ESTABLISHMENT OF INDIGENOUS COASTAL PLANT SPECIES SCREENING TRIALS, SOUTH BRIGHTON, BRIGHTON SPIT AND WAIMAIRI, SOUTH PEGASUS BAY, CHRISTCHURCH

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1996

NZ FOREST RESEARCH INSTITUTE LTD | PROJECT RECORD NO.: 5051

DIVISION: FOREST TECHNOLOGY

RESOURCE CENTRE: INDIGENOUS FOREST MANAGEMENT

CODE: 95 / 96 (Financial Year) | 145 (Resource Centre No.) | 1554 (Project) 00 (Sub-project) | 15 (FRST Output) (Prog.)

WORK PLAN NO.: | EXPERIMENT NO.:

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KEYWORDS: SAND DUNES, FERTILISER, REVEGETATION, INDIGENOUS, MULCH

ABSTRACT*

The Beach Care section of the Parks Unit, Christchurch City Council (CCC) and the Indigenous Forest Management section, New Zealand Forest Research Institute (NZ FRI) are establishing a series of dune revegetation trials along Christchurch beaches. The trials are evaluating the performance of indigenous sand binding species to be established on foredunes as well as a wide range of mainly woody indigenous species to be planted on relatively stable backdune sites presently dominated by the introduced marram grass (*Ammophila arenaria*). This report documents the rationale for revegetation of dunes along Christchurch beaches and the establishment of six separate planting trials from the Spit to Waimairi Beach.

* **Note: This material is unpublished and must not be cited as a literature reference.**

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INTRODUCTION

The Beach Care section of the Parks Unit, Christchurch City Council (CCC) and the Indigenous Forest Management section, New Zealand Forest Research Institute (NZ FRI) are establishing a series of dune revegetation trials along Christchurch beaches. The trials are evaluating the performance of indigenous sand binding species to be established on foredunes as well as a wide range of mainly woody indigenous species to be planted on relatively stable backdune sites presently dominated by the introduced marram grass (*Ammophila arenaria*). This report documents the rationale for revegetation of dunes along Christchurch beaches and the establishment of six separate planting trials from Brighton Spit to Waimairi Beach.

BACKGROUND INFORMATION

The CCC are setting up a Coast Care programme for Christchurch over the next five years to develop and enhance 12 beach parks from the Waimakariri River south to Gollans Bay on Godley Head in Lyttleton harbour (Fig. 1). The need for such a programme has been recognised by the CCC over the last three years in a management plan for beaches and coastal parks in Christchurch (Christchurch City Council 1995).

For many years, exotic sand binding species such as marram grass and sand stabiliser species such as ice plant (*Carpobrotus edulis*) have been used in an effort to reduce erosion. Due to lack of information on alternative species including local indigenous species, and the need to maintain a near continuous plant cover on the dunes, marram and ice plant are still currently used on a large scale to revegetate bare sand areas on Christchurch beaches. However, in the policy section of the Management Plan, there is a strong emphasis on revegetation of the dune system to stabilise sand using indigenous coastal species.

Some planting of indigenous species has taken place on Christchurch dunes over the last few years, in particular, large numbers of pingao have been planted by local authorities with some degree of success. Coastal woody and herbaceous species have also been successfully established in a trial at North Brighton (Colin Meurk, Landcare Research, pers. comm.). There are also a range of indigenous coastal species planted and maintained by CCC along carparks and along the coastal road for scenic purposes. Although isolated areas have been planted in native coastal shrubs and trees in the past, there has been no effort to establish a solid canopy cover on the backslopes and dune slack areas.

In a comprehensive report of the vegetation of the foreshore from the Waimakariri River in the north to Taylors Mistake in the south, McCombs (1992) provides some recommendations as to which species are appropriate to plant in various locations. Background information is given for the major species that occur in this area including some historical information such as early reports on the occurrence of spinifex (*Spinifex sericeus*) in the area which have long since gone. Pingao is the other major sand binding specie found in this area but is in much reduced numbers. A large number of indigenous and exotic species that occur on the Christchurch dunes both on fixed dunes and dune slacks are described in

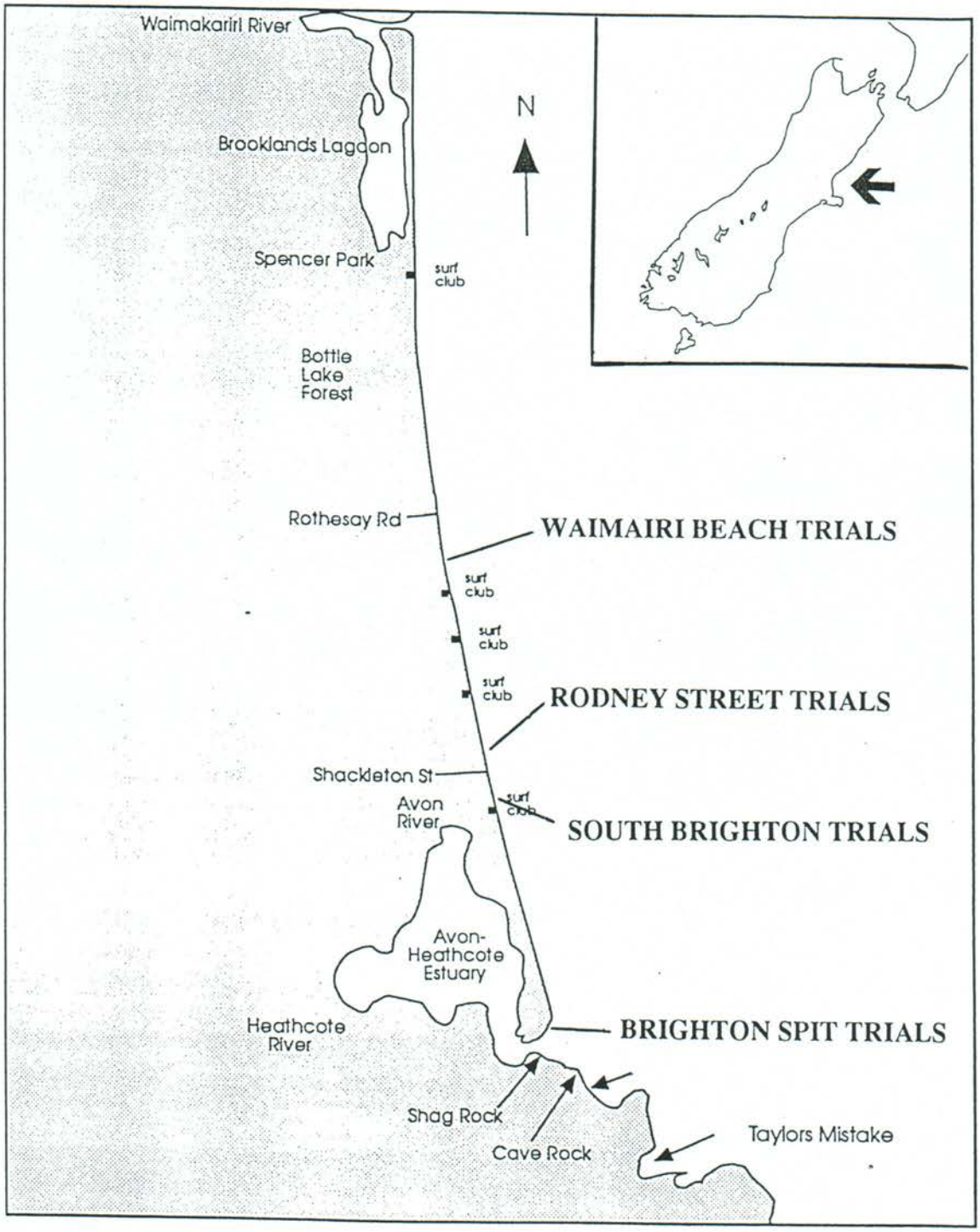

Figure 1: Location of indigenous coastal plant species screening trials, South Pegasus Bay, Christchurch.

detail in McCombs. This report has therefore been used to a large extent to guide selection of indigenous species for the current planting trials.

The Coast Care programme proposes to plant and maintain 20,000 native trees and shrubs in the 1995 planting season and more again every year for the next five years. The purpose of this is not only to improve the scenic values of the coastal environment, but to enhance the ecological and recreational values for the local community and visitors to the coast, as well as provide sustainable long term stability of the dunes with low maintenance.

Trials were therefore considered necessary to determine the most appropriate species and the most effective methods for large scale revegetation on these dunes. The performance of these trials will also be compared with the performance of several other NZ FRI sand dune trials established on a number of North Island sites (Bergin & Herbert 1994; Bergin et al. 1995; Herbert & Bergin 1991). These long term trials will also assist the City Council in fulfilling its obligation under the Resource Management Act where it is required to monitor environmental projects that it undertakes.

OBJECTIVES

The overall objective of these revegetation trials on a South Island east coast dune site is to first, investigate practical techniques for establishing indigenous sand binding plants on foredunes, and second, to determine appropriate strategies for establishing mainly indigenous shrub and tree species on stabilised back dunes dominated by either marram grass or ice plant.

Specific aims include:

- To establish pingao and sand fescue planting trials using nursery-raised seedlings.
- To establish a pilot direct seed sowing trial of spinifex on foredunes.
- To investigate techniques for establishing nursery-raised seedlings of a range of appropriate indigenous species for revegetation of back dune sites.
- To evaluate a range of treatment options including site type, species, application of fertiliser at planting and use of mulch.
- To compare autumn and spring planting and sowing of selected treatments.
- To provide, in the long-term, coastal managing agencies and local Beach Care community groups, guidelines for revegetation of sand dunes using a range of indigenous species for establishing on appropriate sites.

SPECIES

Species that have been planted in the trials are for the most part coastal species that occur naturally in the Canterbury region. Where appropriate, stock has been raised from seed collected within the local region.

Botanical name	*Maori or common name*	*Condition/type of stock*
Sand binders:		
Austrofestuca littoralis	sand fescue	rx 90; variable size
Desmoschoenus spiralis	pingao	rx 90 containers
Spinifex sericeus	spinifex	seed heads; uncertain of viability
Woody species:		
Pittosporum crassifolium	karo	
Cassinia leptophylla	cottonwood	rootrainers

Coprosma acerosa	sand coprosma	rx 90; small seedlings
Coprosma robusta	karamu	
Dodonea viscosa	akeake	rootrainers; tall seedlings
Griselinia littoralis	broadleaf	rootrainers; good seedlings
Leptospermum scoparium	manuka	rootrainers; tall seedlings
Myoporum laetum	ngaio	PB 5 containers; large seedlings
Muehlenbeckia astonii		PB 5 containers
Pittosporum tenuifolium	kohuhu	rootrainers; spindly seedlings
Corokia cotoneaster		PB 5; moderate size

Other species:

Phormium tenax	harakeke	PB 5 containers & divisions
Cordyline australis	cabbage tree; ti kouka	rootrainers
Euphorbia glauca	sand milkweed	rx 90; good size
Poa cita	silver tussock	paper pots
Cortaderia richardii	toe toe	divisions
Schoenoplectus pungens	three square	rx 90 containers
Scirpoides nodosus	knobby club rush	rx 90 containers
Juncus spp	wiiwii	small containers
Discaria toumatou	matagouri	small containers

PLANTING SEASON

Six trial sites were established along the coast at the south end of Pegasus Bay which is managed by the Christchurch City Council (Fig. 1). Two trial sites testing indigenous sand binding species were located on the foredune in autumn 1995; three trials were located on stabilised back dune sites (two trials established autumn 1995 and the other spring 1995); and a dune slack planting trial established in spring 1995.

SITE DESCRIPTIONS

Foredune sites

South Brighton - A frontslope trial was planted with pingao and sand fescue seedlings in April 1995 (refer Appendix 1 for trial treatments and map). Spinifex seed was sown directly onto dunes. The front slope trial was on a sandy slope devoid of vegetation at a slope of about 1:4 to a height of about nine metres above mean sea level. The top of the slope comprised a partially vegetated (marram grass) crest. This slope is exposed to the full force of the prevailing easterly winds (Plate 1).

Brighton Spit - As for the foredune site at South Brighton, pingao and sand fescue were planted and spinifex seed sown on a bare foredune site in May 1995 (Plate 2). Top height of backdunes at this site were only about 6 m above mean sea level with the trial located near the toe of the dune just above high water mark. The slopes planted were about 1:10 or flatter, and devoid of vegetation and exposed to prevailing onshore winds (refer Appendix 2 for trial treatments and map).

Backdune sites

South Brighton - A backslope trial using up to 12 tree and shrub species was established in April 1995 with the site divided into two zones; an exposed seaward zone of 1:6 slope affected by prevailing onshore wind and salt spray and sand deposition; and a sheltered landward zone which is lower consisting of shallow slopes of 1:8 or otherwise flat (Plate 3). The backdune site is approximately 120 m wide and is dominated by an almost continuous canopy of tall marram grass with other exotic grasses beneath particularly Yorkshire fog (*Holcus lanatus*). Occasional shrubs including elderberry (*Sambucus nigra*), boxthorn (*Lycium ferocissimum*), cabbage tree (*Cordyline australis*), flax (*Phormium tenax*), and tree lupin (*Lupinus arboreus*) as well as macrocarpa (*Cupressus macrocarpa*) are scattered throughout particularly on landward dune sites. The dunes in this location are relatively stable and have been growing in height since marram grass was established in the 1930's (refer to Appendix 3 for trial treatments and map).

Rodney Street recontour dune - These narrow dunes (approximately 50 m wide) opposite Rodney Street have been stabilised by performing a full dune recontour in the late 1980's. Ice plant was established immediately after the earthworks were completed, and remains as the primary vegetation on the dune. Marram grass is beginning to establish, but is still very sparse (Plate 4). The site was divided into two zones, exposed and sheltered. The exposed zone is on the seaward side of the crest is exposed to the prevailing easterly wind with the sheltered zone on the landward side of the crest. The frontslope is at about 1:4 and the backslope is at 1:6 with the dune crest height at 8 m above mean sea level. A range of indigenous tree and shrub species similar to that at the South Brighton backdune site were planted at this site in late April 1995 (refer to Appendix 4 for trial treatments and map).

Waimairi - This site is similar to the wide South Brighton backdune site dominated by a dense cover of marram grass. For the relatively exposed zone on the seaward side of the trial area, plots were established below the crest of the foredune on a slope of 1:5 whereas plots on the inland zone were planted on fatter low-lying dune. Up to 16 species of trees and shrubs were planted at this site in early September 1995 (Plate 3). The layout of the blocks is similar to the South Brighton back dune site (refer to Appendix 5 for trial treatments).

Dune slack site

Waimairi - Two adjacent low-lying sites dominated by the exotic grass Yorkshire fog (*Holcus lanatus*) were selected to test performance of six indigenous species considered suitable for colonising dune slacks. Such sites are likely to be frost hollows but will have a wetter moisture regime than elevated dune sites. This pilot trial involved planting a limited number of seedlings in groups along dune slack margins and performance will be compared with groups planted within the centres of dune slacks at lower elevation where cold air ponding and frosting is expected. Species planted and trial treatments are listed in Appendix 6. This trial was planted in early September 1995.

TRIAL DESIGN

For the foredune sites, trials were established using a Randomised Complete Block design to ensure any major variation within each trial site could be minimised for data analysis and interpretation. Foredune trials comprised 5 replicates with plots of 10 or 20 seedlings depending on species with up to 3 fertiliser treatments applied randomly within each replicate.

For the backdune sites and South Brighton and Waimairi Beach, trials were established using a split-plot design with 4 replicates or blocks and 12 and 16 mainplots per replicate respectively. Within each replicate, species were randomly positioned in main plots consisting of 20 seedlings. Each mainplot was subdivided into four 5-tree subplots with the four treatments (control, fertiliser, mulch, fertiliser plus mulch) applied randomly among the subplots. The growth and quantitative variables will be analysed using standard split-plot analysis of variance methods.

ESTABLISHMENT METHODS

The plot layout and treatment identification methods are described for foredune and backdune trials in Figure 2.

Foredune sites

Pingao: Plots were planted on the seaward face of foredunes on bare sand. 20 pingao seedlings per 3 m diameter plot were planted and each plot given one of three treatments:

- control - no fertiliser
- Magamp slow release fertiliser incorporated into the planting hole at planting
- Elite slow release fertiliser applied as for Magamp

Each plot was identified by a centrally located numbered wooden peg with 30 cm and 50 cm above ground at South Brighton and Brighton Spit sites respectively to allow measurement of any future change in sand levels in the vicinity of each plot. Five replicates were established at each site.

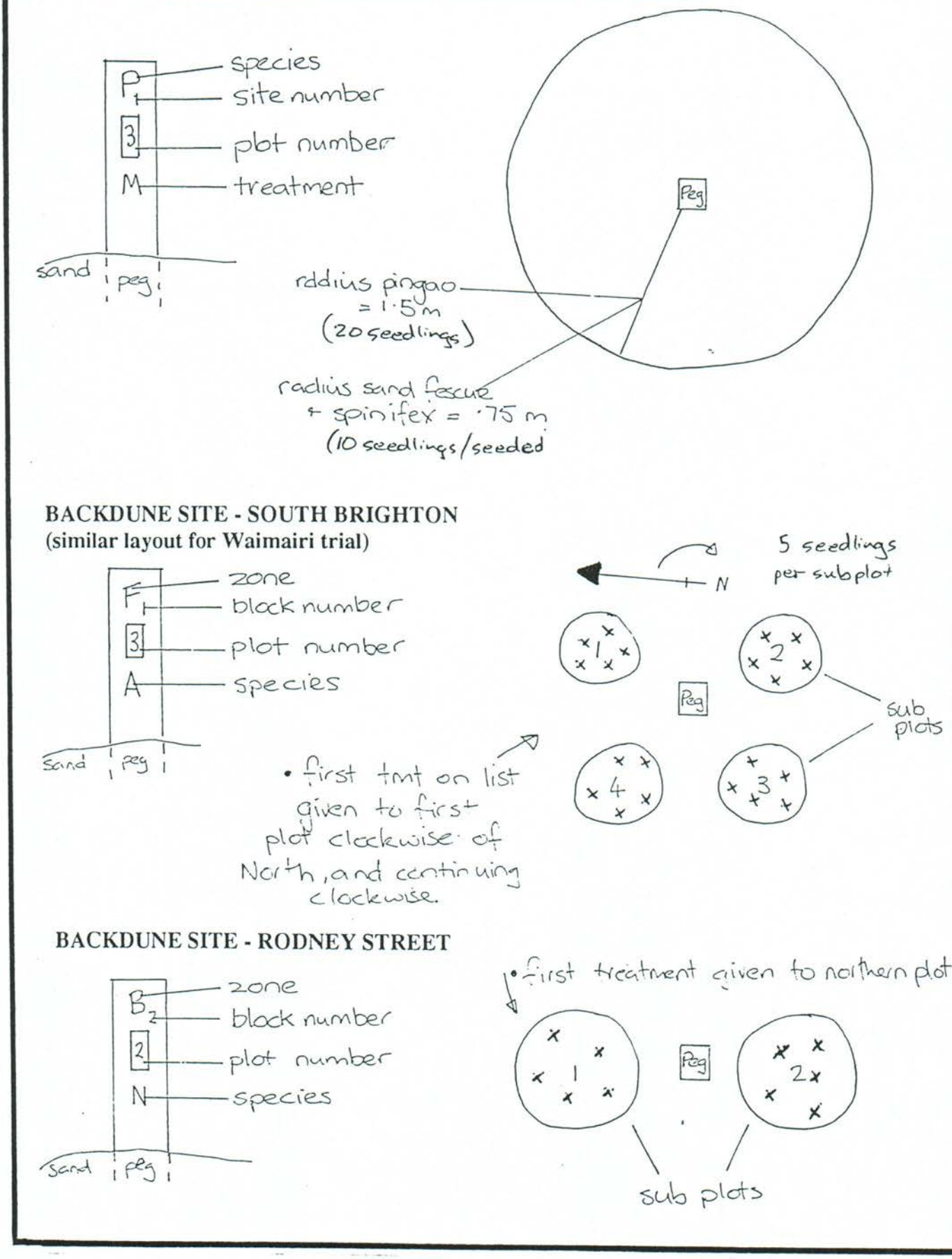

Figure 2: Plot layout and identification of treatment allocations, Christchurch Sand Dune Restoration Trials.

Treatments were coded on the marker pegs as follows:

P = pingao
1 - 5 = replicate number
M = Magamp fertiliser was applied
E = Elite fertiliser was applied
Aluminium tag = plot number.

Pingao were planted well into the sand below the wet sand line. Since no other vegetation was present it was very easy planting. Planters worked in groups of two or three, one marking the circle with string and stick, one digging holes and one planting with the appropriate treatment. Approximately 30g of fertiliser (handful) was applied to each seedling in the fertiliser plots and incorporated into sand at the upper level of the hole during planting.

Sand fescue: Ten sand fescue seedlings were established in 2 m diameter plots at each site with two treatments - fertiliser (Magamp) and no fertiliser. Plots were established and identified as per pingao plots but with A to indicate *Austrofestuca*.

Spinifex: Spinifex seedheads or individual seed were planted in ten plots at South Brighton and Brighton Spit respectively. Provision was left to apply fertiliser at the South Brighton site when germination occurred and Magamp was applied at sowing at the Brighton Spit site. A handful of seedheads (2-3 seedheads) were placed into a spade hole 100-150 mm deep as is used widely in New South Wales. Plots were identified as for the other sand binders with and S code indicating spinifex.

Backdune sites

Marram sites - On the marram dominated sites at South Brighton and Waimairi, 12 and 16 indigenous coastal plant species were planted at each site respectively. At each site 4 replicates were established with one mainplot for each species per replicate. Each mainplot comprised 4 adjacent subplots. Subplots consisted of 5 seedlings of a single species planted within a 1.5 - 2 m diameter gap cleared of marram using spades. Motorised scrub bars were used as well as hand clearing methods (Plate 5). Each plot was cleared of vegetation including most of the root mass to leave bare sand. Each mainplot was identified by a single numbered wooden peg. All four plots within a main plot had the same species planted but with one of four treatments randomly applied to each plot in a clockwise direction from north. The treatment combinations were:

- control - no fertiliser or mulch
- Magamp fertiliser applied at planting (30 g - handful)
- mulch of pulled up marram grass spread over planted plot
- mulch and fertiliser

Mulch was applied immediately after planting. It consisted of chopped marram grass that had been removed during site clearance and consisted of a high percentage of old dead growth. Mulch was spread over the whole plot, to cover any exposed soil. Approximately 30 - 40g of fertiliser (small - medium handful) was applied to each seedling in the fertiliser and fertiliser plus mulch plots, and incorporated into the sand at planting (Plate 6).

At the Waimairi backdune site, an additional fertiliser and mulch treatment was applied to four species to give a total of nine treatment combinations. These additional treatments were:

- application of liquid organic fertiliser
- compost/bark mulch ex CCC organic recycling plant

Therefore, for these species, main plots comprising 9 adjacent plots were identified with one of nine treatments allocated to each plot. The compost/bark mulch consisted of sieved relatively coarse wood material with no fines.

At both South Brighton and Waimairi Beach trials, Replicates 2 and 4 were located on the relatively exposed backslope of the foredune and Replicates 1 and 3 were located on the relatively sheltered lower backdune (refer to diagram in Appendix 3).

Ice plant site - As for the marram site, plots of 5 seedlings of a single species were planted. Twelve indigenous coastal plant species were planted. Seedlings were planted within the ice plant cover with no attempt to remove it. Two treatments were applied to paired plots; unfertilised control and Magamp applied at planting. Paired plots were identified using numbered pegs.

The Rodney Street trial was the only ice plant site. Replicates 2 and 4 were located on the exposed frontslope and Replicates 1 and 3 located on the relatively sheltered backslope.

Dune slack pilot trial - Six species were planted in paired 5 seedling groups to compare lower centre microsites that are likely to be frost hollows with elevated microsites near the edge of the dune slack. This pilot trial was established on 2 dune slack sites where grassed plots were cleared by motorised scrub cutters and turf scalped from plots before planting. Half of the groups planted for each species was fertilised at planting with Magamp.

MONITORING AND MAINTENANCE

Planting height and cover will be measured for all seedlings soon after planting to provide a baseline on which to determine growth rate. Each site will be inspected by Beach Care and Park Ranger staff of the CCC at three monthly intervals at least for the first year to record any factors affecting plant performance such as browsing by rabbits or hares. A survival assessment is required at each site 3-6 months after planting.

A full plant survival and growth assessment is required at least one year after planting and for up to two further years depending on overall performance of each trial. The major parameters to be measured are:

- survival
- plant height (in cm)
- plant cover - greatest width of the live crown of each plant (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 addition information on plant condition (eg., browsing)

The subjective assessment of plant vigour and health is to 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 (Appendix 7). Except for the sand binders, all seedlings are to be identified and measured separately. 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. A Plot Configuration box for each plot of five seedling allows for a diagram to assist with relocation of individual seedlings where the top of the form is oriented north.

For pingao, spinifex and sand fescue, survival and plant performance is assessed on a plot basis. Options for measuring growth include recording multiple heads, presence of stolons, plant height and percentage cover of plants within plots. Sand movement since planting can also be measured from plot peg heights. Field measurements will be entered into the computer directly off field sheets for analysis.

Trials will need to monitored for degree of weed growth and releasing by hand and herbicides considered where necessary. Watering of seedlings may also be considered during prolonged droughts.

REPORTING

The early establishment phase is usually the most critical phase for survival of planted seedlings particularly on difficult sites such as sand dunes. An indication of appropriate species and establishment techniques is likely within the first year of planting for these trials along Christchurch beaches. A progress report on performance of trials one year after planting is planned and there may be scope to give preliminary recommendations on preferred species for management scale planting. However, further trials will be required to refine treatments including developing practical site preparation and weed control strategies on back dune sites.

ACKNOWLEDGMENTS

Those who assisted in trial establishment were:

Chris Freeman - Management Planning Officer, Parks Unit - overall project brief, approval of funding
Rodney Chambers- Coast Care, Christchurch - supervision of trial planting, trial maintenance
Kate McCombs - Botanist, Parks Unit - assistance with trial design, choice of species
Arthur Adcock - Senior Ranger Spencer Park, Parks Unit - help with practical implementation
Ian Ellingford - Senior Ranger, Parks Unit - help with practical implementation
Brian Harmon - Task Force Green - trial preparation and planting supervisor
Andrew and the Wai-ora Community Trust - clearing of plots and planting
Joe Cartman - CCC Lynwood Nursery manager - provision of seedlings.
Department of Conservation, Nelson Conservancy - supply of spinifex seed
Mark Kimberley, Biometrician, NZ FRI - trial design and treatment combinations

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Plate 1: Where marram is the dominant vegetation a high foredune with a steep front slope has been form. Such dunes become unstable with blowouts occurring at intervals along the beach. The foredune trial at South Brighton was located on a steep foredune site where the indigenous sand binding species pingao and sand fescue seedlings were planted and spinifex seed sown.

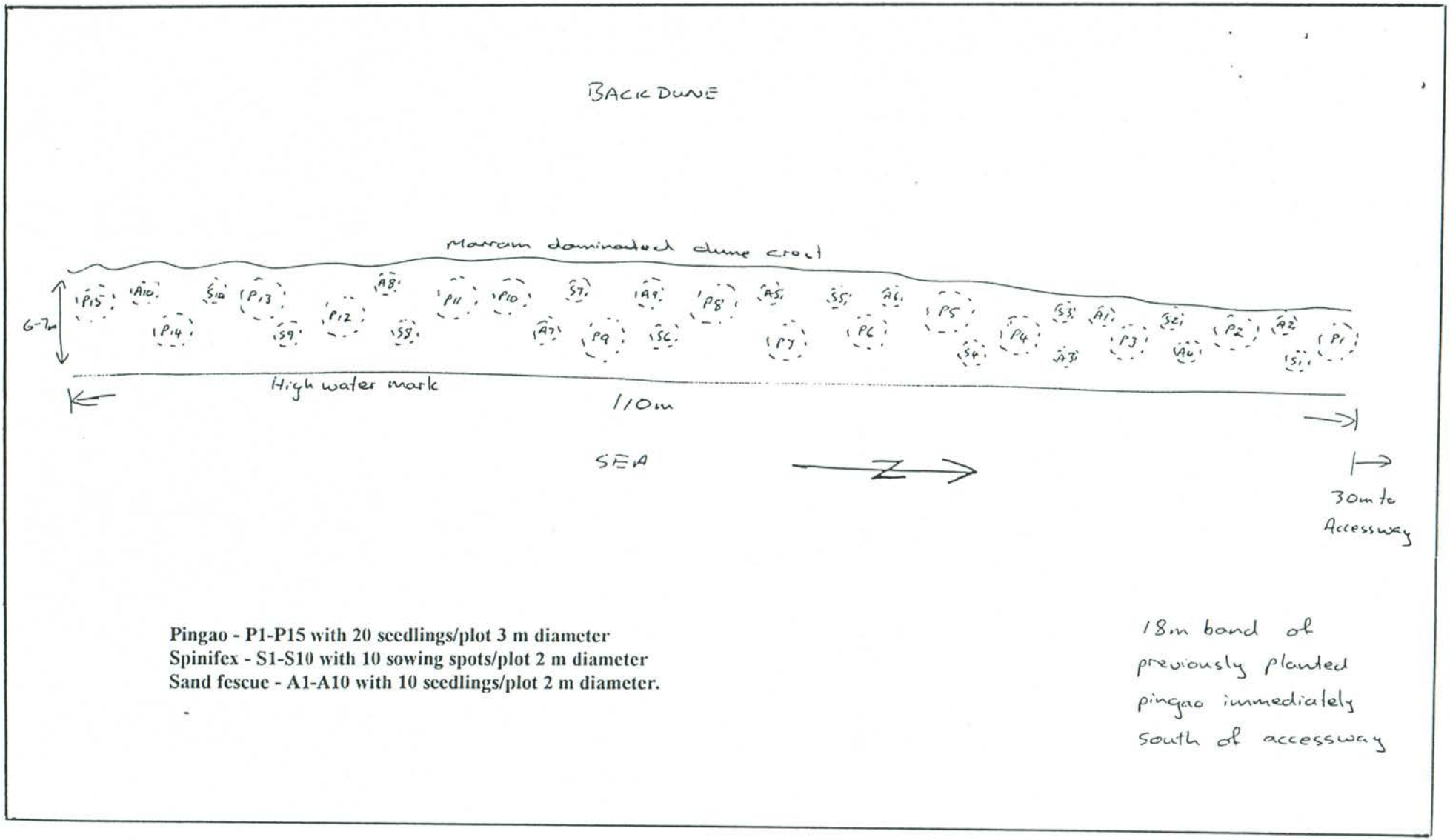
Plate 2: At Brighton Spit, the trial was established on a relatively flat site. Twenty pingao seedlings have been planted in each plot with a centrally located wooden identification peg. Performance of pingao and sand fescue seedlings planted on foredune sites with and without fertiliser will be compared.

Plate 5: Within the dense marram dominated backdune sites at South Brighton and Waimairi Beach, subplots up to 2 m in diameter were cleared using a motorised scrub bar with metal disc blade. Planting sites were also cleared of marram using spades where sufficient labour was available. Five seedlings of a single species were planted in each subplot. Up to 20 different species were planted in the backdune trials to determine the most appropriate species for large scale planting of these difficult sites.

Plate 6: Planting of the several thousand seedlings was carried out by the Wai-ora Community Trust, Task Force Green and the Coast Care and Parks Unit of the Christchurch City Council over 2 weeks in April 1995 and a further week in September 1995. The backdune species screening trials were designed to compare a range of planting treatments with various treatment combinations of fertiliser, mulch and controls. Magamp fertiliser was applied at planting and mulch of either marram grass or coarse woody compost placed around each seedlings of appropriate subplots.

Plate 3: The wide backune sites at South Brighton and Waimairi Beach are dominated by tall stands of marram. At each site where planting trials were established, two broad zones were identified - the exposed backslope of the high foredune on the seaward side of the dune system, and the relatively sheltered lower inland dune of undulating topography.

Plate 4: In contrast to the marram dominated sites, the recontoured trial site at Rodney Street is dominated by ice plant which was planted some 5 years earlier after dune reshaping. A range of indigenous coastal species were planted with and without fertiliser amongst the ice plant without major disturbance to existing vegetation cover so that sand stability was maintained on this exposed site.



Appendix 1: **Layout of foredune planting and sowing trials of pingao, spinifex and sand fescue, South Brighton (opposite Jervois Street), Christchurch.**

APPENDIX 1: Treatment combinations for planted pingao and sand fescue seedlings and sowing of spinifex seed at South Brighton foredune site, Christchurch Sand Dune Restoration Trials.

Pingao - South Brighton

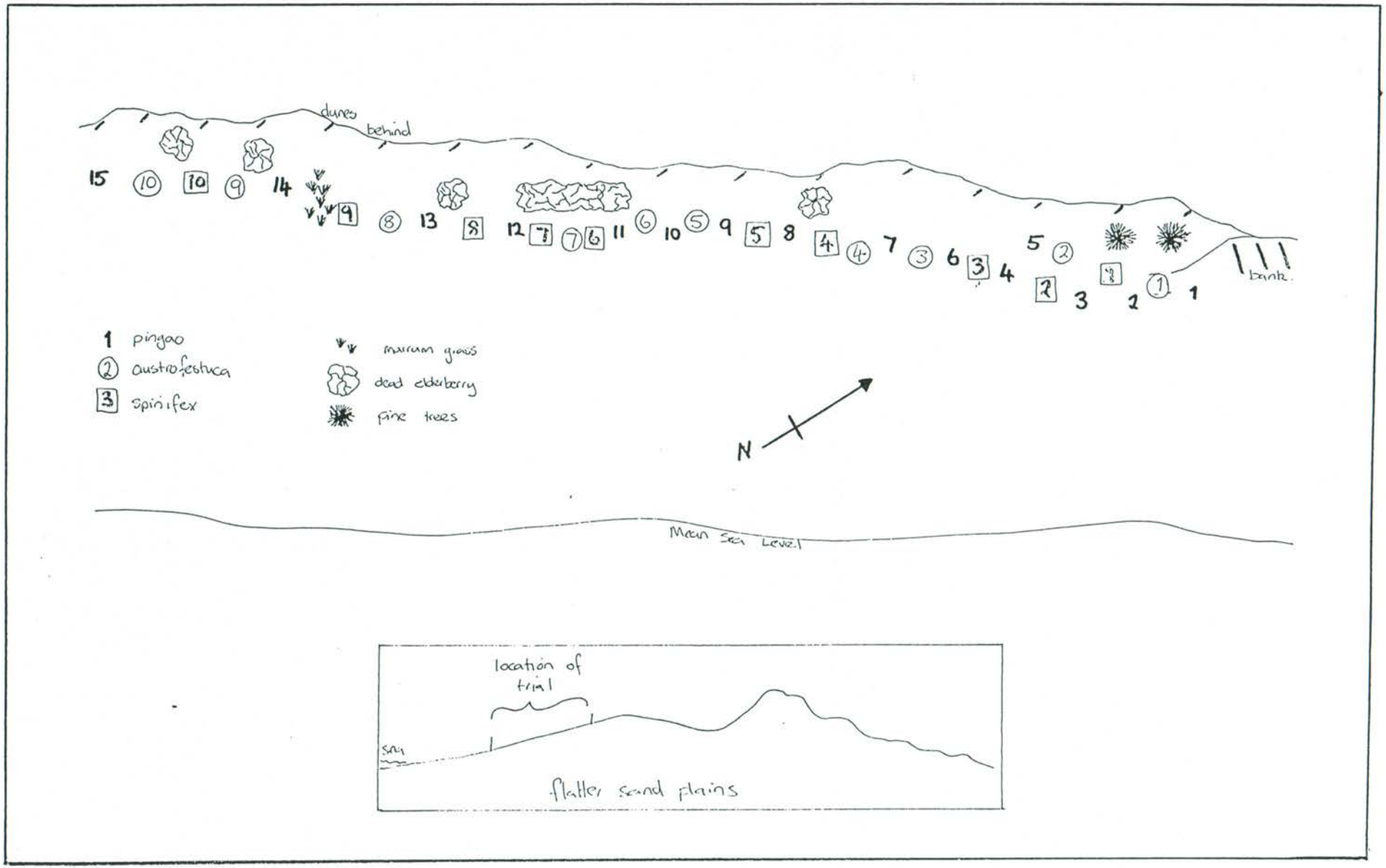
PLOT	BLOCK	TREATMENT
1	1	Elite
2	1	Magamp
3	1	Control
4	2	Control
5	2	Magamp
6	2	Elite
7	3	Elite
8	3	Magamp
9	3	Control
10	4	Elite
11	4	Control
12	4	Magamp
13	5	Control
14	5	Elite
15	5	Magamp

Sand fescue - South Brighton

PLOT	BLOCK	TREATMENT
1	1	Control
2	1	Magamp
3	2	Magamp
4	2	Control
5	3	Control
6	3	Magamp
7	4	Magamp
8	4	Control
9	5	Control
10	5	Magamp

Spinifex - South Brighton

SITE	PLOT	BLOCK	TREATMENT
1	1	1	Control
1	2	1	Magamp
1	3	2	Magamp
1	4	2	Control
1	5	3	Control
1	6	3	Magamp
1	7	4	Magamp
1	8	4	Control
1	9	5	Control
1	10	5	Magamp



Appendix 2: Layout of foredune planting and sowing trials of pingao, spinifex and sand fescue, Brighton Spit, Christchurch.

APPENDIX 2: Treatment combinations for planted pingao and sand fescue seedlings and sowing of spinifex seed at Brighton Spit foredune site, Christchurch Sand Dune Restoration Trials

Pingao - Brighton Spit

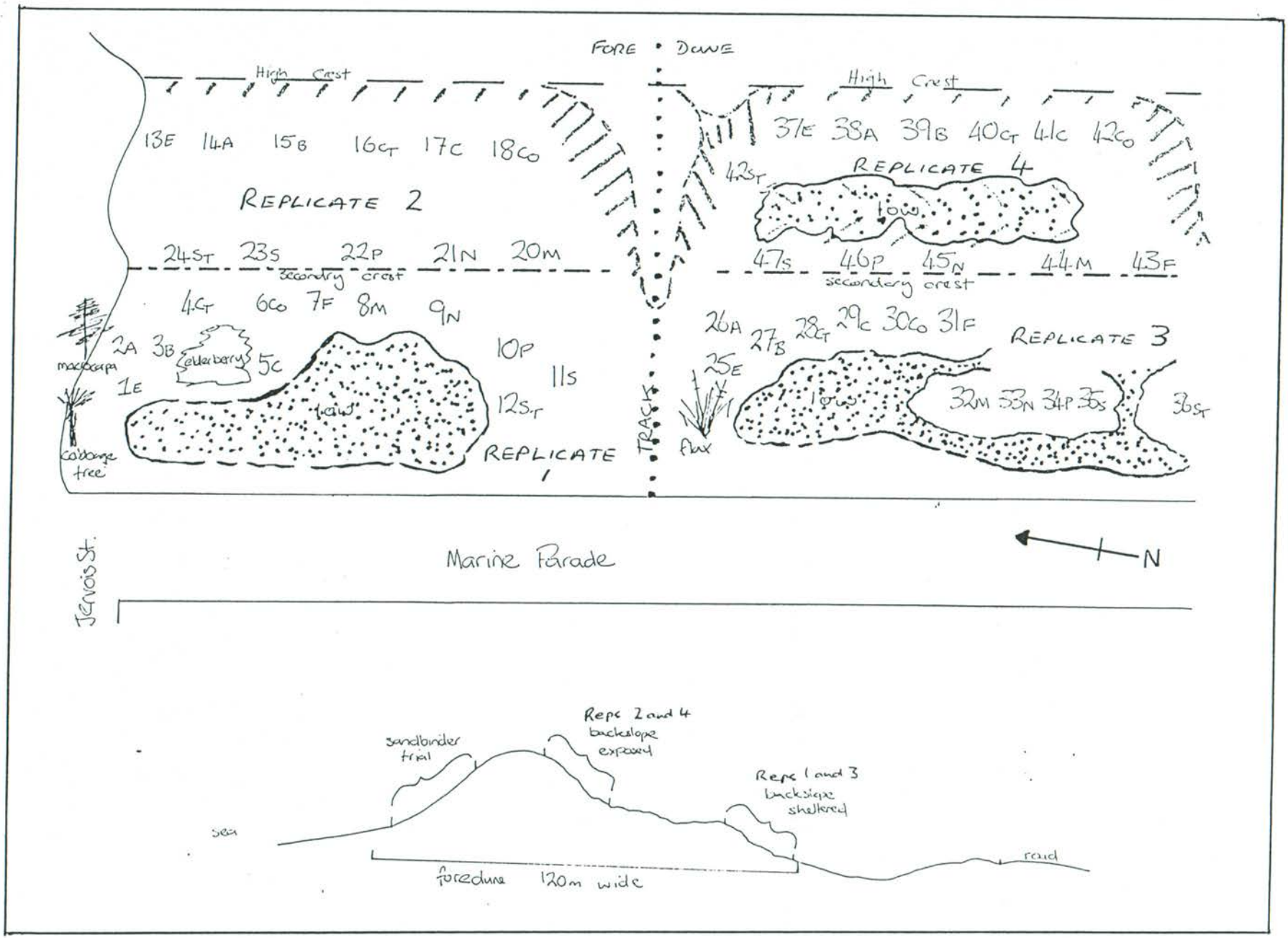
PLOT	BLOCK	TREATMENT
1	1	Control
2	1	Magamp
3	1	Elite
4	2	Control
5	2	Magamp
6	2	Elite
7	3	Elite
8	3	Magamp
9	3	Control
10	4	Magamp
11	4	Elite
12	4	Control
13	5	Elite
14	5	Control
15	5	Magamp

Sand fescue - Brighton Spit

PLOT	BLOCK	TREATMENT
1	1	Control
2	1	Magamp
3	2	Magamp
4	2	Control
5	3	Control
6	3	Magamp
7	4	Magamp
8	4	Control
9	5	Control
10	5	Magamp

Spinifex - Brighton Spit

SITE	PLOT	BLOCK	TREATMENT
1	1	1	Control
1	2	1	Magamp
1	3	2	Magamp
1	4	2	Control
1	5	3	Control
1	6	3	Magamp
1	7	4	Magamp
1	8	4	Control
1	9	5	Control
1	10	5	Magamp



Appendix 3: **Layout of South Brighton backdune coastal plant species trial, Christchurch. The Waimairi Beach trial has a similar layout. Cross section shows location of replicates at the South Brighton foredune trial using sand binding species.**

APPENDIX 3: Treatment combinations on marram dominated stable backdune site for a range of indigenous seedlings planted at South Brighton, Christchurch Sand Dune Restoration Trials.

REPLICATE 1

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
1	1	Euphorbia	Mulch
1	2	Euphorbia	Control
1	3	Euphorbia	Fert+Mulch
1	4	Euphorbia	Fert
2	5	akeake	Control
2	6	akeake	Mulch
2	7	akeake	Fert
2	8	akeake	Fert+Mul
3	9	broadleaf	Control
3	10	broadleaf	Fert
3	11	broadleaf	Fert+Mulch
3	12	broadleaf	Mulch
4	13	cabbage tree	Fert
4	14	cabbage tree	Fert+Mulch
4	15	cabbage tree	Mulchch
4	16	cabbage tree	Control
5	17	cassinia	Fert
5	18	cassinia	Mulch
5	19	cassinia	Control
5	20	cassinia	Fert+Mulch
6	21	corokia	Fert
6	22	corokia	Mulch
6	23	corokia	Control
6	24	corokia	Fert+Mulch
7	25	flax	Control
7	26	flax	Mulch
7	27	flax	Fert+Mulch
7	28	flax	Fert
8	29	manuka	Fert+Mulch
8	30	manuka	Control
8	31	manuka	Fert
8	32	manuka	Mulch
9	33	ngaio	Control
9	34	ngaio	Fert+Mulch
9	35	ngaio	Fert
9	36	ngaio	Mulch
10	37	pohuehue	Fert+Mulch
10	38	pohuehue	Mulch
10	39	pohuehue	Fert
10	40	pohuehue	Control
11	41	sand coprosma	Fert+Mulch
11	42	sand coprosma	Fert
11	43	sand coprosma	Mulch
11	44	sand coprosma	Control
12	45	silver tussock	Control
12	46	silver tussock	Mulch
12	47	silver tussock	Fert
12	48	silver tussock	Fert+Mulch

REPLICATE 2

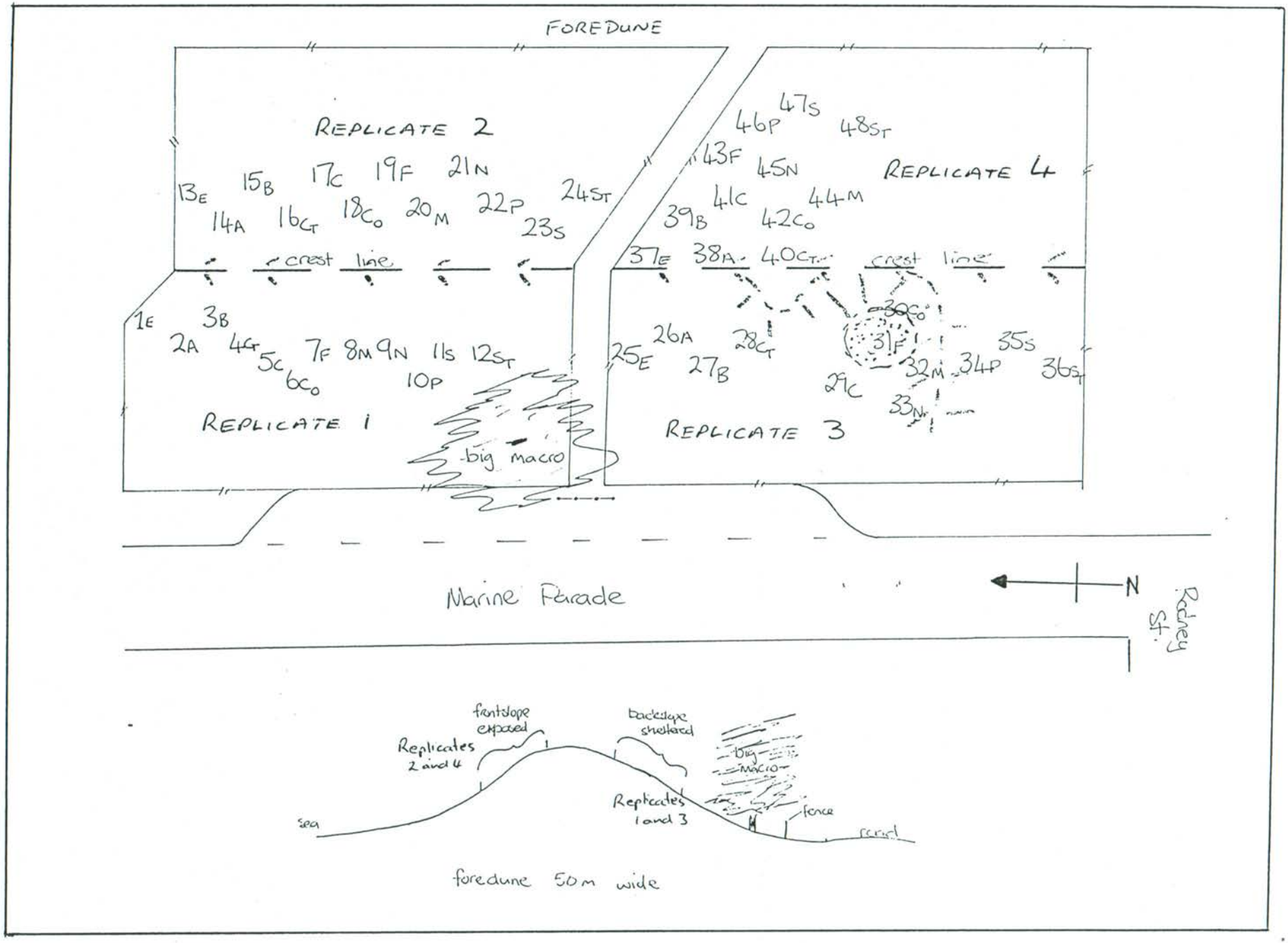
MAINPLOT	SUBPLOT	SPECIES	TREATMENT
13	49	Euphorbia	Mulch
13	50	Euphorbia	Control
13	51	Euphorbia	Fert+Mulch
13	52	Euphorbia	Fert
14	53	akeake	Fert+Mulch
14	54	akeake	Fert
14	55	akeake	Control
14	56	akeake	Mulch
15	57	broadleaf	Fert+Mulch
15	58	broadleaf	Fert
15	59	broadleaf	Mulch
15	60	broadleaf	Control
16	61	cabbage tree	Fert
16	62	cabbage tree	Control
16	63	cabbage tree	Fert+Mulch
16	64	cabbage tree	Mulch
17	65	cassinia	Control
17	66	cassinia	Fert
17	67	cassinia	Fert+Mulch
17	68	cassinia	Mulch
18	69	corokia	Fert
18	70	corokia	Fert+Mulch
18	71	corokia	Control
18	72	corokia	Mulch
19	73	flax	Fert
19	74	flax	Mulch
19	75	flax	Fert+Mulch
19	76	flax	Control
20	77	manuka	Fert
20	78	manuka	Control
20	79	manuka	Fert+Mulch
20	80	manuka	Mulch
21	81	ngaio	Fert+Mulch
21	82	ngaio	Control
21	83	ngaio	Mulch
21	84	ngaio	Fert
22	85	pohuehue	Control
22	86	pohuehue	Mulch
22	87	pohuehue	Fert+Mulch
22	88	pohuehue	Fert
23	89	sand coprosma	Control
23	90	sand coprosma	Fert+Mulch
23	91	sand coprosma	Mulch
23	92	sand coprosma	Fert
24	93	silver tussock	Fert+Mulch
24	94	silver tussock	Control
24	95	silver tussock	Fert
24	96	silver tussock	Mulch

REPLICATE 3

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
25	97	Euphorbia	Fert
25	98	Euphorbia	Mulch
25	99	Euphorbia	Fert+Mulch
25	100	Euphorbia	Control
26	101	akeake	Mulch
26	102	akeake	Fert+Mulch
26	103	akeake	Control
26	104	akeake	Fert
27	105	broadleaf	Control
27	106	broadleaf	Fert+Mulch
27	107	broadleaf	Fert
27	108	broadleaf	Mulch
28	109	cabbage tree	Mulch
28	110	cabbage tree	Control
28	111	cabbage tree	Fert
28	112	cabbage tree	Fert+Mulch
29	113	cassinia	Control
29	114	cassinia	Mulch
29	115	cassinia	Fert+Mulch
29	116	cassinia	Fert
30	117	corokia	Fert+Mulch
30	118	corokia	Control
30	119	corokia	Mulch
30	120	corokia	Fert
31	121	flax	Control
31	122	flax	Mulch
31	123	flax	Fert
31	124	flax	Fert+Mulch
32	125	manuka	Fert+Mulch
32	126	manuka	Control
32	127	manuka	Mulch
32	128	manuka	Fert
33	129	ngaio	Mulch
33	130	ngaio	Control
33	131	ngaio	Fert+Mulch
33	132	ngaio	Fert
34	133	pohuehue	Fert
34	134	pohuehue	Mulch
34	135	pohuehue	Fert+Mulch
34	136	pohuehue	Control
35	137	sand coprosma	Fert+Mulch
35	138	sand coprosma	Mulch
35	139	sand coprosma	Control
35	140	sand coprosma	Fert
36	141	silver tussock	Mulch
36	142	silver tussock	Fert+Mulch
36	143	silver tussock	Fert
36	144	silver tussock	Control

REPLICATE 4

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
37	145	Euphorbia	Fert
37	146	Euphorbia	Fert+Mulch
37	147	Euphorbia	Control
37	148	Euphorbia	Mulch
38	149	akeake	Mulch
38	150	akeake	Fert
38	151	akeake	Fert+Mulch
38	152	akeake	Control
39	153	broadleaf	Fert+Mulch
39	154	broadleaf	Fert
39	155	broadleaf	Control
39	156	broadleaf	Mulch
40	157	cabbage tree	Mulch
40	158	cabbage tree	Fert+Mulch
40	159	cabbage tree	Control
40	160	cabbage tree	Fert
41	161	cassinia	Control
41	162	cassinia	Fert
41	163	cassinia	Mulch
41	164	cassinia	Fert+Mulch
42	165	corokia	Mulch
42	166	corokia	Control
42	167	corokia	Fert
42	168	corokia	Fert+Mulch
43	169	flax	Fert+Mulch
43	170	flax	Fert
43	171	flax	Mulch
43	172	flax	Control
44	173	manuka	Fert+Mulch
44	174	manuka	Fert
44	175	manuka	Control
44	176	manuka	Mulch
45	177	ngaio	Mulch
45	178	ngaio	Fert+Mulch
45	179	ngaio	Control
45	180	ngaio	Fert
46	181	pohuehue	Control
46	182	pohuehue	Fert
46	183	pohuehue	Mulch
46	184	pohuehue	Fert+Mulch
47	185	sand coprosma	Mulch
47	186	sand coprosma	Fert+Mulch
47	187	sand coprosma	Fert
47	188	sand coprosma	Control
48	189	silver tussock	Fert+Mulch
48	190	silver tussock	Fert
48	191	silver tussock	Control
48	192	silver tussock	Mulch



Appendix 4: **Layout of Rodney Street backdune coastal plant species trial, Christchurch. Cross section shows location of Replicate 2 & 4 on front slope and Replicates 1 & 3 on backslope of this recontoured dune.**

APPENDIX 4: Treatment combinations on ice plant dominated stable backdune site for a range of indigenous seedlings planted at Rodney Street, Christchurch Sand Dune Restoration Trials.

REPLICATE 1

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
1	1	Euphorbia	Control
1	2	Euphorbia	Fert
2	3	akeake	Fert
2	4	akeake	Control
3	5	broadleaf	Control
3	6	broadleaf	Fert
4	7	cabbage tree	Control
4	8	cabbage tree	Fert
5	9	cassinia	Fert
5	10	cassinia	Control
6	11	corokia	Fert
6	12	corokia	Control
7	13	flax	Control
7	14	flax	Fert
8	15	manuka	Fert
8	16	manuka	Control
9	17	ngaio	Fert
9	18	ngaio	Control
10	19	pohuehue	Fert
10	20	pohuehue	Control
11	21	sand coprosma	Fert
11	22	sand coprosma	Control
12	23	silver tussock	Control
12	24	silver tussock	Fert

REPLICATE 2

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
13	25	Euphorbia	Control
13	26	Euphorbia	Fert
14	27	akeake	Fert
14	28	akeake	Control
15	29	broadleaf	Control
15	30	broadleaf	Fert
16	31	cabbage tree	Control
16	32	cabbage tree	Fert
17	33	cassinia	Control
17	34	cassinia	Fert
18	35	corokia	Fert
18	36	corokia	Control
19	37	flax	Fert
19	38	flax	Control
20	39	manuka	Control
20	40	manuka	Fert
21	41	ngaio	Control
21	42	ngaio	Fert
22	43	pohuehue	Control
22	44	pohuehue	Fert
23	45	sand coprosma	Control
23	46	sand coprosma	Fert
24	47	silver tussock	Control
24	48	silver tussock	Fert

REPLICATE 3

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
25	49	Euphorbia	Fert
25	50	Euphorbia	Control
26	51	akeake	Fert
26	52	akeake	Control
27	53	broadleaf	Fert
27	54	broadleaf	Control
28	55	cabbage tree	Fert
28	56	cabbage tree	Control
29	57	cassinia	Fert
29	58	cassinia	Control
30	59	corokia	Control
30	60	corokia	Fert
31	61	flax	Control
31	62	flax	Fert
32	63	manuka	Control
32	64	manuka	Fert
33	65	ngaio	Control
33	66	ngaio	Fert
34	67	pohuehue	Control
34	68	pohuehue	Fert
35	69	sand coprosma	Fert
35	70	sand coprosma	Control
36	71	silver tussock	Control
36	72	silver tussock	Fert

REPLICATE 4

MAINPLOT	SUBPLOT	SPECIES	TREATMENT
37	73	Euphorbia	Control
37	74	Euphorbia	Fert
38	75	akeake	Fert
38	76	akeake	Control
39	77	broadleaf	Fert
39	78	broadleaf	Control
40	79	cabbage tree	Fert
40	80	cabbage tree	Control
41	81	cassinia	Control
41	82	cassinia	Fert
42	83	corokia	Control
42	84	corokia	Fert
43	85	flax	Fert
43	86	flax	Control
44	87	manuka	Fert
44	88	manuka	Control
45	89	ngaio	Fert
45	90	ngaio	Control
46	91	pohuehue	Control
46	92	pohuehue	Fert
47	93	sand coprosma	Control
47	94	sand coprosma	Fert
48	95	silver tussock	Fert
48	96	silver tussock	Control

APPENDIX 5: Treatment combinations on marram dominated stable backdune site for a range of indigenous seedlings planted at Waimairi, Christchurch Sand Dune Restoration Trials

REPLICATE 1

MAINPLOT	SUBPLOT	SPECIES	MULCH	FERT
1	1	Karo	None	None
1	2	Karo	None	Magamp
1	3	Karo	Marram	None
1	4	Karo	Marram	Magamp
2	5	Silver Tussock	Marram	Magamp
2	6	Silver Tussock	None	None
2	7	Silver Tussock	Marram	None
2	8	Silver Tussock	None	Magamp
3	9	Kohuhu	None	Magamp
3	10	Kohuhu	Marram	None
3	11	Kohuhu	None	None
3	12	Kohuhu	Marram	Magamp
4	13	Cabbage tree	None	Magamp
4	14	Cabbage tree	None	Organic
4	15	Cabbage tree	Compost/Bark	Magamp
4	16	Cabbage tree	None	None
4	17	Cabbage tree	Compost/Bark	Organic
4	18	Cabbage tree	Marram	Organic
4	19	Cabbage tree	Marram	Magamp
4	20	Cabbage tree	Marram	None
4	21	Cabbage tree	Compost/Bark	None
5	22	Sand coprosma	Marram	None
5	23	Sand coprosma	Marram	Magamp
5	24	Sand coprosma	None	Magamp
5	25	Sand coprosma	None	None
6	26	Cortaderia	None	None
6	27	Cortaderia	None	Magamp
6	28	Cortaderia	Marram	Magamp
6	29	Cortaderia	Marram	None
7	30	Five finger	Marram	Magamp
7	31	Five finger	None	Magamp
7	32	Five finger	Marram	None
7	33	Five finger	None	None
8	34	Flax	Compost/Bark	Organic
8	35	Flax	Marram	Organic
8	36	Flax	None	Magamp
8	37	Flax	None	Organic
8	38	Flax	Marram	Magamp
8	39	Flax	Compost/Bark	None
8	40	Flax	Marram	None
8	41	Flax	Compost/Bark	Magamp
8	42	Flax	None	None
9	43	Cassinia	Marram	Magamp
9	44	Cassinia	Marram	Organic
9	45	Cassinia	Marram	None
9	46	Cassinia	None	Organic
9	47	Cassinia	Compost/Bark	None
9	48	Cassinia	None	None
9	49	Cassinia	Compost/Bark	Organic
9	50	Cassinia	Compost/Bark	Magamp
9	51	Cassinia	None	Magamp
10	52	Akeake	None	Magamp
10	53	Akeake	Marram	None
10	54	Akeake	None	None
10	55	Akeake	Marram	Magamp
11	56	Totara	Marram	None
11	57	Totara	None	Magamp
11	58	Totara	Marram	Magamp
11	59	Totara	None	None
12	60	Manuka	Marram	Magamp

12	61	Manuka	None	None
12	62	Manuka	None	Magamp
12	63	Manuka	Marram	None
13	64	Myrsine	None	Magamp
13	65	Myrsine	None	None
13	66	Myrsine	Marram	None
13	67	Myrsine	Marram	Magamp
14	68	Karamu	None	None
14	69	Karamu	Marram	None
14	70	Karamu	None	Magamp
14	71	Karamu	Marram	Magamp
15	72	Broadleaf	Marram	None
15	73	Broadleaf	None	Magamp
15	74	Broadleaf	None	Organic
15	75	Broadleaf	Compost/Bark	Organic
15	76	Broadleaf	None	None
15	77	Broadleaf	Marram	Magamp
15	78	Broadleaf	Compost/Bark	Magamp
15	79	Broadleaf	Compost/Bark	None
15	80	Broadleaf	Marram	Organic
16	81	Lemonwood	None	None
16	82	Lemonwood	Marram	Magamp
16	83	Lemonwood	None	Magamp
16	84	Lemonwood	Marram	None

REPLICATE 2

MAINPLOT	SUBPLOT	SPECIES	MULCH	FERT
1	1	Silver Tussock	None	None
1	2	Silver Tussock	None	Magamp
1	3	Silver Tussock	Marram	None
1	4	Silver Tussock	Marram	Magamp
2	5	Broadleaf	Compost/Bark	Organic
2	6	Broadleaf	Marram	Magamp
2	7	Broadleaf	Compost/Bark	Magamp
2	8	Broadleaf	None	Magamp
2	9	Broadleaf	Compost/Bark	None
2	10	Broadleaf	None	None
2	11	Broadleaf	None	Organic
2	12	Broadleaf	Marram	None
2	13	Broadleaf	Marram	Organic
3	14	Myrsine	Marram	Magamp
3	15	Myrsine	Marram	None
3	16	Myrsine	None	None
3	17	Myrsine	None	Magamp
4	18	Kohuhu	Marram	None
4	19	Kohuhu	Marram	Magamp
4	20	Kohuhu	None	Magamp
4	21	Kohuhu	None	None
5	22	Five finger	None	Magamp
5	23	Five finger	Marram	Magamp
5	24	Five finger	Marram	None
5	25	Five finger	None	None
6	26	Sand coprosma	Marram	Magamp
6	27	Sand coprosma	Marram	None
6	28	Sand coprosma	None	None
6	29	Sand coprosma	None	Magamp
7	30	Manuka	Marram	None
7	31	Manuka	None	None
7	32	Manuka	Marram	Magamp
7	33	Manuka	None	Magamp
8	34	Cassinia	Marram	Organic
8	35	Cassinia	Marram	Magamp
8	36	Cassinia	Compost/Bark	Organic
8	37	Cassinia	None	Magamp
8	38	Cassinia	Compost/Bark	Magamp

8	39	Cassinia	Compost/Bark	None
8	40	Cassinia	Marram	None
8	41	Cassinia	None	Organic
8	42	Cassinia	None	None
9	43	Akeake	Marram	Magamp
9	44	Akeake	None	Magamp
9	45	Akeake	Marram	None
9	46	Akeake	None	None
10	47	Cabbage tree	Compost/Bark	None
10	48	Cabbage tree	Marram	Magamp
10	49	Cabbage tree	Compost/Bark	Magamp
10	50	Cabbage tree	None	Organic
10	51	Cabbage tree	None	Magamp
10	52	Cabbage tree	Marram	None
10	53	Cabbage tree	None	None
10	54	Cabbage tree	Marram	Organic
10	55	Cabbage tree	Compost/Bark	Organic
11	56	Karamu	Marram	None
11	57	Karamu	Marram	Magamp
11	58	Karamu	None	None
11	59	Karamu	None	Magamp
12	60	Totara	Marram	Magamp
12	61	Totara	None	None
12	62	Totara	Marram	None
12	63	Totara	None	Magamp
13	64	Karo	Marram	None
13	65	Karo	None	Magamp
13	66	Karo	Marram	Magamp
13	67	Karo	None	None
14	68	Flax	Marram	Organic
14	69	Flax	None	Organic
14	70	Flax	Compost/Bark	Magamp
14	71	Flax	None	None
14	72	Flax	Compost/Bark	Organic
14	73	Flax	Compost/Bark	None
14	74	Flax	Marram	Magamp
14	75	Flax	Marram	None
14	76	Flax	None	Magamp
15	77	Lemonwood	Marram	Magamp
15	78	Lemonwood	None	None
15	79	Lemonwood	Marram	None
15	80	Lemonwood	None	Magamp
16	81	Cortaderia	None	None
16	82	Cortaderia	None	Magamp
16	83	Cortaderia	Marram	Magamp
16	84	Cortaderia	Marram	None

REPLICATE 3

MAINPLOT	SUBPLOT	SPECIES	MULCH	FERT
1	1	Lemonwood	Marram	None
1	2	Lemonwood	Marram	Magamp
1	3	Lemonwood	None	Magamp
1	4	Lemonwood	None	None
2	5	Broadleaf	Compost/Bark	Magamp
2	6	Broadleaf	Compost/Bark	Organic
2	7	Broadleaf	None	None
2	8	Broadleaf	Marram	Magamp
2	9	Broadleaf	Compost/Bark	None
2	10	Broadleaf	Marram	None
2	11	Broadleaf	None	Organic
2	12	Broadleaf	Marram	Organic
2	13	Broadleaf	None	Magamp
3	14	Cortaderia	None	None
3	15	Cortaderia	Marram	None
3	16	Cortaderia	None	Magamp
3	17	Cortaderia	Marram	Magamp

4	18	Akeake	None	Magamp
4	19	Akeake	Marram	Magamp
4	20	Akeake	None	None
4	21	Akeake	Marram	None
5	22	Flax	Marram	Magamp
5	23	Flax	None	Organic
5	24	Flax	Marram	None
5	25	Flax	None	None
5	26	Flax	Marram	Organic
5	27	Flax	None	Magamp
5	28	Flax	Compost/Bark	Magamp
5	29	Flax	Compost/Bark	None
5	30	Flax	Compost/Bark	Organic
6	31	Karo	None	None
6	32	Karo	Marram	Magamp
6	33	Karo	Marram	None
6	34	Karo	None	Magamp
7	35	Myrsine	None	Magamp
7	36	Myrsine	Marram	None
7	37	Myrsine	Marram	Magamp
7	38	Myrsine	None	None
8	39	Cabbage tree	None	Organic
8	40	Cabbage tree	Compost/Bark	Magamp
8	41	Cabbage tree	Marram	None
8	42	Cabbage tree	Compost/Bark	Organic
8	43	Cabbage tree	None	None
8	44	Cabbage tree	Compost/Bark	None
8	45	Cabbage tree	Marram	Magamp
8	46	Cabbage tree	None	Magamp
8	47	Cabbage tree	Marram	Organic
9	48	Silver Tussock	None	Magamp
9	49	Silver Tussock	Marram	Magamp
9	50	Silver Tussock	None	None
9	51	Silver Tussock	Marram	None
10	52	Cassinia	Marram	None
10	53	Cassinia	None	Organic
10	54	Cassinia	None	Magamp
10	55	Cassinia	Compost/Bark	Organic
10	56	Cassinia	Compost/Bark	None
10	57	Cassinia	Compost/Bark	Magamp
10	58	Cassinia	Marram	Organic
10	59	Cassinia	Marram	Magamp
10	60	Cassinia	None	None
11	61	Totara	None	Magamp
11	62	Totara	Marram	Magamp
11	63	Totara	Marram	None
11	64	Totara	None	None
12	65	Manuka	None	Magamp
12	66	Manuka	Marram	None
12	67	Manuka	None	None
12	68	Manuka	Marram	Magamp
13	69	Kohuhu	Marram	Magamp
13	70	Kohuhu	None	Magamp
13	71	Kohuhu	Marram	None
13	72	Kohuhu	None	None
14	73	Karamu	Marram	None
14	74	Karamu	None	Magamp
14	75	Karamu	None	None
14	76	Karamu	Marram	Magamp
15	77	Sand coprosma	None	Magamp
15	78	Sand coprosma	Marram	None
15	79	Sand coprosma	Marram	Magamp
15	80	Sand coprosma	None	None
16	81	Five finger	None	Magamp
16	82	Five finger	None	None

16	83	Five finger	Marram	Magamp
16	84	Five finger	Marram	None

REPLICATE 4

MAINPLOT	SUBPLOT	SPECIES	MULCH	FERT
1	1	Manuka	None	None
1	2	Manuka	Marram	None
1	3	Manuka	Marram	Magamp
1	4	Manuka	None	Magamp
2	5	Five finger	Marram	Magamp
2	6	Five finger	Marram	None
2	7	Five finger	None	Magamp
2	8	Five finger	None	None
3	9	Broadleaf	Compost/Bark	None
3	10	Broadleaf	Compost/Bark	Magamp
3	11	Broadleaf	Marram	None
3	12	Broadleaf	Marram	Magamp
3	13	Broadleaf	None	None
3	14	Broadleaf	None	Organic
3	15	Broadleaf	Marram	Organic
3	16	Broadleaf	None	Magamp
3	17	Broadleaf	Compost/Bark	Organic
4	18	Kohuhu	Marram	Magamp
4	19	Kohuhu	None	None
4	20	Kohuhu	Marram	None
4	21	Kohuhu	None	Magamp
5	22	Myrsine	Marram	None
5	23	Myrsine	None	None
5	24	Myrsine	Marram	Magamp
5	25	Myrsine	None	Magamp
6	26	Cabbage tree	Compost/Bark	None
6	27	Cabbage tree	Marram	Magamp
6	28	Cabbage tree	None	None
6	29	Cabbage tree	Compost/Bark	Magamp
6	30	Cabbage tree	Marram	None
6	31	Cabbage tree	Marram	Organic
6	32	Cabbage tree	Compost/Bark	Organic
6	33	Cabbage tree	None	Magamp
6	34	Cabbage tree	None	Organic
7	35	Lemonwood	Marram	Magamp
7	36	Lemonwood	None	Magamp
7	37	Lemonwood	Marram	None
7	38	Lemonwood	None	None
8	39	Sand coprosma	Marram	Magamp
8	40	Sand coprosma	None	Magamp
8	41	Sand coprosma	None	None
8	42	Sand coprosma	Marram	None
9	43	Cassinia	Compost/Bark	Organic
9	44	Cassinia	None	Organic
9	45	Cassinia	Marram	None
9	46	Cassinia	None	None
9	47	Cassinia	Compost/Bark	Magamp
9	48	Cassinia	Marram	Magamp
9	49	Cassinia	Marram	Organic
9	50	Cassinia	Compost/Bark	None
9	51	Cassinia	None	Magamp
10	52	Flax	Compost/Bark	None
10	53	Flax	None	Organic
10	54	Flax	None	Magamp
10	55	Flax	Compost/Bark	Organic
10	56	Flax	Marram	Magamp
10	57	Flax	None	None
10	58	Flax	Compost/Bark	Magamp
10	59	Flax	Marram	Organic
10	60	Flax	Marram	None

11	61	Cortaderia	Marram	Magamp
11	62	Cortaderia	None	None
11	63	Cortaderia	None	Magamp
11	64	Cortaderia	Marram	None
12	65	Karamu	None	Magamp
12	66	Karamu	Marram	Magamp
12	67	Karamu	Marram	None
12	68	Karamu	None	None
13	69	Karo	Marram	None
13	70	Karo	None	Magamp
13	71	Karo	Marram	Magamp
13	72	Karo	None	None
14	73	Akeake	Marram	None
14	74	Akeake	Marram	Magamp
14	75	Akeake	None	Magamp
14	76	Akeake	None	None
15	77	Silver Tussock	Marram	Magamp
15	78	Silver Tussock	None	Magamp
15	79	Silver Tussock	None	None
15	80	Silver Tussock	Marram	None
16	81	Totara	Marram	Magamp
16	82	Totara	None	Magamp
16	83	Totara	None	None
16	84	Totara	Marram	None

APPENDIX 6: Treatment combinations on two dune slack sites at Waimairi, Christchurch Sand Dune Restoration Trials

SITE 1

PLOT	REP	MICROSITE	SPECIES	FERTILISER
1	1	Centre	Juncus	None
1	1	Centre	Juncus	Magamp
2	1	Centre	Schoenoplectus	Magamp
2	1	Centre	Schoenoplectus	None
3	1	Centre	Scirpoides	None
3	1	Centre	Scirpoides	Magamp
4	1	Centre	Flax	None
4	1	Centre	Flax	Magamp
5	1	Centre	Manuka	Magamp
5	1	Centre	Manuka	None
6	1	Centre	Discaria	Magamp
6	1	Centre	Discaria	None
7	1	Edge	Schoenoplectus	None
7	1	Edge	Schoenoplectus	Magamp
8	1	Edge	Flax	Magamp
8	1	Edge	Flax	None
9	1	Edge	Juncus	None
9	1	Edge	Juncus	Magamp
10	1	Edge	Manuka	Magamp
10	1	Edge	Manuka	None
11	1	Edge	Scirpoides	None
11	1	Edge	Scirpoides	Magamp
12	1	Edge	Discaria	None
12	1	Edge	Discaria	Magamp
13	2	Centre	Juncus	Magamp
13	2	Centre	Juncus	None
14	2	Centre	Discaria	Magamp
14	2	Centre	Discaria	None
15	2	Centre	Schoenoplectus	None
15	2	Centre	Schoenoplectus	Magamp
16	2	Centre	Scirpoides	Magamp
16	2	Centre	Scirpoides	None
17	2	Centre	Flax	Magamp
17	2	Centre	Flax	None
18	2	Centre	Manuka	Magamp
18	2	Centre	Manuka	None
19	2	Edge	Discaria	None
19	2	Edge	Discaria	Magamp
20	2	Edge	Manuka	Magamp
20	2	Edge	Manuka	None
21	2	Edge	Scirpoides	None
21	2	Edge	Scirpoides	Magamp
22	2	Edge	Juncus	None
22	2	Edge	Juncus	Magamp
23	2	Edge	Schoenoplectus	None
23	2	Edge	Schoenoplectus	Magamp
24	2	Edge	Flax	Magamp
24	2	Edge	Flax	None

SITE 2

PLOT	REP	MICROSITE	SPECIES	FERTILISER
1	1	Centre	Discaria	None
1	1	Centre	Discaria	Magamp
2	1	Centre	Schoenoplectus	Magamp
2	1	Centre	Schoenoplectus	None
3	1	Centre	Flax	None
3	1	Centre	Flax	Magamp
4	1	Centre	Manuka	None
4	1	Centre	Manuka	Magamp
5	1	Centre	Scirpoides	None
5	1	Centre	Scirpoides	Magamp
6	1	Centre	Juncus	Magamp
6	1	Centre	Juncus	None
7	1	Edge	Schoenoplectus	Magamp
7	1	Edge	Schoenoplectus	None
8	1	Edge	Discaria	None
8	1	Edge	Discaria	Magamp
9	1	Edge	Manuka	Magamp
9	1	Edge	Manuka	None
10	1	Edge	Flax	Magamp
10	1	Edge	Flax	None
11	1	Edge	Juncus	Magamp
11	1	Edge	Juncus	None
12	1	Edge	Scirpoides	None
12	1	Edge	Scirpoides	Magamp
13	2	Centre	Manuka	None
13	2	Centre	Manuka	Magamp
14	2	Centre	Scirpoides	None
14	2	Centre	Scirpoides	Magamp
15	2	Centre	Flax	Magamp
15	2	Centre	Flax	None
16	2	Centre	Schoenoplectus	None
16	2	Centre	Schoenoplectus	Magamp
17	2	Centre	Juncus	Magamp
17	2	Centre	Juncus	None
18	2	Centre	Discaria	Magamp
18	2	Centre	Discaria	None
19	2	Edge	Flax	None
19	2	Edge	Flax	Magamp
20	2	Edge	Manuka	Magamp
20	2	Edge	Manuka	None
21	2	Edge	Scirpoides	Magamp
21	2	Edge	Scirpoides	None
22	2	Edge	Schoenoplectus	None
22	2	Edge	Schoenoplectus	Magamp
23	2	Edge	Juncus	None
23	2	Edge	Juncus	Magamp
24	2	Edge	Discaria	Magamp
24	2	Edge	Discaria	None

NZ FRI FIELD RECORD

TRIAL NAME

PLANTING DATE

RECORDER

Block no.	plot no.	Seedling No.	DATE				DATE			
			Ht (cm)	Spread (cm)	Vigour (1-5)	Comments	Ht (cm)	Spread (cm)	Vigour (1-5)	Comments
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								

Appendix 7: Field record form for plant survival and assessment of sand binding species planted on foredunes at South Brighton Beach and Brighton Spit, Christchurch Sand Dune Restoration Trials.

NZ FRI FIELD RECORD

TRIAL NAME

PLANTING DATE   RECORDER

Plot Configuration	Block no.	Main plot	Sub plot	Seedling No.	DATE				DATE			
					Ht (cm)	Spread (cm)	Vigour (1-5)	Comments	Ht (cm)	Spread (cm)	Vigour (1-5)	Comments
				1								
				2								
				3								
				4								
				5								
				1								
				2								
				3								
				4								
				5								
				1								
				2								
				3								
				4								
				5								
				1								
				2								
				3								
				4								
				5								

Appendix 7: Field record form for plant survival and assessment for the 5-seedling subplots at South Brighton Beach and Waimairi Beach, Christchurch Sand Dune Restoration Trials.