



Adapting to Climate Change in New Zealand

The role of community based dune restoration in the Bay of Plenty

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COAST CARE
BAY OF PLENTY PROGRAMME
WORKING TOGETHER TO CARE FOR OUR COAST



Local Government New Zealand
te pūtahi matakokiri



Ministry for the
Environment
Manatū Mā Te Taiao

“it is not altogether easy to present a picture of the virgin dunes of New Zealand... (as) there are few places where man, his fires, and his grazing animals have not wrought great changes”

Report on the dune areas of New Zealand. Dr. L. Cockayne 1911

- Coastal dunes rank alongside wetlands as amongst the most degraded natural ecosystems in New Zealand.
- However, we depend upon these degraded dunes to buffer the many storms that visit our shores.
- Yet the damaged functional state of our dunes remains largely unrecognised, and unresolved.
- Urgency is required to restore the natural resilience of dunes before existing sea level rise accelerates.
- Understanding the dynamic interaction between native dune plants and coastal sands is the key to future adaptation programmes for sandy coasts.

Importance of natural dunes

Main native sand binding plants



Spinifex *Spinifex sericeus* – Very abundant, least palatable



Pingao *Desmoschoenus spiralis* – Threatened, palatable



Sand Tussock *Austrofestuca littoralis* – Threatened, palatable



Beach Spurge *Euphorbia glauca* – Near extinction, very palatable

The four native front dune species. All these plants exhibit a useful and unique **high tolerance** of salt-water, enabling them to rapidly **colonise sand** returning to the beach after storms.

Typical immediate
post-storm scarp face –
Spinifex still active

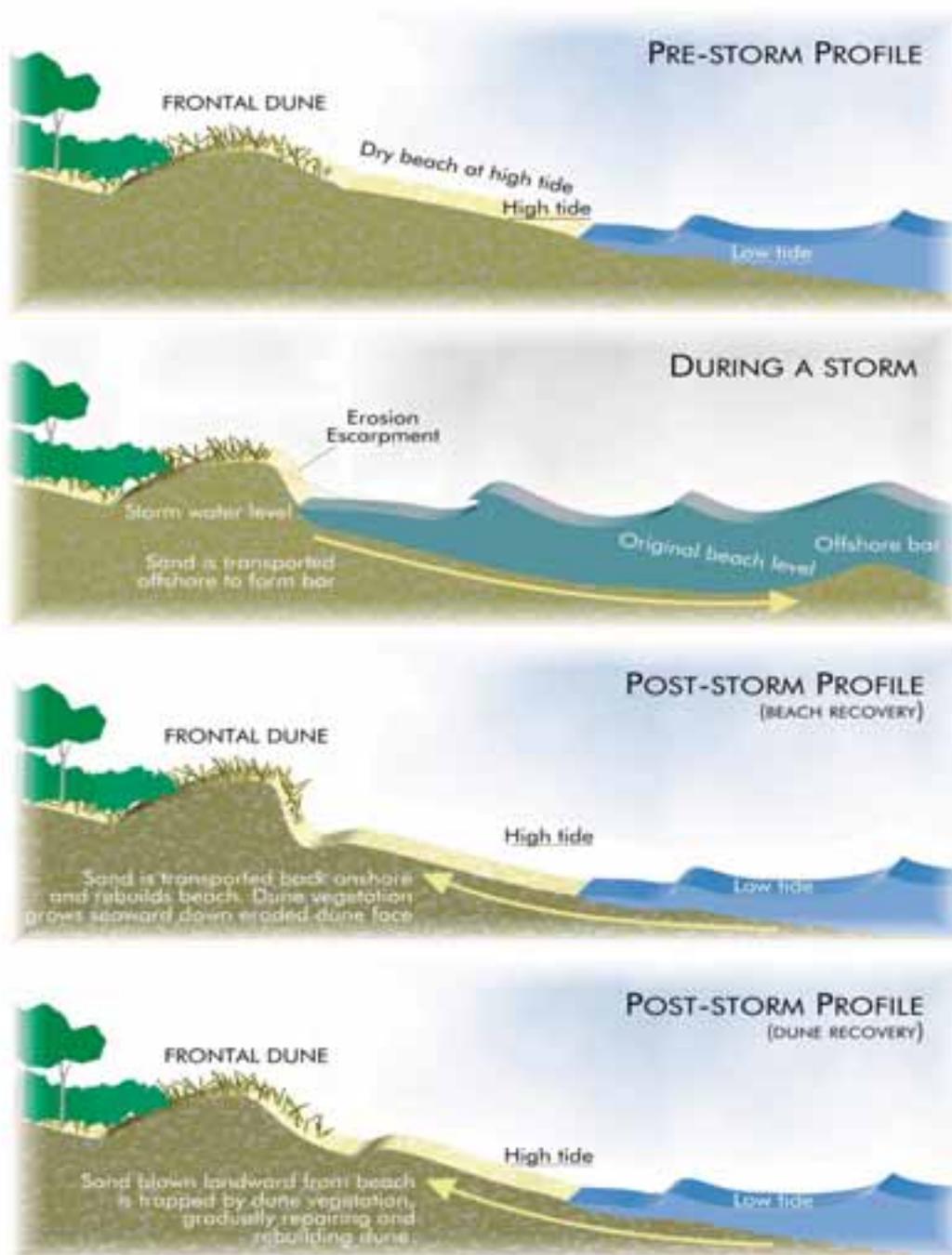


Typical post-storm spinifex
response



Importance of natural dunes

- Dune recovery between storms is critical to prevent ongoing dune retreat.
- Dunes with natural function self-repair after storm cut events – with the native sand binders spinifex and pingao playing a critical role in this process.



The natural storm cut and beach recovery processes.

(Images from Environment Waikato 2001)

- A functional frontal dune must be dominated by a **wide** expanse of native sandbinding species, wide enough to cope with periodic storm erosion events.
- Post storm profile recovery depends upon **native** sandbinding plants colonising the dune scarp, trapping wind-blown sand to repair the dune.

Importance of natural dunes

Sand being trapped by Spinifex

- Native dune grasses have a sparse yet rapid growth habit.
- Their open habit slows and filters wind, so sand drops out of the wind stream and accumulates around these highly adapted plants i.e. the sand accretes.
- The low open habit of native sand binders builds smooth, gently sloping aerodynamic dunes.



- The accretion function of native front dune plants is significant.
- Strong winds preceding rain and storm waves provide fresh accumulations of aerated sand improving dune resilience to wave run-up.

Importance of natural dunes

The **storm energy absorption** function which results from a complex of: natural dune slope + aerated wind-deposited sand + natural vegetation.



June 1997

Degraded dune **self-repair ability** was problematic for decades. In 1978 the BOP Catchment Commission advised residents there were no simple or cheap answers to address their dune instability concerns at Papamoa East.



March 2004

Planting native sand binding species has restored a wide protective dune, which now rebuilds effectively after periodic storm damage. This photo was taken the day after the impact of 10m waves from Cyclone Ivy. On this occasion wave run-up was dissipated naturally by this now resilient dune.

Importance of natural dunes



Yala Safari Beach Resort, Sri Lanka.

Photo courtesy of Dr James Goff, NIWA.

The storm/tsunami protection function of natural dunes is a critical consideration.

The dune seaward of the resort (background) was bulldozed to improve ocean views. The resort was destroyed on Boxing Day 2004 with the loss of 150 lives, only 3 survived.

In contrast, the foreground dune with Tsunami deposited dinghy was NOT overtopped.

Relatively low population pressures in New Zealand provide opportunities for successful reversal of most historical damaging excesses on the coast. More populous nations have moved beyond that point.



Original article sourced from National Geographic magazine; September 2004

Bay of Bengal, Bangladesh

Why is dune restoration necessary?



Typically, simply because natural dune function has been severely compromised by human activities, for example:

Dune bulldozing – Mt Maunganui dunes being bulldozed in 1965

Why is dune restoration necessary?



Dune grazing – This has occurred for over 150 years in New Zealand, resulting in destruction of the palatable native plants, and leading to initiation of the vast wind erosion problems evident on our coastal margins today.

Why is dune restoration necessary?

Development - Often has been allowed too close to the sea.



Camping on the dunes - The results of poor planning to accommodate beach visitors. The local district council has provided these unsustainable camping sites on the 'dune' remnant for beach visitors.

Why is dune restoration necessary?

- Most of the native-plant dominated dune areas in NZ have suffered long-term degradation (>100 years) (Cockayne 1911).
- Their functional plants have been replaced with less suitable introduced species like Marram, Lupin, and Kikuyu etc.
- Ironically, many of these **damaged dunes** are now regarded as 'natural' and even 'iconic', as this state has existed through many people's lifetimes.



Photos sourced from: "Waterfront 2003 / 04- Stunning waterfront properties" BAYLEYS Real Estate Ltd.

Threats to native plants like spinifex and pingao



Tracks over dune crests significantly increase the risk of wave overtopping.

- Vehicle damage, grazing, access management, and encroachments are amongst the main existing threats.
- Vehicle damage to dune plants exacerbates wind erosion.

Threats to native plants like spinifex and pingao



Rabbit grazed pingao - Papamoa

“The endemic products of New Zealand ...are perfect one compared with another; but they are now rapidly yielding before the advancing legions of plants and animals introduced from Europe.”

- Charles Darwin 1859: *On the Origin of species*

- Grazing of native palatable species.
- Even isolated dune areas are still threatened today by feral deer, goats, pigs, hares, rabbits, horses etc.



Threats to native plants like pingao and spinifex

- Access management does matter, and proven effective options now exist.

Threats to native plants like spinifex and pingao



Papamoa 1999

- Encroachment and poor set-back must be reversed.
- Buildings and encroachments are often inappropriately close to the sea.
- Dunes seaward of developments must be wider and dominated by functional (not garden) plants.

The key steps to successful restoration of functional dunes

- Establish a dune restoration community / agencies partnership programme.
- Remove any obvious threat to successful establishment of native dune plants.
- Ensure that sufficient space exists for a restored dune buffer.



The key steps to successful restoration of functional dunes

Community involvement, empowerment, understanding and respect are essential.

- Identify the problems
- Observe the actual effects
- Establish the agreed restoration project
- Observe and publish the project results

THE PROBLEM



Marine Parade, Mount Maunganui

- Destruction of native sand binding plants by dune bulldozing in 1965 and subsequent and poor management of pedestrian use.
- Repeated wind erosion of dune dominated by kikuyu and ice plant.



EFFECT

Sand blowing up and being deposited on the road, which was blocked for three days following the event. Sand is being lost from the active beach system. Removal to re-open the road cost about \$10,000.



RESTORATION PROJECT

Mount Maunganui Coast Care decided that kikuyu and ice plant must be replaced by native sand binding species. Bollards and ropes are being used to protect the planting and delineate the formed accessways.



PROJECT RESULT

The sand no longer reaches the road, instead it is now trapped in the leading 4-5m of dune plants. Bollards and ropes have subsequently been moved seaward to protect advancing plant growth.



The problem - July 1995



The effect – June 1996



Restoration project - June 2002



Project result - July 2004

Project update February 2006



Restored dunes improve many natural beach values:

- Enhanced dune function, especially sand trapping after storms when cross-shore sand exchange is particularly active.
- Improved dune resilience and buffer function.
- Often an improvement to beach width and biodiversity.
- With careful planning and implementation, increased space for people occurs as a result of dune enhancement.



PICTURE: MARK MAKELOWEN 211100RM2250P

COASTCARE'S Mount Maunganui chairman Sandy Garland and environmental management student Alistair Kellet sit next to the spreading bed of ice plants targeted for removal next winter. The ice plants will be replaced with native dune plants.

Coastcare catches the dune bug

By JOHN COUSINS

A BREATHTAKINGLY simple solution to Marine Parade's windblown sand problems is to resume its march along Mount Maunganui's Main Beach.

Restoration of sand dunes south of the beach's toilet block has been a spectacular success by illustrating what happens when nature's lessons are heeded.

Coastcare volunteers are readying to take the next step to bring dunes back to the rest of New Zealand's premier beach 60 years after they disappeared.

The winter of 2004 will see dune plants replace the invasive ice plants spreading along the shoreline on the north side of the

toilets. After that . . . who knows.

Environment Bay of Plenty Coastcare officer Suzy O'Neill says she would love to see dunes once again flourishing along the whole length of the beach and linking up with the first dune restoration along the front of the motor camp — considered a bit radical at the time.

Not that there's much science in bringing back the dunes. It is as simple as fencing off the area, planting spinifex and pingao, and letting nature do the rest. The sand accretes and the dunes grow.

For a few thousand dollars the benefits are huge, which is why Coastcare never gets anything but compliments.

Ms O'Neill said native dune plants trap sand and are an effective buffer to storms. In contrast to ice plants and kikuyu grass. This was starkly illustrated in the big blast of 1996 when huge quantities of sand were dumped onto Marine Parade.

And because white sand is lighter, it whirls into the air and leaves behind black sand. Dunes actually create white, aesthetically pleasing sandy beaches, she said.

If that's not enough, there was also the biodiversity of dunes. The Department of Conservation sows rare natives among the main stabilising plants and the dunes become a habitat to birds,

lizards and native butterflies.

But with local authorities providing the money and professional oversight for Coastcare, there is still a little sensitivity on how far the dunes should be restored towards the Mount Maunganui Surf Lifesaving Club.

Ms O'Neill said the decision to restore long forgotten dunes to the rest of the Main Beach would be left to another day and they would respond to what the community wanted.

In the meantime, Coastcare is still learning from a couple of unofficial tracks that have opened up through the new dune plantings towards Shark Alley — the plots may be too big.

Raising Community Awareness

(Article from the BOP Times)

Dune Restoration at Coastlands East



Before planting commenced.



Four years after planting, the fence disappearing.



*Circles show changing
wave run-up limits*

Sand accumulation by the native dune plants continues, improving the width, height and function of the dune buffer.



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Tauranga



Opotiki District Council



Papamoa East Coast Care

- Motiti Road, the Storm Water Drain
- Dune Reshaping Trial



August 1998.

Saltwater susceptible plants fall over the edge as sand is removed by storm surge. Concrete and rubble has been dropped on the slope in a vain attempt to stem the erosion.



May 2000.

During the frequent autumn abundance of sand on beaches, a small quantity was moved up, under strict control by authorities, to reshape the dune front. This sand was planted with spinifex and pingao immediately to stabilise it.



May 2004.

Just four years later, the plants are successfully restoring front dune function. This photo was taken after the impact of 10m waves from Cyclone Ivy. Note the buildup of sand relative to the storm water drain.

Please Note: Beaches and dunes are very complex and dynamic systems. Relocations of sand can have severe and unexpected consequences. A consent from Environment Bay of Plenty is required for sand disturbance to ensure the greatest opportunity for success, and to minimise the risk to property and the environment.



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Opotiki District Council

Department of Conservation
Te Kaitiaki

Waihi Beach Coast Care – North End Project



August 1995, North End



October 1995, Waihi Beach Coast Care volunteers planting to restore the dune



January 2004, The native dune plants are flourishing and trapping sand on the new protective dune and developing a wider, white-sand beach. Natural protection and human amenity have both been restored.

The key steps to successful restoration of functional dunes



— Indicates storm surge run-up (1972) before the dune was restored.

Brighton Reserve Dune Restoration Waihi Beach



working together to care for our coast



December 1998
The dilapidated and non-functional seawall
Note erosion on the landward 'protected' side.



June 2003
First stage of seawall removal with community help.



June 2003
All smiles as the removal progresses.



Three cheers - Waihi Beach Community Board chairwoman Jacqueline Simpson, Coast Care member Marty Kingsford, and campaigner Ian Campbell farewell the old wall as Lindsay Brown mans the bulldozer.

Hauraki Herald - 1 July 2003



August 2003
Great community support during planting with functional native species.



January 2005
The plants are growing vigorously trapping increasing quantities of sand.



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Opotiki District Council



Department of Conservation
Te Papa Ataturu

Helpful reports:

- The Climate Change Office report “**Community-based Dune Management for the Mitigation of Coastal Hazards and Climate Change Effects: A Guide for Local Authorities**” **April 2005** for more detail of dune restoration techniques.
- “A Review of the Coast Care BOP Programme March 2004”, Environment Bay of Plenty.
- “From Disaster to Restoration: The Power of People”, prepared for the Environmental Defence Society conference 2004, from Environment Bay of Plenty.
- Environment Waikato, 2001: Fragile – A guide to Waikato Dunes. Published by Environment Waikato, June 2001, 33p
- Coastal Dune Vegetation Network (CDVN) Technical Bulletins Nos 1-4 on: Pingao; Spinifex; Sand Tussock; Dune Form and Function.

Coastal Management Options - Costs and Benefits

	Direct Costs	Maintenance Requirement	Impact on Beach
Simple dune replanting programme with community input	\$10–\$40 per linear m. ¹	Minimal; perhaps some targeted fertiliser for one or two subsequent years.	Dune and beach increase in width, improving recreation, amenity and function of the improving dune buffer.
Dune restoration including educational programmes	\$25–\$60 per linear m. ²	Minimal perhaps some targeted fertiliser for one or two subsequent years.	Dune and beach increase in width, improving recreation, amenity and function of the improving dune buffer.
Dune reshaping and replanting	\$250–\$500 per linear m. ³	Minimal; perhaps some targeted fertiliser for one or two subsequent years.	Dune and beach increase in width, improving recreation, amenity and function of the improving dune buffer.
Seawalls and revetments	\$1500–\$4000 per linear m ⁴ .	Expensive maintenance or full rebuild required every 20–40 years	Beach continues to erode, reducing or destroying public access and recreational use.

Notes:

- 1 This cost depends on the density of planting and width of the planted area. The first amount (\$10) equates to 1 dune plant (about \$2.00 each)/m² planted on a 5m wide dune face. The second amount (\$40) is based on a higher density of 2 dune plants/m² on a wind-swept site and 10m dune face. The average cost is often somewhere between these two amounts.
- 2 These costs are derived from the actual costs of the full Environment Waikato and Coast Care Bay of Plenty dune restoration and community education programmes, including all the overheads involved.
- 3 These costs are derived from the dune-reshaping project work undertaken by New Plymouth District Council.
- 4 Debris picked up from rock revetments can add to the destruction of Tsunami (Dr. J. Goff – pers. comm)

Looking forward

- Dunes are important natural coastal buffers that have been severely degraded by a wide range of human activities.
- Restoration of these natural systems is important if coastal communities are to live with and adapt to natural coastal processes such as erosion and accretion cycles.
- Effective restoration techniques for these important natural systems are now well developed and tested.
- Good setback of new development is essential to complement restoration of protective dune buffers.



Pukehina Beach house with poor setback and degraded coastal buffer, after September 2005 storm.

- Dune restoration is part of the new paradigm of coastal management, which focuses on working **with** natural processes, not against them.
- These proven and inexpensive techniques must be adopted **in association with community engagement** as rapidly as possible around the nation's coast:
 - To prevent the ongoing decline in coastal amenity and natural character values.
 - To reduce the risk of coastal land from continuing neglect of our critically important coastal buffers.
 - To reduce the risk to coastal communities (and the insurance industry) from predicted sea level rise.
 - Partnership dune restoration programmes may be the most effective and affordable method of managing climate change impacts on the coast in the short to medium term at least.
 - During the evolution of uncertainty when should people act on ideas? How about **NOW!**



The sea was last here in
June 1996.

So what has changed?

Papamoa Coast Care planted
this dune in 1995. Since then,
sand has been trapped by
these growing dune plants
to build a wide protective
foredune and raised
beach.



And so,
the sea
doesn't
reach here
now.

“ A well-shaped and plant-fixed foredune is a land-form of the greatest importance, since it... forms a natural protection against the inroads of the sea, thus safeguarding the coast”

Valediction – Dr. L. Cockayne – **1911**

Greg Jenks

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