



## 4 Goat Island, Cape Rodney

GOAT ISLAND LIES within New Zealand's first marine reserve, proclaimed in 1975. Extending seaward 1.4 kilometres from high water mark and reaching west for 4 kilometres from Cape Rodney as far as Okakari Point, the Reserve encompasses all the tidal shores and sub-tidal 'cliffs' of the Island, as well as the mainland coast. With its transparent and sheltered waters and its rich flora and fauna it is a perfect location for marine observation.

In 1961 the University of Auckland established its Marine Research Laboratory on the cliff-top immediately across from Goat Island. Our picture looking west (Plate 4) shows the seawater storage tanks of the Laboratory above the grassed bank and in the middle distance is Goat Island Bay, with its mature, strongly eroded papa cliffs. Into the far distance runs the line of the splendid dune coast and sand beach of Pakiri.

Set at the threshold of the Hauraki Gulf, just outside the headland of Cape Rodney, Goat Island faces two ways, having its major appeal in its cluster of contrasts. The outer seaboard with windswept vegetation looks north to the wide fetch of the Pacific. To the south, over against the mainland, old pohutukawas reach out over a broad intertidal platform. These two types of shore arise from contrasts in geology, and for such a tiny islet (9.3 hectares) Goat Island is unusually complex. Between its seaward and landward sides runs a time-gap of 200 million years.

The exposed north and north-eastward parts of the Island are built of the same hard greywacke that forms Cape Rodney. These old metamorphosed sandstones are generally held to date from as early as the Permian period from the end of the Palaeozoic era. Lifted from the sea during the Mesozoic, this foundation became eroded and again submerged. During the early Miocene its eroded surface became covered with the pebble conglomerate that forms the basal beds of the Waitemata series.

On the landward side, this conglomerate can still be seen clearly at the cliff base on the mainland, in the foreground of our picture. Interesting

fossils are to be found in this rock, including large oysters and scallops, sea urchin fragments and an extinct coral, *Cyathoseris*. Near this point, on the platform now called the 'Waterfall Reef', the cliff shows an oblique junction between these two sorts of bedrock. Greywacke forms the resistant tip extending to Cape Rodney, while the softer Waitemata beds continue to the west in the cliffs of Goat Island Bay.

The outcrops to seaward, with waves breaking, are of greywacke. The wave-cut Waitemata (papa) platform lies at the higher level, but in a few places forms no more than a thin veneer, worn away to reveal the older platform underneath. From a nearby eruption, probably in Pliocene times, Goat Island has still a third, and its youngest, type of rock in a dyke of basaltic lava that strikes through its centre.

These geological contrasts, so evident at Goat Island, are matched by different exposure to wind and waves. The greywacke front, to seaward, rises to steep, nearly vertical cliffs, directly open to the north-easterlies. This coast is split by caves and fissures where the white surge drives in as waves pound the shore. Under high wave action the zones become dramatically elevated: first by the mounting of surge, next by upreach of splash and, highest of all, for the greatest distance, by spray.

With a clean atmosphere and a hard rock face, the island's outer surfaces have become covered in vegetation: slow-growing lichens, maritime flowering plants, succulents, and higher up, flax, karo, taupata, manuka and red mapou. To landward pohutukawas reach down to a metre or two above high water, their trunks and boughs supporting a pied shag colony.

Plate 4 Goat Island, near Cape Rodney, seen from the mainland shore, with the white sand beach of Pakiri in the distance. At left are the water tanks of the Marine Research Laboratory. In the foreground is a platform of Miocene sandstone pitted by erosion. Below it, and on the island, is greywacke, fringed with brown algae.

Both between the tides and beyond low water, Goat Island is today the scene of active conservation work. The University was early on responsible for promoting the marine reserve and so put itself under the same conservation restraints as the public at large. At present, specimens can be taken for research only with a special permit. General protection extends to all life within the reserve from high water to the grounds offshore, and gathering of sea food, including urchins and paua, and any line-caught fish, is forbidden. In the years before the reserve was secured food species and the shore around them had taken a punishment from which the habitat has not yet recovered. Divers today bring to Goat Island only their cameras and observant eyes; the day of spear guns and crayfish bags is gone.

With the amateur diving community committed to conservation, there is then a prospect of new hope, with the slopes beyond low water today becoming one of the world's best scientifically investigated underwater habitats.

Already, through the 1970s, the entire area of the Marine Reserve was surveyed by thousands of individual dives, the work of an enthusiastic group of scuba biologists. As a result the Lands and Survey Department has been able to publish a large-scale map showing the detailed boundaries of the underwater communities and new place names of prominent points above and below low water. One is Alphabet Bay; and large letters painted on the rock face at intervals around the Island serve as a guide to divers coming to the surface.

Lying outside the Hauraki Gulf, Goat Island affords the first of those clear oceanic diving waters that attain their full richness at Mimiwhangata and Poor Knights Islands, the latter being also a marine reserve. The communities beyond low water at Goat Island Bay are represented in figure 6, composed from the recent underwater work of researchers.

First, lying just beyond the intertidal, is a shallow swathe of the brown algae *Carpophyllum maschalocarpum* and *C. plumosum* (A). Next to these the common kelp *Ecklonia* would normally have pressed in as a thick forest. At Goat Island kelp does not begin at once: instead there is an open marine meadow (B) dominated by the sea urchins or kina (*Euechinus chloroticus*), grazers that have cut short the *Carpophyllum* fringe above and have felled the *Ecklonia* like trees.

In this cleared meadow the coralline-encrusted rocks are much more productive than kelp forest. As well as urchins, grazing gastropods (the star limpet, *Cellana stellifera*; the top shells *Trochus viridis* and *Cantharidus purpureus*, and the turban shell, *Cookia sulcata*) help to prevent the re-establishment of large algae.

Below the grazed flat the kelp forest (C) still holds its own, offering a spectacular scene for divers, with ecklonia plants up to 3 metres tall and, in the 'forest' shade, a wealth of encrusting life: hydroids ('beards'), polyzoans (minute 'boxed' animals), sponges and ascidians (sea squirts). *Ecklonia* is an offshore plant, avoiding high illumination. At Goat Island it reaches its lower limit at 15 metres below which there is not enough light for photosynthesis.

At these greater depths, freed from competition by kelp, sponges now dominate (D): massive grey lobes (*Ancorina*); vivid yellow crusts (*Cliona*); bright orange footballs of *Polymastia*; red and orange branches (*Raspailia*), tall branched tubes (*Callyspongia*) and brown and orange 'golf-balls' (*Aaptos* and *Tethya* [p.41]).

This sponge garden is a beautiful mosaic and contains a host of other ciliary feeders such as tubeworms, polyzoans, ascidians and sedimentary molluscs. The main disturbance here is caused not by the urchin but by the trigger fish or leather jacket (*Navodon scaber*) constantly nibbling the encrusting animals and creating vacant spaces to allow more species to move in – and there are scores waiting for just such an opportunity.

The edge of the sponge garden is determined by the accumulation of sediment washed down the slopes from the land (E). Its lowest stretch is covered with thick deposits through which only long tubular sponges can push up to the surface. At Poor Knights the sponges continue even further, with more spectacular yellow and scarlet species.

The underwater communities around Goat Island are now a part of the heritage of Auckland divers. Total protection has been particularly important to the bottom-living fishes which are so territorial that, if captured, leave a gap such as that left by the wrenching out of a tree. Some of us will never see this world at first hand, yet there are places at the low water mark where, for instance, sponge gardens can be discovered, giving us a brief glimpse of the diversity that lies beyond.