

Future possible movements of the Manawatū coast under climate change, and their impacts on native vegetation



Jill Rapson

Angelina Smith, Nicholas Singers, Melanya Yuhnevich, Sylvia Villacis Lozada, Ashley Murphy, Matthew Krna, Patrick Johnson

**For F+B
13 Feb 2024
Palm Nth**

*Ecology Group, School of Natural Sciences,
Massey University, Palmerston North, New Zealand*

Disclaimer

I don't know what I'm talking about!!

Don't shoot the (mis-?)informationer!

BUT

Climate change is not going away,

SO.....

Contents: Climate change

Vegetational movements under climate change

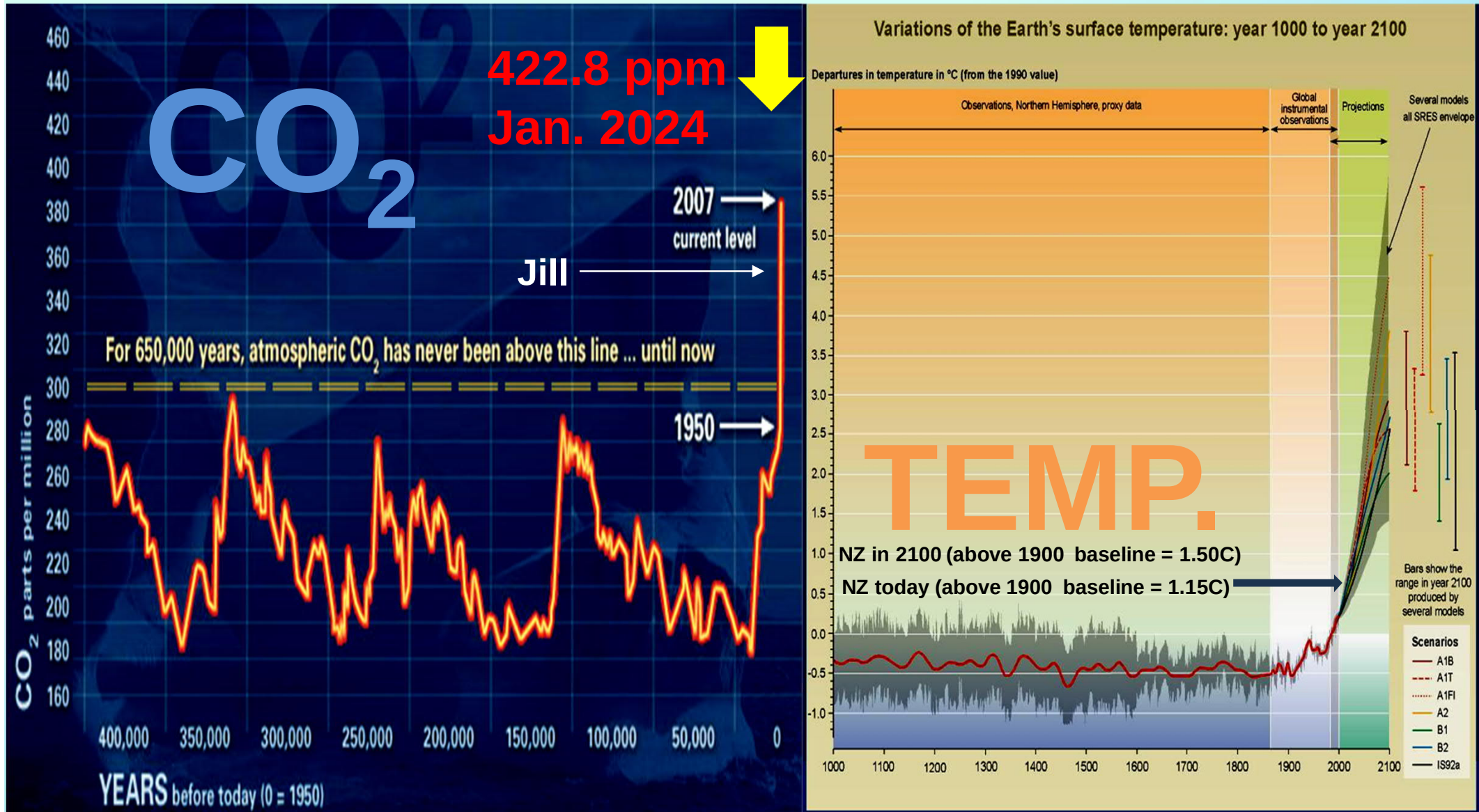
Dunelands and their dynamics

The Manawatū coast and estuary

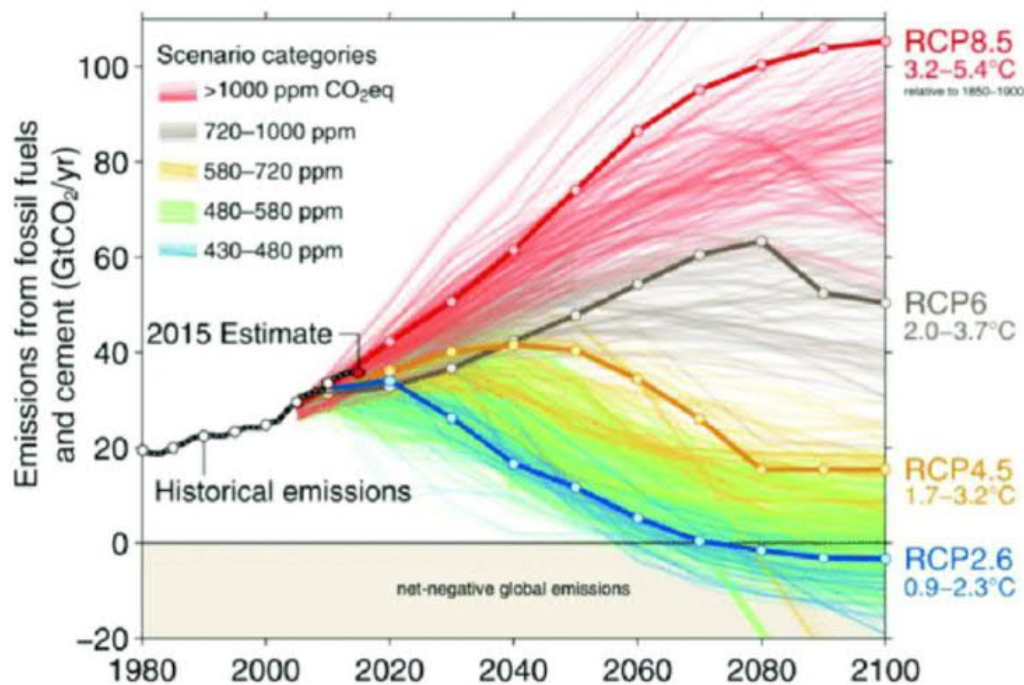
Sea level rise and coastal movements

Some thoughts for the future

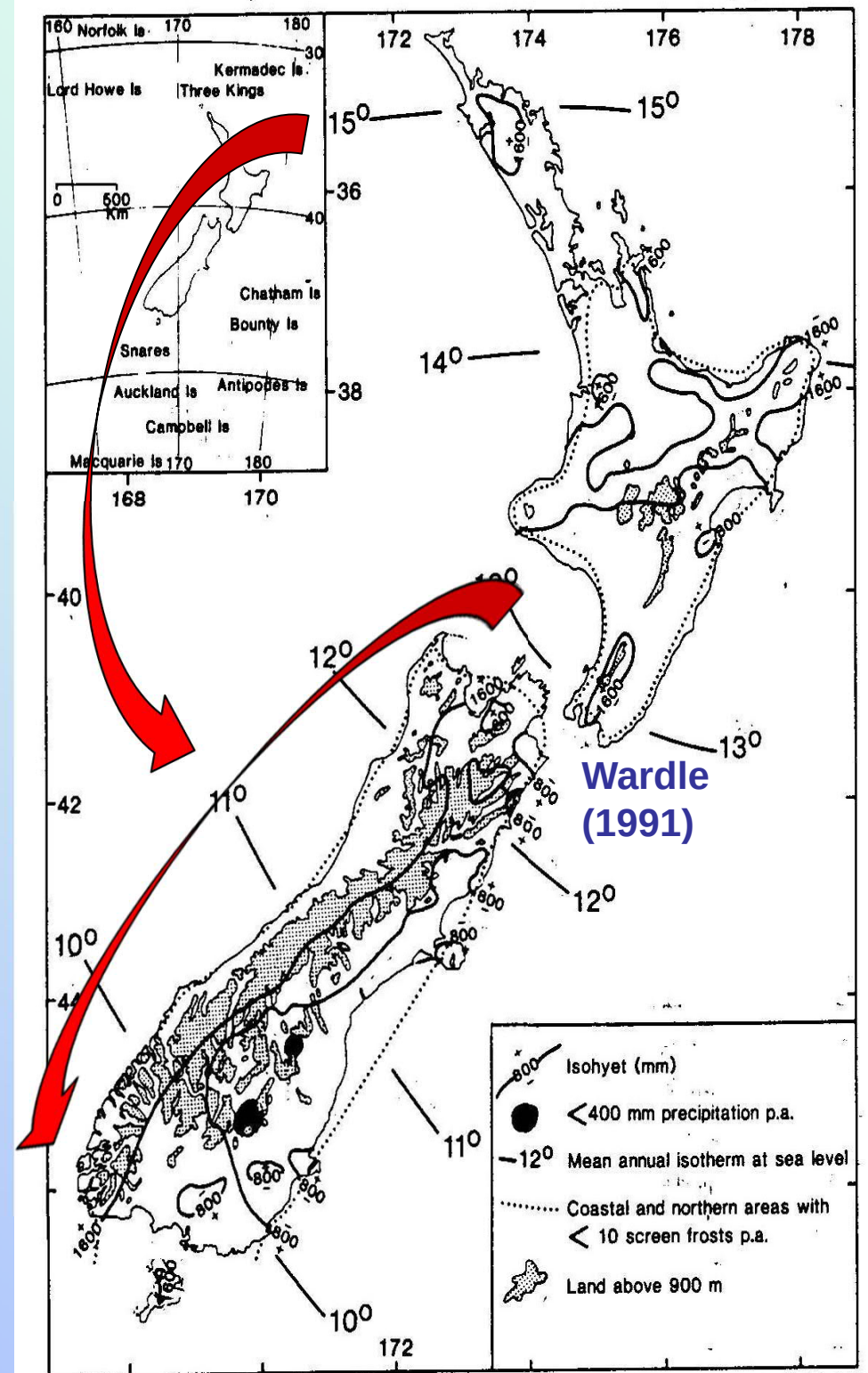
Increasing atmospheric CO₂ and global average annual temperatures



Climate change scenarios - 4°C shifts – Meaning for vegetation



**Manawatū-Whanganui Regional Climate
Change Risk Assessment
Version 1.0. 2 September 2021;
Horizons Regional Council**



Vegetational movements

Vegetation “moves” only slowly, and is often behind climate changes.

Does vegetation move by:

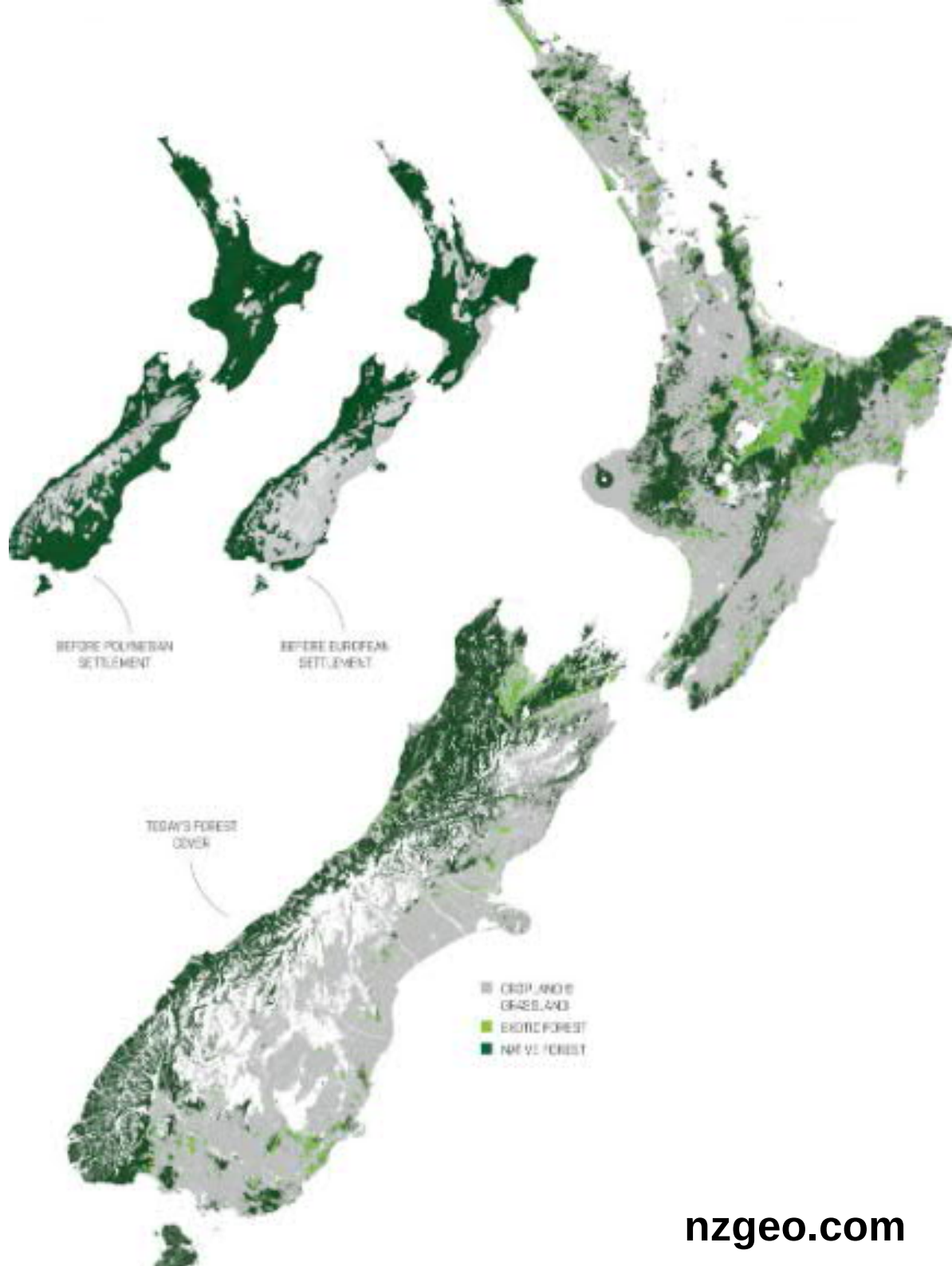
- continuous “roll-over”;
- relocating to adjacent sites;
- starting again at a remote site?

On mountains, communities may be able to move up.

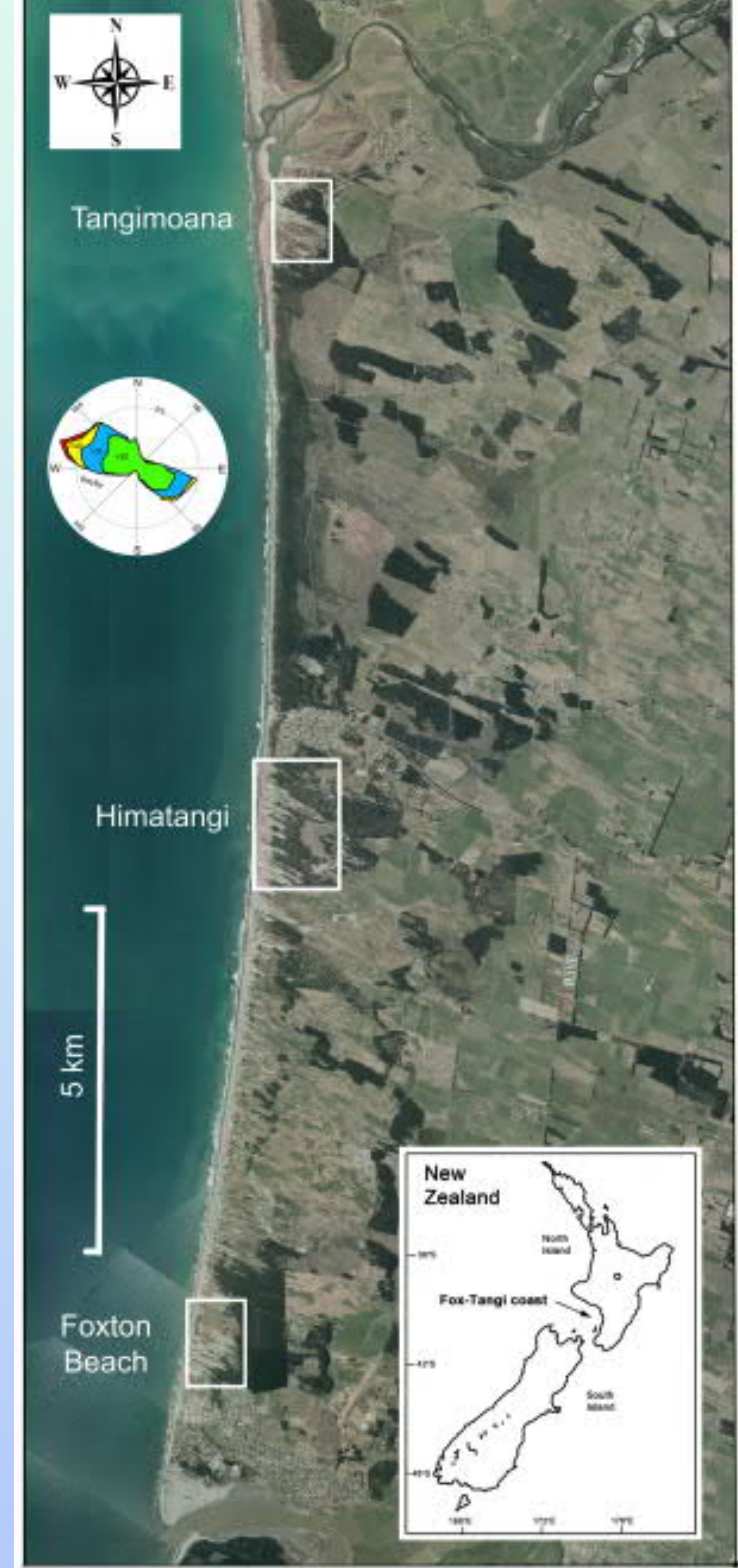
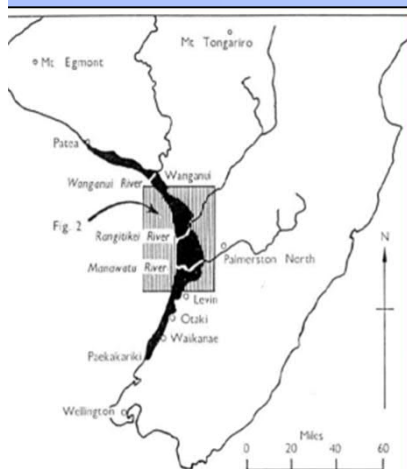
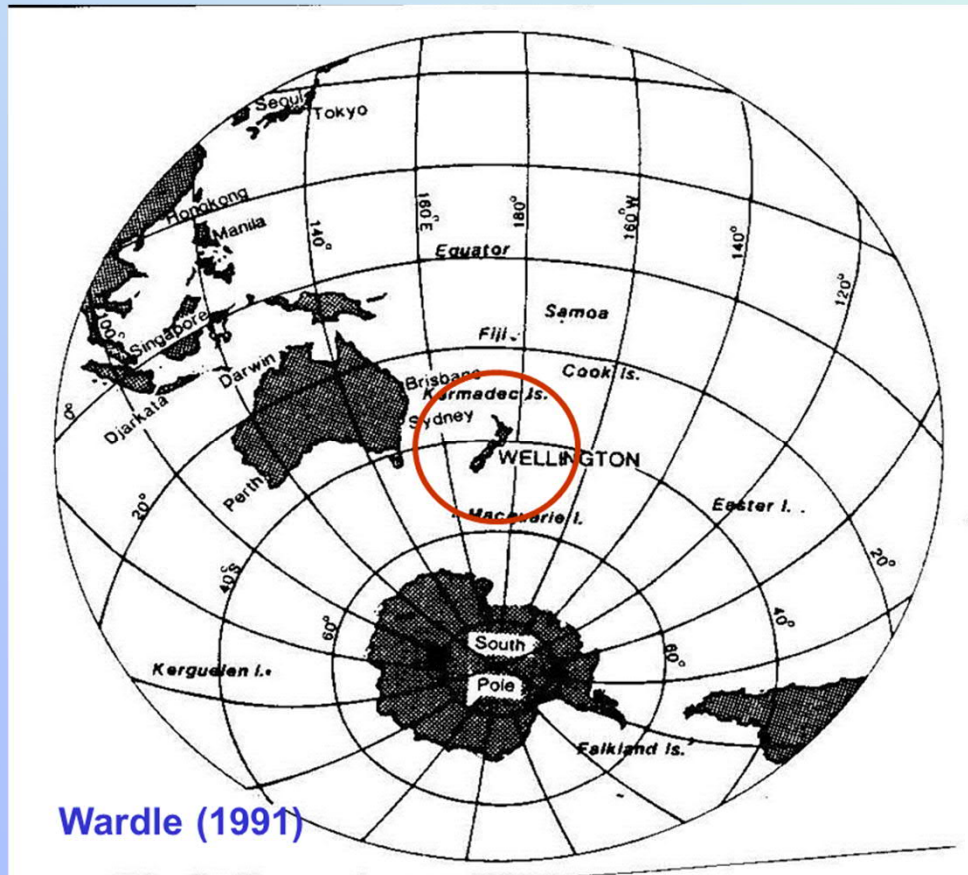
But most habitats are now isolated and dispersal paths are missing.

IAC movements may need to be long-distances.

What barriers are insurmountable?

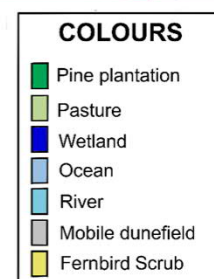
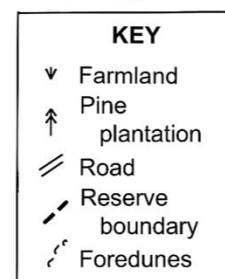
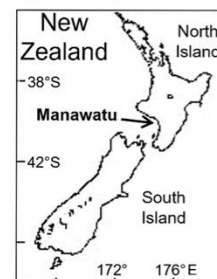
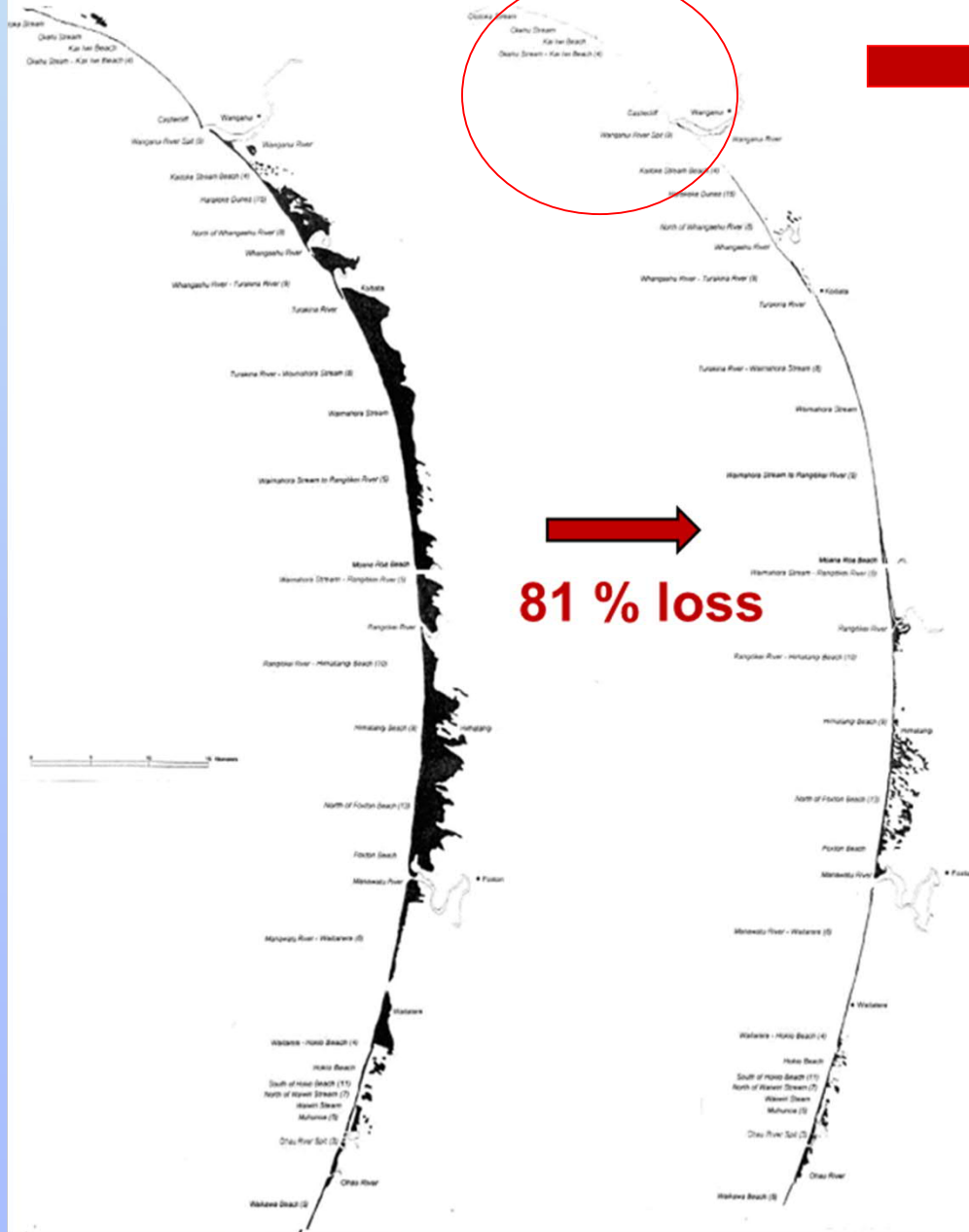


Manawatu coast



1963

1997



Mike Hilton, Ursula Macauley and Ralph Henderson
SCIENCE FOR CONSERVATION 157, DoC Wellington (2000)

Loss of mobile duneland habitats

Dune wetlands with rare turf species



Lilaeopsis orbicularis



Isolepis basilaris



Goodenia heenanii AKA
Selliera rotundifolia



Eleocharis neozelandica



Myriophyllum votschii



Ranunculus acaulis

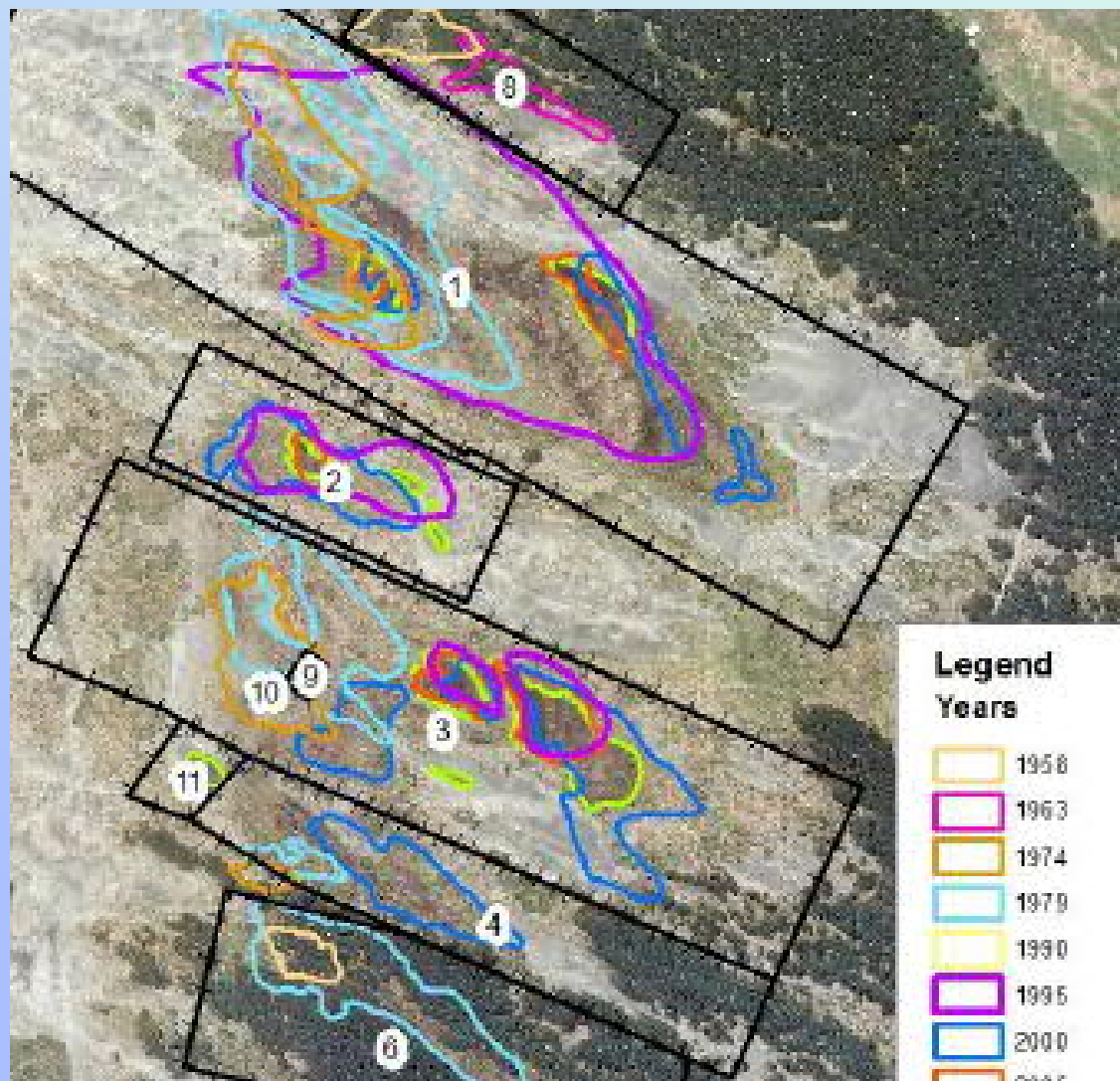


Limosella lineata



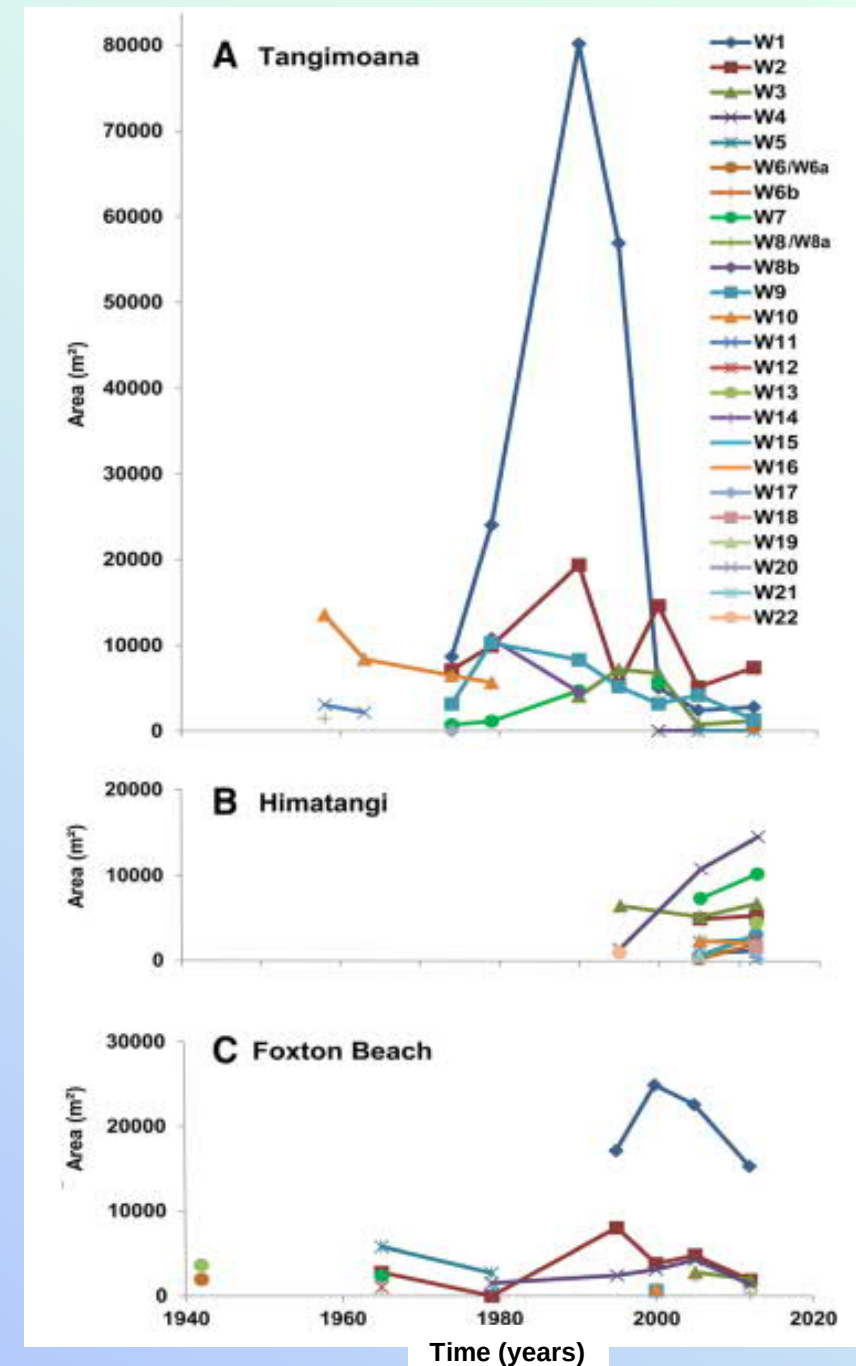
Gunnera arenaria

Wetlands are dynamic in space and time

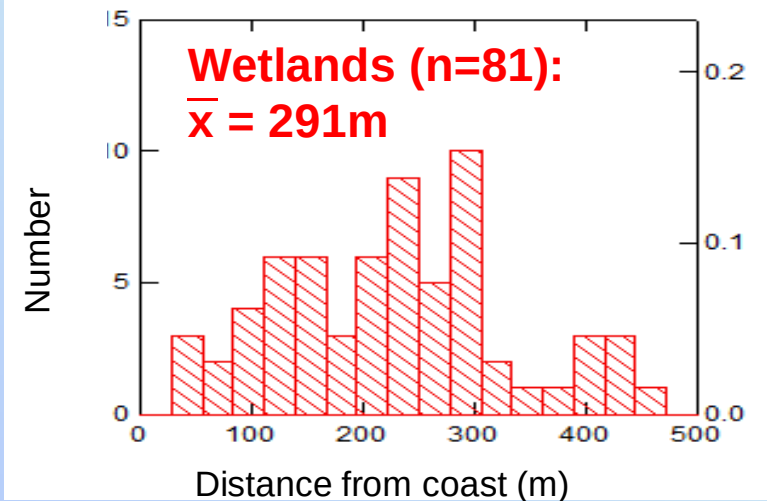
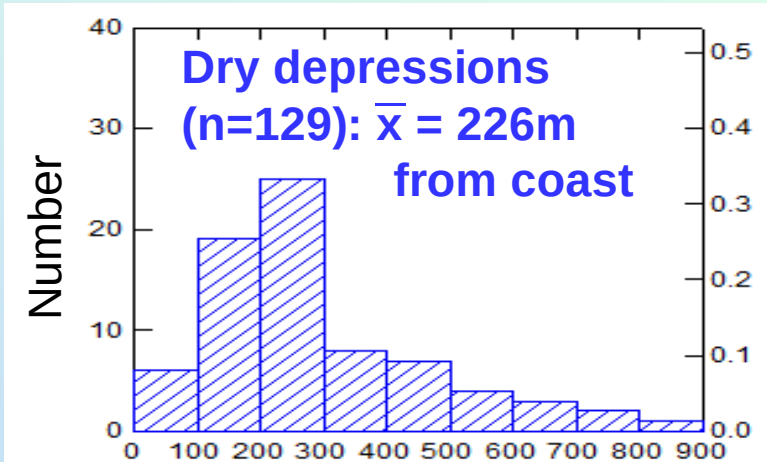
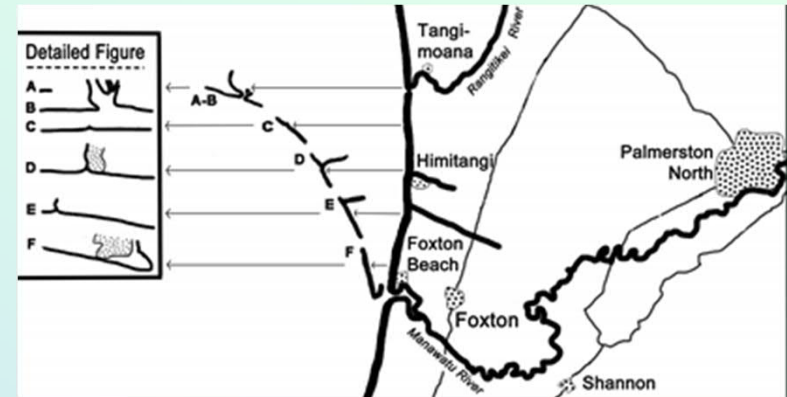
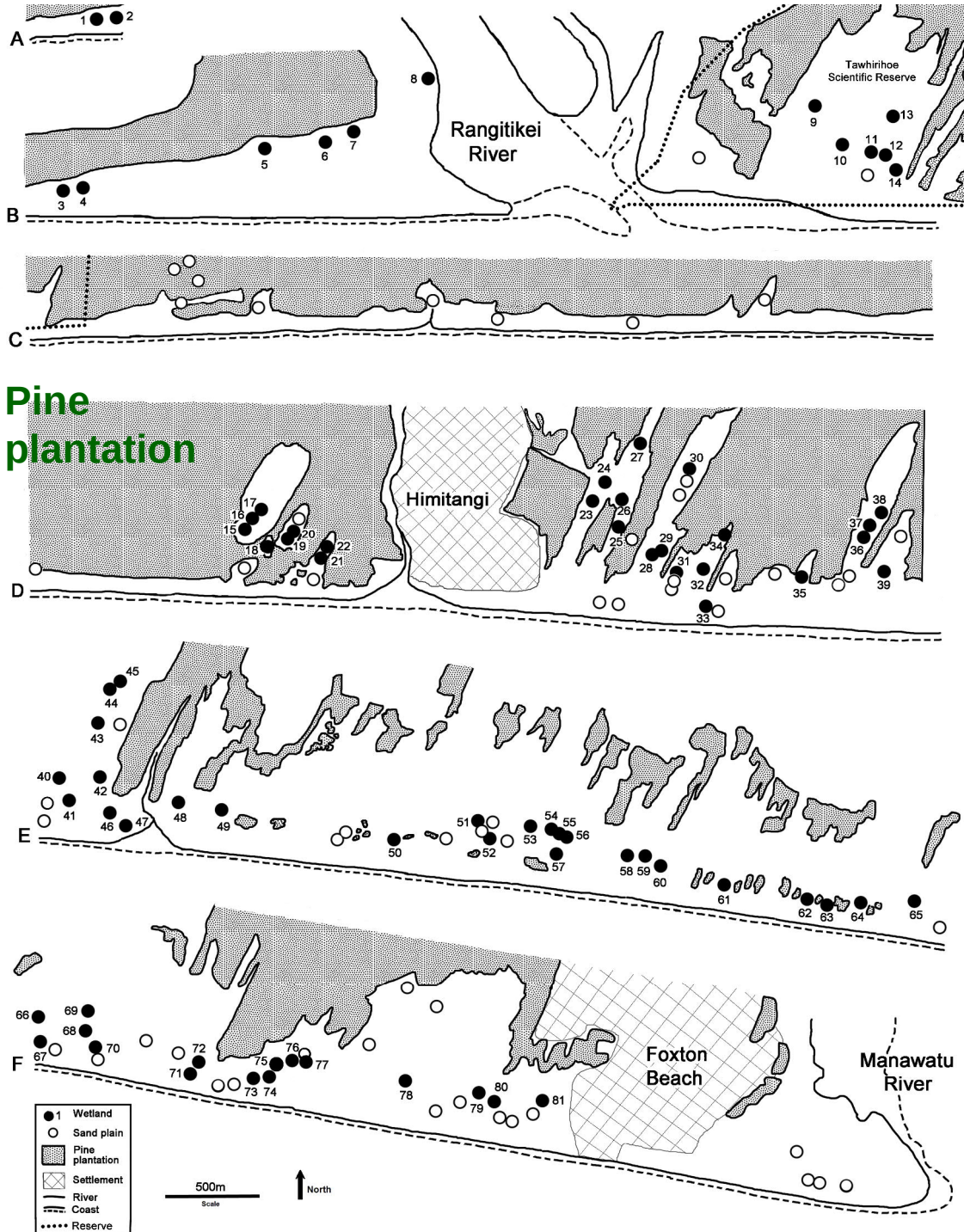


Villacís Lozada SP, Rapson GL (2021). Morphodynamics of short-lived wetlands of coastal dune slacks, Manawatū, New Zealand. *Wetlands Ecology and Management*, 29, 351-367.

Villacís Lozada SP, Rapson GL (2022). Coastal dynamics initiate, relocate and terminate short-lived wetlands of dune slacks, Manawatū, New Zealand. *Land* 11(7):980.



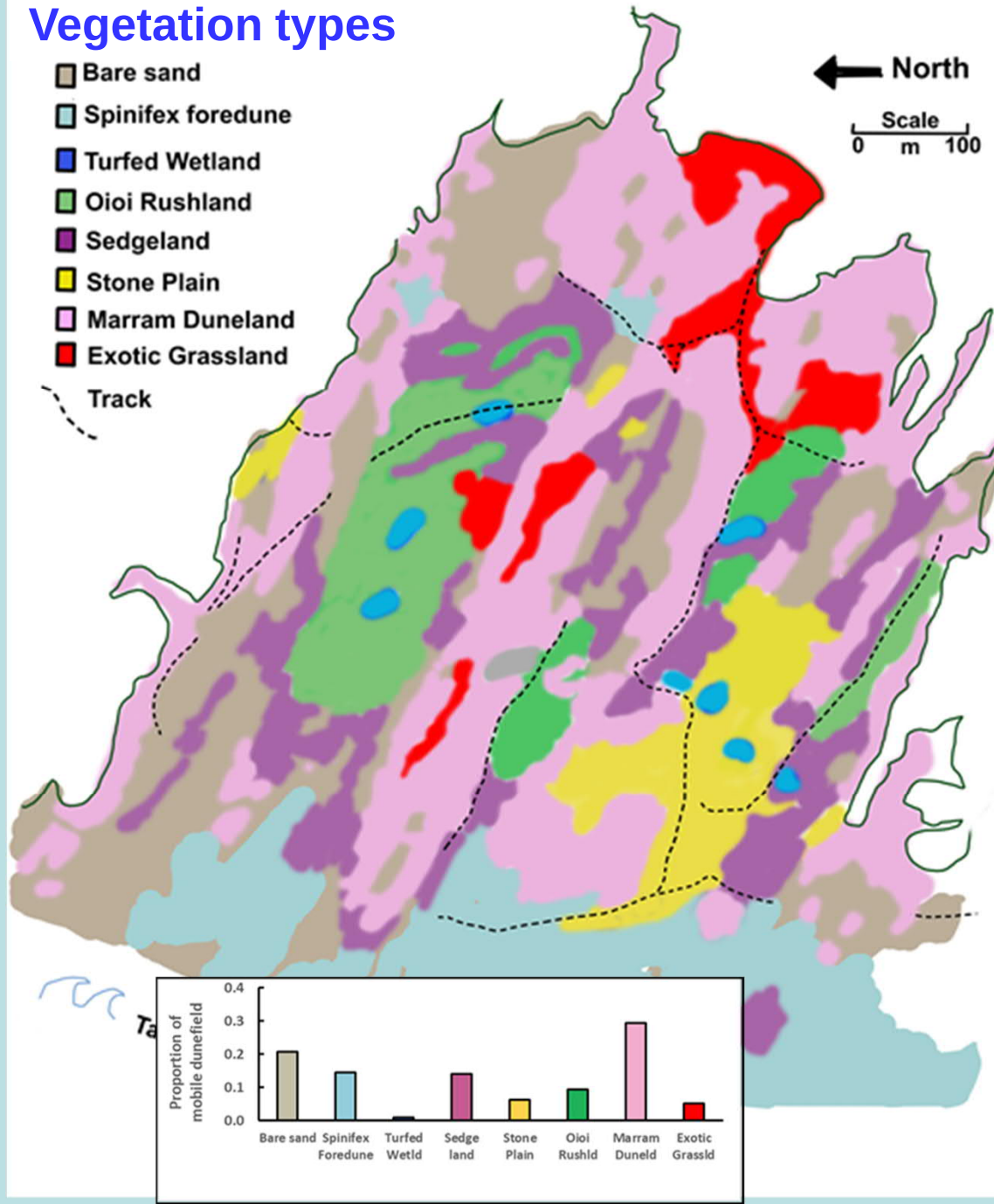
Scaling up along the coast



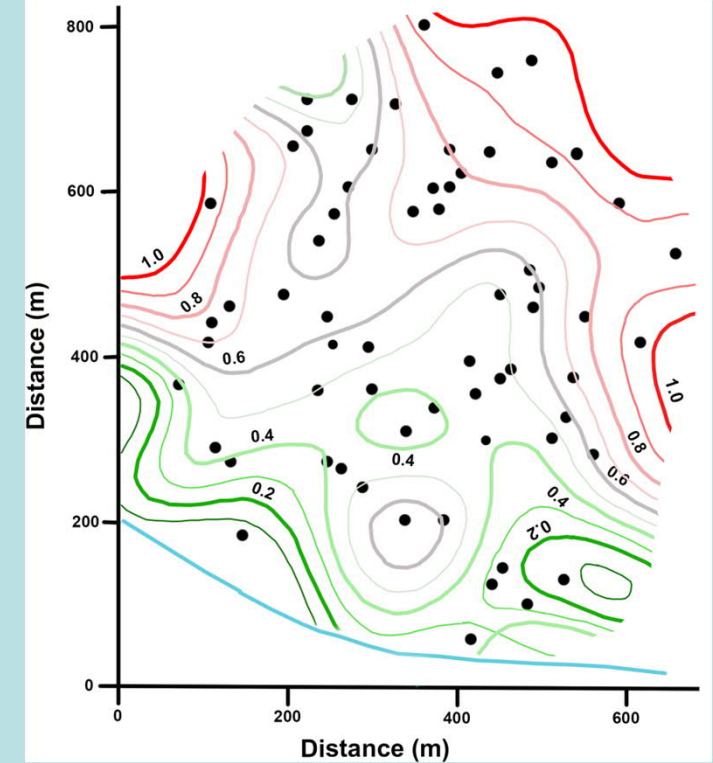
Wetlands with >5 specialist turf species (n=11): 415m

Impact of alien plants on mobile dunelands

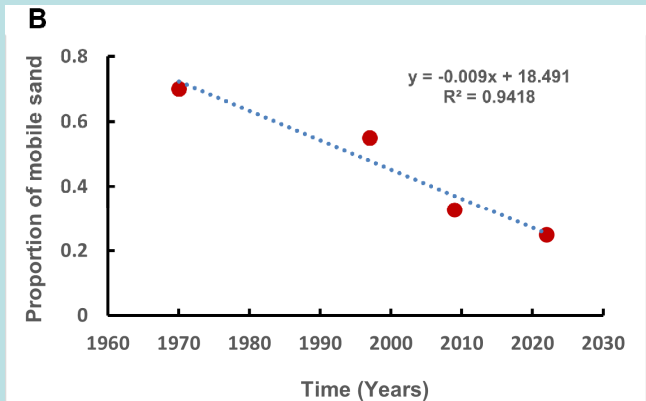
Vegetation types



Native/Alien heat map



Sand stabilised, and vegetation dominated by aliens.



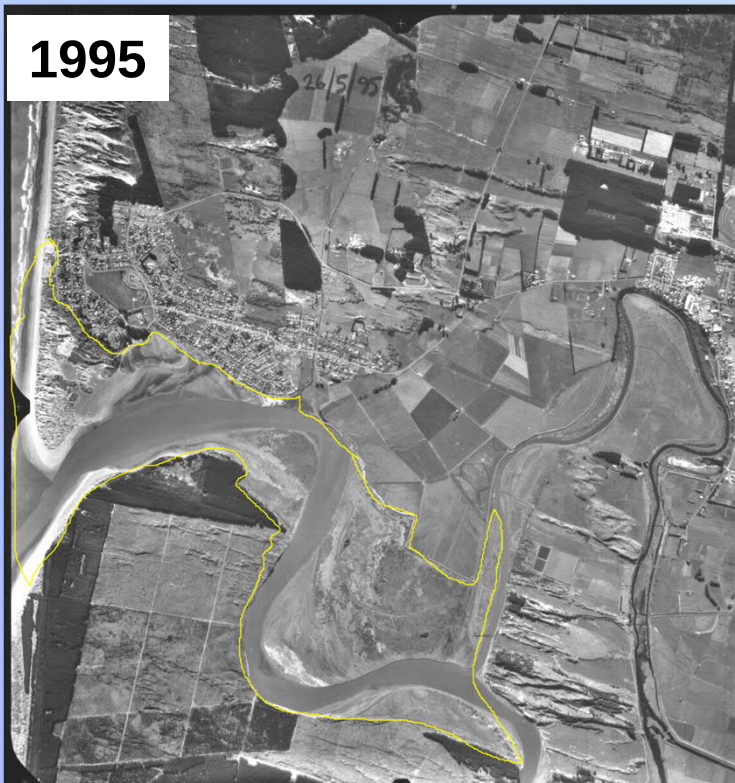
1958



1974



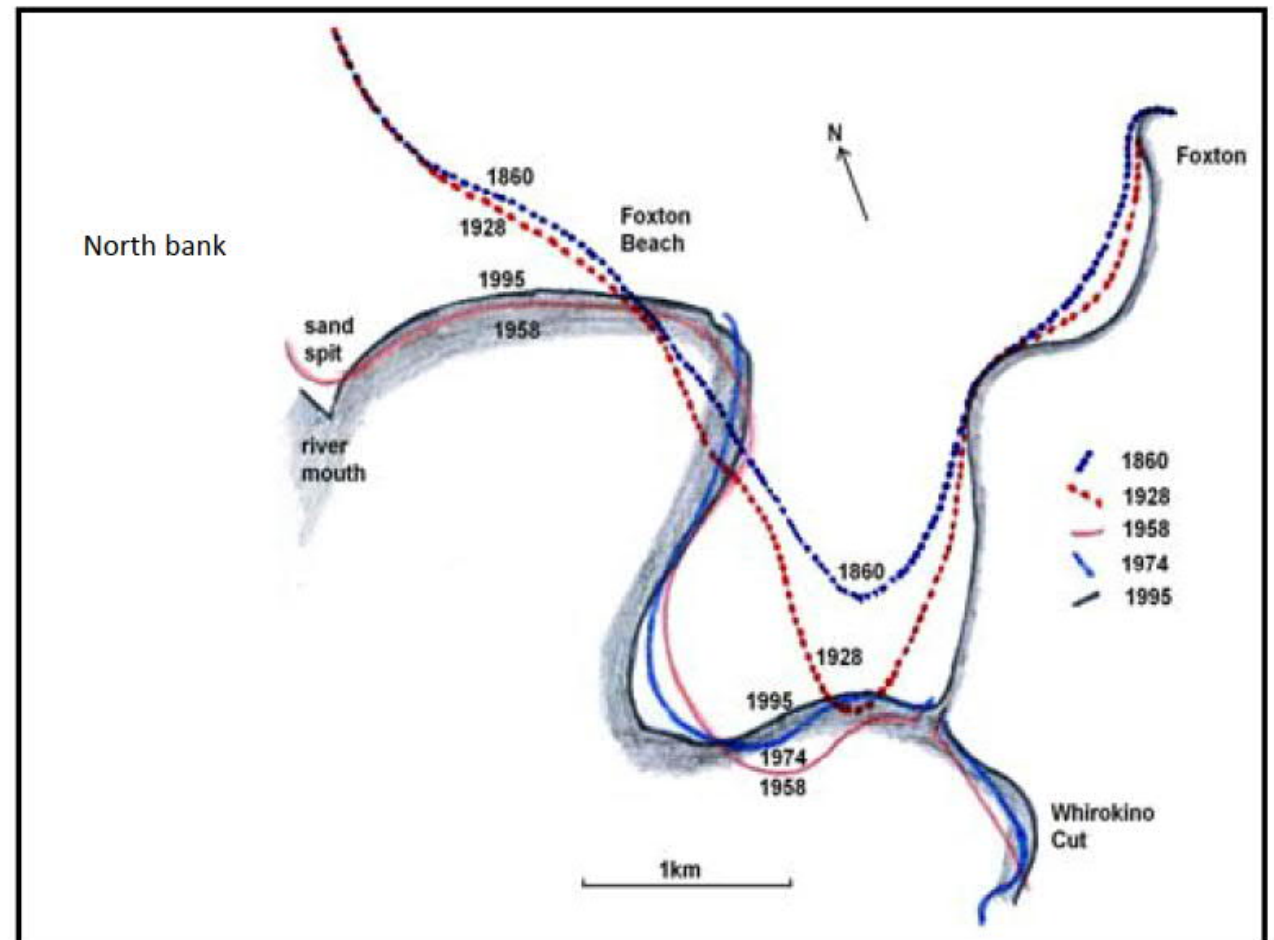
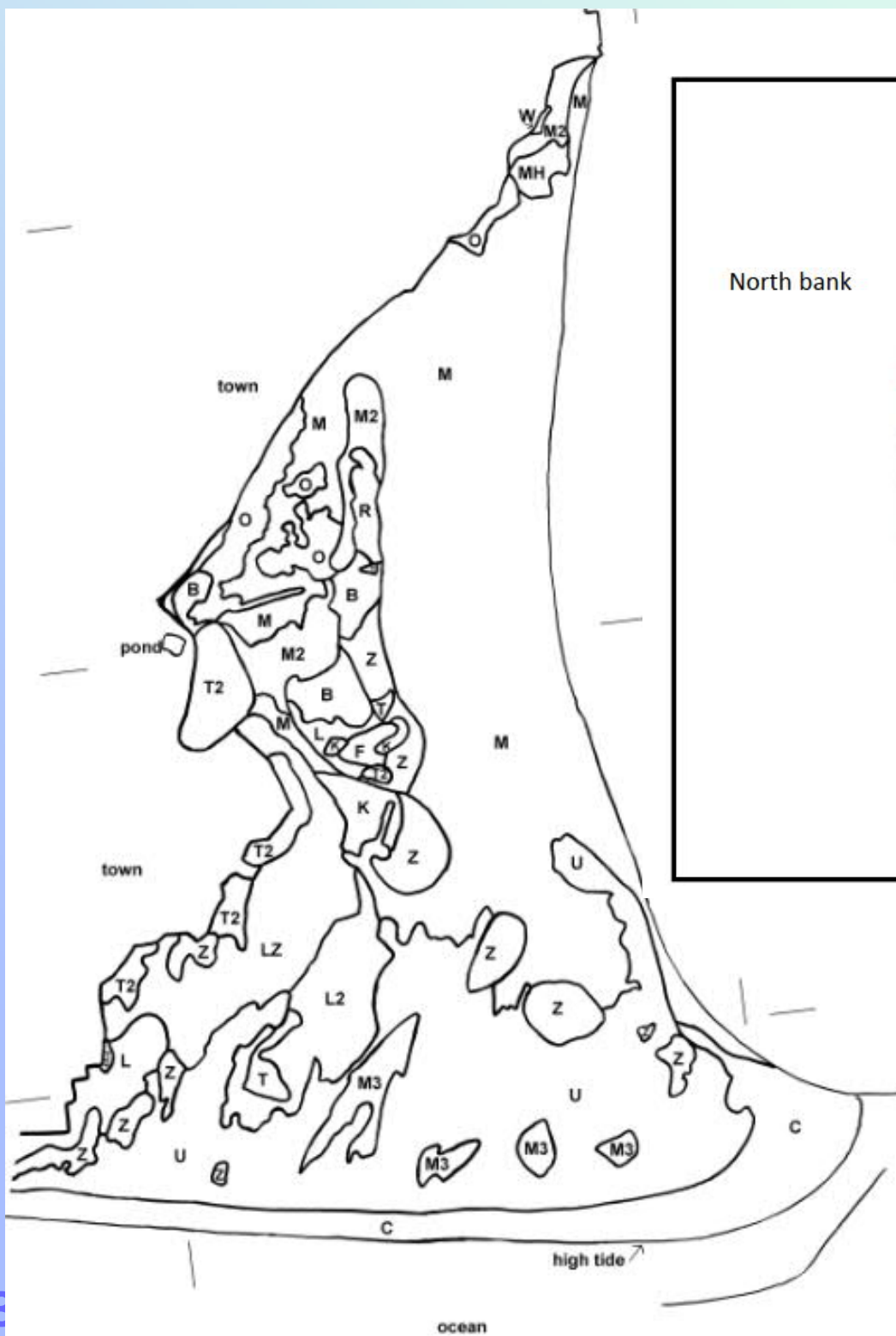
1995



2003



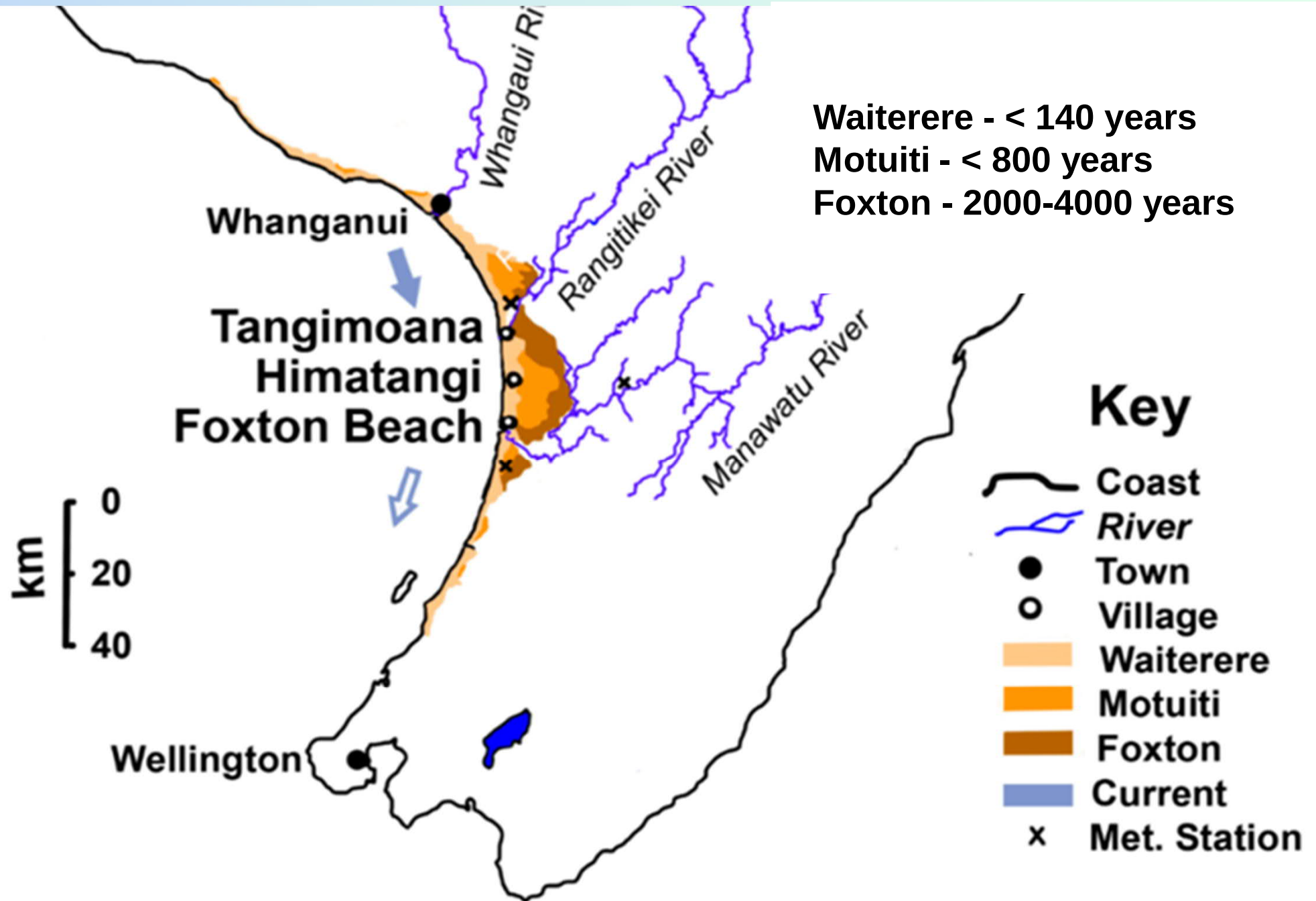
Manawatu estuary



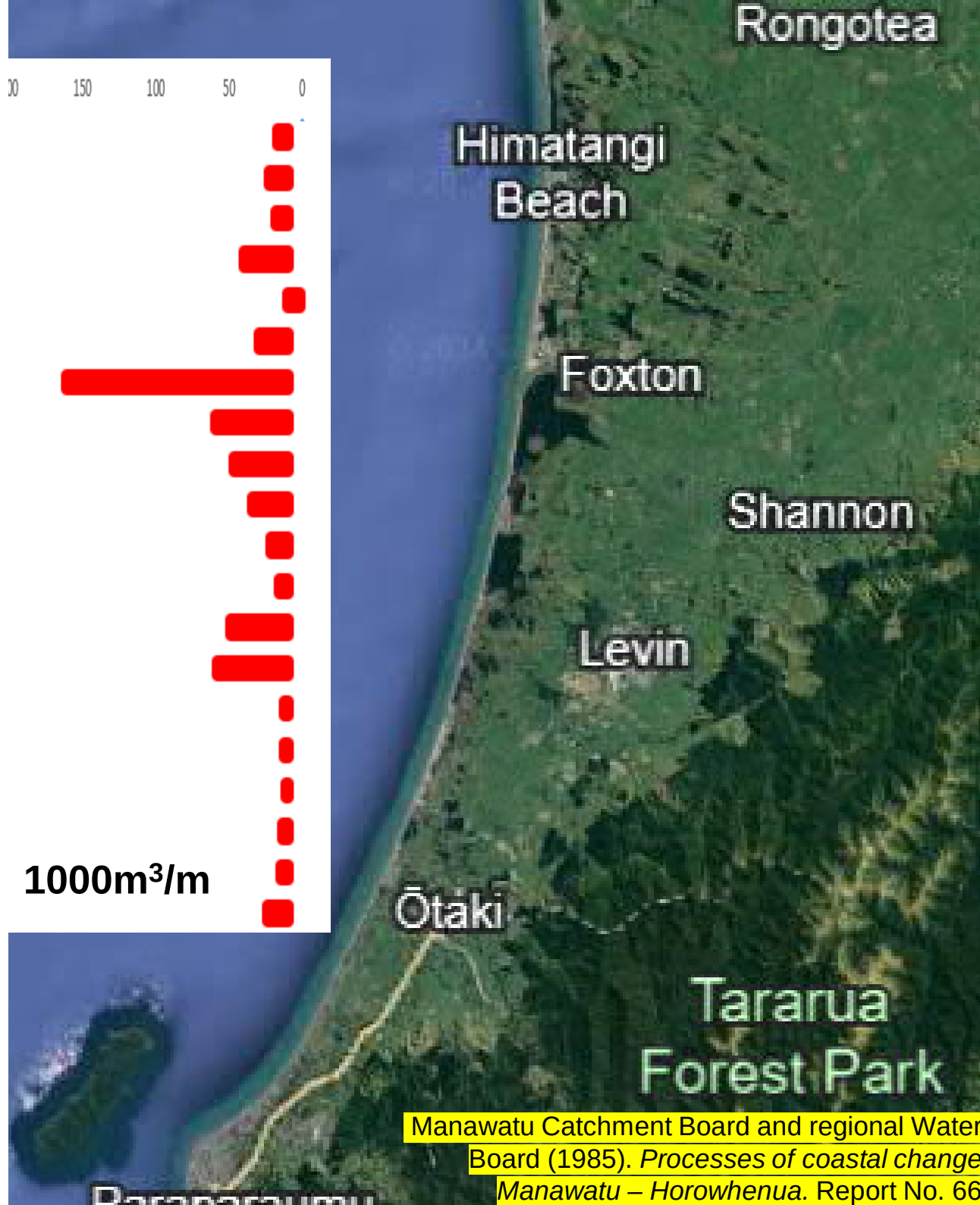
Sediment originates from erosion of mountainlands.

Long-shore drift moves sediment southwards along the coast.

Future of the estuary?



Coastal movements

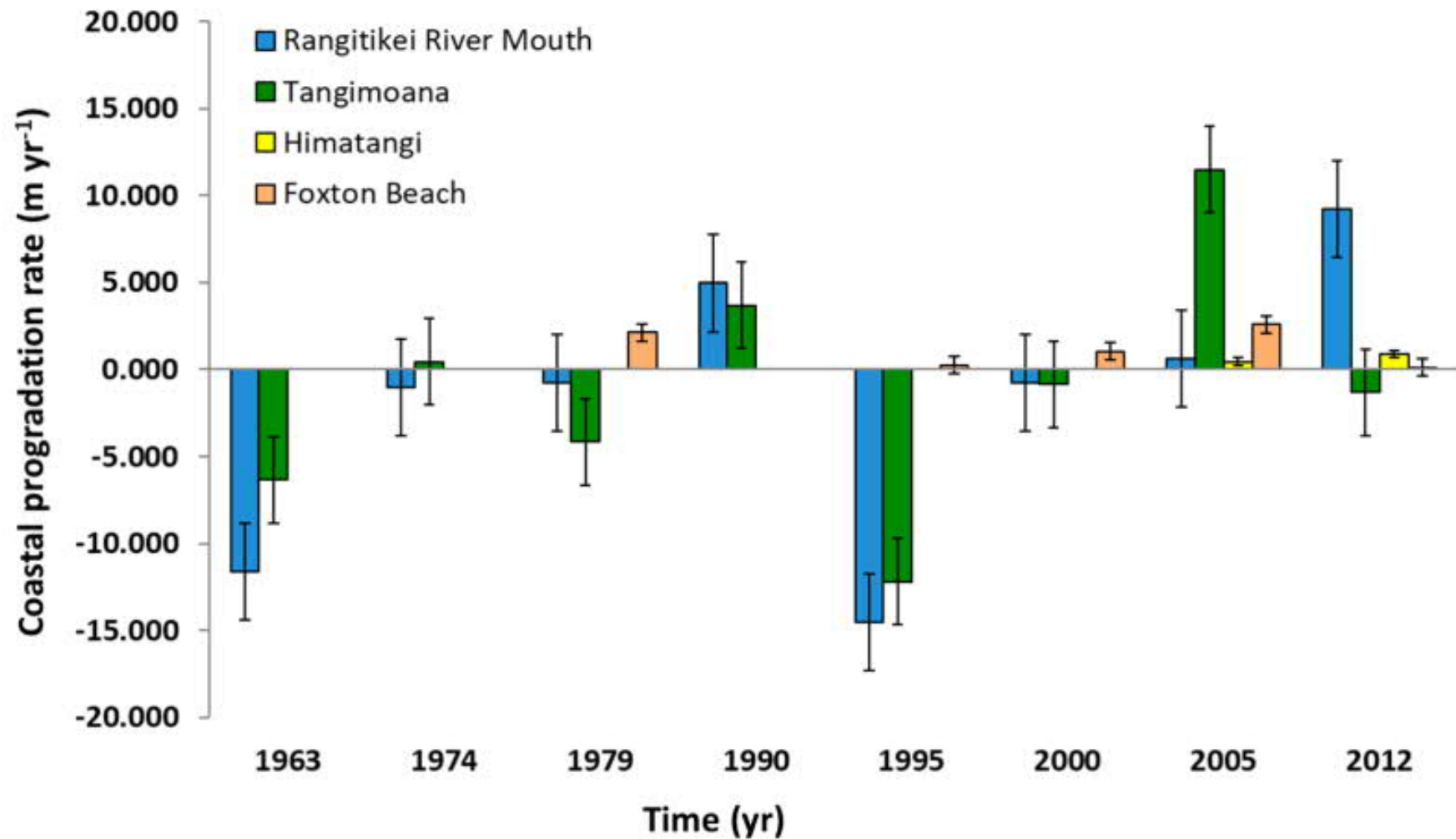


Patrick Hesp:

Progradation rates
at 1 m/yr.

Does this still
occur today?

Progradation rates today

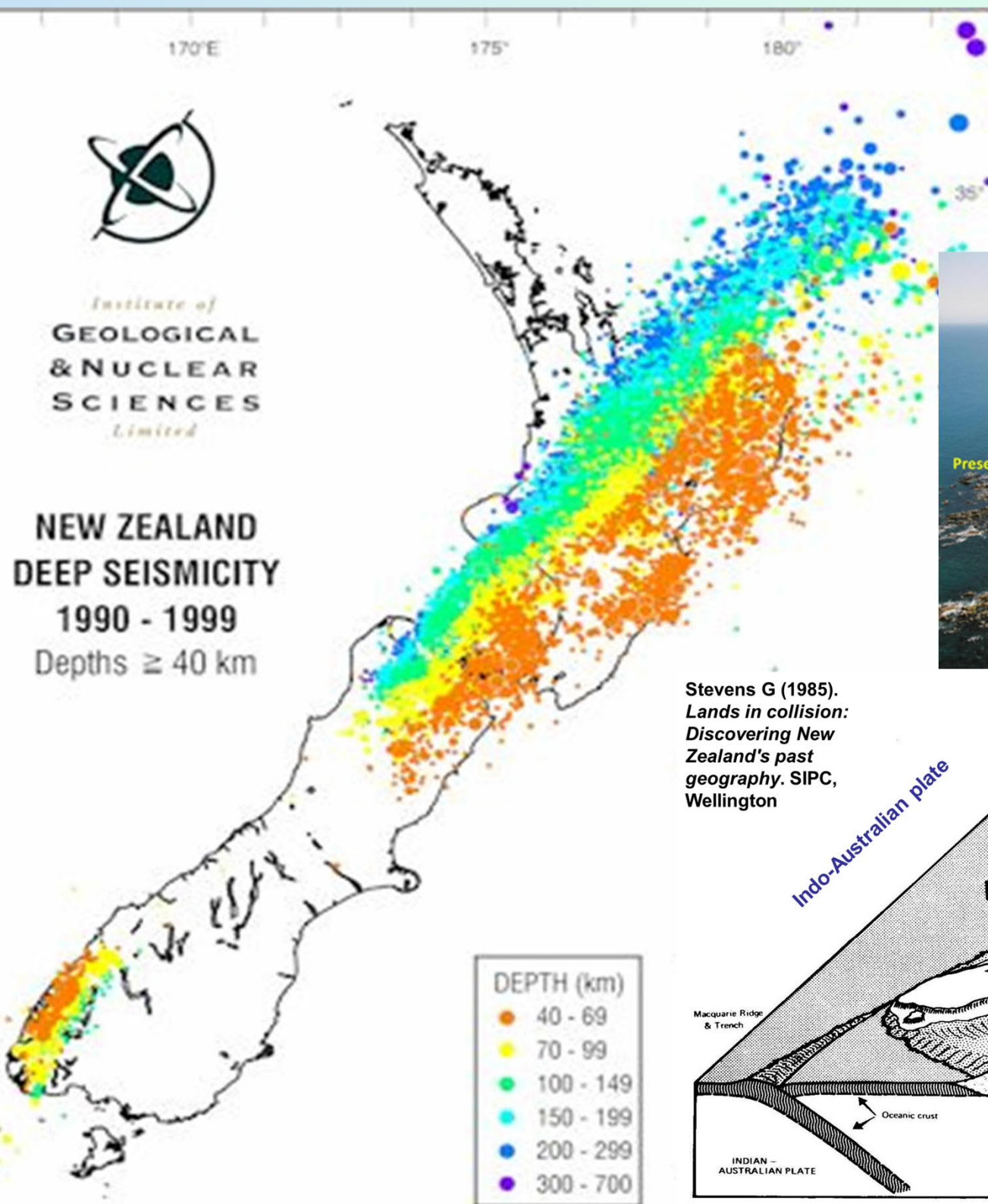


Villacís Lozada SP, Rapson GL (2022). Coastal dynamics initiate, relocate and terminate short-lived wetlands of dune slacks, Manawatū, New Zealand. *Land* 11(7):980.

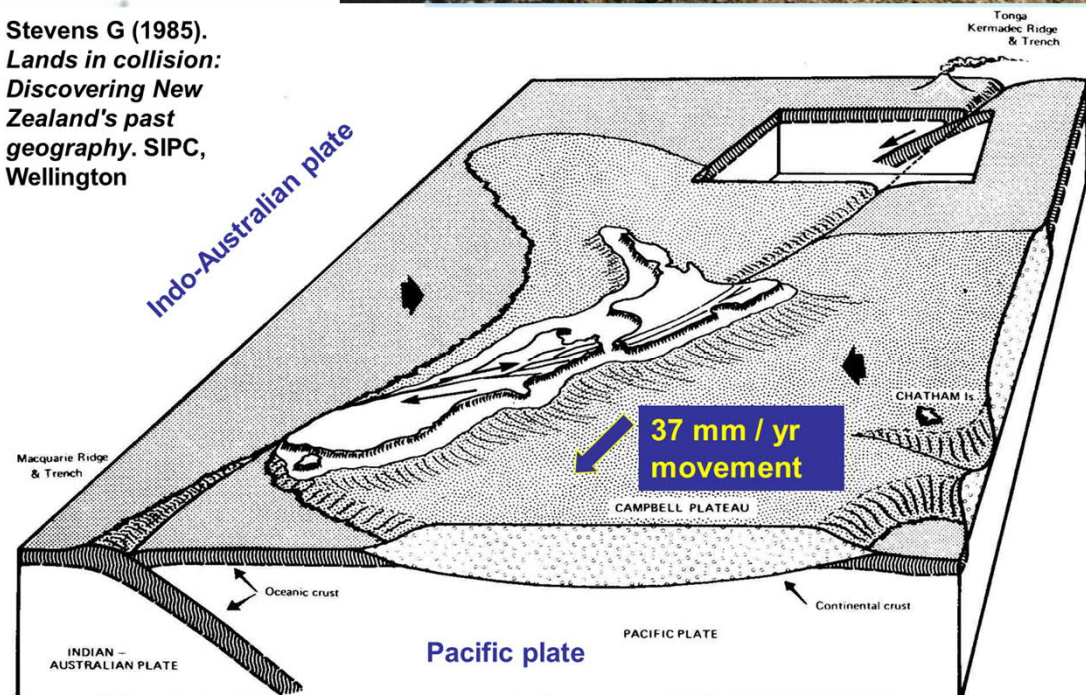
Is the coast still prograding ?



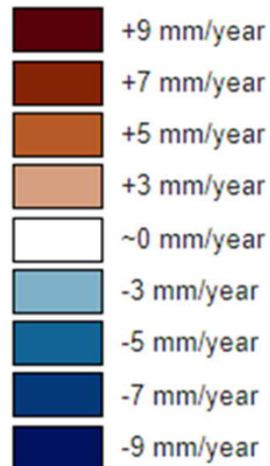
Our local problem



Stevens G (1985).
*Lands in collision:
Discovering New
Zealand's past
geography.* SIPC,
Wellington



Vertical Land Movement

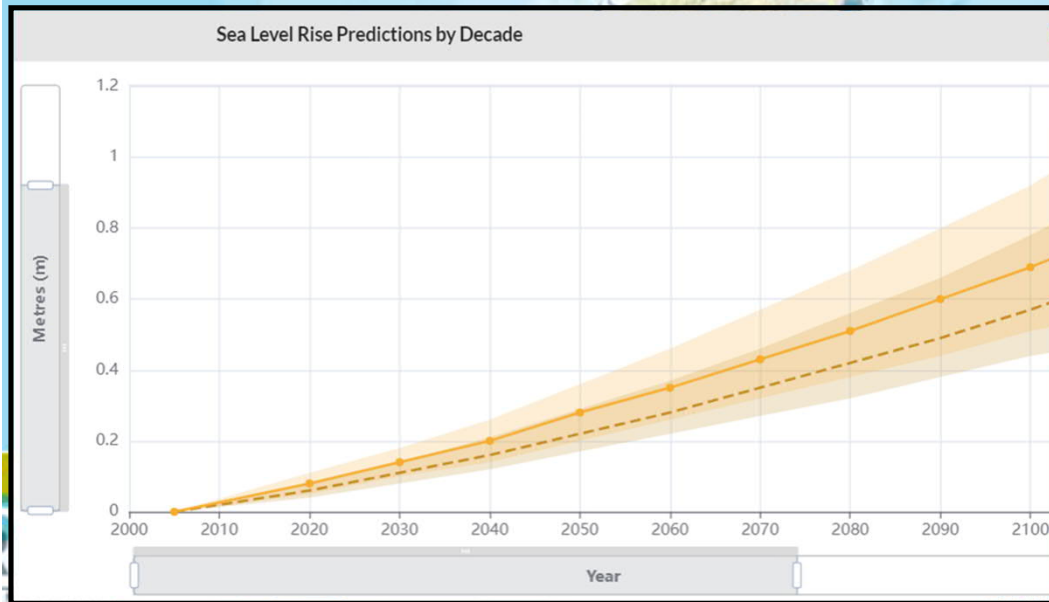


The Manawatu coast is tectonically sinking at about $1\text{--}3\text{ mm yr}^{-1}$, or 10-30 cm over 100 years.

New Zealand's sea level is rising at 2.2 mm yr^{-1} , or 22 cm / century.

Sea level rise at Manawatu is predicted to be about 60 cm by 2100.

How does this affect the coast and estuary?



Manawatū Estuary



**85 cm
of sea
level
rise**

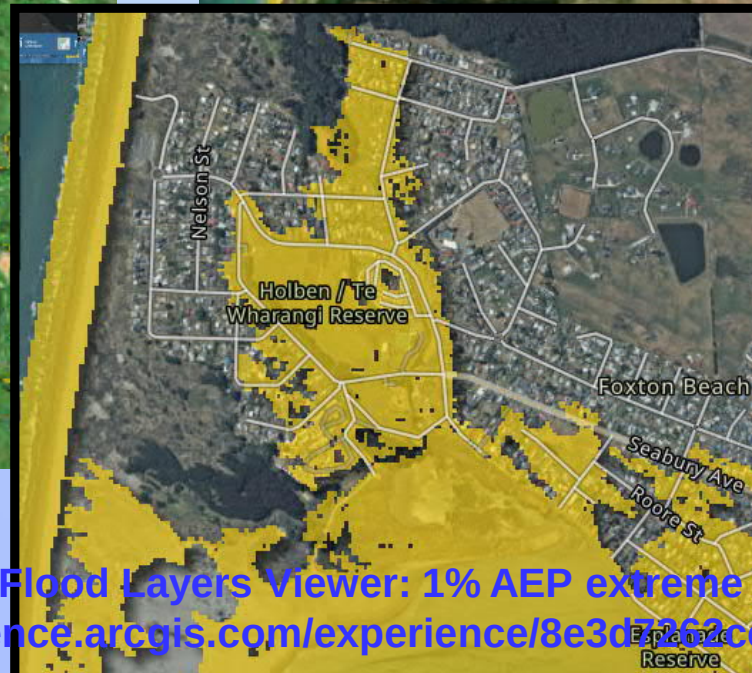
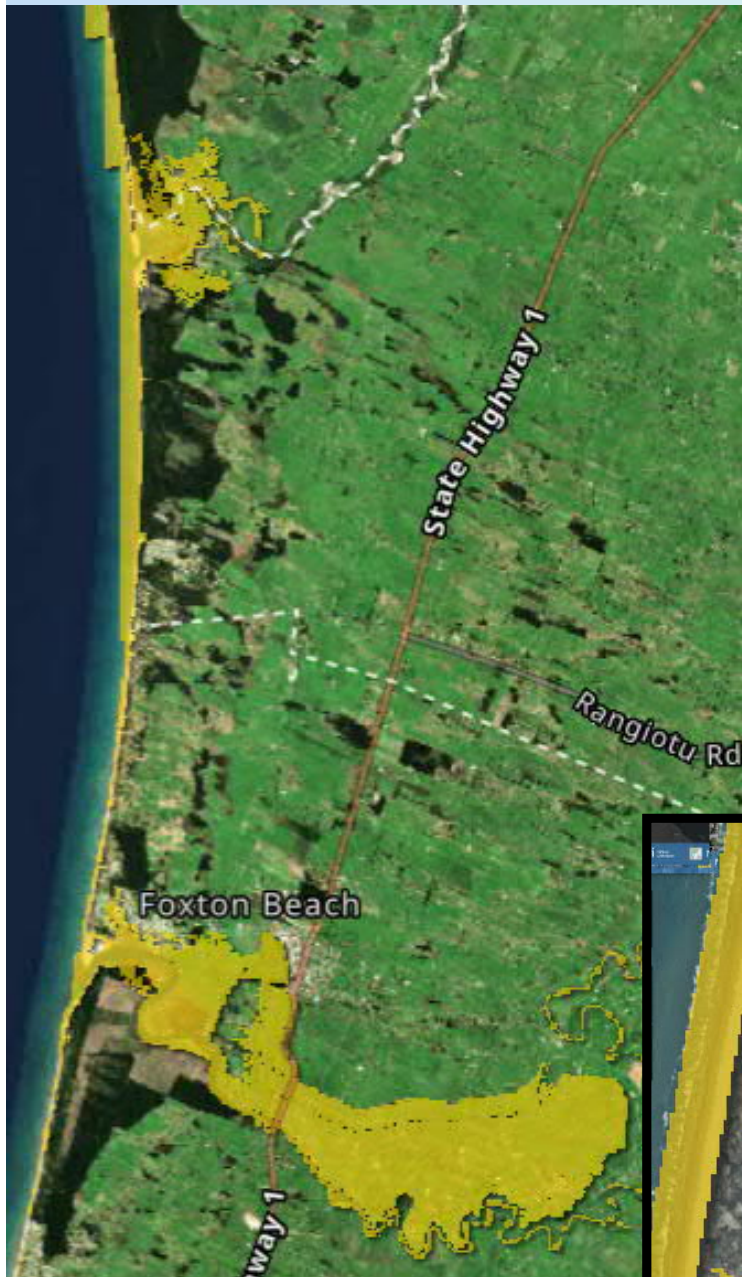


Given current topography, the yellow area will be (best guess) submerged permanently.

Tidal reaches should occur **above** this.

Islands of higher or harder materials may persist.

What else is going to happen?



Effect of sea level rise on the beach

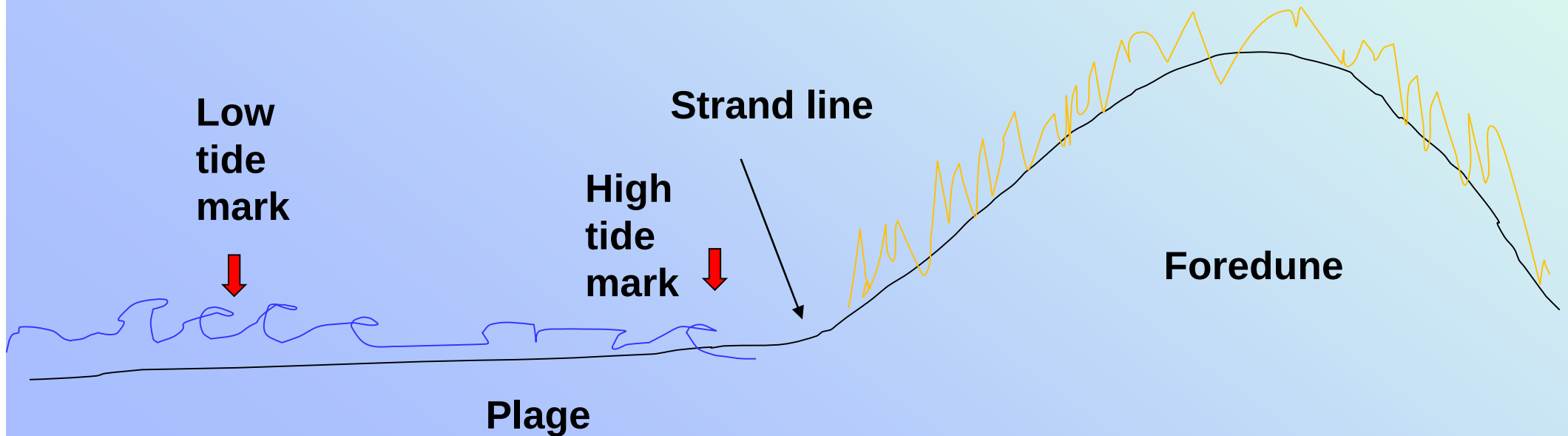
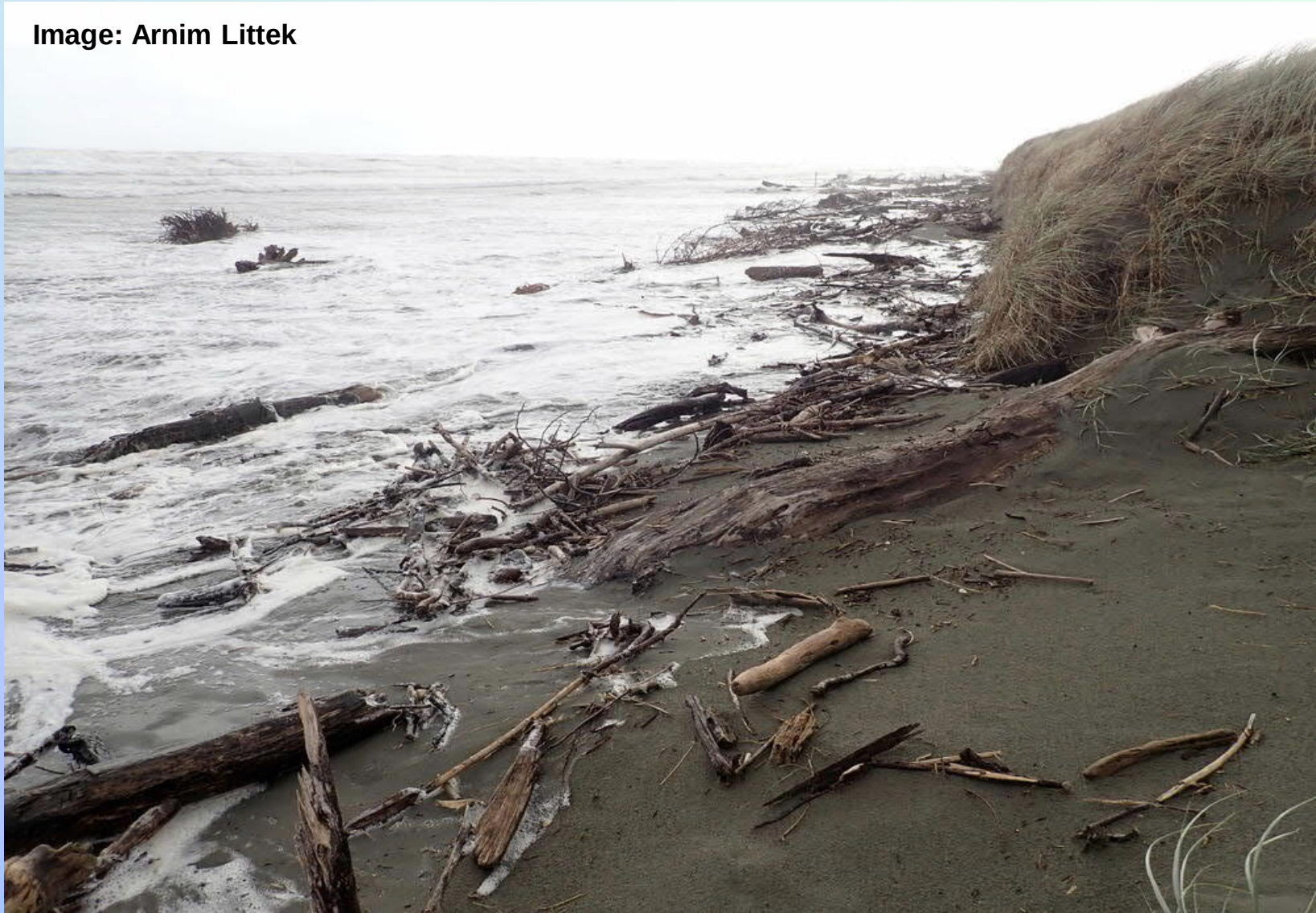


Image: Arnim Littek

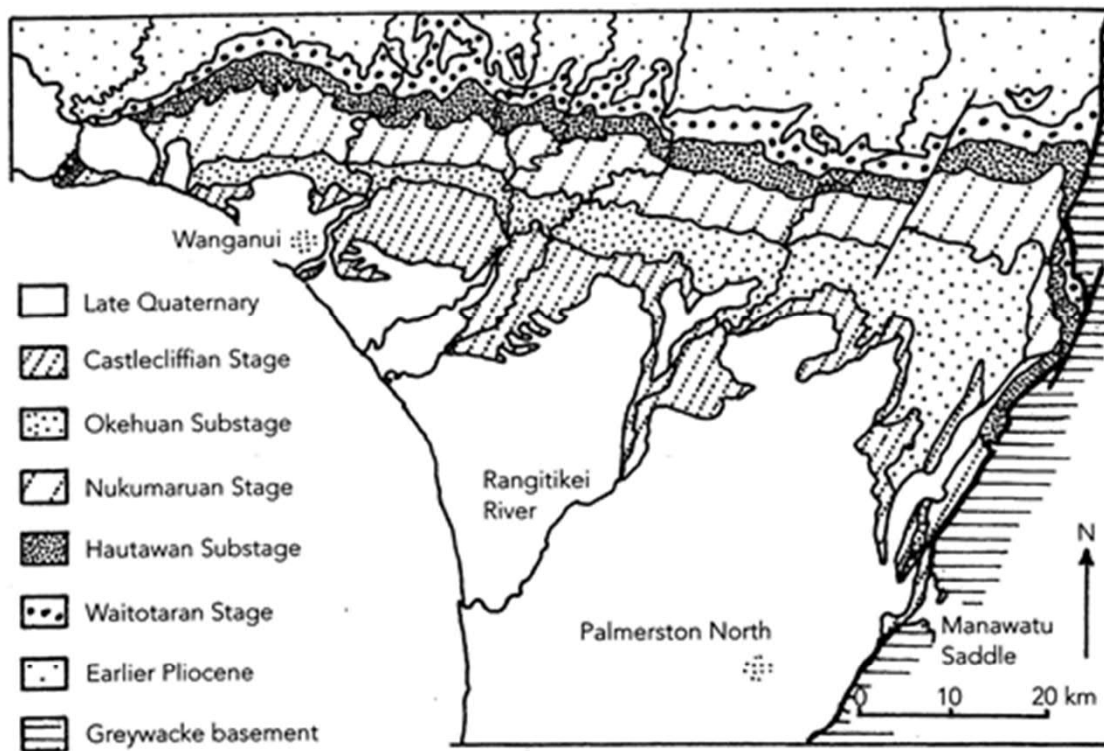


Wave energy is “increasing”.

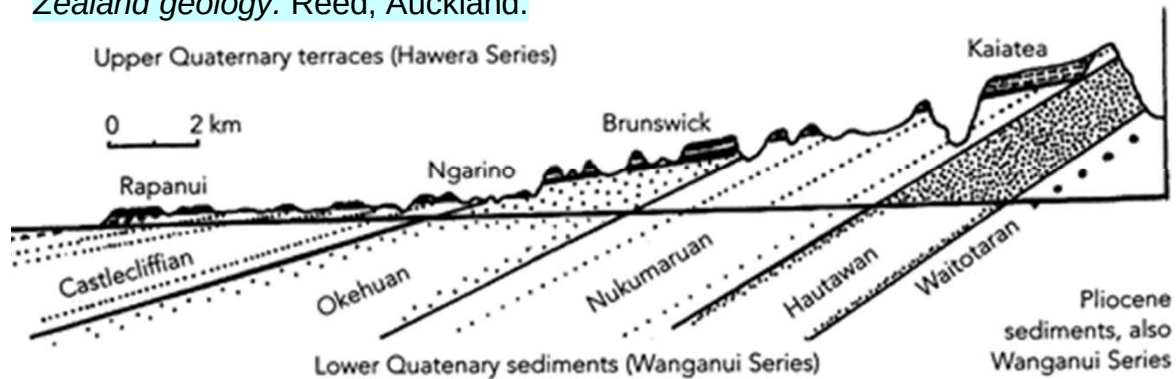
Means (?) that the wave impacts are not in balance with the energy-dissipating shape of the beach.

What is to stop the foredune's sand from eroding away ?

Our local problem



Thornton J (2003). *The Reed field guide to New Zealand geology*. Reed, Auckland.



the slope is steepened because the height is exaggerated;
the slope of the Wanganui Series rocks is 6-8 degrees.

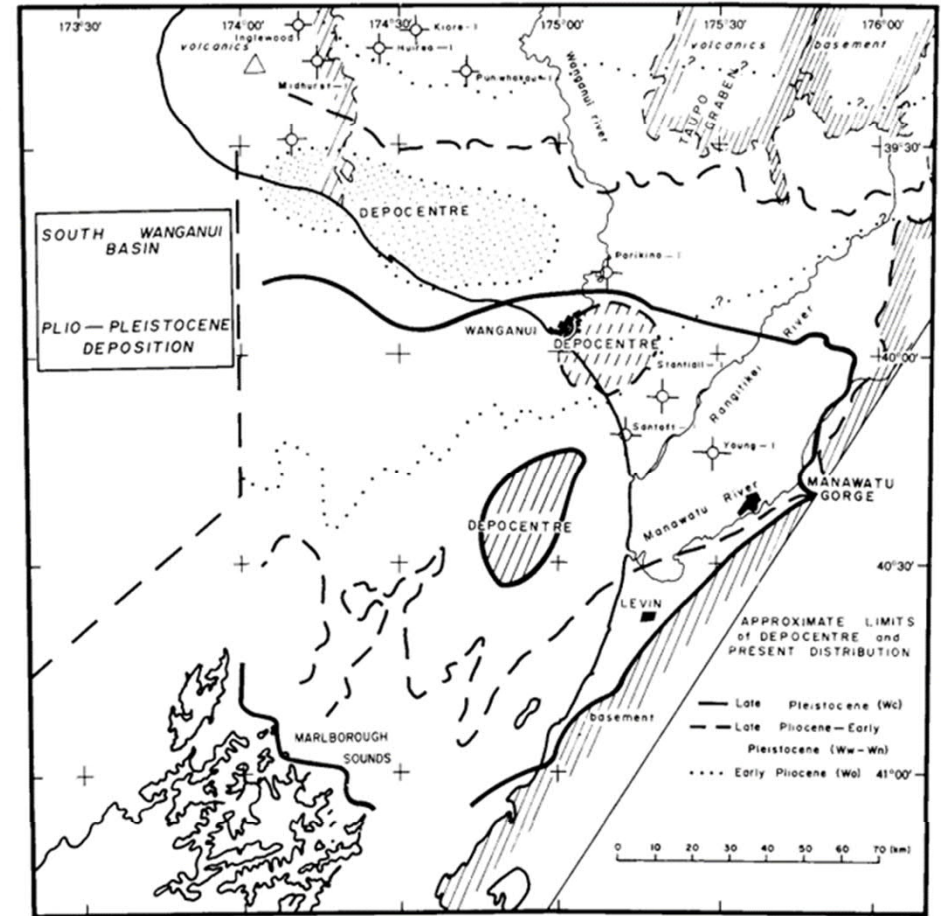
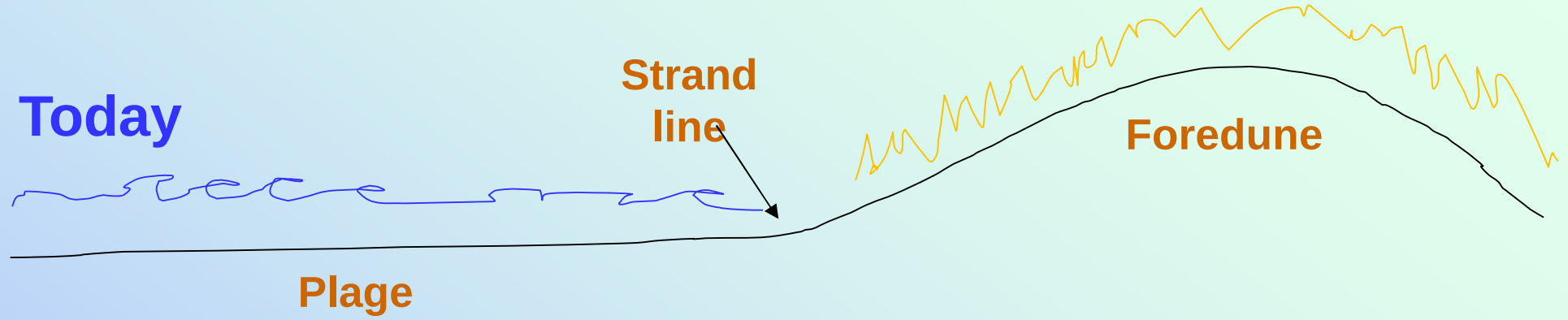


Fig. 20 Map of South Wanganui Basin showing approximate limits of depocentres and present distribution of early Pliocene, late Pliocene-early Pleistocene, and mid-late Pleistocene sediments.

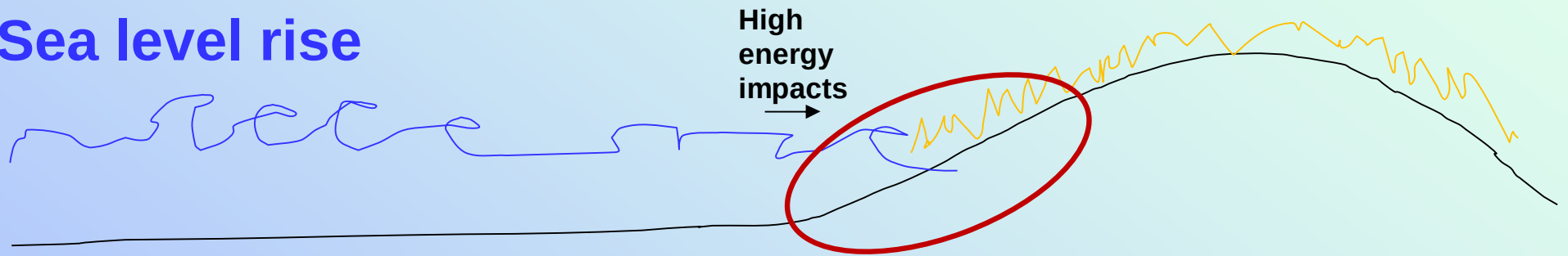
Anderton PW (1981). Structure and evolution of the south Wanganui Basin, New Zealand. *New Zealand journal of geology and geophysics*, 24(1):39-63.

Huge submarine basin off Manawatu bight - Whanganui geosyncline – depositional or erosional?

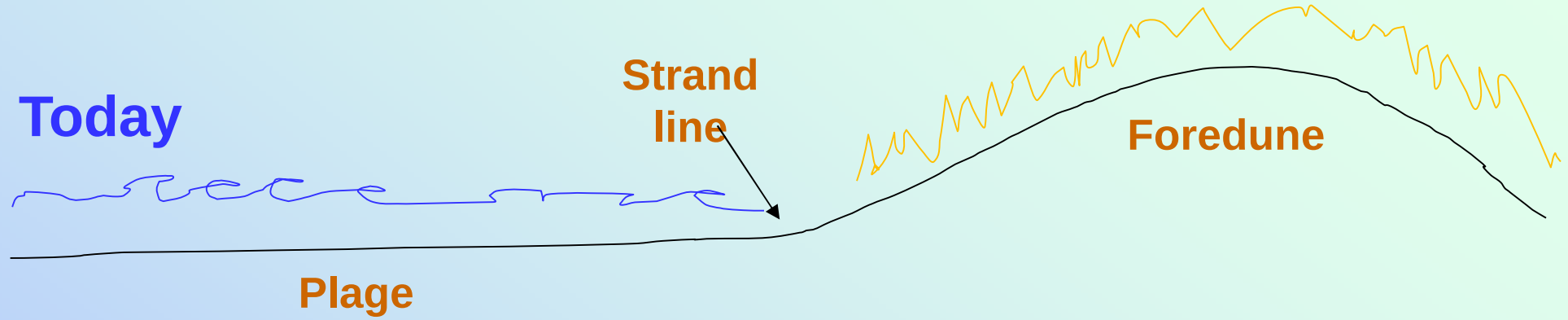
Today



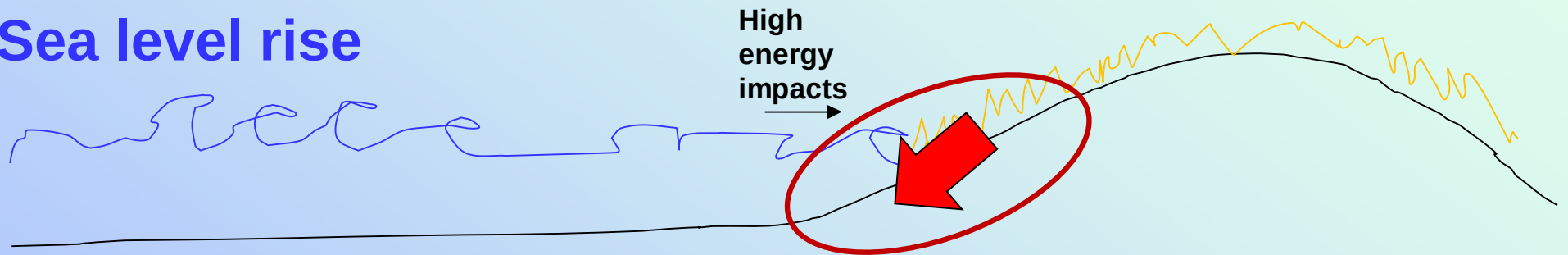
Sea level rise



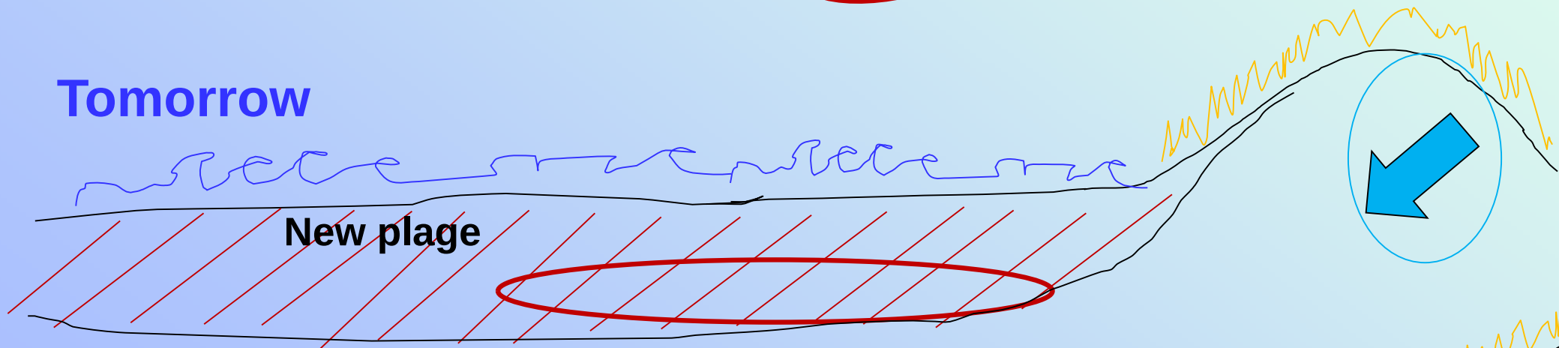
Today



Sea level rise



Tomorrow



The future



**Waiterere
dunes –
140 years**

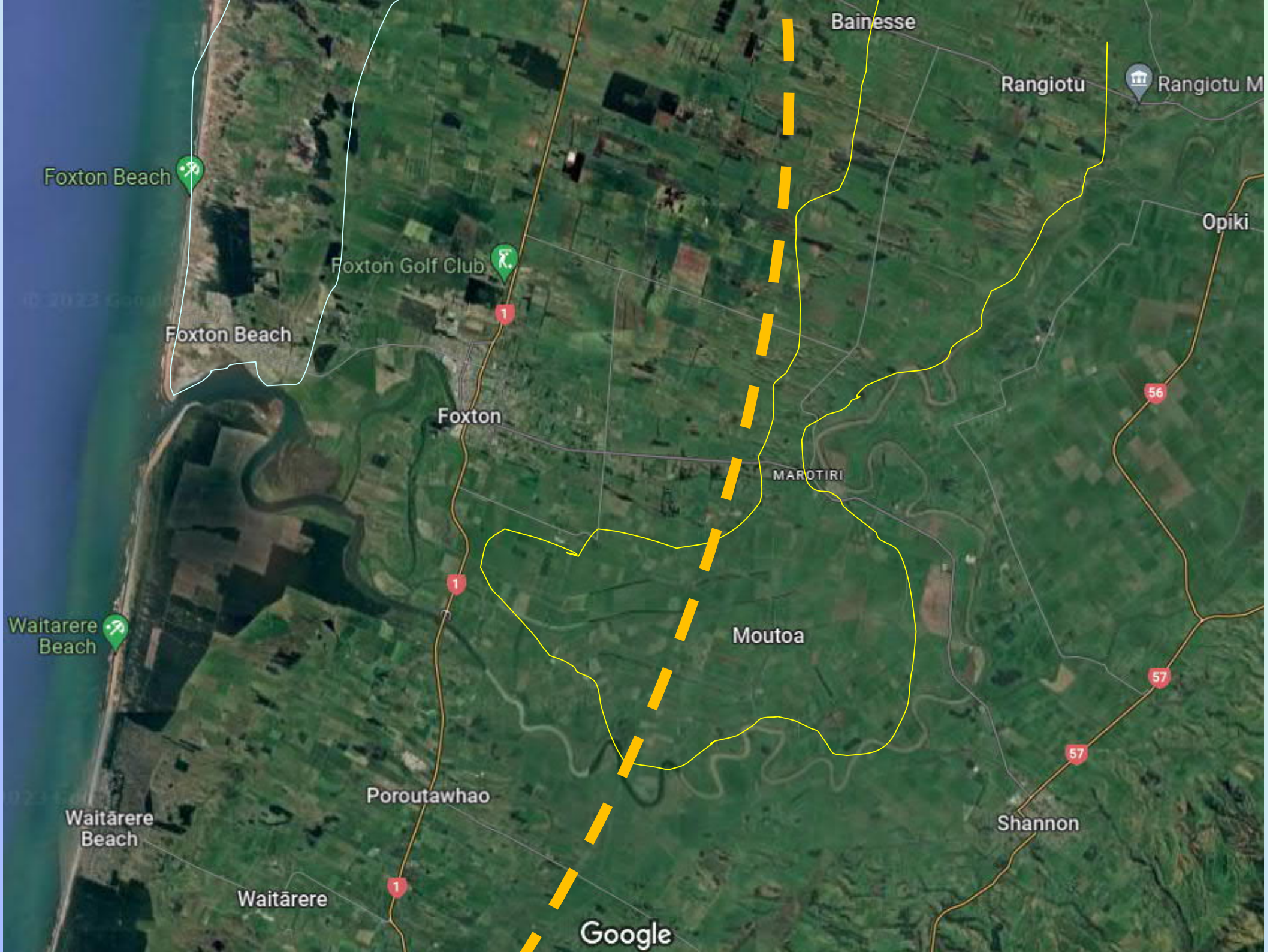
**Motuiti dunes –
800 years**

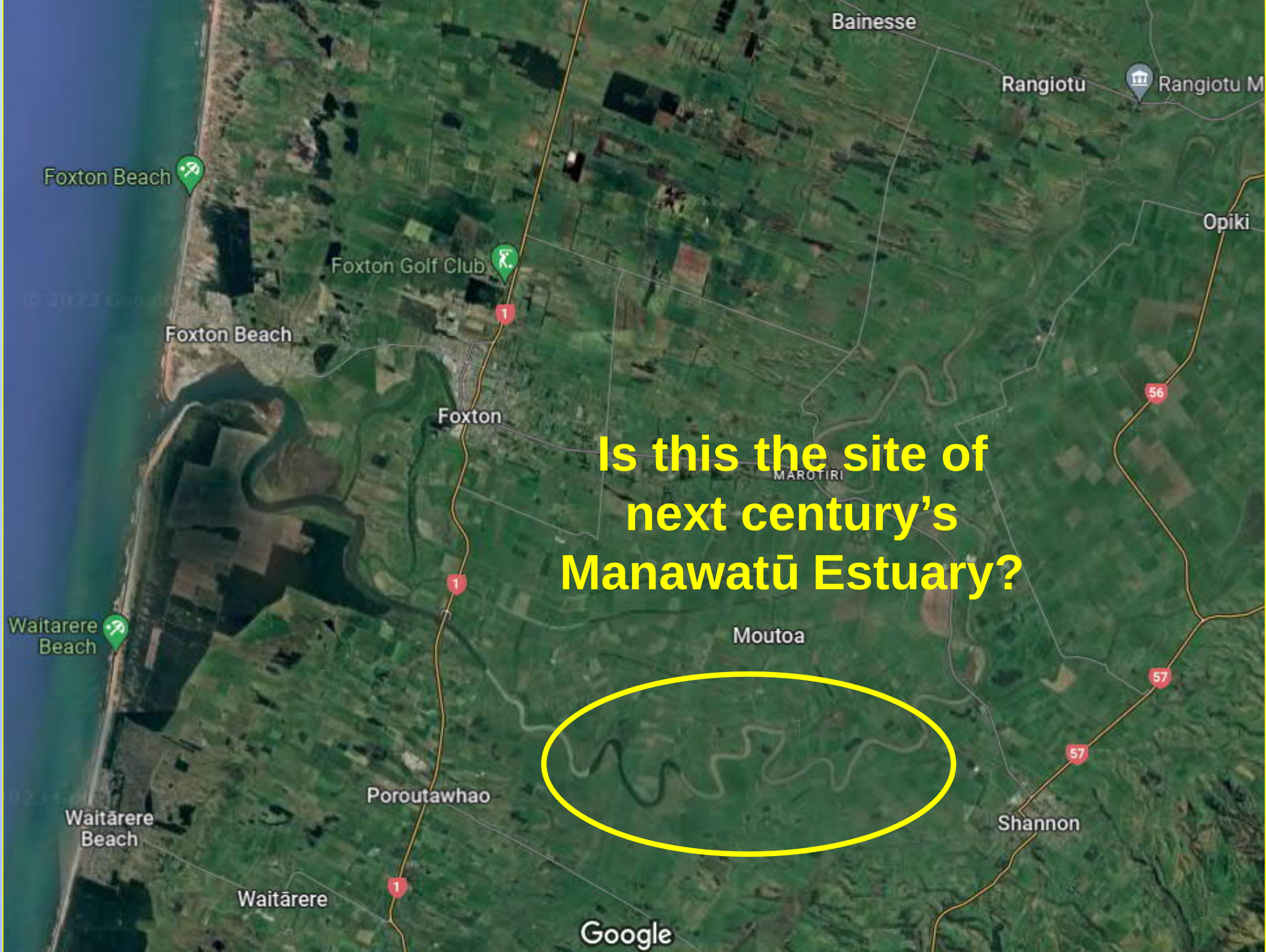
**Foxton dunes –
4000 years**

Dunes come, so therefore dunes can go!

Where is our future coast?







Is this the site of
next century's
Manawatū Estuary?

Future of the duneland habitat ?

Today's mobile duneland will not **persist** in the face of invading alien plants.

Today's ephemeral dune wetlands are **novel** (not natural) communities.

They are assembled from **random** subsets of suitably pre-adapted spp. which then dispersed to the newly arising sites.

Probably they arose because of human **destabilisation** of the dunefields.

Will they assemble in the same way under different climatic scenarios? Probably, depending on the density of aliens.

Will they assemble in the same PLACE under different climatic scenarios? No; the coast will be elsewhere, probably further inland.

Future of the estuarine habitat

Today's Manawatu Estuary is probably NOT going to **persist**.

The location and nature of the estuary in the past is unknown / unknowable ?

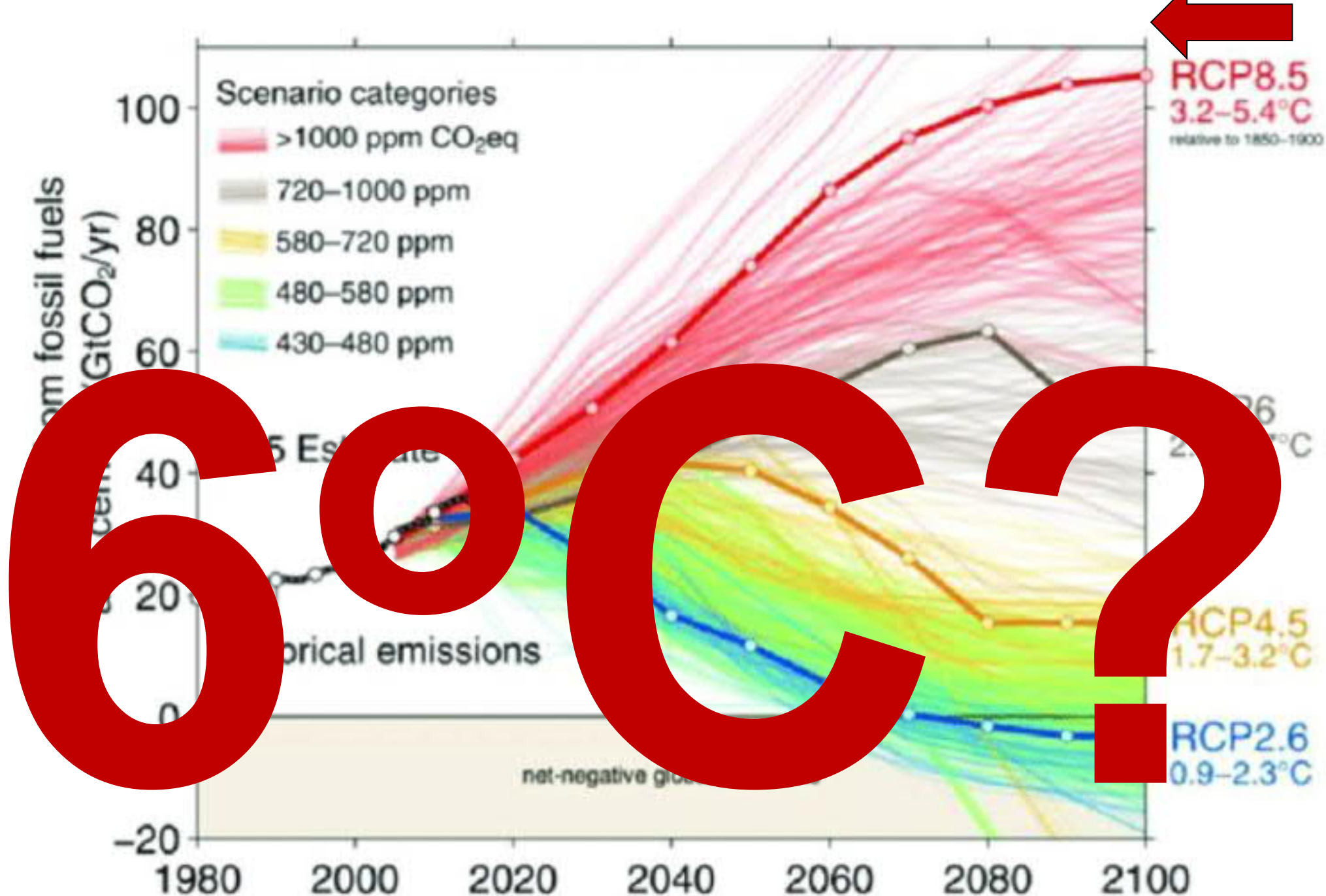
The estuary will either disappear or **move** upstream.

Estuaries need a **large, open, flat site** unencumbered by people's infrastructures.

A (range of) locations for **future estuaries** may be available.

Will the estuary assemble in a new place?

Estuaries are easy to conserve as their flora is adapted to regular change in their habitat, is highly dispersable, and their life cycles are short.



Time for some long-term planning ?

“Out” the zones where infrastructure is threatened.

Adapt management of these threatened zones.

Plan for management of change in other zones.

Plan for threatened native habitat.

Research on

- coastal movements**
- sediment deposition and relocation**
- impact on fresh-water tables**
- genetic diversity and tolerance ranges of natives.**

Prioritising the good things we want today with the need for long-term planning ??

Some suggestions for MET

Work out a range of future possible locations for the estuary under different climate change scenarios and erodibility of the dunelands.

BY: Consulting some coastal / offshore geomorphological experts.

Plan on identifying potential locations.

BY: Long-term planning, consultation, and science.

Acquire suitable locations as they become available, salty, unfarmable or abandoned.

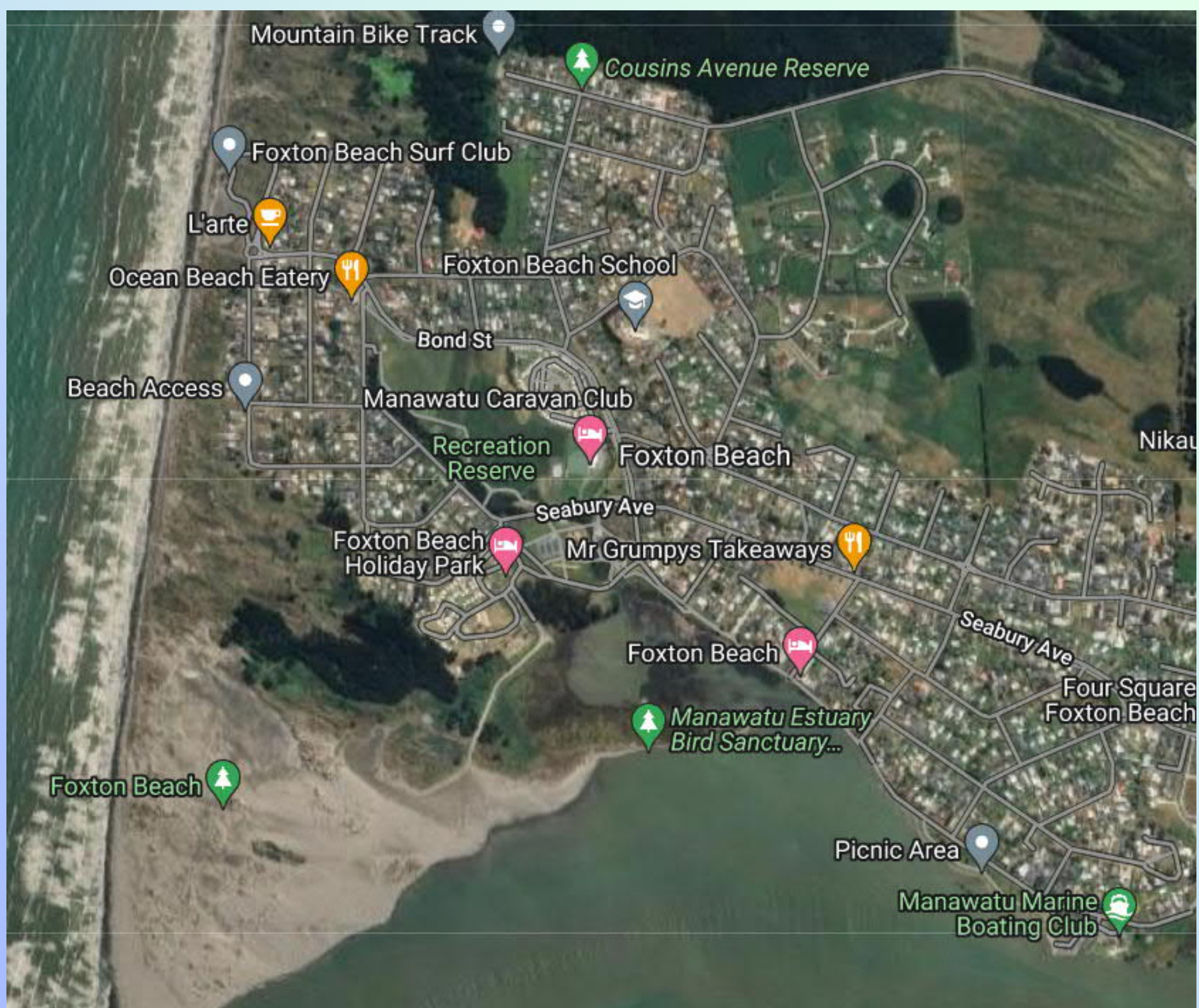
BY: Purchase and land-banking.

Protect local stock of species in case appearance of new estuarine habitat is erratic.

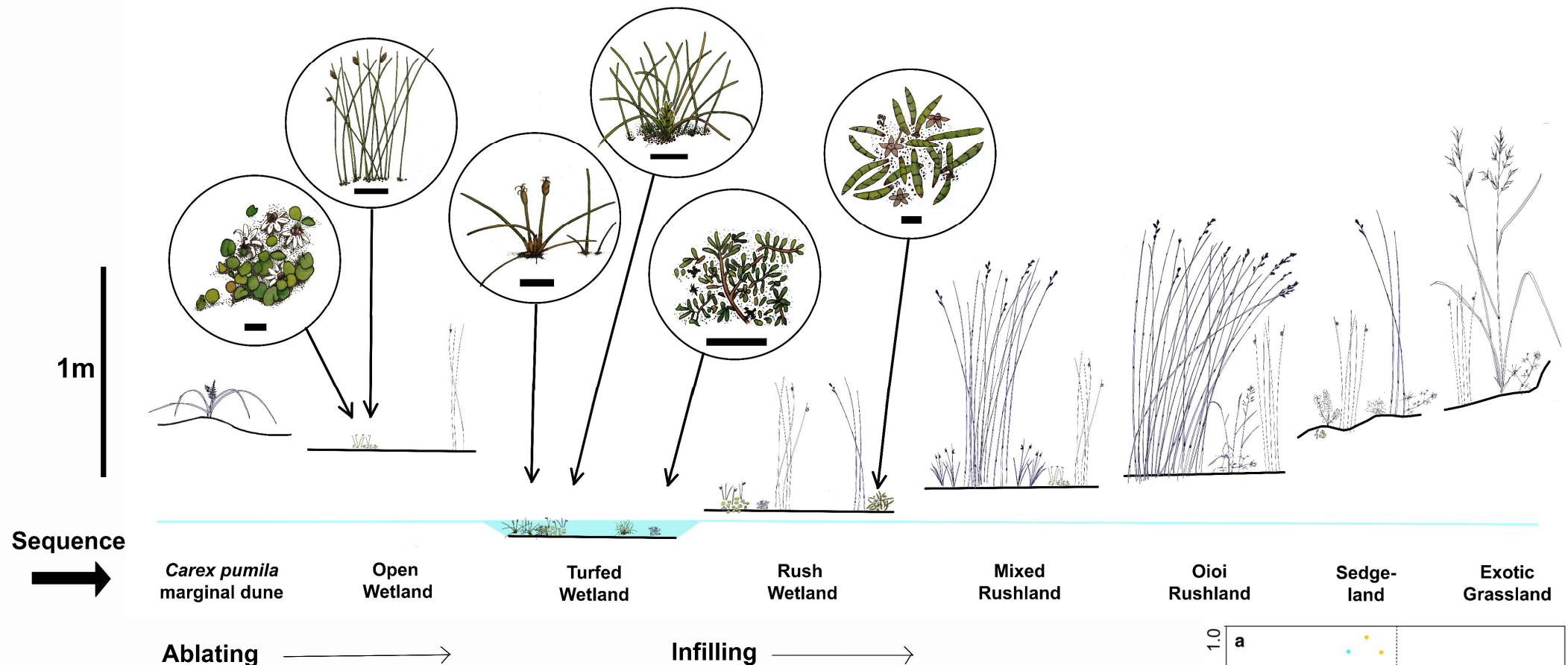
BY: Establishment of seed banks or nurseries to perpetuate availability.

Acknowledgements

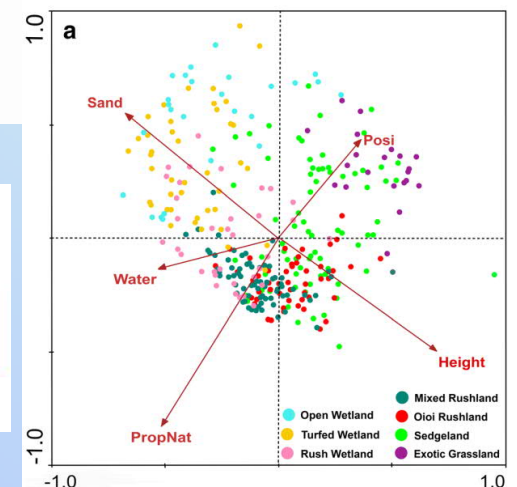
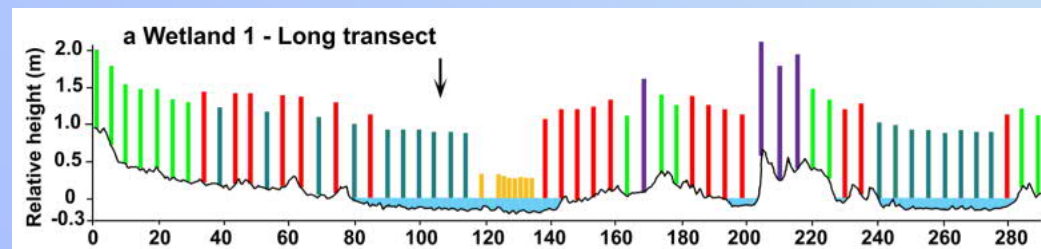
- To all those who have come to the beach with me or waited patiently in the carpark.
- Department of Conservation, especially Viv McGlynn, Kelly Stratford and Margaret Metcalfe for letting me play, and all the guys who dig, fence and spray.
- Massey University for not noticing I was not in my office.
- Horowhenua Regional Council and Massey, INR summer scholarship for funding for Ange McBridie.
- Nick Singers for starting off all my dune research.
- Melanya Yuxhnevich for finding her own funding.
- Paul Horton, Tanenuiarangi o Manawatu and Massey MURF for funding for Ashley Murphy.
- Ange, Ash and all others who helped with field work.
- MET and F+B for making me actually compile some of these ideas.



Wetland succession is successful



Murphy AL, Singers NJ, Rapson GL (2019). Created dune slack wetlands effectively host rare early successional turf communities in a dynamic dunefield, New Zealand. *Journal of coastal conservation*, 23, 203-225.



Wetlands are stable enough to have endemics



Pimelea arenaria – sand daphne



Pimelea actea, rare sand daphne

