

INDIGENOUS PLANT ESTABLISHMENT TRIALS, AWHITU PENINSULA

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INTRODUCTION

The Awhitu Peninsula on the south head of the Manuka Harbour is dominated by high sand cliffs along the coast and extensive sand dune country landward of the cliffs which is for the most part in pasture. The sand country is either older relatively stable Redhills Sand or the more recent Pinaki Sand which is prone to serious erosion. The unstable sand dunes on the latter sand type can be extensive in area and spectacular. They impact on pasture growth with significant losses of livestock carrying capacity for some farmers (Lambrechtsen & Hicks 1995).

With support from the Auckland Regional Council, local landowners formed the Awhitu Peninsula Land Group with an initial objective to reduce erosion of the coastal sand country. The intention of the group is to carry out a range of activities leading to a sustainable management plan for their area and to carry out these activities primarily by involving landowners, and other interest groups in the district including Ngaati Te Ata. As part of a research programme developed for the Group (Hicks 1995), one priority area of research identified was an investigation of appropriate indigenous species to use on erosion-prone sites which are to be retired permanently from grazing.

This work plan briefly outlines the establishment of collaborative planting trials using indigenous tree and shrub species and monocots to be initiated in mid-1996 by the Awhitu Peninsula Land Group and the New Zealand Forest Research Institute.

PREVIOUS WORK

Although there are guidelines for planting of indigenous species, most previous research has concentrated on revegetation of relatively sheltered inland sites and planting of upland forest sites (eg., Evans 1983; Pollock 1986; Beveridge *et al.* 1985, 1987). NZ FRI sand dune trials to date have concentrated on the indigenous sand binding plants that occur on the unstable foredune (eg., Herbert & Bergin 1991; Bergin & Herbert 1994). Existing information on techniques for stabilisation of sand country using indigenous tree and shrub species relevant to the Awhitu Peninsula has recently been compiled by Lambrechtsen & Hicks (1995a, 1995b).

Recent indigenous coastal species screening trials have been established at Whitianga Beach on a modified backdune (Bergin *et al.* 1995) and on marram (*Ammophila arenaria*) dominated backdune sites at South Brighton and Waimairi Beaches in Christchurch (Bergin, Herbert & White 1996). Although these beaches are substantially different to the Awhitu sand country, preliminary results will be of some relevance to revegetation at Awhitu Peninsula. However, a planting trial is considered necessary to determine the most appropriate species and the most effective techniques for large scale revegetation on unstable Awhitu sand country.

OBJECTIVES

The overall objective of a revegetation trial at Awhitu Peninsula is to determine practical and cost effective techniques for establishing an indigenous vegetation cover on erosion-prone sand country.

Specific aims include:

- To evaluate performance of planted seedlings of a limited range of appropriate local indigenous species.
- To evaluate a range of treatment options including up to three site types, and site preparation treatments.
- To provide the Awhitu Peninsula Land Group, other local interest groups and local authorities with guidelines for revegetation of unstable sand dunes using indigenous species.

METHOD

Trial design and treatments

Five indigenous plant species will be tested on 3 different site types as follows:

1. Rank grass site - spray with herbicide to create 60 cm diameter circular planting spots for planting of a single seedling.
2. Recently planted marram site - plant in natural gaps between or adjacent to sparsely planted marram.
3. Dense marram site - use existing natural gaps with minimal hand clearing where necessary to create a 60 cm diameter planting spot.

At all site types, the trial is a Randomised Complete Block design consisting of 8 replicates each with 5 plots. Each plot will consist of 5 seedlings of the same species. Each treatment will consist of 40 seedlings (8 reps x 5 seedlings).

Treatment combinations and seedling requirements are:

8 replicates x 3 site/treatments x 5 seedlings x 5 species = 600 seedlings (ie., 120 seedlings/species).

The species to be planted for each plot for the 3 site types are give in the Appendix.

Planting pattern and pegging

The 5 seedlings within a plot will be planted at 50-70 cm spacing in a range of configurations depending on location of suitable planting spots. There will be a at least 1.5 m spacing between plot edges. Treated wooden pegs will be used to identify each plot with unique numbers on aluminium tags nailed to all pegs. Species codes can be marked onto pegs to allow quick reference during establishment of the trial. Plot numbers and random species allocations for each site has been produced by computer before the trial is established.

Planting sites

The 3 proposed site types are typical of areas retired from grazing that are eroding or have the potential to be major problem erosion areas on sand country along the exposed western side of Awhitu Peninsula. Three sites with different vegetation types are available on David Craig's property on the Pinaki Sand type:

1. Ungrazed pasture of rank grass recently retired on vegetated dunes along cliff edge
2. Recently planted marram on blowouts - irregular areas with high proportion of exposed sand

3. Dense marram - dunes dominated by a tall continuous cover of marram with limited gaps between clumps.

All sites have been permanently retired from grazing and fenced to exclude stock.

Time of planting

The trial will be established in autumn 1996 (late May/early June) by the Awhitu Peninsula Land Group with support from NZ FRI where required.

Species

Species proposed for planting in the trial will be local indigenous species based on species composition of vegetation remnants on similar sites nearby. Previous NZ FRI trial planting elsewhere and local knowledge of growing conditions has influenced the choice of hardy coastal species most likely to be successful on these sites. These are:

<i>Botanical name</i>	<i>Maori or common name</i>	<i>Source of stock</i>
Woody species:		
<i>Pittosporum crassifolium</i>	karo)
<i>Metrosideros excelsus</i>	pohutukawa) nursery raised
<i>Dodonea viscosa</i>	akeake) seedlings
<i>Cassinia leptophylla</i>	tauhinu; cottonwood)
Other species:		
<i>Phormium tenax</i>	harakeke	divisions off nearby plants
<i>Isolepis nodosus</i>	knobby club rush	clumps from nearby plants

Only 5 species will be tested from the above list dependent on availability. Note that the first 5 species are used in the species/treatment list in the Appendix but knobby club rush can be substituted where necessary.

Planting stock will be sourced from local nurseries and will be local genetic material where possible. Not all woody species may be available at short notice. A minimum of 200 seedlings of each species is required for the trial. Well-conditioned, tall (50 cm+) seedlings are preferred for planting particularly on difficult sites where competition from marram and weeds is expected. Divisions of harakeke can be split off nearby mature plants with leaves cut back and any seedheads removed. Clumps of 5-10 cm diameter of knobby club rush can be obtained from established plants using a spade.

Site preparation

Due to the exposed nature of the site and the importance of retaining an almost continuous cover of vegetation to prevent sand erosion, site preparation will involve creating small planting spots for the planting of a single seedling.

Grass sites are to be sprayed with Roundup and Pulse as is normal forestry practice using knapsack sprayers or spotguns to create 60 cm diameter spots for the planting of a single seedling.

For the recently planted marram site, there should be sufficient bare sand available between marram clumps to plant indigenous seedlings with no clearance of marram.

For the dense marram site, natural gaps should be used where possible with expansion of planting spots by cutting back overtopping vegetation and minimal removal of marram clumps only where necessary. Marram can be cut by a motorised scrub bar or by slasher.

Application of fertiliser

Approximately 30 - 40g of Magamp medium granule slow-release fertiliser (small-medium handful) will be applied to all seedlings. Preliminary results from previously established sand dune trials using the same species consistently indicate that fertiliser boosts growth and improves vigour compared to unfertilised seedlings (Bergin *et al.* 1995). Fertiliser is to be incorporated into the sand at planting.

MONITORING

Planting height and cover will be measured for all seedlings soon after planting to provide a baseline on which to determine growth rate. The site will be inspected regularly at three monthly intervals at least for the first year to record any factors affecting plant performance such as browsing by rabbits or hares, and in particular, growth of grass, marram and weeds. A survival assessment will be carried out within 6 months after planting.

A full survival and plant growth assessment is required annually for at least 3 years after planting depending on overall performance of planted seedlings. The major parameters to be measured are:

- survival
- plant height (in cm)
- plant cover - length (maximum width of the live crown of each plant in cm) by breadth (width at right angle to length measurement in cm)
- subjective assessment of plant vigour and health as one of five categories:
 - 1 - very unthrifty - few or no leaves, just alive
 - 2 - unthrifty - loss of leaves, poor foliage colour and plant vigour
 - 3 - average - moderate health and vigour
 - 4 - good - minor browsing or leaf discolouration, otherwise good growth
 - 5 - excellent - healthy plant with good foliage colour and growth
- comments - any additional information on plant condition (eg., browsing)

The subjective assessment of plant vigour and health is to be based on a comparison of seedling condition within each species, not between species. Dead seedlings are entered as a dash (-).

Plant growth assessment will be entered onto customised NZ FRI Field Record Forms (sample form attached). All seedlings are to be identified and measured separately. Configuration of seedlings in each plot are to be recorded on the form using seedling numbers 1-5 in the first column to indicate position of seedling relative to adjacent seedlings and the plot identification peg. This not only allows for the history of each seedling to be followed but also enables a more robust statistical analysis of the data compared with using plots averages.

Field measurements will be entered into the computer directly off field sheets for analysis.

WEED CONTROL

The most likely cause of high mortality of planted seedlings is competition from weeds in the first two years or so. At each inspection, weed regrowth will need to be assessed. Weed control options for each treatment will need to be decided depending on degree of weed growth and suppression of planted seedlings.

The preferred option for control of weeds is the spraying of herbicide while weeds are small. Herbicides to be considered for weed control include Roundup and Pulse or a mix of Versatile (broadleaves), Gallant (grasses) and Foresite (germination inhibitor). Herbicides are to be applied carefully around each planted seedling using a knapsack sprayer with a coarse fan nozzle. However, hand weeding may be required occasionally where weeds are too large relative to planted seedlings for spraying.

RESPONSIBILITIES

Responsibilities for the establishment, maintenance and monitoring of the trial will be as follows:

Ecological Research Associates

- provide regional perspective and research brief
- assist with work plan including trial location and treatments
- co-ordinate supply of planting stock and herbicide requirements
- assist with data interpretation and technology transfer

Awhitu Peninsula Group

- assist with selection of suitable trial location typical of problem erosion sites
- site preparation and planting of trial
- assistance with monitoring of planted seedlings
- regular inspection of site and maintenance of fencing, etc.
- weed control where required with appropriate treatments

NZ FRI

- provide trial design and listing of treatment combinations and write work plan
- supply numbered identification pegs
- supply field sheets for plant growth assessment
- guide Group members undertaking monitoring of trial performance
- data entry and analysis, interpretation of results and technology transfer

It is proposed to finalise the work plan in early May 1996 with NZ FRI assisting pegging of the trial sites in mid-May and planting to be undertaken by the Awhitu Group in late May. Spraying of grass sites and any marram sites could be carried at time of pegging, ideally at least 2 weeks prior to planting.

ACKNOWLEDGMENT

Mr David Craig has kindly offered suitable trial sites on his Hamilton Road property. Mark Kimberley (Biometrician, NZ FRI) assisted with trial design and will assist with data analysis.

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APPENDIX - Indigenous Species Planting Trial Design, Awhitu Peninsula

Rank Grass Site

Plot	Block	Species	Treatment
1	1	tauhinu	Sprayed Spot
2	1	karo	Sprayed Spot
3	1	akeake	Sprayed Spot
4	1	pohutukawa	Sprayed Spot
5	1	harakeke	Sprayed Spot
6	2	akeake	Sprayed Spot
7	2	pohutukawa	Sprayed Spot
8	2	tauhinu	Sprayed Spot
9	2	harakeke	Sprayed Spot
10	2	karo	Sprayed Spot
11	3	karo	Sprayed Spot
12	3	pohutukawa	Sprayed Spot
13	3	harakeke	Sprayed Spot
14	3	akeake	Sprayed Spot
15	3	tauhinu	Sprayed Spot
16	4	harakeke	Sprayed Spot
17	4	karo	Sprayed Spot
18	4	tauhinu	Sprayed Spot
19	4	pohutukawa	Sprayed Spot
20	4	akeake	Sprayed Spot
21	5	karo	Sprayed Spot
22	5	akeake	Sprayed Spot
23	5	tauhinu	Sprayed Spot
24	5	pohutukawa	Sprayed Spot
25	5	harakeke	Sprayed Spot
26	6	akeake	Sprayed Spot
27	6	tauhinu	Sprayed Spot
28	6	karo	Sprayed Spot
29	6	harakeke	Sprayed Spot
30	6	pohutukawa	Sprayed Spot
31	7	tauhinu	Sprayed Spot
32	7	harakeke	Sprayed Spot
33	7	akeake	Sprayed Spot
34	7	karo	Sprayed Spot
35	7	pohutukawa	Sprayed Spot
36	8	akeake	Sprayed Spot
37	8	pohutukawa	Sprayed Spot
38	8	karo	Sprayed Spot
39	8	harakeke	Sprayed Spot
40	8	tauhinu	Sprayed Spot

Recently Planted Marram Site

Plot	Block	Species	Treatment
1	1	harakeke	Nil Hand Clear
2	1	karo	Nil Hand Clear
3	1	tauhinu	Nil Hand Clear
4	1	pohutukawa	Nil Hand Clear
5	1	akeake	Nil Hand Clear
6	2	pohutukawa	Nil Hand Clear
7	2	karo	Nil Hand Clear
8	2	tauhinu	Nil Hand Clear
9	2	akeake	Nil Hand Clear
10	2	harakeke	Nil Hand Clear
11	3	pohutukawa	Nil Hand Clear
12	3	harakeke	Nil Hand Clear
13	3	tauhinu	Nil Hand Clear
14	3	akeake	Nil Hand Clear
15	3	karo	Nil Hand Clear
16	4	karo	Nil Hand Clear
17	4	tauhinu	Nil Hand Clear
18	4	akeake	Nil Hand Clear
19	4	pohutukawa	Nil Hand Clear
20	4	harakeke	Nil Hand Clear
21	5	karo	Nil Hand Clear
22	5	harakeke	Nil Hand Clear
23	5	akeake	Nil Hand Clear
24	5	tauhinu	Nil Hand Clear
25	5	pohutukawa	Nil Hand Clear
26	6	harakeke	Nil Hand Clear
27	6	karo	Nil Hand Clear
28	6	pohutukawa	Nil Hand Clear
29	6	tauhinu	Nil Hand Clear
30	6	akeake	Nil Hand Clear
31	7	karo	Nil Hand Clear
32	7	harakeke	Nil Hand Clear
33	7	tauhinu	Nil Hand Clear
34	7	akeake	Nil Hand Clear
35	7	pohutukawa	Nil Hand Clear
36	8	harakeke	Nil Hand Clear
37	8	karo	Nil Hand Clear
38	8	akeake	Nil Hand Clear
39	8	tauhinu	Nil Hand Clear
40	8	pohutukawa	Nil Hand Clear

Dense Marram Site

Plot	Block	Species	Treatment
1	1	akeake	Minimal Hand Clear
2	1	karo	Minimal Hand Clear
3	1	tauhinu	Minimal Hand Clear
4	1	pohutukawa	Minimal Hand Clear
5	1	harakeke	Minimal Hand Clear
6	2	karo	Minimal Hand Clear
7	2	pohutukawa	Minimal Hand Clear
8	2	tauhinu	Minimal Hand Clear
9	2	akeake	Minimal Hand Clear
10	2	harakeke	Minimal Hand Clear
11	3	tauhinu	Minimal Hand Clear
12	3	karo	Minimal Hand Clear
13	3	akeake	Minimal Hand Clear
14	3	pohutukawa	Minimal Hand Clear
15	3	harakeke	Minimal Hand Clear
16	4	harakeke	Minimal Hand Clear
17	4	karo	Minimal Hand Clear
18	4	akeake	Minimal Hand Clear
19	4	tauhinu	Minimal Hand Clear
20	4	pohutukawa	Minimal Hand Clear
21	5	tauhinu	Minimal Hand Clear
22	5	harakeke	Minimal Hand Clear
23	5	akeake	Minimal Hand Clear
24	5	karo	Minimal Hand Clear
25	5	pohutukawa	Minimal Hand Clear
26	6	akeake	Minimal Hand Clear
27	6	karo	Minimal Hand Clear
28	6	harakeke	Minimal Hand Clear
29	6	tauhinu	Minimal Hand Clear
30	6	pohutukawa	Minimal Hand Clear
31	7	pohutukawa	Minimal Hand Clear
32	7	akeake	Minimal Hand Clear
33	7	harakeke	Minimal Hand Clear
34	7	tauhinu	Minimal Hand Clear
35	7	karo	Minimal Hand Clear
36	8	tauhinu	Minimal Hand Clear
37	8	pohutukawa	Minimal Hand Clear
38	8	harakeke	Minimal Hand Clear
39	8	karo	Minimal Hand Clear
40	8	akeake	Minimal Hand Clear