# VEGETATION OF THE SAND COUNTRY BORDERING THE WAITAKERE RANGE, AUCKLAND : THE SOUTHERN BEACHES

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SUMMARY: An account is given of sand country vegetation at Whatipu Beach in which distribution of plant species is related to physiographic features.

## INTRODUCTION

Along the western margin of the North Island there is a broken strip of sand country totalling 480 km in length — more than half the coastline (excluding the deeper harbours). As well as being a significant part of the coastal landscape, beaches are important areas for recreation because of their extent, location and topography. With the spread of commercial forestry onto coastal sand and the development of many beaches as holiday resorts, the character of the sand country is changing rapidly. This paper describes the vegetation not yet grossly modified at the mouth of the Manukau Harbour (Figs 1 and 2).

FIGURE 1. *Aerial view of Whatipu Beach, Manukau Heads and Harbour. Whites Aviation dated 2.4.57.*

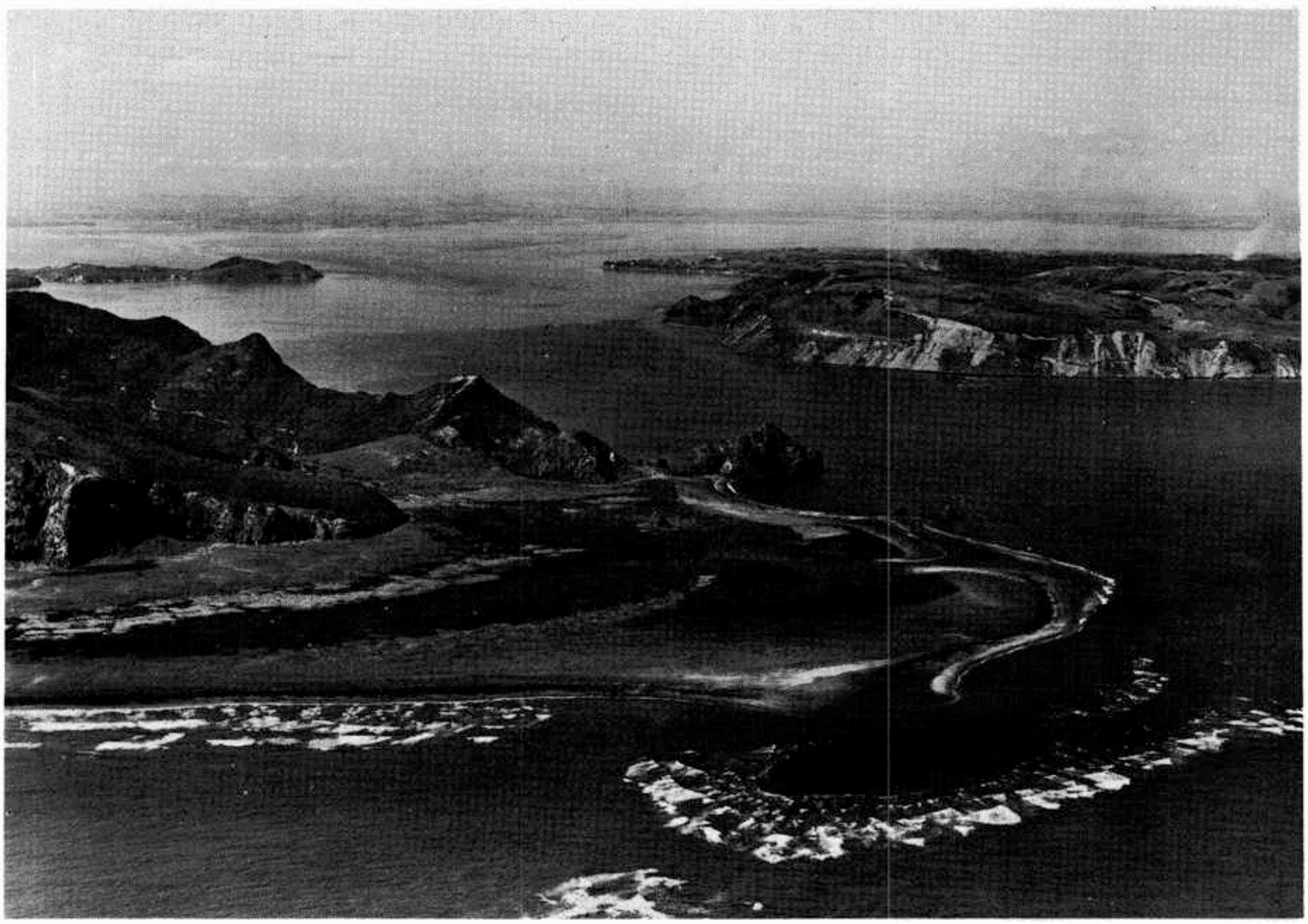


FIGURE 2. *Locality map. Wind roses for Whenuapai (A) and Auckland city (B) are from data in New Zealand Meteorological Service Miscellaneous Publication 122, 1966.*

## LOCATION

The region under consideration is one of two sections of coast between the Manukau and Muriwai (Fig. 2). It extends as a series of connected beaches from the Manukau entrance to near Karekare seven kilometres to the north. In this paper it is referred to as Whatipu Beach. The sand here has a maximum width of more than one kilometre and is backed by the Waitakere Range with cliffs over 200 m high. In the second section, lying between Karekare and Muriwai, sand is confined to bays and the hinterland is mostly lower and less precipitous.

## PROGRADATION

The remarkable feature of the Whatipu Beach is the rapid build-up of sand (Fig. 3). In 1940, when the shoreline was at Cutter Rock, the area of sand south of Ohaka Head was 188 ha. Since then another 567 ha has been added. By 1949 the shoreline had moved out a little and a large island formed a few hundred metres offshore. The channel became nearly filled with sand but the depression is still occasionally invaded by very high seas and is flooded at times in winter with fresh water. Aerial photos dated 1954, 1960 and 1969 show progradation averaging more than 40 m per year west of Cutter Rock where maximum build-up has occurred. A compass

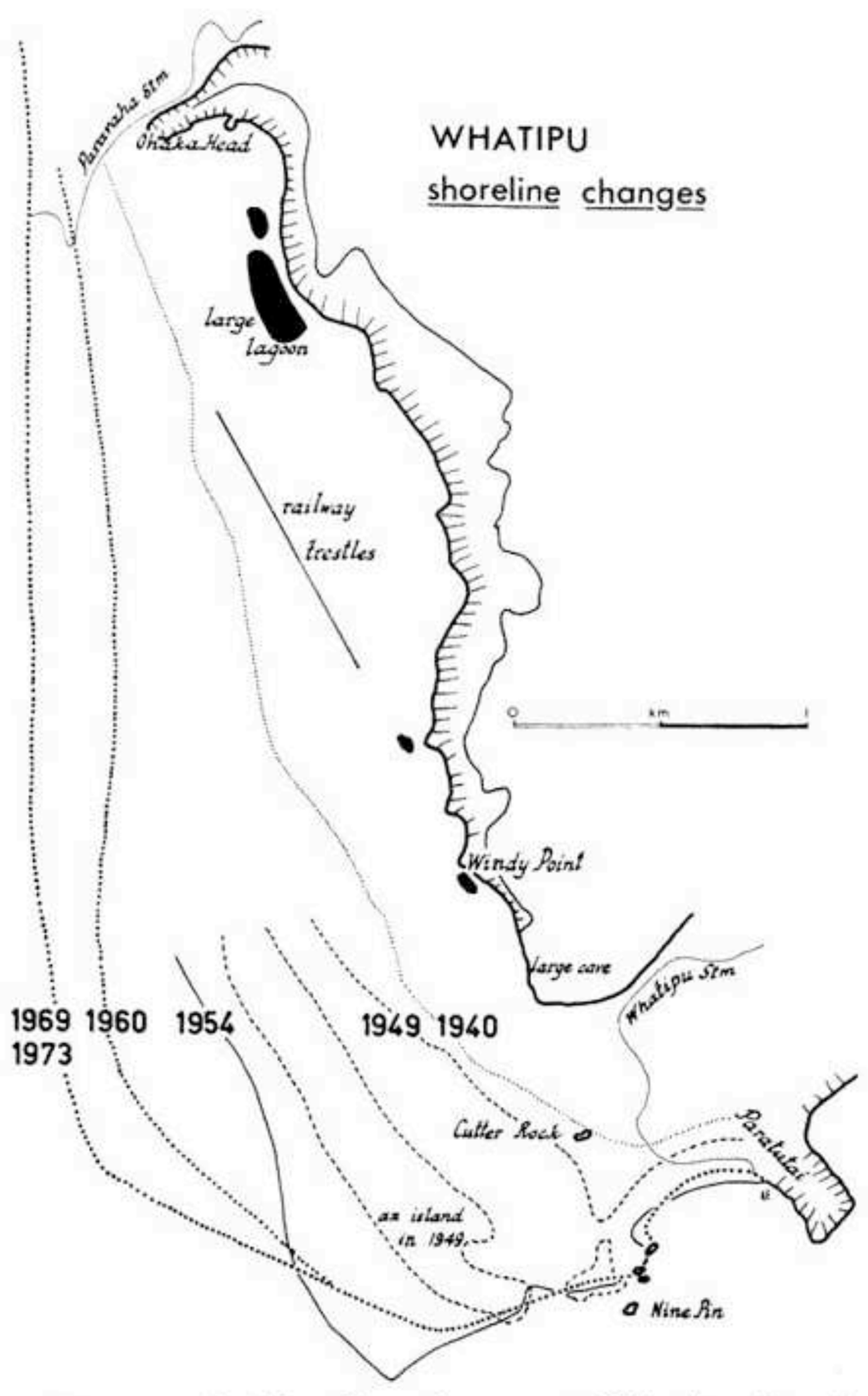


FIGURE 3. *Shoreline changes at Whatipu Beach.*

survey on 3 July, 1973 indicated that no significant change in the shoreline has occurred since 1969.

The fine sand, consisting of magnetite, feldspars, augite and quartz, is brought from both south (Westland current) and north (West Auckland current) to this area of convergence (Brodie 1960).

## TOPOGRAPHY

The sand country at Whatipu is of low relief. Except for the mobile dunes which reach to a height of perhaps 20 m and the very much lower incipient fore dune there are few places where the difference in elevation is more than a few metres between the highest and lowest parts. Inside the 1940 shoreline in the south about one-quarter of the land surface is submerged briefly in winter flood waters. This feature distinguishes Whatipu from all other beaches in the Auckland region and permits the development of vegetation on the wet unstable sand plains similar to that on the Wellington west coast (Esler 1969, 1970). Wet sand plains providing a habitat for these communities occur around Cutter Rock, near Ohaka Head and within the winter flood levels of the large lagoon and the lagoon near Windy Point. The wetness of the depressions is attributable to their low elevation and the flooding from minor streams which do not find direct outlet to the sea. The tendency for water to be impounded is increased by the fineness of the sand particles and the addition of silt in flood waters.

Water in depressions at the base of the cliffs is confined in some places by mobile dunes and forms wet plains and swamps (Figs 4 and 5). The sand on these plains has been stable for 100 years or more and has a topsoil up to 10 cm deep. Topsoil is shallower on the dunes, particularly where recent sand has overlain the older deposits.

Movement of sand is effected mainly by wind, but some is moved by flood water. Wind is predominantly from a westerly quarter (Fig. 2) and the topography shows this influence to some degree. The Manukau entrance channels wind in this direction carrying some sand with it. Wind gaps created by the Whatipu and Pararaha streams allow some sand to be blown into these valleys. In most other places the mobile sand does not reach the bases of the cliffs in large quantities because of reduced wind velocity, back eddying and the relatively small amounts of sand on the move.

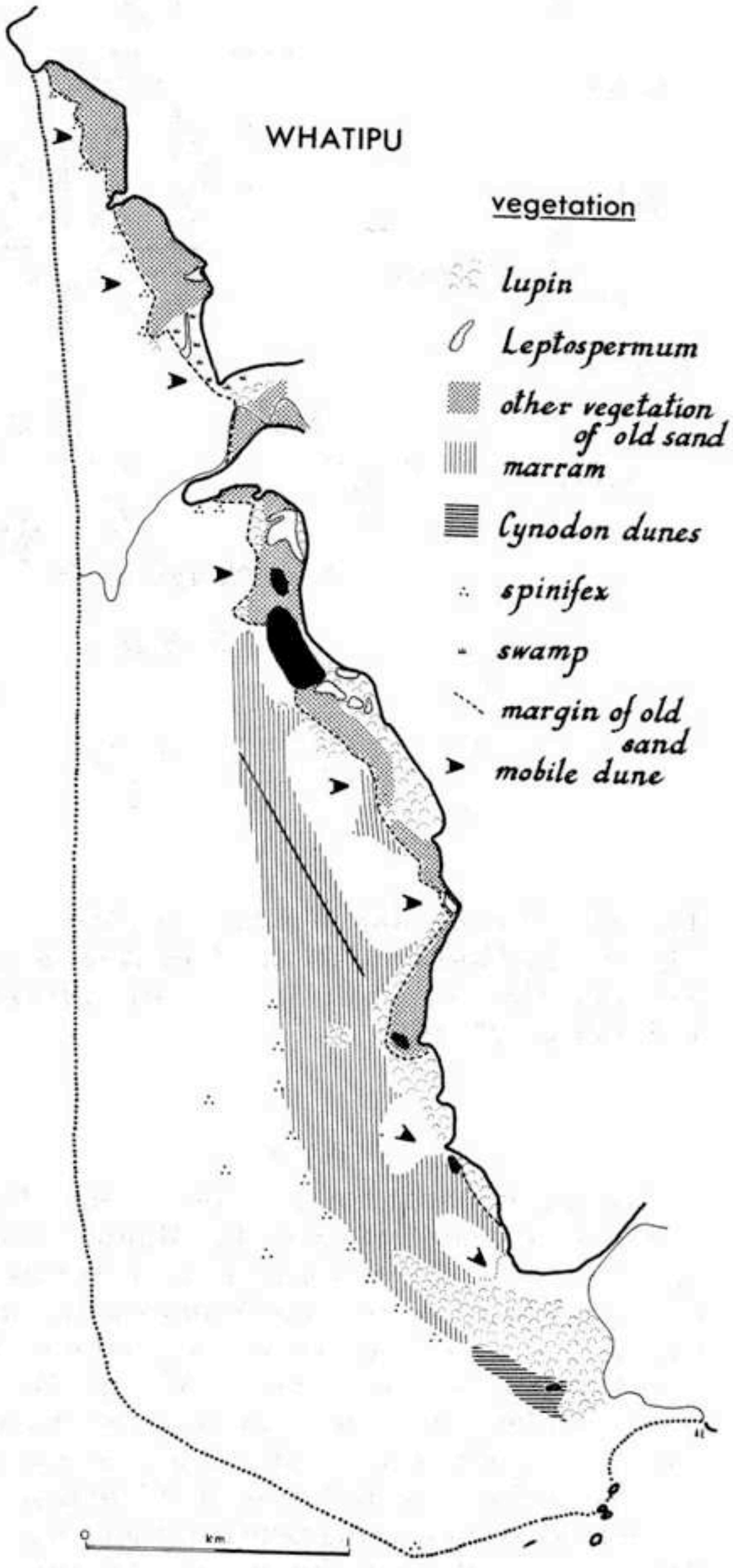


FIGURE 4. *Vegetation map of Whatipu Beach.*

FIGURE 5. *Large lagoon from Ohaka Head, July 1973. Communities of lupin, tea tree and mariscus surround the small lagoon. Marram in the region of the railway trestles stretches beyond the large lagoon. A mobile dune lies on the right.*

## PLANT COMMUNITIES OF THE YOUNG SAND

Over most of the area, except against the base of the cliffs where sand has been stable for many decades, sand is either drifting or has been fixed for no more than 20 years. In 1953 nearly all the land inside the 1940 shoreline is said to have been bare sand, a statement verified from aerial photos. Stabilisation by both natural and artificial means began about 1953.

Natural stabilisation seems to have begun with the formation by spinifex *(Spinifex hirsutus)* of an incipient fore dune running northwards from Cutter Rock along the 1940 shoreline for about one kilometre. The growth of the dune has been retarded by cattle grazing the spinifex.

In the depressions sand plain vegetation of the type described by Esler (1969, 1970) has developed. The most regular colonists are *Myriophyllum votschii, Lilaeopsis orbicularis, Triglochin striatum, Scirpus cernuus, Carex pumila* (which occupies nearly all low-lying places on the young sand) and the exotic *Leontodon taraxacoides.* The widespread dispersal of these species is effected in part by flood waters extending across the flats from the lagoons. There is no apparent reason for the more restricted distribution at Whatipu of *Limosella lineata, Eleocharis novo-zelandica, Lobelia anceps, Selliera radicans* and *Juncus caespiticius.* These are species characteristic of such sites in the Manawatu.

Indian doab *(Cynodon dactylon)* is one of the few exotics which is relatively abundant in these communities. It tolerates long periods of inundation on the plains and grows on the dry dunes. *Paspalum paspalodes* grows in the depressions in some places.

In a later stage of succession *Leptocarpus similis, Juncus maritimus* and *J. articulatus* make an appearance. *Leptocarpus* is always well trimmed by cattle, and grazing has probably prevented the species from becoming a dominant as it does on the wet sand plains of the Manawatu.

Artificial stabilisation of sand has been attempted by the lessee of the farm in the Whatipu valley. Plants introduced for this purpose are the grasses Indian doab, *Paspalum paspalodes, P. dilatatum,* carpet grass *(Axonopus affinis),* buffalo grass *(Stenotaphrum secundatum),* kikuyu grass *(Pennisetum clandestinum)* and the legumes *Lotus pedunculatus, L. subbiflorus* and lupin *(Lupinus arboreus).* Marram grass *(Ammophila arenaria)* is abundant on Whatipu Beach and may have been established for stabilisation purposes, or it could have been self-introduced.

Indian doab has spread onto wet and dry sites on young and old sand and is a significant species in all these habitats. Near Cutter Rock it has assumed a dune-building role (Fig. 4), the resulting dunes being low and flat-topped with many intervening depressions. Aggregations of rabbit droppings on these dunes have stimulated the grass to grow a few centimetres taller and the dunes have grown taller locally under this influence. In many other places Indian doab has formed mounds and has spread across the wet sand plains and habitats similar to those occupied by *Carex pumila.* However, it does not occupy all the very wet depressions where *Triglochin* and its

associates thrive. *Paspalum paspalodes* is rather less adaptable. The other grasses (except marram) can still be found where they were established near Cutter Rock. They have not become conspicuous on the young sand but are likely to spread.

*Lotus subbiflorus* is plentiful on the dry stable sand but *L. pedunculatus* is a plant of the old wet plains.

Lupin is the most evident of the leguminous plants introduced to fix sand (Fig. 4). Establishment has been accomplished without first planting marram. This is contrary to the usual practice in reclamation of coastal sand. It could not have been achieved so simply in a region with stronger winds and greater quantities of drifting sand.

The lupin has encouraged a set of associated annuals which occur only sparingly on sand away from the lupin stands. The main species are Australian fireweed *(Erechtites atkinsoniae)*, fleabane *(Erigeron floribundus)*, inkweed *(Phytolacca octandra)* and the native *Parietaria debilis*. These annuals would have much less chance of holding a place in the community if the lupins were not defoliated annually by the kowhai moth *(Mecyna maorialis)*.

Mariscus sedge *(Cyperus ustulatus)* forms an interesting association with lupin in a narrow band above the winter water level of the flooded plains where it is too wet for lupin. The sedge apparently takes advantage of the high water table and is nurtured by the lupin because it grows in no other habitat on the young sand. On the oldest dunes mariscus grows at all elevations, the presence of a topsoil apparently takes the place of a high water table and the benefit derived from its association with lupin. This situation warrants investigation.

After marram arrived at Whatipu Beach there would be few limitations to its unaided increase by seed. Seedlings appear in the autumn on the margins of the wet sand plains. If they escape grazing by cattle and rabbits, and have a sufficient supply of incoming sand, the seedlings build minor dunes the following summer. These project above the winter water level but further increase in dune size is determined by the supply of sand reaching them. A further restriction is placed on dune growth by the preferential grazing of these vigorous young plants. Thus, by grazing marram and spinifex, cattle are restricting the capacity of the taller grasses to fix sand.

Over a large area near the railway trestles marram is not vigorous because the accumulation of sand necessary for its survival is restricted by the wet plain on the seaward side. Inland from the trestles there is insufficient vegetation to fix the mobile dune. Possibly spinifex would have covered all mobile dunes if there had been no grazing. However, I have found it to be very unusual for spinifex to grow in quantity on the landward side of other vegetation but know of no explanation for this behaviour.

The high mobile dunes have a long gentle wind sweep and a slip face of 29° from the horizontal. These are mostly encroaching onto old sand or swamps, but the movement is very slow. At the mouth of the Pararaha there is some counter movement by winds blowing down the valley.

## PLANT COMMUNITIES OF THE OLD SAND

The less restrictive habitat of the old sand permits a greater range of plant species to establish. The topsoil provides a reservoir of nutrients and moisture which encourage plants excluded from the young sand. Diversity is further encouraged by a gradient of moisture regimes from dry dunes, through wet plains to swamps. Grazing provides a habitat for casual species which might not otherwise grow there by keeping the vegetation short and disturbing the soil.

The vegetation of the dry dunes is varied. In limited areas with thin topsoil there is mainly *Muehlenbeckia complexa,* in others *Muehlenbeckia* and mariscus with *Solanum sodomaeum* and blackberry *(Rubus fruticosus)*.

Lupin is not confined to the young sand but is quite extensive near the cliffs. The sites that it occupies have less topsoil than the other parts of the older dunes. Either the surface has been disturbed by trampling or the topsoil is buried beneath fresh sand.

Turf composed of a wide range of species has

formed on the dry flats. The main grasses are *Microlaena stipoides,* Indian doab, ratstail *(Sporobolus africanus),* browntop *(Agrostis tenuis),* carpet grass and *Eragrostis elongata.* Not unexpectedly, such a dry habitat has many annuals such as *Lotus subbiflorus, Cotula australis* and *Ranunculus parviflorus.*

There are small patches of manuka *(Leptospermum scoparium)* on both wet and dry flats. Pohutukawa *(Metrosideros excelsa)* is confined to a few narrow bands near the cliffs. Although growing in the sand the trees may have established on the cliffs before sand drifted around their bases.

Wet sand plains are moist in summer and mostly inundated in winter, when many become coninuous with nearby swamps and lagoons. Parts not flooded in winter have a turf of Indian doab, *Paspalum paspalodes,* carpet grass and *Lotus pedunculatus* although it is not usual for all species to be present together. Tall rushes are not plentiful but *Juncus australis, J. effusus* and *J. gregiflorus* usually grow in this zone. Where the level of the ground has been raised by fresh incoming sand *Leptocarpus* may be present but it is more common in wetter situations with *Juncus maritimus.*

As the water level recedes in spring the "tide mark" defines the limits of the various wetland species along the moisture gradient. First carpet grass reaches its limit but the other turf species continue for some distance towards the deeper water and are joined by *Cyperus brevifolius, Juncus articulatus* and *Galium palustre.* At the lower level a group of aquatics — *Myriophyllum propinquum, Ludwigia palustris, Potamogeton cheesemanii* and *Ranunculus rivularis* — form a close grazed turf in summer. Beyond them in the permanent water grow raupo *(Typha orientalis)* and *Baumea articulata.*

## THE FUTURE

Whatipu Beach is remote from the noise of traffic and relatively undisturbed by man. For these reasons it has an appeal to many people. Attempts are being made to have the cattle removed from the beach and the adjoining portion of Centennial Memorial Park in the Waitakere Range. Without cattle spinifex, marram and *Leptocarpus* will be allowed to develop normally on young sand and there will be some changes in the topography as a result. With relief from grazing and trampling vegetation on the old sand will become more dense and rank.

With or without cattle Whatipu Beach is very valuable as an area for research and teaching. If some of the exotic plants had not arrived the beach would have had even more value for this purpose. It could have been one of the few areas in New Zealand where natural development and dynamics of sand country vegetation and topography could proceed relatively uninfluenced by man or foreign plants. This opportunity has been lost.

Kikuyu grass is not prominent at present but will eventually blanket a large area of sand. No longer will we be able to study the delicate ecological situations where many species are matched with changing habitats in time and space.

On the other hand the whole beach may be swept away just as quickly as it formed. This was the fate of a similar beach at Manukau South Head (Smith 1878).

ACKNOWLEDGMENTS

I am grateful for the critical reading of this paper by Mr J.E. Braggins and Mrs M.J.A. Bulfin.

## REFERENCES

BRODIE, J.W. 1960. Coastal surface currents around New Zealand. *New Zealand Journal of Geology and Geophysics* 3: 232-252.

ESLER, A.E. 1969. Manawatu sand plain vegetation. *Proceedings of the New Zealand Ecological Society* 16: 32-35.

ESLER, A.E. 1970. Manawatu sand dune vegetation. *Proceedings of the New Zealand Ecological Society* 17: 41-46.

SMITH, S.P. 1878. Notes of a traditional change in the coast line at Manukau Heads. *Transactions of the New Zealand Institute* 10: 514-516.