A macroinvertebrate index to assess stream bed stability

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Outline

- Background
  - Stream bed stability
- Macroinvertebrate Index
  - Calibration
  - Development
  - Validation
- Conclusions
  - Applications
  - Further work

Background

Climate change

Anthropogenic pressure

Flow regime and sediment dynamics

- Effects on substrate stability
- Response of lotic ecosystems

How to quantify aspects of stream bed stability relevant to these ecosystems?

- Direct measurement (e.g. SBSI)
- Biotic Index

Stream bed stability

Disruption of stable state by

- Different processes
  - Entrainment
  - Deposition
  - Transport
  - Abrasion

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  - Shear forces exerted by flowing water
  - Other forces on stream bed

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- Other forces on stream bed

Controlled by

- intrinsic factors: imbrication, embeddedness, sorting, …
- extrinsic factors: flow regime, sediment supply, connectivity, land use, geology, …

Background

Benthic stream invertebrates

- play a key role in lotic ecosystems
- respond to environmental factors on various scales

Abiotic factors
e.g.
•Physico-chemical water parameters
•Hydraulic conditions
•Substrate
•….

community composition

Biotic factors

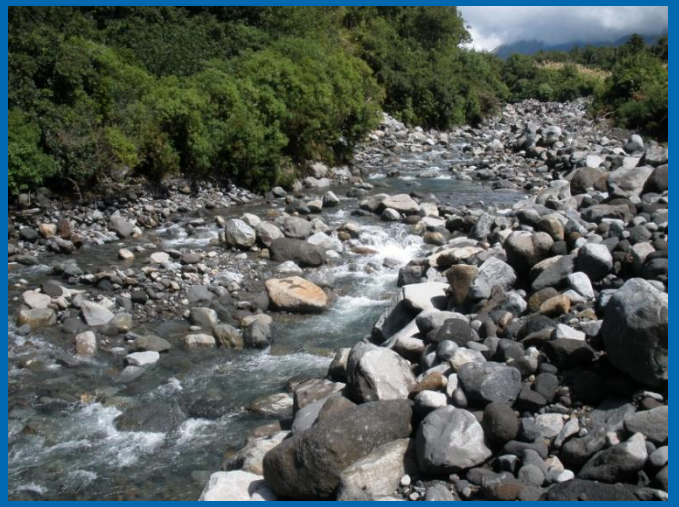
•Predation
•Competition

- community composition used to indicate ecological integrity, water quality and state of habitat

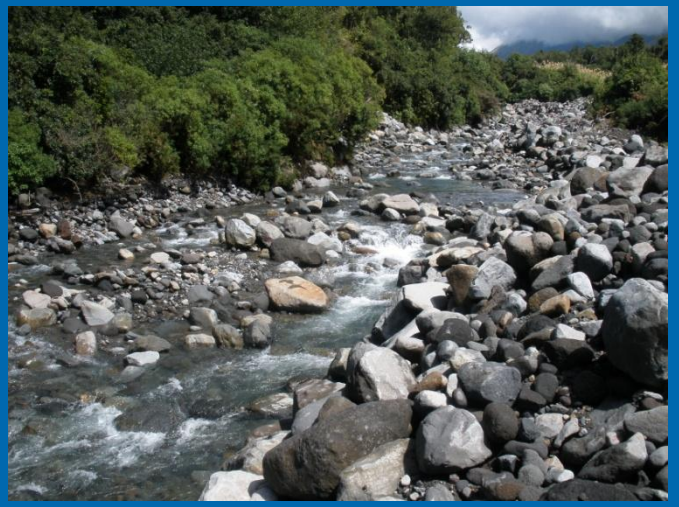
Macroinvertebrate index

Specifications:

- Biotic community index
- Based on invertebrate samples from upland streams
- Stony riffles



Macroinvertebrate index



Specifications:

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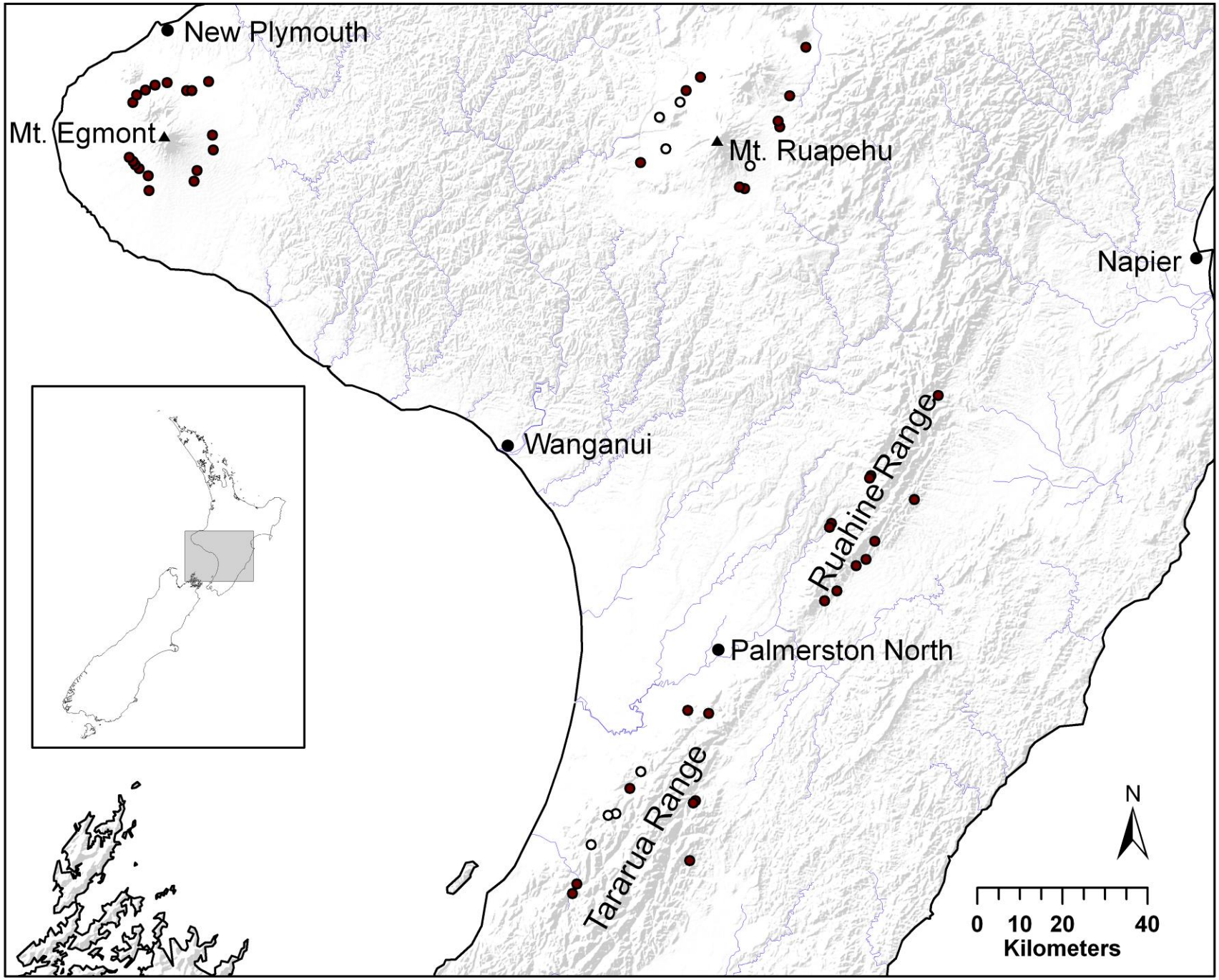
Calibration:

- Entrainment and transport of in situ marked tracer stones
- Cover of relevant aspects of stream bed stability[1]
- At 46 sites

Validation:

- At 8 random sites

[1] Schwendel et.al. (2011). Linking disturbance and stream invertebrate communities - how best to measure bed stability. JNABS **30**: 11-24.


New Plymouth
Mt. Egmont
Mt. Ruapehu
Napier
Wanganui
Ruahine Range
Palmerston North
Tararua Range
N
0 10 20 40
Kilometers

Calibration

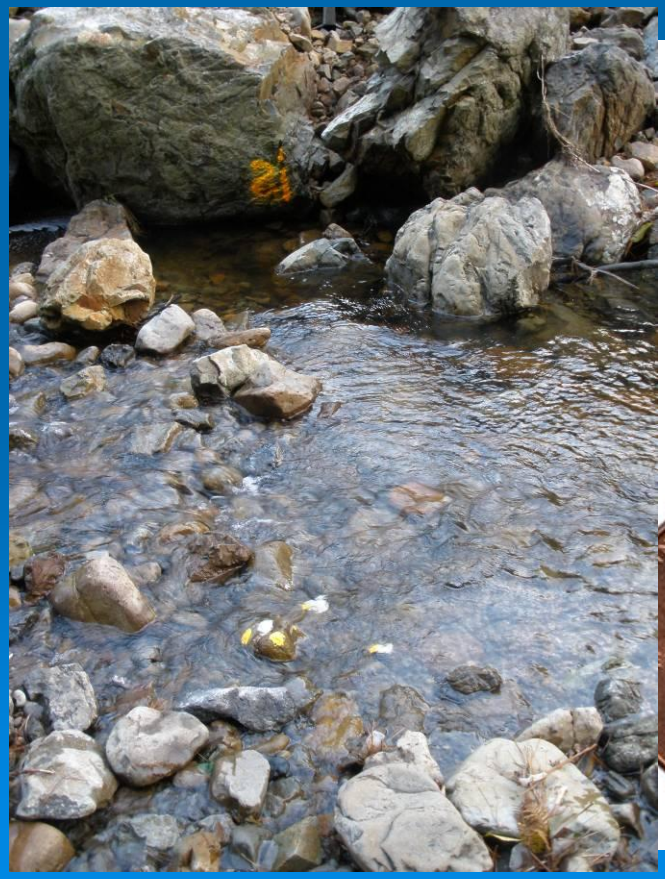
- In situ marking of 5 tracer stones in each of 3 size fractions: D_{50}, D_{70}, D_{90}

  → no disturbance of imbrication

Tracer stones

- RFID tags attached under water

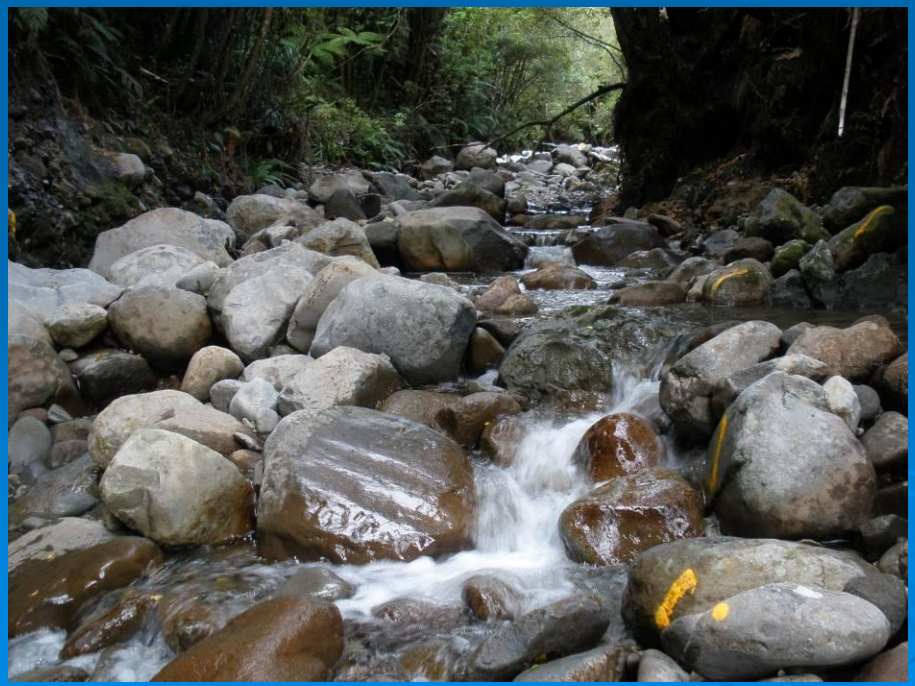
  → easy and non-invasive relocation and identification with portable antenna



23 mm glass tag

Tracer stones

- Measurement of travelled distance weighted by size class:
  - Movement over 6 months
  - Conversion to an index of bed stability: TTM
  - Classification of sites in 4, 7 and 11 classes according to TTM



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- Indicator Species Analysis in PC-ORD with each of the 3 bed stability classifications
  - Abundance of taxa in a class
  - Faithfulness of taxa to a particular class

  → Indicator Values for each taxa and each class

- Tested for significance on random dataset

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- Allocation of scores to taxa ranging from -10 (unstable) to 10 (stable)

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- Averaging of scores derived from all 3 bed stability classifications

Hydrobiosis umbripennis -6.5

Psilochorema bidens -4.0

Hydrophilidae -5.0

Hydrochorema sp. -3.5

Zeolessica cheira 10.0

Hydrobiosis spatulata 9.0

Confluens hamiltoni 9.0

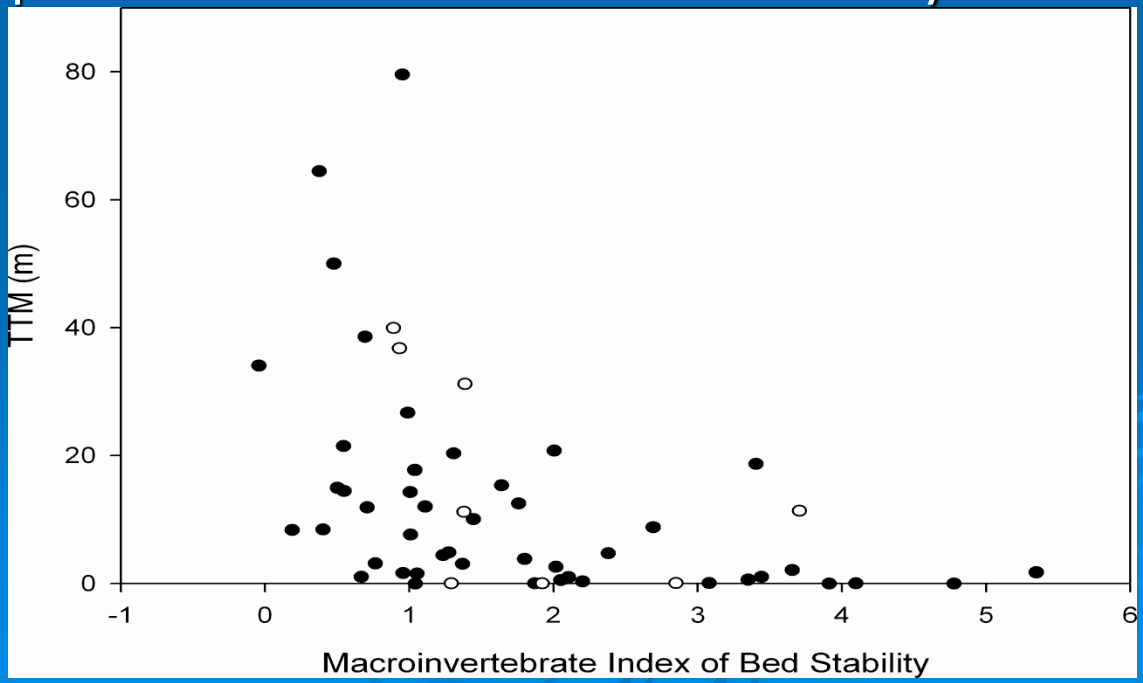
Triplectides sp. 9.5

Orthopsyche sp. 9.0

Validation

Site scores

- weighted by taxa abundance
- strongly correlated with conventional bed stability measures
- improved M5P tree model of bed stability when added to the pool of habitat variables
- model explained 69% of variation in bed stability



Conclusions

- Restriction of taxa scores to New Zealand
- Methodology of development transferable to other countries

Schwendel et al. (2011). A macroinvertebrate index to assess stream-bed stability. Marine and Freshwater Research **62**: 30-37.

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- Extension of range of use of other biotic indices
- Monitoring of biological response to natural substrate movement, river engineering, gravel mining, etc.

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Further work:

- Validation in other regions and lowland rivers

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Thanks for your attention