

**ESTABLISHMENT OF THE
INDIGENOUS SAND BINDER SPINIFEX
(*SPINIFEX SERICEUS*) ALONG THE
SAND DUNES OF CHRISTCHURCH**

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Restoring our coastal environments using native plants

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ABSTRACT

Christchurch City Council has implemented significant restoration and management programmes for over a decade along the coastline bordering the city of Christchurch. On foredunes, the focus was initially on large-scale planting of pingao (*Desmoschoenus spiralis*) but now there is increasing interest in the use of the other major indigenous sand binder spinifex (*Spinifex sericeus*), which was last recorded in Canterbury in the 1940s.

Following the successful reintroduction to the region at the relatively sheltered bay of Taylors Mistake, spinifex has since been established over the last decade at several sites along the more exposed New Brighton beaches. A survey of 10 sites along the main beach from Southshore to Bottle Lake Forest has shown that spinifex can be successfully established. Furthermore, the small colonies of well-established spinifex are building small incipient dunes that extend up to 10 m seaward of the existing steep marram grass-dominated foredune face. These incipient dunes are estimated to have accumulated sand to a height of 1.2 m and have formed low peninsular-like extensions seaward that have endured several years of storms and dune erosion. Monitoring of dune transects over the next few years will assist in quantifying the effect of planted spinifex on formation of incipient dunes that may be attributed to the planting of spinifex.

The Council plans to expand spinifex planting along Christchurch beaches. Based on the success of planting to date, it is recommended spinifex is planted at lower densities of only 2-3 rows along dunes so that significantly greater distances of foredunes can be planted more cost-effectively compared to high density planting options. In addition, the greater use of fast-release, high-nitrogen fertiliser broadcast over planted seedlings in late spring and autumn should be considered as a practical method to boost growth. The continuation of best-practice guidelines including use of tall high-quality nursery-raised seedlings, incorporating slow-release fertiliser at planting, planting seedlings into deep holes, and the control of rabbits is also recommended.

KEYWORDS: sand dunes, restoration, planting, *Spinifex sericeus*, fertiliser

INTRODUCTION

The Coastcare section of the Parks Unit, Christchurch City Council (CCC) have had a Coast Care programme for the Christchurch coastline since the early 1990s aimed at developing and enhancing beach parks within their region (Christchurch City Council 1995). This has included a number of dune revegetation trials in collaboration with the former Coastal Dune Vegetation Network (CDVN), now the Dune Restoration Trust of NZ (DRTNZ). Collaborative trials evaluated the performance of indigenous sand binding species established on foredunes and selected mainly woody indigenous species on backdune sites dominated by marram grass (*Ammophila arenaria*) (Bergin *et al.* 1997; Bergin and Kimberley 1999).

CCC has implemented significant restoration and management programmes for over a decade along the coastline bordering the city of Christchurch. On foredunes, the focus had been initially on large-scale planting of one of the two major indigenous sand binding species in New Zealand, pingao (*Desmoschoenus spiralis*). The other major indigenous sand binder spinifex (*Spinifex sericeus*), which was last recorded in Canterbury in 1944 (Simpson 1974), has been successfully reintroduced to the region as part of these collaborative trials. Pilot trials of spinifex have been established at several sites along the main Christchurch beaches and early performance has indicated its good potential as an effective sand binder on foredunes along this active coastline. CCC plan to expand to larger planting programmes using a greater proportion of spinifex on several sites along the Christchurch beaches.

Environment Canterbury (ECAN) has a comprehensive network of dune profile transects in their region to monitor long-term changes in dune morphology. A collaborative project between ECAN and the former CDVN involved incorporating a vegetation component with dune transects along the beaches of Christchurch and this has been refined by ECAN in recent years. Transects are measured at six monthly intervals quantifying changes in sand movement in relation to broad vegetation cover types.

A brief review of the performance of the current spinifex programme focussing on the trials and management programmes will assist the CCC Coast Care Unit with forward planning of the dune revegetation programme, and in particular increased use of spinifex. There is also scope for targeting and coordinating dune profile surveys by ECAN to compare changes in sand levels between foredunes planted with and without spinifex.

BACKGROUND

Dune characteristics

Christchurch beaches are characterised by a relatively high, partially vegetated foredune and an undulating 50-120 m wide backdune strip dominated by dense marram grass. Roading and residential development lie behind the backdune. In places, carparks and Surf Club buildings intrude onto the foredune.

The 8-11 m high foredunes have steep seaward slopes often devoid of vegetation except at the crests. The beaches of Christchurch are directly exposed to the prevailing easterly winds. Blowouts originating on the seaward-face are the source of large volumes of sand which are blown inland at intervals and reach the road and other developed areas. The

stable backdune has a continuous cover of tall marram grass with widely scattered mostly exotic shrubs and trees including patches of tree lupin (*Lupinus arboreus*).

Dune planting programme

For many years, marram grass and introduced ice plant (*Carpobrotus edulis*) have been used in an effort to reduce erosion of the foredune. Both species are available locally at low cost, are easy to establish on a large-scale and grow vigorously on exposed sites. The council has lowered and re-contoured unstable sections of the foredunes using bulldozers to shift excess sand seaward. Revegetation with marram grass and ice plant is seen as the most cost-effective means of controlling erosion, although restoration of natural vegetation sequences across the whole dune system would be preferred.

A Coast Care programme was initiated in the mid-1990s (Christchurch City Council 1995) and continues to be actively managed by the city council's Coast Care Unit in collaboration with the local community and other agencies. The goal is the development and enhancement of 12 beach parks from the Waimakariri River south to Gollans Bay in Lyttleton Harbour. Specific objectives of the programme are improvement of the scenic values; enhancement of the ecological and recreational values of the dune ecosystem; and sustainable long-term stability of the dunes. There continues to be a strong emphasis on revegetation with indigenous coastal species and a desire to develop techniques for rehabilitation of degraded dunes to emulate a sequence of natural plant communities from foredune to backdune. Under the Coast Care programme, thousands of coastal species have been, and continue to be, planted and maintained annually.

Large numbers of pingao have already been planted with some degree of success although rabbit browsing can be an ongoing problem for newly planted sites. An early coastal woody and herbaceous species planting was successful at a North Brighton site opposite Thomson Park (Colin Meurk, pers. comm.). CCC planting at the same site, of particularly the back slope within once dense marram grass, has seen a cover of a range of backdune indigenous species become well established.

Foredune planting trials

In 1995, the Christchurch City Council and the former Forest Research Institute (FRI) initiated a series of large-scale planting trials on foredunes at several sites along the Christchurch beaches. The trials tested indigenous species recommended by McCombs (1992) as practically and ecologically appropriate for the area.

The Christchurch trials were part of a nation-wide series of foredune planting trials focussing mainly on establishment of pingao. The other foredunes trials, all in the North Island, were established during the early to mid-1990s and included Waikawau Bay and Whiritoa Beach in the Coromandel Peninsula, Port Waikato on the west coast, and Nuhiti Beach on the East Coast (Bergin and Kimberley 1999).

The Christchurch trials located at South Brighton Beach and Southshore Spit involved planting pingao and sand tussock (*Austrofestuca littoralis*) on the seaward face of the foredunes. The seaward slope was largely devoid of vegetation, but the dune crest was dominated by marram grass. The dune face was exposed to the full force of the prevailing easterly winds.

Experimental factors included planting nursery-raised container-grown sand binders in small groups with and without different slow-release fertiliser formulations. One year after planting there were no significant differences for pingao in survival or growth associated with fertiliser treatment at the South Brighton site although severe rabbit browsing at the other site severely affected performance. Survival rate after one year was low for sand tussock at both sites, largely due to severe rabbit browsing of newly planted seedlings.

The lack of response of growth of pingao to fertiliser in the Christchurch trials is in contrast to results from the North Island trials where application of slow-release fertiliser at time of planting had a significant positive effect on growth of sand binders. The greater mobility of the finer sand combined with the strong on-shore easterly winds at South Brighton site evidently favoured pingao establishment and may have compensated for any nutrient deficiency (Bergin and Kimberly 1999). Sand accumulations of up to 20 cm were observed within 12 months. Fresh sand, possibly containing additional nutrients (Wills 1965) may have masked the effect of fertiliser.

Backdune planting trials

Backdune trials were also established in the mid-1990s at several sites along the Christchurch coast (Bergin *et al.* 1996). These trials typically comprised, small clearings (1.5 m in diameter) cut in the dense marram grass using motorised scrub bars. Most of the underground stems and roots were removed with spades. Small groups of nursery-raised seedlings of 16 coastal indigenous woody shrub and tree species were planted in the clearings. Small clearings were considered most appropriate on these difficult sites in providing some shelter for planted seedlings. Small clearings would also be less vulnerable to sand erosion compared with larger clearings. A randomised complete block design with 4 replicates was used so that effects of site, fertiliser treatment at time of planting and bark mulch placed around the base of planted seedlings could be assessed separately.

Performance of 13 species was poor due to unseasonal frosts, browsing by rabbits and vigorous regrowth of marram grass and weeds. Three species, tauhinu (*Ozothamnus leptophyllus*), sand spurge (*Euphorbia glauca*) and harakeke (*Phormium tenax*), performed satisfactorily. With adequate shelter and early weed control, other shrub species such as akeake (*Dodonaea viscosa*) and nagaio (*Myoporum laetum*) also performed well. These species have become the major hardy indigenous coastal species used in successful larger-scale plantings undertaken by the CCC on backdunes over the last few years.

Monitoring of dune profiles and vegetation cover

Several New Zealand Regional Councils have established a series of transects to monitor changes in sand movement (erosion and accretion) on coastal dunes over time. Most of these are monitored on a regular basis focussing on developing long-term trends in sand movement.

In the mid-1990s, in collaboration with the Canterbury Regional Council, a pilot vegetation monitoring system was developed by the former Forest Research Institute for application to 45 permanent dune transects located along the Christchurch coast and regularly monitored by the Regional Council. Major species composition and percentage ground cover were assessed at a series of fixed Geographic Information System (GIS) co-ordinates along transects. The system allowed collection of data on long-term changes in vegetation composition in relation to sand movement on these dune systems. The role that marram grass plays in modifying sand movement on dunes was of particular interest for the

Christchurch dune system. The vegetation component of this has been refined by ECAN over subsequent years and there is scope for its use in monitoring foredunes planted with spinifex.

OBJECTIVES

The objectives of this project are:

- To review the early establishment trials on Christchurch foredunes focussing on the performance of planted spinifex seedlings.
- To inspect and briefly describe the extent and condition of existing spinifex planting sites along the Christchurch dunes.
- In collaboration with CCC and ECAN, to initiate monitoring of a representative foredune site planted with spinifex and dune profiles at other selected sites to assess long-term trends in sand movement with and without spinifex.
- To provide recommendations to assist CCC plans for larger scale planting of spinifex planting programmes in the Christchurch region.

METHODS

Review

Information on the location and early performance of the first spinifex trials established in the mid-1990s along the Christchurch dunes was collated and briefly summarised.

Assessment of spinifex sites

Existing sites planted with spinifex from Taylors Mistake on the northern side of Banks Peninsula to Bottle Lake Forest at the northern outskirts of Christchurch City were inspected in July 2008 with CCC and ECAN coastal staff. At each site, site history was recorded, and the area of planted spinifex was mapped and plant cover and vigour subjectively assessed. The seaward extension of each planted area of spinifex was also measured in relation to areas immediately adjacent without spinifex. Photographs were taken at all sites.

Monitoring of selected planting site

Over 600 nursery-raised seedlings were planted by the CCC and the Wai-ora Community Trust immediately south of the Waimairi Surf Club along the main Christchurch beach. A sample of 100 spinifex seedlings was assessed immediately after planting to provide a baseline on which to determine growth rate. As with all dune planting trials, this included:

- plant height (in cm)
- plant cover - greatest width of the live crown of each plant (in cm)
- subjective assessment of plant vigour and health as one of five categories:
 - 1 - weak - few or no leaves, just alive
 - 2 - unthrifty - loss of leaves, poor foliage colour and plant vigour
 - 3 - average - moderate health and vigour
 - 4 - good - minor browsing or leaf discolouration, otherwise good growth
 - 5 - robust - healthy plant with good foliage colour and growth
- comments - any addition information on plant condition (eg., browsing)

The subjective assessment of plant vigour and health was based on a comparison of seedling condition within each species, not between species.

At the spinifex planting site at Waimairi, Justin Cope of ECAN carried out a topographical survey before planting. This included an unplanted area immediately south of the planted spinifex for comparison of sand movement. Surveying will be repeated at 6-monthly intervals as part of the ECAN dune profile monitoring programme.

In addition, ECAN have identified the location of dune profile sites that either intersect or are immediately adjacent to existing planted spinifex sites. This will allow comparison of sand movement of planted and non-planted spinifex foredunes at several sites.

RESULTS

Review of early spinifex trials

Historical records indicate that the southern limit of spinifex was near to Christchurch (McCombs 1992) but no local populations existed in the mid-1990s when CCC began planting spinifex in the Canterbury region. The first attempts at establishing spinifex in the 1990s at two Christchurch beaches (South Brighton and Taylors Mistake) were part of collaborative trials between CCC and the former Forest Research Institute.

South Brighton

The first attempt at re-introducing spinifex to the Canterbury region in the recent past was part of a foredune trial established in autumn in 1995 that included planting of pingao and sand tussock. The trial incorporated a direct seeding treatment of spinifex as described in Bergin (1999) where seedheads were sown directly into spots. As with similarly designed trials in the North Island, only 5% of the direct seed sowing spots had one or more germinated seedling 6 months later when warmer spring weather stimulated delayed germination. However, within 2 months, all seedlings had disappeared. Excessive sand movement on the relatively steep site and strong easterly winds in late spring were the probable cause of seedling demise (Bergin *et al.* 1999).

The CCC Coast Care Unit also established 100 18-month old spinifex plants raised from cuttings in 1995 with 30 g of Magamp incorporated into the planting pit of each plant. Inspection of planted seedlings 2 months after planting indicated high survival and strong growth of most seedlings. Some seedlings were inundated by sand accumulation near wind break fences on the seaward edge of the foredune. However, there was poor survival 12 months after planting due to excessive sand accumulation.

Taylors Mistake

In 1996, the CCC Coast Care Unit planted about 1000 spinifex seedlings on part of the relatively sheltered beach of Taylors Mistake (Bergin and Kimberley 1999). All seedlings had been raised at the Christchurch City Council's Linwood Nursery.

Twenty groups of 10 seedlings planted in autumn 1996 were used to test two factors:

- Application of Magamp at planting.
- Use of rabbit-proof enclosures.

Seedlings for the trial were planted in autumn and assessed for a range of parameters 6 months and 12 months after planting.

A high survival rate was noted in late 1996. No browsing damage to spinifex outside the enclosures was observed despite the presence of rabbit sign in the vicinity of the trial. The 25-35 cm high seedlings were vigorous and it was clear that significant growth had occurred since planting. No differences attributable to fertiliser treatment were apparent at this stage. One year after planting, survival rates exceeded 85%. Height growth, plant spread and mean length of stolons had all been increased significantly by the application of fertiliser (Table 1).

Table 1: Performance of spinifex seedlings planted in autumn 1996 at Taylors Mistake, Christchurch. Plants were assessed after 12 months.

Fertilised	Survival (%)	Height (cm)	Spread (cm) [†]	Plant vigour*	Mean runner length (cm)	Mean no. runners per plant
No	87.a	40.0 a	62.4 a	4.1 a	58.3 A	0.69 a
Yes	94.a	43.8 b	72.9 b	4.7 a	78.9 B	1.04 a

* Plant vigour: 1 – weak; 2 – unthrifty, 3 – average, 4 – good, 5 – robust.

[†] Plant spread calculated as square root of (length x breadth).

These southern-most spinifex establishment trials indicated similar trends in performance of planted spinifex to trials established in the same year in warmer northern localities in the North Island (Bergin and Kimberley 1999). Nursery-raised seedlings planted at Whiritoa Beach, Coromandel, and at Taylors Mistake showed similar survival and growth rates to those of planted pingao seedlings. As with northern trials, fertiliser did not affect spinifex survival (Fig. 1) but improved growth rates (Fig. 2).

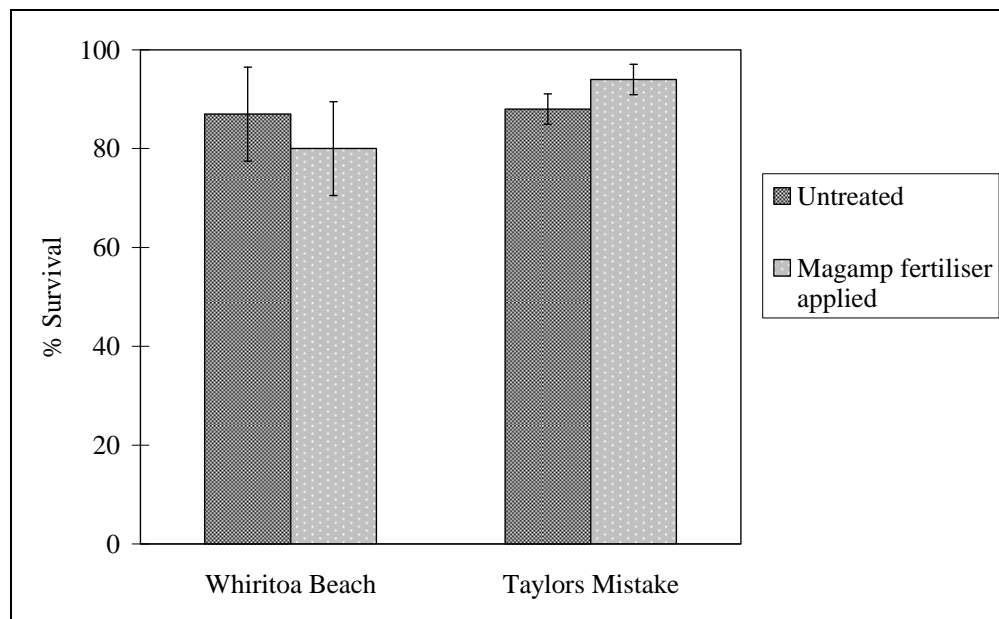


Figure 1: Survival of planted spinifex in two trials after 12 months. Bars show standard errors of means.

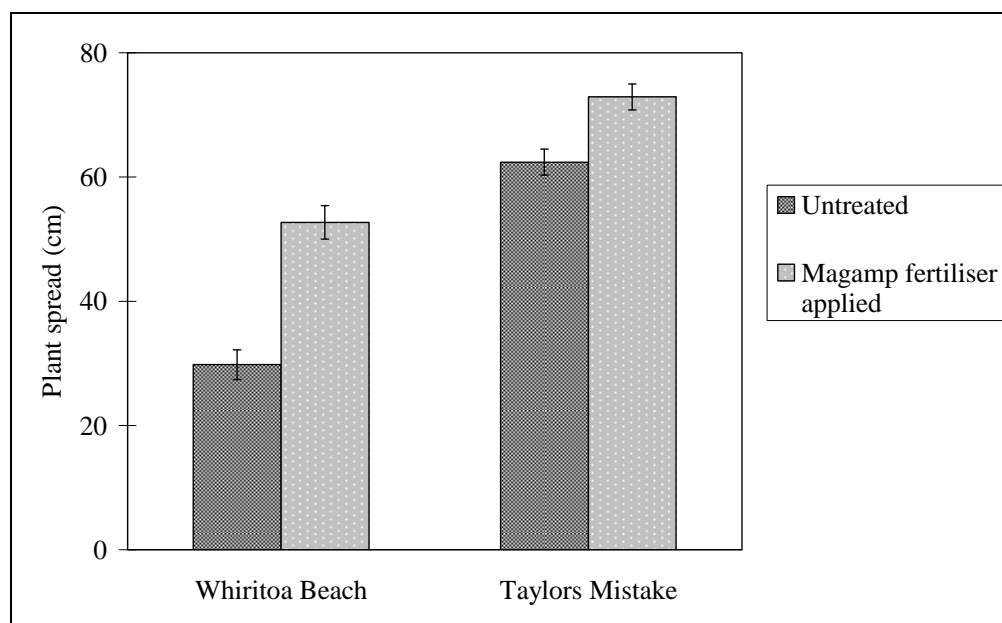


Figure 2: Average spread of planted spinifex in two trials after 12 months. Bars show standard errors of means.

Interestingly, growth of spinifex was greater at Taylors Mistake than at Whiritoa Beach in spite of Simpson's (1974) observation that Christchurch represented the southern limit of the natural distribution of spinifex in pre-European times. Considerably more sand accretion was evident at the South Island foredune planting trial compared to the northern trial.

Performance of spinifex

Eleven sites where spinifex had been planted over the last decade, and still existed, were inspected (Fig. 3). From north to south, these include a planting at Bottle Lake Forest at the northern limit of the city, several planting sites from Waimairi at North Shore to South Brighton, spinifex established at Sumner, and the earliest plantings at Taylors Mistake at the southern limit of Christchurch city. Extent of spinifex cover including seaward extension of an incipient dune is presented for each site in Table 2 as well as for 2 further sites planted in 2008.

Notes are given for each of the spinifex planting sites based on publications and reports of the former Coastal Dune Vegetation Network (now held by Dune Restoration Trust of NZ), information supplied from CCC and ECAN, and brief inspections at each site in July 2008. Updated information will be included as this come to hand. Photographs taken in July 2008 are shown for each site.

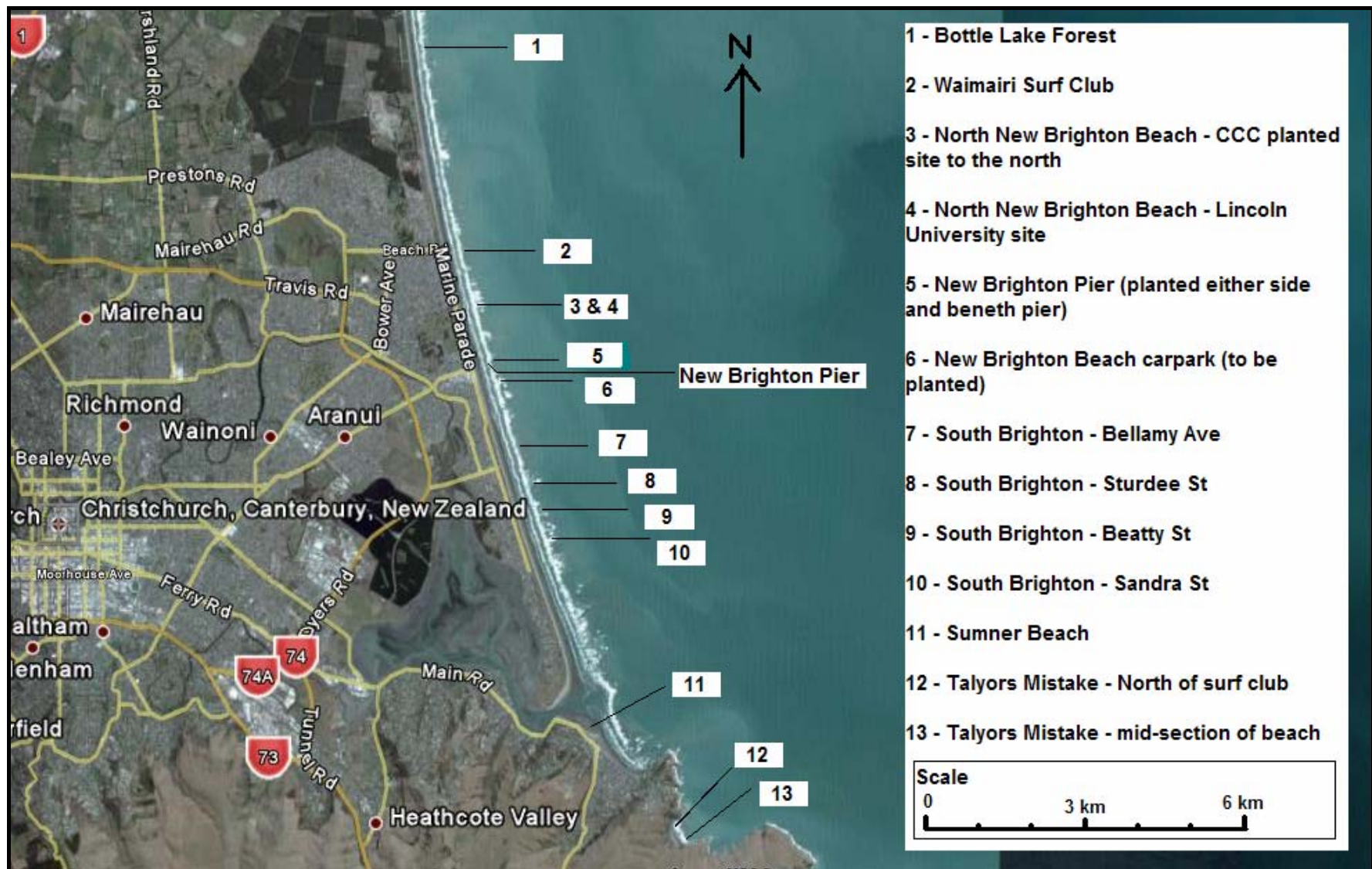


Figure 3: Location of the sites of existing planted spinifex along the Christchurch coast from Bottle Lake Forest in the north to Taylors Mistake in the south.

Table 2: Location and extent of spinifex-dominated dune cover at each of the existing planting sites along the Christchurch coastline. The New Brighton carpark site had not yet been planted when survey undertaken.

Location	Approximate dimensions of spinifex dune (m)	Estimated area of spinifex cover (m²)	Seaward extension of spinifex-dominated incipient dune (m)
Bottle Lake Forest	32 m long 16 m wide	380	9-10
Waimairi Surf Club	84 m long 3 m wide	250	0
North New Brighton Beach – Lincoln University site	80 long 7 m wide	560 (includes pingao)	0
North New Brighton Beach – CCC planted site to north	68 m long 5 m wide	340	0
New Brighton Pier	102 long approx 2-3 m wide	Heavily modified site	Heavily modified site
New Brighton Beach carpark (to be planted)	-	-	-
South Brighton – Bellamy Ave	18 m long 9 m wide	110	8
South Brighton – Sturdee St	12 and 14 m long 7-9 m wide	120	5-7
South Brighton – Beatty St	20 m long 18 m wide	200	2-3
South Brighton – Sandra St	18 m long 15 m wide	180	5
Sumner Beach	107 m long 5-10 m wide	500	Not estimated but fences moved seaward
Taylor's Mistake – mid-section of beach	125 m long 6-12 wide	1000	Fences moved seaward several times
Taylor's Mistake – north of Surf Club	84 m long 3-4 wide	200	Not estimated

Bottle Lake Forest

- One of the earliest plantings of spinifex along the main Christchurch beach – planted at least 8 years ago with less than 30 plants (Jason Roberts, pers. comm.).
- Plants raised from stolon cuttings harvested from the newly established Taylors Mistake planting; one year old plants raised in RX90 containers at the CCC Linwood Nursery.
- Plants were severely browned off by a heavy frost when inspected one year after planting in mid winter (D.O. Bergin, pers. obs.) but plants recovered.
- Excellent development of a small incipient dune up to 32 m long and 16 m in wide dominated by spinifex sward extending 9-10 m seaward of the main foredune face.
- Spinifex sward dense and vigorous over seaward part of colony; landward spinifex dense but not as vigorous due to less sand accumulation.
- Rabbit browsing of spinifex runners particularly along seaward edge of colony.



One of the earliest plantings of spinifex on the main beaches of Christchurch adjacent to Bottle Lake Forest. Note the vigorous sward of spinifex several metres seaward of the marram grass foredune.



Rabbit damage evident especially on new growth of spinifex stolons that are extending to the high water line.

Waimairi

- Foredune site immediately south of the Waimairi Surf Club.
- Foredune planting area immediately landward of high water mark and devoid of vegetation.
- Spinifex planted in early July 2008 at 40-50 cm spacing comprising up to 6 rows.
- Spinifex raised in Tinus root trainers at Naturally Native New Zealand Plants Ltd Whakatane nursery using seed sourced from nearest South Island sites.
- Area surveyed by ECAN before planting of spinifex; an ECAN permanent dune transect intersect near southern end of planted zone.



Foredune site at Waimairi about to be planted with several rows of spinifex. As with significant sections of the coast from Southshore northward, the lower foredune slope is often devoid of vegetation and provides the ideal zone for establishing spinifex.



Tall high-quality spinifex seedlings raised in the Naturally Native New Zealand's National Coastal Revegetation Centre at Whakatane. Seedlings were raised from local South Island sourced seed in Tinus root trainers.

North New Brighton Beach (Lincoln University site)

- Located between Cygnet Street to the north and Leaver Terrace to the south.
- Site had been recontoured in 2000 to reduce dune height and stabilise active dunes moving landward.
- Comprises various mixtures of spinifex and pingao planted in area immediately south of accessway.
- Planted foredune 80 m long and 7 m wide which has been fenced.
- Planted last year in joint project between CCC and Lincoln University (Hannah Buckley and students).
- It is understood dune profile transects were not established. ECAN may be able to set up a topographical survey of the planted area.



Various mixtures of pingao and spinifex planted in a 7 m wide zone by Lincoln University students in collaboration with the Christchurch City Council's Coast Care Unit.



Both spinifex and pingao plants were planted one year earlier and are already forming a small dune.

North New Brighton Beach (CCC site to north)

- Located to the north of the fenced sand binder planted area established last year by Lincoln University and immediately north of the accessway.
- Several hundred spinifex planted in June 2008 at 40-50 cm spacing by CCC.
- This northern area is 68 m long and 5 m wide.
- Some recently established plants partially uncovered next to accessway due to loss of sand from wind.
- Marram grass, lupin and iceplant landward of planted spinifex areas.



Spinifex seedlings planted one month ago at 40-50 cm plant spacing. Up to 10 rows of spinifex have been planted to form a dense cover along the foredune.



Despite a dense planting pattern and ensuring seedlings were planted into deep pits, a decrease in sand levels within weeks of planting can expose root systems of newly planted sand binders. Planting sites are monitored carefully so that seedlings can be replanted.

New Brighton Pier

- Spinifex planted 2 years ago on both sides of the pier in front of the New Brighton library.
- Well-established narrow zone of planted spinifex up to 3 m wide seaward of vigorous plantings of pingao, shore spurge and taupata (*Coprosma repens*).
- Plants established within shelter of shade cloth fence; shade cloth removed recently.



A dense zone of spinifex has successfully established along the heavily used foredunes adjacent to the New Brighton library and pier.



A mixture of pingao, sand spurge and *Carex* species have been planted landward of the spinifex with a range of indigenous coastal shrubs, particularly taupata further inland.

New Brighton Beach carpark

- Located immediately seaward of the carpark south of the New Brighton Pier.
- Four bays separated by boarded accessways currently dominated by mostly ice plant and scattered small colonies of pingao with areas of mobile sand.
- Low sand fence with 150 x 50 mm treated wooden planks fixed to tops of posts.
- Proposed that 2000 pingao and 6000 spinifex to be planted in mid-July 2008 in at least one bay.
- An ECAN transect is located through one of the bays seaward of the carpark. This bay will be planted with spinifex and pingao to monitor sand movement.



The heavily used carpark and New Brighton is to be planted in spinifex and pingao.



Accessways are critical for keeping beach users off planted sites. Spinifex has not as yet been planted here where pingao and ice plant have failed to maintain a vegetation cover along the toe of the foredune.

South Brighton – Bellamy Avenue

- Spinifex site planted 4 years ago located seaward of Bellamy Avenue, north of lookout; 12 spinifex planted originally (Jason Roberts, pers. comm.).
- Excellent development of spinifex sward and formation of an incipient dune extending 8 m seaward of the steep face of the foredune. 2 m of scattered less thrifty spinifex immediately landward of main sward.
- Spinifex-dominated incipient dune has an estimated maximum height of 1.2 m of sand accumulation.
- Toe of steep foredune immediately landward of spinifex dominated by pingao, sea rocket (*Cakile maritima*) and ice plant.
- Success of spinifex contrasts with the relatively poor performance of pingao planted in trial areas in the mid-1990s immediately to the south.



A small group of spinifex planted only 4 years ago has formed a small incipient dune and contrasts with the patchy performance of pingao in the background planted over 10 years ago.



A good example of a small spinifex colony within 4 years of planting forming a peninsular-like extension of sand seaward of the foredune dominated by pingao.

South Brighton – Sturdee Street

- Access through Te koro koro Reserve, immediately north of Sturdee Street.
- Original planting of 12 spinifex planted 4-5 years ago.
- Comprises 2 adjacent vigorous colonies of spinifex separated by 5 m of bare sand at high water mark and ice plant landward.
- Each colony 12-14 m long and 9 m wide with pingao and ice plant on landward side.
- Extension of incipient dune up to 7 m seaward of existing foredune face.
- Spinifex-dominated incipient dune up to estimated 1.2 m high.
- Immediately south, 2 rows of spinifex planted in 2007 established that has formed a 13 m long x 2-3 m wide dune.
- To the north, one row of spinifex planted in 2007 to form a 11 m long x 2 m wide dune.
- 2007 plantings healthy and indicate that planting more than 2 rows of spinifex may not be required for large scale planting programme along foredunes.



An excellent illustration of the extension seaward of a small planted colony of vigorous spinifex.



Two rows of well-established spinifex planted one year earlier illustrates that dense planting of many rows may not be required to get a spinifex-dominated sward established along foredunes.

South Brighton – Beatty Street

- Located immediately south of accessway opposite Beatty Street.
- ECAN transect to the north of the accessway.
- This site was planted in 2003-04 with 2-300 plants.
- 20 m long section of vigorous spinifex with 2-3 m extension of dune toe beyond adjacent foredune slope.
- 18 m wide colony with vigorous spinifex on seaward half and grey-coloured spinifex on landward semi-stable component.
- Surrounded on landward side by a mix of ice plant, marram grass and dead tree lupin.



An ‘outlier’ of a spinifex-dominant incipient dune seaward of pingao and ice plant covered foredune.



Spinifex in mixture with pingao and exotics on the landward side is less vigorous than the sward of spinifex more seaward.

South Brighton – Sandra Street

- Seawarded extension of foredune with spinifex to high water mark where there appears to be a shallow embayment formed from previous erosion.
- 18 m long healthy sward of spinifex with vigorous cover of seaward part of colony and smaller area of semi-stable landward dune with less vigorous spinifex.
- Patches of ice plant, marram grass surround landward edge of spinifex to dune crest.
- As with most of these small spinifex plantings in South Brighton, stock sourced from CCC Linwood Nursery raised from cuttings.



The sward of spinifex in foreground is seaward of the ice plant in the background. Spinifex is vigorous on the most seaward part of the incipient dune compared to less vigorous spinifex landward where there has been less sand accumulation.

Sumner Beach

- Spinifex first planted on dunes adjacent to restaurant about 5 years ago by CCC as part of landward landscape plantings in the area.
- Areas fenced with bollards and ropes due to high use; seaward fences have been moved seaward as spinifex sward extends.
- Backslope of low dune dominated by range of planted indigenous coastal species including taupata, shore spurge, koromiko and akeake. Large scattered ngaio.
- Spinifex planted over several years including latest seaward zone planted in mid-2008 in bare sand areas within fences.
- Excellent establishment of spinifex dominated foredune over 100 m long and up to 10 m wide and significant accumulation of sand since planting began.
- Spinifex runners growing through fence subject to trampling.



Significant build-up of sand to create a spinifex-dominated dune in a high use area at Sumner Beach. The fence has been moved seaward to accommodate vigorous growth of planted spinifex.



Attractive fencing options erected at heavily used beaches are still effective in keeping the majority of beach users to formal accessways and reducing trampling damage to foredunes planted with indigenous sand binding plants.

Taylor's Mistake – north of Surf Club

- Planted several times over recent years with spinifex resulting in a patchy less vigorous narrow zone of sand binders compared to the main site.
- More spinifex planted at this northern end where previous plantings have had poor survival.
- Zone available for planting is relatively narrow (4 m) between high water mark and dense cover of exotic species on back zone.
- Invasion of exotics from inland zone onto foredune including ice plant and marram grass contributing to poor performance.



The relatively sheltered bay of Taylor's Mistake provided the opportunity to successfully re-introduce spinifex in the mid-1990s to Canterbury since it was last recorded in the region some five decades earlier.



North of the Surf Club at Taylor's Mistake planted spinifex has had to compete within a narrow zone with vigorous exotics such as ice plant.

Taylor's Mistake – mid section

- Main spinifex planting area located in the central part of the beach immediately seaward of the carpark.
- Site of first re-introduction of spinifex to the Christchurch region; planting trial established in 1996 as described earlier in report.
- The first planting and subsequent further plantings to extend spinifex has been highly successful. Fences along front zone have been moved several times due to vigorous extension of spinifex runners seaward.
- Spinifex dune now 125 long and 6-12 m wide.
- Backdune sites dominated by marram grass with scattered planted tauhinu, harakeke, taupata and ngaio. Also scattered tree lupin.
- Spinifex used as source of cuttings for propagation at the CCC Linwood Nursery to supply plants for other Christchurch foredunes. As found in other regions, plant production from cuttings is less efficient and more expensive compared to raising seedlings from seed.
- Spinifex seeding at Taylor's from early plantings but low viability. May need to increase proportion of males from plants raised from cuttings.



This spinifex colony along the central section of Taylor's Mistake has expanded from a planting trial established in 1996 and represents the first introduction of spinifex to the Canterbury region since it was last recorded in the 1940s. The front fence has been moved several times seaward to cope with the vigorous growth of spinifex.



The semi-stable backdune remains dominated by exotic species including marram grass and scattered patches of tree lupin.

Monitoring a selected planted spinifex site

Spinifex were planted immediately south of the Waimairi Surf Club, accessed directly via the carpark at the intersection of Marine Parade and Beach Road. Up to 6 rows were planted by the Wai-ora Community Trust at 40-50 cm spacing between rows and between plants. Plants were raised in Tinus Root trainers by Naturally Native New Zealand nursery from seed collected locally. Wire baskets contain 40 seedlings (10 booklets of 4 plants each) with plants up to 70 cm high. Planting density along the foredune was approximately 10 plants per metre.

Based on a sample of 100 seedlings measured after planting, average height was 39.6 cm, average plant spread 26.3 cm², and with the highest average plant vigour score of 5 – robust.



Spinifex seedling were planted by the Wai-ora Community group using best-practice guidelines including incorporation of slow-release fertiliser in deep planting pits.



Up to five rows of spinifex were planted along the foredune and will be monitored for survival and growth. ECAN surveyed sand levels before planting and will continue monitoring at 6-monthly intervals as part of their permanent dune transect survey programme.

DISCUSSION

Re-introduction of spinifex back to the Christchurch dunes has been successful over the last decade, some 60 years since it was recorded in the area where one male plant had been last recorded in the region (Simpson 1974). The success of the first planting of spinifex at the relatively sheltered Taylors Mistake site provided the impetus to establish several small planted colonies along the main beach at New Brighton where the coast is considerably more exposed than the Taylors Mistake site.

The failure of the first trial established at the South Brighton Surf Club, one year after the first planting at Taylors Mistake, was due to large accumulations of sand. This emphasises the difficulties of establishing sand binders along exposed parts of the eastern South Island. In addition to severe erosion from occasional storms and high seas, dunes are typically subject to persistent on-shore winds as well as an influx of considerable volumes of sand.

Nevertheless, planting of spinifex in subsequent years at 10 other sites along the main beach from Southshore to Bottle Lake Forest has shown that spinifex can be successfully established. Furthermore, the small colonies of well-established spinifex are building low incipient dunes that extend up to 10 m seaward of the existing steep marram grass-dominated foredune face. These incipient dunes are estimated to have accumulated sand to a height of 1.2 m and have formed low peninsular-like extensions seaward that have endured several years of storms and dune erosion.

While the plantings are small in extent, the placement and vigorous growth of spinifex at the toe of the marram grass dominated foredune has clearly favoured its establishment. Most sites have seen significant expansion of spinifex cover despite only a few spinifex originally planted at many of these sites (Jason Roberts, CCC Coast Care Unit, pers. comm.). Spinifex is very effective in tolerating the extremes of wind, salt spray and sand movement in this zone more effectively than marram grass or ice plant. Even where pingao has become well established on the foredune, spinifex has been effective in building a small incipient dune seaward of the pingao. The monitoring of dune transects by ECAN, and more comprehensively at the recently planted Waimairi site, over the next few years will assist in quantifying the effect of planted spinifex on formation of incipient dunes that may be attributed to the planting of spinifex.

The CCC is keen to extend their spinifex planting programme considerably along the Christchurch dunes. With over 10 km of coastline between the Southshore Spit and Bottle Lake Forest to the north, a large-scale planting programme of spinifex will be expensive. Cost of seedlings for the Waimairi site planted in mid-2008 were \$2.30 each. At a plant density of up to 5 rows at 40-50 cm plant spacing, as established at the Waimairi site, at least 10 plants per linear metre of coast will be required. Planting 1 km of foredune will cost at least \$23,000 for the seedlings alone.

However, there are indications from recent planting that a sward of spinifex may successfully establish along the foredune where only 2-3 rows of seedlings are planted. Lower planting densities should be evaluated further. Planting low numbers of spinifex over longer stretches of the foredune spreads risk of losses from localised erosion events.

Resources will still need to be directed at controlling rabbit populations to reduce impact of browsing.

Broadcast fertiliser trials of fast-release high-nitrogen fertiliser (e.g. Urea – 46% N) onto established spinifex on several North Island coastal sites have shown a significant increase in growth (Bergin 1999). Broadcasting fertiliser in spring and autumn during rainy periods will boost growth of newly planted spinifex and will be a more cost effective strategy for encouraging establishment of lower numbers of spinifex along foredunes rather than using higher densities of nursery-raised plants for establishing wider zones.

RECOMMENDATIONS

From this review of over a decade of establishing spinifex along the foredunes along the Christchurch beaches, it is recommended that:

- The option of planting spinifex at a lower density comprising only 2-3 rows at 50 cm plant spacing should be evaluated further. If successful, lower density planting options will allow significantly greater distances of foredunes to be planted compared to the higher seedling costs of high density planting.
- Continue to use high quality, tall, nursery-raised seedlings of spinifex such as those supplied for the 2008 planting season raised in Tinus root trainers.
- Best-practice planting guidelines are continued to be used in all foredune planting programmes including incorporating slow-release fertiliser into the planting pit at time of planting, and planting seedlings into deep to holes to avoid exposure of roots where on-shore winds reduces sand levels soon after planting.
- Rabbits are controlled at all planting sites to reduce impact of browsing on planted spinifex.
- Planting sites are monitored regularly to determine causes of mortality or other factors that may be affecting performance so that management regimes can be modified accordingly.
- Once spinifex is established, consider broadcast applications of fast-release high nitrogen fertiliser to boost cover and increase spread to form a dense sward.
- Transects and topographical monitoring sites established by ECAN are surveyed at 6-monthly intervals for a minimum of 2 years to quantify sand movement of foredunes planted with and without spinifex.

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