella polypoides* approx. 20 cm tall.	Tag still in place tho' no. missing. Tie loose around base with slight constriction apparent (Fig. 3 & Plate 9).
2	Unidentified branching sp. approx. 8 cm tall.	Tag missing. Base of sponge very thin but attached firmly to rock. (Fig. 3).
3	*Raspailia ramosa* approx. 6 cm tall.	Tag missing. No obvious damage.
4	?*Axinella polypoides* approx. 4 cm tall.	Tag missing. No obvious damage.
5	?*Axinella polypoides* approx. 4 cm tall.	Tag missing. No obvious damage.

TABLE 1 (cont.)

Sea fans (all Eunicella verrucosa)

6	approx. 20 cm tall. Relatively free of weed.	Tag present tho' no number. Loose aroundbase of stalk. No obvious harm. Healthy specimen (Plate 8).
7	approx. 25 cm tall. Badly affected by drift weed. Only tips of branches healthy. Debris removed revealing horny skeleton underneath.	Tag present tho' no number.Loose. Almost entirely covered by weed. Only 3 cm tip of one branch still growing, due to smothering weed **not** the tag.
8	approx. 20 cm tall. Healthy specimen.	Tag present tho' no number. Loose around base. No obvious harm.
9	approx. 20 cm tall. Healthy specimen.	Tag present tho' no number. Loose around base. No obvious harm.
10	approx. 35 cm tall. About 25% of fan's area covered by drift weed.	Tag present tho' no number. Loose around base. Possible damage to base of stalk by tag, tho' could have been due to attached mermaid's purse (Fig. 3).

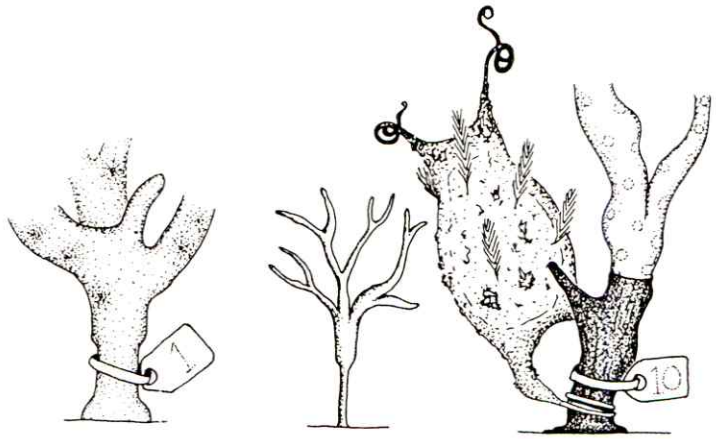


Fig. 3 Examples of tagged sponges (Nos. 1 & 2) and sea fan (No. 10) (See also Plates 8 & 9)

4.2 Quarry Bay boulders

In spite of a few days of calm weather immediately preceding our visit to Lundy, there was still a fair amount of particulate matter in suspension at this site which had resulted from strong easterly winds the week before. This served to reduce the visibility to 3-4 m, creating back-scatter problems with the flash for the viewpoint photographs of boulders 1 & 2 (see Plate 2) and the photographs of individual sea fans and sponges (see Plates 4 & 7).

Photographs were taken using a Nikonos V, 15 mm Nikkor lens and viewfinder, SB 102 flash gun and Fuji 50 ASA slide film. A large grid board (marked as 2 cm x 2 cm squares by white lines against a black background) was placed behind each sea fan, while a smaller one (marked in the same way) was used for the smaller and more delicate sponges. Identification of individual sea fans and sponges prior to photographs being taken again proved difficult, and it is hoped that

the tags will make this task somewhat easier. Recognition difficulties arise when visibility is poor, and when both sea fans and sponges have become smothered by growths of annual foliose algae, by drift algae, or, as has been the case with sea fan 1c, they disappear entirely. The reason for this happening is not entirely clear: either the sea fan would have been accidentally knocked off by a diver at some time during the two years since the monitoring work was carried out (unlikely); or the fan had become completely smothered by drift weed, died and lost its grip at its point of attachment (more probable).

4.3 M.V. "Robert"

The wreck of the M.V. "Robert" lies on her starboard side in about 20 m of water, approximately 1 km due east of Tibbets Point off the east coast of Lundy (Fig. 1). She sank in 1975, though her whereabouts remained undiscovered until 1979 when K. Hiscock carried out an initial survey of colonising organisms (Hiscock, 1981). The marine life growing on her was resurveyed in 1980, 1986 and 1987.

The purpose of the 1990 work was not to resurvey the wreck but to establish a number of monitoring sites on her. The best way to do this was considered to be taking viewpoint photographs from a number of easily relocatable positions, and to clear two small areas of attached and encrusting organisms in order to assess re-colonisation. The cleared areas are approximately 30 cm x 30 cm, one on the side (horizontal, upward facing), and the other on the top (vertical) of the superstructure towards the stern of the vessel (see Plate 11). The positions chosen for viewpoint photographs are given in Fig. 4. In order to help with the accurate relocation of these positions, members of the Ilfracombe and N.Devon Sub-Aqua Club have agreed to make a scale drawing of the wreck.

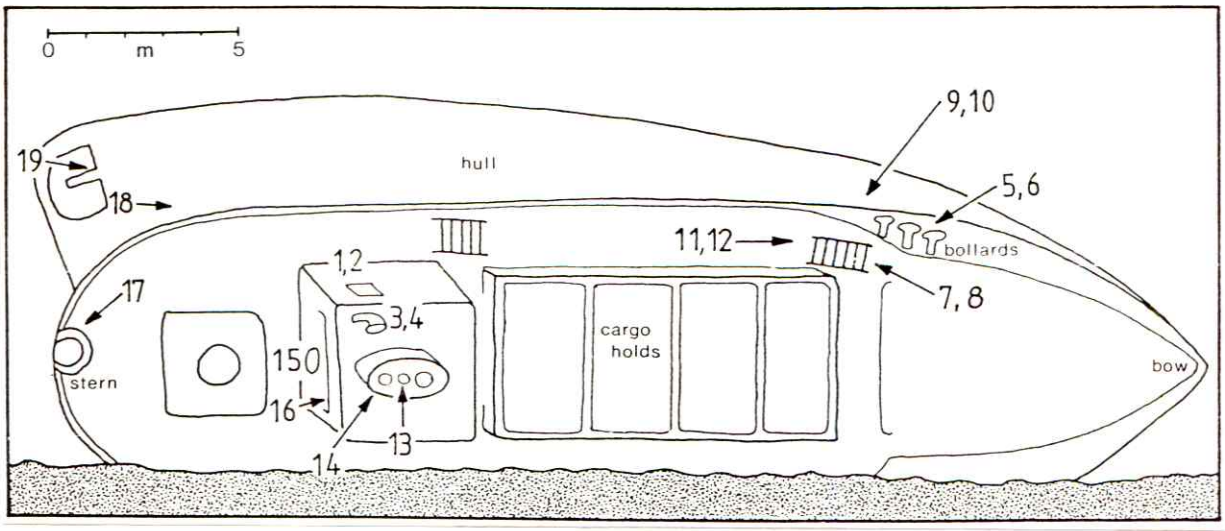


Fig. 4 Diagram indicating the positions of viewpoint photographs on the wreckof the M.V. "Robert". (N.B. Drawn by S.Bolt from memory, so not to scale).

5. Searches for the red band fish, Cepola rubescens

The red band fish Cepola rubescens is a beautiful eel-like fish which grows to 80 cm in length and lives in burrows dug in muddy gravel (Plate 19). In 1977, the population of red band fish off the east coast of Lundy was estimated at 16,000 individuals. By 1983, no fish were found, even after extensive searches. The reason for this population crash is uncertain, though a number of possible theories have been suggested. In July 1987, a discrete group of 15 burrows and 6 fish were found off the Quarries, though they were not present at the same site in September of the following year. A full account of the searches for the red band fish is given by Irving (1989).

The searches for populations of Cepola continued in 1990. The site at which the fish had been seen in 1987 was first checked (though the pig-iron left to mark the site could not be found), followed by drift/swim dives off the Quarries, Halfway Wall Bay and Gannets' Bay. Searches were carried out using a Hellaphone underwater communications set (Plates 14 & 15), which uses ultrasound and therefore allows the diver to operate freely from the surface operator/vessel. This was the first time this equipment had been used during these searches and it worked very successfully. The diver is able to report points of interest to a scribe sitting in the boat on the surface, while a third person notes sighting marks on the coast at set time intervals in order to plot the diver's course. The results of these swims are given in Fig. 5.

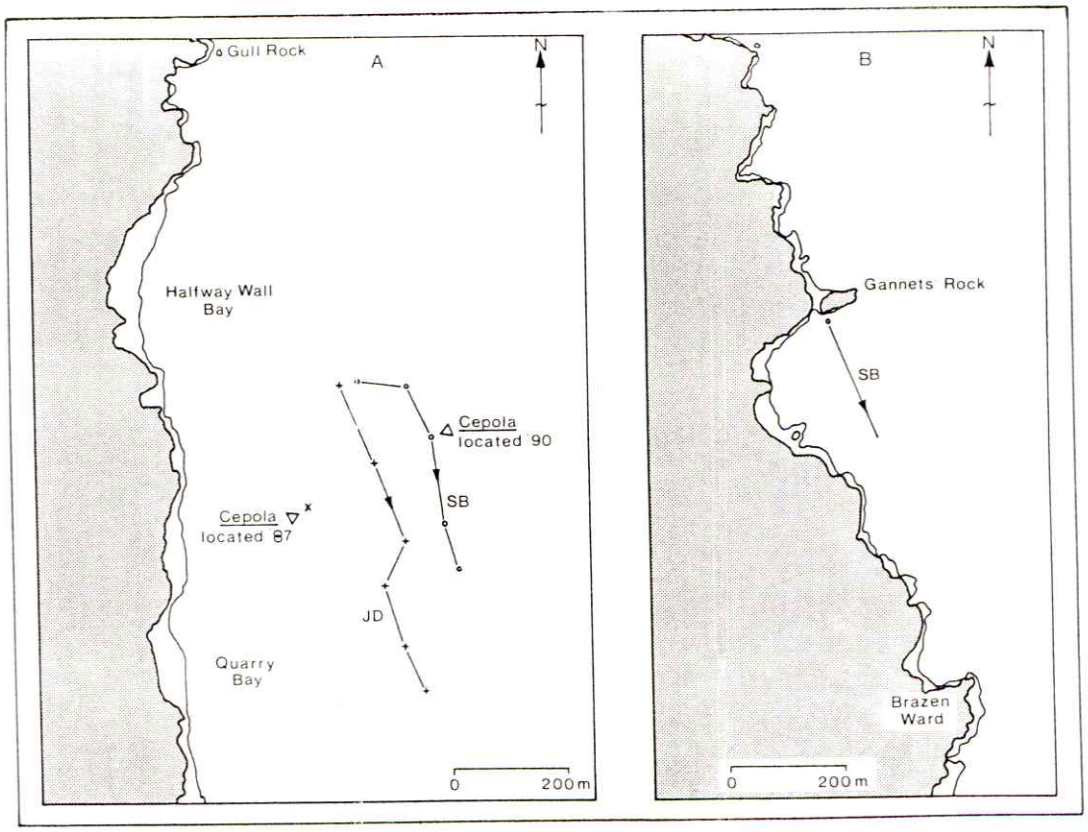


Fig. 5 Plots of diver swim searches for Cepola, July 1990 (JD = Jon Davies (diver); SB = Steve Bolt (diver)).

Three Cepola burrows were located at 22.3 m bsl (= 16.7 m bcd) by Steve Bolt after initially catching sight of a fish part way out of one of them. One of the burrows was about 6 cm across, with the other two being about 4 cm across. The burrow entrances were round, slightly funnel shaped and the burrows themselves went vertically down (Plate 18). The fish disappeared into its burrow almost as soon as it was seen, and did not reappear. This allowed it to be recognised but no further description of the fish was possible. The site was marked with a temporary shot line.

A later search for further fish/burrows was carried out by two divers swimming on a bearing of 160° from this shot line. Three more groupings of burrows were found, which gave a total of 12 (including the original three). Some of the burrows looked as though they had been recently used, while others did not. No further fish were seen.

The search at Gannets' Bay was undertaken by the diver entering the water close to the western end of Gannets' Rock and then swimming over the sea bed on a bearing of 160° (Fig. 5). The bottom at 18 m bsl (= 13.8 m bcd) was of flat, softmud with frequent crustacean burrows. Almost immediately after the start of the dive, a "patch" of 4-5 Cepola burrows were encountered, one burrow being about 8 cm in diametre with the others being 3-4 cm. A further 8-10 "patches" of Cepola burrows were located whilst swimming on the bearing of 160°, totalling a possible 30 - 40 burrows in all. However, no fish were seen.

Several benthic animals are responsible for creating burrows in mud. The burrows can vary in diametre and orientation in the substrate, usually sufficient clues to guess at the burrow's usual occupant. However, unless the animal in question is seen at or close to the burrow, it can often be difficult to determine precisely which animal lives in any specific burrow. Cepola burrows are typically 6-8 cm in diametre at their entrances, the shaft being vertical, 60-70 cm deep (Atkinson and Pullin, 1977). The top section of the shaft is sometimes linked with the gradually-sloping tunnels of the angular crab Goneplax rhomboides, which are approximately 4 cm in diametre. It may be, therefore, that several of the burrows observed in "patches" in Gannets' Bay are those of Goneplax and not Cepola, though it is possible they may be of young Cepola.

6. Counts of Tritonia odhneri on Eunicella verrucosa

The following two paragraphs are taken from the report of the 1987 monitoring studies (Howard 1987).

"The sea slug Tritonia odhneri was first described in 1963 from specimens collected in Brittany and is currently known to occur from southern Spain to the west coast of Ireland, with records in Britain

from North Cornwall other than Lundy. In 1975 it was found at Lundy by Brown and Hunnam (1976). Their work included a quantitative study of the abundance of Tritonia on its host Eunicella verrucosa. They describe Tritonia as being commonly encountered along a stretch of coast from Brazen Wall to Halfway Wall Bay. Along two transects off Brazen Ward, 36 colonies of E. verrucosa were encountered of which 11 (30%) had a total of 22 spawn masses and 25 adult T. odhneri. In view of the scientific interest of this species and the known variability of abundance of sea slugs, a study was undertaken at the Quarry Bay monitoring site to assess the abundance of T. odhneri in 1896, and repeated in 1987 [and 1990]."

"The survey area selected was divided into three sections: the area of the transect line and to 10 m north; the area south of the transect marker buoy (to about 20 m south); and the area north of 10 m from the transect line for a further ca. 25 m. The band of boulders occupied by sea fans from the algal dominated shallow boulders to the mud plain was fairly narrow and provided the opportunity to include all the sea fans present. Each Eunicella encountered was closely inspected and the following features recorded:

Size of fan (large, medium or small, where L = larger than 20 x 25 cm, M = 10 x 15 cm, S = smaller than 10 x 15 cm).

Number of Tritonia odhneri present.

Number of egg masses of T. odhneri present.

Drift weed cover of sea fan (on a scale of 1 to 10).*

Amount of sea fan dead (on a scale of 1 to 10).* "

[* These were not recorded as accurately in 1990, but cover of drift weed was noted]

The results of the 1990 studies are set out in Table 2. A total of 23 Eunicella were inspected, which unfortunately was considerably fewer than were looked at in 1986 (76) and in 1987 (63). Five Tritonia and 14 egg masses were recorded from 8 sea fans. Thus 35% of sea fans supported Tritonia or their eggs (Plate 16).

This figure of 35% compares with 11% in 1987, 22% in 1986 and 30% in 1975. However, the sample size was considerably smaller in 1990 than in the previous years, so this apparent increase in abundance should not be viewed in direct comparison. Still, it is encouraging to note that after the poor showing in 1987, numbers of Tritonia are being maintained.

TABLE 2

Sea fan	Size	No. of Tritonia	No. of egg masses	Notes
C. Eno:	Quarry Bay, NW of transect			
1	M	-	-	
2	M	-	-	Mermaid's purse
3	M	-	1	Weed cover
4	M	-	-	Mermaid's purse
5	M	2	5	Weed cover
6	L	-	-	
7	S	-	-	
8	L	1	-	
9	M	-	-	
10	L	-	2	Stragly

TABLE 2 (cont.)

S. Bolt:	Quarry Bay, W side of transect			
1	S	-	3	
2	M	1	2	White sea fan
3	M	-	1	White sea fan
4	M	-	-	In crevice
5	L	-	-	Weed cover
6	M	-	-	Mermaid's purse
7	S	-	-	Weed cover
8	S	1	-	
S. Warman:	Quarry Bay, S end of transect			
1	S	-	-	10% weed cover
2	M	-	-	40% weed cover
3	M	-	-	
4	M	-	-	
5	S	-	-	

7. Searches for possible west coast monitoring sites

The possibility of having a monitoring site (or sites) off the west side of the island has been talked about since the monitoring studies were set up in 1984. Such a site would allow direct comparisons to be made between the physical conditions experienced by the exposed west side and the relatively sheltered east side. However, the prevailing westerly and south-westerly winds do make the west side of the island

far more difficult to reach and the timing of visits unpredictable. This may mean that it could prove impossible to visit the site(s) in the future during the July sublittoral monitoring week.

The weather remained calm throughout the week we were there in July 1990, which meant we were able to inspect two possible monitoring sites (one in Jenny's Cove and the other off Battery Point) and assess their suitability. Full descriptions of these dives are given in Appendix III (see also Plate 21). While both had ample examples of horizontal and vertical surfaces over which a transect could be positioned, easy relocation of the sites could prove difficult. In Jenny's Cove, there seemed to be few appropriate crevices into which pitons could be hammered, so site marking would need to be done using ringbolts drilled into the granite. This could take some time to complete, so a further 2 days work would be necessary, firstly to decide on a suitable site and secondly to set up the transect and mark the site.

8. Discussion

A. On fieldwork in 1990

It was fortunate that the week of 14th - 21st July was blessed with good weather. This meant that, of a very full work programme, all the objectives set out in Section 1 of this report were accomplished. It should be remembered, however, that on future visits the weather may not be so fair, for which contingencies must be allowed. We were also fortunate in having no malfunctions with the photographic equipment, allowing us efficient use of man dives.

Site Relocation

This year, only one team member (RI) of the four had dived on the monitoring sites. Indeed, he was the only one to have dived anywhere around Lundy! This could have led to difficulties (for instance, if he had been unable to dive for some reason or other), but fortunately it didn't. There were a few minor difficulties, however, in relocating some sites and individual pitons/ringbolts at those sites.

The relocation of sites relies on the following factors:

(1) accurate sighting marks on the surface;
(2) photographs and diagrams which can be used under water by the divers;
(3) knowledge of the local topography;
and (4) some means of site marking (e.g. sub-surface marker buoys).

If any of these 4 factors are missing or are found to be inaccurate, then the task of relocating the site quickly and easily is made that much more difficult. Obviously, the more team members which

are familiar with the sites from previous years, the greater the chances of swift site relocation. The sub-surface marker buoys which had been left to mark the Quarry Bay and Gannets' Rock monitoring sites at the end of the 1988 work were both missing. The reason for their disappearance is not known. As both pitons/ringbolts holding the buoy line were still intact, the lines must have come undone, but whether this was as a result of natural causes or whether they were untied by sports divers remains a mystery.

Certainly, markers of this sort aid site relocation; perhaps buoys and/or individual ringbolts/pitons should be marked more clearly with something like: "Marine Nature Reserve - experiment in progress". One reason why this hasn't been done already is that it is likely to attract attention to the area, and thereby increase the likelihood of accidental damage being done by inquisitive divers to those species under study. The opposing view is that by clearly marking sites (perhaps with a brief description of their purpose), the profile of the MNR could be raised. One possible solution would be to ask the Warden or members of the local Ilfracombe and N.Devon Diving Club (who visit the island regularly during the summer) to keep a regular check on the sub-surface site markers.

Site maintenance

Site maintenance is proving to be costly in terms of using up man-dives, time which could be usefully spent on other tasks. This year, for the first time since the start of the sublittoral monitoring studies, a team of 4 divers (plus 1 cook/diver) was used. In the past, the team consisted of 3 divers (plus 1 cook/diver). This allowed us more man-dives in total, though site relocation restrictions (as mentioned above) meant that dives and dive personnel needed careful ordering.

The type of site markers that are being used at present (pitons and ringbolts) have been shown to have a useful underwater life of between 3 - 5 years. After this time they are so badly corroded as to need replacing. The method of replacing ringbolts is to drill a new hole into the granite rock, which, with the equipment available, is a time-consuming and energy-sapping exercise. The replacement of one ringbolt at the western end of the Knoll Pins transect took 6 man-dives to complete successfully. This is an unnecessary waste of valuable diving time.

Serious consideration needs to be given to replacing **all** the existing ringbolts and pitons with stainless steel or non-ferrous (e.g. brass) ringbolts which would be non-corroding. Location holes for these could be re-drilled using an underwater hammer-action compressed air drill with tungsten-carbide bits. Though these bolts would cost more at the outset, considerable saving would be made in the long run through lower maintenance costs.

Cepola searches

Use of the Hellaphone diver-surface cmmunications system worked well this year during the swims/drift dives, and its use would be recommended for future years. It was pleasing to re-discover the presence of Cepola off the Quarries during the second search in that area, and the discovery of likely Cepola burrows in Gannets' Bay. If searches are to be continued in future years, then these should certainly take place during July. It would also be interesting to undertake searches during May and June, and also at different times of the day (to include an evening dive). It is possible that visiting diving groups, or members of the Ilfracombe and N.Devon Club, could be encouraged to carry out such searches.

West coast monitoring site

The establishment of a monitoring site off the west coast has always had a rather low priority in the past when viewed against the list of tasks which require completing during a week's fieldwork. Our inspection of possible areas this year allowed us to assess the difficulties in setting up such a site, and for re-visiting it in future years. Certain questions need to be addressed first though, as to what useful information such a monitoring site could provide. Obviously it could provide comparative data to those collected from east coast sites, especially with regard to silt deposition, species growth rates etc. It would be useful as well to include certain species which are not present on the east coast transects. If only one site is decided upon, the transect should include adequate coverage of both horizontal and vertical bedrock/boulder surfaces. As the chances of visiting such a site annually are slight (on account of adverse weather conditions), the transect should be marked with non-corroding markers.

B. On future sublittoral monitoring work

The present sublittoral monitoring studies were initiated in 1984. Reports of the work undertaken in 1985 (Hiscock), 1986 (Hiscock) and 1987 (Howard) included some comparisons of results. Hiscock (1989) has also analysed these results with regard to the stability of communities, reproduction and recruitment by certain species, and to climate change. However, since 1987, no full assessment of change in the marine communities and in growth rates of certain species has taken place. Before any proposals can be agreed upon for future sublittoral monitoring work at Lundy, a full analysis of the photographic results obtained so far needs to be undertaken. Such a desk study (of perhaps 2-3 months duration) could also serve to pull together all the information which is known about the island's marine fauna and flora, including temporal changes.

Perhaps in conjunction with this, a meeting should be arranged inviting all those involved in marine monitoring work in this country to attend, so that ideas could be pooled and results shared. It is

likely that the Nature Conservancy Council would be looked upon as the probable instigators and organisers of such a meeting.

Once an analysis of the Lundy photographic results had been completed, a decision could be made as to how often the monitoring work needed to be undertaken: once a year (as now)?; once every two years?; or even less frequently? This would allow for greater forward planning of fieldwork visits to the island. A future site maintenance programme would depend on whether it was decided to use non-corroding markers to mark transects. If non-corroding markers are continued to be used, then maintenance of these will be required each year. It is possible that maintenance could be carried out by volunteer divers, perhaps as part of a Marine Conservation Society expedition to the island.

In order to compliment the species monitoring programme, regular sea water temperature recordings need to be kept, preferably by the Warden. (I understand Andrew Gibson is already doing this). Meaningful measurements of turbidity are far harder to obtain, primarily because the amount of matter in suspension changes from day to day and at different depths, and that the methods used must be easily and exactly repeatable. The Warden has been distributing questionnaires to visiting divers, one question of which relates to underwater visibility. However, divers' estimates of horizontal visibility have been shown to vary greatly, so information obtained in this way may not be very reliable.

9. Recommendations for future work

The following recommendations are given in light of discussions amongst fellow team members and the Lundy Warden.

1. Serious consideration must be given to the most appropriate means and methods of continuing the Lundy sublittoral monitoring programme. A long-term strategy must be agreed for future funding to be available and for the participation of NCC staff.

2. A desk study should be commissioned to assess the results of the Lundy sublittoral monitoring studies to date, and also to draw together all information known on the marine fauna and flora within the Marine Nature Reserve.

3. All the ringbolts and pitons marking transect sites should be replaced with ringbolts made of stainless steel or some other non-corroding metal. The use of a hammer drill and best quality drill bits for this are to be recommended. Time should be allowed, and funds made available, for this "full service" of all the sites to be accomplished, hopefully in 1991.

4. Further thought should be given to the most appropriate way of marking branching sponges at the Quarry Bay site for the purposes of positive identification.

5. Adequate time should be allowed for the exact position of the transect ALT4 to be determined at the Knoll Pins. A new concrete marker block should be placed at the lower end of the transect (if the old one cannot be found) with a sub-surface marker buoy firmly attached to it.

6. Following investigations of possible west coast sites in 1990, a site off the Battery at approximately 20 m should be chosen and a monitoring site established there.

7. Viewpoint photographs should be re-taken, and an assessment of re-colonisation of cleared areas should be made on the wreck of the M.V."Robert".

8. Searches for the red band fish Cepola rubescens should be continued at both the Quarry Bay/Halfway Wall Bay site and at Gannets' Bay. Serious consideration should be given to involving volunteer divers in this work - either the local diving clubs or members of the Marine Conservation Society.

9. Photographic monitoring at established transect sites should be continued, the frequency of this depending on the outcome of the analysis of results so far.

10. Acknowledgements

We are grateful to the Landmark Trust and the Lundy islanders for their help and cooperation; to the Captain and crew of the M.V. "Oldenburg" for assistance with our inflatable and associated diving equipment; to the Lundy Warden Andrew Gibson and his son Chris for their advice and assistance; and to the Ilfracombe and North Devon Sub-Aqua Club members for undertaking to complete an accurate scale drawing of the wreck of the M.V. "Robert" in order to assist future viewpoint photography and monitoring.

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Appendix II

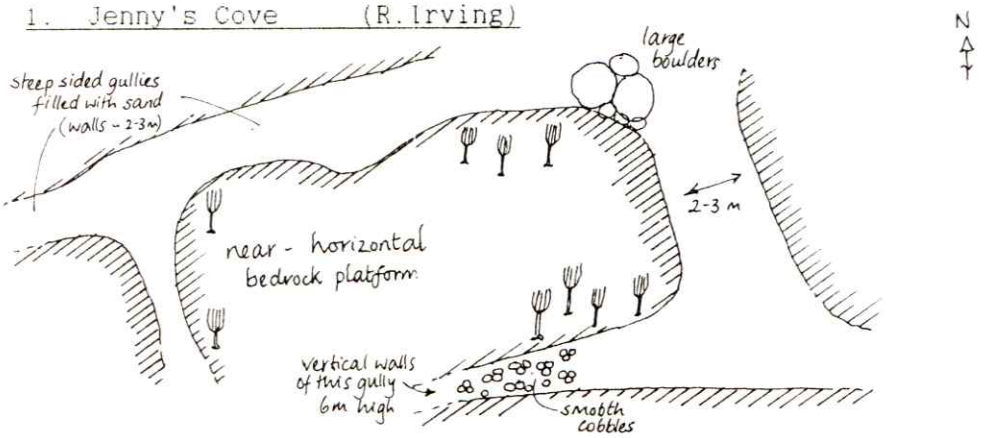
Historical Account of Monitoring Studies at Lundy

DESCRIPTION OF SURVEY	TECHNIQUES USED	WORK CARRIED OUT
Photographic monitoring at the Knoll Pins	Initially by viewpoint photography of a conspicuous cave. Pitons and ringbolts were used in 1984 to mark a transect relaid on each survey. Sequential photographs 50 x 50 cm taken along the top and bottom of the transect. Mosaic of 22 x 16 cm taken in a cave below the transext line. Photographs taken by viewfinder with 28 mm lens in 1984 and with framer and 15mm lens 1985 to 1988, plus 1990.	Views of "the cave" in 1981 and 1983 to 1988 inclusive, and again in 1990. Photographs at about transect line position in 1983. 50 x 50 cm and 22 x 16 cm photographs taken 1984 to 1988 inclusive, plus 1990.
Photographic monitoring at Quarry Bay	Ringbolts were used in 1984 at the edge of the boulder slope to mark a transect, relaid on each survey. Photographs of 50 x 50 cm along the transect and of 22 x 16 cm on the side of one boulder. Viewpoint photographs of individual sponges and sea fans. Transect photographs taken by 28 mm lens and parallax-corrected view finder in 1984 and with 15 mm lens and framer in 1985 to 1988, and in 1990. Photographs of individual animals taken with standard lens using parallax-corrected viewfinder.	Photographs taken 1984 to 1988 inclusive, plus 1990.
Photographic monitoring at Gannets' Rock	Pitons and ringbolts were used in 1984 down the cliff north of Gannets' Rock Pinnacle to mark a transect relaid on each survey. Sequential 50 x 50 cm photographs along the transect taken by view finder with 28 mm lens in 1984 and with framer and 15 mm lens in 1985 to 1988, plus 1990.	Photographs taken 1984 to 1988 inclusive, plus 1990.
Surveys of the red band fish Cepola rubescens	Tow dives using telephone communication along set position and direction in Halfway Wall Bay using transit marks. Swim across Gannets' Bay. Present transit marks and methods were determined by Hiscock in 1983. Cepola located in 1987. 4 x 50 m transects N, E, S, and W of Cepola site worked in 1987. Circular searches around Cepola site in 1988. Swim searches continued in 1990, with another Cepola located off the Quarries and burrows found in Gannets'Bay.	The area was surveyed systematically in 1977 by Pullin and Atkinson (1978). Tow dive surveys in 1983 to 1988 inclusive. Circular searches around 1987 Cepola site in 1988. Swim searches in 1990.
Algal Limits Monitoring	A location with steeply sloping rocks extending below the lowest limit of foliose algae at the Knoll Pins. 50 x 66.6 cm photographs taken using framer and 15 mm lens along four transects. Depth profiles were drawn but monitoring is in relation to topographical features and the transect. Difficulty relocating ALT4 in 1990.	Established and photographed in 1985. Photographed in 1986 and 1987. Only Transect 4 photographed in 1988 with recording of species present. Transects 4 & 3 photographed in 1990 with species recorded.
Abundance of Tritonia odhneri on Eunicella verrucosa	First undertaken at the Quarry Bay site in 1986. Each sea fan was inspected and the presence and numbers of Tritonia and spawn recorded.	Survey in 1986, 1987 and 1990.
Observations on the wreck MV "Robert"	Observations and photographs of the communities living on the wreck. Specific viewpoint locations determined in 1990. Two 30 x 30 cm patches cleared on superstructure in 1990 to study resettlement.	First surveyed in 1979 having remained indiscovered for four years after sinking. Resurveyed in 1980, 1984, 1986 and 1987. Viewpoint photographs taken in 1990.

Appendix III

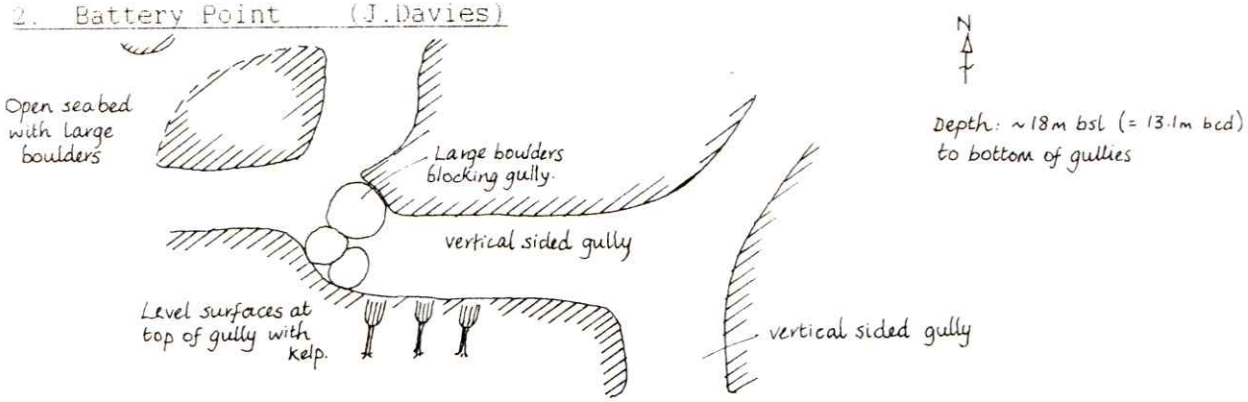
DIVE DESCRIPTIONS FROM POSSIBLE WEST COAST MONITORING SITES

1. Jenny's Cove (R.Irving)



Dived in approximately the centre of the Cove. Sea bed at 20 m bsl (= 15.1 m bcd) was of massive near-horizontal platforms of granite intersected by sand-filled gullies with walls 1-2 m high. Kelp was present on top of the bedrock outcrops with a band of foliose algae below. There was little that stood proud of the rock in the circalittoral, indicating that strong wave action affects this area from time to time, scouring the rock surfaces with mobile cobbles and sand. Though there were ample examples of both horizontal and vertical surfaces, it was difficult to envisage how these could be easily relocated.

2. Battery Point (J.Davies)



An interesting site with a mixture of vertical and horizontal surfaces. Massive boulders have created a series of vertical- sided gullies. Vertical surfaces were encrusted with a bryozoan turf (Crisia sp. and Bugula spp.) with A. digitatum. All surfaces had a covering of silt. Base of gullies had cobbles with very sparse encrusting life - suggests reasonably strong water flow through gullies. Horizontal surfaces were characterised by kelp forest with foliose and filamentous algal turf below.

Site has potential as a monitoring site: the range of horizontal and vertical surfaces provide good variety (see Plate 20). The gullies could be easily located and mapped as necessary.

Plate 1 Quarry Bay: SE face of Boulder 2, 29.7.85 (LSM/92/85)

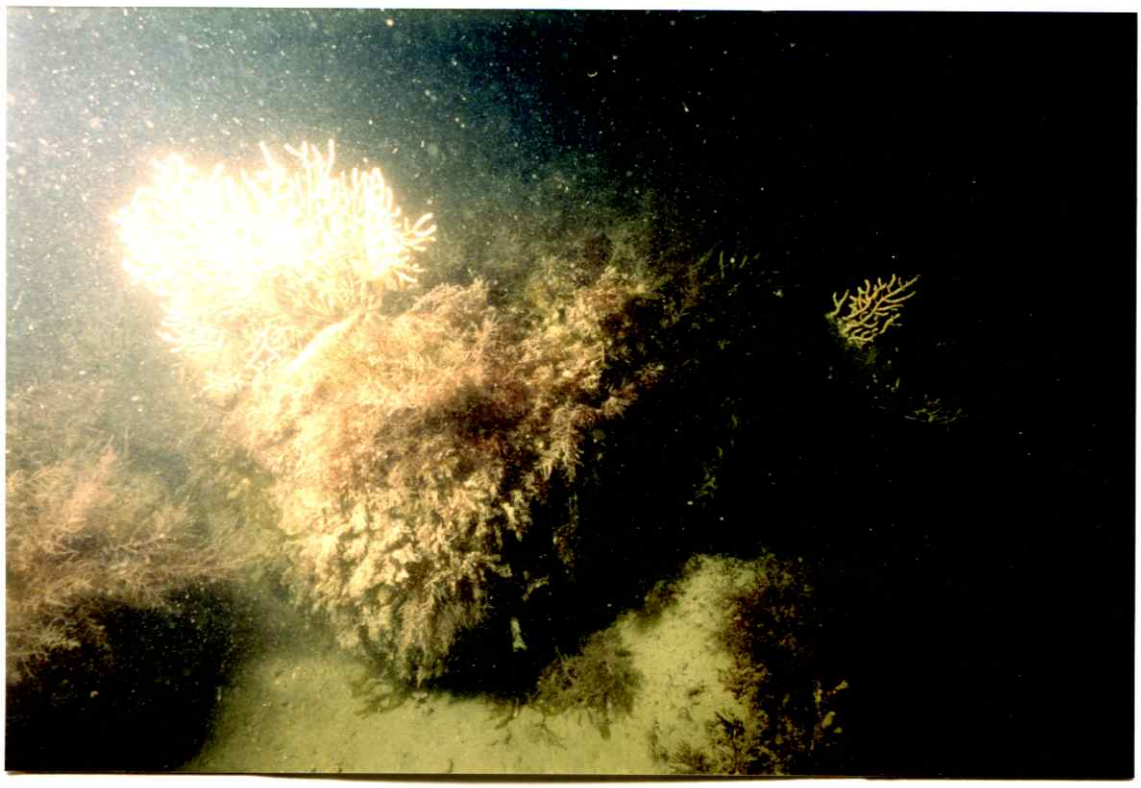


Plate 2 Quarry Bay: SE (S) face of Boulder 2, 17.7.90 (LSM/041/90)

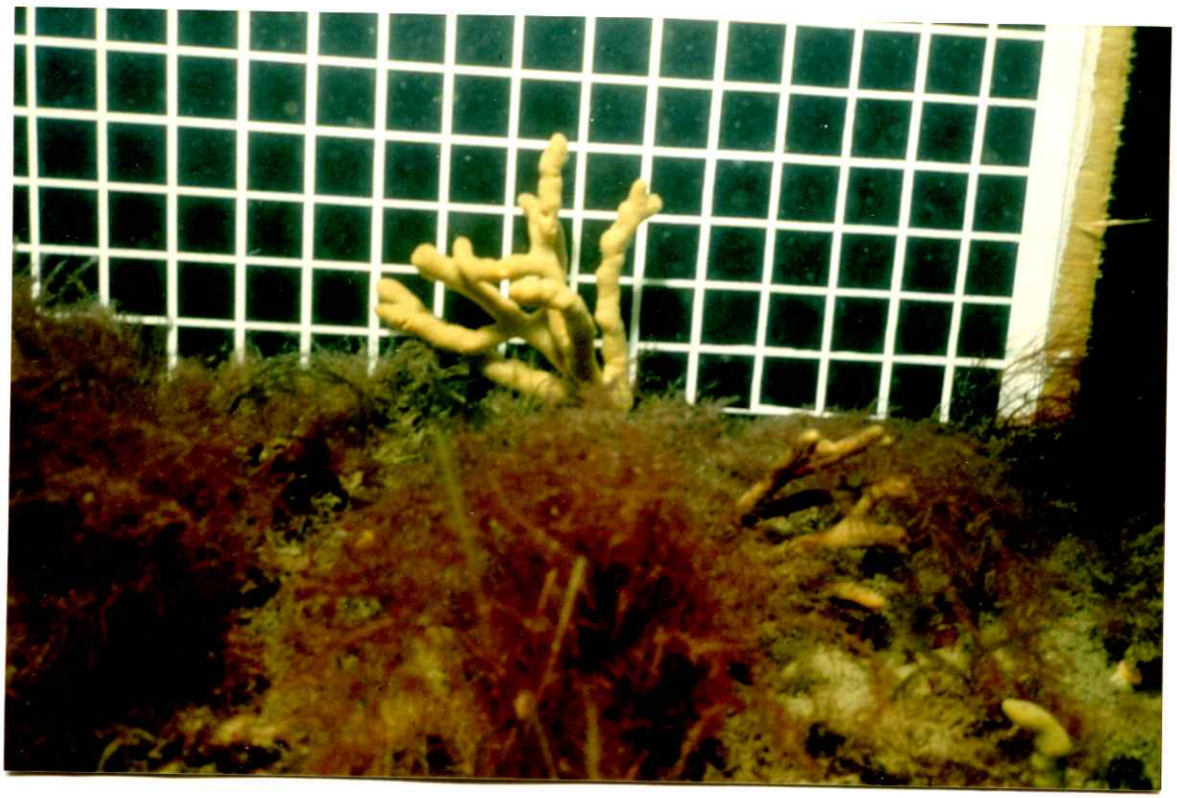


Plate 3 Quarry Bay: Axinella polypoides No.1e, 27.7.86 (LSM/56/86)

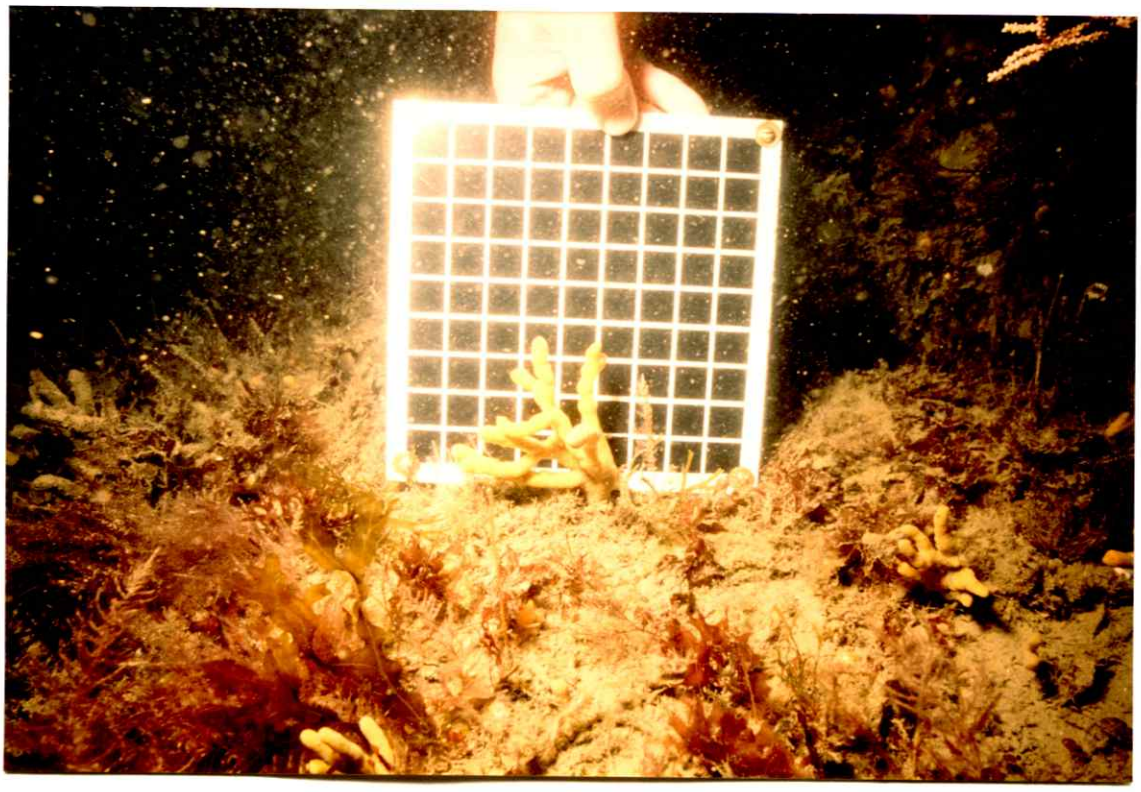


Plate 4 As above, 17.7.90 (LSM/49/90)

Plate 5 Quarry Bay: Eunicella verrucosa No.2g 29.7.85 (LSM/87/85)

Plate 6 As above, 28.7.86 (LSM/61/86)

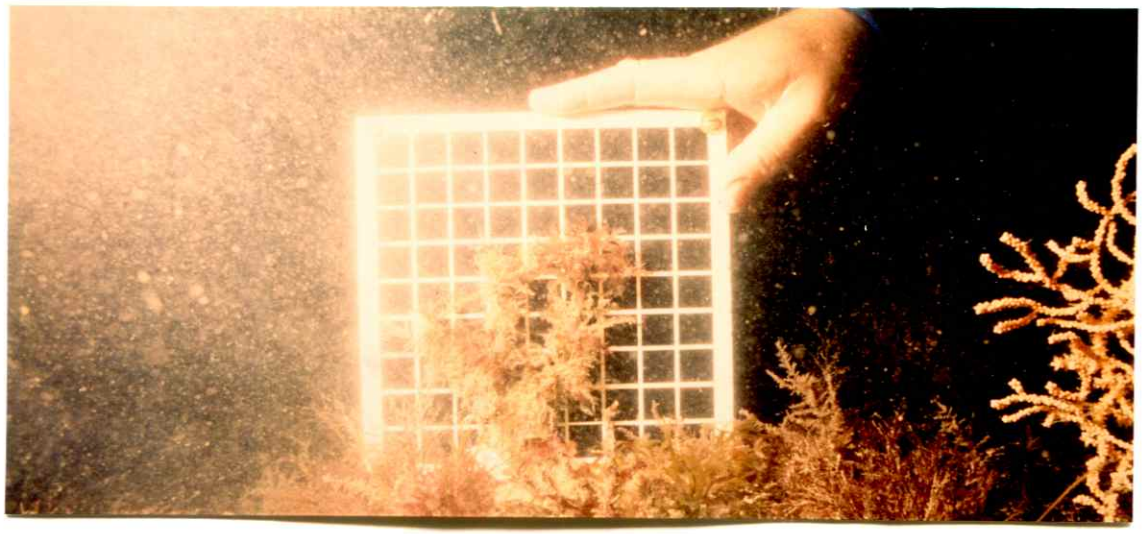


Plate 7 As above, 17.7.90 (LSM/56/90)

Plate 8 Quarry Bay: Experimentally tagged Eunicella No.6 (LSM/87/90)

Plate 9 Quarry Bay: Experimentally tagged Axinella No.1 (LSM/63/90)

Plate 10 Quarry Bay: Broken Axinella polypoides. This was found during the first dive at this site, and may have been knocked off accidentally by a diver undertaking monitoring work. It demonstrates how fragile such long-lived organisms are to rough treatment.

Plate 11 Cleared patch on the superstructure of the wreck of the MV "Robert".

Plate 12 Knoll Pins Transect, 1.5-2.0 m L 30.7.85 (LSM/161/85)

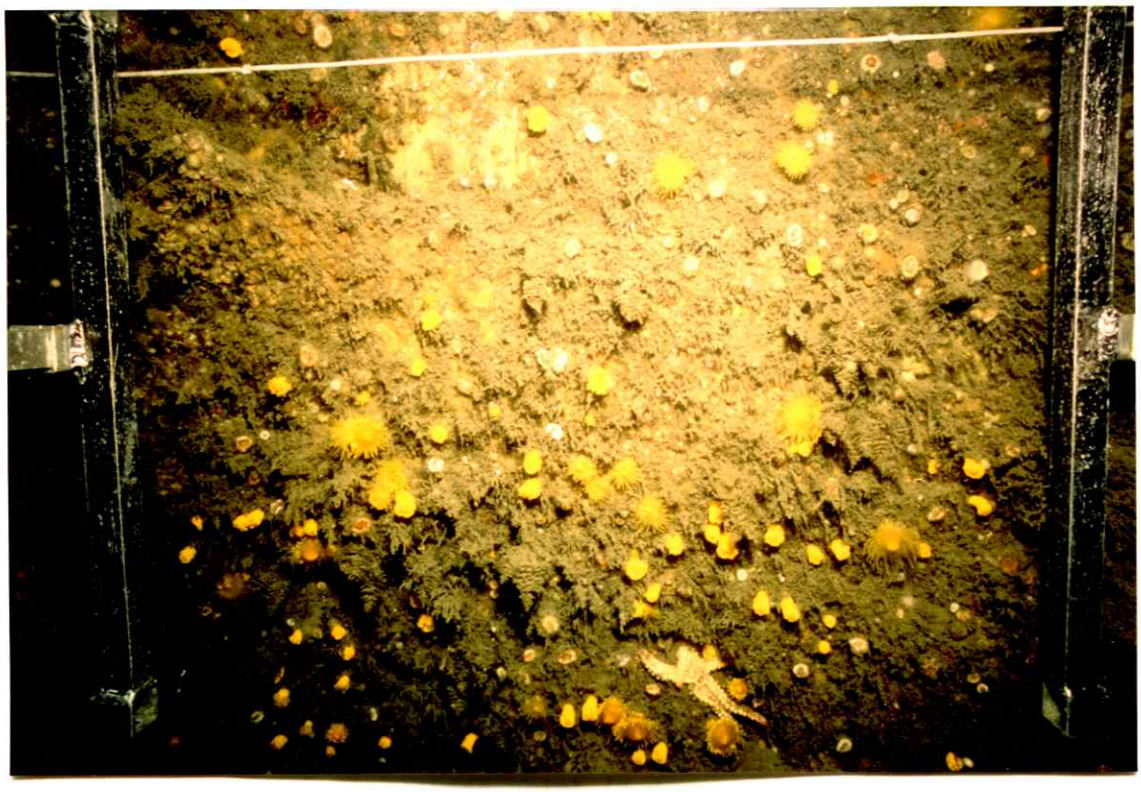


Plate 13 As above, 17.7.90 (LSM/102/90)

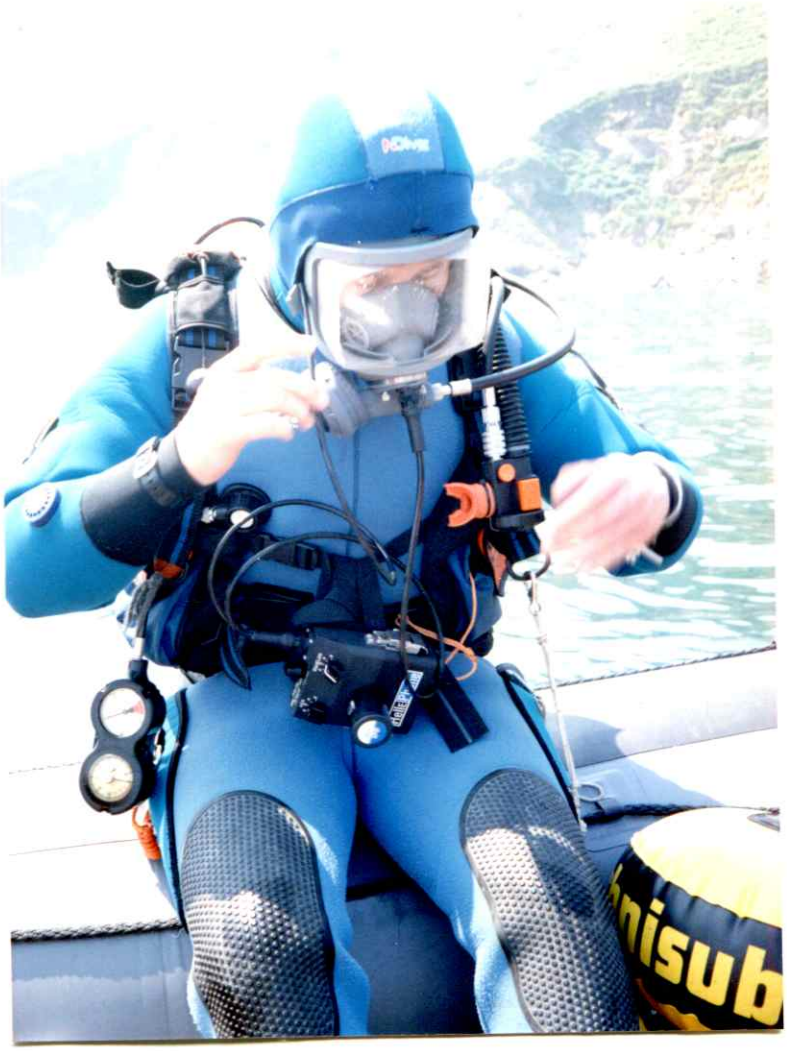


Plate 14 Diver kitted up with "Hellaphone" underwater communications set. A full-face mask allows the diver to speak. A small microphone passes the message to a transmitter strapped to the diver's chest, which, by means of ultrasound pulses, conveys it to the listener on the surface (or to a fellow diver under water).

Plate 15 Diver and "listener" in surface support vessel. Notice the "pick-up" microphone which is lowered by its cable into the water.

Plate 16 The nudibranch Tritonia odhneri (left) and spawn coil (right) on Eunicella verrucosa (picture width 8 cm).

Plate 17 A basking shark Cetorhinus maximus, about 6 m long, encountered in Jenny's Cove, 19.7.90

Plate 18 Burrow of the red band fish Cepola rubescens, off the Quarries, 18.7.90

Plate 19 A male Cepola rubescens in its burrow off the Quarries, 23.7.87

LUNDY SUBLITTORAL MONITORING 1990

LIST OF PHOTOGRAPHS (TRANSPARENCIES)

Photo No.	Site and Description
LSM/001/90 - 002/90	Quarry Bay, transect line: location of LH bolt at N end of line. RI 17/7/90
LSM/003/90 - 004/90	Quarry Bay: broken axinellid sponges. RI 17/7
LSM/005/90 - 034/90	Quarry Bay, transect line: E side first, then W. SB 17/7
LSM/035/90 - 037/90	Quarry Bay, transect line: location of bolt at S end. SB 17/7
LSM/038/90	Quarry Bay: Boulder 1, N face RI 17&18/7
LSM/039/90	" : " S face "
LSM/040/90	" : " SW face "
LSM/041/90	" : Boulder 2, S face "
LSM/042/90	" : " S face "
LSM/043/90	" : " N face "
LSM/044/90	" : " N face "
LSM/045/90	" : 1a Eunicella (no.1) "
LSM/046/90	" : 1a " (no.1) "
LSM/047/90	" : 1b Eunicella (1c missing)(no.2)"
LSM/048/90	" : 1d Axinella "
LSM/049/90	" : 1e Axinella "
LSM/050/90	" : 2a Eunicella (no.3) "
LSM/051/90	" : 2c Axinella "
LSM/052/90	" : 2c Axinella "
LSM/053/90	" : ?2d and ?2e sponges "
LSM/054/90	" : 2f Axinella "
LSM/055/90	" : 2f Axinella "
LSM/056/90	" : 2g Eunicella (no.4) "
LSM/057/90	" : 2h Eunicella (no.5) "
LSM/058/90 - 061/90	" : Tagged Eunicella no.10 JD 17/7
LSM/062/90 - 065/90	" : Tagged Axinella no.1 "
LSM/066/90 - 069/90	" : Tagged Axinella no.2 "
LSM/070/90 - 073/90	" : Tagged Eunicella no.6 "
LSM/074/90 - 075/90	" : Tagged Eunicella no.7 "
LSM/076/90 - 077/90	" : Tagged Eunicella no.8 "
LSM/078/90 - 079/90	" : Tagged Eunicella no.9 "
LSM/080/90	" : Tagged sponge no.3 RI 18/7

Photo No.	Site and Description	
	M.V."Robert": viewpoint photographs	SB 20/7
1+2 LSM/321/90	" : top scraped patch on superstructure	
LSM/322/90	" : side scraped patch on superstructure	
3+4 LSM/323/90	" : air vent on superstructure	
LSM/324/90	" : " " " "	
5+6 LSM/325/90	" : bollards, f'w'd port side	
LSM/326/90	" : " " " "	
7+8 LSM/327/90	" : outer steps, f'w'd port side	
LSM/328/90	" : " " " " "	
9-10 LSM/329/90	" : bow corner (port side)	
LSM/330/90	" : " " " "	
11-12 LSM/331/90	" : inner steps, f'w'd port side	
LSM/332/90	" : " " " " "	
13 LSM/333/90	" : steam pipe, funnel (conger hole)	
14 LSM/334/90	" : top/aft of superstructure	
15 LSM/335/90	" : hole in aft side of superstructure	
16 LSM/336/90	" : axinellid sponge on rail, stern area	
17 LSM/337/90	" : ring on centre of stern	
18 LSM/338/90	" : bare/rusty patch on hull, aft	
19 LSM/339/90	" : propeller shaft	
LSM/340/90	Jenny's Cove: Basking shark	JD 19/7
- 344/90		
LSM/345/90	Off the Battery: Hydroid/bryozoan turf on bedrock. "	
LSM/346/90	" : " " " " "	
LSM/347/90	" : Marthasterias & A.digitatum on turf.	
LSM/348/90	" : Polymastia boletiforme & Asterias.	
LSM/349/90	" : Infralittoral bedrock, sparse algae.	
LSM/350/90	" : Maia squinado, upper infralittoral.	
LSM/351/90	" : Vertical infralittoral bedrock	
LSM/352/90	" : " " "	
LSM/353/90	" : Ballan wrasse, Labrus bergylta	
LSM/354/90	" : Edible crab, Cancer pagurus	

Photo No.	Site and Description	
LSM/081/90	Quarry Bay: Tagged sponge no.3	RI 18/7
LSM/082/90	" : Tagged sponge no.4	"
- 083/90		
LSM/084/90	" : Tagged sponge no.5	RI 18/7
- 085/90		
LSM/086/90	" : Tagged Eunicella no.6	"
- 087/90		
LSM/088/90	" : Tagged Eunicella no.8	"
- 089/90		
LSM/090/90	" : Tagged Eunicella no.10	"
- 092/90		
LSM/093/90	Knoll Pins: horizontal transect line	RI 17/7
- 126/90	E to W, above/below.	
LSM/127/90	" : location of marker piton, E end	
- 128/90		
LSM/129/90	" : location of E end piton	RI 18/7
LSM/130/90	" : location of piton to R of cave	
LSM/131/90	" : location of central piton	
LSM/132/90	" : location of W end piton	
LSM/133/90	" : location of W end piton	
LSM/134/90	" : location of W end piton	
LSM/135/90	" : wide angle views of cave area	SB 20/7
- 147/90		
LSM/148/90	" : Close-up, LH side of cave	SB 16/7
- 183/90		
LSM/184/90	" : Close-up, RH side of cave	SB 17/7
- 220/90		
LSM/221/90	" : ALT4 transect (?approx.)	JD 19/7
- 244/90	from lower end, alternating upwards.	
LSM/245/90	" : Pentapora beside ALT4	
LSM/246/90	" : Parazoanthus beside ALT4	
LSM/247/90	" : ALT3 transect (?approx.)	SB 20/7
- 272/90	from lower end, alternating upwards.	
LSM/273/90	" : deepest alga, beside ALT3, @24m bsl.	
LSM/274/90	Gannets' Rock: vertical transect	JD 19/7
- 307/90	from lower end, alternating upwards.	
LSM/308/90	" : Pentapora at base of cliff	
LSM/309/90	" : location of "additional" piton (1st up)	
LSM/310/90	" : piton to R of Alcyonium clump	
- 311/90		
LSM/312/90	" : location of "additional" piton (3rd up)	
LSM/313/90	" : location of top piton	
- 314/90		
LSM/315/90	" : location of top and buoy pitons	
LSM/316/90	" : location of buoy piton(s)	
- 317/90		
LSM/318/90	Off Quarry Bay: Cepola burrow	JD 18/7
- 320		