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COASTAL DUNE VEGETATION NETWORK
ANNUAL GENERAL MEETING
AND FIELD TRIP
18-19 MARCH 1999

compiled by

G.A. Steward, F.J. Ede

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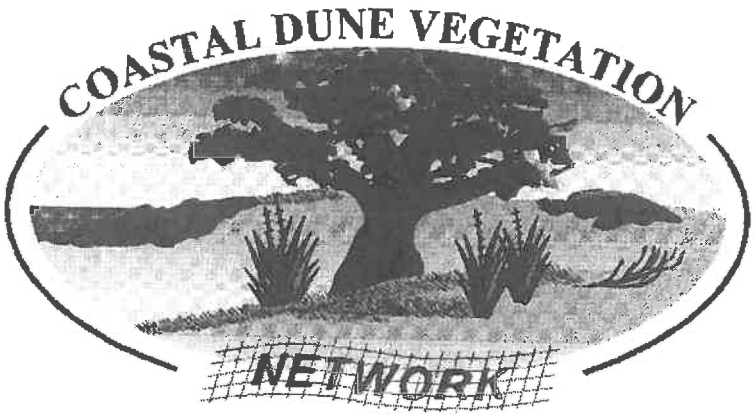

SPONSORING ORGANISATIONS

The Coastal Dune Vegetation Network would like to acknowledge and thank the following organisations who are official sponsors of the Coastal Dune Vegetation Networks Annual General Meeting and Field Trip.

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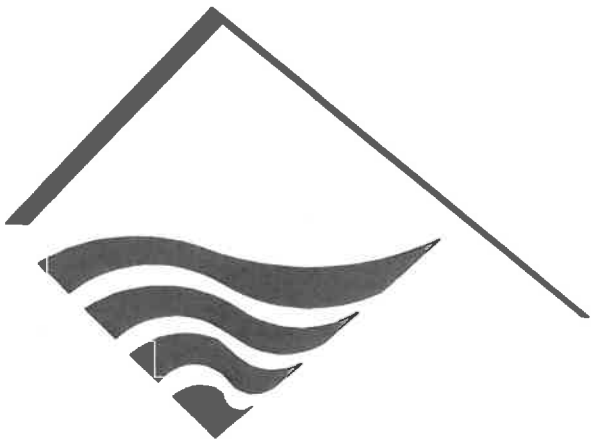

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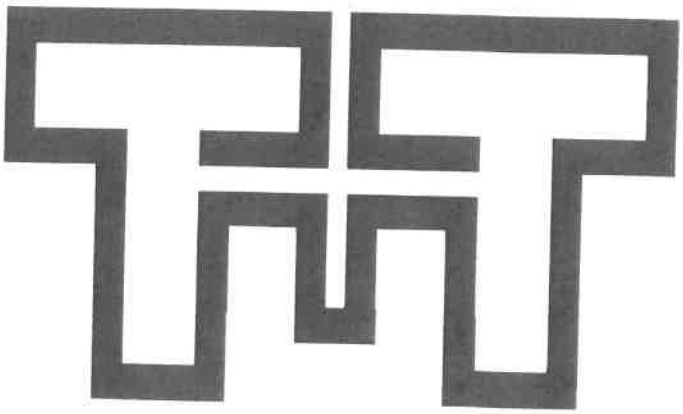

CONTENTS

MISSION STATEMENT

To provide a forum for the free exchange of information on sustainable management of coastal dune ecosystems with emphasis on the use of vegetation to restore natural character, form and function.

NETWORK OBJECTIVES

The objectives of the Network are:

1. **To provide direct funding support, from Financial Members, for prioritised research projects.**

2. **To provide leverage through Members contributions to attract Public Good Science Funds and optimise returns to the Coastal Dune Vegetation Network.**

3. **To respond to coastal resource managers and user-sourced research priorities through a process of mutual prioritisation in consultation with collaborators.**

4. **To provide high quality, timely, research-based information and management outcomes to Coastal Dune Vegetation Network membership through field trips, meetings, workshops, and by other appropriate means.**

AGENDA

Thursday 18 March - Field Trip (hosted by Maxine Slater and Trish Davidson, New Plymouth District Council)

10.00 am	Registration and Morning Tea - Eastend Surf Club, Nobs Line, Off Devon Street East, New Plymouth
10.30 am	Commence field trip (walk down beach to Fitzroy Surf Club)
11.15 am	Board buses at Fitzroy
11.30 am	Waiwhakaiho revegetation project
12.30 pm	Oakura Beach - Lunch
1.15 pm	Discussion of issues at Oakura Beach
3.00 pm	Ahu Ahu Rd beach access
4.30 pm	Return to Eastend Surf Club and Rydges New Plymouth

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7.00 pm Barbeque dinner around pool, Rydges New Plymouth

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AGENDA

Friday 19 March - Technical and Business Sessions

Venue for day's activities - Pouakai Room, Rydges New Plymouth

8.30 am Formal Welcome by the Mayor of New Plymouth

8.40 am First Technical Session - Discussion of Current CDVN Projects
- Report on technical bulletins and other technology transfer projects
(F. Ede and D. Bergin, ***Forest Research***)
- Report on fertiliser trial
(D. Bergin and M. Kimberley)
- Report on spinifex nursery trials
(F. Ede, D. Bergin and A. Fair, Naturally Native NZ Plants Ltd.)
- Report on spinifex planting trials
(D. Bergin, J. Dahm, H. Spence and S. Hinton)
- Report on spinifex phenology work
(D. Bergin, F. Ede, M. Kimberley and H. Beeser)

10.00 am Morning tea

10.30 am Second Technical Session - Discussion of Restoration of Exposed Sites Trials
- Rates of parabolic dune movement on the Manawatu coast
(P. Hesp, Massey University)
- Managing blowouts - The Santoft Forest experience
(P. McCarthy, Ernslaw One Ltd.)
- Reshaping coastal dunes
(L. Grant, Manawatu Wanganui Regional Council)
- Progress at Port Waikato
(H. Spence, Environment Waikato)
- CDVN trials on exposed sites
(F. Ede)

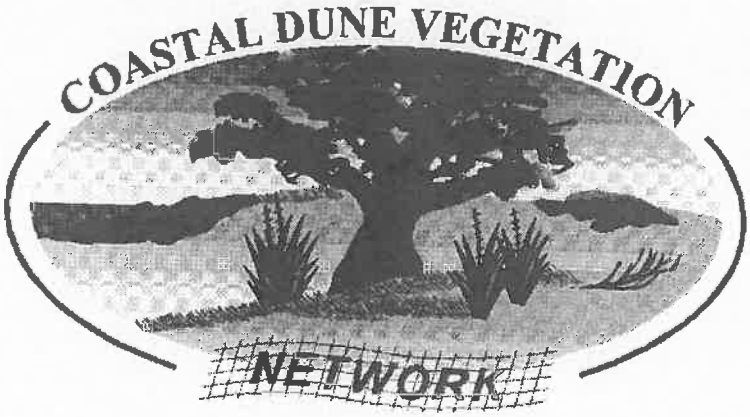
12.00 pm Lunch

1.00 pm Business Session
- Apologies
- Coordinators report
- Financial report
- Future directions for CDVN
- Role of FRST and MfE in funding dune revegetation research
- Web site
- Potential international conference - discussion
- Venue 2000 meeting
- Other business

****

Thursday 18 March

Field Trip



FIELD TRIP NOTES

Maxine Slater, Trish Davidson, Paul Jamieson and Mitchell Dyer
New Plymouth District Council

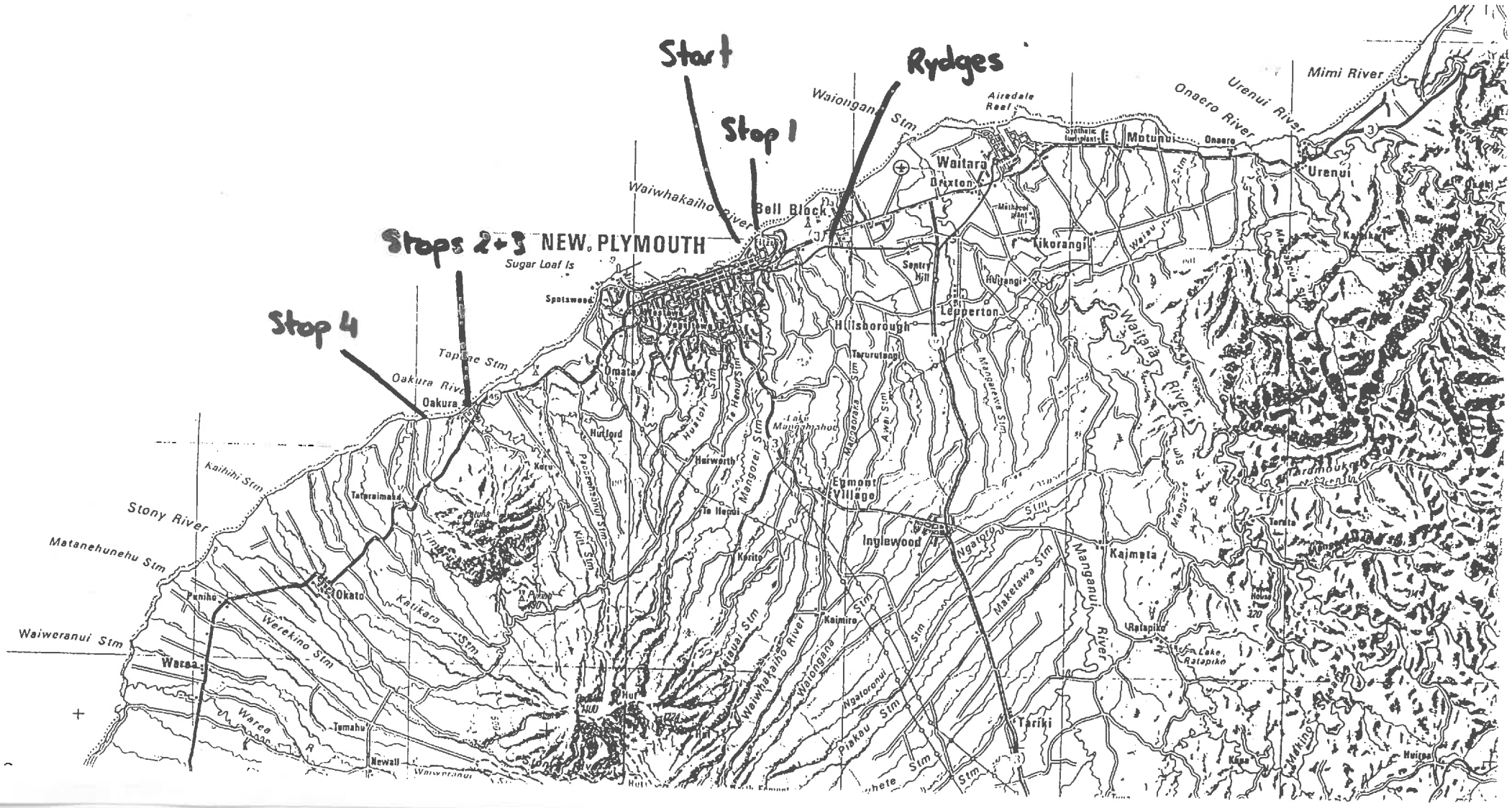
GENERAL

Welcome to the New Plymouth District with its black iron sands and dynamic coastline adjoining the Tasman Sea. This exposed region is subjected to an extreme high-energy wave environment, including strong winds and periods of heavy rain, providing a challenge to coastal managers.

The New Plymouth District coastline extends from the Hangatahua [Stony] River in the south to the Mokau River in the north. The coastline has been actively eroding since the decline of the Last Great Ice Age about 18000 – 20000 years ago, and the associated Post Glacial Marine Transgression, [Gibb, 1986, in Gibb, 1996]. Erosion has continued through the Holocene to the present day.

The coastline can be divided into two distinct coastal landscapes, based on the geology of the region. South of Buchannans Bay [just north of Motunui] a predominantly rocky reefed coastline reflects the dominance of the volcanic deposits from Mt. Taranaki, and its earlier predecessors [Pouakai, Kaitaki, and Paritutu]. Historical [this century] erosion rates on this section of coast typically vary from 0 to 0.4 metres per year. North of Buchannans Bay is a cliffed coastline reflecting the high erosional rates [0.5 – 2.0 m/yr] of the papa [siltstone] lithologies.

Field Trip Stops



Human factors have also impacted on coastal geomorphology particularly within the New Plymouth City area with the development of Port Taranaki, coastal erosion protection works, and the reclamation of land at the mouth of the Huatoki Stream.

Of particular significance for the New Plymouth City coast, and possibly also for that coast further to the north has been the development of Port Taranaki which began in 1879. The main breakwater at the Port interrupts the longshore sediment transport system which has an estimated net transport rate from south west to north east in the order of 220 000m3/year. Maintenance dredging from the Port removes sediment in the order of 180 000m3/year.

START OF FIELD TRIP East End/Fitzroy Beaches

These two beaches are the city's most popular recreational beaches and are sites of intense use. There are two Surf Life Saving Clubs within the 2km stretch providing patrolled swimming. The area includes a motorcamp and is also popular for surfing, walking and windsurfing, it is also backed by a continuous band of coastal reserve.

Historically this coastline, as with the entire New Plymouth foreshore, consisted of wide sandy beaches backed by dune systems. It can be seen that this is not the case today, with a narrow beach backed by modified dunes at Fitzroy and East End, and a rocky seawalled coast between East End and Port Taranaki.

The seawall below the East End Surf Club is 290 metres long and was constructed in 1995. Key conditions in the granting of the coastal permit for this seawall included profile monitoring requirements to ensure that that there is no deterioration in the recreational value of either East End or Fitzroy beaches.

In early 1996 a 20 000m3 sand renourishment was undertaken in front of the East End seawall in association with the Port Taranaki dredging operation. The end erosion effects of the seawall can be seen to the east with recent erosion of the foredune. Here the fragile dunes are over steep due to historical modification by clay capping. The clay prevents a natural angle of repose from forming, leaving the dune face susceptible to further erosion, while decreasing the potential for natural foredune accretion. Given the low elevation and the close proximity of development behind this dune system, this is a challenging area and your thoughts and ideas are welcomed!
The access ramp down to East End Beach was constructed before Christmas and, combined with the good summer, has noticeably increased use of this area. There was a large stormwater outlet at this point and this was modified and reduced at the time. Next summer the stormwater will be completely diverted to a swale system through the reserve to the rear, and directed to the Te Henui Stream.

The rear dune from East End through to Fitzroy was planted in the mid 1980's with flax, taupata, karo, pohutukawa, ngaio.
The reason for plant selection was cost, availability, the fact that they were easily planted by project groups (eg: PD at that time), their ability to withstand coastal conditions and natural character. Ice plant, pingao and spinifex have been planted on the foredune by various groups over the years.

Over the past three years there has been a progressive programme of provision and upgrading of access to the beach and the construction barriers to control pedestrian access.

In the carpark at Fitzroy beach you will notice the stone filled trenches, constructed early this summer, which are soakage pits for storm water. Previously stormwater was discharged to the foreshore. It is considered that the trenches will alleviate localised foreshore erosion associated with the former stormwater outlet points. The effects of the trenches on foreshore water table levels and erosion is uncertain at this stage.

STOP 1 Waiwhakaiho Revegetation Project

As we drive to the Waiwhakaiho Rivermouth we pass Lake Rotomanu, an artificial recreational lake, constructed in a former quarry site.

The most obvious structure at Waiwhakaiho is the 100m groyne constructed in several stages from the late 1970's to the early 1980's. Records show that it was constructed in response to the degradation of the rivermouth and beach area caused by the extraction of sand and gravels further up river.

The beneficial accretional effect of the groyne can be seen by comparing 1983 and 1993 aerial photos which show that the vegetation line has grown by 18m near the groyne, tapering to zero change approximately 480m towards Fitzroy.

This area is also of particular interest because of a dune management programme carried out fifteen years ago. Between 1983-1985 local artist Michael Smither introduced a method of sand catching using intertwined branches and driftwood. Plantings and placement of branches and driftwood were carried out by community based work schemes at the time. Marram was also planted on the back dune area and a small number of spinifex.

It is fair to say that the scheme was received with scepticism in some quarters and this eventually led to its unfortunate termination. However the long term success of the programme can be seen today with the build up of the foredune. It can also be seen that spinifex has established itself well in this area and most other vegetation is from natural regeneration. Carex pumila and clubrush are also evident and have colonised the foredune well. Plantings of the car park area were carried out in October 1998 by the local Coast Care Group.

We now head west to the popular coastal community of Oakura for lunch. Oakura Beach is also very intensely used for recreation and grades from east to west from a very limited natural buffer zone between the sea and adjacent development through to the undeveloped coastal margin at the western end. There are three sites that we will particularly look at in this area.

STOP 2 (and lunch!) Oakura Beach Surf Club

This is the main node of activity containing a Surf Lifesaving Club and other recreational facilities. Locals can remember a time when kikuyu grew down to the toe of the dune, and access tracks were ruts in the bank. In the 1970's flax was planted at this toe along with marram and lupin. Then in the early 1990's fences and accessways were constructed to control pedestrian access, the flax planting was reinforced and other ornamental plantings added to the rear along with some spinifex on the foredune.

Foredune plantings were carried out by the local coast care group last year. The area is subject to storms and the beach sand levels can vary significantly. The two streams on either side of the beach are subject to moving, in particular the one to the west which is periodically straightened using machinery, to prevent cutting back of the dune.

STOP 3 End of Motorcamp

This is the proposed site of one of the CDVN trials for the revegetation of exposed sites.

Historically the dunes here were flattened and capped with clay. Again this prevents a natural angle of repose from forming, leaving the dune face susceptible to further erosion, while decreasing the potential for natural foredune accretion. The area is now vegetated in kikuyu and is subject to erosion during severe storm events.

The escarpment face to the rear is worthy of mention. Locals can remember this being cleared and completely covered in gorse. It has since naturally regenerated in mahoe, karaka, kawa kawa, flax, brittlewood, and karo. Plantings at the toe of the escarpment have been carried out since the early 1990's. The main species are cabbage trees and flax due to their resistance to rabbits, which have been a problem in establishing plantings. Other species are karaka, taupata and pohutukawa.

STOP 4 Ahu Ahu Road

This area has more of a wild feel about it and is used by picnickers, swimmers, surfers, windsurfers, walkers and runners.

Offshore reefs dissipate wave energy providing some protection of foreshore sand and foredunes from wave action in this area. One site we will view was planted by school children last year. The pohutukawa have been planted along the road way, while the spinifex growing to the west are naturally occurring. There has been little active planting in this area. Spinifex seed was collected from the colony here for propagation this year.

The escarpment from Oakura extends along here with the base of it being planted in flax, cabbage tree and karaka. Worthy of note is the boneseed which you will see. At one time this was experimentally because of its tolerance to coastal conditions, however it is now progressively being removed. It can be seen that this plant is not as invasive in here as it is in other parts of the country.

We now head back to East End, and if time permits we will go via Centennial Drive which gives a magnificent view of the Sugar Loaf Islands (Nga Motu) Marine Protected Area. There is presently a move to have this area made into a Marine Reserve.

We trust you have enjoyed your travels and welcome your discussion and ideas.

References:

Gibb, J G (1996). Strategic Options for the Sustainable Management of Coastal Erosion along Urenui Beach, New Plymouth District. Report prepared for NPDC.

Taranaki Catchment Commission (1985-6) Taranaki Coastal Resources. Sheet Series.

Taranaki Catchment Commission (1987) Coastal Erosion Rates & Data Index. Sheet Series.

Taranaki Catchment Commission (1987) Coastal Erosion Hazard Assessment for Clifton County.

OAKURA BEACH - POTENTIAL TRIAL SITE
"RESTORATION OF EXPOSED SITES" TRIAL SERIES

Proposed Trial Design

A 100 - 150 m stretch of the existing dune will be mechanically recontoured to remove the clay cap on the top of the dune and to reshape the dune into a more appropriate shape.

The treatments which are likely to be incorporated into this trial include:

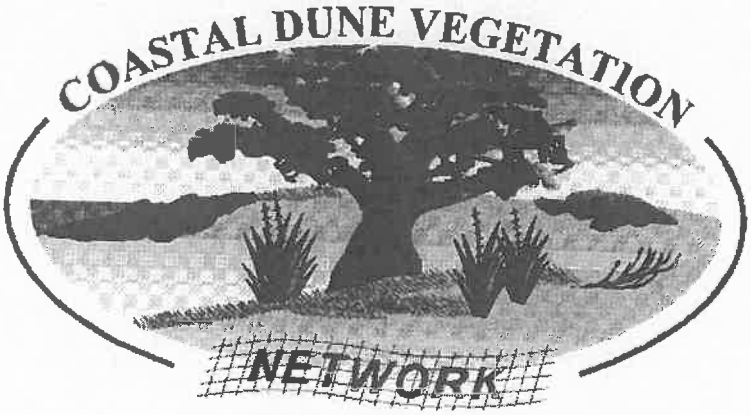
- standard sand fence design using plastic netting
- brushwood sand fence of similar length and height to standard fence
- standard planting of spinifex seedlings at set density
- planting of pingao seedlings at set density
- planting of sand binder seedlings with and without fertiliser
- combinations of sand fences and sand binder seedlings
- combination of rear dune planting with other treatments
- use of fences at top of dune to protect rear dune plantings
- use of brushwood matting to stabilise sand, prior to planting

A number of these treatments will be repeated along the beach in an area that has not be recontoured.

Monitoring of this trial will include regular measurements of plant survival and growth, and surveying of a number of transects across the beach profile.

Friday 19 March

Technical Session



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- Progress at Port Waikato
  (H. Spence, Environment Waikato)
- CDVN trials on exposed sites
  (F. Ede)

12.00 pm — Lunch

PROGRESS REPORT: TECHNOLOGY TRANSFER

1) Pingao Technical Bulletin
The first technical bulletin produced by the Coastal Dune Vegetation Network, in association with the Ministry for the Environment (MfE), was entitled
Pingao on Coastal Sand Dunes - Guidelines for Seed Collection, Propagation and Establishment, by D.O. Bergin and J. W. Herbert, 1998.

This was a very high quality publication, and has set the standard for further technical bulletins. A great deal of positive feedback has been received about this publication, and the authors and production team are to be congratulated on the excellent job they have done.

2) Spinifex Technical Bulletin
The text for the second bulletin in the MfE funded series has been written by David Bergin, with the photographic component nearing completion. Copies of the text were sent to a number of reviewers in early February, and once comments have been received back from these people, the text will be amended and the draft layout of text, figures and photos will be assembled. This technical bulletin will be published by the end of the financial year.

3) Sand Tussock Technical Bulletin
Sand tussock is the topic of the third technical bulletin being funded by MfE. David Bergin has completed the first draft of the text, and this is currently under review. The photography requirements for this technical bulletin will be completed in April. Text revision and layout work will be completed in time for this technical bulletin to be published by the end of the financial year.

4) Coastal Dunes Technical Bulletin
Publication of this technical bulletin is being directly funded by the CDVN. The first draft of text is currently being reviewed by referees. When this process is completed the authors (Patrick Hesp and Jim Dahm) will amend the text as required and select the photographs and figures needed to illustrate it. The graphics and layout tasks will be undertaken by the ***Forest Research*** graphics team, in conjunction with the authors, as is the case for all the technical bulletins in preparation. This technical bulletin will be also be published by the end of the financial year.

Copies of the three technical bulletins that will be published this year will be available to all CDVN members, under the same arrangement as for the pingao bulletin.

It is hoped that an application will be made to MfE for further funding for more technical bulletins in August, 1999. There is sufficient information to prepare a technical bulletin on issues of coastal sand dune management, and members are encouraged to suggest other possible topic areas for future publications.

5) Coastal Dune Vegetation Network Web Site
Members of the Network requested at the 1998 meeting that the possibility of a formal Network web site be established. After some investigation of costs and of web site structures, the coordinating committee agreed that it was appropriate that a CDVN web site reside in the existing ***Forest Research*** web site.

In the first instance the site will only contain information about the Network, the publications and newsletters produced by the Network, members and membership criteria, the constitution etc. Cross-linkages with a number of other organisations such as councils and Naturally Native Ltd. will also be included. However, it is envisaged that the web site would eventually be organised in such a way that users could input data about coastal dune revegetation projects into a data base structure incorporated into the web site.

It is expected that the web site will be operational within this financial year, and members will be informed when it does go on-line.

RESPONSE OF FOREDUNE VEGETATION TO APPLICATION OF FERTILISER ON SAND DUNES, BAY OF PLENTY

D. O. Bergin & M. O. Kimberley
***Forest Research*, Rotorua**

INTRODUCTION

Experience in Australia and from trials set up by ***Forest Research*** on two Coromandel beaches in the mid-1990s has indicated that fertiliser treatment of existing spinifex colonies is an efficient way of improving the vigour and extent of spinifex (Barr, Mason & Sultman 1983; Bergin & Herbert 1994). In October 1997, an operational-scale fertilising of the foredunes was undertaken along some 50 km of the Bay of Plenty coast by the local Coast Care groups in collaboration with Environment BOP and the local District Councils. Ten tonnes of urea was donated to the BOP Coast Care programme by the local fertiliser company Petrochem Ltd. The dunes along the beaches of Mount Maunganui, Omanu and Papamoa were fertilised by Coast Care groups but four sites were demarcated and left unfertilised during the operational programme. These sites were used to test a range of treatments with urea and provided an opportunity to evaluate the response of existing vegetation cover to fertiliser on a larger scale than was possible in the Coromandel trials. Detailed background and rationale for these trials as well as the trial design and initial assessments are given in a report to the 1998 CDVN Annual Meeting (Bergin, McGlone & Jenks 1998).

OBJECTIVES

- To monitor a range of rates and timings of application of urea fertiliser broadcast on a spinifex-dominated foredune.
- To determine a cost-effective and practical technique for large-scale application of urea fertiliser on sand dunes.
- To add results to the database and publish results in the form of guidelines for coastal managers interested in use of fertilisers to enhance existing foredune vegetation and to decrease dune erosion.

METHOD

Trial Sites

Four trial sites were established along the beaches of Mount Maunganui, Omanu and Papamoa. The sites are typical of most of the Bay of Plenty coastline which is characterised by a wide flat beach below mean high water mark and relatively low undulating backdunes. At the time the trial was established in October 1997, an erosion scarp up to 1.5 m high occurred along most parts of the beach where the toe of the foredune and vegetation has been removed by winter storms. Consequently, the fertilised zone is located immediately landward of the erosion scarp. This zone is mainly dominated by spinifex but significant colonies of pingao are present along the coast.

Trial Treatments and Design

Urea, a nitrogen based fertiliser, was used on all of the four sites. This was applied at different rates and times to test the effect of the various treatments. Two control plots were left unfertilised at each site.

The treatments applied to each plot for the four sites are shown in Appendix 1. The rates of application were: 100, 200, 400 and 800 kg N/ha. Single and split applications were tested for each rate. For the single application, all fertiliser was applied in spring 1997, and the other half in autumn 1998. The rate of fertiliser applied to each plot was calculated on the basis of N content of urea (46% N).

Each of the four sites or replicates consisted of 10 plots. Each plot was 10 m x 10 m and extended across the width of the natural dune. Treatment combinations for each plot were allocated randomly within each block (Appendix 1). The appropriate weight of fertiliser was applied to each plot by hand broadcasting fertiliser from a bucket to give an even spread throughout each plot.

Monitoring of Vegetation

In order to quantify the effect of fertiliser on vegetation, post-treatment vegetation cover was assessed using a point sampling frequency technique (Bergin, McGlone & Jenks 1998). The first assessment was carried out early February 1998 prior to the autumn fertiliser treatment, and a second assessment was carried out in February 1999. A list of names of plants found during the assessments is given in Appendix 2.

RESULTS

Vegetation cover

The first assessment indicated that average total vegetation cover on non-fertilised sand dune plots was relatively high at 62% (Bergin, McGlone & Jenks 1998). These control plots were covered in nearly 40% of spinifex, 8% sand convolvulus (*Calystegia soldanella*), and 6% pingao (*Desmoschoenus spiralis*). Herbaceous exotic weed species made up most of the remaining vegetation at all sites but all at relatively low levels of cover.

At the second assessment 10 and 16 months after application of fertiliser, total vegetation cover on non-fertilised plots was 51.5% (Table 1). Spinifex remained the dominant cover at nearly 37% with 4 % of sand convolvulus and 3% of pingao. Other indigenous species and weeds were at relatively low levels.

Response to fertiliser

Within four months of the initial fertiliser application, there was a significant boost to vegetation cover where 200 kgN/ha or more had been applied (Fig. 1). There was no response in growth to fertiliser for other species including weed cover.

The second assessment carried out almost a year after the first fertiliser application showed a significant increase in growth of spinifex to application of fertiliser at the 100 kgN/ha rate and this trend continued up to and including the 400 kgN/ha rate (Table 1; Fig. 2). Although total vegetation cover increased steadily from 51% with no fertiliser to nearly 80% cover where 800 kgN/ha had been applied, most of the increase in cover was attributed to the spinifex component which increased from 37% in non-fertilised control plots to over 70% where fertiliser had been applied. As with the 4-month assessment, there was no significant increase

Table 1: ***Percentage cover by species averaged across all four trial sites for the range of fertiliser treatments, February 1999. Urea fertiliser was applied at rates from 100 to 800 kg N/ha in single and split applications in October 1997 and February 1998. Code indicates broad grouping of the species (other than spinifex) as follows: W - weeds, mainly exotic herbaceous weeds and grasses, O - other species, mainly indigenous species and a woody exotic species.***

Code	Species	Fertiliser application rate (kg N/ha)				
		0	100	200	400	800
	Spinifex sericeus	36.9	50.4	54.1	63.9	71.2
O	*Calystegia soldanella*	3.9	4.5	4.9	3.1	4.5
W	*Taraxacum officinale*	2.3	1.1	1.5	1.0	0
O	*Lupinus arboreus*	0.9	0.1	0.2	0.9	0.9
W	*Lagurus ovatus*	1.1	1.1	0.7	0.6	0.3
W	*Gazania rigens*	0.1	0	0.2	0.1	0.2
W	*Lachnagrostis filiformis*	0	0.1	1.1	0	0.8
W	*Senecio skirrhodon*	0.7	0.4	0.3	0.1	0
W	*Carpobrotus edulis*	0.4	1.1	5.7	2.4	0.1
W	*Cakile maritima*	0	0	0	0	0.1
O	*Muehlenbeckia complexa*	0.8	1.1	0.1	1.4	0.2
O	*Isolepis nodosa*	0	0.4	0	0	0
O	*Desmoschoenus spiralis*	2.9	6.4	8.8	10.0	1.1
O	*Deyeuxia billardieri*	1.2	0.3	0.2	0.3	0
W	*Holcus lanatus*	0	0.1	0.1	0.1	0.1
O	*Pittosporum crassifolium*	0.1	1	1	1	1
W	*Oxalis corniculata*	0.2	0	0	0.1	0
W	*Orobanche minor*	0	0.1	0	0	0
	Total vegetation cover	**51.5**	**67.2**	**77.1**	**85.8**	**79.5**

in weeds or other indigenous species with application of fertiliser. There was no significant difference between single and split applications at any rate of fertiliser application.

DISCUSSION

There was clearly an early boost to new growth of spinifex within four months of application of urea fertiliser at the higher rates tested. Inspection of fertilised sites within a few weeks of fertiliser application showed a greener spinifex cover compared to the light brown colour of spinifex in unfertilised plots. Although the lower rate of 100 kgN/ha did not show a significant boost to growth in the first assessment, 4 months after application, the following assessment 10 to 16 months after application did indicate a significant increase in spinifex cover.

Of interest is the lack of response of spinifex cover to the lowest rates of fertiliser 4 months after application of fertiliser. A minimum of 200 kg N/ha was required to boost growth at this early stage (Fig. 1). The BOP operational-scale fertilising programme carried out at the same time that the trials were established aimed to broadcast approximately 50 kg N/ha in spring and a repeat application of 50 kg N/ha in autumn. Preliminary assessment of spinifex cover suggests that a greater rate of fertiliser than 50 kg N/ha should be applied if the aim is to ensure an immediate boost in spinifex cover.

It took time for the impact of the larger rates of fertiliser to boost spinifex cover. By the second assessment, there was a significant increase in spinifex growth at the 200 and 400 kgN/ha levels but no additional benefit in applying the largest rate of 800 kgN/ha. Results indicate that the most effective fertilising strategy for giving an immediate boost to growth is to apply a minimum of 200 kgN/ha of urea to the foredune. For a maximum boost in vegetation cover, an application of up to 400 kgN/ha is required. However, application rates above this level are not likely to give additional benefit. Australian studies have given similar results and recommendations based on extensive fertiliser trials with spinifex (Barr, Mason & Sultman 1983; McKenzie, Mason & Sultman 1989).

As with the Coromandel fertiliser trials, fertilising dunes with fast-release fertilisers do not significantly increase the weediness of the site (Bergin & Herbert 1997). Fertiliser in fact increases the cover of spinifex probably due to the taller stature of the plant compared many of the exotic herbaceous and grass species present.

FUTURE RESEARCH DIRECTION

With the current Mount Maunganui Beach-Papamoa Beach fertiliser trial, several aspects of research will require continuing and, where possible, further investigation. These include:

- Monitoring the response of vegetation cover to application of fertiliser for at least a further year to determine the most effective technique for fertilising degraded dunes.
- Producing guidelines for coastal managers interested in using fertilisers on foredunes to assist in improving vegetation cover and improving dune erosion.
- Comparing seedhead production and proportion of formed seed in large blocks of fertilised and unfertilised foredune.
- Determining the effect of fertiliser on both above and below ground plant biomass.
- Determining the pathway of nutrients in both dune vegetation and substrate after application of fertiliser.

The monitoring of the existing trials will continue for a further year with funding from the Coastal Dune Vegetation Network (CDVN) for 1999/2000. This will include publishing guidelines on fertilising dunes which will be incorporated into the next CDVN Technical Bulletin on spinifex. The other research projects on seedhead production, biomass, and nutrition studies are part of the long term ***Forest Research*** Sand Dune Research Programme funded by the Foundation for Research, Science and Technology.

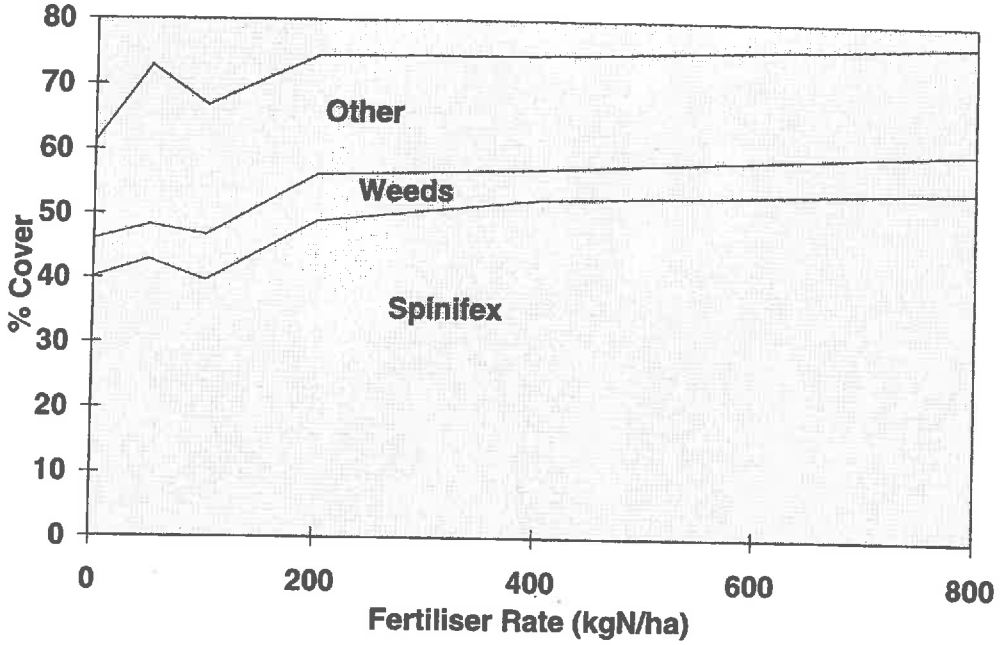

Figure 1: Percentage cover by spinifex and plant groups averaged across all four trial sites for the range of fertiliser treatments within the first 6 months of application of fertiliser. Urea fertiliser was applied at rates from 50 to 800 kg N/ha in one application in mid-October 1997. Refer to Table 2 for broad groupings of weed (W) and other (O) categories.

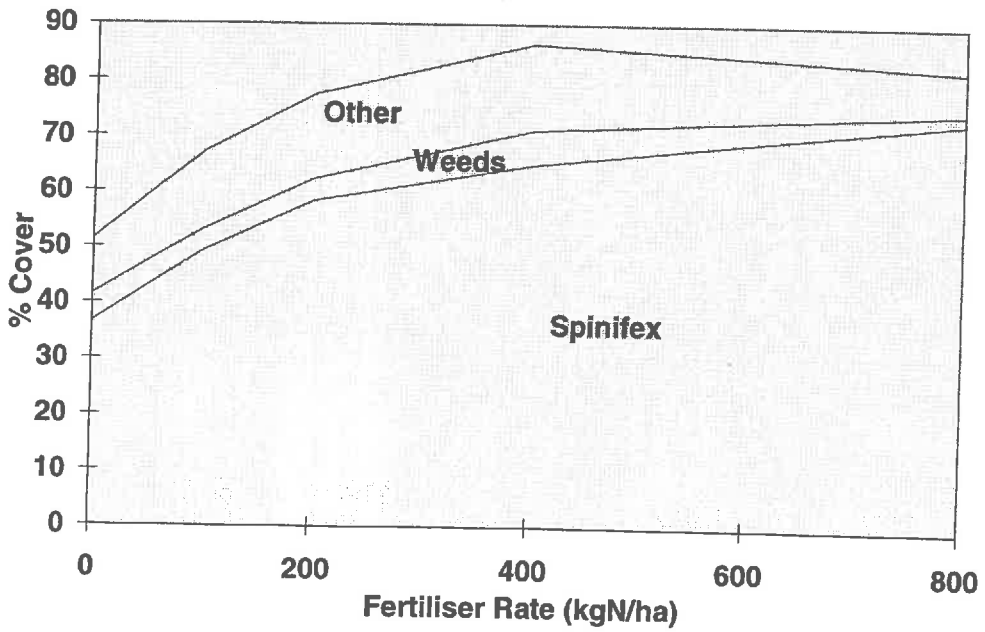

Figure 2: Percentage cover by spinifex and plant groups averaged across all four trial sites for the range of fertiliser treatments 12-18 months after of application of fertiliser. Urea fertiliser was applied at rates from 50 to 800 kg N/ha in single and split applications in October 1997 and February 1998. Refer to Table 2 for broad groupings of weed (W) and other (O) categories.

ACKNOWLEDGEMENTS

Fiona Ede and Helena Beeser assisted with establishment of the trial including application of fertiliser. Jeremy Cox, Heidi McGlone and Jessamy Herbert assisted with assessment of vegetation cover. Petrochem Ltd, part of the BOP Fertiliser group of companies, kindly supplied the urea fertiliser for the trials as well as the operational-scale fertilising of the foredunes from Waihi Beach through to the eastern beaches of Opotiki, a total treated area of 50 km.

REFERENCES

Barr, D. A. & McDonald, T. J. 1980: The effect of nitrogenous and phosphatic fertilisers on the growth of sand spinifex grass (Spinifex hirsutus). Pp. 22-32 *in* Beach Protection Authority of Queensland. Dune Stabilisation and Management Research Programme. Report Number D 01.4.

Barr, D. A.; Mason, B. J. & Sultman, S. D. 1983: The effect of combinations of urea and superphosphate on the growth of sand spinifex grass (Spinifex hirsutus). Pp. 62-73 *in* Beach Protection Authority of Queensland. Dune Stabilisation and Management Research Programme. Report Number D 02.1.

Bergin, D. O.; Herbert, J. W. 1994: Establishment of spinifex fertiliser trials, Matarangi Beach and Whiritoa Beach, Coromandel. New Zealand Forest Research Institute, Rotorua. (Unpubl.). 9p.

Bergin, D. O. & Herbert, J. W. 1997: Revegetation of sand dunes in New Zealand using indigenous species. Proceeding of *Pacific Coasts and Ports '97 Conference*, 7-11 September 1997, Christchurch. Vol. 1: 425-30.

Bergin, D. O.; McGlone, H. M.; Jenks, G. 1998: Establishment of a fertiliser trial on sand dunes, Mount Maunganui, Omanu and Papamoa beaches, Bay of Plenty. *In* Coastal Dune Vegetation Network Annual General Meeting and Field Trip 12-13 March 1998. Compilers G. A,. Steward & F. J. Ede. ***Forest Research***, (Unpubl.). 13-23.

McKenzie, J. B.; Mason, B. J.; Sultmann, S. D. 1989: Fertilising strategy for sand spinifex grass (*Spinifex sericeus*). Pp. 73-86 *in* Beach Protection Authority of Queensland. Dune Stabilisation and Management Research Programme. Report Number D 02.28.

APPENDIX 1 - Fertiliser treatments for plots at the four sites located along Mount Maunganui and Papamoa Beaches, Bay of Plenty.

Plot No.	Site No.	Fertiliser Type	Fertiliser Rate (kg/ha)	Timing of application *	Fertiliser applied to each plot ** (kg)
1	1	Control			
2	1	Urea	400	single	8.696
3	1	Urea	400/400	split	8.696
4	1	Urea	50/50	split	1.087
5	1	Urea	100	single	2.174
6	1	Urea	400	single	8.696
7	1	Control			
8	1	Urea	200	single	4.348
9	1	Urea	800	single	17.392
10	1	Urea	100/100	split	2.174
1	2	Urea	200	single	4.348
2	2	Urea	400	single	8.696
3	2	Control			
4	2	Urea	800	single	17.392
5	2	Urea	50/50	split	1.087
6	2	Urea	400/400	split	8.696
7	2	Urea	100/100	split	2.174
8	2	Urea	100	single	2.174
9	2	Urea	200/200	split	4.348
10	2	Control			
1	3	Urea	50/50	split	1.087
2	3	Urea	400	single	8.696
3	3	Urea	200	single	4.348
4	3	Urea	100/100	split	2.174
5	3	Control			
6	3	Urea	100	single	2.174
7	3	Urea	200/200	split	4.348
8	3	Control			
9	3	Urea	800	single	17.392
10	3	Urea	400/800	split	8.696
1	4	Urea	100/100	split	2.174
2	4	Urea	400/400	split	8.696
3	4	Urea	100	single	2.174
4	4	Urea	400	single	8.696
5	4	Control			
6	4	Urea	200/200	split	4.348
7	4	Urea	50/50	split	1.087
8	4	Urea	800	single	17.392
9	4	Control			
10	4	Urea	200	single	4.348

* Timing of fertiliser application - for single applications, all fertiliser was applied in Spring (October 1997); for split applications half rate was applied in Spring (October 1997) with the remainder applied in Summer (February 1998).

**Indicates the actual amount of fertiliser applied to each plot in spring and summer where appropriate.

APPENDIX 2 - List of plant species found in the fertiliser trial plots, Mount Maunganui and Papamoa Beaches, Bay of Plenty.

Botanical name	Common or Maori name	Brief plant description
Spinifex sericeus	spinifex	indigenous sand binding grass
Calystegia soldanella	sand convolvulus	indigenous sand dune creeper
Taraxacum officinale	dandelion	exotic herb common on stable dunes
Lupinus arboreus	yellow tree lupin	exotic woody shrub
Lagurus ovatus	harestail	exotic grass common on dunes
Gazania rigens	livingstone daisy	exotic herbaceous ground cover
Lachnagrostis filiformis		exotic grass
Senecio skirrhodon	gravel groundsel	exotic herb
Carpobrotus edulis	ice plant	exotic succulent ground cover
Cakile maritima	sea rocket	exotic herb often just above high tide level
Pittosporum crassifolium	karo	indigenous shrub
Muehlenbeckia complexa	pohuehue	indigenous woody ground cover
Osteospermum fruticosum		exotic herb
Oxalis corniculata	horned oxalis	exotic herb
Holcus lanatus	Yorkshire fog	exotic grass
Orobanche minor	broomrape	exotic parasitic herb
Isolepis nodosa	knobby club rush	indigenous rush
Desmoschoenus spiralis	pingao	indigenous sand binding sedge

PROGRESS REPORT: PROPAGATION OF SPINIFEX

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INTRODUCTION

One of the biggest obstacles facing coastal dune revegetation projects has been the limited supply of healthy spinifex plants available from nurseries at a reasonable cost. It has been difficult to consistently produce large numbers of seedlings commercially, year after year. Individual plant costs have been high due to the difficultly in extracting large quantities of formed seed from seedheads; low germination rates; and the loss of seedlings during handling in the nursery. In addition to this, high plant mortality often occurs when seedlings are planted out on the dunes.

The Network has a research project addressing this issue, which commenced in 1997 in collaboration with Naturally Native New Zealand Plants Ltd., near Tauranga. The results from the first year of the project, a nursery propagation pilot trial, were reported to the Network meeting in March, 1998. The design and results from a commercial scale trial undertaken at Naturally Native with spinifex seed collected in 1998 are presented here. The growth of seedlings raised in the pilot trial and planted out on the open dune in autumn and spring, 1998, are also included in this report.

OBJECTIVES

- to use the most promising seed preparation and nursery techniques from the pilot trial, for large-scale commercial production of spinifex seedlings
- to determine the optimum times for sowing and for moving seedlings from covered nursery facilities to open standing out-areas, to minimise the time containers needed to be under cover, and hence minimise costs
- to determine the time required to raise robust spinifex seedlings in relation to planting times
- to quantify the cost per seedling, including the cost of labour and materials at each stage
- to determine if other seed preparation techniques can improve germination rates (initially small scale only)

MATERIALS AND METHODS

Spinifex seed heads were collected from the following sites in the summer of 1998:
Te Henga (Bethels Beach), Kariotahi and Port Waikato on the west coast;
Matarangi, Whangamata, Tairua, Whiritoa and Papamoa on the east coast.

Formed seeds were sorted from the seed heads and on 6 May, 1998, 10,080 seeds were sown directly into Hillson's root trainers filled with the standard nursery potting mix, which had proved to be the best sowing option from the pilot trial. The root trainers were then placed in a covered growing area. A second sowing of 500 seeds from Kariotahi, was undertaken at the end of July, to determine if viable plants could be raised in a shorter time span. A third sowing was undertaken on 20 October, 1998, of 10,830 seeds, due to the reasons described below in the Results section.

Seedlings from the May sowing were to be moved from the covered area to standing out areas in three successive groups, to determine the optimum time for moving seedlings to uncovered areas, as late frosts have caused seedling mortality in the past.

A small number of seed from Papamoa were included in a second trial designed to test a range of seed preparation techniques. These techniques included stratification of seeds and different soaking operations, and are described in Table 1.

Table 1: Seed Preparation Techniques Applied to Spinifex Seed from Papamoa, Sown on 13 June, 1998

Treatment	Number of Spikelets/Seeds	Description
1a	100	Spikelets stratified in fridge for 9 weeks in moist sphagnum, then sown into root trainers
1b	100	Spikelets stored dry in fridge for 9 weeks, then sown into root trainers
1c	100	Spikelets stored dry at room temperature until sown into root trainers (Control)
2a	100	Spikelets soaked in sea water for 5 days prior to sowing into root trainers (Control is 1c)
2b	100	Spikelets soaked in fresh water for 5 days prior to sowing into root trainers (Control is 1c)
2c	100	Spikelets soaked in washing soda for 5 days prior to sowing into root trainers (Control is 1c)
3	96	Naked seed dissected from spikelet and sown into root trainers (Control is 1c)
4	-	20 whole spikes soaked for 5 days in sea water, spikelets with seed sown into root trainers (Control is 1c)

RESULTS

There were no visible signs of germination in any of the seeds sown in May - July by early September. In mid-September, the local population of sparrows discovered that freshly germinating spinifex seeds provided not only useful nesting material, but also very nutritious dinner supplements! Despite the covering of frost cloth placed over the root trainers to prevent the sparrows removing the seeds, a sustained 24-hour attack by the birds resulted in removal of more than half the seed, and seed not consumed was scattered around the area. Some of this seed was replanted, but it was not possible to determine the origin of the seed. The root trainers with remaining seed were quickly moved to a covered area which was bird-proof.
One consequence of this loss was that it was not possible to determine germination rates of any of the seeds sown, and so the second major sowing was undertaken in October, as described above. However, it was decided that it was not appropriate to repeat the small seed preparation trial at the time, and this will be repeated in 1999.

Seed was available from 6 of the collection sites for sowing in October, but the late date of sowing was not ideal, and germination rates were consequently quite low. An earlier sowing was not possible due to constraints of space. The proportion of seeds sown in October that had

produced plants at 31 December, 1998 ranged from 74% from seed sourced at Papamoa to 10% for seed sourced further south along the Bay of Plenty coast. Seed from a number of sources had germination rates of 23% or less.

DISCUSSIONS/CONCLUSIONS

Despite the action of the birds in causing serious destruction in this trial, several things have been learned and will be applied in further nursery trials. Obviously, the first lesson is that it is important to maintain a bird-proof shelter for germinating spinifex seeds, until seedlings have a large enough root system to resist the action of the birds. This may limit the number of seedlings that can be produced in any one year for nurseries with limited bird-proof covered areas.

It is also important to time the sowing of seed to minimise the amount of time that containers with ungerminated seed are occupying growing space. If containers are to be placed in unheated areas, then it is unlikely that seed sown in autumn will germinate until spring, when soil temperatures have risen sufficiently to allow germination. Delaying sowing until late winter/early spring will keep space costs down, and at Naturally Native, it is predicted that an early August sowing is most likely to be optimal, with plants being moved outside when they are 15 cm tall. If this is the case, then the time at which containers are moved from covered areas to open areas is less of a concern, as it is unlikely to happen before early summer, when the threat of late frosts is much reduced. It is also of interest to determine whether seed sown in spring can produce seedlings that are large enough to be planted on the dunes within 9 - 12 months of sowing.

Thirdly, observation of undisturbed root trainers showed that a number of seeds did not germinate. Germination results of whole spikelets from the 1997 pilot trial varied from 54% to 73%, and earlier trials at ***Forest Research*** found similar germination rates. To overcome this problem, it is planned that 2 spikelets with formed seed will be sown in each root trainer. If two seedlings emerge in a root trainer, one will be carefully removed and pricked out into a root trainer empty of seedlings, when the seedlings are still very small. It is hoped that this procedure will also help minimise the cost of seedling production.

In 1999, a new commercial scale operation will be undertaken, using seed collected from a range of sites from both coasts. This operation will incorporate the modifications described above, and it is hoped that good germination data will be available from this work. In addition, the seed preparation trial will be repeated.

The seedlings that have been produced in 1998/99 will be planted back on the beach from which the seed was sourced, with some of them being included in planting trials that will monitor their survival and growth. This will also occur with seedlings produced in 1999/2000.

PROGRESS REPORT: PLANTING SEEDLINGS, SOWING SEED AND TRANSPLANTING RUNNERS OF SPINIFEX ON COASTAL FOREDUNES, COROMANDEL PENINSULA

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[2] **Environment Waikato, Hamilton East**

INTRODUCTION

Planting seedlings

Spinifex (*Spinifex sericeus*) is the key indigenous sand binding plant on coastal foredunes on most parts of the sand dune coast throughout the North Island and the upper regions of the South Island. As part of the ***Forest Research*** Sand Dune Research Programme and the Coastal Dune Vegetation Network (CDVN), techniques for large scale propagation and establishment of spinifex are being investigated. Although some spinifex seedlings have been raised in nurseries and pilot planting trials established by ***Forest Research*** over recent years, there have been difficulties in raising large quantities of seedlings on a consistent basis for both trial and operational scale plantings. Small pilot planting trials show that spinifex seedlings can be successfully planted on a bare foredune (Bergin & Herbert 1997).

A current research priority by the CDVN in collaboration with Naturally Native NZ Plants Ltd, Oropi, is the development of large scale nursery techniques for raising spinifex seedlings (Ede, Bergin & Fair 1998). Up to 1200 seedlings were produced in the first year of trials and available for planting in trials on sand dunes. All seedlings were incorporated into a planting trial on several Coromandel Peninsula beaches evaluating a range of treatments.

Seeding on dunes

Direct seeding of spinifex seed onto to dunes is used on a large scale in New South Wales and Queensland with considerable success (Soil Conservation Service of NSW 1990; Beach Protection Authority of Queensland 1981). Small scale direct seeding trials of spinifex seed onto bare foredunes have been undertaken in two regions in New Zealand by the *Forest Research* in collaboration with Environment Waikato and Christchurch City Council. Generally, results have been poor due to a low proportion of formed seed in seed collections used (Bergin & Herbert 1997). Assessment of the 1998 collections of spinifex seed indicate higher proportions of formed seed compared to previous years where seed has been collected and assessed. Therefore, a further direct seeding trial was established on two Coromandel beach sites to compare performance with planted seedlings.

Runners

Transplanting of spinifex runners has been used in Australia with some success (Bergin 1993) and with generally poor results to date in pilot trials and operational scale attempts in New Zealand (Bergin & Herbert 1997). Transplanting of runners were therefore evaluated incorporated in this trial on two Coromandel sites.

OBJECTIVES

- To evaluate the performance of nursery-raised seedlings of spinifex planted on three beaches on the Coromandel Peninsula.
- To determine the growth response of spinifex seedlings to application at planting of a slow-release fertiliser.
- To compare the performance of spinifex planted on an upper and lower foredune site at one location.
- To monitor the germination and growth of spinifex seed direct sown onto bare foredunes at two beaches on the Coromandel Peninsula.
- To monitor the performance of spinifex runners onto a bare foredune site at two locations.
- To compare performance of spinifex with autumn and spring planting of seedlings, sowing of seed and transplanting of runners.

ASSESSMENT OF SEEDLINGS, SEED AND RUNNERS

Seedlings

Seed collected from eastern beaches of the Coromandel in early 1997 was sown in October in 1997 at the nursery of Naturally Native NZ Plants Ltd, Oropi, and pricked into Hillsons rootrainers in January 1998. Height of the green leaf portion for the longest leaf of each plant were measured for a sample of 20 seedlings from each provenance at time of autumn planting in mid April 1998. Root collar diameters were also taken for the largest diameter stem at the base of each seedling for same seedling sample. Heights and root collar diameters are summarised in Table 1. Overall, height of seedlings 6 months after sowing were about 55 cm with root collar diameter about 5 mm.

*Table 1: **Height and root collar diameter of nursery-raised seedlings of spinifex used in autumn planting trials at several beaches on the Coromandel Peninsula***

Provenance	Average pulled up height (cm)	Average root collar diameter (mm)
Whiritoa	59.1	4.95
Whangamata	52.6	4.65
Tairua	51.5	5.35
Matarangi	55.7	5.1

Roots systems of raised seedlings were occupying most parts of the rootrainer cavity but there was room for more root development. Consequently, seedlings needed to be handed carefully to ensure that potting mix remained largely undisturbed during planting. At least half the seedlings were growing new tillers from the base. Considering seedlings were only sown six months previously and seedlings pricked into the rootrainers only 3 months earlier, root systems and shoots have developed well. Earlier seed sowing and pricking out are therefore likely to give larger more robust seedlings in 12-15 months after sowing.

Seed

In contrast to some years, the proportion of formed seed in each spike (seedhead) of spinifex seed collections made in 1998 from some sites along the eastern Coromandel coast are reasonable high (Table 2).

*Table 2: **Proportion of formed seed in spinifex seed collected from Coromandel beaches in 1998.***

Provenance	Seed per spike or seedhead (%)
Whiritoa	7.4
Whangamata	32.7
Tairua	29.6
Matarangi	15.4

Runners

Australian programmes use 60 cm to 1 m lengths of runner tips from spinifex stolons with some 50% survival estimated one year after transplanting (Bergin 1993). Inspection of dunes in autumn 1998 indicated there was reasonable numbers of newly grown stolons on some beaches. In contrast, earlier pilot trials have shown there are difficulties in collecting newly grown spinifex runners in early spring due possibly to the lack of growth in winter and burial of runners by sand in winter storms. This trial compared availability and performance of transplanted spinifex runners in autumn and spring.

TRIAL SITES, LAYOUT AND TREATMENTS

Trials were established at three Coromandel beaches - Whiritoa, Whangamata and Tairua in collaboration with local community-based Beach Care groups. All trials were located on the foredune where the indigenous sand binders are expected to perform best where there is likely to be some sand movement. There was either no vegetation present or only scattered *Carex* spp. and sand convolvulus (*Calystegia soldanella*).

Whiritoa Beach

The trial was located at the southern end of the beach adjacent to the Urupa where previously trials of sand binders have been established in collaboration with the Te Koha O Rapa Tio Tio Trust. Plots were planted within gaps and along the seaward edge of previous plantings and natural plant colonies. The site is a flat foredune with a large sand plain on the seaward side that rarely becomes inundated with high seas during storms. The trial comprised:

- Eight plots of planted spinifex seedlings, four with fertiliser and four without fertiliser - 16 seedlings per 3 m diameter plot.
- Eight plots of sown seed, four with fertiliser and four without fertiliser - 15 sowing spots per 2 m diameter plot.
- Eight plots of runners, four with fertiliser and four without fertiliser - three runners per 2 m diameter plot.

A list of plot treatments is given in Appendix 1 for the Whiritoa site.

Whangamata Beach

The planting trial was located approximately 50 m eastward of the Mooloo Crescent accessway near the centre of the main beach. The site is a relatively steep 3-5 m long slope formed since an erosion scarp was created during storms the previous winter. Plots were sited along the slope parallel to the beach. The trial comprised:

- Eight plots of planted spinifex seedlings, four with fertiliser and four without fertiliser - 20 seedlings per 3 m diameter plot for Plots 1-6, 12 seedlings per 3 m diameter plot for Plots 7-8.

A list of plot treatments is given in Appendix 2 for the Whangamata site.

Tairua Beach

This site was a largely unvegetated area approximately 30 m x 40 m on a long sloping foredune near the centre of Tairua Beach. A fenced board and chain accessway traversed the area near the northern side. For the planted seedlings only, plots were established on two sites - an upper foredune site and a lower foredune site. The trial comprised:

- Eight plots of planted spinifex seedlings, four with fertiliser and four without fertiliser - 15 seedlings per 3 m diameter plot on upper foredune site.
- Eight plots of planted spinifex seedlings, four with fertiliser and four without fertiliser - 15 seedlings per 3 m diameter plot on lower foredune site.
- Eight plots of sown seed, four with fertiliser and four without fertiliser - 15 sowing spots per 2 m diameter plot.
- Eight plots of runners, four with fertiliser and four without fertiliser - five runners per 2 m diameter plot.

A list of plot treatments is given in Appendix 3 for the Tairua site.

TRIAL DESIGN AND ESTABLISHMENT

Trial design

The trials were a Randomised Complete Block design with four replicates per treatment. Blocks contain paired plots with and without fertiliser. All plot were either 2 m (seed & runners) or 3 m (planted seedlings) diameter circular plots. Distances between edges of adjacent plots was a minimum of 1 m. At Tairua and Whiritoa, 50 mm x 25 mm treated wooden peg was placed at 60 cm above sand level to identify each plot or pairs of plots. All sites were mapped to enable relocation of plots for future monitoring.

Planting

Planting involved placing seedlings in deep spade holes dug at a spacing of 50-70 cm apart within the 3 m diameter circular plot. Seedlings were planted about 50 cm below root collar to ensure root systems were within the lower moist zones in the sand and to improve chances of survival if there were any decreases in sand level.

Sowing seed

Seed was direct sown on dunes using the NSW method of placing a handful of intact seedheads (approximately 3-4 seedheads) into a spade hole about 100 mm deep. Fifteen sown spots were placed at approximately 50 cm spacing within 2 m diameter circular plots.

Transplanting runners

Three or five 1 m long runner tips collected from nearby established spinifex colonies were placed into trenches within a 3 m diameter plot. Trenches were 10-15 cm deep with about 10 cm of the runner tip left exposed. Runners were transplanted with tips facing downhill.

Fertiliser application
Half of the seedling, seed and runner groups at all sites were fertilised. Fertilising involved incorporating approximately 30-40 g of the slow-release fertiliser Magamp (medium granules) with each seedling, seed sowing spot and runner trench at the time of establishment. For planted seedlings, fertiliser was incorporated into the sand evenly around the plug of potting mix containing the root system as the seedling was planted ensuring fertiliser was not placed at the base of the planting hole or on the surface of the sand. For seed sowing and runner transplanting, fertiliser was evenly spread around the seed and runner respectively taking care not to place all fertiliser at the bottom of the sowing pits and runner trenches.

Spring and autumn comparison
At the three beaches, spinifex seedlings were planted in autumn (April 1998) and in spring (October 1998). Autumn and spring seed sowing and transplanting of runners were compared at the Tairua and Whiritoa sites.

MONITORING AND MAINTENANCE

All trials were established in collaboration with local Beach Care groups and Environment Waikato. Beach Care members assisted. All sites were inspected every 3 months by ***Forest Research*** with full assessment of trials one year after establishment for both autumn and spring planting and sowing. Growth parameters assessed for seedlings included survival, plant height, plant cover (width x breadth of the live crown of each plant) and a subjective assessment of plant vigour. For seed sowing plots, weekly inspection where conducted by the Tairua Beach Care Group, particularly Stan and Kath Ayling. This made it possible to identify when seedlings emerged at this site.

FIRST YEAR RESULTS

Performance of spinifex was significantly better at the Tairua Beach site than at the Whiritoa and Whangamata sites. At Whiritoa, large quantities of sand inundated the autumn establishment trial resulting in poor growth of planted seedlings and poor survival of runners. Emergence of seedlings from buried seed was not observed. At Whangamata where only seedlings had been planted, good early survival and growth, particularly of fertilised plots was observed for both autumn and spring plantings but high seas during strong easterly gales in late spring has reduced seedling numbers significantly. Early results for the Tairua Beach site are briefly presented and discussed.

Nursery-raised spinifex seedlings planted at the Tairua Beach site show high early survival for both autumn and spring plantings (Table 3). However, fertilised seedlings are consistently more vigorous compared to non-fertilised seedlings. Stolons had started to growth with the autumn seedlings planted 9 months earlier with a considerably greater number and growth of runners of fertilised spinifex. Many fertilised plants produced several stolons exceeding 3 m in length.

Table 3: Performance of planted nursery-raised seedlings established in Autumn and Spring 1998, Tairua Beach. Seedlings were assessed in January 1999.

	Autumn				Spring			
	Survival (%)	Vigour score*	No. of runners	Average runner length (cm)	Survival (%)	Vigour score*	No. of runners	Average runner length (cm)
Fertiliser	96.7	4.9	20.4	299.4	94.2	4.6	0	0
No fertiliser	93.3	2.1	0.9	50.5	96.7	2.3	0	0

* Vigour score : 1 - weak, 2 - unthrifty, 3 - average, 4 - good, 5 - robust.

The relatively sheltered site at Tairua Beach has probably contributed to more success with emergence of seedlings from direct seeding compared to previous trials. Here there was less than 3 cm of sand movement within the first 6 months of establishment (Table 4). Up to 60% of the total number of burial spots over 8 different plots had at least one seedling established 6 months after sowing in autumn with up to 45% for spring sowing. Some burial spots had over 20 germinated seedlings with faster emergence of seedlings from spring-sown seed than autumn-sown seed. There was no seedling emergence from autumn sown seed until the warmer spring temperatures. As autumn-sown seed may take several months to germinate, risk of failure is increased due to excessive sand movement. Where fertiliser had been applied, usually only one or two seedlings survived but had benefited with increased growth and better health compared to densely stocked and unthrifty small seedlings that had germinated in non-fertilised burial spots.

Table 4: Performance of seed burial spots for spinifex seed directly sown on dunes in Autumn and Spring 1998, Tairua Beach. The trial was assessed in January 1999.

	Autumn			Spring		
	Survival (%)	Vigour score*	Height (cm)	Survival (%)	Vigour score*	Height (cm)
Fertiliser	20	4.3	15	45	4.5	16
No fertiliser	60	1.0	7.5	38.3	1.7	6.5

* Vigour score : 1 - weak, 2 - unthrifty, 3 - average, 4 - good, 5 - robust.

Previous ***Forest Research*** trials on the same and at other sites has resulted in only 5% of transplanted stolon sections surviving. To date, up to 20% of stolons have survived from the autumn planting and up to 70 for the more recent spring transplanting at the Tairua Beach site (Table 5). Interestingly, survival was greater for non-fertilised stolon sections although the few survivors in fertilised plots did have better growth and vigour. The higher survivals to date at Tairua may also be due to the relative ease of locating sufficient quantities of actively growing runners on this site compared to previous trial sites. Considerable sections of existing spinifex stands at Tairua Beach have been fertilised by the local Beach Care group over the last 2 years resulting in improved vigour including stolon production.

Table 5: Performance of stolon sections transplanted in Autumn and Spring 1998, Tairua Beach. The plots were assessed in January 1999.

	Autumn			Spring		
	Survival (%)	Vigour score*	Height (cm)	Survival (%)	Vigour score*	Height (cm)
Fertiliser	5	5	25	35	5	35
No fertiliser	20	2.5	9	70	3.3	25

* Vigour score : 1 - weak, 2 - unthrifty, 3 - average, 4 - good, 5 - robust.

CONCLUSIONS

Early results from these trials confirm results from previous planting trials (Bergin, Kimberley & Ede 1998) that nursery-raised spinifex seedlings can be successfully established on bare foredunes on the eastern coastal sites of the Coromandel Peninsula. Spinifex seedlings responded positively to application of the slow-release fertiliser Magamp at the rate of 30g per plant incorporated with the sand at time of planting. As with pingao (*Desmoschoenus spiralis*), a slow-release fertiliser should be used with any operational-scale planting of spinifex.

Seed sown directly on dunes at Tairua Beach has shown that seed will germinate on dunes. Up to 60% of burial spots with at least one live seeding although the long term fate of these small seedlings is yet to be observed. Previous trials in New Zealand had achieved less than 10% of burial spots with at least one seedling although direct seeding of dunes in Australia is a proven technique. There has also been greater survival of runners at Tairua compared to previous trials. These early results indicate that direct seeding or transplanting of cuttings for spinifex may be practical on some sheltered sites in favourable years. However, the planting of nursery-raised spinifex seedlings with fertiliser will give considerably greater success on a wide range of sites and is therefore likely to remain the preferred method for revegetation of bare dunes. Continued emphasis on developing large-scale techniques for raising spinifex seedling in nurseries at reasonable cost is required.

ACKNOWLEDGEMENTS

These trials have been established, maintained and monitored in collaboration with Beach Care groups at Tairua Beach, Whangamata Beach and Whiritoa Beach. With the Beach Care groups, Environment Waikato supplied and organised materials including pegs, fertiliser and fencing for each of the trial sites and Naturally Native NZ Plants Ltd provided the spinifex seedlings. The enthusiasm and assistance from the local Beach Care members at each site is gratefully acknowledged: in particular Stanley and Kathleen Ayling who undertook intensive monitoring of the planting and seeding trial at Tairua Beach; Tony Wilson, Tairua Beach; Brian Walmsley and Bob Taite, Whangamata Beach; and Te Koha O Rapa Tio Tio Trust, Whiritoa Beach.

REFERENCES

Beach Protection Authority of Queensland 1981: *Sand spinifex grass. Coastal sand dunes. Their vegetation and management.* Beach Protection Authority of Queensland, Leaflet No. IV-01. 2p.

Bergin, D. O. 1993: Propagation and establishment of spinifex (*Spinifex sericeus*). A visit to nurseries and sand dune revegetation sites, Australia, June 1993. New Zealand Forest Research Institute Project Record No. 3930 (Unpubl.). 18p.

Bergin, D. O. and Herbert, J. W. 1997. Revegetation of sand dunes in New Zealand using indigenous species. Proceeding of Pacific Coasts and Ports '97 Conference, 7-11 September 1997, Christchurch. Vol. 1: 425-30.

Ede, F.; Bergin, D. O.; Fair, A. 1998: Spinifex propagation pilot trial. Paper presented Coastal Dune Vegetation Network Annual General Meeting and Field Trip, 12-13 March. Forest Research unpublished report. 11p.

Soil Conservation Service of NSW 1990: *Coastal dune management. A manual of coastal dune management and rehabilitation techniques.* Soil Conservation Service of NSW, Sydney. 76p.

APPENDIX 1 - List of plot treatments for spinifex seedlings, seed and runners established at Whiritoa Beach, April 1998 (plots marked A) and October 1998 (plots marked S).

Block No.	Plot No.	Plant type	Fertiliser
1	1	Seedlings	Yes
1	2	Seed	No
1	3	Seedlings	No
1	4	Seed	Yes
1	5	Runners	No
1	6	Runners	Yes
2	1	Seedlings	Yes
2	2	Runners	Yes
2	3	Seedlings	No
2	4	Runners	No
2	5	Seed	No
2	6	Seed	Yes
3	1	Seed	Yes
3	2	Seed	No
3	3	Seedlings	No
3	4	Runners	No
3	5	Runners	Yes
3	6	Seedlings	No
4	1	Seed	No
4	2	Seedlings	Yes
4	3	Seed	Yes
4	4	Seedlings	No
4	5	Runners	Yes
4	6	Runners	No

APPENDIX 2 - List of plot treatments for spinifex seedlings established at Whangamata Beach, April 1998.

Block No.	Plot No.	Plant type	Fertiliser
1	1	Seedlings	Yes
1	2	Seedlings	No
2	3	Seedlings	Yes
2	4	Seedlings	No
3	5	Seedlings	Yes
3	6	Seedlings	No
4	7	Seedlings	Yes
4	8	Seedlings	No

APPENDIX 3 - List of plot treatments for spinifex seedlings, seed and runners established at Tairua Beach, April 1998 (plots marked A) and October 1998 (plots marked S).

Block No.	Plot No.	Plant type	Fertiliser
1	1	Seedlings	No
1	2	Seedlings	Yes
1	3	Seed	No
1	4	Seed	Yes
1	5	Runners	No
1	6	Runners	Yes
2	7	Seedlings	No
2	8	Seedlings	Yes
2	9	Seed	No
2	10	Seed	Yes
2	11	Runners	No
2	12	Runners	Yes
3	13	Seedlings	No
3	14	Seedlings	Yes
3	15	Seed	No
3	16	Seed	Yes
3	17	Runners	No
3	18	Runners	Yes
4	19	Seedlings	No
4	20	Seedlings	Yes
4	21	Seed	No
4	22	Seed	Yes
4	23	Runners	No
4	24	Runners	Yes
5	25	Seedlings	No
5	26	Seedlings	Yes
6	27	Seedlings	No
6	28	Seedlings	Yes
7	29	Seedlings	No
7	30	Seedlings	Yes
8	31	Seedlings	No
8	32	Seedlings	Yes

PROGRESS REPORT - FLOWERING AND SEEDING OF SPINIFEX

D. O. Bergin, F. J. Ede, M. O. Kimberley & H. F. Beeser
***Forest Research*, Rotorua**

INTRODUCTION

The proportion of sound seed within spinifex seedheads is often low and tends to vary considerably between locations and years. Collections from a number of North Island sites over several years have often produced little or no sound seed. This has implications for the restoration of bare sites with spinifex where techniques are being developed to either plant nursery-raised seedlings or sow seed directly on dunes. Extraction of formed seed from seedheads for sowing in the nursery is a promising technique for raising large numbers of spinifex seedlings. However, extraction is a very slow, labour intensive process, and hence expensive, particularly when the seedheads contain very few sound seed. This project aims to determine which factors affect the production of formed seed and eventually to provide managers and Coast Care groups with practical information and guidelines for the collection of seedheads with a reasonable proportion of formed seed for revegetation purposes.

WORK PROGRESS

Progress has been made on several aspects including:

- Maintain and update the database on seed collection and germination spanning the last 5 years.
- Collection of 1999 seed from several North Island locations; determine proportion of formed seed and add to database.
- Monitoring pollination time; photographing male and female flower development on an east and west coast site of the North Island.
- Compiling a comprehensive bibliography on the flowering and seeding of spinifex including papers, articles and books from both Australia and New Zealand.
- Carrying out a rapid survey of spinifex male and female colonies, site factors and spinifex stand characteristics on several east coast North Island sites.
- Attendance at Seed Symposium 99, Massey University, College of Sciences, February 1999; ongoing discussions with seed scientists and seed testing laboratory staff.
- In collaboration with local Beach Care groups and locals, initiation of planning and establishment of trials at two Coromandel beaches to monitor flower and seedhead development in treated and control sites.

RAPID SURVEY SPINIFEX TRIAL

Rationale

A rapid survey of spinifex stands was undertaken on a large number of sites along Papamoa and two Coromandel beaches. The aim was to determine if there are any broad correlations between the proportion of formed seed found in seedheads, and major site factors and stand characteristics using a sample of seedheads collected at each site. This would provide indications of factors likely to be implicated in seed formation, and assist in the planning of a more intensive study.

Method

Seed collections were taken from a wide range of sites along each beach. The survey was undertaken in late January while all seedheads were attached to parent plants. Seed begins to detach from parent plants in early February along the Bay of Plenty coast.

Female spinifex colonies identified by a cluster of seedheads were located along the foredune of each beach. Up to 50 seedheads were collected at random from the female colony. A number of site and spinifex stand factors were recorded:

- Size of the female colony (3 size categories)
- Width of spinifex zone from high water mark to the boundary between the spinifex dominated foredune and reardunes dominated by other vegetation.
- Average height of spinifex foliage in the vicinity of the seed collection site.
- Distance of mid-point of female colony from high water mark.
- A subjective assessment of the seeding vigour of female colony in terms of relative density of seedheads (5 categories).
- Distance to up to 5 closest male colonies within a 50 m radius.
- Direction to each male colony.
- A subjective assessment of flowerhead vigour for each male colony based on presence/absence of smut and density of flowerheads (5 categories).
- Size of each male colony (3 categories).
- Grid reference of seed collection site.

Fertilised and non-fertilised sections of Papamoa Beach were sampled. Sampling was carried out at a total of 30 sites at Papamoa and 8 sites at each of Matarangi Beach and Tairua Beach.

Seed collected at each site is currently being assessed for the proportion of formed seed in each seedhead. This is carried out by carefully pulling the seedhead apart and pressing the base of each spine between the thumb and forefinger where the seed is enclosed. A spine with a swollen base contains a formed seed.

Interim Results

To date seedheads from less than half of the female colonies surveyed have been processed. The proportion of formed seed in the Papamoa seed collections assessed are relatively high compared to collections made in previous years. The proportion ranges from 15-68% of spikelets in a seedhead with formed seed. Preliminary analysis of this data indicates that two closely related factors are significantly correlated to proportion of formed seed in seed collections (Table 1; Fig 1). Seedheads collected from female colonies that had a male flowering plant nearby had a significantly higher proportion of formed seed than females located at greater distances from flowering males. Generally the greatest proportion of formed seed in seedheads was found where seedheads were collected from female colonies that were within 2 m of a male plant. Similarly, the greater the number of male colonies in the vicinity of a female colony, the higher the proportion of formed seed within that colony. At this stage no other stand or site characteristics had significant correlations with seed formation.

*Table 1: **Correlation coefficient between percentage of formed seed of each female colony and the site/spinifex stand factors.***

Factor	Formed Seed
Size of female colony	-0.13
Width of spinifex zone	-0.02
Height of spinifex vegetation	0.03
Distance to seaward edge	0.10
Female vigour	0.34
Distance to nearest male plant	-0.52*
Male vigour	0.23
Size of male colony	0.11
Number of male colonies	0.50*

* Significant at p = 0.05

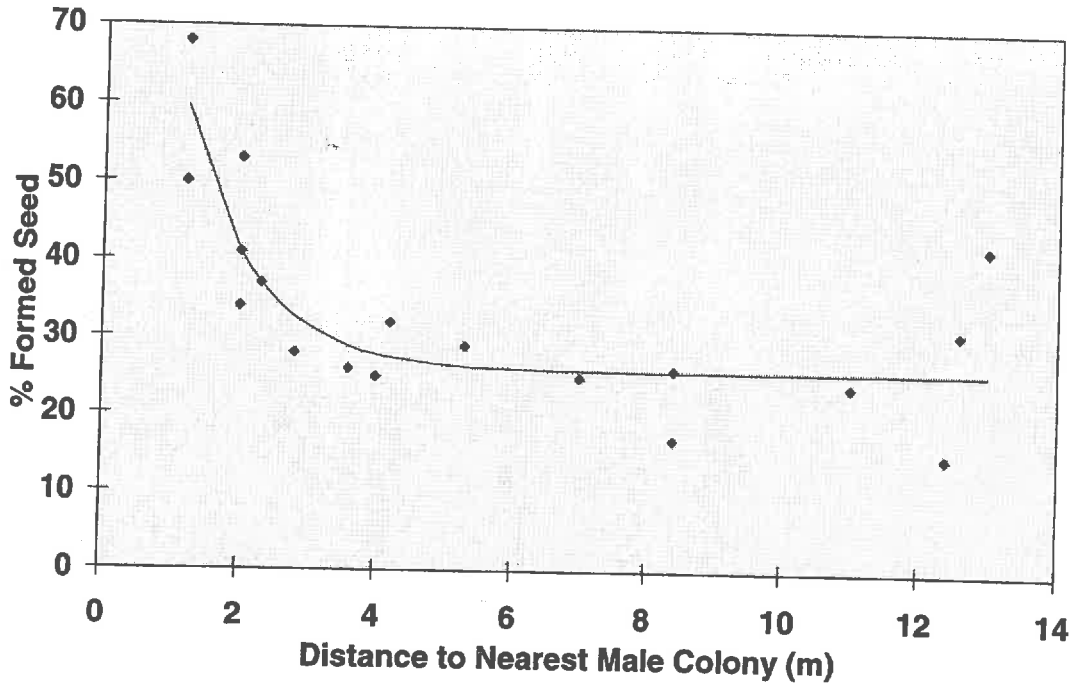

Figure 1: Percentage of formed seed found in female colony and distance to the nearest flowering male colony.

Although it is too early to draw firm conclusions from this partial data set, these interim results suggest that proximity of male and female plants may be an important factor in determining the formation of seed in spinifex.

Once all seed collections have been processed and data analysed, factors that appear to be influencing seed formation will be investigated further. In addition, all separated formed seed will be included in a germination test to determine the proportion of viable seed in formed seed.

PRIORITIES FOR THIS PROJECT

This project will continue with CDVN and FRST support for at a further 3 years. Priorities for research will include:

- Completion of the rapid survey - seed sorting, data analysis, determining significance of correlations with key site/stand factors.
- Initiation of intensive studies on factors affecting seed formation based on results of the survey.
- Undertaking seed testing using standard techniques involving laboratories in Palmerston North.
- Continuing to evaluate seed formation from seedhead collections from fertilised and non-fertilised sections of dunes.
- An evaluation of the effect of smut on seed formation on beaches with and without the presence of the floral smut.
- Establishing trials on at least two sites evaluating a range of fungal treatments to eliminate smut.
- Testing the effect of other nutrients on plant nutrition and seed formation.

PARABOLIC DUNES OF THE MANAWATU REGION

Dr Patrick Hesp
Massey University

The dunefield which extends from Wanganui to Otaki is the largest dunefield in New Zealand, and one of the largest in the world.

Although the Manawatu coast prograded approximately 4 km during the Holocene stillstand (last 6,500 years), and continues to prograde at approximately 0.5-1.0 m/yr, highly effective aeolian processes have resulted in dunes associated with the barrier migrating up to 16 km inland. However, were it not for the removal of large volumes of aeolian sand from the coastal reservoir the coast would have prograded much further seaward during Holocene time.

The conditions necessary for the development of a large parabolic and transgressive dune barrier, which include a good supply of fine sandy sediment, a dissipative beach, and a favourable onshore wind regime, are all present at the Manawatu coast. The westerly wave-approach direction generates longshore drift of at least 200 000 m3/yr from the eroding Taranaki/Wanganui towards the southeast, as demonstrated by over 100 years of rapid accretion against the northwestern jetty at the Wanganui River river mouth. Rivers such as the Wanganui and Whangaehu contribute sediment to this flow while further to the south sediment is delivered to the coast by several rivers, especially the Rangitikei and Manawatu Rivers. The gradual change in coastal orientation to one which is more normal to the dominant wave-approach direction results in a change from erosion to long-term progradation to the south of the Whangaehu River mouth.

The fine sand size of c.2.5 phi (0.18 mm) not only favours a modally dissipative beach state with a wide, multi-barred surf zone and wide gently sloping foreshore at low tide, but is also close to the optimal size for aeolian transport. The wind climate is also favourable, with an onshore westnorthwesterly wind resultant and winds recorded at Ohakea Air Force Base being sufficiently strong to initiate sand transport for approximately 33% of the time. The onshore drift potential at Ohakea is moderate but it is high at Wanganui Airport which is closer to the coastline.

The present coastline comprises a large foredune/blowout complex well vegetated by the introduced Ammophila arenaria and increasingly by Spinifex sericeus and some Desmoschoenus spiralis (Pingao). Strong winds result in the multiple development of blowouts, which commonly extend and evolve downwind into parabolic dunes. Modern rates of parabolic dune migration are some of the highest in the world, and range from 5 to 10 m yr-1 for dunes migrating into forest, to 70 to 400 m yr-1 for dunes migrating across low intermediate species and grassland respectively.

The original vegetation of spinifex and pingao was clearly ineffective in stabilising historical foredunes , and large scale transgressive dunefields, sheets and parabolic dunes migrated inland in at least four phases. The dune ridges are aligned almost exactly parallel with the WNW resultant for sand moving winds.

Radiocarbon dates from deposits associated with the dunes supports the pedological findings of Cowie (1963) that dune migration occurred in phases, but indicated that the phases were less distinct than originally suggested by Cowie. Dunes appear to have migrated inland throughout the Holocene stillstand. However, two major phases of transgressive dune initiation commenced at the coast about 6000 and 3000 years ago and lasted about 2000 years. The dunes continued to migrate inland at c. 5 m/yr long after initiation ceased, and two thousand years ago both phases were migrating simultaneously at different distances inland. Further dune instability occurred during the past 700 years and these dunes migrated 2-4 km from the coast. This latest phase is considered by some (e.g. Cowie, 1963) to have been initiated by Maori, and later, European activities. Since progradation continues today, and blowouts and parabolic dunes continue to develop despite significant human intervention (planting, dune re-shaping and fertilising), it may be that early human activity merely aided a natural process and the development of the latest dune phase.

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MANAGING BLOWOUTS - THE SANTOFT FOREST EXPERIENCE

Pat McCarthy
Ernslaw One Ltd

In 1990 Ernslaw One Ltd acquired the Crown Forestry Licences for Santoft and Tangimoana Forests in the Manawatu. These sand forests have over twenty five kilometres of foredune frontage. A maintenance and stabilisation programme was developed for the dunes. This programme involves surveying the foredunes each year for damage, and then prioritising the worst areas for maintenance. In April of each year the foredunes are fertilised by helicopter with urea at a rate of 50 kg/ha. In May foredune reshaping is undertaken where the worst of the blowouts have occurred. Following foredune fertilising and reshaping, marram grass is planted. A further urea application is made in September at the same rate as the earlier application (50 kg/ha). This has been the Ernslaw One practice since 1990.

PROGRESS AT PORT WAIKATO

Harley Spence
Environment Waikato

Sand dunes are a dynamic natural buffer between the land and marine environments and therefore an important component of New Zealand's coastal ecosystem. Dunes provide a unique habitat for endemic vegetation and fauna. Anthropogenic pressure on dunes has resulted in widespread damage throughout large areas of New Zealand.

Port Waikato is a small settlement located at the southern and landward end of a large sand spit extending across the mouth of the Waikato River. Public access to the ocean beach, particularly pedestrian and vehicle traffic, extensively destroyed the dune vegetation in this area. As a consequence, the sand dunes in this area were seriously damaged by wind erosion - with migrating sands causing problems for some of the landward properties.

After preliminary discussions with individuals and community groups, Environment Waikato and the Franklin District Council launched a community based partnership to address the problem. The Beach Care group, formed in Easter 1993, has attracted widespread community support. The group encompassed a wide range of community interests – including those actively involved in off-road vehicle activities, implicated in much of the severe dune damage.

However, there was also scepticism from within some elements of the community, who regarded the Beach Care approach as "soft" and naïve. Alternative "get tough" and regulatory/enforcement approaches were advocated by these sectors.

Despite the relatively untested nature of the Beach Care partnership, it has proved to be a very useful forum – enabling the various community interests to improve communication, develop a common agreement in regard to management issues and objectives, and to work together to develop and implement management action.

As a consequence, within just four years, the Beach Care group has successfully repaired the severe fore-dune damage and re-established a good cover of native sand-binding dune grasses. Pedestrian and vehicle access problems have also been addressed – successfully protecting the restored dune while enhancing public access and amenity.

The experience and success of this community based, partnership approach has also encouraged the community, local iwi and various agencies to now attempt to use a similar partnership approach to address significant land degradation issues over the entire area of the 3km dynamic coastal spit.

This experience is similar to that emerging at a large number of sites around the globe and emphasises the critical role community based, multi-stakeholder partnerships can play in effectively promoting sustainable management of coastal ecosystems.

RESTORATION OF EXPOSED SITES

F.J. Ede and D.O. Bergin
***Forest Research*, Rotorua**

INTRODUCTION

Much of the coastal dune revegetation work using indigenous species that has been successful the past six or more years has been located in North Island east coast areas, particularly on the Coromandel and Bay of Plenty coasts. A number of dedicated Beach and Coast Care groups have been involved in these revegetation programmes, which have been built upon the results of research trials at sites on the east coast. One of the biggest issues with these restoration programmes is the impact of human use on the beach and dune systems, and replanting programmes have included the provision of appropriate accessways, fences and signage to encourage users to modify their behaviour in order to minimise the human impact on the dune system.

While several valuable lessons have been learnt from these projects, there are problems directly applying the same principles to revegetation projects where physical factors such as wind and wave erosion, and storm events have a much greater impact on the coastal ecosystem. Along the west coast of the North Island there are a number of areas where the prevailing westerly winds and frequent storms have resulted in the failure of revegetation programmes using indigenous species. Many kilometres of sandy coastline on the west coast have been stabilised using marram grass, legumes and then planted in radiata pine, which provides an economic resource for the country. But even in these areas, vigilance is required to prevent blowouts in the sand dunes developing into serious problems. As well, along the Canterbury coast of the South Island, the success of revegetation projects using indigenous species has been limited by factors such as the accretion of large quantities of sand (50,000 m^3/annum along a 20 km stretch of coastline), competition from exotic species and low annual rainfall.

There have been some successful revegetation programmes in these areas, particularly using spinifex on the west coast, as demonstrated on the field trip at the Waiwhakaiho River site, and at Port Waikato. These successes provide some guidelines which can be incorporated into future planting programmes. However, there is still the need for further research into techniques of dune management that can optimise the success of replanting programmes in these areas.

CDVN TRIAL PROGRAMME

Timetable

The Network is contributing research funds to a suite of trials at sites along the west coast of the North Island (Bethels Beach, New Plymouth and Santoft) and on dunes in the Christchurch region. Other trial sites may be added to this group in the future. Initial site visits have been made to all of these sites by local managers and scientists from ***Forest Research*** to identify potential trial sites and to discuss the issues that are important at each site. A draft trial design is currently being prepared, and further site visits to refine the design for each site will be required over the coming months. The first trials will be installed in the 1999/2000 year, with the remaining trials installed the following year. Monitoring of the trials will continue for 3 - 4 years.

Trial Design

It is envisaged that at each trial, there will be two or three treatments which will be common to all trials. This will enable comparisons to be made between trials and will allow better predictive capability of the results of trials in these areas to other areas. A number of additional treatments may be incorporated into the individual trials, depending on the nature of the site and the wishes of the local community and managers. Each treatment will be repeated as many times as possible within the trial area, to provide for robust statistical analysis of the results.

The following list of treatments provides a general description of the treatments only. The final trial design will provide complete details of each treatment used at each site, and will be incorporated into the work plan written for these trials.

Treatment 1 - Sand Fences

One common treatment using sand fences will be incorporated into all trials. This will standardise the construction materials of the sand fence, the positioning of the fence with respect to the high tide mark, the height of the fence and the length of the fence.

Other treatments involving sand fences could include variations on the positioning of the fence; the height and length of fences; the construction materials used in the fence (e.g. at Oakura it has been suggested that a fence made from manuka brush be tested); and the effects of having two or more sand fences offset, along the dune profile.

Treatment 2 - Indigenous Sand Binders

The second common treatment will involve planting an indigenous sand binder at a set spacing in the same position in each trial. In the North Island, this sand binder is likely to be spinifex, but pingao may be used in the Christchurch trial.

Variations involving sand binders could include changing the planting density; changing the planting pattern or position; interplanting two or three species of indigenous sand binder; and varying the type of planting material - e.g. comparing the growth of nursery raised seedlings, runners and seedlings arising from buried seed. Treatments could also include comparisons of the growth of indigenous sand binders with the growth of exotic species, such as marram grass and ice plant.

Treatment 3 - Fertiliser

On the east coast, it has been found that adding about 30 g of fertiliser at planting time is beneficial to the growth of indigenous sand binders, and it is recommended that all plantings incorporate fertiliser. However, it is possible that sand binder growth is less limited by nutrients the sites in this trial series, due to the rate of accretion of sand in these systems. Therefore it would be of interest to measure plant growth with and without fertiliser, as a treatment, and also to trial different types of fertiliser applied at planting time.

Treatment 4 - Weed and Pest Control
In the Christchurch trial area, much of the existing vegetation is marram grass, and although some preliminary trial work has been done to study methods of controlling marram and interplanting it with indigenous species, more work is required. Ice plant has been used extensively in Christchurch to stabilise reshaped dunes, and the local managers want to know the best method of interplanting the ice plant with pingao.

Other treatments which may be incorporated into trials will test the efficacy of different types of rabbit control methods.

Treatment 5 - Reduction of Drought Effects
Many coastal areas are prone to periods of drought which can severely inhibit plant growth. Treatments with different types of mulch; with hydration gels (such as 'Crystal Rain'); and variations in time of planting (e.g. spring vs autumn) could all be included in these trials.

Treatment 6 - Rear Dune Species
Because of the limited width of the potential fore dune at some sites (e.g. Oakura), the inclusion of treatments incorporating planting indigenous rear dune species to provide stability and shelter would help determine whether this is feasible to plant these species before the foredune has been stabilised.

Treatment 7 - Mechanical Recontouring
At three of the trial sites, bulldozers are likely to be used to recontour the dunes. Some of the treatments will be applied to areas that have been mechanically recontoured and to nearby areas that have not be recontoured, so comparisons of results can be made.

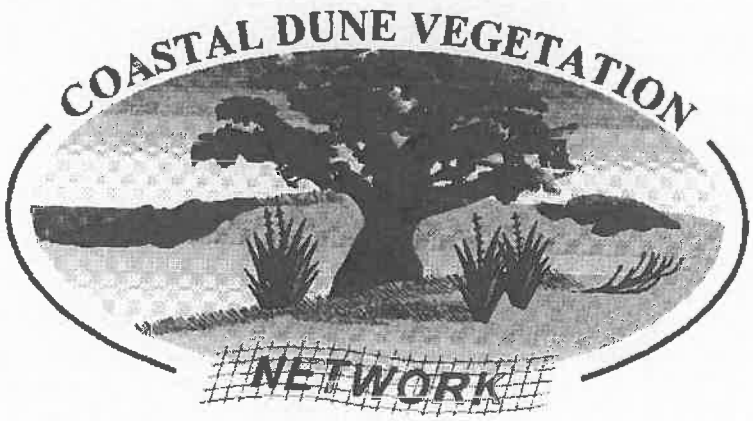
Treatment 8 - Combinations
It is possible to combine a number of treatments to determine if these combinations are more effective that the treatments on their own. Examples of likely combinations include sand fences plus sand binders; sand binders planted with and without fertiliser into exotic species (ice plant or marram); sand fences, sand binders and rear dune plants in the same corridor etc.

Each trial in this series will test a unique set of treatments and combination of treatments, which are the most appropriate for that locality.

Costs
The Network has committed $8,000 in the current year and $10,000 in the coming two years to fund these trials. This funding, in conjunction with $15,000 per year from FRST, covers the costs associated with scientist time required to prepare, establish and monitor the trials and to report on the trials. The remainder of the costs associated with the trial will need to be met by the organisation requesting the trial (council or forestry company). These include the direct costs of fencing materials, plants, recontouring, fertiliser, weed and pest control chemicals etc. Labour costs for trial establishment may also be a direct cost, or may be provided in-kind, by the local community. It is anticipated that the total of these costs for the council/company will be about $10,000 per trial, but it will depend on the treatments included in the trial.

Friday 19 March

Business Session



AGENDA

1.00 pm Business Session

- Apologies
- Coordinators report
- Financial report
- Future directions for CDVN
- Role of FRST and MfE in funding dune revegetation research
- Web site
- Potential international conference - discussion
- Venue 2000 meeting
- Other business

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APOLOGIES

Dr Jeremy Gibb	Coastal Management Consultant
Libby Boak	Gold Coast City Council, Australia
Don Ross	NZ Landcare Trust
Helen Ricketts	NZ Landcare Trust
Sharyn Westlake	Opus International Consultants Ltd
Robyn Skelton	Waiariki Institute of Technology

CDVN COORDINATORS REPORT 1998 - 1999

F.J. EDE

One of the real strengths, I believe, of the Coastal Dune Vegetation Network is the diversity of backgrounds of the people involved in the Network. As numbers on our mailing list continue to grow (now at 150), so too there is growth in the range of organisations represented. We have representatives from 20 local authorities here at this meeting, coming from as far afield as Southland District Council to Whangarei District Council. A number of Beach and Coast Care members from groups on both the east and west coasts, and even Great Barrier Island, are attending this meeting, as are members of the New Zealand Landcare Trust. DoC, AgResearch, ***Forest Research***, Massey University and Waiariki Institute of Technology in Rotorua are all represented here. It is good to also see staff here from the local Conservation Corps, which is a DoC based training initiative. Others in the group are employed by various nurseries, forestry companies and consultancy firms.

So whatever your background might be, I want to thank you for your contributions to this meeting and I want to encourage you to continue your involvement in the Network over the coming months. We will continue to keep you up to date on the activities of the Network through the twice yearly newsletter and I know that David Bergin would welcome any contributions from members for these newsletters.

Over the past six months I have been privileged to be able to travel to different parts of the country to discuss coastal dune management issues with local managers, and I anticipate that this will be an ongoing process. It is rewarding for me to see the range of activities under way in different places and to witness the level of commitment that local communities have for their coastal environment. It is important that each of us take responsibility for the environment we live in and work towards implementing land management systems that work in harmony with the environment.

I have also been heartened by the recent publication produced by the Ministry for the Environment (MfE) and DoC entitled "Our Chance to Turn the Tide - New Zealand's Biodiversity Strategy". This draft document outlines the options for our country over the next 20 or more years with respect to our management of all ecosystems - both productive and protected. This document describes a commitment by central government to working towards the application of land management systems that are sustainable, not only in ecological and environmental terms, but also economically, socially and culturally. Integral to the success of this strategy is the commitment of all New Zealanders to embrace the ideas and concepts contained in it. I believe that we are already a long way down this track with many of our coastal ecosystems, due largely to the dedicated commitment of people within many local authorities who have encouraged the development of Beach and Coast Care groups and have been involved in consultation with locals over coastal issues. As we head to the new millennium, the challenge is to take that level of dialogue already present for one ecosystem type, and apply it to the many ecosystems that make up our environment. The model developed by the Beach and Coast Care system is a useful starting point for developing other types of community groups where locals can have a voice and a role in enhancing their environment.

This biodiversity strategy is one indicator of many, that both central government and many industries are finally realising that we need to take action on a range of environmental issues. It is hoped that the funding bodies will recognise the need for good research to underpin the development of sustainable land use systems. And I believe that the Coastal Dune Vegetation Network, with its strong representation of a wide diversity of groups interested in coastal dune management, has an important role to play.

In conclusion, I want to recognise some of the people without whom the Network would not operate. I want to thank Greg Steward, our faithful scribe and secretary who does a great job keeping the paperwork ticking over. Harley Spence continues to chair meetings in a very able fashion, both the AGM and our coordinating committee meetings. Mark and Esme Dean and their team at Naturally Native are an integral part of our spinifex research project and we are very grateful to them for their tremendous contribution. And I want to acknowledge the excellent job that Maxine Slater and Trish Davidson and team have done in preparing this meeting and making it the success that it is. Thanks to you all.

COASTAL DUNE VEGETATION NETWORK
FINANCIAL STATEMENT 1 JULY 1998 - 28 FEBRUARY 1999

Revenue for Full 1998 - 1999 Year	
14 annual subscriptions at $3,000 each	**$42,000**
Budget for Full 1998 - 1999 Year	
1) Administration	$15,000
2) Spinifex propagation project	$8,000
3) Spinifex phenology project	$5,000
4) Restoration of exposed sites	$8,000
5) Fertiliser trial	$3,000
6) Web page and additional printing costs for technical bulletin	$3,000
Total	**$42,000**

Expenditure to date:

1) Administration	
- Personnel	$8,655
- Operating	$1,930
2) Spinifex propagation	
- Personnel	$4,114
- Operating	$804
3) Spinifex phenology	
- Personnel	$3,385
- Operating	$819
4) Restoration of exposed sites	
- Personnel	$3,455
- Operating	$1,025
5) Fertiliser trial	
- Personnel	$1,700
- Operating	$604
6) Web page and bulletin printing costs	
- Set-up of web site	$0
- Additional printing costs	$0
Total	**$26,491**

Notes:
1) All figures exclude GST.
2) 'Operating' includes all costs associated with travel, accommodation, mailouts etc.
3) $5,000 has been carried over from the previous financial year for printing costs for the Coastal Dunes technical bulletin.

MEETING PARTICIPANTS

Dr Grant Douglas	AgResearch, Grasslands
Patrick Thorp	Auckland City Council
Harvey Brookes Ngaire Sullivan Karen Baverstock Andy Spence Erica Kuschel	Auckland Regional Council
Brodie Young Justin Cope	Canterbury Regional Council
Jason Roberts	Christchurch City Council
Colin Ogle Graeme La Cock Bob Mankelow David Phizacklea	Department of Conservation
Tony Hall Christine Hall Greg Jenks	Environment Bay of Plenty (Bay of Plenty Regional Council)
Jim Dahm Harley Spence	Environment Waikato (Waikato Regional Council)
Greg Herrick Pat McCarthy	Ernslaw One Ltd
Dr Fiona Ede David Bergin Dr Ruth Gadgil Greg Steward Helena Beeser Diana Gainsford	Forest Research
Andrew Moor	Franklin District Council
Sally Hobson	Hawke's Bay Regional Council
Peter Shore Roger Wiffen John Storey	Horowhenua District Council
Judy Robb Kelly Crandle	Hutt City Council
Don Clark Dave Harrison Aaron Madden Lachie Grant	Manawatu-Wanganui Regional Council
Dr Patrick Hesp Tim Odea	Massey University, Dept. of Geography
Trish Taylor Ron Southey	Masterton District Council
Alan Benson Grace Benson	Medlands Beachcare Group, Gt Barrier Island
Mark Dean	Naturally Native NZ Ltd
Andrew Thomson	New Plymouth Boys' High School

Maxine Slater Trish Davidson Ken Schiscka Paul Jamieson Richard Denney John Andrews Ron Scott Ken Shorter Helen Johnson Russell Gilmour	New Plymouth District Council
Lucinda McIntyre Jennifer Jury Roy Komene	New Plymouth YMCA/NZ Conservation Corps.
Ewan McGregor	NZ Landcare Trust
Clive Neeson Nadine Morretti Margaret Sullivan Rodger Duckmanton	Oakura Beach Coastcare
Shirley Griffiths	Omapere Beachcare Group
Sonya Dyett-Carthew	Parkscape Nursery
Craig Davis	Rodney District Council
Graeme Mander	Royal Forest and Bird Protection Society - Tauranga Branch
Kepa Toa	South Taranaki District Council
Bala Tikkisetty	Southland Regional Council
Terence Heffenan Shirley Heffenan	Tairua Beachcare
Neil Larsen Kerry Wright Anne Coplestone Trevor Downing	Taranaki Coastcare
Mitchell Dyer Jo Spencer Paul Radich	Taranaki Regional Council
Philip Smith	Taupo Native Plant Nursery Ltd
Suzy O'Neill	Tauranga District Council
Graeme Silver	Waiariki Institute of Technology
Kathryn Howard	Waitakere City Council
Jo Fagan Nigel Clarke	Wellington Regional Council
Glenys Mullooly	Whangarei District Council
Mark Sturgess Karen Sturgess	Worldnet

APPENDIX I

LIST OF CDVN PUBLICATIONS AND NEWSLETTERS

Publications:

Bergin, D.O. and Herbert, J.W. 1998. Pingao on Coastal Sand Dunes. Guidelines for seed collection, propagation and establishment. Coastal Dune Vegetation Network Technical Bulletin No.1. New Zealand Forest Research Institute Limited.

Newsletters:

Coastal Dune Vegetation Network Newsletter No.1, December 1997.

Coastal Dune Vegetation Network Newsletter No. 2, September 1998.

Coastal Dune Vegetation Network Newsletter No. 3, December 1998.