

FORESHORE VEGETATION

from the Waimakariri River
to Taylors Mistake

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1992

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The author wishes to thank
Hugh Wilson
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of drawings from his book
"Stewart Island Plants"
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INTRODUCTION

This report is intended as a resource document, primarily for the Parks Unit of the Christchurch City Council. It has been written to assist in the preparation of a management plan for the foreshore area.

The vegetation present is described and recommendations are made as to which species would be appropriate to plant in various locations. Background information is provided for a number of the species involved.

TERMINOLOGY

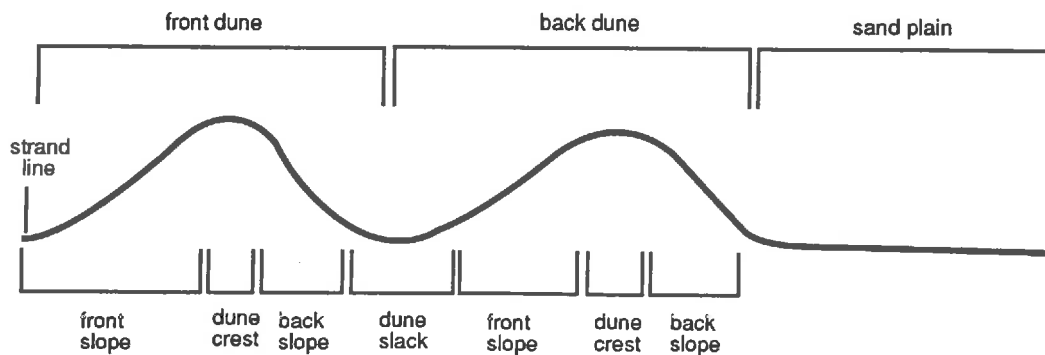
PLANT NAMES

Where possible, common names have been used in the text. The appendix at the back lists the corresponding botanical names. Common names have also been substituted in the older references (this has been indicated by square [] brackets).

FORESHORE TERMINOLOGY

The following terms have been used in this report in referring to parts of the dune system (Figure 1):

strand line	the line at which debris accumulates on the seaward side of a dune, at the base of the dune.
front slope	the seaward side of a dune
back slope	the landward side of a dune
dune crest	the very top of a dune
fore dune	the dune closest to the sea
back dune	any dunes on the landward side of the foredune
dune slack	the area between dunes, that is usually hollow and damp
sand plain	a flat area of sand



1. Parts of a dune system.

HISTORY

In the late 1800's it was found that land management practices (especially grazing and fire) had resulted in dune instability, over and above the cycle of erosion and accretion that would normally occur. Large tracts of sand were found to be moving in and covering land, especially agricultural land. A number of species were introduced to try and improve stability. The most successful of these was marram, which is now widespread and is the dominant sand binding species.

Both of the major native sand binding species (pingao and *Spinifex*) were formerly present on the dunes covered by this report. Pingao is still present, although in much reduced numbers.

Spinifex is no longer present, although there is evidence of "seed bearing plants on North Beach as recently as the 1940's" (Simpson 1974). Possible explanations for the current absence of *Spinifex* in this area include grazing pressure by rabbits, or an inability to withstand severe frost, combined with competition from marram.

Past records of the dune vegetation in Canterbury refer to a number of other species that are no longer found or are now uncommon (eg Armstrong 1879, Pegg 1913). A number of these would be suitable for re-planting.

CURRENT VEGETATION

A brief description is given here of the various stretches of dune and their vegetation. Time constraints meant that a full-scale vegetation survey to assess the foreshore area was not possible, however what was observed during visits to each area has been recorded. The locations referred to are shown in Figure 2.

There is a more detailed species list, based on field visits between 1984 and 1988, by Johnson (1992) included as Appendix I. Both are included because although the list by Johnson is more comprehensive, it does not distinguish between areas (either along the coast or within the dune system).

A. Waimakariri River south to Spencer Park

The front slope of the dunes adjacent to Brooklands Lagoon are dominated by marram. A few small patches of pingao are present. Flax is also present on the front slope in several places.

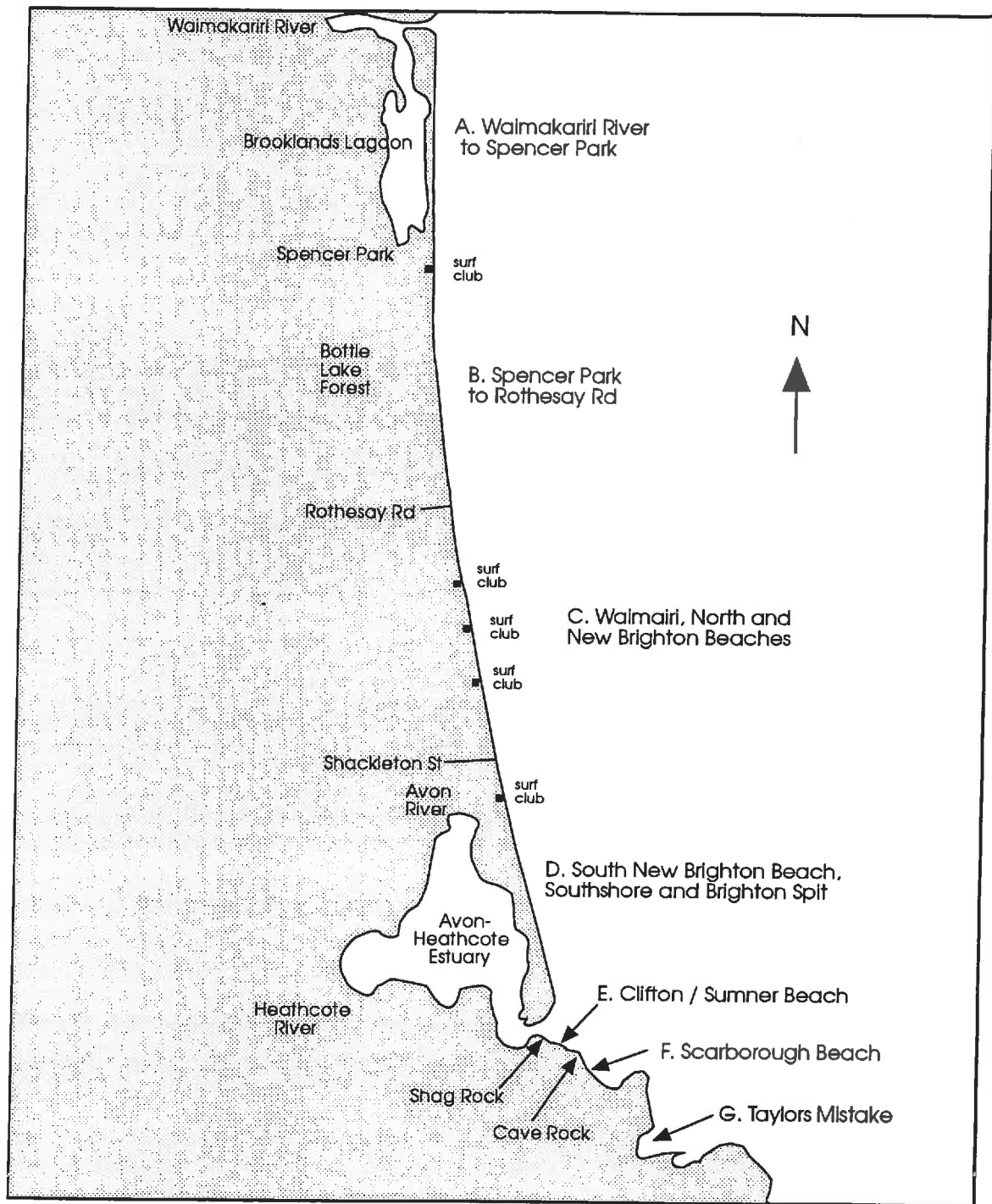
The back slope of the dunes supports marram, cottonwood, flax, radiata pine, gorse and tree lupin. Also present in small quantities are akeake, manuka, saltmarsh ribbonwood and ngaiio. In the vicinity of Spencer Park there is introduced iceplant as well.

Further inland there are various species associated with the lagoon (mainly rush and sedge species, as well as small herbs).

B. Spencer Park to Rothesay Rd

The dunes here extend inland the width of 3 or 4 lines of dunes and for some distance they are backed by Bottle Lake Forest (Figure 3). The front slope is dominated by marram. Several patches of pingao are also present, despite some grazing occurring (Figure 4).

Behind the fore dune there are a number of tracks that go through marram (which is quite patchy in places) and pine (Figure 5).



2. Location of areas mentioned in text.



3. Dunes adjacent to Bottle Lake Forest.



4. Pingao that has been grazed.



5. Marram, in patches.

South of the forest there are only scattered pines and the dunes are again dominated by marram. Other grasses include Yorkshire fog, creeping bent and haretail. One patch of lyme grass was present some way inland.

In the areas furthest inland there are species characteristic of stable dunes, such as toetoe, flax, bracken and blackberry. In the damper hollows there are rush species such as knobby club rush, jointed wire rush and *Juncus pallidus*.

Where there are dense areas of pines there is often not much growing beneath.

There are a mixture of conifer species, the most common being radiata pine. Also common in some areas is macrocarpa. For quite some distance (adjacent to Bottle Lake Forest) the pines extend right to the crest of the fore dune (Figure 6). Cottonwood is also present, on the backslopes.

C. Waimairi, North and New Brighton Beaches (Rothesay Rd to Shackleton St)

The front slope of the fore dune is dominated by marram and introduced iceplant, with some purple groundsel. The ice plant has and is being planted all along, especially adjacent to the Waimairi Surf Club. There is the occasional patch of pingao near to Brighton, but none at the northern end.

Sections of dune at the northern end have been flattened (sand has been removed) and re-planted with a mixture of marram and introduced iceplant.

Lyme grass is present on the back slopes of the dunes for most of the length of North Beach. South of the Waimairi Surf Club there are several poroporo shrubs, plus radiata pine, macrocarpa and tamarisk.

Planting has also been carried out on the back slope. The dunes opposite Thomson Park were planted as part of a community project (Meurk 1990). The successfully planted species include ake ake, hebe, ngaio, taupatu and pohutakawa.



6. Pines extending right up to the dune crest.

D. South New Brighton Beach, Southshore and Brighton Spit (Shackleton St to the end of the Spit)

The most common species on the front slope of the fore dunes are marram, lupin, purple groundsel, catsear and introduced ice plant. Occasionally present is the succulent *Cotyledon orbiculata*. Immediately north of the South Brighton Surf Club and extensively south of it, there is pingao growing in patches.

The back slope of the fore dunes has similar species with some additions, a particularly common one being lyme grass. Puha and hawksbeard are present. Harestail grass grows almost on the dune crest, but slightly to the lee side of it. Introduced ice plant is present on the lee side, but is less abundant there than on the front slope.

The dune hollows are mainly filled with grasses such as Yorkshire fog and creeping bent. There are also several rush species present; *Juncus pallidus* and jointed wire rush.

The area behind the fore dune has a larger number of species. The grasses include marram, tall fescue, prairie grass and creeping bent. The herbs include sheep's sorrel, purple groundsel, yarrow, vetch, puha and peppergrass. Shrubs include flax, tree mallow, toe toe and some broom. Gorse and boxthorn are both present. Tree species noted were macrocarpa, radiata pine (including some rather dead looking seedlings), white poplar, boxthorn, cretan mallow, cabbage tree, ake ake, pohutakawa and ngaio. Plants of boneseed were also found, one of these being on the front slope of the fore dune. A single plant of cottonwood was found, close to the road - this species is much more common north of Rothesay Rd.

Near Caspian St there is *Cotyledon orbiculata* adjacent to the road.

E. Clifton / Sumner Beach (Shag Rock to Cave Rock)

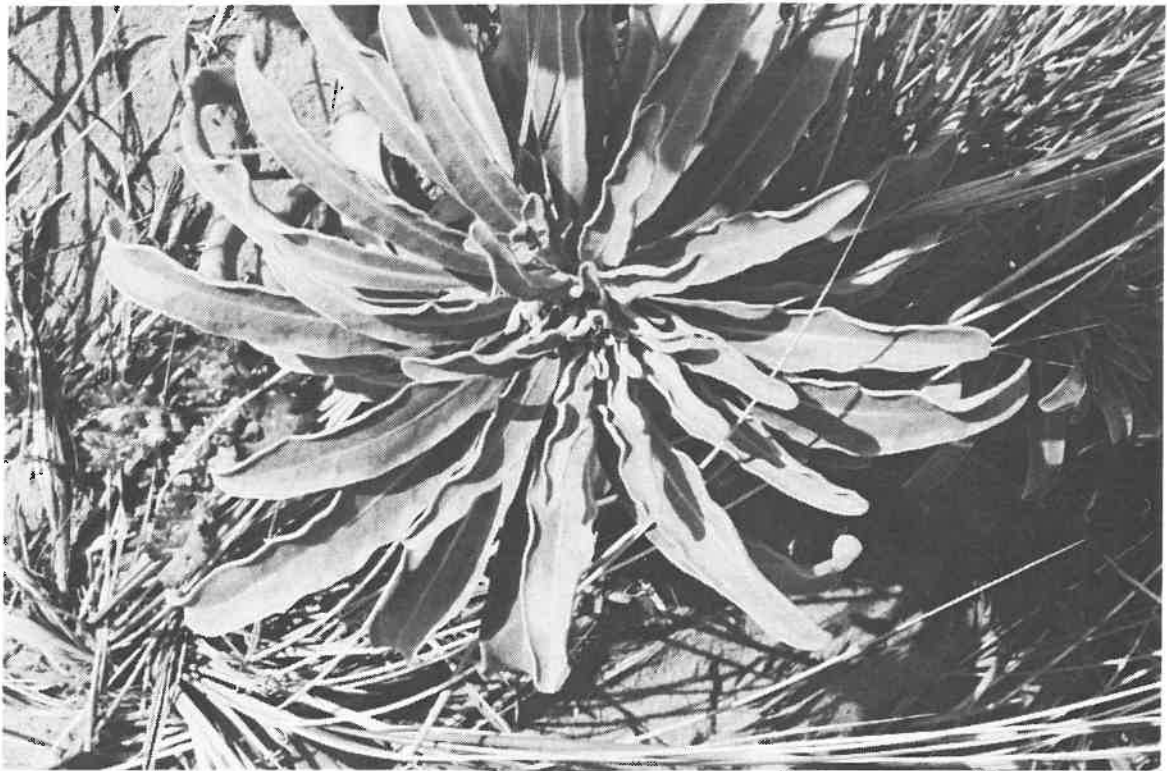
Currently there is very little dune present at Sumner. Marram is the most common species. There is some introduced ice plant but not nearly as much as along the Brighton dunes. There is no lyme grass; the only other grass species are prairie grass, Yorkshire fog and chewing's fescue.

In the dune slack area that is east of the life-saving club building there are a mixture of species. The herbs include purple groundsel, catsear, haresfoot trefoil, dwarf mallow, ?? and puha. A small amount of the native ice plant also appears to be growing there (although positive identification was not possible without flowers). Also some woody herbs - id reqd.

The tree species include ngaio, boneseed, tree lucerne, broom, radiata pine, ake ake, lemonwood, taupatu and some tree mallow.

Immediately east of the dune-dune slack area there is a patch of knobby club rush.

West of the buildings there are various species lining the rocky bank up to the road. These include wallflower (Figure 7) and *Echium candicans*.



7. Wallflower amongst marram.

F. Scarborough Beach

There are a few species growing on top of the rocks piled along the shoreline at Scarborough. They include bucks horn plantain, purple groundsel, tree mallow and Yorkshire fog. Behind these taupatu, ngaio and macrocarpa have been planted.

G. Taylors Mistake

Marram and introduced ice plant are abundant. There is also some lyme grass. There is some creeping bent, danthonia and tall fescue in the slight hollows. Purple groundsel and dwarf mallow are present.

The shrubs and trees are lupin, tree mallow, boneseed, taupatu, ngaio, radiata pine and macrocarpa.

FEATURES OF EACH SPECIES

Dune plants can be grouped according to their location within the dune system. The groups covered here are sand binders, sand stabilisers, plants of dune slacks, and plants of stable dunes.

The information presented comes from a variety of sources. It should be noted that the characteristics of a particular species (eg the dune height that it can build) may vary between locations due to factors such as the prevailing wind direction and speed.

SAND BINDERS

Cockayne (1967) summarises the features of ideal sand binders as "plants with rapidly growing underground stems, which possess the faculty of rooting near the tips of the branches and putting forth new shoots as fast as the old ones are buried".

The three main sand binders that are currently present on the dunes covered by this report are marram, pingao, and to a lesser extent, lyme grass.

The relevant characteristics of sand binders include; their ease of establishment, the rate at which they are able to build dune, the type of dunes formed and which part of the dune system they prefer. Some of the features of each are described below and compared later on.

LYME GRASS *Elymus arenarius*

European, grass.

Lyme grass contributes to stabilisation - especially of back dunes where marram can not grow because of poor nutrients. The plants can easily be pulled out, but it is a good dune binder which doesn't out compete the other species, due to its open habit (Patridge *pers comm.*).

Hubbard (1954) describes lyme grass (in Britain) as being an "effective sand-binder, spreading by its extensively creeping rhizomes and by seeds, sometimes dominating large areas of dunes, or growing mixed with marram and other sand grasses. It succeeds best in loose sand at the foot or on the seaward side of the dunes." In contrast, lyme grass in the study area seems to only grow on the back slope of the foredune, or on back dunes. It is much more common south of Rothesay Rd, where it has been planted.

MARRAM GRASS *Ammophila arenaria*

European, grass.

Marram grass (Figure 8) grows most often from stem fragments and only occasionally from seed. Seedlings are palatable (eg to sheep and hares) although generally plants are not. Nevertheless, in the study area some grazing does occur.

Establishment is usually on dunes that are de-stabilised.

- "Blow-outs do not occur freely and those that do seem to originate where marram or [pingao] grow with *Spinifex*"
- *Spinifex* has a greater tolerance of sea water compared to marram.

As discussed earlier, this species is not currently found on the dunes covered by this report, although plants were present in the past. Nor was this species listed by Pegg (1913). Canterbury was formerly the southern limit of its distribution. It is possible that the increased pressures that now exist (eg grazing and competition) exclude *Spinifex* from the area. The current southern limit on the east coast is Cape Cambell (Wardle 1991).

However, a description of some of the features of *Spinifex* has been included in case its re-establishment is attempted. At least some trial planting of this species is recommended. Wardle (1991) notes that the recovery of *Spinifex* in some areas has been achieved, through protection and sometimes artificial seeding as well.

COMPARISON OF SAND BINDING SPECIES

PINGAO vs MARRAM

Partridge (1991) has made a detailed study of the interaction between pingao and marram at Kaitorete Spit. He suggests that prior to the introduction of marram, pingao was already gone from many dune systems, due to the high instability of the dunes that resulted from grazing of sandhills and other marginal land practices. Marram was then planted and in many places has never directly entered into competition with pingao. Nevertheless, where both species are present, some displacement does occur. This is "achieved by the marram drying out the upper layers of sand where pingao is rooted and then subsequently using lower layers to obtain moisture". Possible additional factors that have been suggested by Cockayne (1967) include the lack of palatability of marram plants and the ease with which it establishes.

The study by Partridge (1991) identifies a number of situations where marram and pingao can successfully co-exist. The situations described include:

- on "the front face of the fore dune where marram spread is restricted".
- in an unstable situation, "through re-starting of the establishment phase, which favours pingao".

In discussing the situation at New Brighton, Partridge notes that:

"..remnants of pingao exist on marram dominated dunes...stability may however be only temporary... the whole dune system has been subjected to frequent erosion and building phases. During the building phase pingao probably establishes at the strand line along with marram, but as marram frequently seems unable to completely colonise the building front foredune face, there is the opportunity for pingao to persist. In the absence of pingao, such 'gaps' in the marram remain bare, and indeed seem to be prime sites for the commencement of dune blowouts" (p. 22).

If however pingao was included in the species regularly planted (following phases of erosion), a population may persist. Regular collection of seed from existing plants would be required.

It may be possible to effectively plant both marram and pingao - and perhaps a combination would be more successful than either species by itself.

OTHER SAND BINDERS

Pingao and marram are the two main sand binders on the dunes covered by this report. The other species that is common on the front slope of the foredune is introduced ice plant. The

sand binding part of pingao (Figure 14) and marram (Figure 15) is a rhizome (underground stem). Introduced ice plant has sub-woody stems and fibrous roots (Figure 16) which may also contribute to stabilisation.

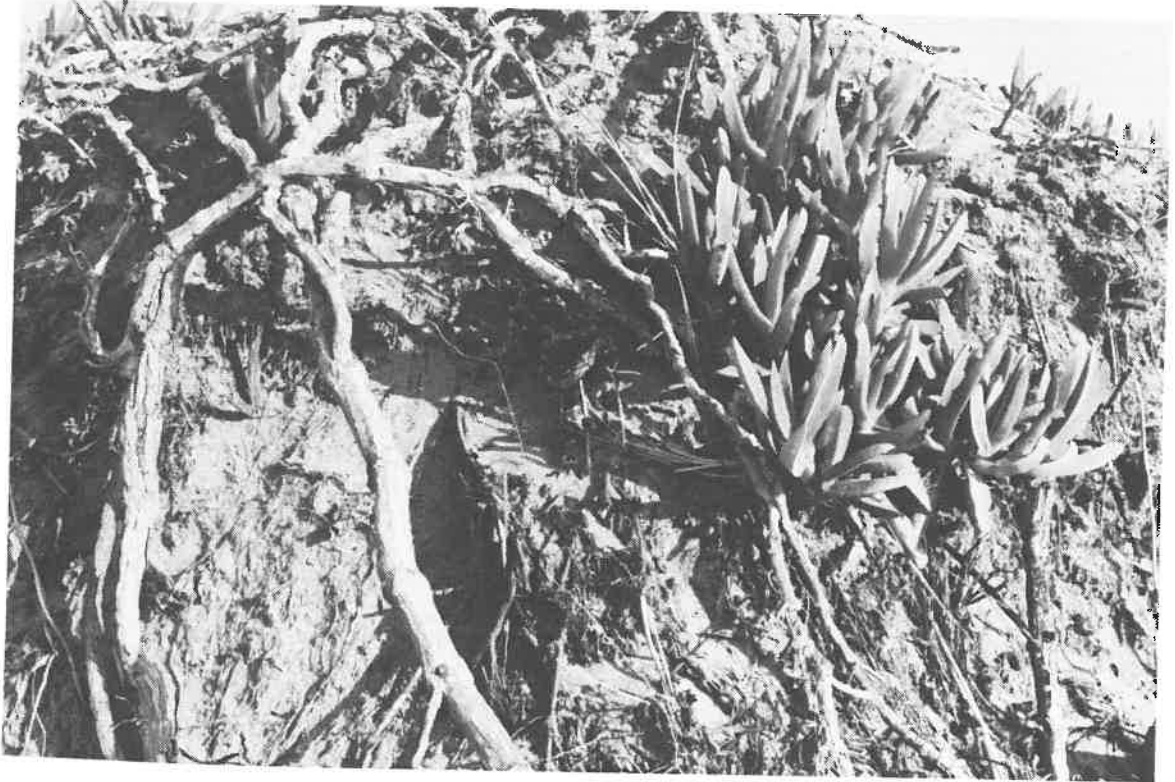
Characteristics of the existing and potential sand binders are compared in Table 1. Figure 17 compares the dune profiles formed by marram, *Spinifex* and pingao.



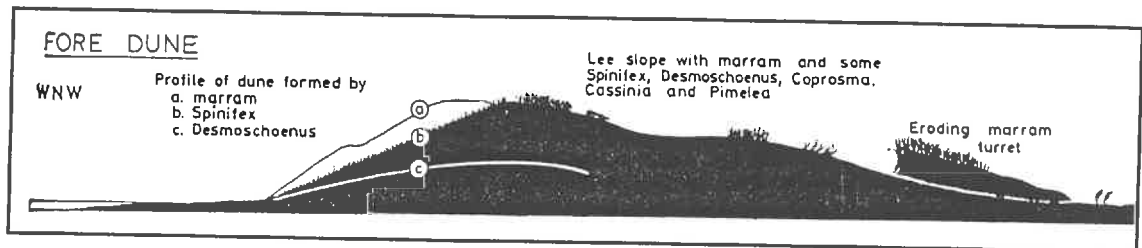
14. Exposed rhizomes of pingao.



15. Marram, showing exposed rhizomes.



16. Exposed stems and roots of introduced ice plant.



17. Dune profiles in the Manawatu. (After Esler 1970).

SAND STABILISERS

Most of the species listed here act as sand stabilisers to some degree, through their ability to shelter sand from the wind, often by forming a mat-like cover. The remaining grow in amongst the true stabilisers, benefiting from their protection but contributing little to stabilisation.

CATSEAR *Hypochoeris radicata*

Introduced, flatweed.

Catsear (Figure 18) grows in amongst marram, especially on back slopes and dune crests. It has a long tap root. Cockayne (1911) notes that this species is able to tolerate dry conditions so long as there is shelter (which marram provides).



18. Catsear, amongst marram.

Coprosma spp. *Coprosma* spp.

Native, shrubs.

Several of the *Coprosma* species will grow on coastal sites, eg *C. acerosa*, *C. crassifolia* and *C. rigida*. Sand coprosma (*C. acerosa*) is described in detail further on.

COTTONWOOD / TAUHINU *Cassinia leptophylla*

Native, shrub.

Cottonwoods (Figure 19) grow on partly stabilised dunes and are usually between 0.5-5 m tall. Unlike some of the other dune shrubs, such as sand coprosma and sand daphne, cottonwoods are unable to extend their growth to keep above sand level. Hence they may become buried. Their more open structure (non-divaricate) means that the sand can also be blown away again and the plants will often survive such burying (Wardle 1991).



19. Cottonwood, on the back slope of a fore dune.



20. Detail of cottonwood.

Pegg (1913) describes the distribution of cottonwood as "common on active dunes on both ends of New Brighton beach, where it is a characteristic heath plant."

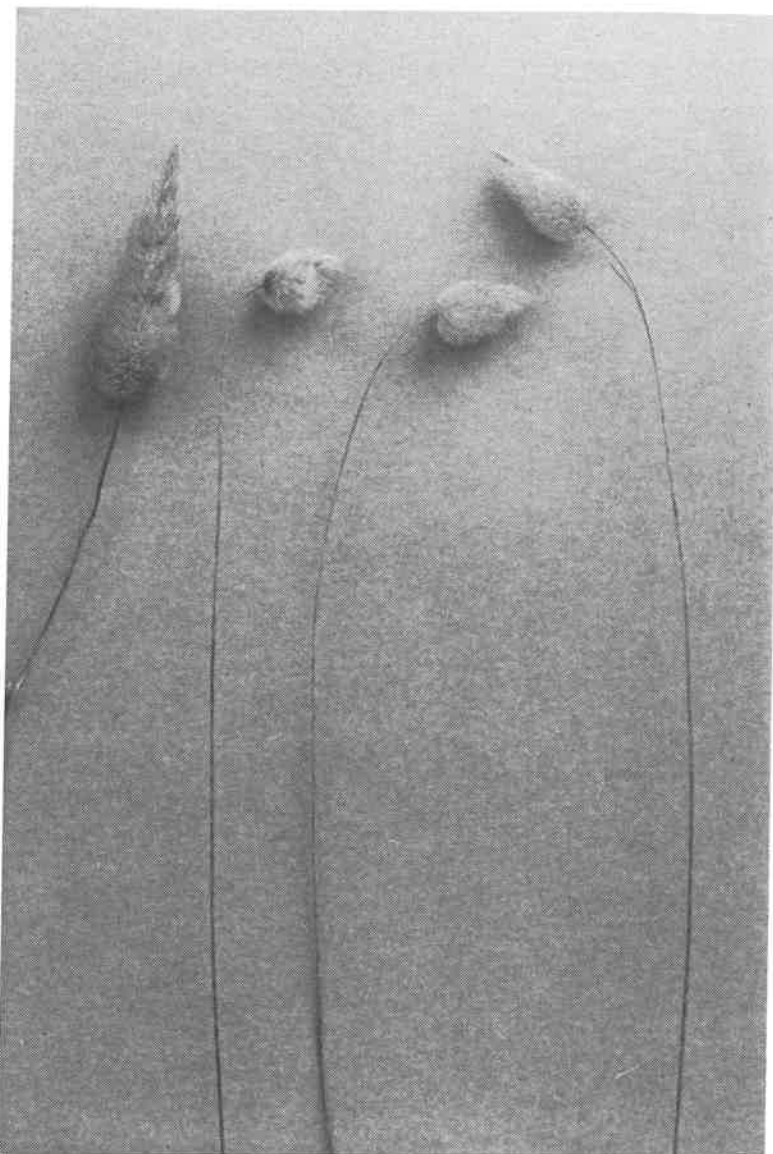
Currently cottonwood is present on the back slopes, mainly from Brooklands Spit south to Rothesay Rd.

Formerly a number of native species of *Cassinia* were recognised, but Webb *et al.* (1988) consider that although there is local variation, classification into distinct species is not appropriate. If possible, any propagation of this species should be from local material.

HARESTAIL GRASS *Lagarus ovatus*

Introduced, grass.

This species (Figure 21) is an annual which is fairly common along the dunes, mainly just on the lee side of the fore dune crest. Although harestalk provides some cover on the dunes for part of the year, it probably contributes little to dune stabilisation.



21. Harestail grass seed heads.

INTRODUCED ICE PLANTS *Carpobrotus edulis* & *C. aequilaterus*

Introduced, succulent herb.

Both of these species are mat forming perennials and have stems to 6 m long with leaves that are sharply 3-angled. The general habitat for this species is "cliffs and sand dunes, coastal and inland on railway and roadside cuttings" (Allan 1961).

Carpobrotus edulis (Figure 23) has been used extensively in the study area to provide dune stability (Figure 24). Although not a sand binder, introduced ice plant is unusual in that it grows successfully on both the front and back slopes of the fore dune. A steady supply is available from the banks of the oxidation ponds.

A small amount of *C. aequilaterus* may also be present in the study area - this species is generally smaller and its flowers are purple rather than yellow. In contrast to *C. edulis*, the usual habitat for this species is "coastal rocky sites, mostly steep banks and cliffs" (Allan 1961).

Hybrids occurring between the two *Carpobrotus* species, as well as intergeneric hybrids between *Carpobrotus* and the native ice plant (*Disphyma australe*), makes species identification sometimes unclear.

NATIVE BROOMS *Carmichaelia* spp.

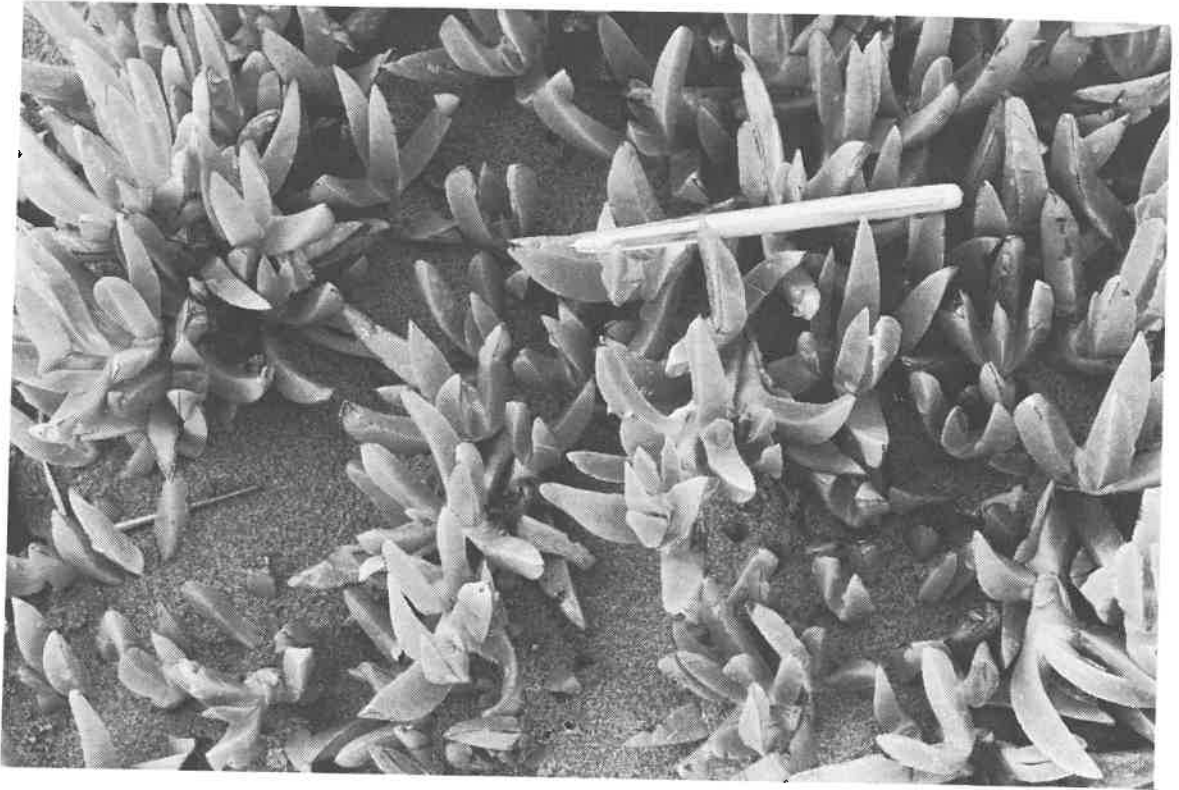
Native, shrubs.

A number of species of *Carmichaelia* have been recorded for the study area. However it is not always clear which species is being referred to as positive identification is not always possible unless the plant is flowering and some names have been used to which there are no current references.

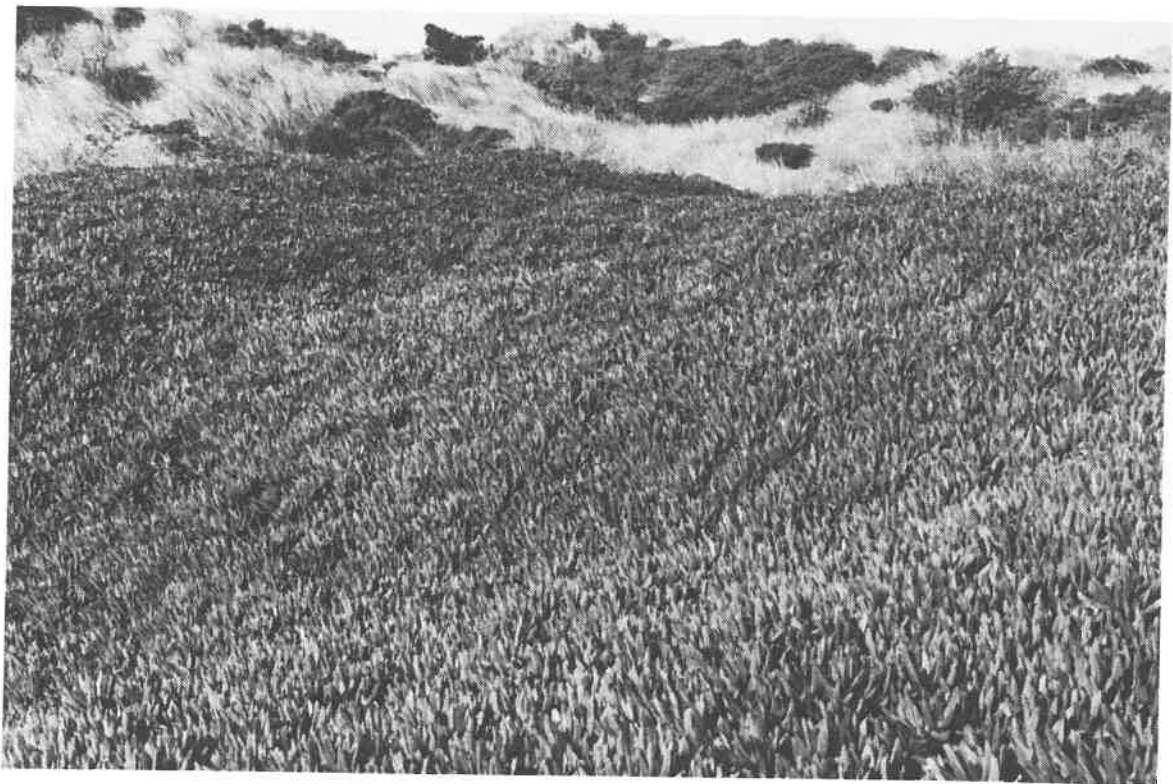
C. kirkii is one species that does seem to have occurred here in the past.



22. *Carmichaelia* sp.



23. Introduced Iceplant (*Carpobrotus edulis*).



24. Introduced Iceplant covering a dune at South Brighton.



25. Native ice plant.

NATIVE ICE PLANT *Disphyma australe*

Native (endemic), succulent herb.

This species is similar in appearance to the introduced ice plant species but is smaller. *Disphyma* occupies a similar niche to *Carpobrotus aequilataerus*.

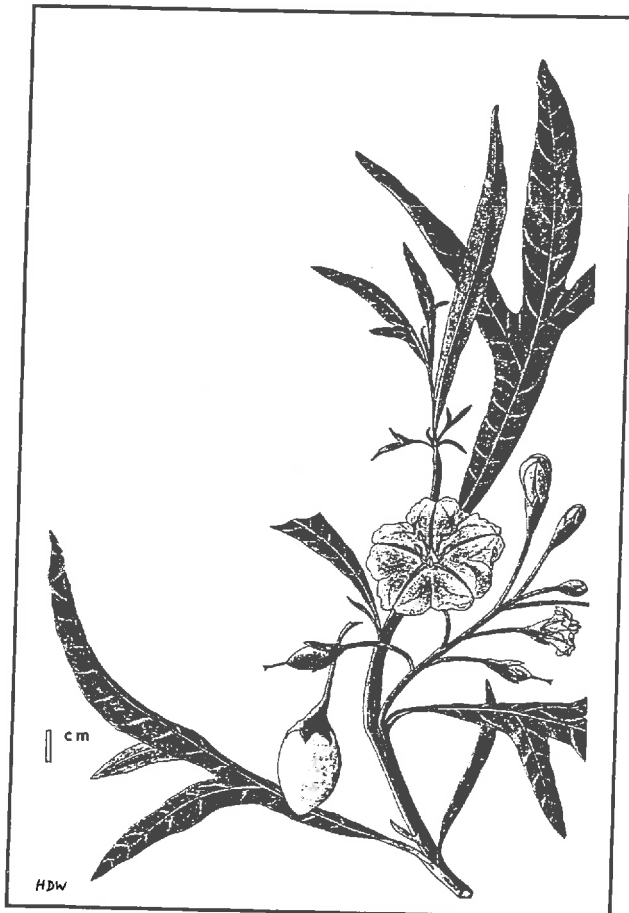
POHUEHUE *Muehlenbeckia complexa*

Native, liane.

This is a scrambling woody vine, up to 6 m tall and which will form "tangled masses in absence of support" (Allan 1961). Pohuehue is also found in grassland areas such as the Port Hills.



26. Pohuehue, amongst silver tussock.



POROPORO *Solanum laciniatum*

Native, shrub/tree.

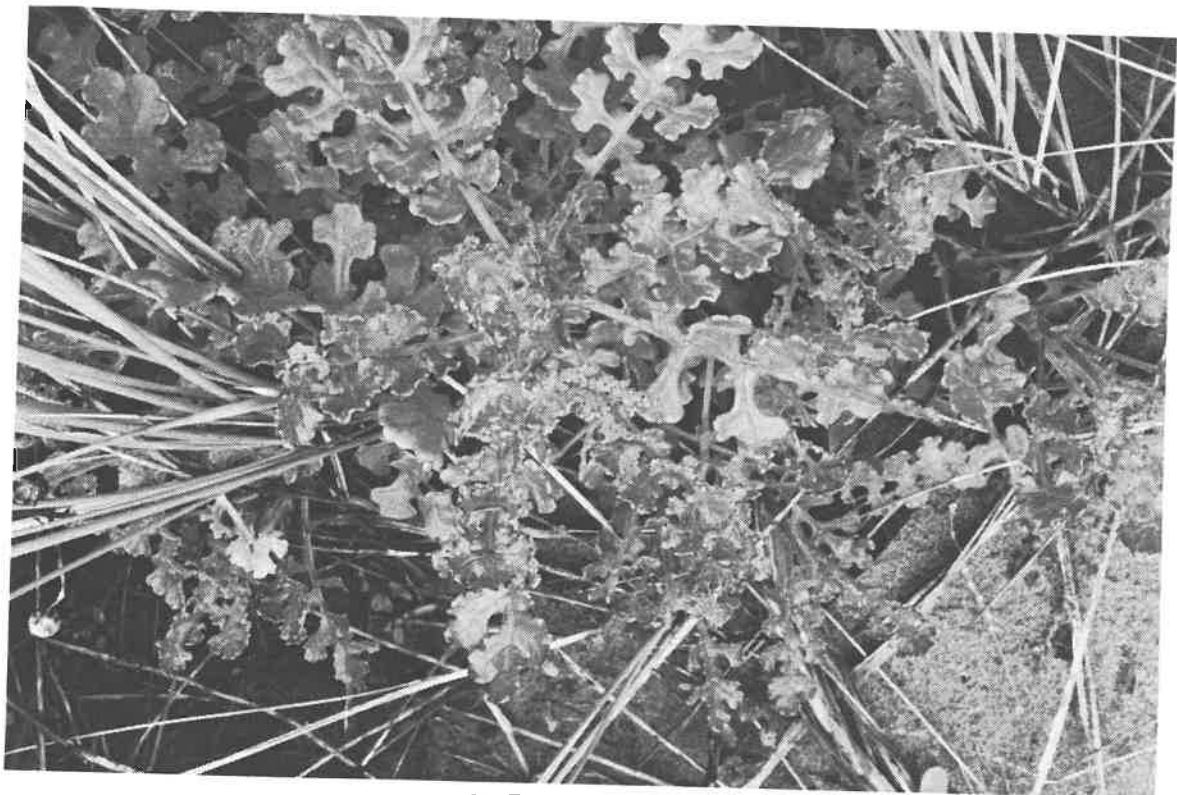
Poroporo (Figure 27) is usually less than 3 m tall and grows on coastal and lowland forest margins (Allan 1961). It is currently growing in sandy areas around the Avon-Heathcote estuary.

PURPLE GROUNDSEL *Senecio elegans*

Introduced, herb.

This species (Figure 28) grows 10-60 cm tall and is an annual that is found throughout the study area, although more commonly in the southern part. Typically it grows on back slopes, but it does sometimes grow on the front slope of the fore dune as well.

27. Poroporo (Wilson 1982).



28. Purple groundsel.

RADIATA PINE *Pinus radiata*

Introduced, tree.

Radiata pine is a medium to large tree that has been extensively planted and is also self-seeding in places such as Brooklands Spit and adjacent to Bottle Lake forest.

Further planting of this potentially weedy species is not recommended as native species could be used for the same purpose.

SAND COPROSMA *Coprosma acerosa*

Native, shrub.

This is a low-growing shrub (Figure 29) which forms a cushion like mass up to 2 m diameter and up to 2 m tall (Allan 1961). The stems root adventitiously when buried (Wardle 1991). Sand coprosma collects sand, but will be completely buried if too much sand is accreting.

Sand coprosma was recorded by Pegg (1913) as "found fairly frequently, in rounded masses, on the active dunes at both ends of New Brighton beach; often in company with [cottonwood]". However there appear to be no plants of this species in the study area and none were recorded by Johnson (1992). This may be due to the current instability of the dunes. Currently the most suitable area for establishment would probably be immediately south of Rothesay Rd.

SAND DAPHNE / AUTETAURANGA *Pimelea arenaria*

Native, shrub.

Sand daphne (Figure 30) grows on coastal dunes and in hollows. The main stems of sand daphne are prostrate, rooting, and often buried in sand. The plant itself grows to 40 cm tall (Allan 1961).

In 1913 Pegg recorded sand daphne as present on active dune. "Only two shrubs of [sand daphne] were found [at New Brighton], though it is common in New Zealand dune areas generally...they grew on the active dune, in exposed position, among [pingao]".

SAND MILK-WEED / WAIUATUA *Euphorbia glauca*

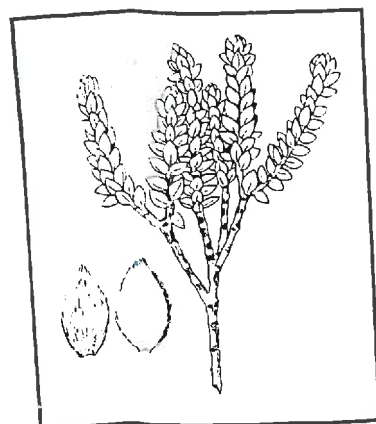
Native (endemic), herb.

Sand milk-weed (Figure 31) grows up to 1 m tall and is found on coastal sands and rocks throughout New Zealand, although its distribution tends to be local (Allan 1961).

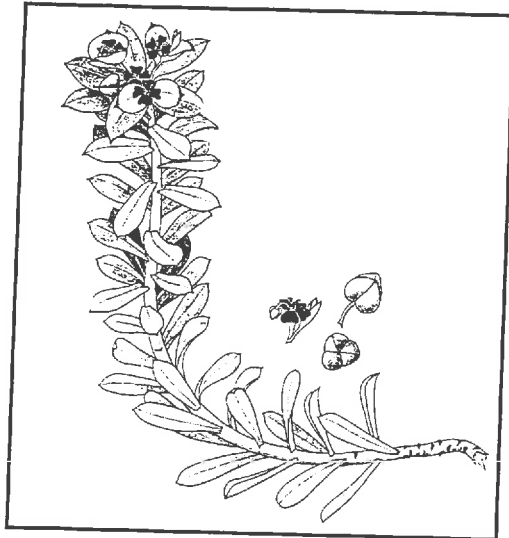
Although milk-weed was common in the past, its distribution on the east coast of the South Island has now been reduced to 5 known localities. A number of species are out competed by marram but sand



29. Sand coprosma (Wilson 1982).



30. Sand daphne (Poole & Adams 1986).



31. Sand milk-weed (Wilson 1982).

milk-weed is apparently able to survive amongst marram, which makes its declining distribution difficult to explain (Wardle 1991).

It does not currently grow in the study area, but was probably present in the past (Simpson & Mason 1981).

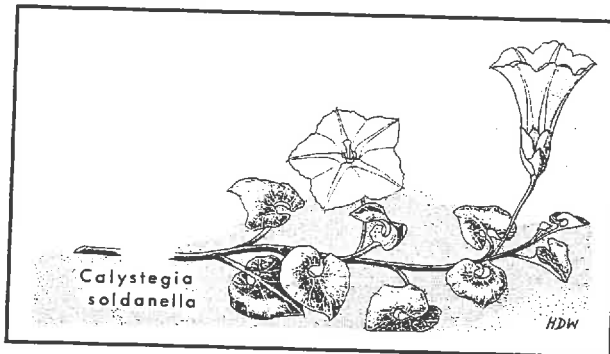
SHORE CONVULVULUS *Calystegia soldanella*

Native, liane.

Shore convolvulus is very effective at stabilising sand because its leaves and stems form a continuous cover over the sand, thereby protecting it from wind. It can however be buried by incoming sand. Mostly it grows "from the top of the beach to the crest of the foredune.

Its well-spaced leaves lie flat on bare sand between colonies of the taller sand-binders, but where it persists into denser vegetation, stems twine up supporting plants" (Wardle 1991). Low patches or mounds form that can reach 2 m diameter.

Was formerly present on active dunes at New Brighton (Pegg 1913). There is currently some shore convolvulus on the eastern side of the Avon-Heathcote estuary, at Wetland Reserve II. It is also recorded in the study area by Johnson (1992).



32. Shore convolvulus (Wilson 1982).

SPRAWLING POHUEHUE *Muehlenbeckia ephedroides*

Native, shrub.

A much branched prostrate to sprawling shrub, almost leafless, with stems up to 1 m or more long (Allan 1961). This species is not currently present in the study area.

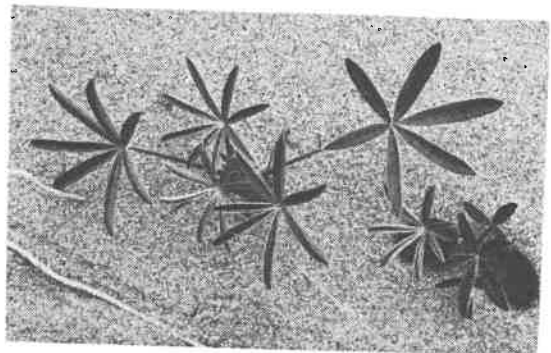
TREE LUPIN *Lupinus arboreus*

Introduced, shrub.

A woody perennial shrub that has been extensively planted, especially in association with either marram or pine trees. Tree lupin is a very effective sand stabiliser but it is not a sand binder.

Even in 1913 this species was widespread, described by Pegg (1913) as covering "extensive patches on dune and plain".

However Johnson (1992) notes that its status and distribution are in a state of flux due to the effects of the fungus *Colletotrichum gloeosporioides*. Molloy *et al.* (1991)



33. Tree lupin seedling.

record the devastation of tree lupin caused by this fungus, in association with kowhai moth, at Kaitorete Spit.

DUNE SLACKS

The plants listed here are ones that will grow in damp dune hollows.

ARROW GRASS *Triglochin striatum*

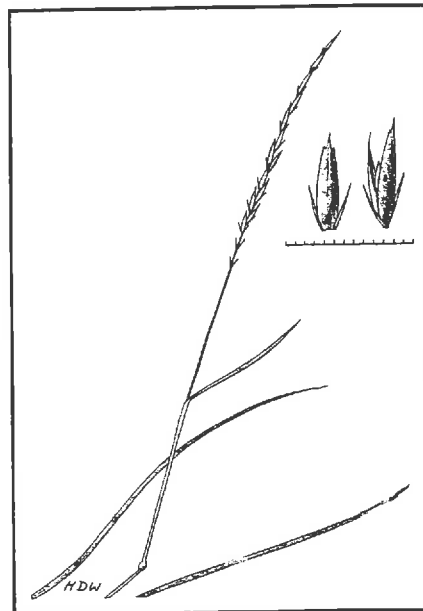
Native, herb.

Arrow grass (Figure 36) is a herb with linear leaves and is usually between 2 and 40 cm tall.

BACHELOR'S BUTTON *Cotula coronopifolia*

Native, herb.

This is a perennial herb that grows up to 30 cm tall, although it is usually less than 10 cm tall (Figure 37).



34. *Cockaynea laevis* (Wilson 1982).

Cockaynea laevis

Native, grass.

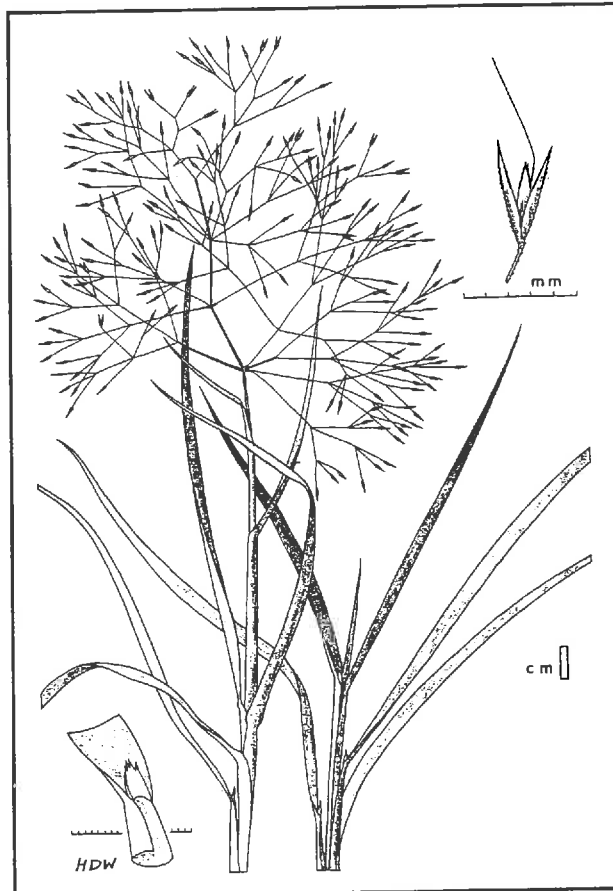
Cockaynea laevis (Figure 34) was recorded by Simpson and Mason (1981) near Leithfield "in an interdune hollow with scrub vegetation". However this grass was not found during the current study and was not recorded by Johnson (1991).

Deyeuxia billardieri

Native, grass.

Cockayne (1911) describes this species as a "tufted perennial grass forming small green patches about [30 cm] long by [15 cm] broad" (Figure 35).

Recorded at New Brighton by Wall (1922), but no longer present.



35. *Deyeuxia billardieri* (Wilson 1982).



36. Arrow grass.



37. Bachelor's button.

DUNE BUTTERCUP *Ranunculus acaulis*

Native, herb.

This species is a low growing fleshy herb (Figure 38), that grows in coastal dampish sands (Allan 1961).

Recorded at New Brighton by Wall (1953) and at Spencer Park by Simpson and Mason (1981). Not currently present.

DWARF MAZUS *Mazus pumilo*

Native, herb.

Dwarf mazus (Figure 39) is a small prostrate perennial herb that grows on swamp margins and in boggy ground (Allan 1961).

Johnson & Brooke (1989) note that this species could be confused with one of the common flatweeds, but that the flowers are distinctive. This species is vulnerable.

Eleocharis neozelandica

Native (endemic), sedge.

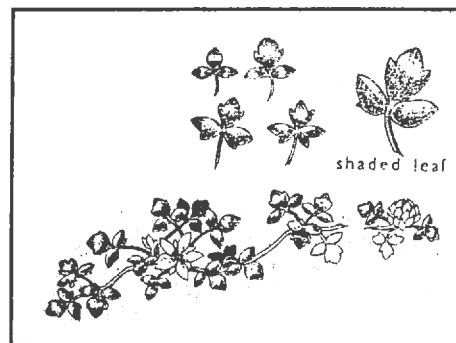
This is a small sedge, only 3-6 cm tall. The habitat of *E. neozelandica* is "coastal in damp places among sand dunes, or on sandy margins of tidal creeks (Allan 1961)".

Simpson and Mason (1981) note that this species has "not [been] seen for many years but this tiny plant is easily over looked and is worth watching for. At some times of the year the short culms turn rich gold in colour and attract attention".

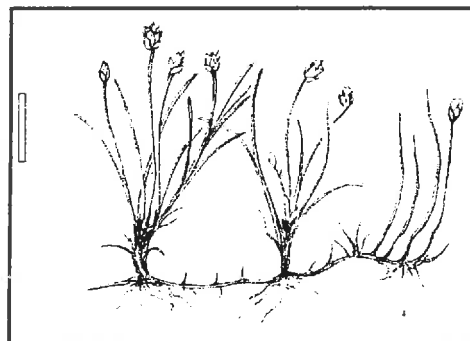
This species is now considered endangered (Johnson and Brooke 1989).



39. Dwarf mazus, at the botanic gardens.



38. Dune buttercup (Wilson 1982).



40. *Eleocharis neozelandica* (Johnson & Brooke 1989).

KNOBBY CLUB RUSH *Scirpoides nodosus*

Native, sedge.

Plants of knobby club rush grow to 30-90 cm tall. The usual habitat for this species includes coastal banks, dunes and sometimes wet ground (Johnson & Brooke 1989).



42. Lake clubrush.

LAKE CLUBRUSH *Schoenoplectus validus*

Native, sedge.

Lake club rush (Figure 42) is not widespread on the east coast of the South Island. There is some lake club rush present around the margins of the Avon-Heathcote estuary, but there is none in the study area.. Up to 2 m tall, with stems up to 1 cm in diameter (Johnson & Brooke 1989).



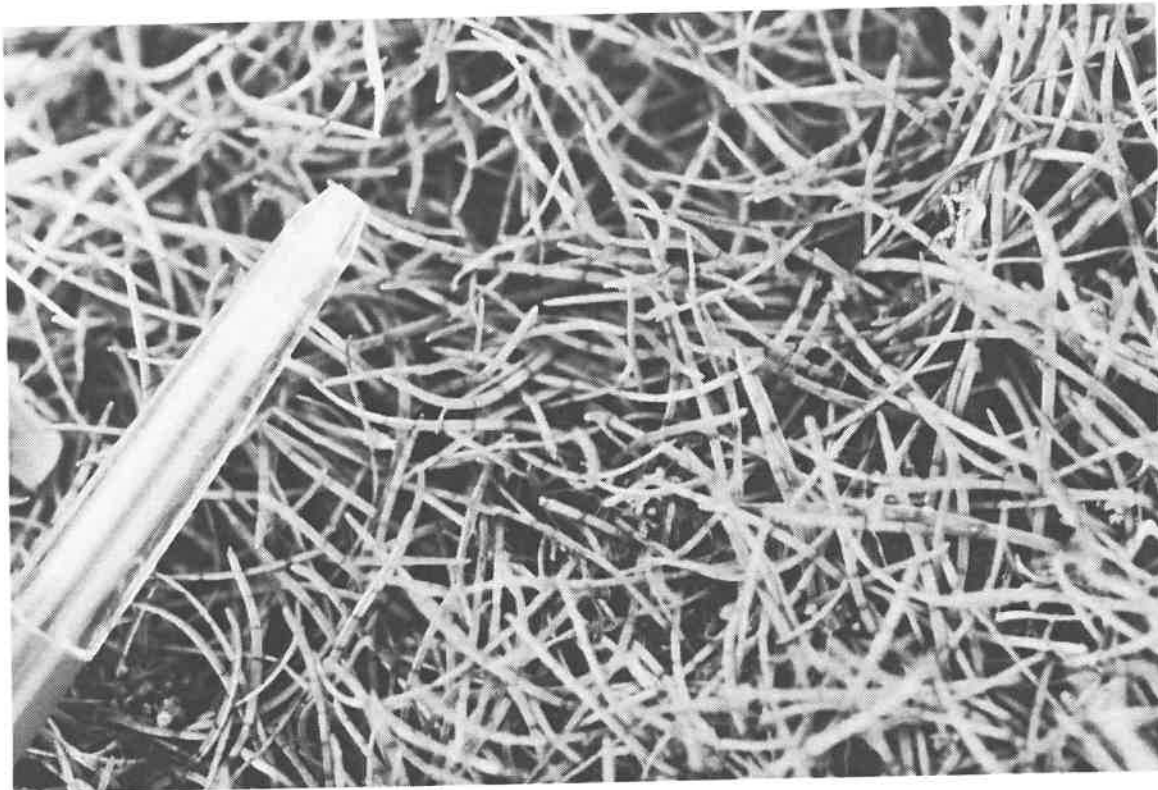
41. Knobby clubrush.

Lilaeopsis novae-zelandiae

Native, herb.

This is a small rush-like herb, only 2-5 cm tall.

In 1913 this species was "found in damp places towards north end of New Brighton beach, often carpeting the ground in company with *Selliera radicans* and *Epilobium*." (Pegg 1913). It is not currently present in the foreshore area and was not recorded by Johnson (1991). There is some present at Bexley wetland.

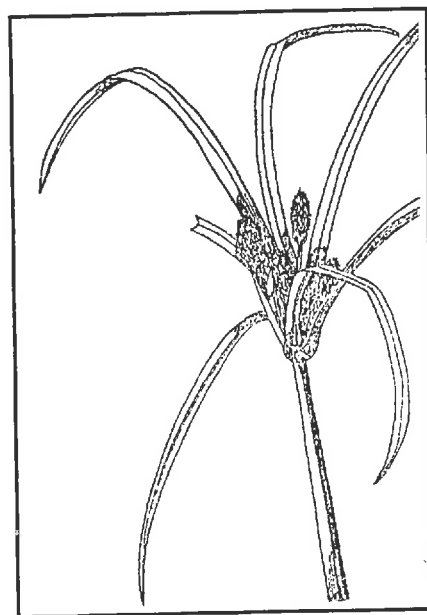


43. *Lilaeopsis novae-zelandiae*.

GIANT UMBRELLA SEDGE *Cyperus ustulatus*

Native (endemic), sedge.

This sedge (Figure 44) is usually between 60 and 100 cm tall (Allan 1961). It is not currently present.



44. Giant umbrella sedge (Moore & Adams 1963).

JOINTED WIRE RUSH / OIOI *Leptocarpus similis*

Native, herb.

Jointed wire rush is a rush-like herb, to 1.5 m tall. The stems are grey-green, yellow-green or reddish (Moore & Edgar 1970). "If massive movement of sand does not occur the species spreads extensively by rhizomes to become dominant" (Esler 1969).

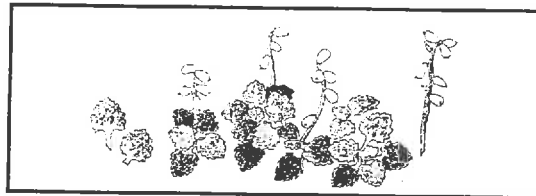
This herb was "found commonly in moist hollows, sand-plains, and marshy places" (Pegg 1913). It is still present in hollows, but not in very great quantities. The largest area of jointed wire rush is adjacent to Bottle Lake Forest.

SAND GUNNERA *Gunnera dentata*

Native (endemic), herb.

This is a small creeping herb with leaves to 4 cm long. It is also dioecious (ie separate male and female plants).

Sand gunnera was formerly common "in damp sand hollows, towards north end of New Brighton beach; not found at south end." (Pegg 1913). It is no longer present.



46. Sand gunnera (Wilson 1982).

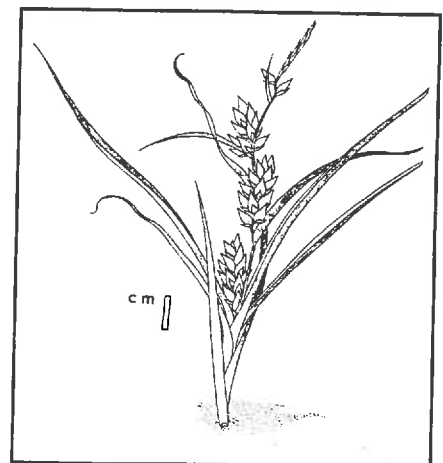
SAND SEDGE *Carex pumila*

Native, sedge.

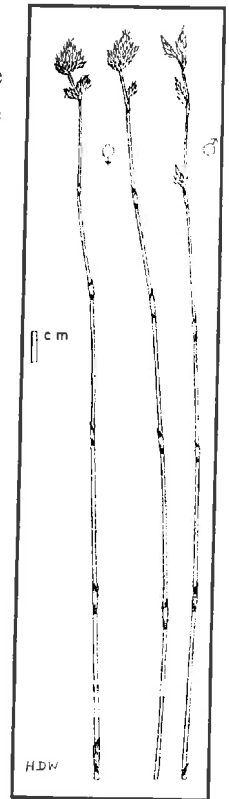
Leaves up to 40 cm long.

This species grows in moist sand hollows or plains. "No other plant of the sand plains has greater ability to gather sand, a feature which leads to its own extinction where sand supply is plentiful (Esler 1969)".

Sand sedge is currently present on the sand plain area adjacent to Bottle Lake Forest and was recorded by Johnson (1991). It was more widespread in 1913 when it was "Found in moist sand hollow or plains commonly in northern portion of the New Brighton beach (Pegg 1913)".



47. Sand sedge (Wilson 1982).



45. Jointed wire rush (Wilson 1982).

SEA PRIMROSE *Samolus repens*

Native, herb.

Sea primrose (Figure 49) is a perennial herb with "stems up to 40 cm long, branching, prostrate, rooting at nodes or sprawling. (Allan 1961)". It is present within the study area, although not in any great quantity.

Selliera radicans

Native, herb.

Selliera radicans (Figure 50) is a herb with "far-creeping stems and branches, rooting at nodes...forming matted patches up to 50 cm or more diameter (Allan 1961)".

S. radicans is recorded by Johnson (1991).

THREE SQUARE

Schoenoplectus pungens

Cosmopolitan, sedge.

Three square (Figure 48) is a distinctive sedge with stems that are triangular in cross-section. It grows to 30-60 cm tall, with a diameter of 1-4 mm. Three square is "one of the first plants on ground able to support salt swamp plants, excluded by [jointed wire rush] and [sea rush] which exclude the light (Cockayne 1967).

Three square does grow within the study area at present.



48. Three square.



49. Sea primrose.



50. *Selliera radicans*.

FIXED DUNES

Currently the main area of fixed dunes is adjacent to, and south of, Bottle Lake Forest. Some of these species would also be suitable on the ~sand plain / stabilised dune areas along the South Brighton part of the study area.

AKEAKE *Dodonea viscosa*

Native, shrub/tree.

Ake ake are dioecious (ie separate male and female plants) and may exceed 6 m in height. There are a few present within the study area. - a couple at Brooklands and at North Beach. The southern limit for ake ake on the east coast is Banks Peninsula.

CABBAGE TREE *Cordyline australis*

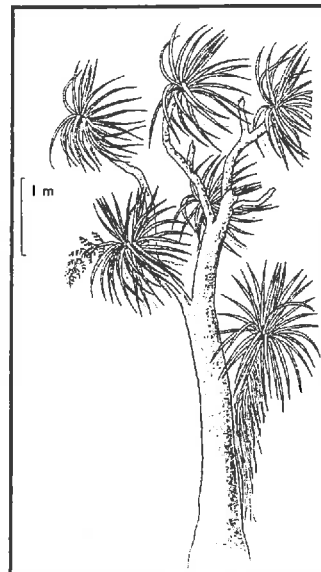
Native (endemic), tree.

These trees are typical of "forest margins, open places, abundant near swamps (Moore & Edgar 1970)" and are successful in coastal areas (Figures 52 & 53.

There are currently some scattered through - especially immediately south of Bottle Lake Forest, where there are some fairly stable dunes.



51. Ake ake.



52. Cabbage tree (Wilson 1982).



53. Back dune area at South Brighton, with cabbage trees.



54. Flax at South Brighton.



55. Manuka (Wilson 1982).

FLAX / HARAKEKE *Phormium tenax*

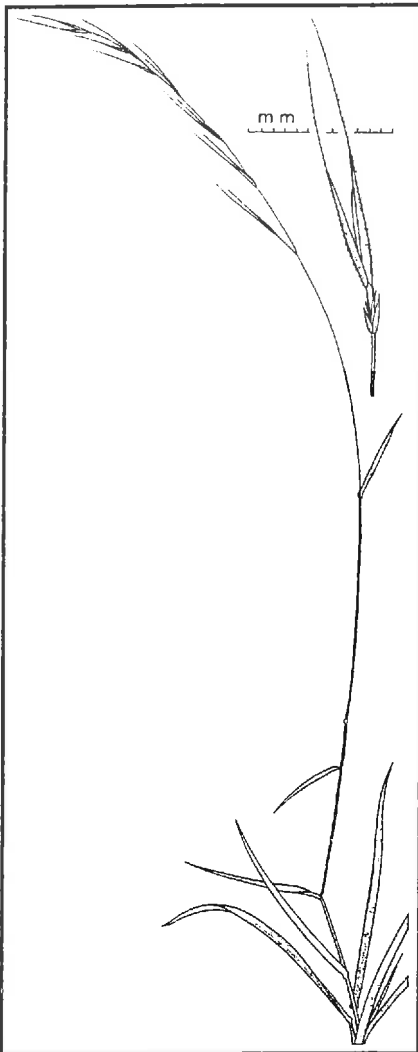
Native.

Flax will grow successfully on stable sand and it is currently found in some locations of the study area - mainly on the stable dunes just south of Bottle Lake Forest (Figure 54).

MANUKA *Leptospermum scoparium*

Native, shrub/tree.

Manuka (Figure 55) used to be widespread within the study area, but is now absent. Its distribution in 1913 is described by Pegg as "very common on stable dune, and especially upon heath plains; it forms close brown patches of varying size, interspersed among [cottonwood], [matagouri], [native broom], [jointed wire rush], and [knobby clu-brush]".



56. Meadow rice grass (Wilson 1982).

MATAGOURI *Discaria toumatou*

Native, shrub/tree.

Matagouri (Figure 58) is "a much branched ~deciduous, spiny shrub or tree up to 5 m or more (Allan 1961)".

Matagouri is not currently present and was not recorded by Johnson (1991). In the past however it was common, at New Brighton at least (Pegg 1913).

MEADOW RICE GRASS *Microlaena stipoides*

Native, grass.

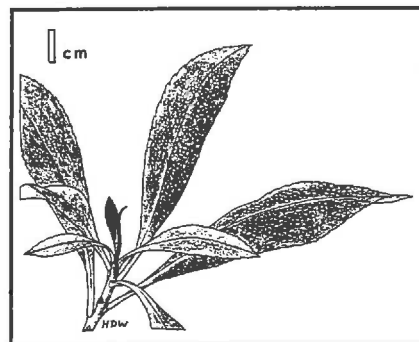
Meadow rice grass forms "slender tufts from [a] creeping rhizome (Wilson 1982)". Armstrong records the presence of this species in 1879, but it is not present in the study area at this time. It is however present on the Port Hills.

NATIVE JASMINE

Parsonsia heterophylla
& *P. capsularis*

Native, liane.

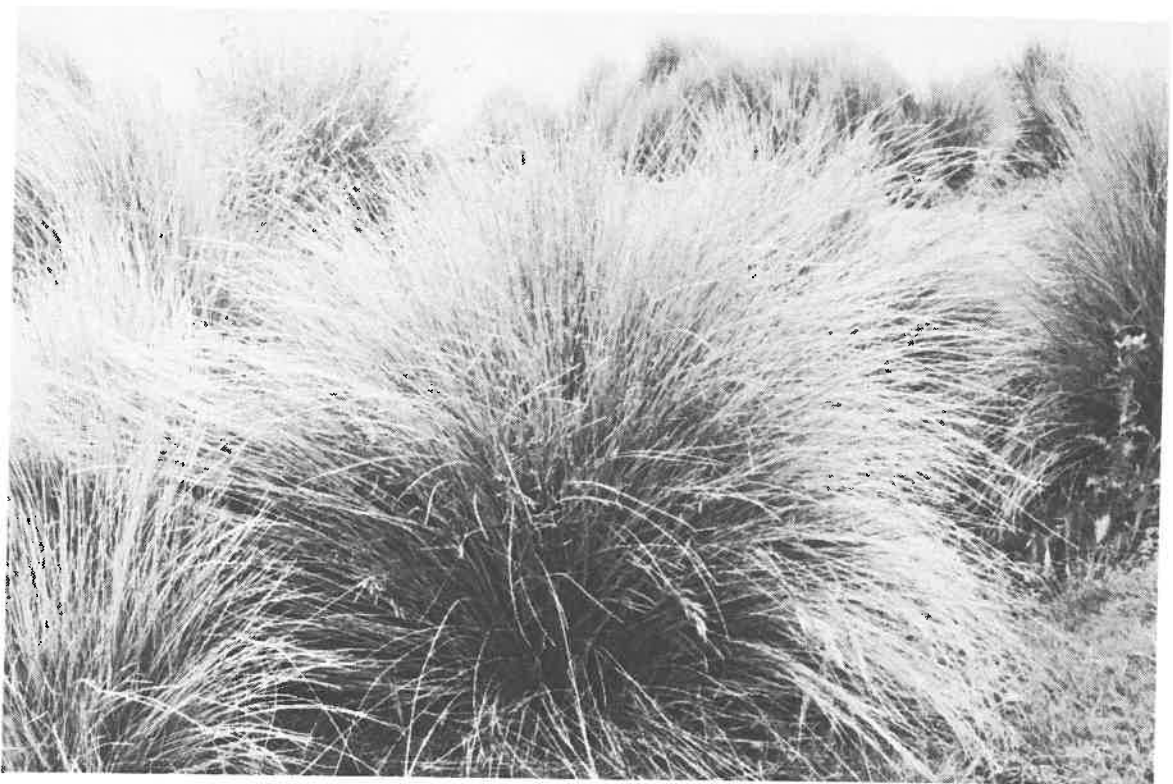
Both species have a somewhat variable leaf form and an attractive flower.



57. Ngaio (Wilson 1982).



58. Matagouri.



59. Silver tussock.

NGAIO *Myoporum laetum*

Native, tree.

Ngaio can grow to 10 m tall but are often low-growing in coastal areas.

There are several small ngaio present in the study area.

SILVER TUSSOCK *Poa cita*

Native, grass.

This species is currently present in the Avon-Heathcote estuary, but not on the foreshore. Silver tussock was formerly present "on active dunes, often just inland to the foredune; also at times in dune-hollows (Pegg 1913)".

TAUPATU *Coprosma repens*

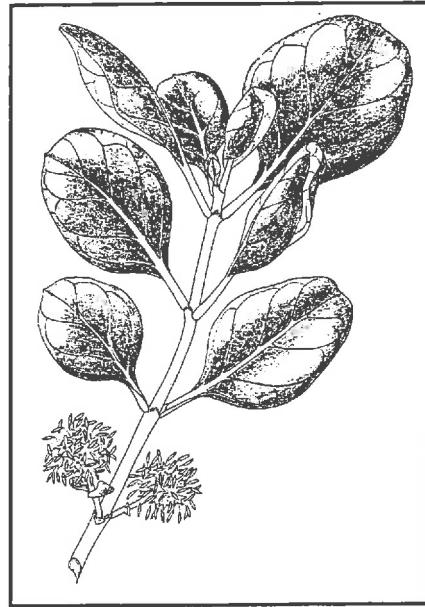
Native, shrub.

A few taupatu are present, which have probably been planted. (Simpson and Mason 1981).

TOETOE *Cortaderia richardii*

Native, grass.

There is some toe toe immediately south of Bottle Lake Forest, where there are some stable dunes.



60. Taupatu (Wilson 1982).



61. Toetoe, near Bottle Lake Forest.

COASTAL TREE & SHRUB SPECIES

Historical records of vegetation in Canterbury, such as the 'black maps' of 1856 (Wilson 1989) show no coastal forest in the study area. The northern part of the area is labelled with 'manuka scrub and fern' - perhaps better described as shrubland.

Nevertheless, tree species may be useful in certain locations, especially where they act to provide shelter from wind.

The following list of tree / shrub species are ones that grow in coastal areas nearby or that have been found to be successful in Canterbury.

The species have been listed and grouped according to their 'naturalness' - ie whether they are naturally occurring in the study area..

It is recommended that the first group be given preference and that the second group be used to some extent. The third groups should be avoided if possible - attractive and functional 'specimen' trees can be found amongst the native flora.

(The latitude of the study area is ~43.5°.)

GROUP 1 Species native to Canterbury (Also see the following table)

(* marks species mentioned in more detail elsewhere in this report)

ake ake*	<i>Dodonea viscosa</i>
cabbage tree*	<i>Cordyline australis</i>
karaka	<i>Corynocarpus laevigatus</i>
lancewood	<i>Pseudopanax crassifolius</i>
ngaio*	<i>Myoporum laetum</i>
pigeonwood	<i>Hedycarya arborea</i>
puka	<i>Griselinia lucida</i>
titoki	<i>Alectryon excelsus</i>

GROUP 2 Native species that are not naturally occurring in Canterbury (The southern limit of most of these species is north of the study area.)

Chatham Island ake ake	<i>Olearia traversii</i> (Chatham Islands)
kohekohe	<i>Dysoxylum spectabile</i> (to lat. 41° 30')
northern rata	<i>Metrosideros robusta</i> (to lat. 42° 30')
<i>Olearia albida</i>	(to lat. 38° 30')
tawa	<i>Beilschmiedia tawa</i> (to lat. 42°)

GROUP 3 Introduced species

chinese tamarisk	<i>Tamarix chinensis</i>
macrocarpa	<i>Cupressus macrocarpa</i>
maritime pine	<i>Pinus pinaster</i>
Norfolk Island pine	<i>Araucaria heterophylla</i>
radiata pine	<i>Pinus radiata</i>

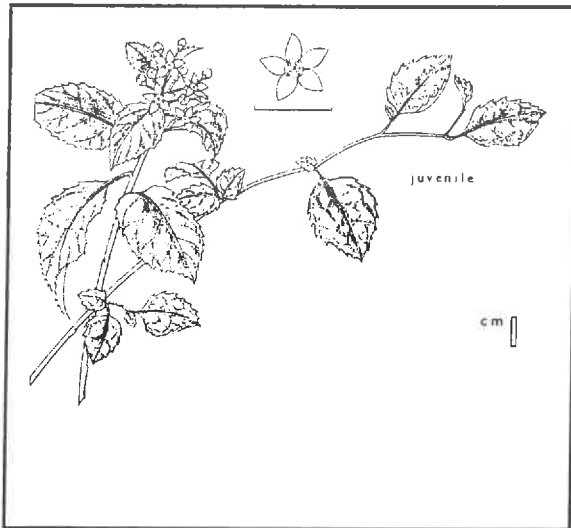
In addition to tree and shrub species, coastal forest would normally include an assortment of herbs, ferns etc. The species recorded by Mason (1967) for Gore Bay (Table 3) give an indication of the sort of species found in coastal forest nearby.

Table 3. The following coastal forest species were listed by Mason (1967) for Gore Bay.

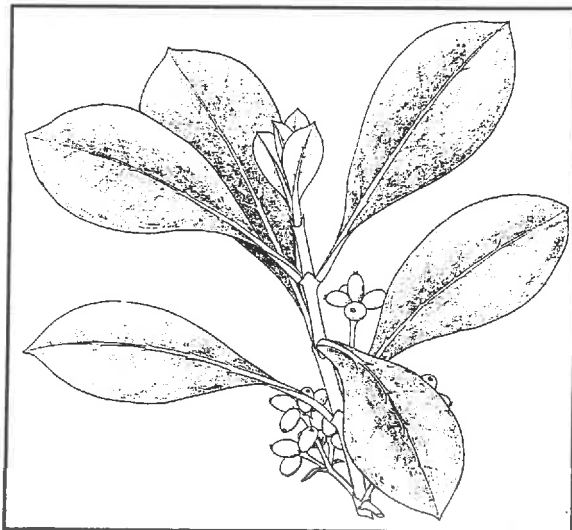
BOTANICAL NAME	COMMON NAME	PLANT TYPE	HEIGHT	FIGURE NO.
<i>Helichrysum aggregatum</i>		shrub	to 3 m	62
<i>Lophomyrtus obcordata</i>	rohutu	shrub	to 5 m	
<i>Hebe salicifolia</i>	koromiko	shrub	to 5 m	100
<i>Coprosma lucida</i>	glossy karamu	shrub / tree	to 3 m	64
<i>Macropiper excelsum</i>	kawakawa	shrub / tree	to 6 m	
<i>Coprosma robusta</i>	karamu	shrub / tree	to 6 m	101
<i>Dodonea viscosa</i>	ake ake	shrub / tree	to 6 m	51
<i>Olearia paniculata</i>		shrub / tree	to 6 m	
<i>Pittosporum tenuifolium</i>	silver matipo	tree	to 8 m	103
<i>Pseudopanax arboreus</i>	fivefinger	tree	to 8 m	
<i>Griselinia littoralis</i>	broadleaf	tree	to 10 m	104
<i>Melicytus ramiflorus</i>	mahoe	tree	to 10 m	
<i>Carpodetus serratus</i>	putaputaweta	tree	to 10 m	63
<i>Myoporum laetum</i>	ngaio	tree	to 10 m	57
<i>Cordyline australis</i>	cabbage tree	tree	to 12 m	52
<i>Rubus cissoides</i>	bush lawyer	climber		105
<i>Parsonsia heterophylla</i>	native jasmine	climber		
<i>Muehlenbeckia australis</i>	pohuehue	climber		107
<i>Calystegia tuguriorum</i>	shore convolvulus	climber		32
<i>Metrosideros perforata</i>	white rata	climber		
<i>Tupeia antarctica</i>	mistletoe	mistletoe		



62. *Helichrysum aggregatum*



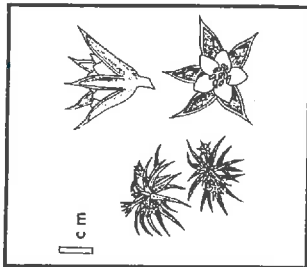
63. *Carpodetus serratus* (Wilson 1982)



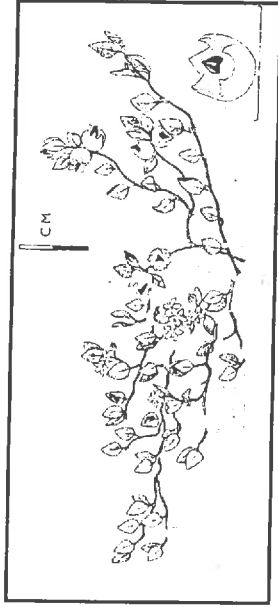
64. *Coprosma lucida* (Wilson 1982)

Table 2. Native species suitable for the foreshore area, as suggested by Colin Meurk (1990). Information on plant type and size is mainly taken from the appropriate flora volumes (Allan 1961, Moore & Edgar 1982, Webb *et al.* 1988).

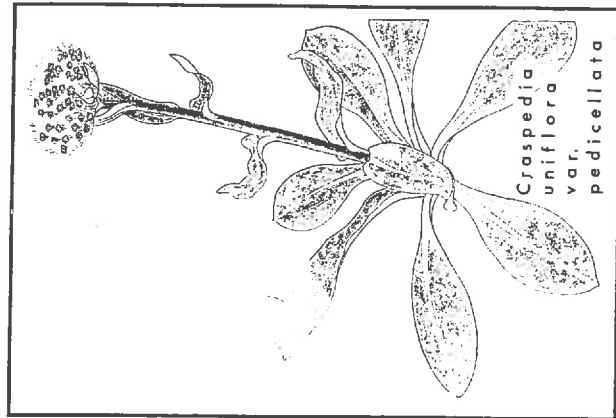
BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE			
					front slope	crest	back slope	front slope	crest	back slope	front slope
(a) FRONT SLOPE											
<i>Spinifex sericeus</i>	silvery sand grass	grass		13	*	*	*				
<i>Carex pumila</i>	sand sedge	sedge	to 40 cm	47	*		*				
<i>Desmochoenus spiralis</i>	pingao	sedge		10	*	*	*				
<i>Calystegia soldanella</i>	shore convolvulus	climber		32	*	*	*	*	*	*	*
(b) BACK SLOPE OR SAND PLAIN (P indicates sand plains or plateaux)											
<i>Austrofestuca littoralis</i>	shore fescue	grass		12		*	*				
<i>Zoysia minima</i>	sand twitch	grass					P				
<i>Colobanthus sp.</i>		herb	small	65			P	*			
<i>Craspedia uniflora</i>	puatea	herb		66			P	*			
<i>Einadia triandra</i>	poipapa	herb	prostrate-creeping				P	*			
<i>Geranium sessiliflorum</i>	native geranium	herb	small	67			P	*			
<i>Linum monogynum</i>	rauhia	herb	small	68			P	*			
<i>Scleranthus biflorus</i>	kohukohu	herb	small				P	*			
<i>Disphyma australe</i>	ice plant	succulent herb	creeping	25			P	*			
<i>Coprosma acerosa</i>	sand coprosma	shrub	to 2m	29			P	*			
<i>Muehlenbeckia axillaris</i>	pohuehue	shrub	prostrate	69			P	*			
<i>Muehlenbeckia ephedroides</i>	pohuehue	shrub	prostrate to sprawling				P	*			
<i>Pimelea arenaria</i>	sand daphne	prostrate shrub	to 40 cm	30			P	*			



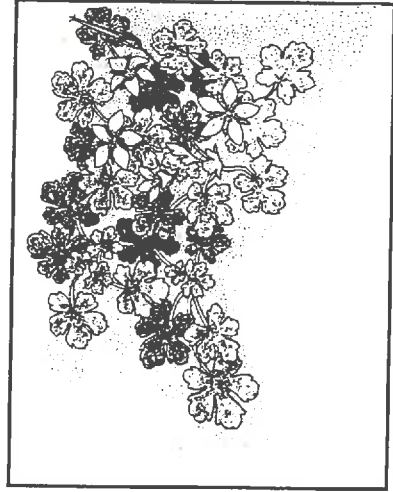
65. *Colobanthus muelleri*
(Wilson 1982)



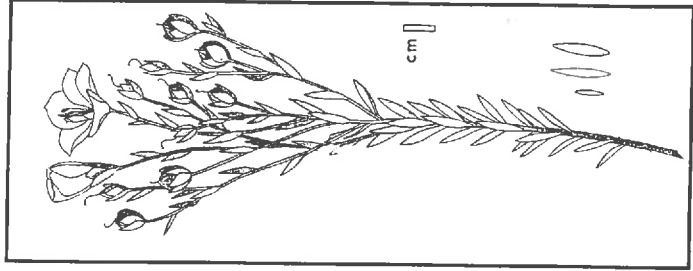
69. *Muehlenbeckia axillaris* (Wilson 1982)



66. *Craspedia uniflora* (Wilson 1982)



67. *Geranium sessiliflorum* (Wilson 1982)



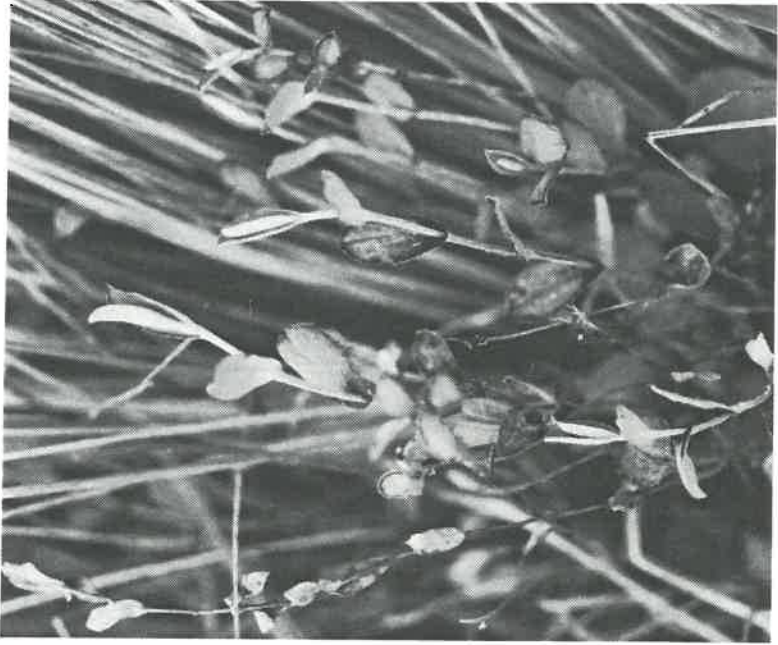
68. *Linum monogynum*

Table 2 (c) BACK SLOPE AND AREAS BEHIND (S indicates brackish dune slacks)

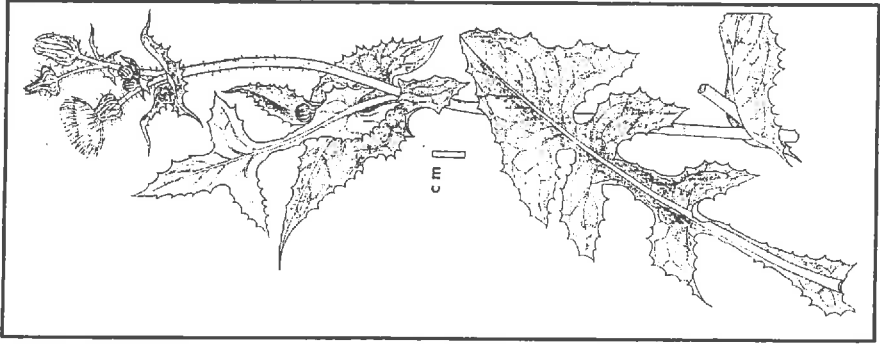
BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE			BACK DUNE			
					front slope	crest	back slope	front slope	crest	back slope	slack	front slope	crest	
<i>Scirpoides nodosa</i>	wiwiwi	rush-like		48			*			*	*	S		
<i>Acaena</i> spp.	piri piri	herbs		70			*			*	*			
<i>Gnaphalium</i> spp.	cudweed	herb	small	71			*			*	*			
<i>Helichrysum filicaule</i>	creeping everlasting	prostrate herb	to 15 cm	62			*							
<i>Lobelia anceps</i>	punakuru	herb	to 40 cm				*				*			
<i>Sonchus</i> spp.	puha	herb	.	72			*			*	*		*	
<i>Wahlenbergia gracilis</i>	rimuroa	herb	up to 40 cm	73			*			*	*			
<i>Euphorbia glauca</i>	NZ spurge / milkweed	herb	up to 1 m	31			*			*	*			
<i>Brachyglottis</i> spp.		herbs & shrubs					*			*	*		*	*
<i>Habragis erecta</i>	toatoa	herb / subshrub	to 1 m	74			*							
<i>Coriaria sarmentosa</i>	tutu	subshrub	up to 1 m	75			*			*	*			
<i>Hymenanthera crassifolia</i>	porcupine shrub	low-growing shrub	to 2 m				*			*	*			
<i>Cassinia leptophylla</i>	tauhinu/cottonwood	shrub	up to 5 m	19			*			*	*		*	
<i>Hebe elliptica</i>	koromiko	shrub	to 2 m	79			*			*	*		*	
<i>Leucopogon fraseri</i>	patotara	prostrate shrub	to 15 cm	76			*			*	*			
<i>Muehlenbeckia astonii</i>	pohuehue	shrub	to 2 m				*			*	*			
<i>Muehlenbeckia complexa</i>	pohuehue	shrub		26			*			*	*		*	
<i>Coprosma repens</i>	taupata	shrub / tree	up to 8 m	60			*			*	*		*	*
<i>Clematis abfoliata</i>	leafless clematis	climber		78			*			*	*		*	*



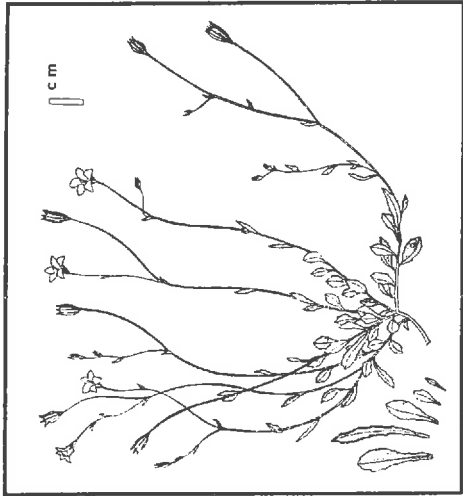
70. *Acaena novae-zelandiae*



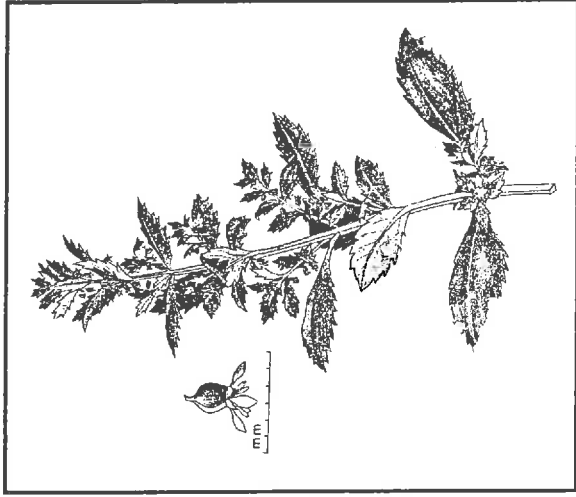
71. *Gnaphalium luteo-album*



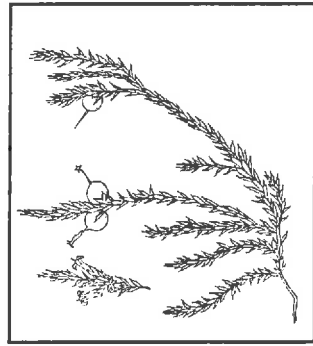
72. *Sonchus oleraceus* (Wilson
1982)



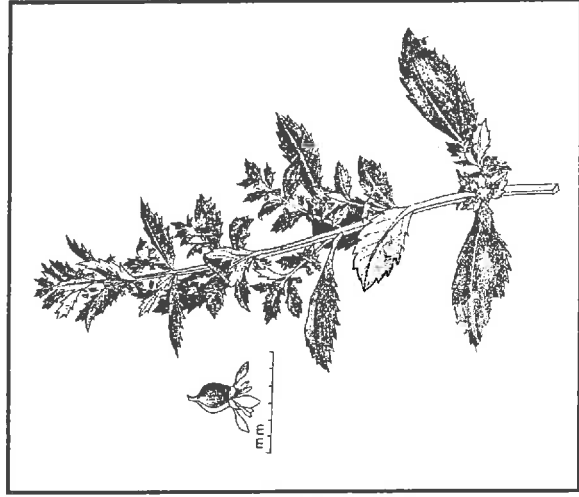
73. *Wahlenbergia gracilis* (Wilson 1982)



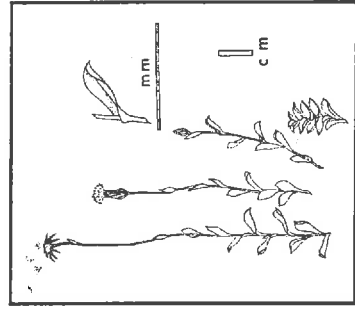
74. *Halragis erecta* (Wilson 1982)



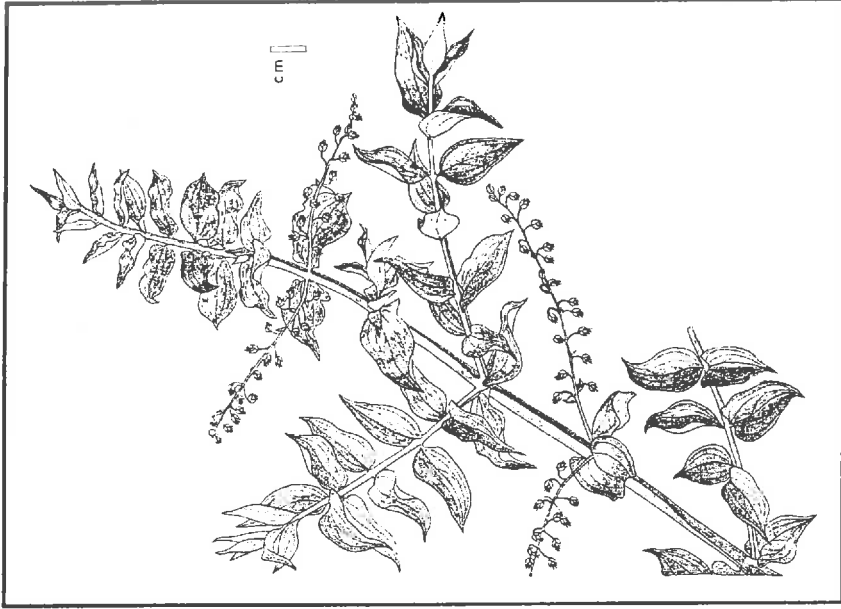
76. *Leucopogon fraseri* (Wilson 1982)



74. *Halragis erecta* (Wilson 1982)



77. *Hefichrysum filicaule* (Wilson 1982)



75. *Coriaria sarmentosa* (Wilson 1982)



79. *Hebe* sp. on dunes at New Brighton



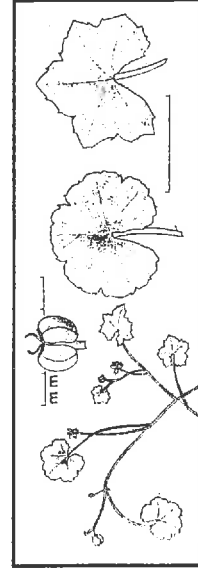
78. *Clematis afoliata*

Table 2 (d) DUNE SLACKS

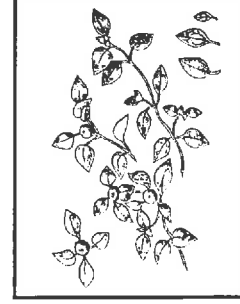
BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE						
					front slope	crest	back slope	slack	front slope	crest	back slope	slack	front slope	crest
<i>Deschampsia caespitosa</i>	hair grass	grass		83				*				*		
<i>Cortaderia richardii</i>	toetoe	grass		61				*				*		
<i>Hierochloa redolens</i>	kaaretu / holy grass	grass		84				*				*		
<i>Juncus</i> spp.	wiiwii	rush		85				*				*		
<i>Phormium tenax</i>	harakeke/NZ flax			54				*				*		
<i>Blechnum penna-marina</i>	hardfern	fern		86				*				*		
<i>Centella uniflora</i>		herb		80				*				*		
<i>Epilobium</i> spp.	willowherbs	herb	small	87				*				*		
<i>Gunnera monoica</i>		herb	small	88				*				*		
<i>Hydrocotyle</i> spp.	pennywort	herbs	small	81				*				*		
<i>Nertera</i> spp.		slender herbs		82				*				*		
<i>Potentilla anserinoides</i>	silverweed	herb	small	89				*				*		
<i>Pratia angulata</i>	paanakenake	herb	small	90				*				*		
<i>Viola cunninghamii</i>	haaka	herb	to 15 cm	91				*				*		
<i>Coprosma propinqua</i>	miki miki	shrub	~3 m	92				*				*		



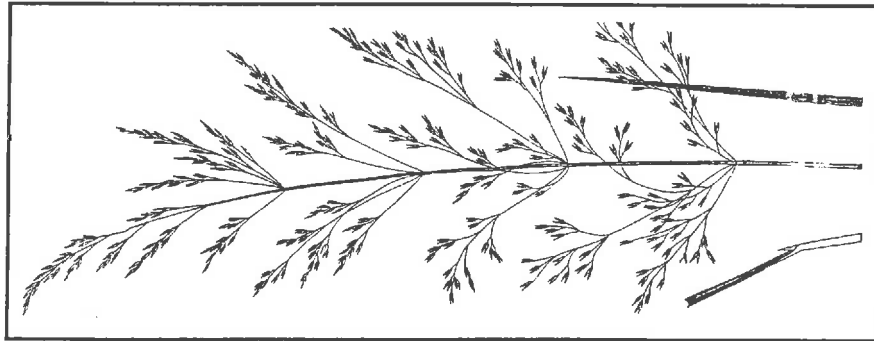
80. *Centella uniflora* (Wilson 1982)



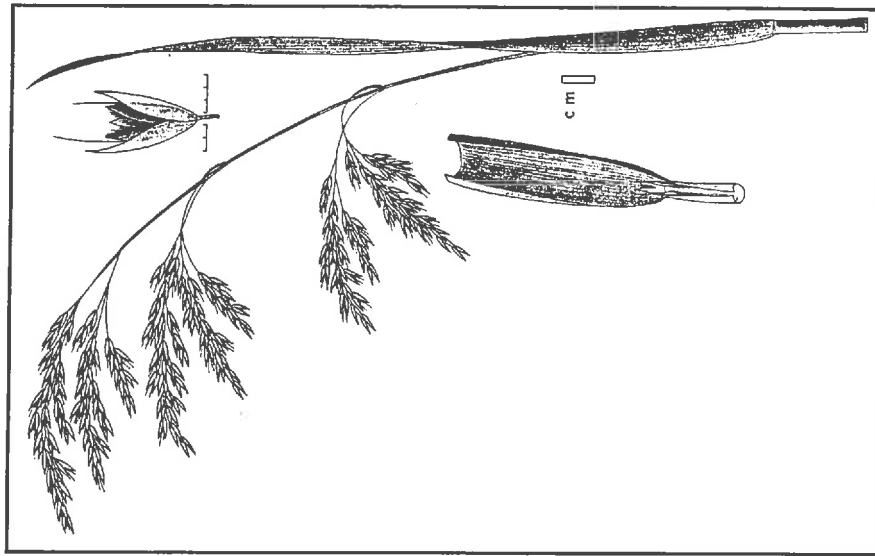
81. *Hydrocotyle novae-zelandiae* (Wilson 1982)



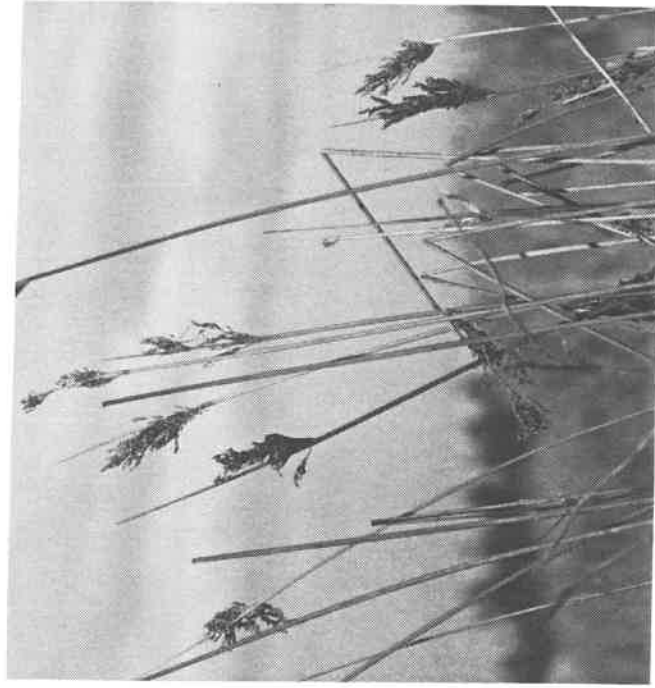
82. *Nertera depressa* (Wilson 1982)



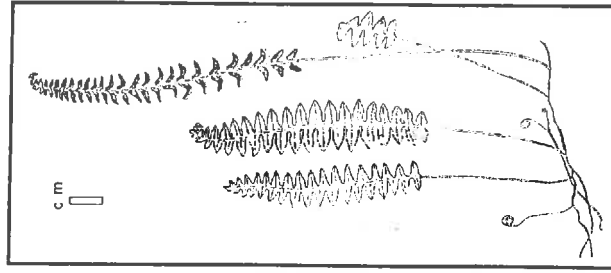
83. *Deschampsia caespitosa*
(Wilson 1982)



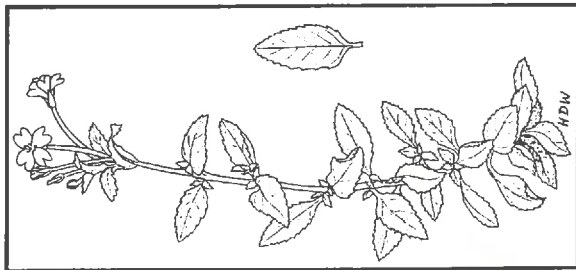
84. *Hierochloa redolens* (Wilson 1982)



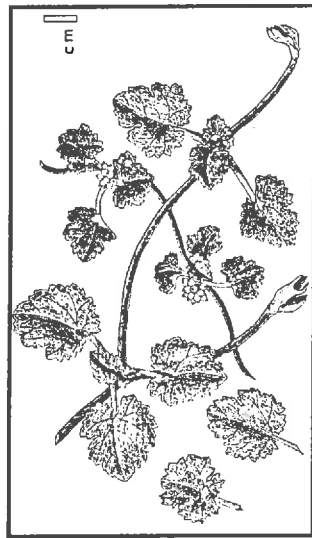
85. *Juncus* sp. north of Rothesay Rd



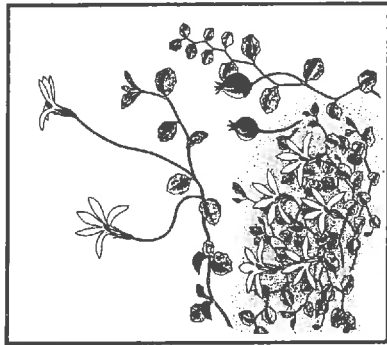
86. *Blechnum penna-marina* (Wilson 1982)



87. *Epiobium pubens*
(Wilson 1982)



88. *Gunnera monoica* (Wilson 1982)



90. *Pratia angulata* (Wilson 1982)



91. *Viola cunninghamii* (Wilson 1982)



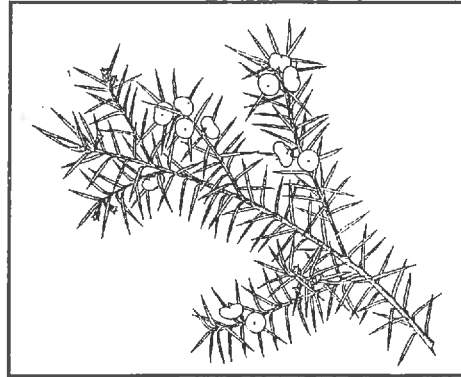
89. *Potentilla anserinoides* (Wilson
1982)



92. *Coprosma propinqua*
(Wilson 1982)

Table 2 (c) EITHER SLOPE OF THE BACK DUNES

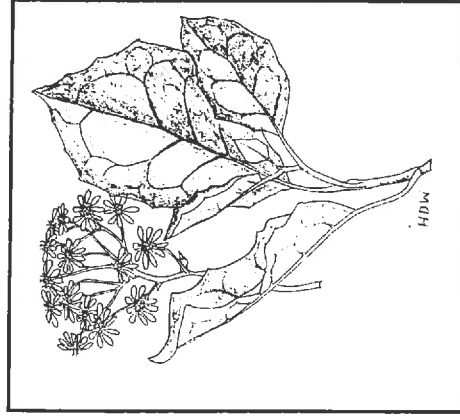
BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE				BACK DUNE											
					front slope	crest	back slope	slack	front slope	crest	back slope	slack	front slope	crest						
<i>Leucopogon juniperina</i>	mingi mingi	prostrate shrub	to 15 cm	76						*										
<i>Sophora prostrata</i>	prostrate kowhai	prostrate shrub	to 2 m	94						*		*								
<i>Carmichaelia robusta</i>	NZ broom	shrub / tree	2 m							*		*								
<i>Solanum laciniatum</i>	poroporo	shrub / tree	to 3 m	27						*		*								*
<i>Discaria toumatou</i>	tumatakuru / matagouri	shrub / tree	to 5 m	58						*		*								
<i>Olearia</i> spp.	heketara	trees / shrubs		95						*		*								
<i>Dodonea viscosa</i>	akeake	shrub / tree	to 6 m	51						*		*								*
<i>Kunzea ericoides</i>	kanuka	shrub / tree	to 15 m							*		*								*
<i>Mycoporum laetum</i>	ngaito	tree	to 10 m	57						*		*								*



93. *Cyathodes juniperina* (Wilson 1982)



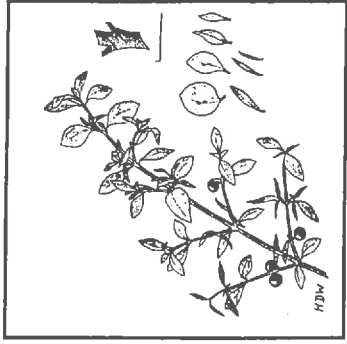
94. *Sophora prostrata*



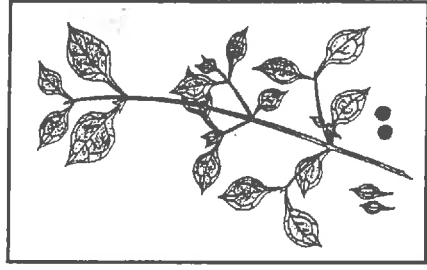
95. *Olearia arborescens* (Wilson 1982)

Table 2 (f) BACK SLOPE OF THE BACK DUNE AND BEHIND

BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE			BACK DUNE		
					front slope	crest	back slope	slack	front slope	crest	back slope	slack	front slope
<i>Libertia ixioides</i>	mikoikoi / native iris	iris	~ 50 cm	96					*			*	*
<i>Pteridium esculentum</i>	rarahū / bracken	fern		97					*				*
<i>Pomaderris phyllifolia</i>	tauhinu	shrub	to ~1 m						*				
<i>Coprosma thamnoides</i>	miki miki	shrub	to 1 m	98					*			*	*
<i>Coprosma areolata</i>	miki miki	shrub / tree	to 3 m	99					*			*	*
<i>Hebe salicifolia</i>	koromiko	shrub	to 5 m	100					*			*	*
<i>Lophomyrtus obcordata</i>	rohutu	shrub	to 5 m						*			*	*
<i>Coprosma robusta</i>	karamu	shrub / tree	to 6 m	101					*			*	*
<i>Myrsine australis</i>	mapau	shrub / tree	to 6 m	102					*			*	*
<i>Pittosporum tenuifolium</i>	kohuhu	tree	to 8 m	103					*			*	*
<i>Griselinia littoralis</i>	kapuka	tree	to 10 m	104					*			*	*
<i>Sophora microphylla</i>	kowhai	tree	to 10 m						*			*	*
<i>Cordyline australis</i>	ti kouka / cabbage tree	tree	~ 12 m	52					*			*	*
<i>Corynocarpus laevigatus</i>	karaka	tree	to 15 m						*			*	*
<i>Pseudopanax crassifolius</i>	horeka	tree	to 15 m						*			*	*
<i>Rubus</i> spp.	tataramoa / lawyer	liane / lancewood		105					*			*	*



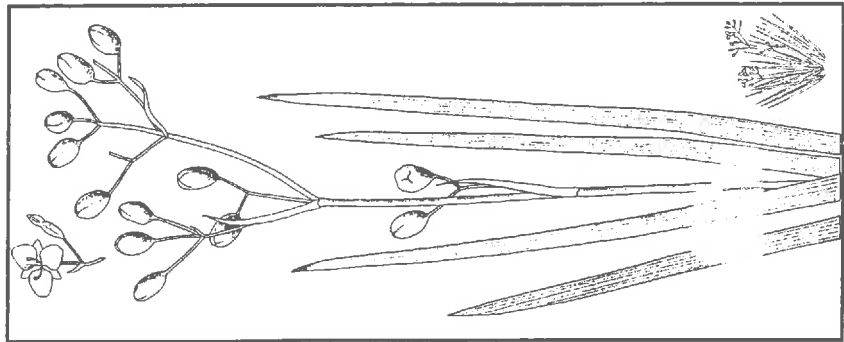
98. *Coprosma rhamnoides* (Wilson 1982)



99. *Coprosma areolata* (Wilson 1982)



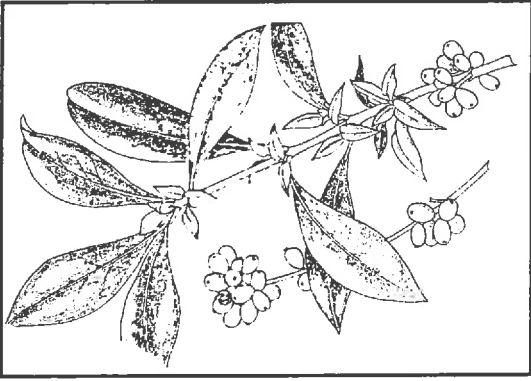
97. Bracken, north of Rothesay Rd



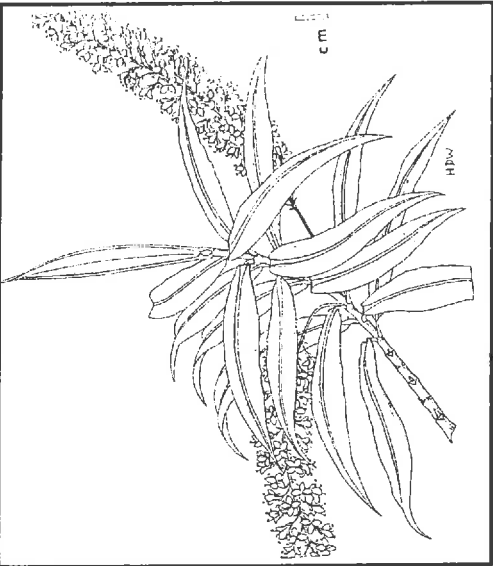
96. *Libertia ixioides* (Wilson 1982)



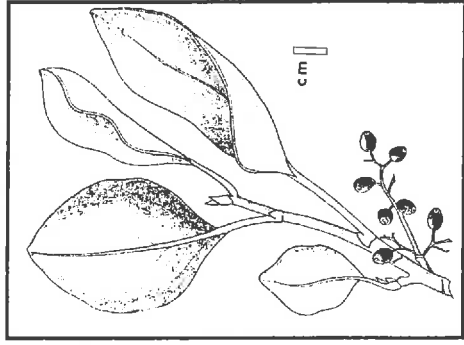
105. *Rubus cissoides*



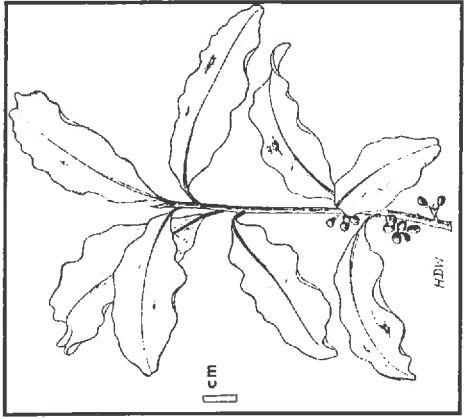
101. *Coprosma robusta* (Wilson 1982)



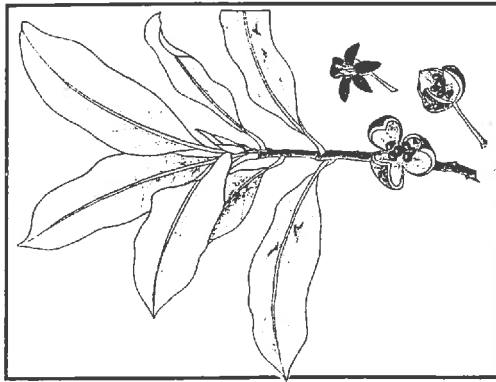
100. *Hebe salicifolia* (Wilson 1982)



104. *Grisebinia littoralis* (Wilson 1982)



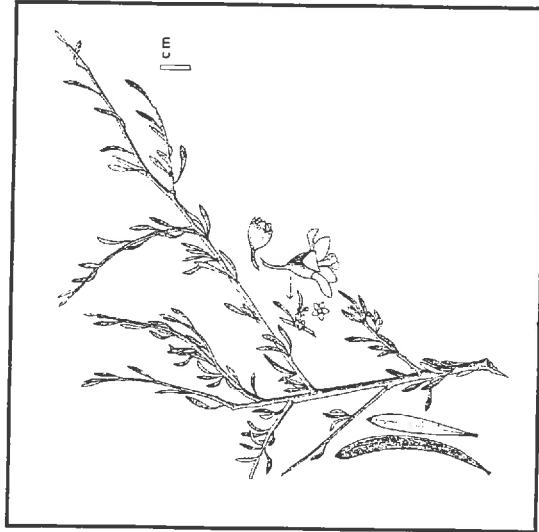
102. *Myrsine australis* (Wilson 1982)



103. *Pittosporum tenuifolium* (Wilson 1982)

Table 2 (g) 2ND DUNE SLACK & BEHIND (S indicates brackish dune slacks)

BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE					
					front slope	crest	back slope	front slope	crest	back slope	front slope	crest	
<i>Schoenoplectus pungens</i>	three-square	rush	30-60 cm	48									
<i>Leptinella dioica</i>		herb	small	37									
<i>Plagianthus divaricatus</i>	maakaka / saltmarsh ribbonwood	shrub	to 2 m	1									
<i>Leptospermum scoparium</i>	manuka	shrub / tree	to 4 m	55								*	
<i>Muehlenbeckia australis</i>	pohuehue	liane	to 10 m	107								*	*



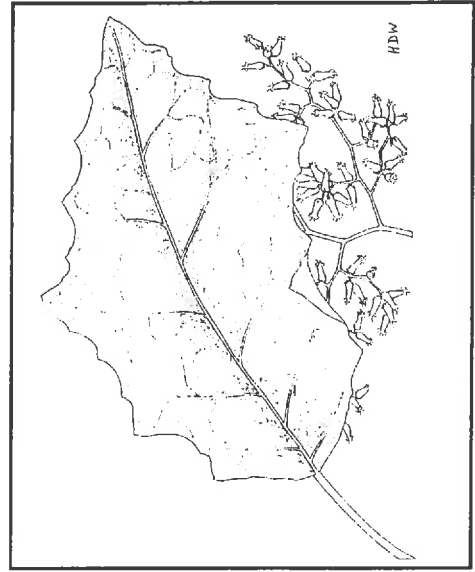
106. *Plagianthus divaricatus* (Wilson 1982)



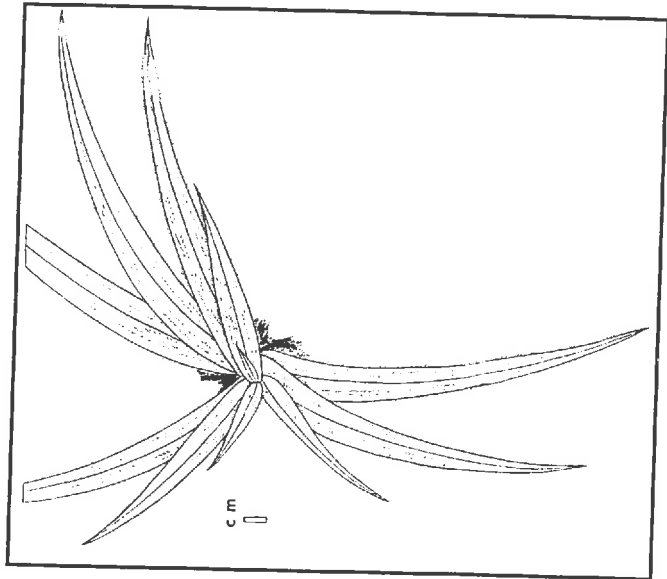
107. *Muehlenbeckia australis*

Table 2 (h) STABLE DUNES

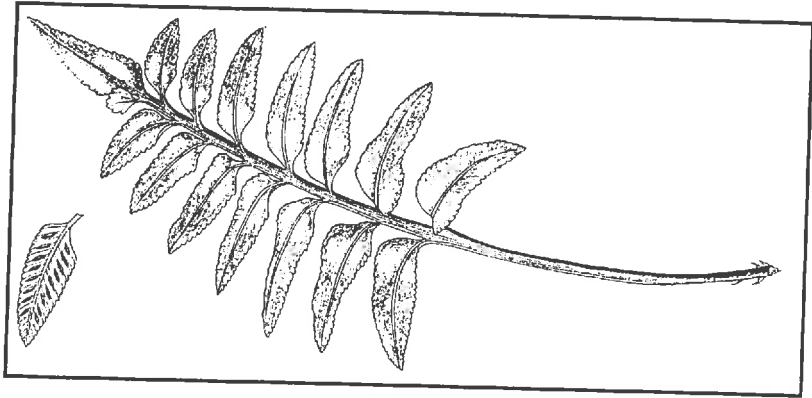
BOTANICAL NAME	COMMON NAME	PLANT TYPE	SIZE	FIGURE NO.	FORE DUNE			BACK DUNE			
					front slope	crest	back slope	front slope	crest	back slope	slack
<i>Astelia nervosa</i>	kakaha	lily	50-150 cm	109					*		
<i>Asplenium</i> spp.	spleenwort	fern		110					*		
<i>Botrychium australe</i>	parsley fern	fern		111					*		*
<i>Cheilanthes</i> sp.		fern		112					*		*
<i>Histopteris incisa</i>	waterfern	fern							*		
<i>Hypolepis ambigua</i>	NZ fern	fern							*		
<i>Phymatosorus diversifolius</i>	hounds tongue fern	fern		113					*		*
<i>Polystichum richardi</i>	shield fern	fern		114					*		
<i>Pyrosia serpens</i>	leather leaf fern	fern (epiphyte)		115					*		*
<i>Brachyglottis repanda</i>	rangiora	shrub / tree	to 6 m	108					*		*
<i>Melicactus ramiflorus</i>	mahoe	tree	to 10 m						*		*
<i>Pittosporum eugenioides</i>	tarata / lemonwood	tree	to 12 m						*		*



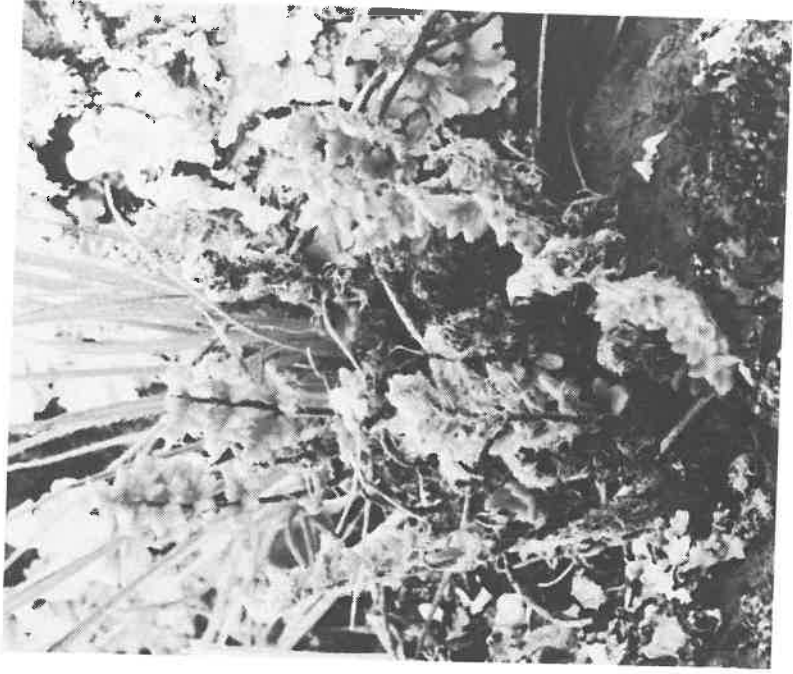
108. *Brachyglottis repanda* (Wilson 1982)



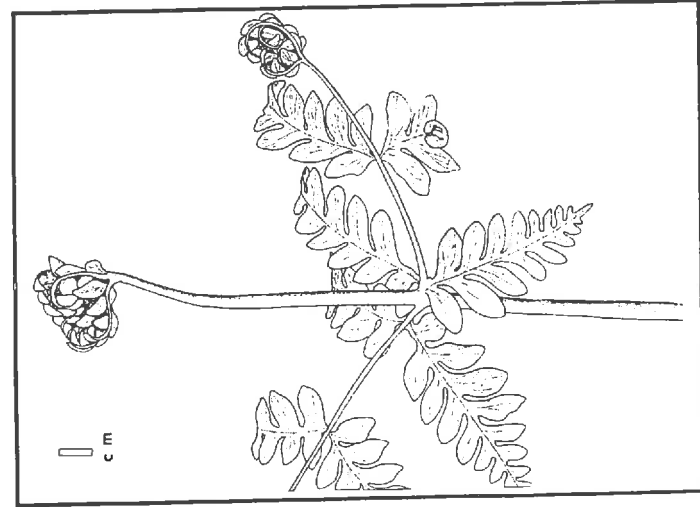
109. *Astelia nervosa* (Wilson 1982)



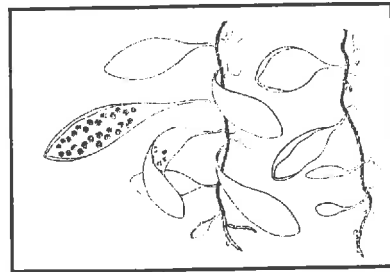
110. *Asplenium obtusatum* (Wilson 1982)



111. *Cheilanthes distans*



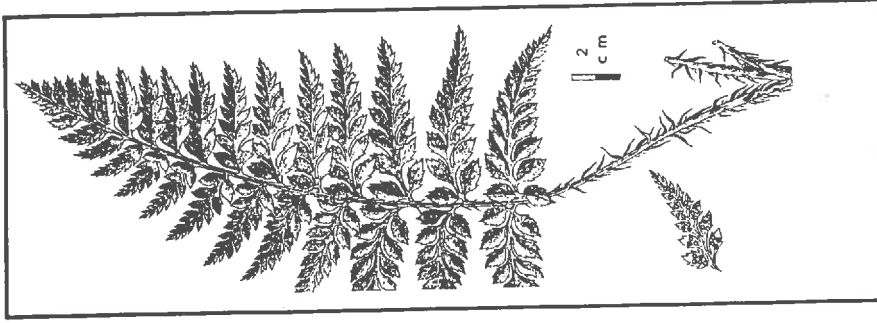
112. *Histiopteris incisa* (Wilson 1982)



115. *Pyrrosia serpens*
(Wilson 1982)



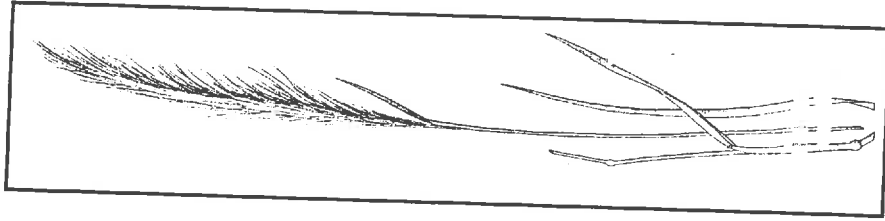
113. *Phymatosorus diversifolius*



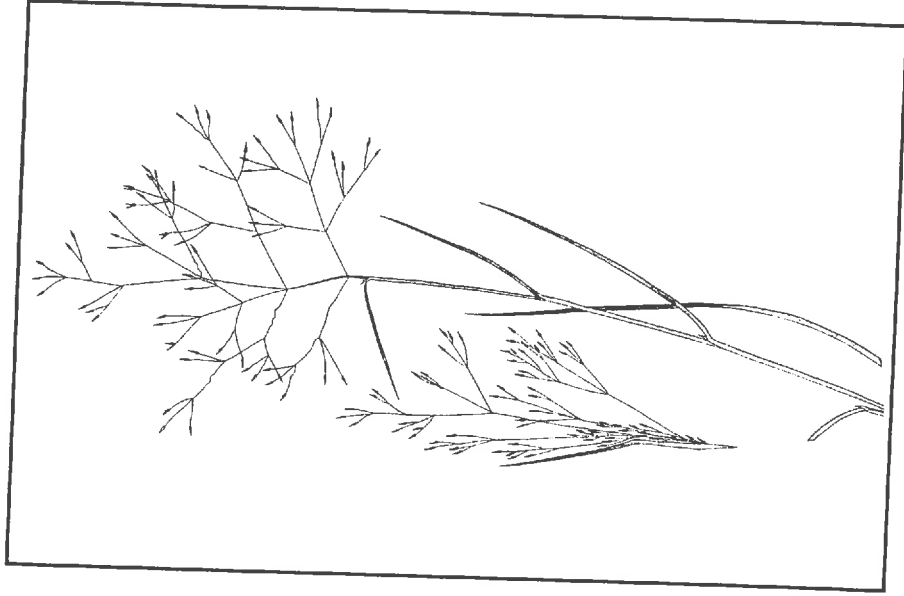
114. *Polystichum richardii*
(Wilson 1982)

Table 2 (i) GRASSES & HERBS FOR OPEN DUNELANDS AND SAND PLAINS

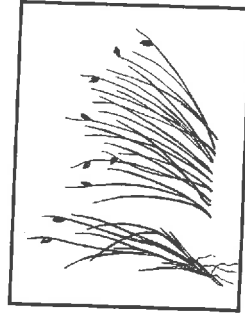
BOTANICAL NAME	COMMON NAME	PLANT TYPE	FIGURE NO.
<i>Cockaynea</i> sp.		grass	34
<i>Deyeuxia</i> spp.		grass	35
<i>Dichelachne crinita</i>	plumegrass	grass	116
<i>Elymus rectisetus</i>	blue wheat grass	grass	
<i>Lachnagrostis</i> spp.		grass	117
<i>Microlaena stipoides</i>	meadow rice grass	grass	56
<i>Poa linsayi</i>		grass	
<i>Pytidosperma</i> spp.	danthonia	grass	119
<i>Poa cita</i>	silver tussock / wii	grass	59
<i>Scirpus</i> spp.		sedge	118
<i>Uncinia</i> spp.	hooked sedge	sedge	120
<i>Luzula</i> spp.	woodrush	herbs	121
Orchids		herbs	



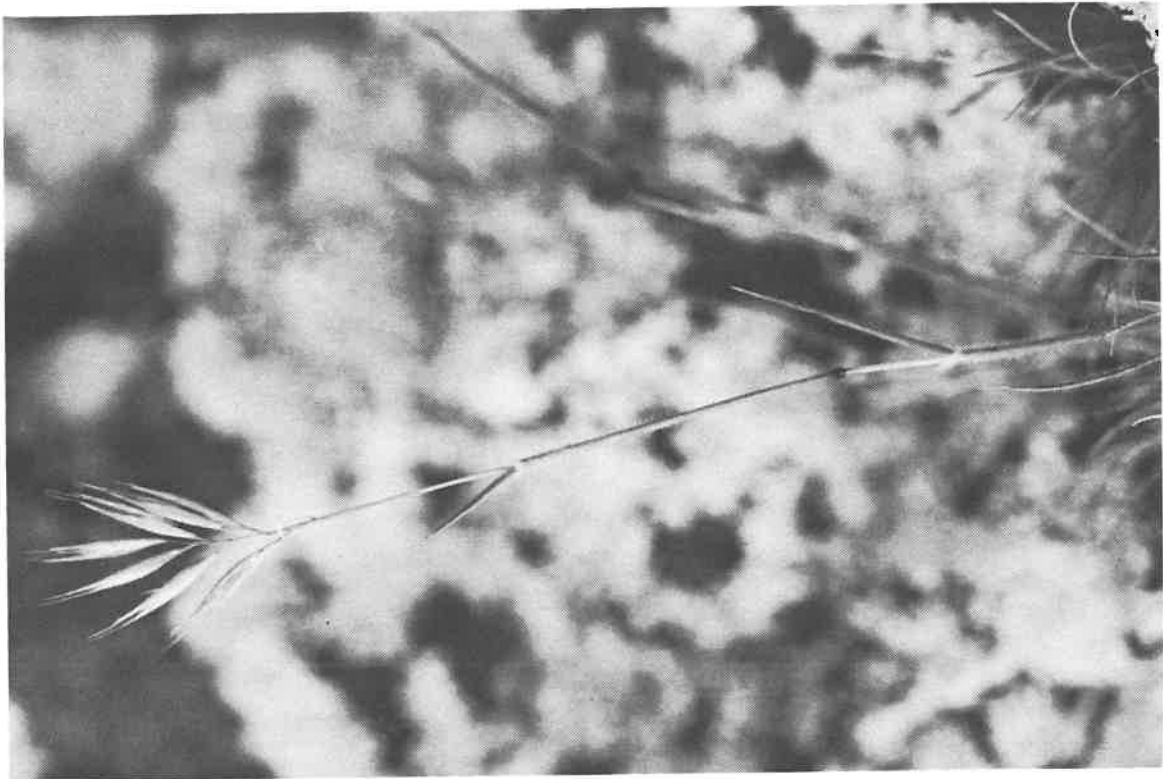
116. *Dichelachne crinita* (Wilson 1982)



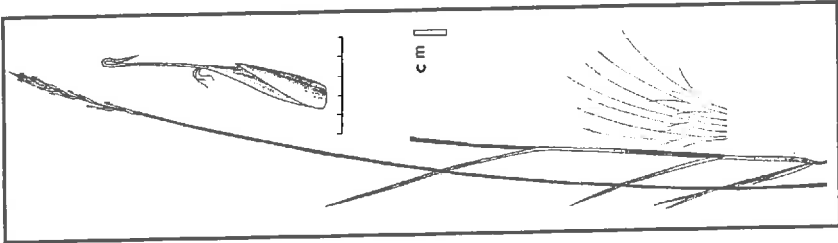
117. *Lachnagrostis* sp. (Wilson 1982)



118. *Scirpus cernuus* (Wilson 1982)



119. *Rytidosperma* sp.



120. *Uncinia strictissima* (Wilson 1982)



121. *Luzula celata* (Wilson 1982)

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Appendix I

Plants from Spencer Park to New Brighton Spit, as recorded in Johnson (1992).

FERNS

Blechnum procerum *

B. penna-marina hard fern

GRASSES

Agropyron junceiforme * sand couch
Agrostis stolonifera * creeping bent
A. tenuis * browntop
Ammophila arenaria * marram grass
Arrhenatherum elatius * tall oat grass
Bromus diandrus * ripgut brome
B. mollis * goose grass
Cortaderia richarii toetoe
Elymus arenarius * lyme grass
Festuca arundinacea * tall fescue
Holcus lanatus * Yorkshire fog
Lagarus ovatus * haretail grass
Poa annua * annual poa
Puccinellia stricta salt grass
Vulpia myuros *

RUSHES AND SEDGES

Carex coriacea
C. litorosa
C. pumila sand sedge
Desmoschoenus spiralis pingao
Isolepis basilaris
Isolepis cernua slender clubrush
Juncus articulatus * jointed rush
J. bufonius * toad rush
J. maritimus var. australiensis sea rush
J. pallidus
J. tenuis slender rush
Leptocarpus similis oioi
Luzula sp. woodrush
Schoenoplectus pungens three square
Scirpoides nodosa

HERBS

Acaena novae-zelandiae bidibid
Achillea millefolium * yarrow
Anagallis arvensis * pimpernel
Apium prostratum native celery
Atriplex prostrata * orache

Brassica sp. *

Calystegia sepium

C. soldanella shore convolvulus

Capsella bursa-pastoris * shepherds purse

Carduus tenuiflorus * winged thistle

Carpobrotus edulis * ice plant

Centaureum erythraea * centaury

Cerastium glomeratum * chickweed

Chenopodium album * fathen

C. ambiguum glaucous goosefoot

Chrysanthemum maximum *

Cirsium arvense * Californian thistle

C. vulgare * Scotch thistle

Claytonia perfoliata * miners lettuce

Conium maculatum * hemlock

Cotula coronopifolia bachelors button

Crepis capillaris * catsear

Disphyma australe ice plant

Epilobium billardierianum

E. ciliatum * tall willow-herb

Erigeron canadensis * Canadian fleabane

Eschscholzia californica * Californian poppy

Fumaria officinalis * fumitory

Galium aparine * cleavers

Gnaphalium luteo-album cudweed

Hypochoeris radicata * hawksbeard

Lavatera cretica * Cretan mallow

Leontodon taraxacoides * hawkbit

Lepidium africanum * peppergrass

L. hyssopifolium

Leptinella dioica

Limosella lineata

Malva nicaeensis * French mallow

M. sylvestris * large-flowered mallow

Matricaria dioscoidea * rayless chamomile

Microseris scapigera

Mimulus repens native musk

Oenothera stricta * sand primrose

Oxalis debilis var. corymbosa * pink shamrock

Parentucellia viscosa * tarweed

Phormium tenax flax

Plantago australis * swamp plantain

P. coronopus * bucks horn plantain

P. lanceolata * narrow leaved plantain

<i>P. major</i> *	broad leaved plantain	<i>Salix cinerea</i> *	grey willow
<i>Polycarpon tetraphyllum</i> *	allseed	<i>S. fragilis</i> *	crack willow
<i>Polygonum aviculare</i> *	wireweed	<i>Sambucus nigra</i> *	elder
<i>Potentilla anserinoides</i>		<i>Tamarix sp.</i> *	tamarisk
<i>Ranunculus repens</i> *	creeping buttercup	<i>Ulex europaeus</i> *	gorse
<i>R. sceleratus</i> *	celery-leaved buttercup		
<i>Rorripa microphyllum</i> *	watercress		
<i>Rumex acetosella</i> *	sheep's sorrel		
<i>R. conglomeratus</i> *	clustered dock		
<i>R. crispus</i> *	curled dock		
<i>R. obtusifolius</i> *	broad-leaved dock		
<i>Sagina procumbens</i> *	procumbent pearlwort		
<i>Samolus repens</i>	maakaokao		
<i>Sebaea ovata</i>			
<i>Selliera radicans</i>			
<i>Senecio elegans</i> *	purple groundsel		
<i>S. glomeratus</i>	fireweed		
<i>S. vulgaris</i> *	groundsel		
<i>Silene gallica</i> *	catchfly		
<i>Sisymbrium officinale</i> *	hedge mustard		
<i>Tetragonia tetragonioides</i>	New Zealand spinach		
<i>Triglochin striatum</i>	arrow grass		
<i>Trifolium arvense</i> *	haresfoot trefoil		
<i>T. dubium</i> *	suckling clover		
<i>T. pratense</i> *	red clover		
<i>Tripleurospermum maritimum subsp. inodorum</i> *			
<i>Typha orientalis</i>	raupo		
<i>Veronica arvensis</i> *	field speedwell		
<i>Vicia angustifolia</i> *			
<i>V. sativa</i> *	vetch		

SHRUBS, TREES & CREEPERS

<i>Cassinia leptophylla</i>	tauhinu / cottonwood
<i>C. vauvilliersii</i>	
<i>Chamaecytisus palmensis</i> *	tree lucerne
<i>Chrysanthemoides monolifera</i> *	boneseed
<i>Coprosma repens (nat.)</i>	taupatu
<i>Cupressus macrocarpa</i> *	macrocarpa
<i>Cytisus scoparius</i> *	
<i>Lavatera arborea</i> *	tree mallow
<i>Lupinus arboreus</i> *	tree lupin
<i>Lycium ferocissimum</i> *	box thorn
<i>Pinus pinaster</i> *	maritime pine
<i>P. radiata</i> *	radiata pine
<i>Plagianthus divaricatus</i>	saltmarsh ribbonwood
<i>Populus alba</i> *	white poplar
<i>P. nigra cv. italica</i> *	Lombardy poplar
<i>Rubus laciniatus</i> *	cut-leaved blackberry