



Restoring Degraded Urban Dunes

Case Study - Eastern Coromandel

INTRODUCTION

As part of a backdune restoration project funded by the Ministry for the Environment's Community Environment Fund (CEF), Waikato Regional Council, and other project partners demonstration trials were undertaken at Cooks and Whangapoua beaches sites along the eastern Coromandel coast, North Island, New Zealand. The work was designed to evaluate an alternative approach to better achieve restoration of appropriate native dune vegetation communities on the weedy dunes that occur seaward of coastal holiday settlements. These heavily modified urban beaches are typical of developed and well used beaches throughout the country.

'Whole of dune' approach

The method of dune restoration involves a 'whole of dune' approach where the dense weed cover of both foredune and backdune are mechanically removed to allow planting of appropriate native plant species within each zone.

In particular, the objectives of the work were to:

- Restore native dune vegetation over the full width of the remnant natural dune;
- Facilitate rapid development of the appropriate native vegetation cover;
- Inhibits weed regrowth;
- Reduce maintenance requirements and in particular herbicide spraying and manual clearance of weeds weed;
- Reduce workload of volunteers in Coast Care groups in restoration and management of their dunes;
- Involve adjacent landowners taking ownership in collaboration with management agencies and the wider community; and
- Ultimately restore indigenous biodiversity and natural dune form and function.

The 'whole of dune' approach involving a component of mechanical earthmoving to more effectively reduce weed cover and subsequent maintenance has brought together key elements found to be successful in earlier restoration work.



BACKGROUND

Many of the dunes where Coast Care groups are involved in restoration occur along the seaward margin of coastal settlements where remnant dunes seaward of private properties are often relatively narrow (e.g. commonly < 30 m) and strongly weed-dominated. Maintenance of coastal sea views can be a major constraint on restoration.

Extensive and successful dune restoration has been undertaken at such sites over the last 20 years, particularly focusing on restoration of the native sand binder (e.g. spinifex, pingao) vegetation zone on the seaward dune face – critical to natural dune building and repair (refer to other Dunes Trust Handbook articles on foredune vegetation in Section 7 and dune form and function Section 2). However, over time, restoration outcomes have often been compromised due to regrowth of aggressive weed species throughout landward zones and re-invasion of foredunes.

Backdune vegetation

Less attention has been given to restoration of the backdune vegetation communities landward of the sand binder zone. There is often also landowner/community resistance to removal of weed species in this area for various reasons. In addition, work to date has often relied on spraying and manual clearance of weeds which is labour-intensive for volunteers. Considerable difficulties have also been experienced with maintenance; serious weed re-invasion being relatively common. Restoration outcomes have also sometimes been compromised by activities such as encroachment of private lawns and/or the dumping of garden wastes onto restored areas.

Coast Care programmes typically have limited budgets for each site and so the difficulties with backdune restoration mean groups often focus on other areas where there are more readily achievable gains. More successful and sustainable approaches are required to facilitate long term dune restoration at degraded urban sites.



Re-invasion of restored foredunes by aggressive weed species spreading from backdunes can occur over time (above) if backdunes dominated by exotics including garden escapes (below) are not also restored to appropriate native species.





RESTORATION APPROACH

The 'whole of frontal dune' approach trialled at the two sites involved restoration over the complete width of the frontal dune – generally landward to property boundaries (though at Cooks the works terminated slightly seaward). The restoration involved the following steps:

- Spraying of the exotic vegetation to achieve total die-off;
- Earthworks using an appropriate machine and skilled operator to remove exotic vegetation cover and restore the substrate to clean loose sand;
- Dense planting (typically 6-8 plants/m²) with appropriate backdune species; planting was undertaken soon after the earthworks to minimise windblown sand; and

- Ongoing monitoring of species performance (survival, growth rates and vigour) and maintenance requirements – primarily detailed site inspections and photographs.

The key ecological premises underlying the approach were:

- The weed-choked sites required significant disruption of the weed communities to inhibit the return of exotic species (including complete kill-off and removal of the exotic vegetation, seed banks and underground components as far as practical).
- Dense planting was required to rapidly facilitate a dense cover of native vegetation that would be self-sustaining and help suppress recovery of exotics including re-invasion from surrounding areas.



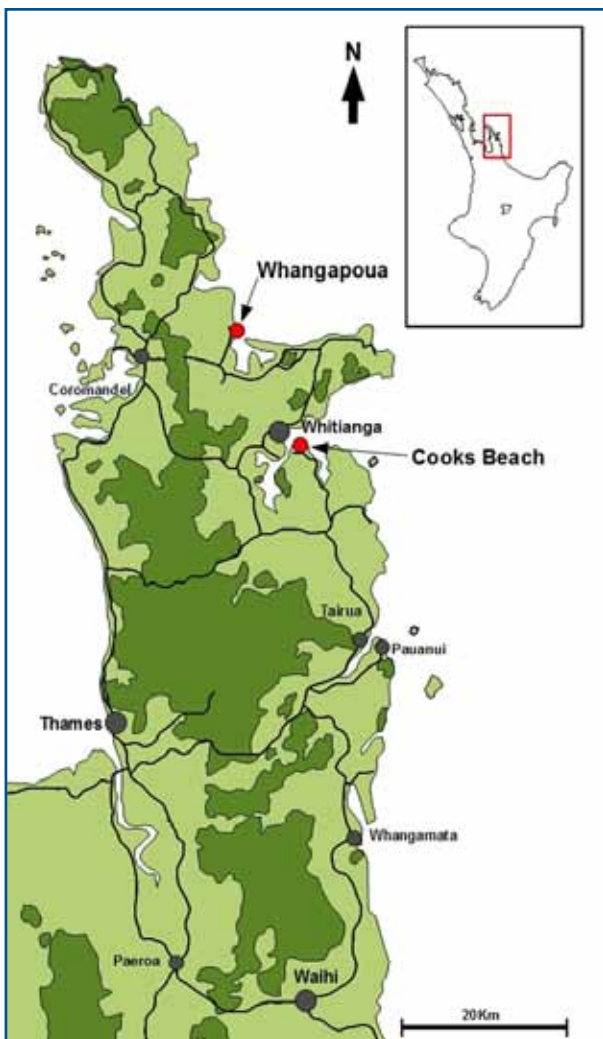
The 'whole of dune' approach involves mechanically removing the dense weedy layer from the dune (inset) to leave clean loose sand to allow planting of native sand binders on the foredune zone and native backdune species on the landward zone.



TRIAL SITES

The 'whole of dune' approach was trialled initially at two Coromandel beaches, Cooks Beach and Whangapoua. These beaches have dunes typical of many east coast holiday settlements comprising a narrow width of remnant dunes seaward of properties with dense weeds and little native backdune vegetation, and constraints imposed on restoration by issues such as views.

Whangapoua Beach is an open coast exposed site while Cooks Beach is more sheltered. However, the dunes at both sites are exposed to ocean storm-swell and subject to duneline fluctuations (commonly up to 10-20 m) associated with storm erosion and recovery.



Whangapoua and Cooks Beach are two popular beaches on the Coromandel Peninsula where the 'whole of dune' approach to restoration has been successfully demonstrated.

SPECIES PLANTED

Knobby club rush (*Ficinia nodosa*) and pohuehue (*Muehlenbeckia complexa*) were used as the primary backdune vegetation community at both sites. These were the dominant native species in early successional recovery in the relevant backdune vegetation zone at both sites.

A small number of other species were also included in planting trials known to occur in this zone on Coromandel dunes but which are now relatively uncommon including *Carex testacea*, New Zealand spinach (*Tetragonia tetragonoides*), sand daphne (*Pimelea villosa*), sand tussock (*Poa billardierei*) and sand coprosma (*Coprosma acerosa*). New Zealand celery (*Apium prostratum*) and Cooks scurvy grass (*Lepidium oleraceum*) were also experimented with.

These additional species were tried in a wide range of microsites within the prepared landward environments – though typically outside the areas where a dense knobby club rush and *Muehlenbeckia complexa* community was anticipated. NZ spinach and sand coprosma were however included in planting over the wider area as both species are sometimes observed in vegetation communities with knobby club rush and pohuehue.

The planting used the smallest plant sizes available for the different species (typically Hilson Root Trainers – RTH) to help offset the additional costs associated with the earthworks and the denser than normal planting. A single slow-release NPK fertiliser tablet was incorporated into each planting pit for all species during planting.

COOKS BEACH

Sand binding zone

The first trial of the approach in backdune areas was undertaken at Cooks Beach in the first year of the CEF backdune research project (2011) – with restoration of the sand binder zone to seaward the preceding year. Further backdune trials of the approach were conducted in both 2012 and 2013 – each extending the restored area further alongshore.



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On each of the three occasions the backdune area cleared and planted was approximately 500-600 m² in extent. In each case, the backdune areas were only cleared and restored once the native sand binder zone to seaward had been successfully restored – to minimise risks of windblown sand issues and accompanying plant loss.

The restoration work was designed in consultation

with adjacent front beach property owners who also organised and undertook the planting.

Restoration of the sand binder zone used a similar approach to the backdune trials. Typical 'before' and 'after' photographs of this work are shown in Figure 1. This work was very successful – typical of similar work at many other sites over the last 20 years.



Figure 1: Restoration of sand binder zone at first Cooks Beach trial site - showing exotic dominated dune before works (top), following excavation and prior to planting (middle) and 1 year after planting (bottom). A two-stage 'whole of dune' restoration process was used to reduce risk of wind-blown sand – the foredunes were restored first to a cover of native sand binders before the landward backdune zone was restored the following year.



Backdune restoration

Prior to the work, the backdune area was densely vegetated with exotic vegetation, particularly agapanthus (*Agapanthus praecox*) and various exotic perennial grasses but also a range of other exotic species including garden escapes. Native species occurred intermingled with the exotic cover – particularly pohuehue and knobby club rush. Apart from one small patch of knobby club rush and two (planted) flax bushes, it was not possible to avoid clearance of the native vegetation as it was simply too intertwined with the exotic vegetation.

Before and after shots of the first backdune restoration are shown in Figure 2. The restoration work was extremely successful in restoring dense native backdune vegetation – with complete vegetation cover largely achieved within one year.



Knobby club rush



Pohuehue

Plant performance

Initially, small numbers of additional species planted amongst the pohuehue and knobby club rush survived. However, as the dense knobby club rush and pohuehue community developed most other species were eliminated - apart from NZ spinach and limited sand coprosma (both intertwined within the knobby club rush and pohuehue community) and *Carex testacea* located in more open areas around the margins.

The knobby club rush and pohuehue community has continued to increase in density – with the picture on the front page of this article showing the same site approximately 27 months after planting. By this time the knobby club rush and pohuehue community was so dense it was difficult to walk through. The two subsequent trials further east in 2012 and 2013 show virtually identical results, though with greater survival of some elements of the plantings of additional species due to better location based on lessons from the first planting.

Weeds and maintenance

Weed invasion of the restored areas has been minimal apart from limited small patches of exotic perennial grasses – probably seeds from the surrounding landscape blown into small gaps in the planting. These were readily eliminated with grass specific herbicide (haloxyfop) with no detrimental effect on the native vegetation. Otherwise, maintenance has been limited to spraying a small width of exotic perennial grasses along the landward margin to prevent horizontal invasion from adjacent lawns.

The results are more successful and far more rapid than previous backdune restoration in similar environments along the eastern Coromandel coast - where the work relied on spraying and manual clearance and less dense (typically 4 plants per m²) planting. In those areas, less complete cover was achieved and serious ongoing reinvasion by exotic vegetation has often been experienced – typically requiring relatively high levels of maintenance to sustain the restoration.



Figure 2: Restoration at first Cooks Beach backdune trial site - showing dune dominated by exotics (top), following excavation and planting (middle) and dense native backdune vegetation 1 year after planting (bottom). Each backdune trial was undertaken the year following restoration of the spinifex zone to seaward (e.g. the works shown in Figure 1).

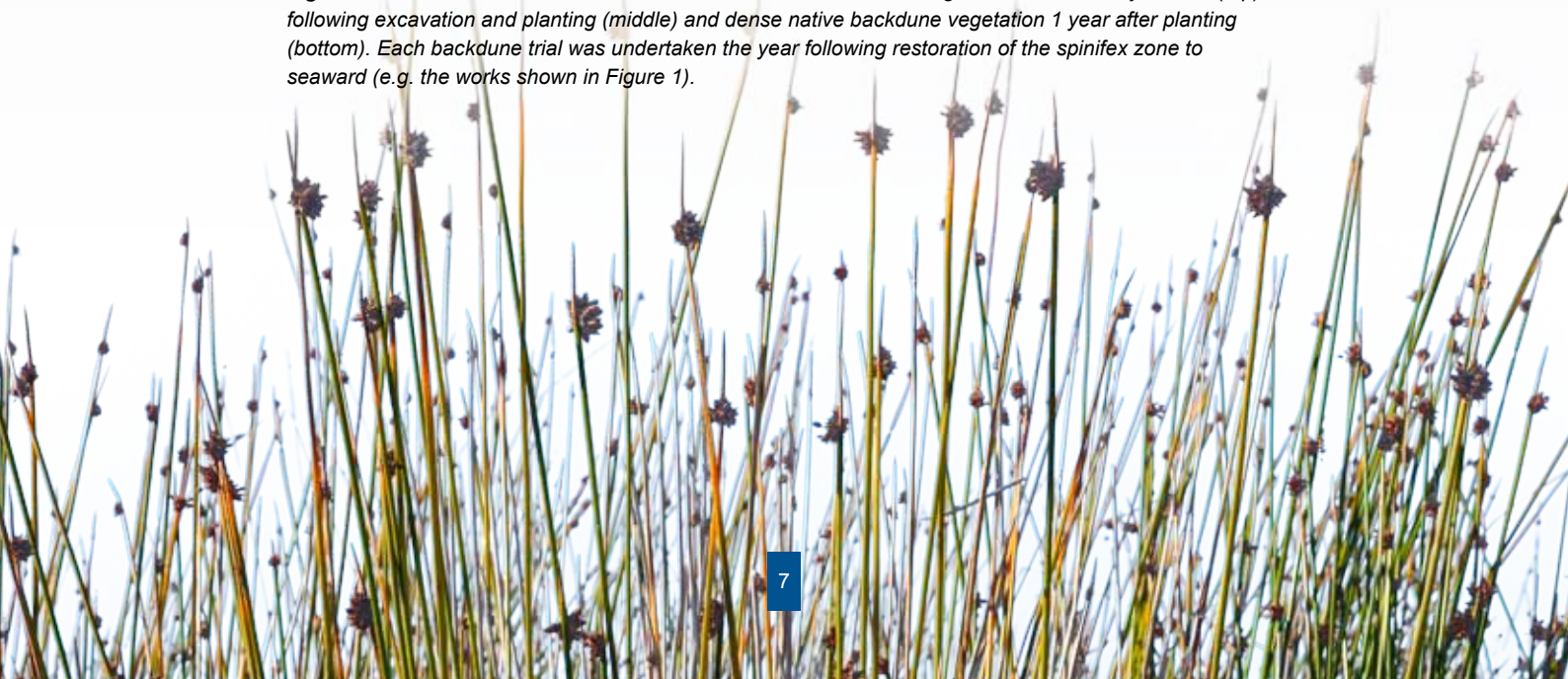




Figure 3: Whangapoua trial area 1 - before clearance (top), 1 month after planting (middle) and 15 months after planting (bottom).



Figure 4: View of second trial site - prior to restoration (top photo), immediately after planting in August 2013 (middle) and in April 2014 about 9 months after planting (bottom).



SUCCESSFUL RESTORATION APPROACH

The “whole of dune” approach trialled has proved very effective at restoring native dune vegetation communities along the seaward margin of coastal settlements - on both the seaward face of the dune and in very weedy backdune environments. In all 5 trials to date, complete cover of native backdune vegetation has been achieved well within 12-15 months of planting, with very little reinvasion of the planted areas by exotic species. The primary maintenance has been limited to managing reinvasion of exotic grasses from lawns along the landward margin.

It has also proved possible to date to re-establish a number of additional backdune species within the restored area to enhance biodiversity, including some threatened species (e.g. sand pimelea and sand coprosma). However, this has required careful location of these species learning from the earliest trials using simple monitoring and it is still too early to conclude that the threatened species will persevere at the sites.



Species 12 months after inter-planting with pohuehue and knobby club rush. These include sand tussock (top left), sand coprosma (top right), sand daphne (middle left), Carex testacea (middle right), NZ spinach intermingled with knobby club rush (bottom left) and NZ spinach as the sole cover in a shady area (bottom right).



Community support

As the 'whole of dune' approach involves substantial disturbance of the foredunes and backdunes including the use of machinery it is critical that all stakeholders are involved in all stages of consultation, planning, implementation and maintenance. This includes the Coast Care groups and wider public at each community, management agencies as well as informing visitors and users at each of the local beaches.

In these Coromandel examples front beach owners and the wider community were involved in all stages. Some parties initially had concerns at the use of earthworks. It was therefore important that the 'whole of dune' approach was trialled on small areas at each location with local communities taking an active role.

The subsequent success of this restoration approach at all sites to date has engendered strong support and involvement from adjacent property owners and the wider community. Landowners and communities are keen to continue the work alongshore in future years until all backdune areas have been restored.



Comparative cost and maintenance

In terms of capital cost, the approach is approximately twice as expensive as simpler backdune dune restoration approaches that do not involve earthworks and high planting densities. For instance, at the sites outlined above the work typically averaged \$15-16/m² using community based approaches - compared to about \$7-8/m² for similar backdune work at other sites that only involved spraying or hand clearance by way of preparation and more typical planting densities (about 4 plants/m²).

However, the maintenance requirements are considerably less. The approach is also more successful at weedy sites than approaches that do not involve site clearance and high

planting densities – many of which are subject to considerable weed re-invasion even with attempted ongoing maintenance. It is also superior in terms of engendering and maintaining community support.





Dense knobby club rush planted 15 months after mechanical removal of dense cover of weeds over this Coromandel backdune.

CONCLUSIONS

Overall, the approach appears to be an extremely useful and effective option for dune restoration along the seaward margin of coastal settlements with seriously degraded dunelands. Even with the limited budgets of most Coastcare programmes, the approach is likely to be more successful over time in effecting sustainable dune restoration and maintaining community support.

However, given the cost, the work is best suited to systematic restoration - where over a period of time it is decided to restore a particular length of dunes. Scattered patches of restoration, long distances apart and surrounded by weeds, are difficult to maintain no matter what approach is used.

In addition, while knobby club rush and pohuehue were the appropriate dominant species at these sites, restoration at any particular site must involve careful selection of the key species appropriate to the site and zone being restored (e.g. see pamphlets in Section 5 of the guidelines). In addition, as at these Coromandel sites, small trials which are carefully monitored are the best approach when the work is first started – as there are always site specific issues and particularities that are difficult to predict. Larger scale operational work should only be undertaken once you have confirmed the best approach for your site.

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'To see the majority of New Zealand dunes restored and sustainably managed using indigenous species by 2050'.