

A DPSIR analysis of aeolian sand dune mobilization along the coast of Manawatu-Wanganui in New Zealand

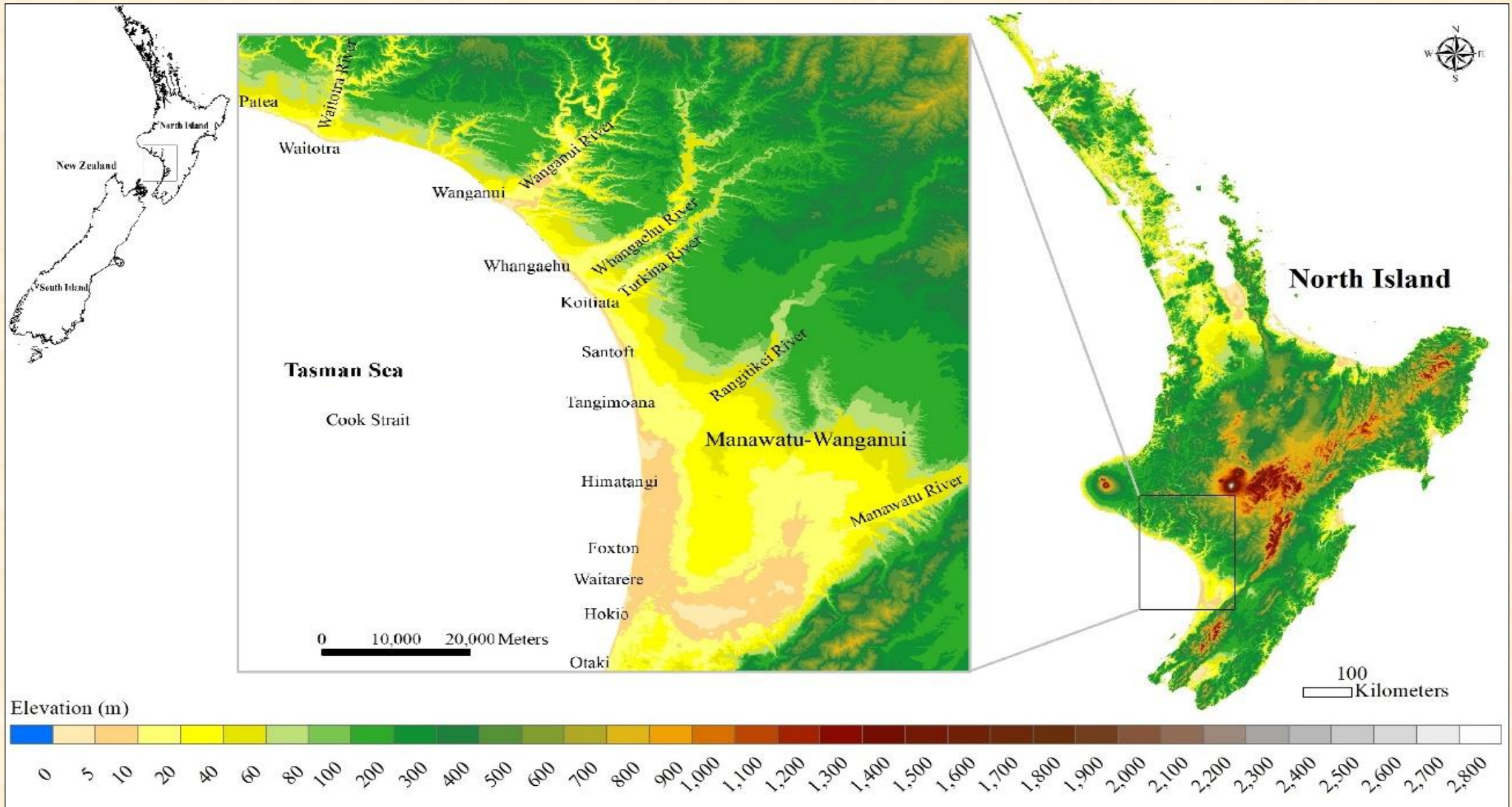
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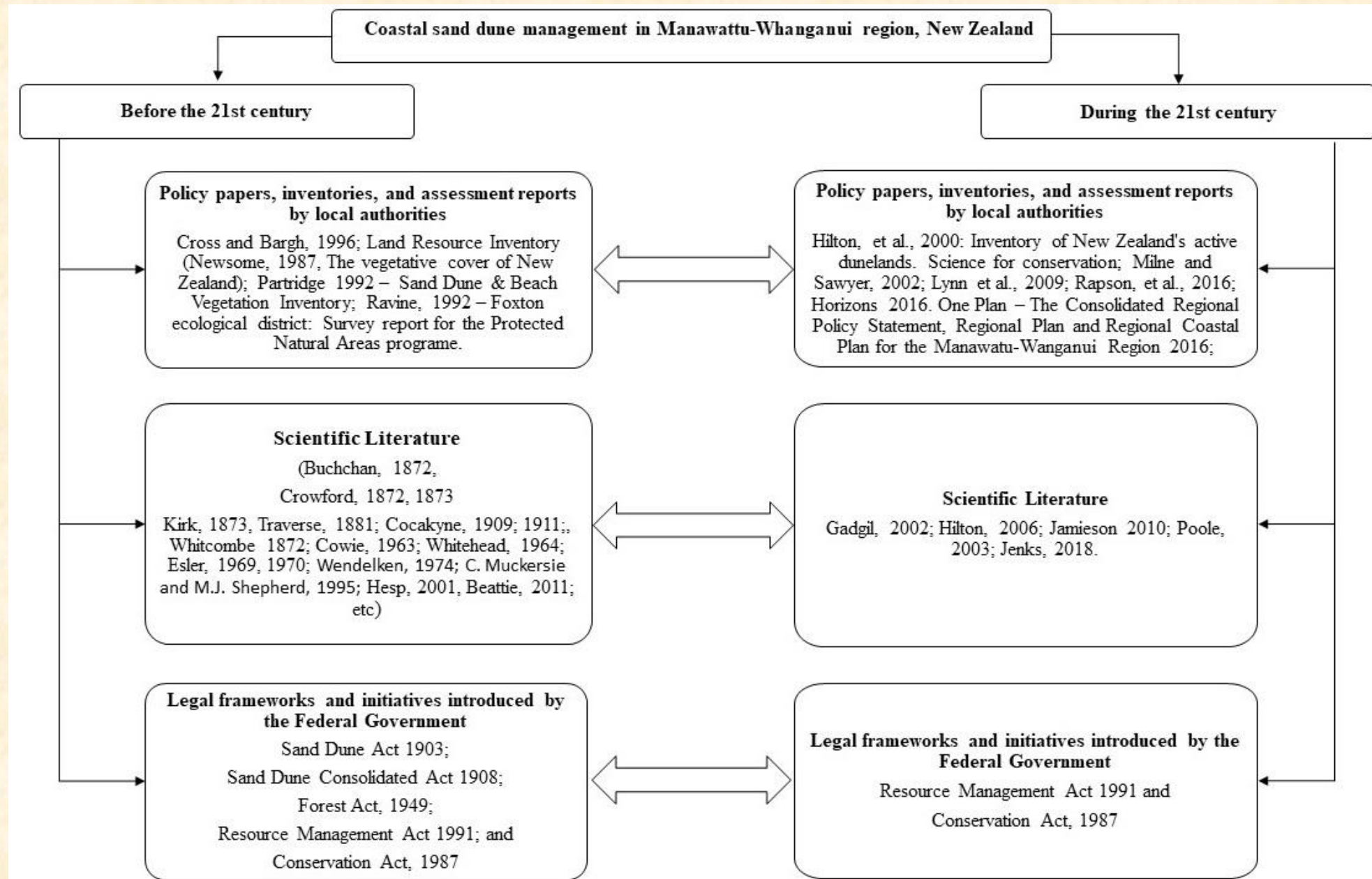
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Study Area: A Digital Elevation Model of the North Island and the Manawatu-Wanganui Dune Field

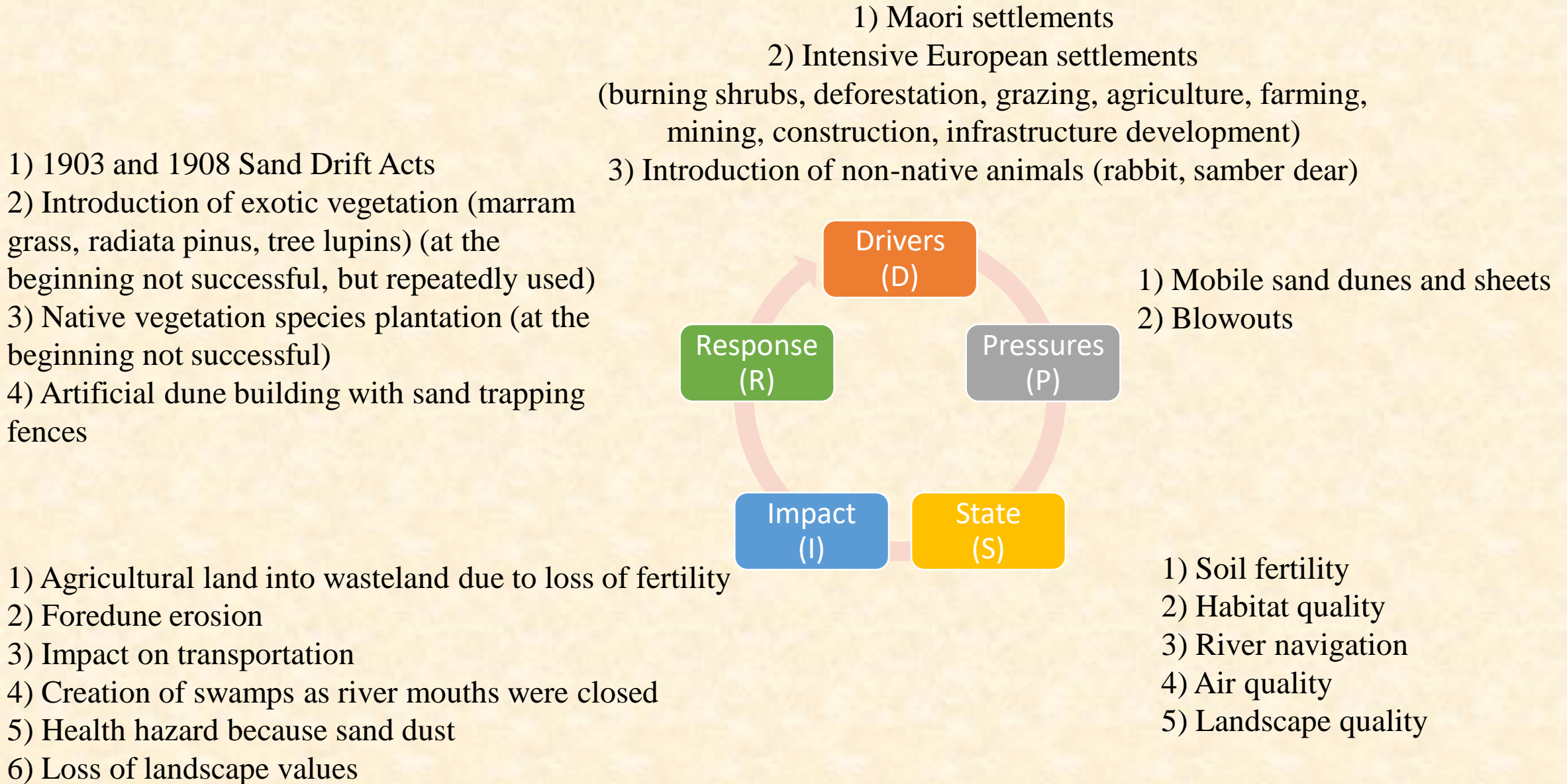


The approach adopted to study the response to managing sand dune drift before and during the 21st century in the Manawatu-Whanganui region



DPSIR analysis of sand drifting in Manawatu-Wangunai

Sand drift (historical) during the 19th and 20th century



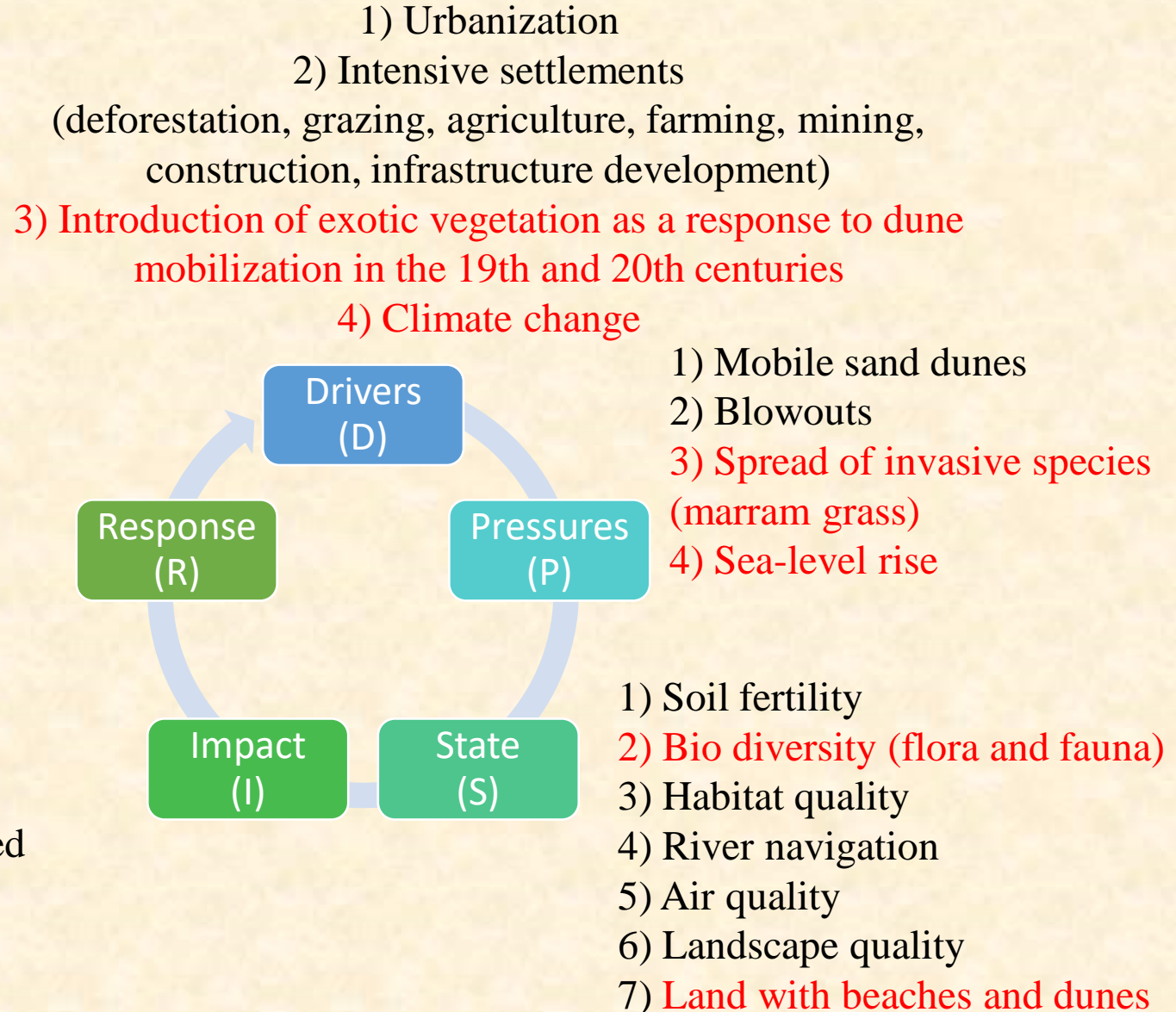
DPSIR analysis of sand drifting in Manawatu-Wangunai

Sand drift during the 21st century

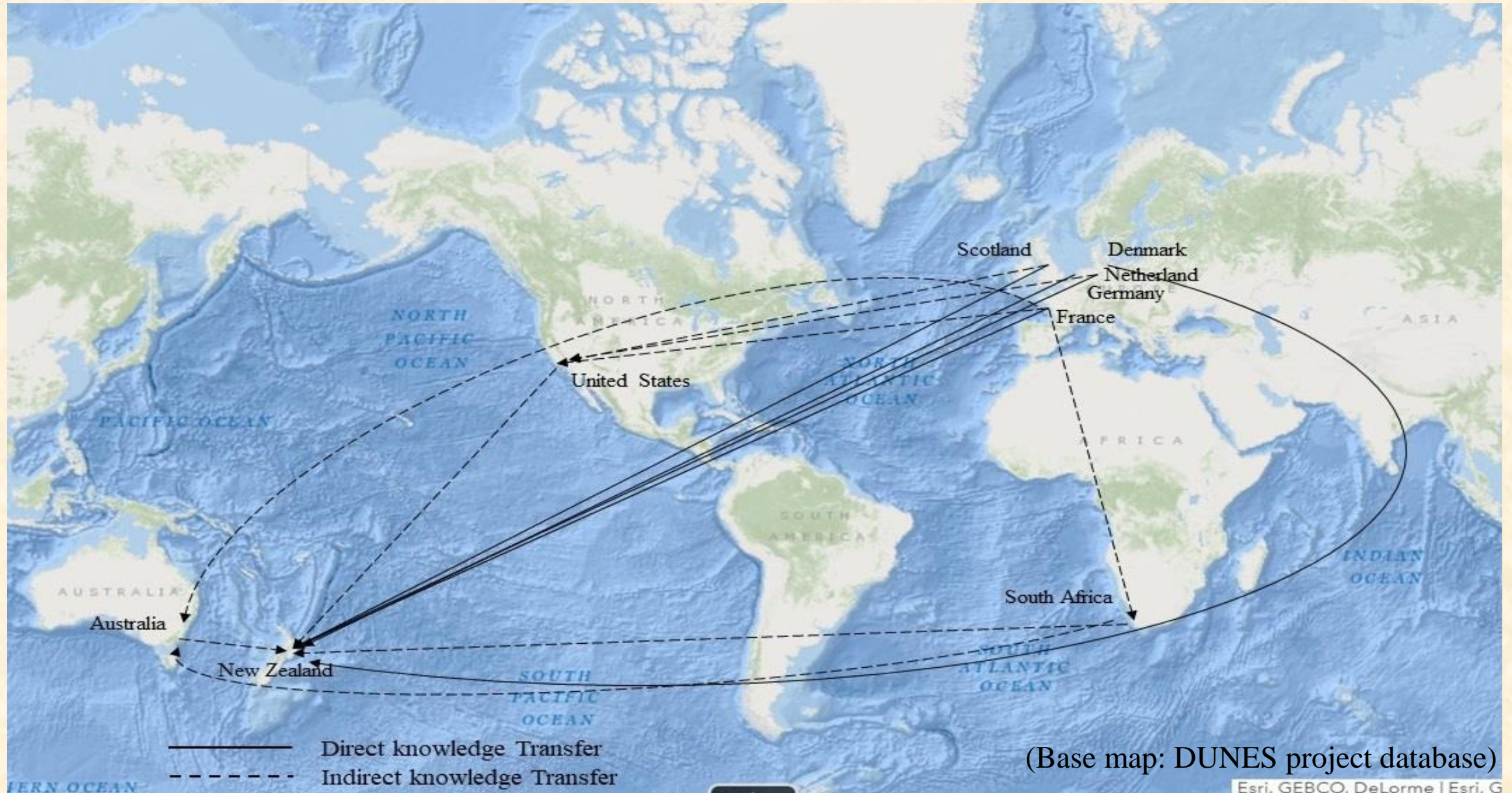
- 1) Resource Management Act 1991 (RMA)
- 2) Integrated management “One Plan” The Consolidated Regional Policy Statement, Regional Plan and Regional Coastal Plan for the Manawatu-Wanganui Region prepared by the Horizons Regional Council

- 3) Removal of exotic vegetation (e.g. marram grass)
- 4) Introduction of native vegetation species
- 5) Artificial dune building with sand trapping fences
- 6) Enhance awareness
- 7) Public participation
- 8) No special attention to SLR in One Plan

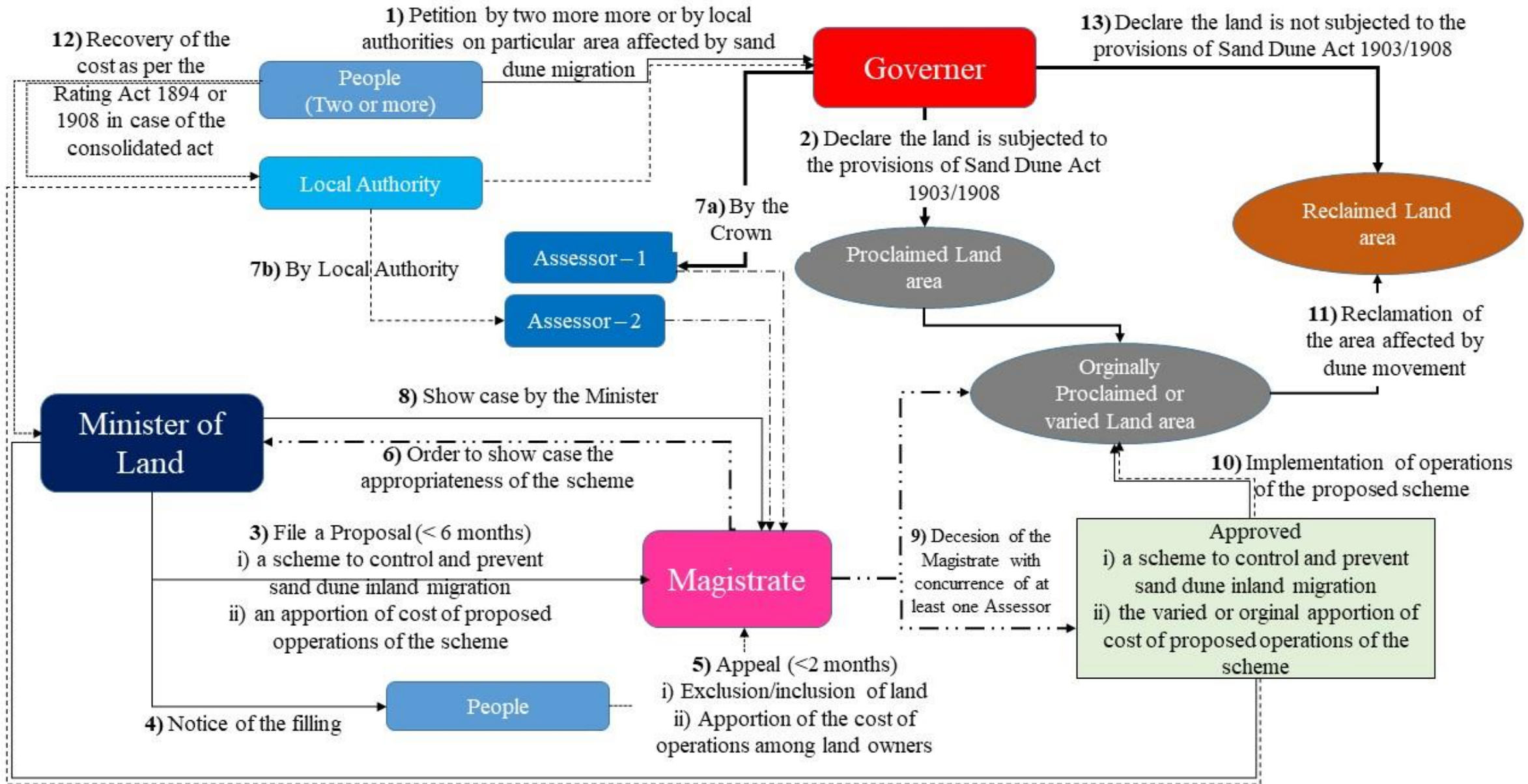
- 1) Land into wasteland due to loss of fertility
- Transportation issues
- 2) **Loss of biodiversity**
- 3) Creation of swamps as river mouths were closed
- 4) Health hazard because sand dust
- 5) Loss of forest cover
- 6) Loss of landscape values
- 7) Change of transgressive dunes to parabolic dunes
- 8) **Coastal inundation and foredune erosion**



Direct and indirect paths of knowledge transfer to New Zealand to manage sand dune drift in the 19th and 20th centuries.



New Zealand's Sand Dune Act, 1903 or consolidated act, 1908



The sequence of the dune stabilization approach fully adopted to New Zealand by 1960s

Based on
Cockayne 2009, 2011;
Whitehead, 1964;
Wenkedelen, 1975.

Primary stabilizer

- Built catching fences
- Foredune formation
- *Marram grass* planting
- Replant damaged areas
- Use fertilizer

Secondary Stabilizer

- Allow Shrubs such as manuka, *Olearia*, *Cassinia* and *Pimelea* may follow naturally
- If the above process is slow, plant tree lupin after two years of marram grass planting

Tertiary Stabilizer

- Establish a protective belt with radiata pines when tree-lupin grows for two to three years.
- Establish plants such as *Olearia traversii*, *Leptospermum laevigatum*, *Osteospermum monoliferum* and *Acacia sophorae* in the lee and on the crest of the foredune

Main institutions involved in dune management in New Zealand

1909

- Department of Lands and Survey (after the enactment of Sand Dune Consolidated Act in 1908)

1915

- Forestry Branch of the Department of Lands and Survey

1919

- The State Forest Service

1931

- The Public Works Department (Due to world wide depression)

1951

- Retrivel of dune management by the Forest Service

1952

- New Zealand Forest Service (after the enactment of the Forests Act 1949)

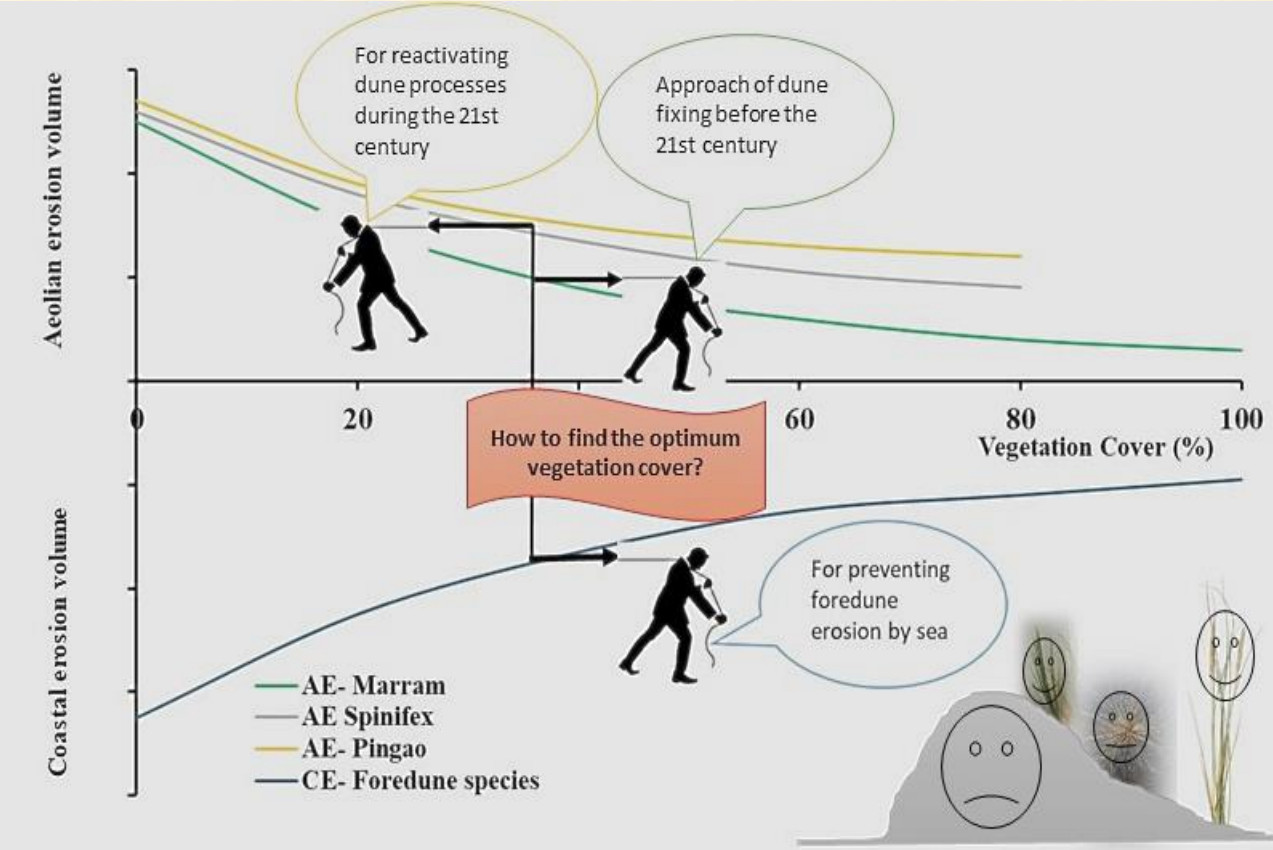
1987

- Department of Conservation (after the abolishing of the New Zealand Forest Service and enactment of Conservation Act 1987)

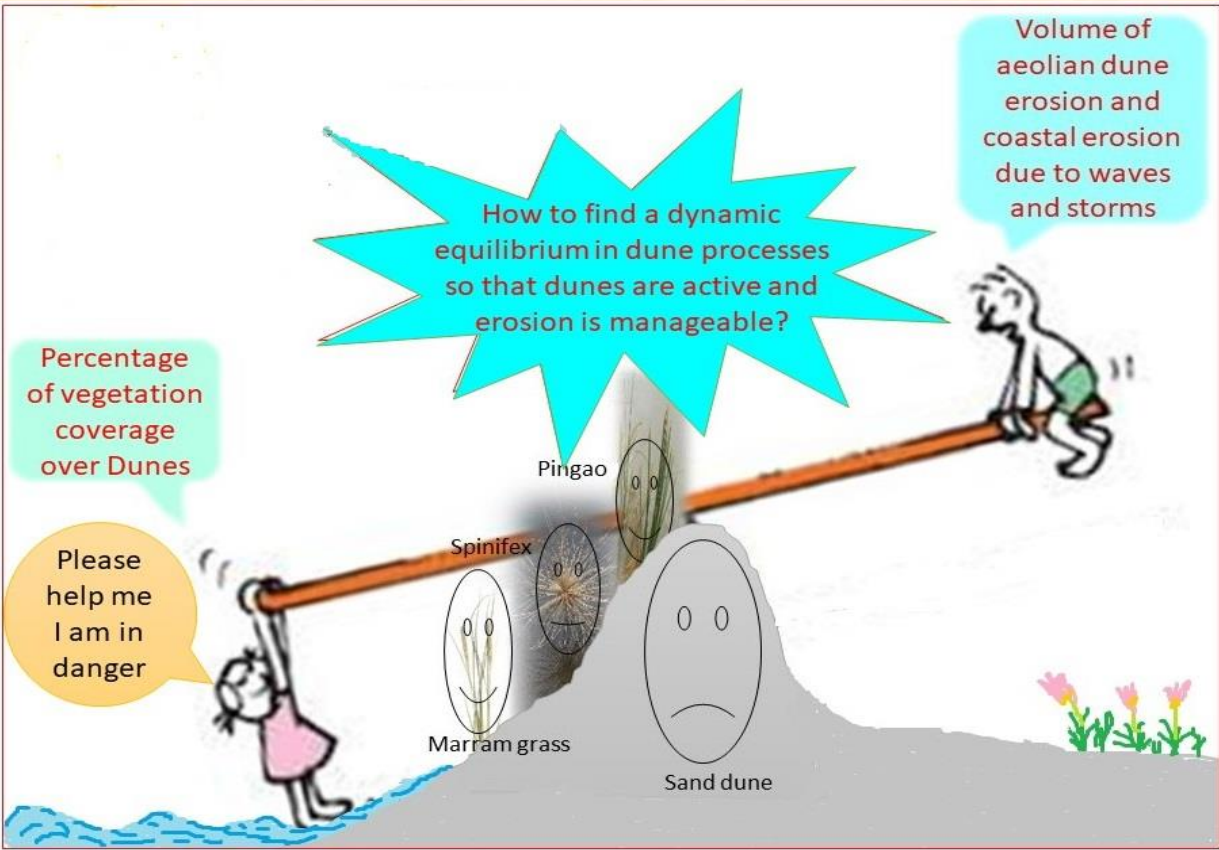
2018

- Reestablishment of the New Zealand Forest in the name of Te Uru Rākau (At present, both the Department of Conservation and Te Uru Rākau have roles in dune management)

A schematic representation of a conceptual model for finding an optimum solution for coastal sand dune management



A schematic representation with conceptual model between erosion volume and the vegetation coverage over coastal sand dunes.



The relationship between erosion volume and the vegetation coverage over coastal sand dunes.

Lessons Learnt and recommendations

- Adaptation of foreign methodologies are recommended only if they can enhance the natural process of the local environments.
- Proper scientific research must be carried out to understand the natural environment and their processes and their sensitivity to change of the system.
- Environmental anxiety may sometimes cause negative impact and can be detrimental in finding sustainable solutions to environmental hazards. Therefore, any mitigation and adaptation approached must be planned and implemented rationally and objectively.
- Public participation should be encouraged in the restoration projects of sand dunes, as it connects the population with the environment and enhance the awareness of natural hazards and boosts precautionary approaches.
- It is required to identify new threats. For instance, accelerated sea-level rise as predicted in numerous studies, including the IPCC, can aggravate the issue as the erosion of foredunes can be increased.
 - Though the eroded sand may be deposited below the sea-level, they will ultimately contribute to the formation of sand dunes further inland.

Thank You