

Ten Years of Research and Implementation, Dune Restoration Trust of New Zealand

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ABSTRACT

The experience of establishing and maintaining a successful network of stakeholders throughout New Zealand that are interested in different aspects of sand dune restoration and management for over decade has produced a number of key lessons. This paper provides an outline of sand dunes in the New Zealand context; the establishment of the Dune Restoration Trust of New Zealand; presents examples of research and implementation; discusses key lessons for effective collaboration on dune management issues between research providers, management agencies, industry and communities; and highlights the future direction for the Trust.

Our experiences in operating a multi-stakeholder network may be relevant for others seeking to develop a similar network in their own countries. There is also potential to develop an international sand dune restoration network.

KEY WORDS: Sand Dune Restoration; Management; National; Network; New Zealand; Dune Restoration Trust of New Zealand.

INTRODUCTION

New Zealand is a narrow country spanning latitudes 34 to 47 degrees South. Sand dune ecosystems occupy about 1100km of the New Zealand coastline. They exist in a range of geomorphic settings such as in the North Island from the high wave and wind energy, large sand volume west coast barrier systems to small isolated pocket beaches more typical of the east coast.

A large proportion of New Zealanders live within 10km of the coastline (Hesp, 2000). In New

Zealand, over the last decade or so, there has been an increasing recognition of the importance coastal sand dunes play in protecting natural, cultural and scientific values (Environment Waikato, 2001; Nordstrom, 1990; Furey, 1997; McFadgen, 2003). Most recently, it has also been recognized that sand dune ecosystems will become increasingly important with the effects of projected climate change (Ministry for the Environment, 2001).

Sand dune stabilization, relying upon exotic species (such as marram grass (*Ammophila arenaria*)), ice plant (*Carpobrotus edulis*), kikuyu grass (*Pennisetum clandestinum*), has been a feature of large scale land management programmes over the last century. Large scale production of indigenous plants for dune restoration purposes was seen as impractical. It is only in the last 15 years that emphasis has been placed on using dune species indigenous to New Zealand for restoration and management purposes.

The demand for new research in this area and the associated need for effective communication methods between researchers, managers and communities led to the formation of the Coastal Dune Vegetation Network in 1996. This network has evolved and is now known as the "Dune Restoration Trust of New Zealand".

This paper provides an outline of sand dunes in the New Zealand context; describes the establishment of the Dune Restoration Trust of New Zealand; presents examples of research and implementation; discusses key lessons for effective collaboration on dune management issues between research providers, management agencies, industry and communities; and highlights the future direction for the Trust.

NEW ZEALAND'S UNIQUE DUNE ECOSYSTEM

The New Zealand sand dune ecosystems developed in geographic isolation and were sheltered from any human influence until around 900 years ago. The sand dune vegetation assemblages reflect this geographic isolation and in addition the climatic and geomorphic variation through out the country.

The key indigenous sand binding species on the seaward face of the foredune are spinifex (*Spinifex sericeus*) (Fig. 1) and the endemic pingao (*Desmoschoenus spiralis*). (Fig. 2). Summaries of existing knowledge on these sand binding species are provided in Bergin and Herbert (1998) and Bergin (1999).



Figure 1, Spinifex



Figure 2, Pingao.

Complexity of dune systems landward of mobile foredunes increase in both landforms and vegetation cover. These range from highly mobile inland dunes such as the parabolic dune fields of the Manawatu plains in the southern part of the North Island to dune wetlands and coastal forest (Hesp 2000). However, there are few examples remaining of intact indigenous dune vegetation sequences landward of the foredune where a diverse community of indigenous herbaceous, woody groundcover, shrub and tree species occur (Partridge, 1992; Johnson 1992).

IMPACT OF HUMAN ACTIVITIES

Human activities over the last 800 years have had a significant impact on the natural form and function of New Zealand's sand dunes (Hesp 2000). These impacts have led to major changes in dune morphology, vegetation cover and composition, and natural coastal processes (e.g. Cockayne, 1909; 1911; Esler, 1978; Environment Waikato, 1999; 2001; Hilton et al., 2000; Jenks and Brake, 2001; Dahm and Spence, 2002a,b; Jenks, 2005). In fact, coastal sand dunes are among the most modified of all New Zealand ecosystems.

Human impacts on New Zealand sand dunes ecosystems are numerous and varied (e.g., McKelvey, 1999; Hilton *et al.*, 2000; Hesp, 2000). These include:

- Removal of lowland forests from back dune areas.
- Wind erosion associated with degradation and damage of indigenous sand binding foredune vegetation.
- Modification of dunes associated with coastal subdivision and development of infrastructure.
- Displacement of indigenous dune vegetation by exotic species.
- Proliferation of coastal structures such as stormwater outlets, seawalls, causeways etc.
- Sand extraction from beach and dune systems.
- Conversion of dune landscapes to productive forestry and farming.

- Effects of introduced animal pests.

Inventories of nearly all New Zealand dunes in the early 1990s indicated a high degree of human induced modification at most sites (Partridge, 1992; Johnson, 1992). Despite this dramatic change in the form and ecological integrity of the sand dune environments, beaches and dunes maintain a critical role in the identity of New Zealanders and are of particular cultural significance to indigenous Maori communities. Beaches and dune environments remain an integral component of New Zealanders' lifestyles and livelihoods.

FORMATION OF A NATIONAL SAND DUNE NETWORK

The Resource Management Act 1991 established in legislation the "national importance of preserving the natural character of the New Zealand coastline". In addition, regional and district government agencies were allocated direct management responsibilities to achieve this outcome. Sand dunes, their natural form and function, and their indigenous vegetation cover, are an essential component of the natural character of sand beaches (Hesp, 2000).

The need for a nation-wide body to coordinate sand dune management and research that focused on restoring natural dune form and function led to the formation of a national Sand Dune Network, now known as the Dune Restoration Trust of New Zealand. The previous network was formed as collaboration between research agencies, regional and local authorities, sand dune forest owners, coastal interest groups and individuals. The Trust continues to build on and develop these partnerships. It aims to provide an open and collaborative forum to discuss dune management issues, provide direction and funding for sand dune research and disseminate scientifically sound restoration and management techniques. Funding for the Trust is sourced directly from central government and from regional and district authorities.

The Trust provides a forum for the free exchange of information on sustainable management of dune ecosystems with emphasis on the use of

vegetation to restore natural character, form and function. With the involvement of a wide range of end users, practitioners and researchers, the network also assists with the identification, prioritisation, implementation and dissemination of research results throughout New Zealand.

A further aim of the Trust is to ensure that wherever possible, best-practice methods based on scientific principles are adopted in restoration of dunes that improve the degree of restoration success rather than a reliance on anecdotal information and untested procedures. Therefore, research trials are established with the active involvement of local communities, landowners and managing agencies aimed at developing practical cost-effective techniques and options for dune rehabilitation.

Membership of the Trust's network includes community groups, Maori groups, regional and district councils, consultants, indigenous plant nurseries, educational institutes, and coastal land and forest owners. The success of the network/Trust has led to it being used as model for the setting up of other multi-stakeholder networks in New Zealand.

A national conference is held in different locations throughout the country annually. These conferences are open to all interest groups and individuals to facilitate discussion regarding sand dune issues from different perspectives. A particularly successful feature is the contribution from those involved in restoring and managing dunes at a local level throughout the conference. A regional roundup by community and management agencies is a highlight of the conference where local restoration issues and techniques are shared. Active participation by local community members is facilitated by low-cost conference fees and accommodation and travel options. Technical sessions allow for a range of presentations but the focus is mostly on practical examples of dune restoration backed up by community-based research trials. Fieldtrips to nearby beaches allow local community groups and managing agencies to demonstrate a range of management and community issues and solutions.

Conferences have also attracted high level local and national political participation. Most recently the Honorable David Parker, Minister for Climate

Change Issues, at the February 2007 event, during which the Minister highlighted the importance of dune restoration as one of the proactive climate change and sea level rise mitigation strategies. Keynote addresses have been given to other conferences by local and regional politicians and by other government ministers.

Over the past 10 years the network/Trust has proven to be an effective mechanism for enhancing the flow of information between scientists, coastal managers and communities across the country. In many cases research results directly influenced management decisions before formal publication has occurred.

Overall, the open and co-operative spirit of the Trust from the individuals and agency staff that have supported its' activities continues to be the cornerstone to the network's successes.

RESEARCH EXAMPLES

In the early 1990s, it was widely recognised that the key to restoring foredunes would rely on developing effective techniques to provide large quantities of the two main sand binding species, spinifex and pingao. This involved establishing research trials to determine effective methods for large-scale seed collection, germination, propagation and planting programmes.

The following sections illustrate the range of challenges and frustrations faced by the Trust members during this process.

Pingao

Before European settlement pingao was common throughout New Zealand (Cockayne 1911). However by the 1990s most populations were small and discontinuous, with virtually no pingao found in some districts. It was widely regarded as an endangered species. This was due to the human induced impacts discussed previously, and particularly grazing by introduced animals (cows, sheep, rabbits, deer, goats, possums, etc).

Trials were initiated and it was quickly established that raising large quantities of pingao seedlings in nurseries was relatively straightforward. Subsequently, planting trials

demonstrated that the inclusion of a slow-release fertilizer with the seedling at the time of planting significantly boosted growth and vigor.

As a result of this work "Guidelines for Seed Collection, Propagation and Establishment" for pingao was published (Bergin and Herbert, 1988) by which time commercial nurseries were already supplying significant quantities of seedlings for restoration purposes.

Spinifex

Spinifex is native to India, Australia, the Pacific Islands and New Zealand. From the 1980s, various Australian agencies were investigating techniques for re-establishing spinifex on their dunes. A number of methods for establishing spinifex were trialed. While transplanting nursery raised seedlings proved to be effective on a small scale, other methods such as direct seeding and transplanting of cuttings were considered to be more practical and less costly (Barr et al., 1987).

In the New Zealand setting, which tends to be cooler than Australia's, initial trials indicated that the most effective method for establishing spinifex would be by planting nursery-raised seedlings. The challenge for the Trust was therefore to develop methods for large scale production of spinifex which were cost-effective.

This work began in the mid 1990s and in contrast to pingao, spinifex proved to be extremely difficult to propagate in large numbers and at low cost. The Trust facilitated a collaborative research effort between management agencies, industry groups and research providers involving phenology studies, seed collection, propagation and planting techniques. The results of this work were published by Bergin (1999) and Bergin and Kimberley (1999), and have led to large scale production of spinifex seedlings becoming available for dune restoration programmes at reasonable cost.

Other research

In addition to the work outlined for spinifex and pingao, the Trust has also facilitated research leading to the following publications:

- Coastal sand dunes form and function (Hesp, 2000);

- Guidelines for seed collection, propagation and establishment – sand tussock (*Austrofestuca littoralis*) (Bergin, 2000);
- Review of the use of marram grass (*Ammophila arenaria*) on New Zealand sand dunes (Gadgil, 2002, 2006);
- Measuring the success of dune restoration (Miller and Paul, 2007).

The Dune Restoration Trust has several other collaborative research projects currently underway. These include:

- Mechanical reshaping of severely degraded foredunes and planting with indigenous sand binding species.
- Investigating the impact of animal pests on dune vegetation and methods for management.
- Trials evaluating methods to replace marram grass-dominated dunes with indigenous dune species.
- Re-establishing indigenous vegetation sequences in southern areas where local plant populations have been severely reduced or have become locally extinct.
- Restoration of semi-stabilised backdunes evaluating a range of coastal indigenous trees and shrubs.
- Investigating the role of a wide range of establishment practices in restoration of dune vegetation assemblages including use of fertilizers, mulches, artificial shelter, etc with planting.
- Investigating factors which influence natural regeneration of indigenous plant communities on degraded dune systems.
- Replacement of exotic coastal production forest with local indigenous forest species successions.

While the focus has been on restoring plant communities to degraded dunes, the Trust will be supporting projects that investigate the indigenous faunal communities that have been devastated in many dune systems in New Zealand.

INTERNATIONAL COLLABORATION

The expected impacts of accelerated sea level rise associated with climate change are a global concern. The Dune Restoration Trust of New Zealand is keen to promote and participate in international programmes that lead to the development of adaptive management techniques in dune restoration for local communities.

In addition, we are seeking to collaborate with other networks around the world to develop and disseminate key messages about the importance of sand dune ecosystems, management and restoration techniques and are keen to facilitate complimentary research programmes.

We invite international participation in the activities of the Trust and would welcome contributions to our newsletters, conferences and research programmes.

CONCLUSIONS

This paper highlights the events that lead to the formation of the “Dune Restoration Trust of New Zealand” and concludes that a nation-wide collaborative network has proven a useful forum for the research on, and management of, New Zealand’s unique sand dune ecosystems

The challenge for the Dune Restoration Trust of New Zealand in the future is to continue to contribute effectively to the sustainable management of New Zealand sand dune ecosystems. This involves maintaining and restoring the natural, amenity, cultural and recreational values that we as New Zealanders attach to the coastline.

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REFERENCES

Bergin, D. O. 1999: Spinifex on coastal sand dunes. Guidelines for seed collection,

- propagation and establishment. *Coastal Dune Vegetation Network Technical Bulletin No. 2*. New Zealand Forest Research Institute Limited. 28p.
- Bergin, D. O. 2000: Sand tussock on coastal sand dunes. Guidelines for seed collection, propagation and establishment. *Coastal Dune Vegetation Network Technical Bulletin No. 3*. New Zealand Forest Research Institute Limited. 20p.
- Bergin, D. O.; Herbert, J. W. 1998: Pingao on coastal sand dunes. Guidelines for seed collection, propagation and establishment. *Coastal Dune Vegetation Network Technical Bulletin No. 1*. New Zealand Forest Research Institute Limited. 20p.
- Bergin, D. O.; Kimberley, M. O. 1999: *Rehabilitation of coastal foredunes in New Zealand using indigenous sand-binding species*. Department of Conservation Science for Conservation Series No. 122. 55p.
- Boyce, W. 1993: Saving the Sand Dunes. Leisure Management NZ, Autumn 1994, 25-26.
- Cockayne, L. 1909: Report on the sand-dunes of New Zealand, their geology, botany with their economic bearing. *Department of Lands, Wellington, New Zealand, Parliamentary Paper C.13*. 29 pp
- Cockayne, L. 1911: Report on the dune-areas of New Zealand, their geology, botany and reclamation. *Department of Lands, Wellington, New Zealand, Parliamentary Paper C.13*. 76p.
- Dahm and Spence, 2002a: *Browns Bay: Coastal Hazards and Management*. Coastline Consultants Ltd. Report prepared for North Shore City Council and Auckland Regional Council, June 2002. 61p + apps.
- Dahm and Spence, 2002b: *Muriwai: Coastal Hazard Management Strategy*. Coastline Consultants Ltd. Report prepared for Rodney District Council and Auckland Regional Council, June 2002. 83p + app.
- Esler, A.E. 1978: *Botany of the Manawatu District*. Government Printer, Wellington. 206p.
- Environment Waikato, 1999: *Waikato State of the Environment Report 1998*. Published by Environment Waikato, Hamilton. 244p.
- Environment Waikato, 2001: *Fragile – A Guide to Waikato Dunes*. Published by Environment Waikato, June 2001, 33p.
- Furey, L. 1997: *Archaeological Sites on East Coast Dune Systems Coromandel Peninsula*. Report prepared for Environment Waikato, July 1997. 6p + apps.
- Gadgil, R.L. 2002: Marram grass (*Ammophila arenaria*) and coastal sand stability in New Zealand. *New Zealand Journal of Forestry Science* 32(2): 165-180.
- Gadgil, R. L. 2006: Marram grass – friend or foe? A review of the use of *Ammophila arenaria* on New Zealand sand dunes. *Coastal Dune Vegetation Network Technical Bulletin No. 5*. New Zealand Forest Research Institute Limited. 32p.
- Hesp, P.A. 2000: Coastal sand dunes form and function. *Coastal Dune Vegetation Network Technical Bulletin No. 4*. New Zealand Forest Research Institute Limited, Rotorua. 28p.
- Hilton, M., MacAuley, U. and Henderson, R. 2000. *Inventory of New Zealand's active dunelands*. Science for Conservation 157. 30p. + 124 maps.
- Jenks, G.K. 2005: *Why Coast Care? In: Steward, G. (Compiler): Proceedings of the Coastal Dune Vegetation Network Conference, Whangarei, February 2005, Tai Tokerau Dunes*. 17-19.
- Jenks, G. K. and Brake, L. A. 2001: *Enhancing Dune Function and Landscape Integrity*. Journal of Coastal Research Special Issue 34, pp 528-534.

- Johnson, P. N. 1992: The sand dune and beach vegetation inventory of New Zealand. II. South Island and Stewart Island. *Department of Scientific and Industrial Research Land Resources. Christchurch, Scientific Report No. 16.* 278p.
- McFadgen, B.G. 2003: *Pre-European Archaeology of the Coast.* Chapter 12 in “The New Zealand Coast: Te Tai o Aotearoa”, Dunmore Press. 312p.
- McKelvey, P. 1999: *Sand forests.* Canterbury University Press, University of Canterbury, Christchurch, New Zealand. 168p.
- Miller, E M; Paul, T.S.H. 2007: Measuring Success - guidelines for the management of sand dune revegetation programmes. *Coastal Dune Vegetation Network Technical Bulletin No. 6.* New Zealand Forest Research Institute Limited. 32p.
- Ministry for the Environment, 2001: *Planning for Climate Change Effects on Coastal Margins.* A report prepared for the Ministry for the Environment as part of the New Zealand Climate Change Programme.
- Nordstrom, K.F., 1990. *The intrinsic value of depositional coastal landforms.* Geographical Review, 80:68-81.
- Partridge, T. R. 1992: The sand dune and beach vegetation inventory of New Zealand. I. North Island. *Department of Scientific and Industrial Research Land Resources. Christchurch, Scientific Report No. 15.* 253p.