

5h Climate change and the beach

Exploring positive and negative impacts on dune systems

Coastal hazards

- New Zealanders love to live and holiday by the sea which has resulted in extensive coastal development and subdivision.
- There are a number of coastal hazards that pose a threat to coastal living.
- These include:
 - Climate change (including associated increase in intensive storms and sea level rise).
 - Tsunamis.

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Objectives for today

- Today we will look at climate change.
 - What does climate change have to do with the beach?

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What does climate change have to do with the sand dunes and the beach?



- Climate change is likely to result in increasingly intense storms and sea level rise.
- Dunes can buffer us from some storm induced erosion.

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Sea level rise

- Sea level has risen by 10-15 cm over the last century.
- Projections are for sea level rises to continue.
- By 2050 sea level is projected to have risen 20 cm and up to 50 cm by 2100 (MfE, 2004).
- Sea level rise has the potential to be a major problem for coastal communities.

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Climate change and coastal erosion

- Climate change means there is likely to be more coastal erosion.
- Even beaches that have been stable and had little erosion may suffer from erosion problems.
 - Coastal properties and infrastructure could be damaged.

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Typical immediate post-storm scarp face – spinifex still active



Typical post-storm spinifex response

Importance of natural dunes

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

Importance of native dune plants

The main native sand binding plants



Kōwhangatara - spinifex *Spinifex sericeus* – Very abundant

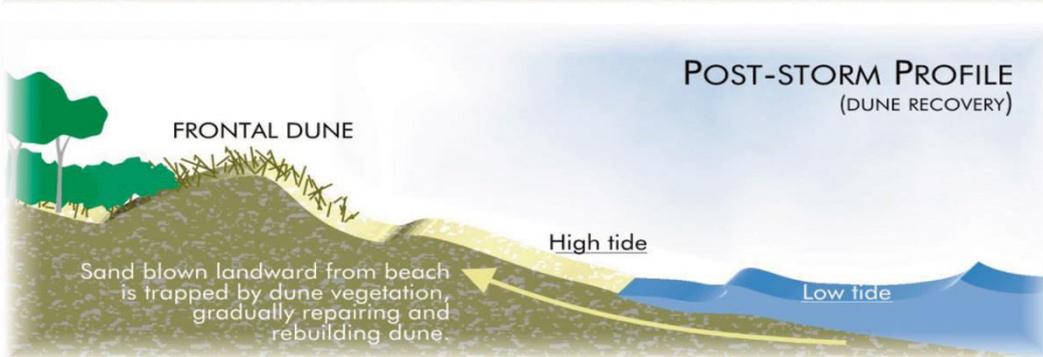
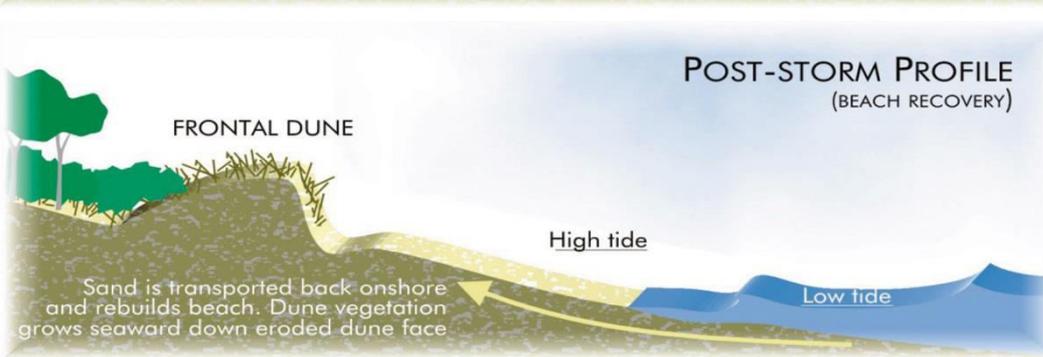
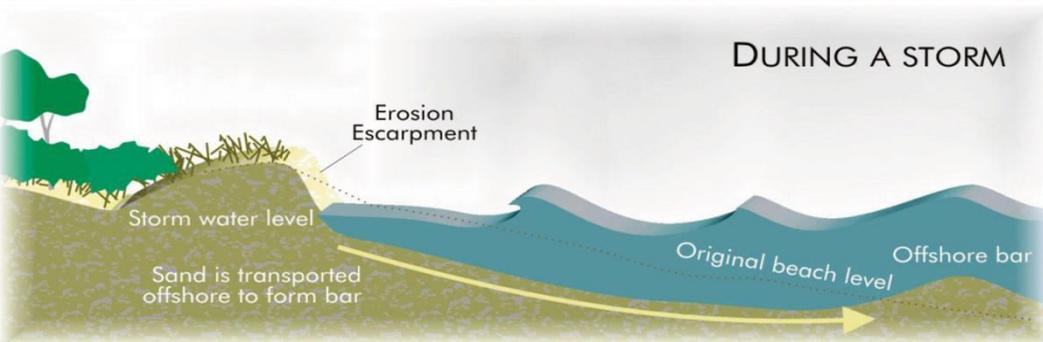
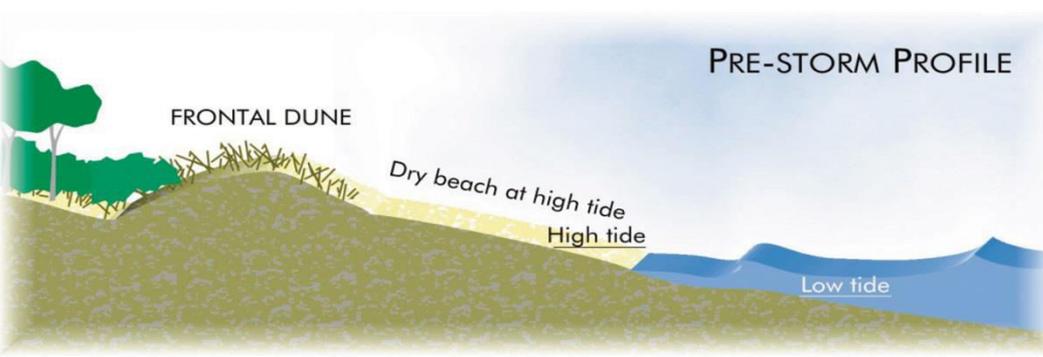


Pīngao *Desmoschoenus spiralis* – Threatened



Hinarepe - sand tussock *Austrofestuca littoralis* – Threatened

The three main 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.



The natural storm cut and beach recovery processes

(Images from Environment Waikato 2001)

- Post storm profile recovery is aided by sandbinding plants colonising the dune scarp, trapping wind-blown sand to repair the dune.

Importance of natural dunes



Sand being trapped by spinifex

(clip from "Life's a Beach" video)

- 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.
See PPT 4b formation and function
- The low open habit of native sand binders builds smooth, gently sloping aerodynamic dunes.

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

Importance of natural dunes

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

June 1997

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



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Importance of natural dunes

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

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 10 m waves from Cyclone Ivy. On this occasion wave run-up was dissipated naturally by this now resilient dune.

Note: It is possible that climate change will shift the dunes further inland in response to sea level rise and increased storm intensity. Plants alone will not stop this process.



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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.

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

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.



Dune Restoration at Coastlands East



June 1996. Before planting commenced.



October 2000. 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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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



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.



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



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



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**

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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.
- “[Coast Care Programme Independent Review](#)”, July 2008, Boffa Miskell Ltd for Bay of Plenty Regional Council
- “[From Disaster to Restoration: The Power of People](#)”, prepared for the Environmental Defence Society conference 2004.
- 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: Pīngao; Spinifex; Sand Tussock; Dune Form and Function.



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Bay of Plenty Regional Council in partnership with Tauranga City Council; Whakatane, Western Bay of Plenty, and Opotiki District Councils; and the Department of Conservation.