VEGETATION OF THE SAND COUNTRY BORDERING THE WAITAKERE RANGE, AUCKLAND: PIHA BEACH

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INTRODUCTION

SAND has been laid along most of the west coast of North Auckland, mainly in long stretches such as at Ninety Mile Beach, Kaipara North Head and Muriwai. Piha Beach is one of the few places where sand has been deposited in a bay. This paper traces changes in topography and vegetation of this beach from 1940 to 1974.

Piha Beach (Fig. 1b) lies between two headlands 2.7 km apart. Two streams have their confluence near the mid point of the beach and a third, with a small estuary, reaches the coast near the southern end. Lion Rock at the outlet of this stream is separated from the beach at high tide. Another rock stack known as Monkey Rock or Takutapu Rock is reached by high tides. The beach has a width of about 200 m but sand has blown beyond the beach to liberally coat parts of the land which rises fairly steeply behind it.

The beach consists of three sections (Fig. 1b)

southern — south of Piha Stream (not further mentioned in this paper),

central — Piha Stream to Wekatahi Stream,

northern — north of Wekatahi Stream.

Some aspects of the environment of this region are given in Esler (1974). Important features are the prevailing westerly winds of moderate strength and the fine-grained sand composed of feldspars, augite and quartz with conspicuous amounts of magnetite.

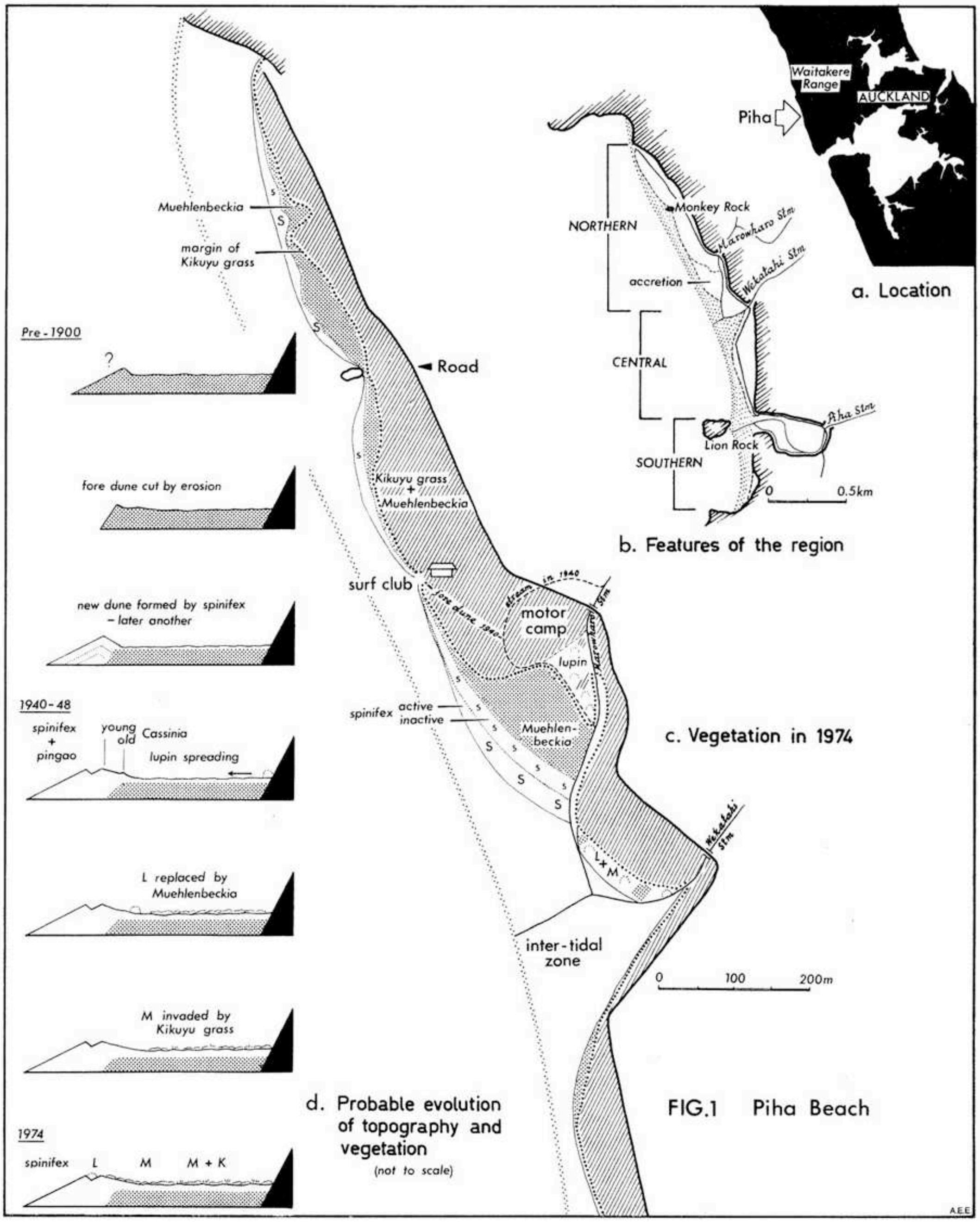
TOPOGRAPHY

In 1940 the topography was recorded in the first of a series of aerial photographs. At that time the fore dune complex was composed of two very distinct ridges parallel to the beach and one less clear behind them. The topography is interpreted as follows (see Fig. 1d). Each crest represented the climax of a dune building phase and each depression between the crests, an interval of erosion of the fore dune. During each period of progradation it is likely that the fore dune had a long gentle seaward face characteristic of dunes covered with spinifex *(Spinifex hirsutus)* as described by Esler (1970) for Manawatu dunes, but modified locally by the presence of pingao *(Desmoschoenus spiralis)*. During the erosion phase deposition and removal of sand would be nearly balanced with high tides periodically undercutting the seaward edge of the dune causing it to steepen to a maximum of 33°, the angle of rest of the sand. In a period of respite sand would again accumulate on the beach and be invaded by spinifex establishing from seed. In this way another dune would be built on the seaward side of the fore dune but separated from it by a depression. Judging from the map by Williamson (1953) the crests were about 20 m apart. Cycles of 11 years were suggested by that author.

The fore dune in the northern section in 1940 ran through the site of the present surf club buildings to meet the Marowharo Stream at the present motor camp (Fig. 1c). The Marowharo Stream after leaving the gorge swept in a large arc around the motor camp site then flowed southwards in a long reach parallel to the beach before turning to enter the sea. No dunes or vegetation can be discerned on the aerial photographs on the seaward side of the long reach.

In the central section the dune complex with its three crests was almost parallel to the road along the beach.

Behind the dune complex in both sections there was an extensive area with low irregular undulations running back to the foot of the hill. This was an old deposit of sand probably mantled with fresh sand blown in from the beach. This strip was almost certainly occupied by Maoris in the past. Diamond (1955) recorded six pa sites within one kilometre of the beach. These were mainly places of retreat, much activity probably centring on the beach which provided many of the necessities of life. In the early part of this century a tramway carried logs along the


Waitakere Range
AUCKLAND
Piha
NORTHERN
Monkey Rock
Marowhara Stm
Wekatahi Stm
accretion
a. Location
CENTRAL
Aha Stm
Lion Rock
SOUTHERN
0
0.5km
b. Features of the region
Muehlenbeckia
margin of Kikuyu grass
Pre-1900
?
Road
fore dune cut by erosion
Kikuyu grass + Muehlenbeckia
surf club
new dune formed by spinifex – later another
fore dune 1940
stream in 1940
motor camp
lupin
1940-48
spinifex + pingao
young
old
Cassinia
lupin spreading
spinifex
active
inactive
Muehlen-beckia
c. Vegetation in 1974
L replaced by Muehlenbeckia
L + M
inter-tidal zone
0
100
200m
M invaded by Kikuyu grass
1974
spinifex
L
M
M + K
d. Probable evolution of topography and vegetation
(not to scale)
FIG.1 Piha Beach
AEE

beach from the Marowharo Stream to the Piha Stream (Diamond, 1966, p. 120).

In 1948 the topography (Fig. 1c) had changed in some places (Williamson, 1953). The Marowharo Stream having cut off the arc, took up a position further inland from part of the long reach, and had joined up with the Wekatahi Stream. On the seaward side of the long reach new dunes covered about 3 000 square metres. This region is referred to in this paper as the Marowharo accretion. It appears from Williamson's map that there was one long dune here fairly well back from the shore with minor ridges diverging from it.

Williamson reported that judging from photographs it seemed that the outer dunes had increased in height and width since 1932. A period of accumulation of sand ended in 1946.

In 1974 accretion and erosion in the northern section are nearly balanced (except at the Marowharo accretion). Because of recent under-cutting the face of the fore dune is fairly steep. It is more than 18° in most places and reaches 33° where the dunes reach their maximum height of 7 metres.

Erosion has been very severe in the central section near the Wekatahi Stream outlet. In 1948 50 m or more of sand lay between the foreshore and the road at its major bend. At this point the whole of the fore dune complex has disappeared and the very high tides reach the foot of a scarp just a few metres from the road.

The Marowharo accretion seems to have increased in size a little. The indentation of the foreshore has become a minor bulge but nearer to the surf club buildings the coast may have retreated slightly. There are now three dune crests on the accretion area. The inner one which was mapped in 1948 (Williamson, 1953) is not well defined because of subsequent sand movement. The two other dunes are narrow near the surf club buildings where they reach a height of 7 m, but are about 25 m wide in the south where they are also much lower. The slope of the foot of the seaward face of the fore dune is 27° decreasing to 13° in the south. The general slope of the surface of each of these dunes in the south is much less than 13° and they are separated by a scarp only about one metre high. The dunes were moulded from an extensive area of sand carried there by the prevailing westerly wind from a large inter-tidal zone at the mouth of the stream nearby.

VEGETATION

In 1940 the fore dune appears in aerial photographs to be fairly evenly covered in spinifex. On the inland face of the second dune there is a narrow strip most likely to be composed of *Cassinia retorta.* Lupin *(Lupinus arboreus)* patches show distinctly, mostly near the foot of the hill.

In 1948 the vegetation of Piha Beach was the subject of a thesis by Miss P. A. Lush (Lush, 1948), the results appearing later as a paper (Williamson, 1953—nee Lush). Much of the paper was devoted to the composition and distribution of the plant communities. At that time spinifex dominated on the fore dune and *Desmoschoenus* took second place. Spinifex was divided into two classes:—

- active spinifex on the fore dune where sand was accumulating,
- inactive spinifex where sand was more stable.

On the Marowharo accretion the spinifex zone was very wide. In the central section and north of Monkey Rock only inactive spinifex bordered the beach, no doubt because recent erosion had prevented the development of a normal fore dune.

The less vigorous spinifex extended inland onto the second dune ridge (or later yellow dune of Williamson) to where *Cassinia* dominated. This zone abutted patches of lupin or graded into communities of exotic plants, particularly *Lotus subbiflorus, Leontodon taraxacoides* (hawkbit) and *Hypochaeris radicata* (catsear), with appreciable quantities of native plants—the grass *Deyeuxia billardieri,* the sedge *Scirpus nodosus* and sand pimelea *(Pimelea arenaria).* Inland from this were communities of *Muehlenbeckia complexa* and *Tetragonia trigyna* with some lupin. Most of the lupin at this time was still at the base of the hill but had been advancing about one metre a year from 1932.

In 1974 little remains of what could be called natural dune vegetation except for the spinifex on the fore dune. It has remained in occupation because

1. there is enough loose sand to enable it to survive in a sub-optimal condition,
2. there are no other species which can grow here successfully enough to replace it.

Besides the vegetation adjustments following erosion and accretion, and the ageing of communities, there have been profound changes resulting from suppression of the natural vegetation by exotic plant species.

CHANGES CAUSED BY EROSION AND ACCRETION

Erosion has caused stagnation of the vegetation by preventing the deposition of fresh sand for

spinifex to invade. For a period prior to 1946 vegetation apparently developed in a regular sequence as sand was added to the shore. When a new fore dune formed, spinifex on the older dune became inactive as the sand stabilised. *Cassinia* established and was possibly replaced by *Muehlenbeckia.* In the current protracted period without fresh sand being deposited spinifex has not prepared the way for *Cassinia* and this species has nearly been eliminated from the beach. Meanwhile *Muehlenbeckia* has encroached to the margin of the spinifex.

In part of the central section erosion has been drastic enough to remove the whole dune complex. As a result the flattish land behind the dunes is now on the foreshore. Here *Muehlenbeckia* hangs over an erosion scarp 5 or 6 metres high.

On the Marowharo accretion spinifex thrived in the accumulating sand but the natural succession of dune species has been deflected by the abundance of exotic plants better able to succeed than *Cassinia.* With the vigorous spinifex on the fore dune there is *Lotus subbiflorus* and the flatweeds *Leontodon* and *Hypochaeris* on the more stable parts. In the shallow depression behind this dune, a fairly complete ground cover is provided by lupin, flatweeds and fleabane *(Erigeron floribundus).* On the second dune inactive spinifex is giving way to flatweeds and a wide range of exotic annuals including *Lotus subbiflorus,* catchfly (*Silene gallica*), harestail (*Lagurus ovatus*) and quaking grass *(Briza maxima).* There is also some lupin. The last relic of *Desmoschoenus* to be found on Piha Beach is losing the battle for survival in this stable sand. *Muehlenbeckia* has advanced to the scarp of the second dune and is eliminating nearly all other plants in its path. Kikuyu grass *(Pennisetum clandestinum)* is moving towards the coast behind *Muehlenbeckia.*

CHANGES CAUSED BY SPREAD OF EXOTIC PLANTS

On the basis of number of significant species the native plants are outnumbered by exotics. The native plants remaining in high numbers in decreasing order of abundance are *Muehlenbeckia complexa, Spinifex hirsutus, Deyeuxia billardieri, Tetragonia trigyna, Scirpus nodosus, Calystegia soldanella* and *Oxalis* sp. (probably *O. corniculata* var. *crassifolia* (A. Cunn.) Hook.f. but not *O. stricta* as suggested by Williamson). Four exotics are much more prominent than the others—Kikuyu grass, lupin, quaking grass and catchfly. Also fairly plentiful are harestail, catsear, hawkbit, *Cynodon dactylon* (Indian doab), *Lotus subbiflorus* and fleabane. It is worthy of note that marram *(Ammophila arenaria)* is still a plant of little consequence on Piha Beach.

Under the conditions at Piha with continual removal and deposition of sand spinifex has no equal on the face of the fore dune. Outside the spinifex zone Kikuyu grass, *Muehlenbeckia* and lupin compete for supremacy. Kikuyu grass and *Muehlenbeckia* are fairly evenly matched and both are antagonistic to lupin.

The taller stature of lupin gives it little advantage over the creeping habit of *Muehlenbeckia* and Kikuyu grass. It is a short-lived perennial and requires fairly open situations for its seedlings to establish successfully. This restriction of seedling habitat by the creepers gives lupin stands a fairly short life span. This is the main reason for lupin disappearing from the places where it grew in 1948. Now lupin plants are fairly numerous near the beach where loose sand drifts in from the fore dune and where *Muehlenbeckia* and Kikuyu grass have not yet invaded. The one major stand of lupin near the Marowharo Stream probably owes its origin to disturbance of some sort before Kikuyu grass arrived. Kikuyu grass has crept into the stand from the edges and will soon replace it. *Muehlenbeckia* on the other hand, establishes in lupin stands from bird-borne seed as well as by marginal advance.

Kikuyu grass was of fairly limited importance in 1948 but now occupies more than 75% of the beach area and excludes almost all other species. There is no habitat on the beach that it cannot occupy, with the possible exception of the spinifex zone. Here it could reach the upper tide mark if the shore was less exposed.

Muehlenbeckia, which since 1948 has spread to become very significant in all places except the spinifex zone, is the only native plant to persist in quantity where Kikuyu grass has invaded. Trampling and mowing of beach sections and public car parks has swung the balance in favour of Kikuyu grass.

While the loss of the natural dune flora to Kikuyu grass may be regretted, a change to dominance by exotic plants is inevitable because of the amount of disturbance associated with the use of the beach as a popular resort. There is no more suitable grass to tolerate trampling, mowing and wheeled traffic. Kikuyu grass will eventually oust nearly all other species remaining on the sand behind the fore dune.

SOME FLORISTIC CHANGES SINCE 1948

Without Williamson's record we would have had no indication of the occurrence of four native species which are not there now. *Pimelea arenaria,* which was listed as occasional in the *Cassinia* zone, has

disappeared. *Coprosma acerosa* can no longer be found at Piha but it still persists in the district. The plant listed as *Zoysia matrella* (probably *Z. planifolia*) does not occur on the beach now but an entity which may be the same species still grows in a number of places along the coast.

No close comparison was made between the wetland floras of 1948 and the present but I am certain that Cook's scurvy grass *(Lepidium oleraceum)* has not persisted. A streamside habitat may not be usual for this species but its identity is not in question because it was well known in the district in the 1930s. Cook's scurvy grass has changed from being an abundant plant to a rarity in New Zealand and has disappeared from the coast bordering the Waitakere Range. Its decline is usually attributed to removal by domestic animals but in parts of the Piha district sheep and cattle have played no part. It seems more likely to have succumbed to insect pests of cruciferous crops and vegetables.

There are a few species on Piha Beach which were not recorded in 1948. Among them are *Lepidium bonariense, Senecio angulatus* and *Coprosma macrocarpa.* This species of *Coprosma* has not always been separated from other large-leaved species in Auckland species lists and is likely to have been overlooked in 1948.

NOTES ON SOME PLANT NAMES

Since 1948 many plants have become known by different names. Most of these changes can be traced in modern floras and in a publication by the New Zealand Weed and Pest Control Society (1969) and some redeterminations are mentioned below to relate the names used by Williamson to plants we know by different names today. *Arundo conspicua* is the wide-leaved coastal *Cortaderia splendens* which Connor described as a separate entity in 1971. *Oxalis stricta* is a name which has erroneously been given to some forms of *Oxalis corniculata.* The plant at Piha appears to be *O. corniculata* var. *crassifolia* (A. Cunn.) Hook.f. It has a thick woody root. *Zoisia matrella* is probably *Zoysia planifolia* Zotov but *Z. minima* (Colenso) Zotov and *Z. pauciflora* Mez. have also been recorded west of Auckland (Zotov, 1971). *Leontodon hispidus* is the hawkbit we know now as *L. taraxacoides* (Vill.) Mérat. The *Erigeron* species are confusing. In the past the specific names of *E. floribundus* and *S. canadensis* have been transposed. I believe that Williamson's record of *E. canadensis* should be *E. floribundus.* The identity of *E. crispus* is uncertain. The reference is probably to *E. pusillus* which does not occur at Piha today but grows on the dunes at Muriwai.

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