

Restoration of Indigenous Biodiversity on Coastal Backdunes

Dune Restoration Trust of New Zealand

Jim Dahm
David Bergin
Michael Bergin

Project funded by the Ministry for the Environment's Community Environment Fund in collaboration with local community Coast Care groups, councils, Trusts and the Department of Conservation



Ministry for the
Environment
Māori: Mō Te Taiao

Community Environment Fund

DUNE RESTORATION TRUST
OF NEW ZEALAND

Keeping our Dunes ALIVE

Focus on backdune restoration

- The last 2-3 decades Coastcare groups and management agencies have successfully implemented restoration of our degraded coastal sand dunes.
- To date, the focus has been primarily on the seaward dune face with using native sand binders.
- Focus has now increased on restoration options for degraded backdunes.
- Backdunes are very complex
 - greater diversity of species and community,
 - range of sub-environments,
 - serious issues with invasive exotic vegetation,
 - grazing animal pests, and
 - human pressure.
- Coastal communities and agencies require practical cost-effective options for restoration of indigenous biodiversity on backdunes.

Modification of backdunes

- The key problem being addressed is the restoration of coastal dunelands, probably the most modified and degraded of all the major ecosystems in New Zealand
- Modification has included
 - almost total removal of original dune forests,
 - extensive disruption and loss of other native dune vegetation, and
 - introduction of a wide range of competing exotic plant species.
 - Grazing animals have also significantly impacted dune ecosystems, particularly more palatable species that evolved without grazing pressure.
 - Human-induced disruption of stabilising dune vegetation also resulted in significant modification of duneland ecosystems by wind erosion – a widespread issue from the 1800's to the mid 1900's.
 - Stabilisation of these sands almost exclusively used exotic species, many of which are now widespread in remaining natural duneland ecosystems.



Loss of backdune biodiversity

- Extensive coastal subdivision and development over the last 30-50 years has also severely impacted remaining dunelands. The combined effect of the above pressures has been significant. For instance:
 - Original native duneland vegetation sequences from sand binding species on the dune face through to mature forest now remain in only 2 sites on the entire east coast of New Zealand.
 - Within the Waikato Region, 98% of coastal sand dune vegetation has been lost since 1840 with the remaining 2% extensively modified
 - Many dune plant species are now listed as nationally threatened including pingao, sand pimelea, sand tussock, and sand spurge.



Restoration guidelines

- The areas of natural duneland ecosystem that remain are typically either narrow truncated ecosystems or small isolated remnants often subject to impact and encroachment from adjacent landuse.
- New Zealand coastal communities have readily grasped this challenge and we now have probably the most successful community based dune restoration programme in the world.
- However, there is almost a complete absence of useful guidance for restoration of backdune areas and this is an urgent need.



Purpose of this backdune project

- To enhance the capacity of local communities and councils to undertake restoration of indigenous biodiversity in coastal backdune environments through:
 - extensive review of existing knowledge and experience
 - setting up demonstration areas and monitoring sites
 - providing practical guidelines for coastal groups, iwi, managing agencies and the wider community
- The aim of this project is to produce and communicate guidelines that will empower communities to more successfully design and undertake restoration of backdune environments.



Specific project objectives

- To review current knowledge and experience in backdune indigenous biodiversity and restoration
- To set up community based monitoring systems for backdune restoration activities
- To set up regional demonstration areas of restored backdunes using local native plant species
- To provide methods for evaluating the performance of backdune restoration
- To communicate findings to the wider community.



Benefits of the project

Environmental

- The project enables communities to design and undertake successful restoration of backdune environments.
- Community based coastal restoration work now includes more emphasis on backdunes as well as foredunes.
- Extending coastal dune restoration inland to degraded backdune environments will significantly enhance biodiversity gains, restoring dune habitat sequences presently rare and providing improved natural linkages and corridors.

Economic

- Duneland restoration significantly enhances the natural and landscape values of coastal dunes, helping to maintain and enhance the values that attract visitors and support local economies. The work also enhances natural protection against coastal hazards.

Benefits of the project

Social

- Empowering communities to enhance natural character and biodiversity positively impacts community well being and resilience, helps develop a dune care ethic and provides individuals an opportunity to meet and share a common interest while working on the projects.

Cultural

- Dune restoration protects the significant cultural values of these areas - including middens, urupa, battlesites and other taonga of importance to Maori. Many threatened dune plants also have significant cultural importance and uses (e.g. pingao).



Project overview

The 3-year project involved:

- Review of backdune restoration initiatives undertaken by Coast Care groups and managing agencies on over 50 sites nationwide
- Assessment of Demonstration Areas set up on backdunes in 6 regions profiling best practice restoration
- Consultation with Coast Care groups in developing effective project outputs
- Publishing 12 technical articles for the Dunes Trust Handbook
- Communication of recommendations on best practice backdune restoration to wider community – website, links, newsletters...



Backdune demonstration areas and review sites

1. Northland

- Taipa
- Rarawa Beach

2. Waikato

- Coromandel
- West coast

3. Bay of Plenty

- Maketu Spit
- Papamoa Beach

4. Wellington

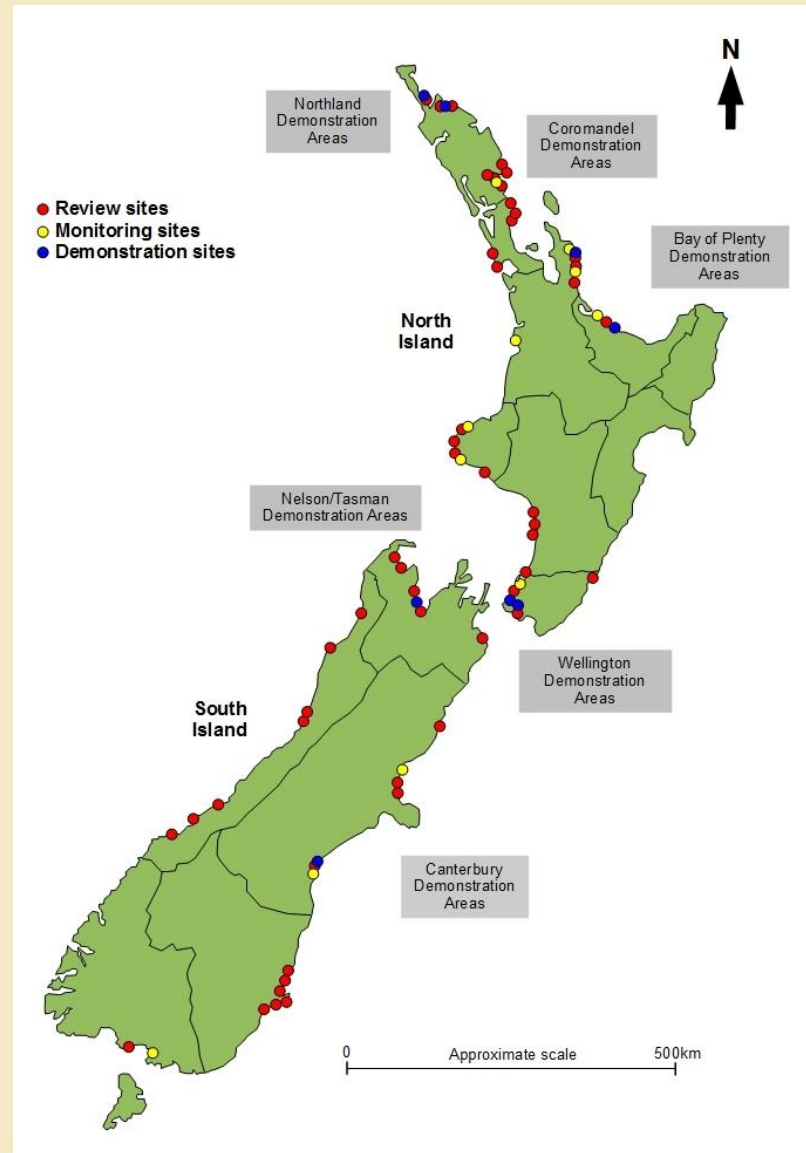
- Whitirea Park
- Waitohu

5. Nelson/Tasman

- Motupipi Spit

6. Canterbury

- Te Kohaka o Tuhaitara, Woodend
- Caroline Bay, Timaru



Northland – Rarawa Beach, Far North

- Restoration has involved removal of the exotic species in small groups and planting of each cleared site with a range of backdune natives supplied from local nurseries.
- Several local schools are involved in the planting of natives in small groups and monitoring of early performance of planted natives.



Northland – Rarawa Beach, Far North (continued)

- Students from the local Te Kao and Ngataki Schools near Rarawa Beach, Far North, Northland, helping the local coast care group (Friends of Rarawa) undertake the establishment assessment of planted natives within a gap cleared of exotic wattle.
- Here students are recording dimensions of plant crown of a planted karo seedling to calculate the plant canopy cover.



Northland – Taipa

- The eastern end of the 1.2 km long north-facing Taipa beach is heavily used with development set closer to the sea than the western end.
- With increasing success in the restoration of foredunes, emphasis is moving to restoring backdunes but the local community require guidelines on choice of species, selection of appropriate planting sites and methods for site preparation, planting and weed management.
- This includes initial attempt as removing kikuyu and buffalo grass from dense patches of naturally regenerating pohuehue using glyphosate which has resulted in dieback of pohuehue.
- Grass-selected herbicide trials were established with the Coast Care group to determine optimum rates and methods of application to control invasive exotic grasses.



Backdunes typically dominated by dense kikuyu and buffalo grasses (left). Spraying with non-selective herbicides by the Coast Care group to eradicate the exotic grass component from naturally regenerating dense stands of pohuehue (right).

Northland – Ruakaka

- Significant backdune area dominated by a wide range of exotic plant species many of which are garden escapes. Some control of the most invasive exotic woody species such as coastal wattle (*Acacia sophorae*) has been carried out but scattered regeneration was still occurring.
- The backdunes north of the Surf Club covering both a recently planted area and a the proposed site for a future demonstration area were mapped and a list of exotic and native plant species collated. The species list is being supplemented by a generic coastal species list for these local beaches obtained from the Northland Regional Council.
- Excellent colonies of *Coprosma acerosa* occur on backdunes along with pohuehue, wiwi, patches on *Carex testacea*, occasional taupata and scattered small trees of pohutukawa, some of which are likely to have been from early plantings.



In the foreground, examples of exotic plants that dominate the backdunes at Ruakaka Beach, Northland - garden escapes (centre), coastal wattle (right) and South African ice plant (left).

Northland – Smugglers Bay

- The Bream Head Conservation Trust was established in 2002 as a partnership between iwi, the community, Northland Regional Council, Whangarei District Council, and the Department of Conservation (DOC) to restore the ecology and cultural values of the reserve.
- An active revegetation programme has been underway establishing a range of local indigenous shrub hardwood and monocotyledon species on slopes around the western end of the reserve.
- Foredune restoration work, pest control, fencing and planting has helped reduce the impacts of an initial erosion problem as a result of rabbit browsing and human disturbance led to a minor blowout which was exposing a coastal midden and starting to affect the backdune areas.
- Weed control work is currently being carried out by spraying the exotic grass in amongst the native pohuehue to release it from competition and allow planting of backdune natives including five finger, manuka, kaunka, pohutukawa, knobbly club rush, cabbage tree.



Auckland – Omaha Beach

- Vegetation and management issues as described in recent report on vegetation survey (Osborne and Stamp 2011) including rabbit browsing, sand fencing, control of exotics and planting options for fore and backdunes.
- Options for community restoration of vegetation to natives include:
 - Strategy for gradual conversion of marram and ice plant to scattered spinifex and pingao dominated dunes.
 - Planting options for backdune area as per Osborne and Stamp (2011) recommendations using a wide range of native groundcover, shrub and tree species where exotic grass dominates.
 - Options for vegetation monitoring plots and establishment of dune profiles.



Backdune area at Omaha Beach near the northern end dominated by exotic grass with potential for planting of a range of native backdune groundcover, shrub and tree species.

Auckland – Te Henga (Bethels Beach)

- Significant progress has been made with shrub and tree vegetation in some mid and back-dune areas, particularly an old stream channel which cuts through the Holocene dune system. Over time the backdunes landward of the seaward frontal dune will transition from spinifex and tauhinu to other vegetation communities.
- Restoration using clumps should focus on species likely to dominate the next stage of succession including pohuehue, knobby club rush and a variety of hardy woody species (e.g. toe toe, karo, taupata, houpara, etc.). In more landward and sheltered areas, species such as mingimingi, hangehange, mahoe, flax, pohutukawa and a wide range of others could also be used.



Successful backdune restoration using a range of native shrub and tree species located in a sheltered low hollow (probably a former stream channel) which runs through the dunes, Te Henga. Pohutukaa dominated forest is developing in mixture with other native species some of which are regenerating.

Auckland – Te Henga (Bethels Beach) (continued)

- Loss of key native backdune species such as sand coprosma (*Coprosma acerosa*).
- Over the past nine months several vegetation surveys have been undertaken including plots and dune profile transects by the Dunes Trust in collaboration with the Auckland Council and the local Te Henga Coast Care group. As part of the backdune project a large mid-backdune sand coprosma planting trial was established along the northern end of the site covering a range of dune slope, swale and dune crest sites.
- The trial was established as part of a weekend public planting day. A full assessment of every seedling (650+) was carried out and all 120 plots were mapped and recorded for future assessments. Monitoring and maintenance is underway in collaboration with project partners.
- *Coprosma acerosa* trial resulted in high losses due to ongoing rabbit browsing along planted transect. Rabbit control was increased in the planted area and is expected to see improved performance of planted natives.



Coromandel – Tairua Beach

- Wiwi has been planted on backdunes either side of the Surf Club and is now forming dense stands within a year of establishment. This species is a key backdune species in any restoration programmes nationwide.
- Other backdune sites at Whiritoa Beach including the central section dominated by pohuehue, much of this naturally regenerating, but with rank exotic grass evident in some areas.
- Planting by the Coast Care group has seen successfully established individual plants or groups of plants of native trees and shrubs including ngaio, karo, taupata and houpara.
- This beach provides many excellent examples of backdune vegetation zonation landward of dune crest from ground cover to shrub and tree species.



- Substantial parts of the backdune at Whiritoa are regenerating in pohuehue and wiwi (left) but a wide range of native woody species including ngaio, taupata, houpara and karo have been planted by the Coast Care group landward of the spinifex-dominated foredune (right).

Coromandel – Onemana Beach

- Excellent combinations of planted wiwi and pohuehue at southern end of beach landward of restored spinifex dominated foredune. Pohuehue forming dense colony amongst and over well-established wiwi. Wiwi appears to be providing means for pohuehue to scramble upwards.
- Excellent contrast between wiwi/pohuehue dominated backdune zone and spinifex-dominant foredune. Sand convolvulus is now naturally regenerating amongst planted natives.



Onemana beach backdune planting carried out by the Coast Care group. Planted wiwi (*Ficinia nodosa*) is one of the more easily established native backdune species (left). A dense cover of pohuehue successfully establishes especially where it has been planted amongst wiwi (right).

Coromandel – Whiritoa Beach

- Focus shifted to backdune planting over recent years with variable success especially for ground cover woody species including pohuehue and sand coprosma. Initial plantings were carried out at the northern end to replace marram grass and coastal wattle, the latter once forming an extensive dense stand.
- North end of beach where planting of native backdune species has included a range of shrub and tree species with mixed success. One site comprises well-established houpara (*Psuedopanax lessonii*) planted by the Whiritoa Coast Care group and Environment Waikato.
- Substantial areas of the northern backdunes are dominated by exotic species including many garden escapes. This includes South African daisies and ice plant, marram grass, regeneration of coastal wattle, cotoneaster and agapanthus. Of most concern is rapid spread of blue pea along backdunes even amongst established native vegetation.



Coromandel – Whangamata, Cooks and Whangapoua

- The backdune demonstration areas at Whangamata, Cooks, and Whangapoua were expanded using best restoration strategies and species layout indicated in pilot trials.



- Views of backdune restoration at Whangapoua Beach less than 1 year after planting (site was bare sand at time of planting)



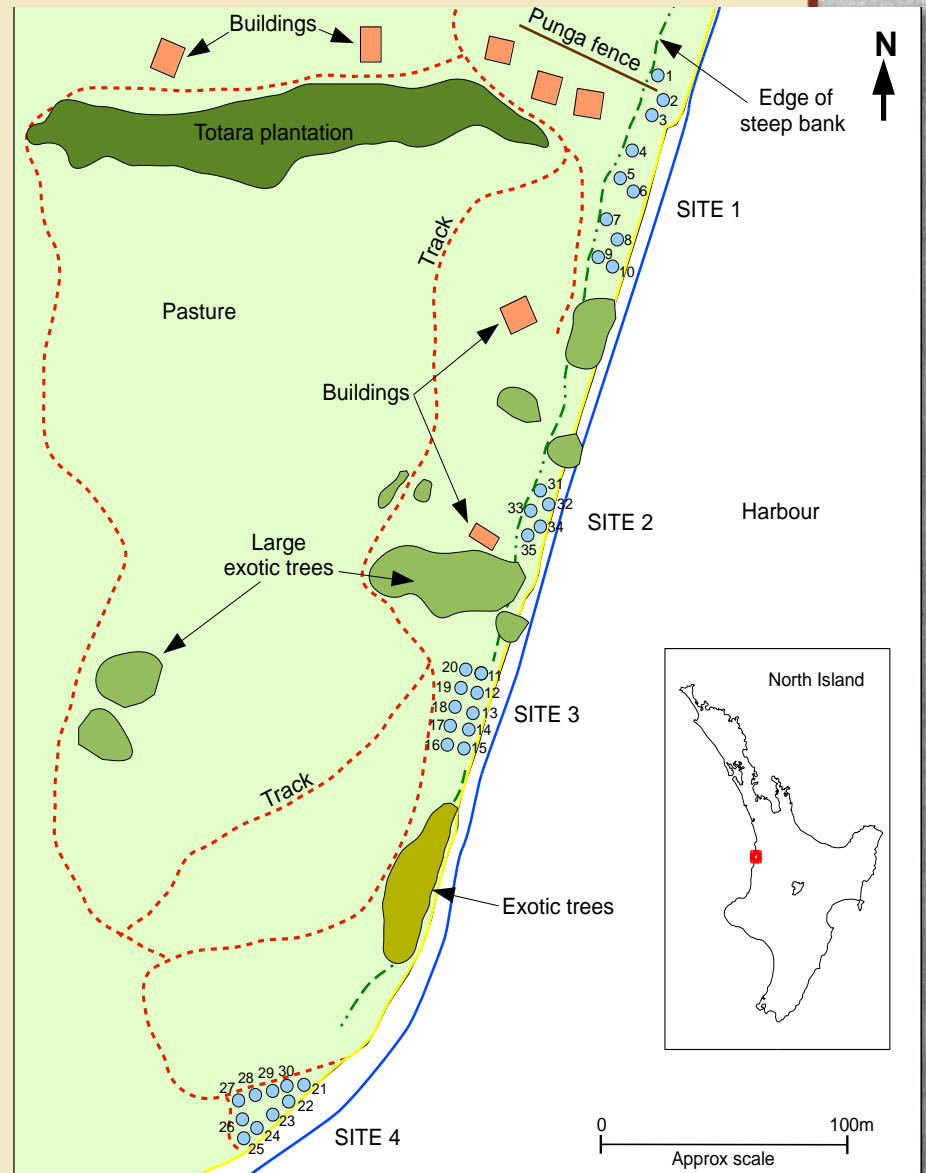
- Similar work also completed at Cooks and Whangamata.

Waikato – Kawhia

- Native shrubs and trees planted at each of the four trial sites have been assessed for survival and growth 3 years after planting.
- All sites were inspected regularly over the first 1-2 years after planting by the local community to determine any problems such as browsing by rabbits or grazing stock.

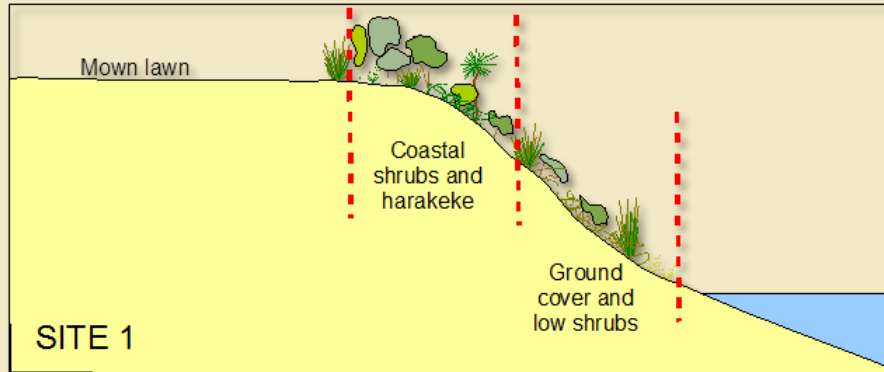


Local iwi involved in measurement of planted native seedlings within plots on steep kikuyu grass-dominated bank.

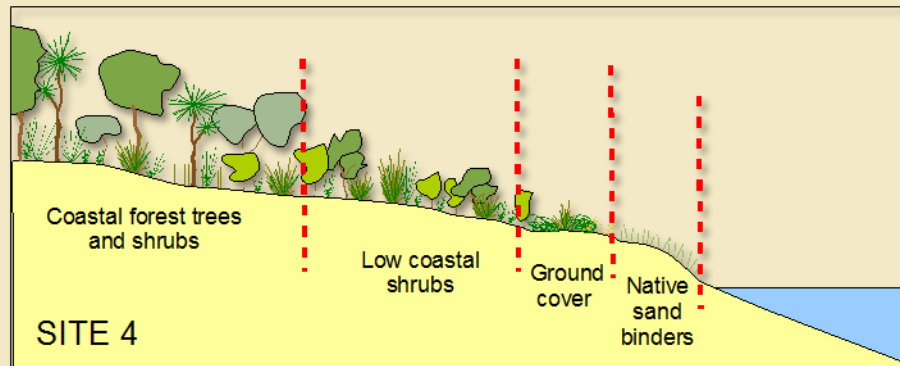


Waikato – Kawhia

For each of the four trial sites, site-specific notes on the performance of planted seedlings and management and monitoring options are listed along a dune profile diagrams indicating the potential sequence of native species that could be restored to each site.



Two zones are occur along this site – a low ground cover of range of native species along the lower bank and broad leaved native shrubs and harakeke and ti kouka along the upper bank.



Gently sloping harbour margin from foredune currently dominated by marram grass to landward areas dominated by exotic grasses with pohuehue. With use of nurse pioneer species to give initial shelter, there is scope to develop a full sequence of coastal native forest with a diverse range of species.

Bay of Plenty – Sunbrae, Papamoa Beach

- Dense urban development on the backdune resulting in limited area for natural dune system and associated vegetation cover.
- Sites invariably dominated by exotic weed species and in many cases deliberate extension of private lawns onto public reserves. The local council agencies are working with beach front owners to restore encroachment sites to appropriate native vegetation along these backdunes.
- As part of the backdunes project several trial blocks established testing a variety of treatments – companion planting of different species; with and without bark/mulch around the newly planted seedlings; use of hydro gel (an additive used at planting to retain moisture around root systems; topping vs non-topping of tall nursery-raised plants).



The trial blocks at Sunbrae Grove along the backdunes area which has recently been reclaimed with removal of all exotic species and replanted in natives. Note the use of bark/mulch (foreground) vs. non-mulched (background).

Bay of Plenty – Papamoa Beach

- Backdune planting trial was established by the Bay of Plenty Regional Council along the dunes beside the Pacific View Road accessway, Papamoa Beach, Bay of Plenty late August 2012. Species planted were wiwi (*Ficinia nodosa*) and pohuehue (*Muehlenbeckia complexa*).
- Pohuehue seedlings comparing three stock types (root-trainer, PB2, 2.5lt untrimmed and 2.5lt trimmed).



Planting wiwi (*Ficinia nodosa*) and pohuehue (*Muehlenbeckia complexa*) at Papamoa Beach, Bay of Plenty backdune trial, 24 August 2012. Plant spacing was 50cm x 50cm and approximately 50:50 wiwi pohuehue.

Bay of Plenty – Papamoa Beach

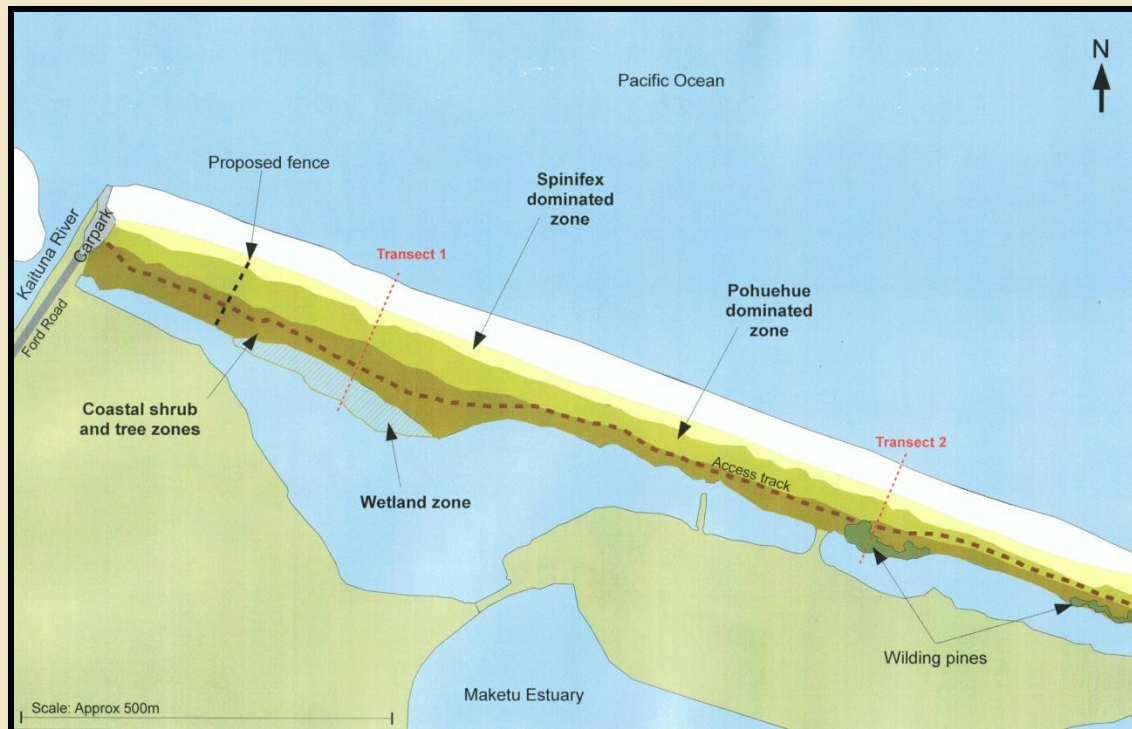
- The trials main aim was the comparison of pohuehue seedlings rasied in and planted out in three stock types with one stock type trimmed and untrimmed (root-trainer, PB2, 2.5lt untrimmed and 2.5lt trimmed).
- October 2012 assessment and site inspection of the backdune trial comparing wiwi and pohuehue planted in August 2012. Note the regrowth of the weed species within the trial plot.
- Initial performance good especially for wiwi although dieback of pohuehue in drought. No difference in trimmed vs non-trimmed wisi



Bay of Plenty – Maketu Spit

- Up to four zones based on vegetation cover and proximity to the sea occur along parts of Maketu Spit. These are:

- the most seaward spinifex-dominated zone,
- the pohuehue dominated zone immediately landward,
- the coastal shrub and tree zone running inland along most of the spit, and
- the wetland zone along part of the estuary margin.

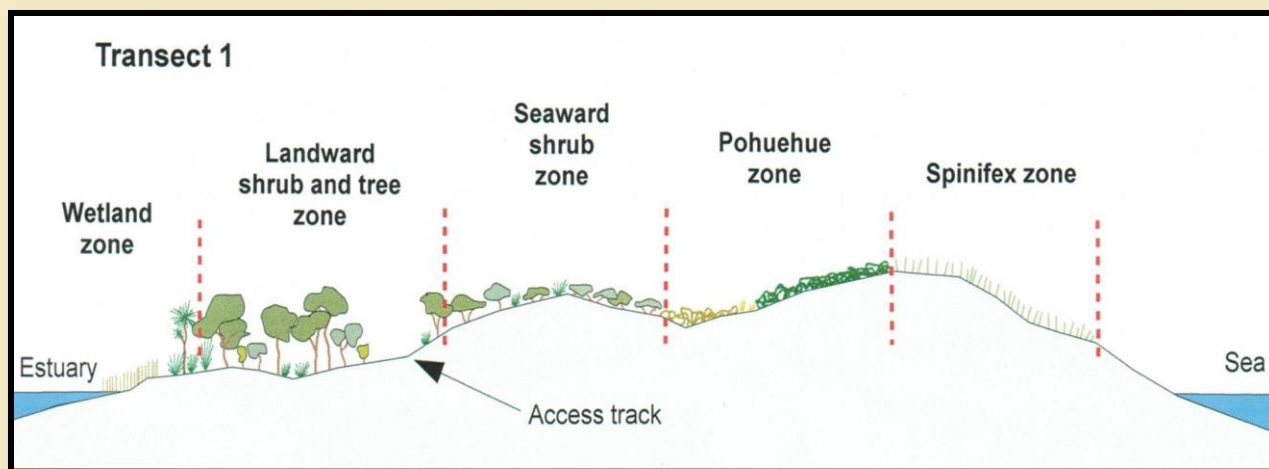


Bay of Plenty – Maketu Spit

Two sites towards the western end of the Spit were established as Demonstration Areas that are the focus of restoration planting and intensive weed control.

Transect 1 – open site

Comprises a representative site 2-300 m west of carpark where establishment of a sequence of coastal native vegetation across the Spit from the foredune to the wetland bordering the estuary is underway



Cross-section of Transect 1 located within the open area of dune approximately 300 m west of the carpark, Maketu Spit. Existing and restored vegetation cover is shown for each of the zones.

Bay of Plenty – Maketu Spit

Transect 2 – wilding pine nurse

Building on the existing restoration plantings, a further sequence of vegetation from foredune to backdune adjacent to and within the pines acting as a nurse for underplanted natives in the landward zones is underway.

As for Transect 1, selective spraying of pohuehue dominated zone to remove exotic grasses and carry out other weed control is continuing as required.

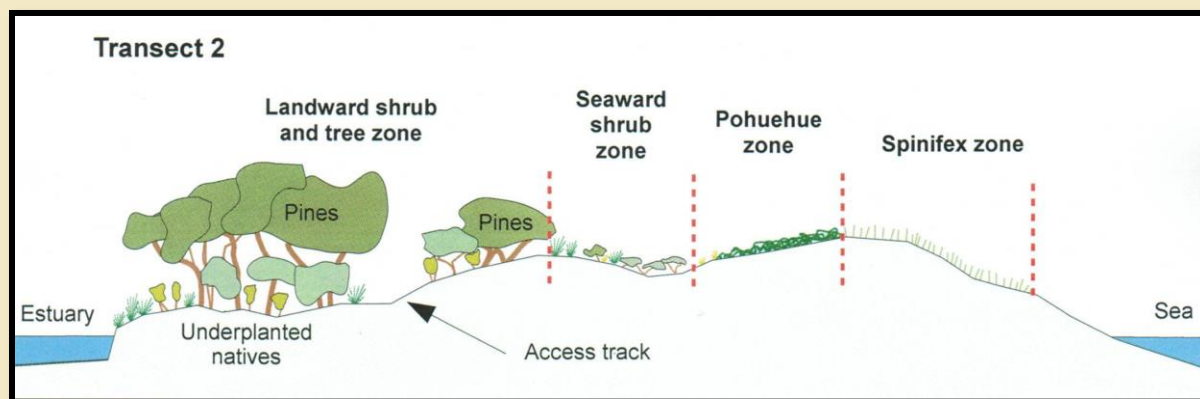


Figure 5: Cross-section of Transect 2 located adjacent to and within the wilding pine area, Maketu Spit. Existing and planted native vegetation cover within the zones is indicated including underplanting of natives within the wilding pines.

Bay of Plenty – Maketu Spit

- A full reassessment of the two initial transect plantings (planted 2011), sand tussock plots (planted 2011) and coastal riparian strips (planted 2012) have been completed. Also the establishment assessment of new plantings across Transect 2 site has been completed.
- Due to the high exposure of the sites the number of surviving plants has been very low. Drought in the first two years following planting had big impact on the plants health leading to many deaths. Most successful species included harakeke, ngaio and ti kouka although the latter were vulnerable to browsing by rabbits.



Bay of Plenty – backdune demonstrations

A field-based workshop underway at Maketu Spit during the planting of native tree and shrub species in small groups in collaboration with the local Coast Care group, Bay of Plenty Regional Council, Department of Conservation, and Western Bay District Council.



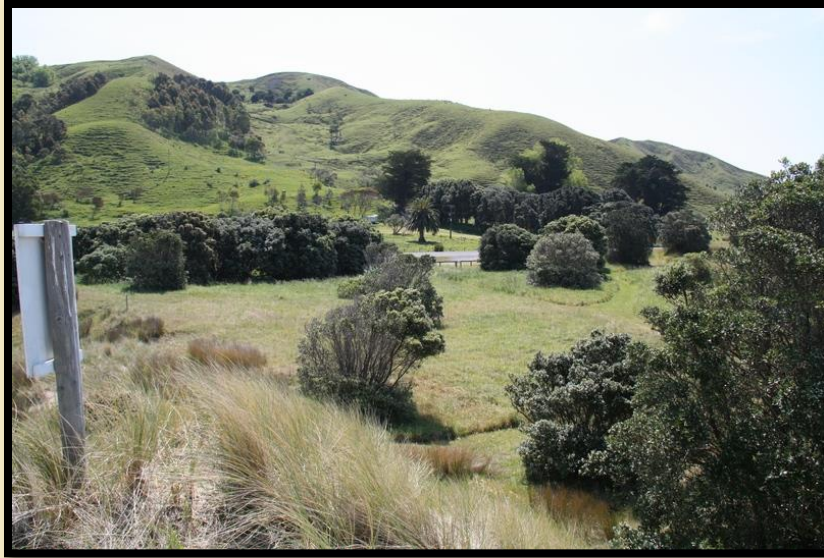
Bay of Plenty – Maketu Spit

- In winter 2013 a new planting was carried out across Transect 2 using a wider range of species.
- Plant protection shelters or Combi-guards that have a weed mat square at the base were placed around most seedlings especially for species that are particularly vulnerable to rabbit browsing.
- Fibre weed mat provided as part of the guards was also added around each seedling within each enclosure to reduce weed growth and increase the survival rate of planted natives.
- Early performance encouraging – plants with protectors with high survival compared to non-protected seedlings.



East Coast – Pouawa Beach

- Pouawa Beach on the east coast of the north island is approximately 20 mins north-east of Gisborne alongside the Whangaara Road.
- To the north near the outlet of the Tarewarewa Stream is the Te Tapu wae o Rongokako Marine Reserve and on land a protected Queen Elisabeth II site covering the large sand dunes.
- The backdunes in the QEII site are dominated by large exotic grassed areas with mown paths providing access to the beach via high marram foredunes. Small groups of pohutukawa are spread throughout the site.



The backdune zone at Pouawa Beach with groups of pohutukawa and wiwi surrounded by exotic grass fields which have mown paths as access from the road/carparks to the beach.

Taranaki – East Beach and Fitzroy Beach

- Both East Beach and Fitzroy Beach are very popular beaches within New Plymouth where there has been significant work on dune restoration focussing on both foredunes and backdunes.
- Weeds have become dominant in restored backdunes of East Beach although there are good examples of well-established backdune species at both East Beach and Fitzroy Beach.
- Options provided to locals for restoration of semi-stable backdunes were the establishment of small groups of the major hardwood coastal species pohuehue and sand coprosma, taupata, ngaio, harakeke and houpara.
- Small group planting will allow easier maintenance and monitoring of plant survival and feedback to locals on which species to focus on in further plantings.



Fitzroy Beach – planted pohuehue, ti kouka and harakeke dominate backdunes with pohutukawa and ngaio as wind-shorn shrubs and trees. This is in contrast to substantial areas of the adjacent East Beach where rank exotic grass has become dominant on semi-stable backdunes.

Taranaki – Te Rewa Rewa, New Plymouth

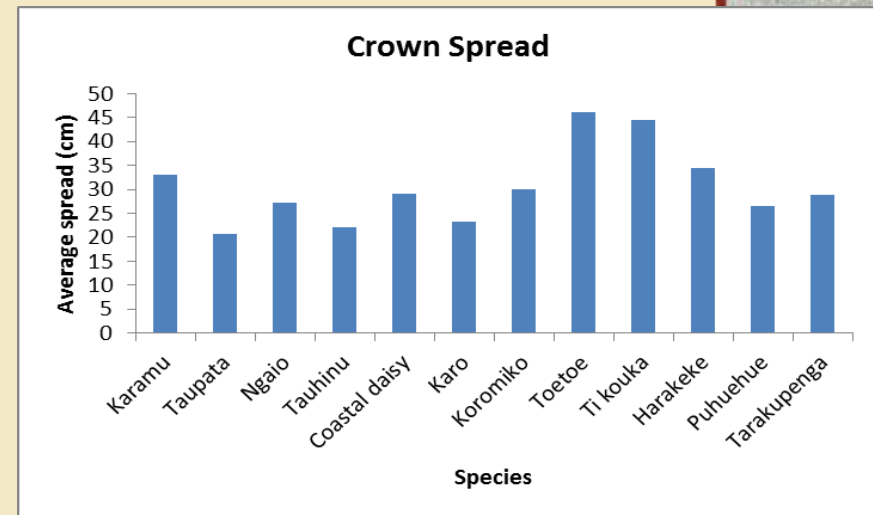
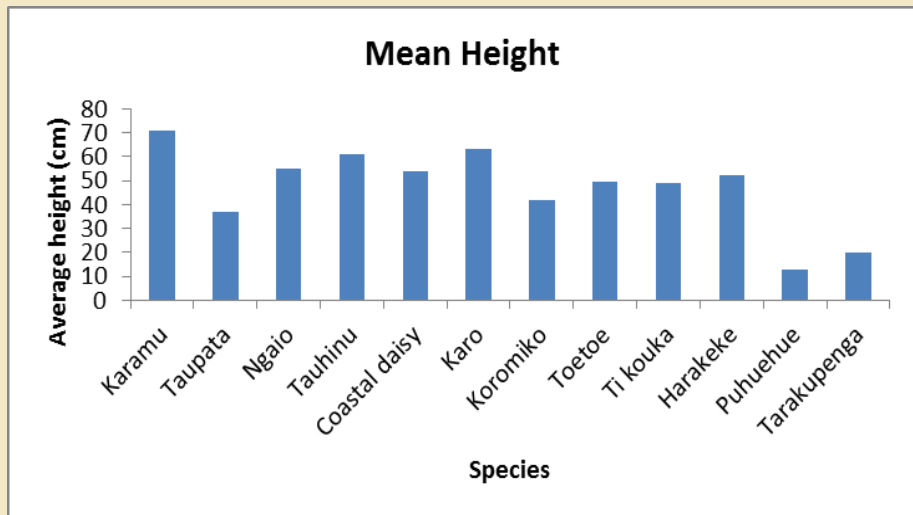
- Over 4000 backdune species planted as part of the nationwide Living Legends programme was recently planted with a range of backdune species. The site is located between the popular award winning New Plymouth to Bell Block coastal walkway and cycleway north of New Plymouth, which includes the iconic Te Rewa Rewa bridge over the Waiwhakaiho River.
- Species planted over a 1 ha backdune site include the major hardy native coastal woody ground cover, shrub and tree species listed in Table 1. Average height, plant spread and plant vigour are presented in Figure 1 based on measurement of a minimum sample of 30 plants per species.



The backdune sand plain dominated by exotic grass and scattered buckthorn was cleared of gorse and recently planted with coastal native ground cover, shrub and tree species as part of the Living Legends programme.

Taranaki – Te Rewa Rewa, New Plymouth

- Four 5 m wide belt transects ranging in length from 50 m to over 100 m were established from the landward extent of planting to the marram grass-dominated foredune. All planted natives were recorded by species and proximity to the sea.
- The backdunes project provided a template for monitoring of this project to ensure information on species performance is maximised and the programme goals are achieved.



Mean height (left) and crown spread (right) for 12 coastal backdune species planted at the Living Legends site at Te Rewa Rewa, New Plymouth.

Wellington – Onehunga Bay, Whitireia Park

- Project Partners the Greater Wellington Regional Council and in particular Robyn Smith have established 3 backdune planting areas at Onehunga Bay, Whitireia Park, near the entrance to Porirua Harbour.
- Several hundred backdune plants were established in community working bees in trial plots following designs developed as part of the CEF project. Native coastal backdune species planted included *Carex testacea*, knobby club rush, New Zealand spinach, *Olearia solandri*, coastal flax, taupata, ngaio and tauhinu.
- Site preparation involved spraying by knapsack blanket planting sites with glyphosate for later planting of natives at 0.5-1.5 m apart depending on species. Seedlings were established in plots of single species to mimic natural patterns and facilitate easier monitoring of plant performance.
- Netting was placed around all palatable plants (most) to prevent rabbit browsing as animal control in a public park is difficult.



Carex testacea (foreground) planted on a backdune site at Whitireia Park, Porirua, by CEF Project Partners local community groups and the Greater Wellington Regional Council. Rabbit guards have been placed around all palatable native species planted in the background.

Wellington – Onehunga Bay, Whitireia Park (continued)

- Community groups involved at several stages of establishment and monitoring. An example of the success of community involvement is appended where Kiwi Conservation Club and their parents were involved in planting and monitoring of backdune plants.
- Feedback from community participants was excellent. In particular, supporters of the Park, the public and youth groups were very pleased to be involved in more than just planting and readily participated in measuring planted seedlings and recording data.
- Up to 50 planted groups comprising coastal kanuka, manuka, coastal flax and toetoe have also been established on landward sites across 14 replicates to compare growth with direct seeding plots in collaboration with Friends of the Park and GWRC.



Successfully established backdune plantings including koromiko, coastal flax, toetoe, karamu, kohuhu, and ngaio at Whitireia Park established by community groups and schools with support from local councils Greater Wellington and Porirua City. Key requirements include control of exotic grass cover, use of high quality nursery stock and providing rabbit protection for newly planted seedlings.

Wairarapa – Riversdale Beach

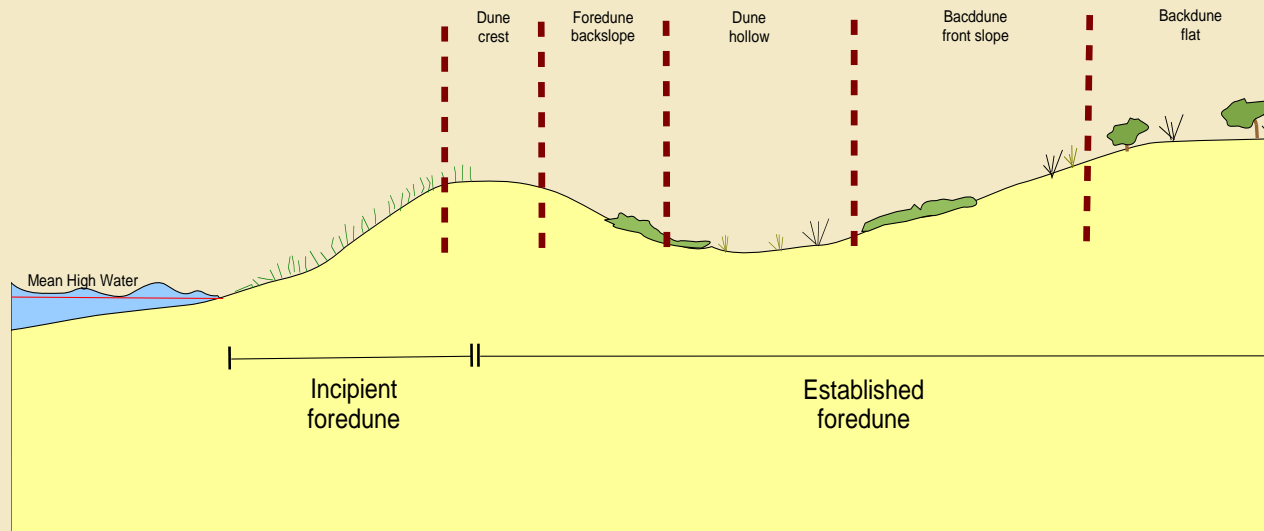
- Council and local residents have undertaken weed control and planting of natives on backdunes focussing initially on dunes in front of 2-3 beachside properties.
- Seed was sourced locally for a wide range of backdune species including less common and rare coastal species such as *Muehlenbeckia astonii*, sand coprosma, *Poa billardiarei*, *Pimelia arenaria* and *Discara tomentosa* (matagouri).
- Inspection of the backdunes confirmed dominance by exotics mainly marram grass, buffalo grass, gazanias, ice plant, and many exotics escaped from gardens.



Backdune area at Riversdale Beach, Wairarapa, dominated by marram grass and other exotics where restoration plans in collaboration with adjoining landowners undertaken to restore indigenous biodiversity.

Kapiti Coast - Waitohu

- The Coast Care group near the Waitohu Stream have been monitoring planting initiatives on backdunes for 4-5 years and provided records of numbers of plants by species established and survival estimates.
- The recommended planting layout for most backdune areas is to focus planting on a small area initially by planting small plots or clusters of natives – this is the focus of the setting up the Demonstration Area at the Waitohu site.



Where planting was planned over a range of sites on a backdunes (established foredune/backdune), the backdune was stratified into one of several site types including dune crest, seaward and landward facing slopes, and dune hollows. This will allow monitoring of performance of natives planted with each of these zones separately.

Kapiti Coast - Waitohu

- Recent establishment of several new planting sites and trials including evaluating manuka planted on lee and windward slopes and swales within the backdune system. Treatments included site shelter and comparing topped vs non-topped tall manuka plants.
- Early results indicate poor survival of manuka on all but the most sheltered sites.
- Small pilot trial of the endangered sand daphne (*Pimelia villosa*) and sand coprosma (*Coprosma acerosa*) has seen some good survival and growth on open backdune sites adjacent to beach accessways.



A typical backdune site has been selected within the Waitohu dunes for the establishment of the backdune Demonstration Area. The site comprises a front and back slope and dune swale dominated by marram grass and scattered boxthorn.

Wellington – Petone

- Petone foreshore where natural regeneration of backdune plants is occurring on recently established spinifex dominated foredunes. Excellent examples of roadside planting of native backdunes species acting as a seed source for semi-stable sand dunes within metres on the seaward side of the seawall.
- Number of plants by species were assessed for height and crown spread along permanent dune profile transects.
- Key native species regenerating naturally on backdunes included *Poa cita*, convolvulus, coastal flax, *Carex testacea*, sand bidibid (*Acaena pallida*), tauhinu and knobby club rush.
- History of the site including management has been collated including previous establishment of foredune planting trials with local community groups and the Hutt City Council.



Native gardens planted along roadsides are acting as an effective seed source for a range of backdune native species found regenerating on semi-stable dunes immediately seaward of the wall, Petone foreshore, Wellington Harbour.

Wellington – Petone (continued)

- Backdune trials near the Petone wharf within the upper Wellington Harbour as part of a collaborative project involving Hutt City Council (HCC) and Friends of Petone Beach coast care group with support from the Greater Wellington Regional Council.
- The main objective of the trials was to develop practical methods for volunteer coastal groups in the restoration of the highly modified dunes characteristic of many parts of the inner Wellington Harbour foreshore from Petone to Eastbourne. This has involved the planting of a range of locally indigenous plant species on backdune and foredune sites, on both sandy and gravel beaches.
- The four species that have performed the best on the semi-stable backdune at Petone with survival of 70% or more with significant lateral growth of the crown and with an average plant vigour score are wiwi, wharakiki, pohuehue and tauhinu.



Wellington – Eastbourne

- Knobby club rush is proving to be the easiest to establish on these highly exposed sites so there is potential to use a higher proportion in early plantings to provide initial shelter before inter-planting groups or single plants of other coastal natives.
- Survival and growth measurement of mixed sand and cobble beaches at Eastbourne completed; very exposed stable backdune sites with high initial mortality of planted natives; most successful species after planting in terms of survival and spread include coastal flax, Spaniard grass (*Aciphylla squarrosa*) and pohuehue.
- Assessment of earlier plantings along sandy beaches at Rona Bay and Days Bay also undertaken; key species with highest survivals include tauhinu, wiwi, *Olearia solandri* and in sheltered sites taupata.



Eastbourne coastline, Wellington. Planting knobby club rush to provide an initial shelter for later inter-planting of less hardy native species is a preferred method for Coast Care groups restoring these degraded, exposed coastal sites.

Nelson-Tasman – Motupipi Spit

- The demonstration site at Motupipi Spit is fairly typical of the wave exposure along the coast and contains a wide range of backdune environments - therefore providing a useful representative site for Golden Bay. Other local Golden Bay sites will also continue to be monitored during the project, together with backdune restoration sites in Tasman Bay.
- Motupipi Spit has a number of advantages as a demonstration site:
 - Planting work has been conducted here for nearly 7 years to date and so there are older plantings that can provide useful information on performance of different species over time in different backdune environments – aiding in design of the demonstration plantings
 - The spit contains large backdune areas with a wide range of different backdune environments (including open coast and estuarine margins as well as a very dynamic estuary entrance area), varying degrees of wind and salt exposure, and varying distances from the coast.
 - The site includes dune areas abutting various estuarine and freshwater wetlands enabling ecosystem transitions and sequences to be restored over time
 - Walking and bike tracks are being progressively developed in the area so that there is considerable opportunity to incorporate public information and learning opportunities with restoration in the area.
 - The site contains a wide range of exotic vegetation including marram along the coastal margin and gorse and tree lucerne further inland. Japanese Honeysuckle is also becoming problematic in some areas. This vegetation provides a range of challenges and learning opportunities for transitioning from exotic to native vegetation communities. The site also has animal pest (particularly hares) and other (e.g. fire) challenges which provide useful learning opportunities.
 - The site is located immediately to the west of a popular golf course which has encroached close to open coast and estuarine margins resulting in a range of environmental and (open coast) erosion hazard issues – so the demonstration area offers a useful indication of what can be achieved by allowing suitable buffer zones for natural processes and environments along the coastal margins.
 - The site is also significant to local tangata whenua and has wahi tapu status.

Nelson-Tasman – Motupipi Spit (continued)

- Restoration work commenced 6-7 years ago, though a large fire about 3 years ago destroyed a lot of the earlier restoration planting.
- Plantings of a wide range of locally sourced native trees and shrubs including akeake, coastal kanuka, coprosma propinqua, pigeonwood, totara, cabbage tree, *Hebe stricta*, ngaio, mountain flax, taupata, mahoe, tauhinu, karamu, and lemonwood.
- In addition, restoration of pingao and spinifex has been undertaken on the marram-dominated frontal dune and planting of lower backdune species such as sand coprosma, sand pimelea, *Austrofestuca littoralis* and knobby clubrush.
- Project includes Tasman District Council Coastcare and Department of Conservation who provide the plants, specialist advice and supervision, undertake a wide range of preparation work and provide equipment to assist with the restoration.
- There is also strong community support with the plantings.



Canterbury – Southshore, Christchurch

- A typical marram grass-dominated backdune complex with scattered exotic and native shrubs where several hundred natives are planted each year by the Christchurch City Council Coast Care Unit in collaboration with local community groups and schools.
- Key native species planted include harakeke, ti kouka, swamp ribbonwood in low areas, nagio, five finger, taupata, akeake and tauhinu. Planting is done in June and July to ensure plants are well established before summer droughts.



Substantial areas of the Southshore Spit in Christchurch require backdune planting. Marram dominated areas are highly vulnerable to deliberately lit fires during dry summers. The site is a highly popular recreational area and attracts local and wider Christchurch city community groups to planting days.

Canterbury – Bottlelake Forest, north Christchurch

- This hugely popular coastal exotic forest park has close to a million visits per year with recreational activities including walking, running, mountain bikes and horses.
- Marram dune and exotics along the coast are vulnerable to fires so a long term objective is to increase native cover on backdunes including enhancing wetlands and permanent and ephemeral ponds. Scope to demonstrate use of sacrificial zone of exotic pines as shelter for establishment of natives, before eventually removing pines.
- Key native shrub species for restoration similar to Southshore Spit.



Lowland sites with ponds and surrounding wetlands that are slowly being restored to native coastal and wetland species just landward of marram dominated dunes along Bottlelake Forest on the northern outskirts of Christchurch.

Canterbury – Tuhaitara Coastal Reserve, Woodend Beach

- Te Kohaka o Tuhaitara Trust aim is to replace in the long term willows and pines that dominate backdunes along 10.5 km of coastline and the riparian areas of the Tutaepatu Lagoon.
- Several restoration initiatives underway in collaboration with the Department of Conservation, Waimakariri District Council and friends of the Trust.
- Five 'biota nodes' have been recently established and rabbit fenced, some with small ponds and wetlands. The aim is to provide seed sources for natural regeneration of natives and food for native birds in the reserve.
- Local schools are involved in developing restoration plans for each node using a range of wetland and riparian plants. Monitoring methods are being developed for backdune restoration for use by the schools for planted nodes and other sites.



Several of these backdune sites within the Te Kohaka site at Woodend Beach have been rabbit fenced in readiness for planting with local backdune species such as pohuehue, sand coprosma, Carex species and a wide range of shrub species in mid-2012 and ongoing monitoring by local schools.

South Canterbury – Otipua Beach

- A backdune planting trial was established by the Timaru District Council along the coastal walkway at Otipua Beach, Timaru, mid 2012.
- Approximately 4500 seedlings were planted with and without protection from rabbits; several rabbit proof plots 12 m x12 m and 70 cm high using 3 cm gauge wire netting constructed around selected plots with unfenced controls.
- Native backdune species planted include pohuehue, cooks scurvy grass, salt marsh ribbonwood, ti kouka, karamu, toetoe, native broom, broadleaf, hebe, harakeke
- All plantings were provided with mulch around their bases. Some of the seedlings planted outside of the rabbit proof plots were given rigid plastic shelters as protection from browsing.



Backdune plantings outside of rabbit proof trial plots at Otipua Beach, Timaru. Note the brown plastic seedling protectors on selected planted backdune natives.

Canterbury – Carloline Bay

- Excellent establishment of a range of backdune species on sand dunes by the Timaru District Council and local community groups including Task Force Green.
- Objective is to plant a wide range of low growing backdune native species landward of the boardwalk including *Poa cita*, *Cortaderia richardii*, pohuehue, shore ribbonwood, shore spurge, harakeke, oioi in lower swales, taupata and ngaio; many local indigenous plants also established.
- Extensive boardwalks and fencing provide protection; regular rabbit control; monthly inspections of sites for weed growth. Significant natural spread and regeneration. Direct seeding successful for pingao and other sedge species on open dunes.



Planted native shore spurge and wiwi quickly dominate semi-stable backdunes providing a low dense cover, Caroline Bay, Timaru

Otago – Ocean View Beach

- On the Otago coast south of Westwood Recreation Reserve is the council reserve Ocean View Beach.
- The foredunes are dominated by exotic marram grass with small groups of old and newer plantings along each side of the walkway and carparks.
- Older planted species consist of taupata, harakeke ngaio and wiwi are surrounded by exotic weed grass and vine species
- New native plants established (within the last three years) consist of hebe, ngaio, harakeke, totara, kohukohu and broadleaf. Spot spray releasing has been carried out to kill the exotic weeds around each of the new small plants.



Release spraying of weed species around the new native seedlings at Ocean View Beach.

Southland – Bushy Point Reserve, Otatara

- Located 5km south west of Invercargill, Bushy Point Reserve is a Department of Conservation reserve managed by the local Otatara Landcare Group.
- Mixed species plantings as part of the Living Legends programme.
- Comprehensive animal pest control programmes have been very successful in reducing the number of possums, stoats, ferrets, rats etc from the area which is also a popular native bird habitat.



Measuring the 2011 Living Legends plantings beside the native (totara dominant) forest remnant at Bushy Point, Otatara. One of several excellent information boards found across the site for visitors with detail on restoration initiatives underway at the Bushy Point Reserve, Invercargill.

Handbook articles on backdune restoration

12 articles for the Dunes Trust Technical Handbook on backdune restoration have been published.

PDF copies can be downloaded from the Dunes Trust website www.dunestrust.org.nz

1. Backdunes – an introduction
2. Zonation and succession on coastal sand dunes
3. Native ground cover species on mid-dunes
4. Native shrub and tree species for planting on backdunes
5. Planting natives on sand dunes – getting started
6. Weed control options for coastal sand dunes
7. Monitoring coastal sand dunes – an introduction
8. Coastal forest species on sand dunes
9. Wiwi – knobby club rush – the wonder plant of backdunes!
10. Restoration of sand daphne – a plant in decline
11. Restoring degraded urban sites – Case study - Coromandel
12. Establishing natives on sand dunes - Caroline Bay, Timaru



Project Partners

Along with the Ministry for the Environment's Community Environment Fund (CEF) the Dunes Trust thanks the following partner organisations for their funding and ongoing involvement in the Backdune Project.

We also appreciate the fantastic efforts of the community groups working in each of these regions on their local projects.

