

MARINE BIOLOGICAL MONITORING AT LUNDY

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INTRODUCTION

Monitoring studies are intended to follow changes in species and communities with time. The work described here was aimed at monitoring natural fluctuations and establishing the longevity of some of the species of high conservation importance present on the shore and underwater at Lundy. Such information is important for management of natural resources and provides a background against which the effects of man's activities can be assessed.

For Lundy, there is an historical basis in the writings of Professor L. A. Harvey (Anon., 1949; Harvey, 1950, 1951) to help discover whether similar species are present on the shore now to those present in the late 1940's and early 1950's. Also, records from the early studies carried out by diving from 1969 to 1976 provide descriptions of underwater communities which can be compared with current observations. This approach can reveal some large changes. For instance, the shore communities, including rare species described by Professor Harvey, are apparently much the same now as over thirty years ago. However, the subtidal population of the red band fish *Cepola rubescens* in Halfway Wall Bay which was estimated to be about 14,000 individuals in 1977 (Pullin *et al.*, 1978) now appears to be extinct. Similarly, the brightly coloured sea slug *Greilada elegans* which was so abundant in 1975 and 1976 is now rarely seen. Some subtidal species appear to be present in remarkably similar numbers at the same sites from year to year, particularly the sea anemones, corals, soft corals and sea fans, but also sea urchins, wrasse and many others. Such informal observations detect gross changes or similarities but do not generally record trends of decreasing or increasing abundance or give any information on the longevity or growth rates of individual organisms. Such data are essential to the conservation of marine species and communities. Decisions regarding management of marine areas must be based on a knowledge of the dynamics of the communities being conserved and the likely degree of disturbance that is acceptable. A highly changeable community where species are recruited rapidly and die quickly is much less vulnerable to disturbance than one which is composed of very long-lived, slow-growing species with poor or no recruitment. In 1984, the Nature Conservancy Council commissioned studies of intertidal and subtidal communities including the establishment of marked sites to monitor any change in the main species present, particularly those of conservation importance, and to investigate the growth, recruitment and loss of individuals within those areas. Much of the work was undertaken again and expanded in 1985. Locations where work is being undertaken are shown in Fig. 1. This note describes the work we are doing and some preliminary results. Full results are given in reports to the NCC (Hiscock, 1984 a and b and 1986).

INTERTIDAL AREAS

In 1984, sites were established to monitor changes in rockpool communities at the Devil's Kitchen and above Mermaid's Pool at Lametry, to record from groups of cup corals on the southern and eastern coasts, and to study groups of anemones in one of the caves at Rat Island. Photographs were also taken of the shores at the Landing Beach and Lametry Bay from viewpoints below the Castle and from the South Light steps respectively. Relocation of all of these sites or of the viewpoints for photography of shores depends on the use of photographs and sketches held by the author and by the Nature Conservancy Council.

Rockpools

Rockpools on the slate platform of the Devil's Kitchen are rich in species and occur at all levels on the shore. In April 1984, a series of seven pools were selected for study, starting in the entrance to the subterranean passage and down to low water of neap

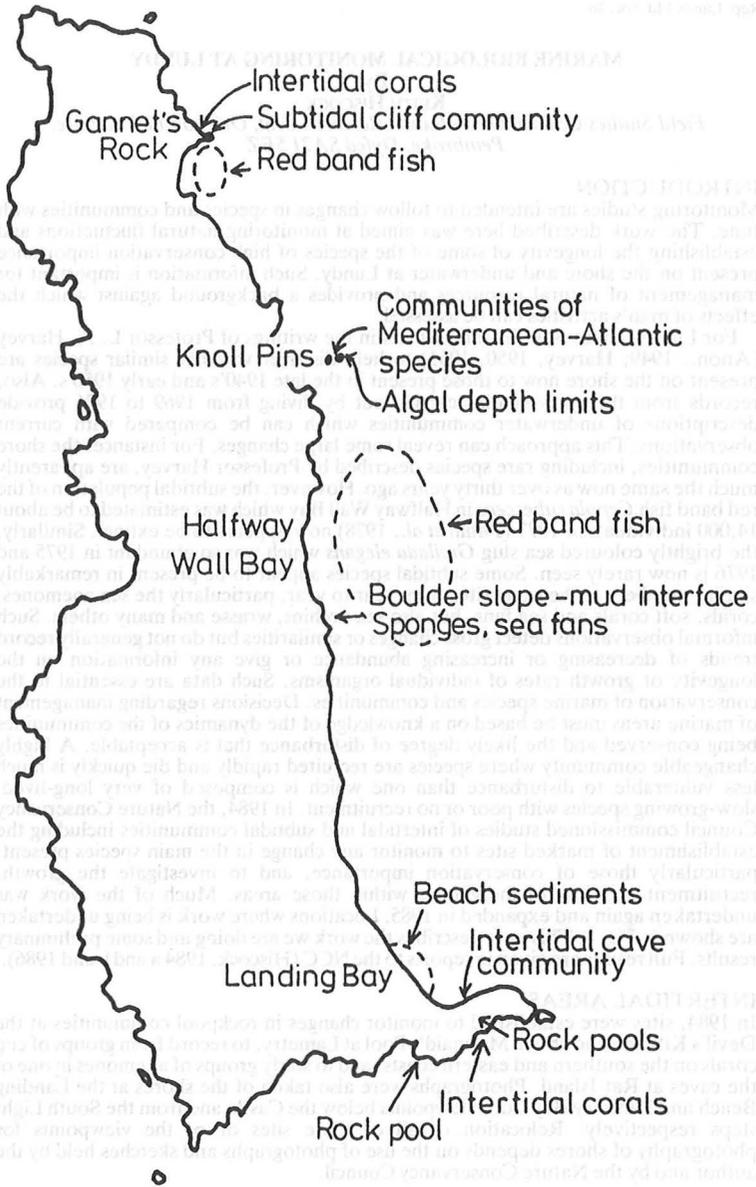


Fig. 1. Marine biological monitoring at Lundy. Locations where work is currently being undertaken.

tide level. The conspicuous species of algae and animals present in each pool were listed and a note of abundance made, but no sampling was carried out. In July/August 1985, the pools were resurveyed rapidly by comparing the 1984 list with the species present in the pools. All areas of shore including pools showed an increase in the abundance of the green alga *Enteromorpha*. In general, the species composition in pools was very similar, although the abundance of the finely branching red alga *Ceramium rubrum* was much greater in some pools in August 1985, probably a seasonal change. Also, the cushion star, *Asterina gibbosa*, was present on boulders in the uppermost pool but had most likely been underneath the boulders in April 1984 when it was not listed. There were many blennies and shrimps present in August, a seasonal influx.

At Lametry, a large, high-level pool contains an extensive area of the southern alga *Bifurcaria bifurcata*. Initial estimates of abundance by eye were made independently by three workers. Their estimates were of 30%, 25-30% and 25% cover. Measurements of the percentage of the pool covered by *B. bifurcata* were made by stretching a tape measure at positions 50 cm apart across the pool and measuring the length along the tape overlying *Bifurcaria*. The whole exercise was undertaken three times by two separate workers who recorded 28.7%, 25.7% and 26.6% cover. A visual estimate of percentage cover by experienced workers appears to provide a good basis for monitoring the abundance of this species — supported by measurement if any change is suspected. In 1985 it was planned to undertake a visual estimate of cover in the pool but foul weather prevented access.

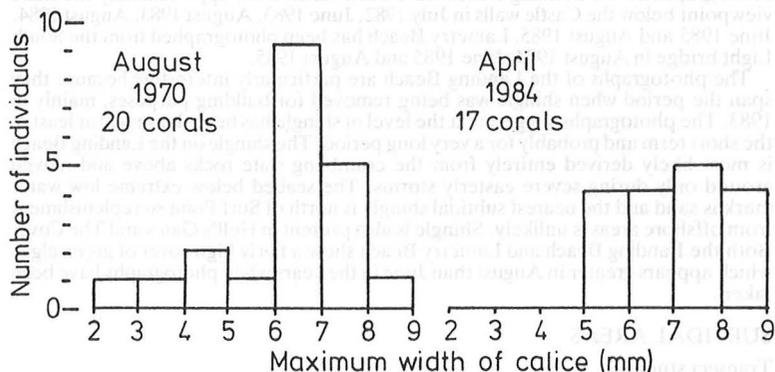


Fig. 2. Number of individuals and size distribution of *Balanophyllia regia* at the Devil's Kitchen monitoring site in August 1970 and April 1984.

Cup corals

Both the Devonshire cup coral *Caryophyllia smithii* and the scarlet and gold star coral *Balanophyllia regia* occur on Lundy. One site to measure the size and plot the numbers and locations of *B. regia* was established at the Devil's Kitchen in a location where the corals present there then had been measured and mapped in 1970 by K. Hiscock. The site was relocated and corals mapped and measured in April and September 1984. Fig. 2 shows the size of individuals and notes density on each occasion.

The site was not visited in 1985 due to rough seas.

Survey sites were also located north of Gannet's Rock in April 1984 and surveyed again in August 1985. Five *Caryophyllia smithii* present in April 1984 were present in the same locations as sketched then with no apparent recruitment or loss in the areas. Eleven *Balanophyllia regia* were present in the same locations as sketched in 1984 with one additional individual and three of the individuals sketched in 1984 not found.

Corals reproduce by the production of planulae larvae. *C. smithii* produces larvae between January and March which remain in the plankton for approximately ten weeks (Tranter *et al.*, 1982). *B. regia* produces larvae between May and July. The larvae may settle very quickly or swim feebly for several days before settling. In the aquarium, corals have been found to die only if starved or smothered by silt although predation by the painted topshell *Calliostoma zizyphinum* on *B. regia* has also been observed. (P. Tranter, K. Hiscock — observations). *B. regia* also survives crushing providing that a small amount of tissue remains and this might be important at the site north of Gannet's Rock where nearby boulders are obviously highly mobile.

Cave anemones

Large populations of anemones (*Actinia equina*, *Sagartia elegans* and dwarf *Metridium senile*) occur in some intertidal caves on Lundy and, at one of these sites, markers were established to allow photography of the same area of rock on each visit. A continuous series of 22 × 16 cm photographs was taken along the top and bottom of a line stretched between two stainless steel screws using a Nikonos camera equipped with 35mm lens, supplementary close-up lens, framer and Oceanics 2000 flashgun.

Comparison of photographs taken in 1984 and 1985 showed that very little change had occurred with anemones present in the same locations in each year.

Photographs of the Landing Beach and Lametry Beach

Photographs of the Landing Beach have been taken from approximately the same viewpoint below the Castle walls in July 1982, June 1983, August 1983, August 1984, June 1985 and August 1985. Lametry Beach has been photographed from the South Light bridge in August 1984, June 1985 and August 1985.

The photographs of the Landing Beach are particularly interesting because they span the period when shingle was being removed for building purposes, mainly in 1983. The photographs suggest that the level of shingle has been depressed at least in the short term and probably for a very long period. The shingle on the Landing Beach is most likely derived entirely from the crumbling slate rocks above and moved around only during severe easterly storms. The seabed below extreme low water mark is sand and the nearest subtidal shingle is north of Surf Point so replenishment from offshore areas is unlikely. Shingle is also present in Hell's Gates and The Cove. Both the Landing Beach and Lametry Beach show a fairly high cover of green algae which appears greater in August than June in the years when photographs have been taken.

SUBTIDAL AREAS

Transect studies

The sublittoral communities present on Lundy are exceptionally varied, a reflection of the wide range of habitats available for colonisation. Also, there are species of very high conservation importance because of their rarity elsewhere in Britain. Many of these species are highly colourful anthozoans including the sea fan *Eunicella verrucosa*, the pink sea fingers *Parerythropodium coralloides*, the red sea fingers *Alcyonium glomeratum*, the yellow cup coral *Leptopsammia pruvoti*, the corals *Caryophyllia inornatus* and *Hoplania durotrix*, and the zoanthid anemone *Parazoanthus axinellae*. The branching sponges such as *Axinella polypoides* and *Homaxinella subdola* are also conspicuous species we believe to be long-lived and very slow to colonise or grow. Studies of these species are particularly relevant to conservation of the area because of the isolation of populations from other than local recruitment and the potential for damage due to collection or damage by such activities as finning or exhaust bubbles lodging in the roofs of caves.

Another feature of underwater areas we wanted to look at in 1985 was the limits of algal penetrations with depth. Algae require light for photosynthesis and light is attenuated with depth below the surface due mainly to absorption and scattering from suspended particles. The turbidity of the water is a feature of water quality which might change with man's activities including the dumping of sewage sludge or the building of a tidal barrage in the Bristol Channel. But turbidity changes daily and

an effective way to monitor changes in turbidity is to use the biological features of the environment which integrate that change through the year and from year to year. Thus a study of the depth limits of the main algal zones (the kelp forest, dense or sparse foliose algae) would both help to detect long-term changes in water turbidity, and be interesting for the information it reveals on year-to-year fluctuations in zones and species.

Four locations were selected for study:

1. **North of Quarry Bay** at the edge of the mud plain where photography of boulders provided the opportunity to record the conspicuous species present, particularly sea fans and branching sponges, and the level of the mud plain in relation to the boulders.
2. **The Knoll Pins (north side)**. Communities of Mediterranean-Atlantic cup corals and soft corals are best-developed here. Part of this site has been photographed since 1981.
3. **The Knoll Pins (east side)**. Rock surfaces slope steeply to depths of up to 30 m below chart datum here and therefore provided the best location for the establishment of a site for monitoring changes in algal depth limits.
4. **Gannet's Rock Pinnacle**. This is a submerged pinnacle east of Gannet's Rock very similar to the emergent rock but with sediment piled against the south side. The north face provided a second location where Mediterranean-Atlantic anthozoans, particularly *Leptopsammia pruvoti* and *Alcyonium glomeratum*, could be monitored.

All these studies relied on the use of photography for recording. At Quarry Bay, the Knoll Pins (north) and Gannet's Rock Pinnacle, site locations were marked by pitons hammered into crevices, or holes were drilled with a small air-powered drill and ring bolts screwed into plastic plugs inserted into the holes. A line marked at 50 cm intervals was stretched along a chosen area of rock and additional pitons or ring bolts used to hold the line close to the rock. Colour-transparency photographs were taken along each side of the line to produce a mosaic of pictures all along and 50 cm each side of the line. At the Quarry Bay sites and Knoll Pins (north), a sequence of 22 × 15 cm areas were photographed over fairly flat rock to provide close-up photographs. At Quarry Bay, some sponges and sea fans were photographed against a board marked with a 2 cm grid. The Knoll Pins (east) site established in 1985 to monitor algal limits was not marked but an isolated and distinctive group of boulders at the base of a rock slope and near to the lowest limits of foliose algae, together with other topographical features along the transect, acted as markers. This transect was in four sections, each 8.33 m long with a line marked at 66.6 cm intervals. Each line was sketched and profiled using a depth gauge later calibrated against a shoreline to read depth below sea level at each mark. This was corrected to depth below chart datum using predictions and formulae in Admiralty tide tables. All of the photographs were taken with Nikonos underwater cameras equipped with flashguns. In 1984, distance photographs were taken mainly with a 28 mm lens and various film types, mainly Ektachrome 200. A parallax-corrected viewfinder was used to line up the photographs. Results from these photographs were adequate but of poor definition and colour. Also, the camera-to-subject distance and the angles at which the photographs were taken varied slightly from frame to frame, making the production of a mosaic difficult. In 1985, a hollow-section aluminium frame with camera and flashgun attached was used to maintain a constant distance away from the line. The frame was set with two ends, each 55 cm long and 70 cm apart, to enable the full 50 cm picture height and the full 50 or 66.6 cm picture width to be included in each photograph. Also, a Nikkor 15 mm lens was used in 1985 so that the camera-to-subject distance was less, and Fuji 50 ASA film was used to provide better definition and colour. Close-up photographs were taken in both years with a Nikonos supplementary lens, distance rod and framer attached to the 28 mm lens. Kodachrome 64 film was used in 1984 and Fuji 50 in 1985, both giving excellent results. All films (except Kodachrome) were processed each evening to provide a check on quality and to ensure complete coverage.

In order to compare the photographs taken in 1984 and 1985 from Quarry Bay, Knoll Pins (east) and Gannet's Rock Pinnacle, matching transparencies were viewed side-by-side on a light table with the aid of a magnifying glass and a note made of any

individuals apparently lost, and of any apparently new individuals. Photographs of sea fans and sponges taken against a scale in 1984 and 1985 were viewed side by side and separate branches identified to measure growth from base to tip of the same branch. Preliminary results show the following:

Comparison of the large format photographs from 1981-1985 were most useful in assessing change in populations of the anthozoans *Leptopsammia pruvoti*, *Caryophyllia smithii*, *Parazoanthus axinellae*, *Alcyonium glomeratum*, encrusting sponges and erect branching sponges. Populations of all of these species were remarkably stable. No loss or gains could be found in the rapid comparison carried out and individual organisms were of a very similar size to that in 1984. However, there were many more *Marthasterias glacialis* present in 1984 than in 1985 and larger clumps of *Cellaria* sp. and *Bugula turbinata* in 1984 than 1985. The small sea squirt *Clavelina lepadiformis*, which was present in small amounts in 1984, was not seen in 1985 photographs. Another sea squirt, *Stolonica socialis*, was more abundant in 1985 than in 1984 although the group occupied the same location. A colony of ross, *Pentapora foliacea*, on one of the transects had clearly grown by a few centimetres whilst another large colony present in 1984 had disappeared leaving bare or sparsely colonised rock behind.

Close-up photographs enabled comparison of the abundance of small species. As with the large format photographs, comparison showed very stable communities with anthozoans and sponges particularly stable.

Growth of *Eunicella verrucosa* branches was irregular. Where the background board appeared to be positioned in the same location as in 1984, growth in height appeared to be between 1 and 2 cm. Individual branches appeared to have grown generally by about 1 cm in length (using branch positions as markers). The heights and branch lengths of axinellid sponges were the same in 1984 and 1985.

No analysis of photographs of algal depth limits has yet been undertaken, although the limits of the main zones were recorded *in situ* as follows:

Deepest kelp: 7.3 m below chart datum

Deepest very dense foliose algae: 11.5 m below chart datum

Deepest dense foliose algae: 13.5m below chart datum

Deepest foliose algae: 21.8 m below chart datum.

Searches for the red band fish *Cepola rubescens*

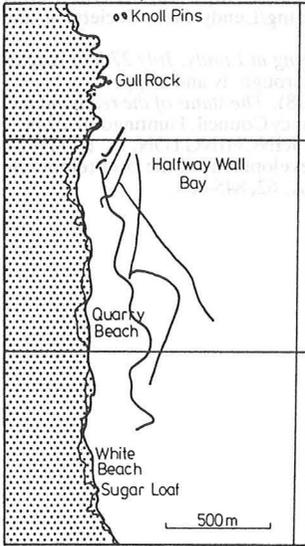
In 1976 and 1977 a series of detailed studies were undertaken of the red band fish *Cepola rubescens* (Pullin and Atkinson, 1978). Populations in Halfway Wall Bay and Gannet's Bay were particularly thoroughly investigated. The work undertaken in 1977 was designed especially to estimate the size of the populations and swimlines, transects and television tows were used. Casual observations in subsequent years suggested a steady decline in numbers, and in 1981 only one group could be found. In 1983 an Underwater Conservation Society Working Party searched the area by a series of towed dives but found no red band fish (Hiscock, 1984c). Their transit marks were used in 1984 and 1985 to resurvey the same area by a series of tows with the diver in communication with the towing boat by telephone. Also, swimlines were made across the muddy seabed in Gannet's Bay. Positions were recorded at intervals throughout the dive using a sighting compass to take bearings on conspicuous features. The areas surveyed in each year in the region of Halfway Wall Bay are shown in Fig. 3.

No red band fish were seen in 1984 or 1985 although one hole likely to be of one of these fish was observed in 1985.

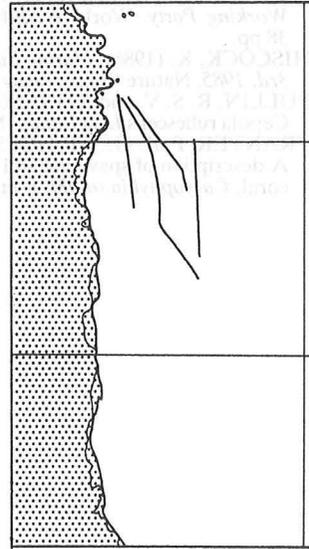
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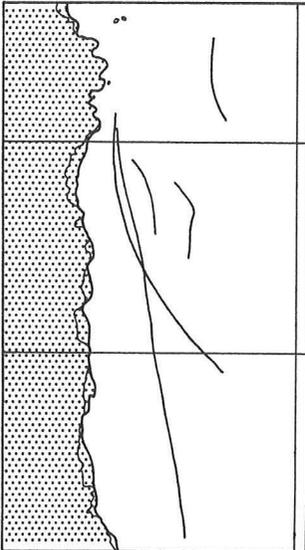
Camera tows July 1977.



Diver tows. June 1983



Diver tows. July/August 1984



Diver tows/drifts. July/August 1985

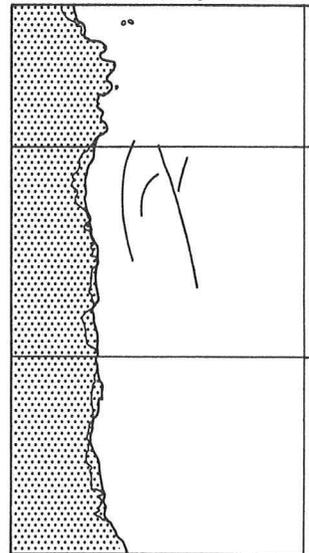


Fig. 3. Searches for the red band fish. Position of camera tows (1977) and tow or swim lines by divers in 1983, 1984 and 1985 in the region of Halfway Wall Bay.

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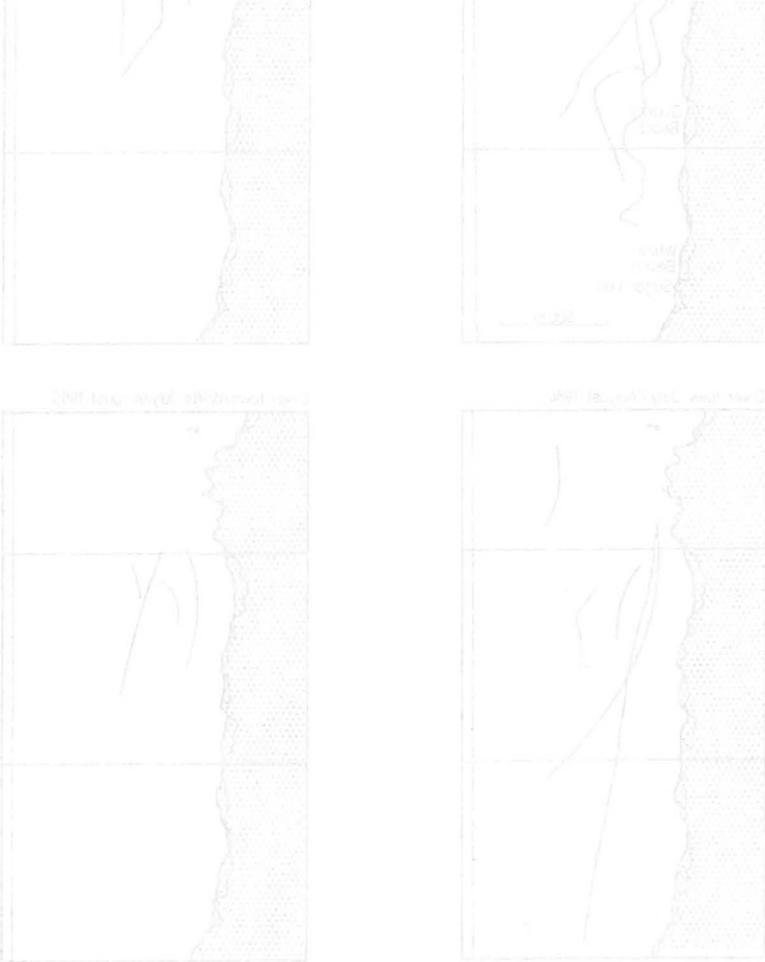


Fig. 3. Transects for the red band fish. Position of transects in 1977 and 1982 in the region of Lundy, Cornwall, UK.