



MARINE ECOLOGY

Work on the shores of Lundy is laborious and slow, and since much of it can only be done over the three or four days of a spring tide it follows that several years must elapse before any far-reaching conclusions may be drawn. What follows must therefore be regarded as an interim report.

The main problems which it is hoped to elucidate relate to the differences in the distribution of seaweeds and shore animals as they are influenced by (a) the degree of exposure to the prevailing weather, and (b) the nature of the substratum. So far it has proved possible to make preliminary observations at some eleven points around the coast of the island. Of these, only two lie on the fully exposed west coast, at Jenny's Cove where there is no beach, the rock falling sheer into deep water, and at Goat Island where a quite extensive flat beach can be examined. Six granite shores have been examined along the east coast; a vertical rock face below Puffin Slope, and boulder strewn shores at the north side of Gannets' Rock, Gannets' Combe, Brazen Ward, Quarry Beach, and Ladies' Beach. The remaining three are slate shores, between the Landing Beach and the Miller's Cake, and the north and south shores of Rat Island.

The first impression received on surveying any of the shores of the eastern side is one of luxuriance and prodigality. The boulder strewn platform of the beach is densely clothed with algae from near H.W.M. right down to and below L.W.M. More detailed examination reveals a normal succession from *Pelvetia canaliculata* at the splash zone, through *Fucus spiralis*, *F. vesiculosus* and *Ascophyllum nodosum*, *Fucus serratus* to the *Gigartina*, *Rhodomenia*, *Laminaria* communities near low water mark. And the plants grow in the greatest abundance. But, with few exceptions, these shores present such uniformity of conditions that the flora,

although rich in numbers is very poor in species. The major differences between these beaches lie in (a) the size of the boulders and hence the ease with which they may be shifted by wave action, and (b) the degree of shelter provided by indentation or otherwise of the coast. The latter is considerable at Gannets' Combe where the algal flora is correspondingly more luxuriant, and the incidence of *Ascophyllum nodosum* is higher. But the boulders here are for the most part very large and immovably wedged together, and very little variety of species may be seen. Few, if any, pools occur anywhere on this platform, and it is not even easy to reach and examine the substratum, except at Ladies' Beach, where the boulders are smaller and it is possible to turn them by hand and examine the encrusting fauna on their undersides and also the underlying sand and gravel of the bottom. Such pools as do exist along the east coast are almost confined to the solid rock of the promontories which flank the northern and southern extremities of successive bays. The pools occur for the most part at and above mid-tide level and lie in narrow clefts associated with the jointing of the granite. Lying as they do on the promontories they are far more exposed to wave action than are the intervening beaches, and indeed they present conditions reminiscent of the exposed western coast. Although small and specialized and shaded for most of the day, they have proved far the richest habitats in algal species. They do not however offer any basis for comparison of the different shores, but only of the special conditions existing within themselves.

Perhaps the most interesting of these eastern shores may prove to be that immediately north of Gannets' Rock. Only one brief visit has been paid to this so far, but it appears that ecological conditions vary much more widely here, with consequently a greater variety in both fauna and flora. Moreover, as will appear later, the passage between the rock and the mainland appears to present a transition between the exposed shores of the west and north and the shelter of the east side. During subsequent visits to Lundy we shall pay more attention to this region.

At the south-east corner of the island lie the only slate beaches so far examined. Here the conditions are very different, in that the softer, laminated slate weathers into quite different rock features from those presented by the harder, igneous granite. A short extent of open shore stretches between the northern end of the Landing Beach towards Ladies' Beach. Only the levels between about mid and high tide have been examined. These are covered by a fearful tangle of huge slate blocks, the smooth surfaces of which harbour a comparatively sparse flora which presents a regular and normal zonation. Small red algae and the like are scarce and are confined to tiny pools and crevices at the bases of these blocks. However, the laminaria zone has not been examined, and it is possible that this may prove much richer. Certainly this is the

case on the two shores of Rat Island, which incidentally have been examined in greater detail than any of the others round the island, partly on account of their ready accessibility and partly because they present a greater diversity and richness of ecological conditions, thus necessitating very close attention. The northern shore, constituting in effect the southern shore of the Landing Cove, is comprised for the most part of steeply sloping gullies extending up on to the cliff face from the fine shingle bottom of the bay. This bottom is not more than a foot or so above low water springs, and consequently the bases of the gullies are awash except at good spring tides. The strata dip at a high angle in these gullies and many pools of greater or less size occur along their length and support a much richer flora and fauna than are to be found elsewhere. Few loose, turnable boulders occur, but the vertical, sometimes overhanging or arched, walls of slate are densely populated by encrusting species of red algae, such as *Plumaria elegans*, *Chylocladia* spp. etc., together with sponges, bryozoa, barnacles, tunicates and hydroids. Where this crust is sparse colonies of *Balanophyllia regia* may be found, or in the narrower gullies *Tealia felina*. Few actively mobile animals occur except in the pools and under the few loose slabs of slate. Gastropods are however abundant on the encrusted surfaces, including *Patella vulgata*, *P. athletica*, *Patelloidea virginea*, *Nucella lapillus*, *Ocenebra erinacea*, *Nassarius incrassatus*, *Calliostoma zizyphinus*, *Archidoris britannica* and *Goniodoris nodosa*. Annelids are, for the most part, tube- or crevice-dwelling, and the arthropods sessile, or small and weed inhabiting.

On the southern shore of Rat Island, in the bay known as the Gates, conditions are again different. The same, steeply dipping strata occur, but now the gullies lie athwart the prevailing weather, and a deeply cut bay is sheltered by long ridges which run out south-south-east. This shore is much more extensive than the northern beach, and is by far the richest of any examined both in species and in numbers of animals and plants, as it is also in diversity of habitats. From the splash zone the cliffs descend steeply to a gently sloping beach which extends from just above three-quarter tide level in a long series of ridges and gullies down to low water mark. The gullies dry out at low water springs for the greater part of their length, but may remain covered during neaps. Deep pools however occur in the course of some of them, particularly in their lower regions. The ridges between rise by a series of vertical steps and narrow shelves, and the whole is clothed with a garment of algae the communities of which vary at different levels and under different conditions. The tops of the ridges may be broad and uneven, and often quite extensive pools occur here, each with their characteristic algal communities. The floors of the gullies are mostly covered with fine slate chips and sand, on which rest, or in which are partly embedded, larger slabs of rock.

On turning these a rich fauna is revealed, in which are conspicuous many amphipods and isopods, porcelain crabs and true crabs, such as *Carcinus maenas*, *Portunus puber* and both species of *Xantho*, the small prawn *Leander squilla*, various nemertine and polychaete worms, encrusting Bryozoa, sponges, tunicates, barnacles etc., the starfish, *Asterina gibbosa*, several species of brittle star and the sea urchin, *Psammechinus miliaris*. Fishes include blennies and gobies, pipe fish, barbels and the Cornish sucker. In one or two places, as also on the northern beach, the uncommon crustacean, *Nebalia bipes* is to be found by turning over the surface sand at the edges of the pools.

On the west coast the most striking feature of both shores so far examined is the paucity of species which are able to resist the tremendous force of the south-westerly weather which so frequently beats upon them. The fucoids which so densely clothe the shores elsewhere are here scarce and stunted, except in the few indentations deep enough to afford some shelter. Over the greater part of the west coast, as far as may be determined by examination from above, the dominant *Fucus* is the small, compact plant which has been examined at Jenny's Cove and Goat Island, but which has not yet been satisfactorily determined. At first it was believed to be *Fucus anceps*, but this species has only been recorded from one point, Kilkee, on the west coast of Ireland. Full determination must await the collection of more material next year. But the interim opinion of Dr. Mary Parke of Plymouth, and Miss C. I. Dickinson of Kew is that it may prove to be a variety, *vesiculosus* of *Fucus vesiculosus*. Whatever the taxonomic position of the plant it is a striking feature of this exposed coast, and we have traced it, usually as the only *Fucus* of any significance, from Goat Island in the south up the west coast and round as far as Gannets' Rock at the north-east. At the channel between this rock and the mainland the plant stops abruptly, giving way to *Fucus vesiculosus* which, from this point southward, occupies its characteristic position in the algal zones on the shore.

At Jenny's Cove it is possible to get down to water level on a pyramid of rock which stands up out of deep water on the northern side of the cove. No true beach occurs, but a narrow flat shelf of rock may be reached near low water mark, and provided no heavy swell is running, may be examined in comfort. It is only at extreme low water that anything approaching a complete plant cover occurs. Here there is a belt of *Gigartina mammilata* and *Laminaria digitata* which does not however form a complete cover on the vertical sides of the rocks. The *Laminaria* plants are stunted and their fronds severely torn and abraded by wave action. Above this zone the rocks are bare over much of their extent, except for an encrustation of calcareous species, the *Lithothamnions* forming an almost complete sheath over the granite, with the close, short tufts of *Corallina officinalis* var. *compacta* wherever a crevice or rugosity

offers a foothold. The *Lithothamnion* cover is particularly prominent in the shallow pools which occur here and there on the rock shelves, giving them an appearance of extreme uniformity. Despite this however they carry a sparse population of small red and green algae, many of which appear only to be able to maintain themselves attached to the shells of limpets, and these snails often carry miniature gardens on their backs. As might be expected, many of these species occur only in this particular habitat, and have only been recorded on the east coast from those pools which as has been shown present conditions somewhat similar to these. The only weeds of any size to occur over this region are *Gigartina* and the above mentioned *Fucus*, together in a well defined zone extending approximately up as far as mid-tide level, and forming sparse colonies. Apart from a few scattered plants of *Chondrus crispus* and *Alaria esculenta* the only other alga of note is *Porphyra umbilicalis* which occurs sometimes in dense aggregates over a narrow vertical range of not more than a foot at just above mid-tide level.

The fauna is composed entirely of sessile or sedentary species, with the exception of the small blennies which inhabit the tidal pools. Crevices are rare and generally inhospitable owing to (a) the manner in which the granite weathers into flat or rounded surfaces becoming only shallowly indented at the joints, and (b) the covering of *Lithothamnion* which accentuates the streamlined effect, filling and covering all cracks and rugosities. Among a sparse fauna sponges, hydroids, barnacles and *Mytilus* are prominent. The *Littorinas* are represented by *L. neritoides*, which is present in large numbers over an extremely wide vertical range, rising some seventy or eighty feet above H.W.M., and *L. saxatilis* in small numbers where some crevice shelter is available. The only other gastropods are the limpets and dog whelk, the shell of the latter showing the usual thickening on this exposed shore, and *Patina pellucida*, the rainbow limpet. The latter, at Easter 1948, was exhibiting extraordinary behaviour, as it was also to a lesser extent at Rat Island, by occurring, not only in its normal habitat on the fronds of *Laminaria* and other broad fronded weeds, but also on the bare rock face and on the *Lithothamnion* coating it. For the rest, the fauna list may be completed by the addition of a few tubicolous or crevice-dwelling annelids, and occasional specimens of amphipods and isopods.

Conditions are much less strenuous at Goat Island, where a number of granite stacks, of which Goat Island is the largest and farthest seawards, stand detached from the cliff on one of the few beaches exposed above mean sea level along the whole length of the west coast. Moreover, south of the stack lies a fairly deep inlet or cove which is sheltered from all but direct westerly seas by Goat Island to the north and by a rocky headland which projects westward on its southern verge. It occasions no surprise therefore to find here, in addition to most of the species from Jenny's Cove, a proportion of those more characteristically associated with the shelter of the

east coast. Among algae for instance, *Pelvetia canaliculata*, a few patches of *Fucus vesiculosus*, *Himantalia lorea*, and *Chylocladia reflexa* occur, and correlated with this, the fauna begins to include some of the weed haunting species. But the significance of a particularly numerous population of *Littorina neritoides*, which includes a high proportion of striking colour varieties has yet to be investigated.

It is unfortunate that the treacherous and precipitous nature of the cliffs has hitherto precluded examination of the south coast, between the Shutter and the Gates. Here may be expected some interesting transition conditions both between exposure and shelter and between slate and granite substrata. As we have already remarked however, it may be possible to trace one of these changes at the other end of the circuit, at Gannets' Rock, and further examination of this region may yield interesting data. This does not of course preclude the possibility of attempting some examination of the island's southern shore, if means can be found for it.

During the course of two seasons' work on these shores Mr. and Mrs. Harvey have had extensive help from their daughter, Margaret, and from June Thrower, Bente Holm, Brian Francis, J. H. Hemsley and W. A. Gliddon, to whom, as also to Roland Barker and Hugh Boyd, it is a pleasure to record their grateful thanks. The lists of both fauna and flora of the shores grow yearly. They will not be recorded here, but copies will be compiled and may be consulted either at the Hon. Secretary's laboratory, or on Lundy. No list of the animals exists for comparison with present records. Of Tregelles' list of algae (*Trans. Devons. Ass.* 69, 1937) some ninety species of his 131 have been recorded, in addition to about fifty which he did not find.