Using targeted eDNA-based detection of taonga (treasured) species to track current and historical distributions

Konstanze Steiner, Georgia Thomson-Laing, Jacob Thomson-Laing, Niamh Dyer, Charles Lee, Marcus Vandergoes, Tom Drinan, Anastasija Zaiko, Susie Wood

OUR LAKES OUR FUTURE

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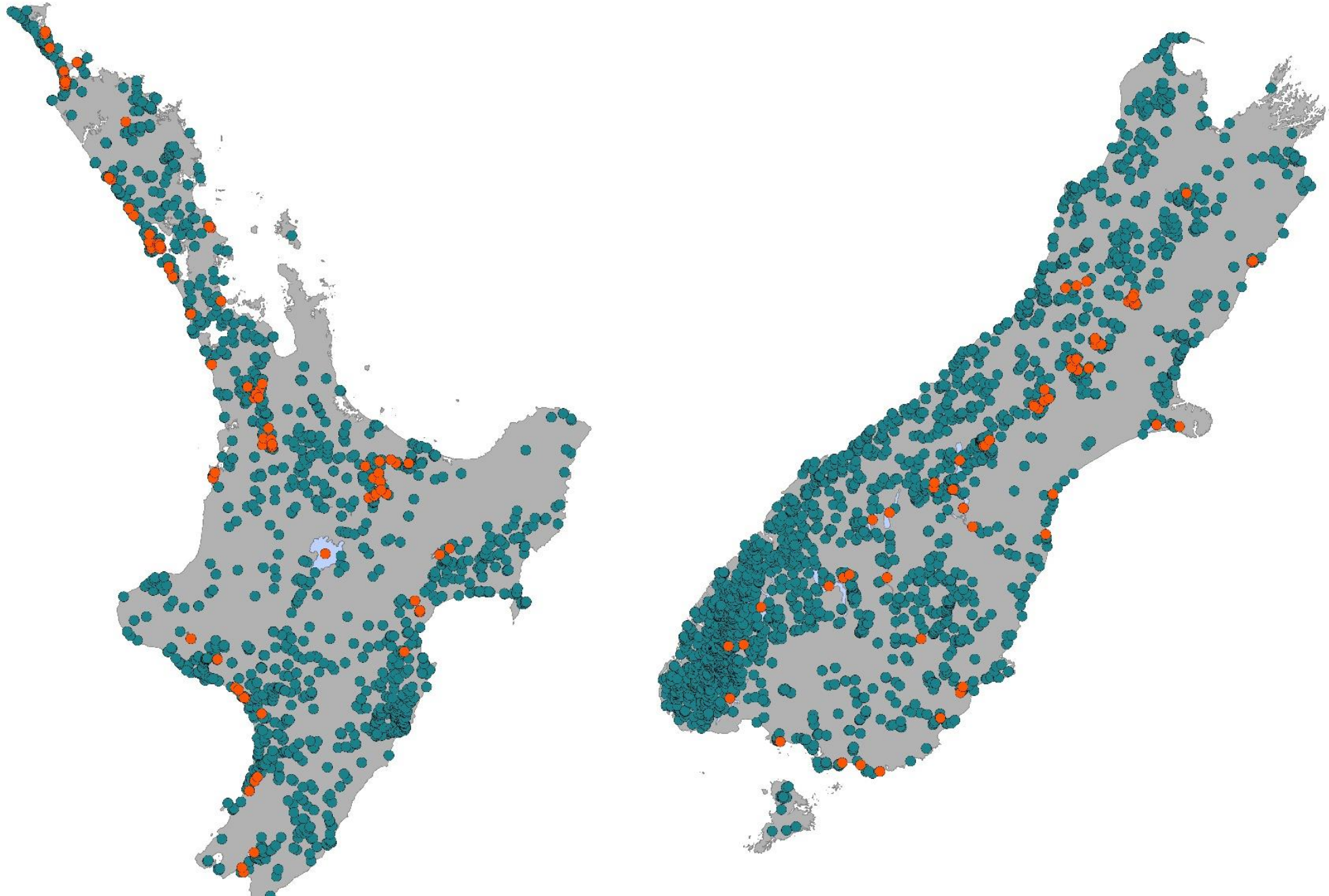
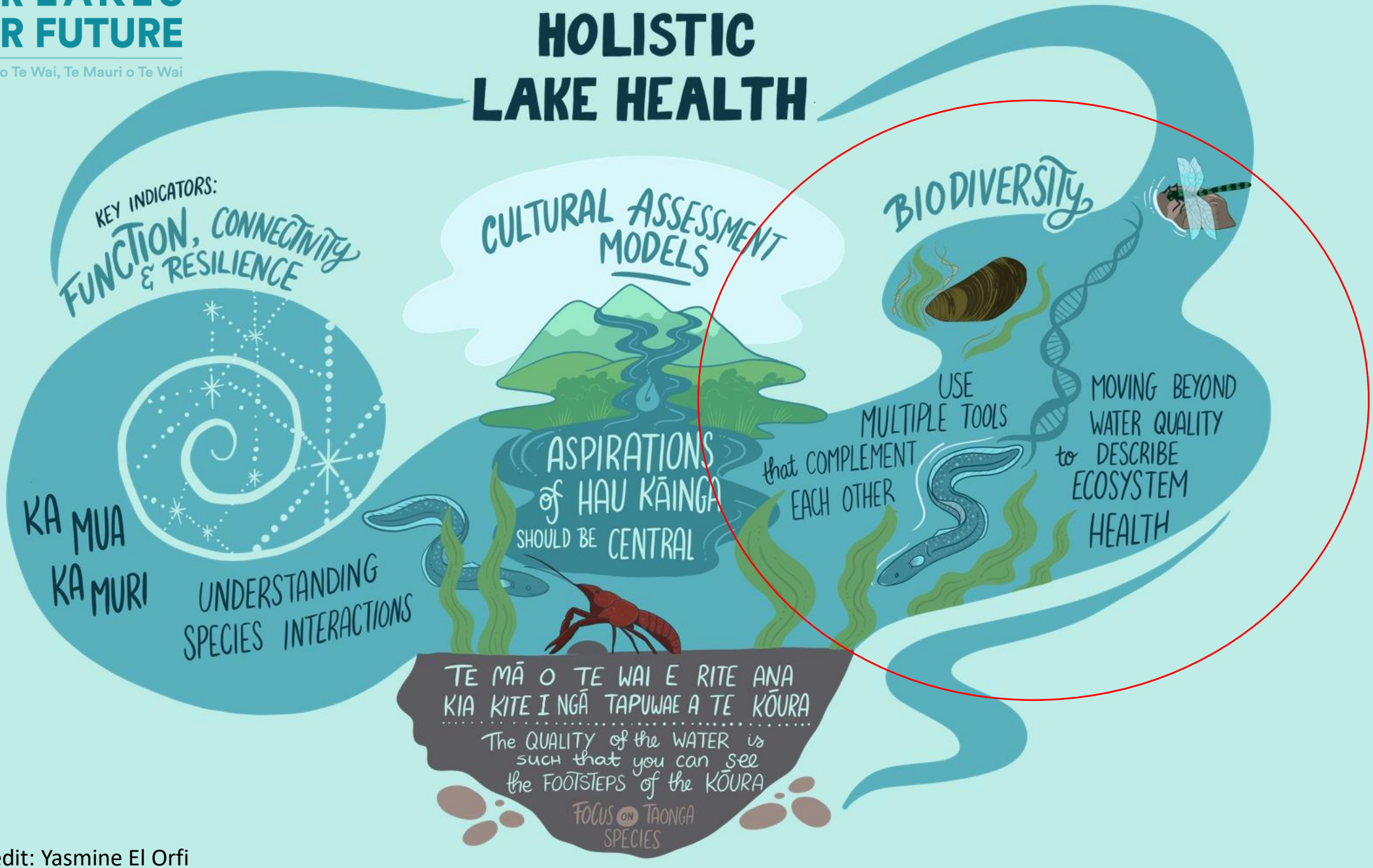


OUR LAKES OUR FUTURE

Te Mana o Te Wai, Te Mauri o Te Wai

HOLISTIC LAKE HEALTH



Live Illustration Credit: Yasmine El Orfi

Kākahi/kāeo/torewai

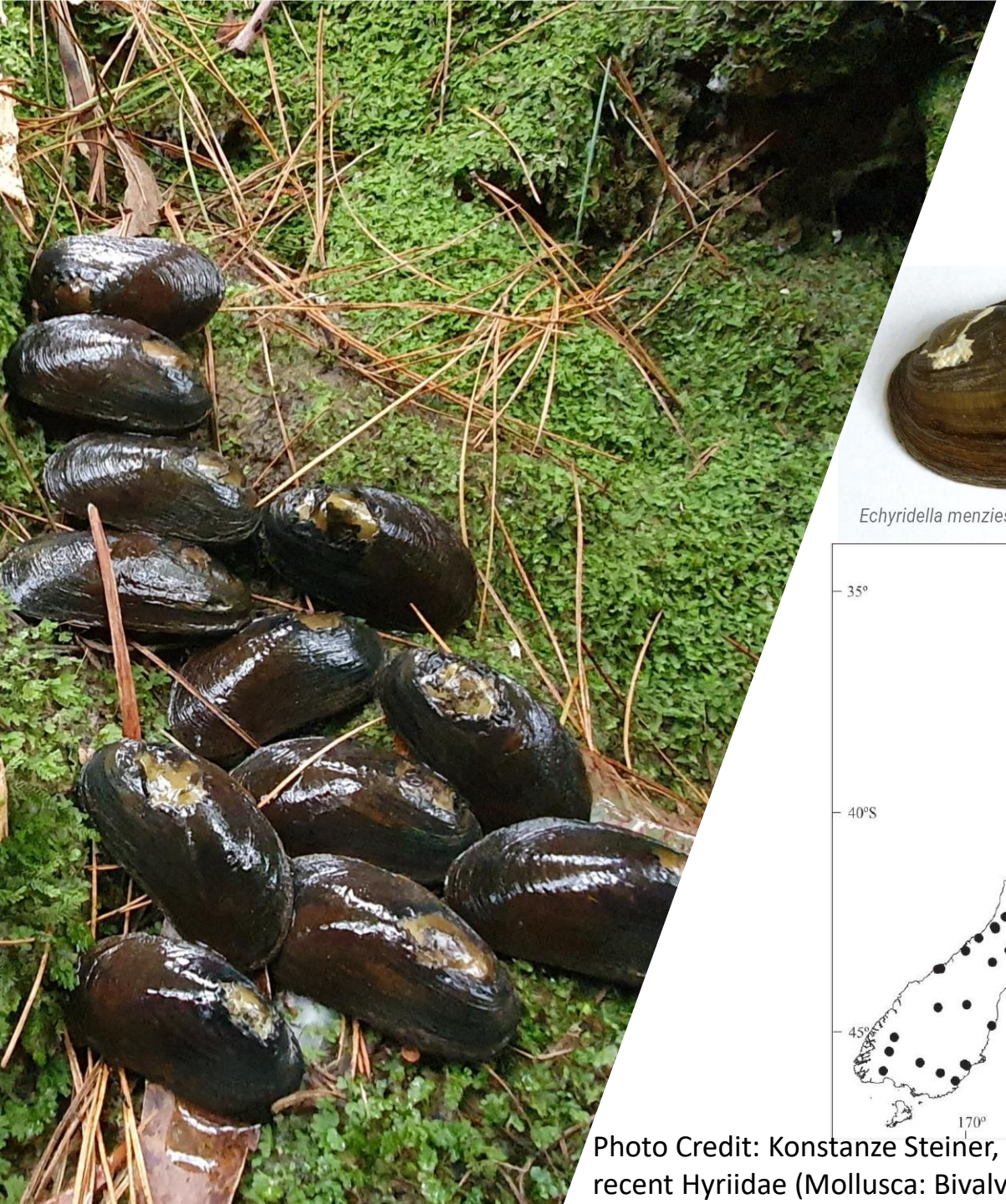
Kōura/kēwai

Tuna

Taonga Species

Photo Credit: Konstanze Steiner, Bruce Green, Taniwha | New Zealand Geographic

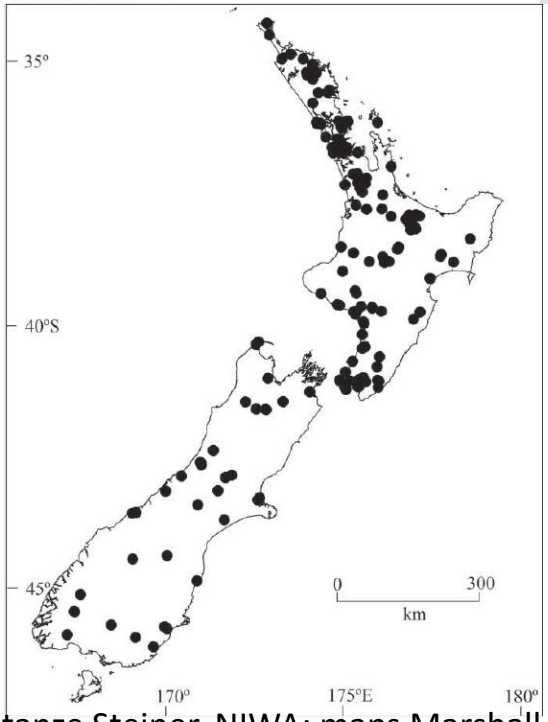
KĀKAHI – *ECHYRIDELLA SP.*



Echyridella menziesii

Echyridella onekaka ▲

Echyridella aucklandica ■



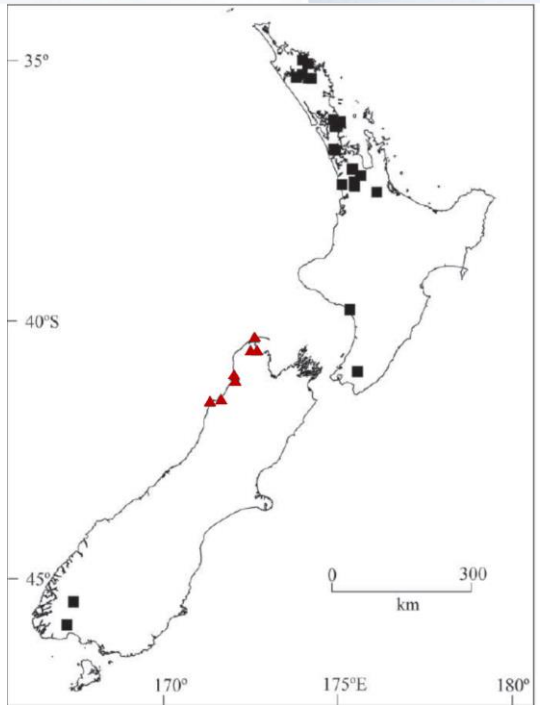
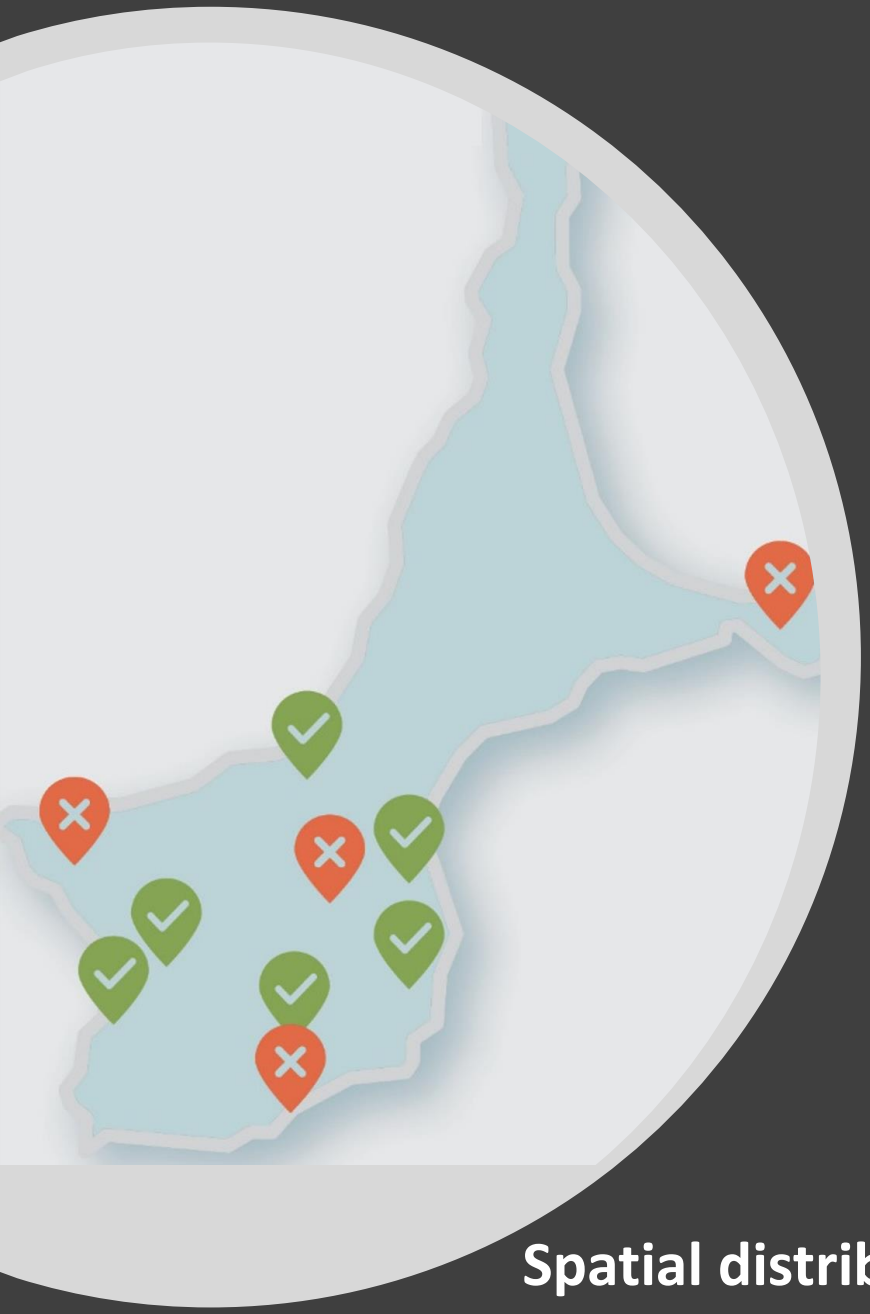


Photo Credit: Konstanze Steiner, NIWA; maps Marshall, B. A., et al. (2014). "New Zealand recent Hyriidae (Mollusca: Bivalvia: Unionida)." Molluscan Research 34(3): 181-200.



Spatial distribution and sampling strategy

Assay development

Historical distribution

Kākahi eDNA projects

Assay development

- Optimization
  - Annealing temperature/time
  - Primer/probe concentrations
  - Cycle number
- Validation
  - Sensitivity
  - LODs
  - Specificity
  - Cross-Reactivity

Received: 9 November 2021 | Revised: 11 March 2022 | Accepted: 16 March 2022

DOI: 10.1002/edn3.302

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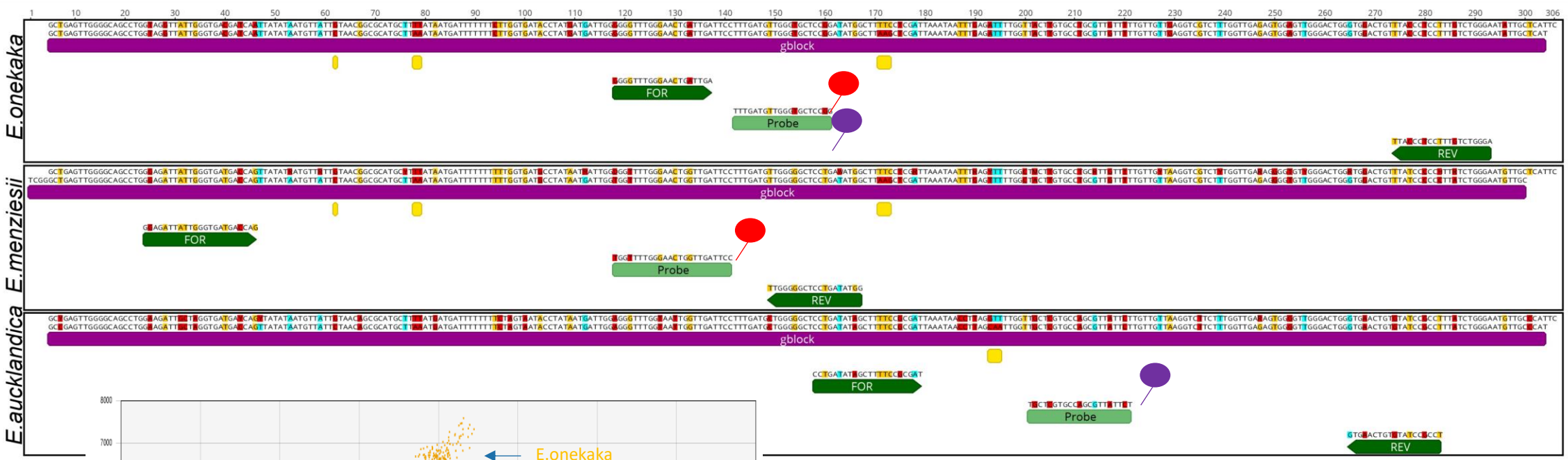
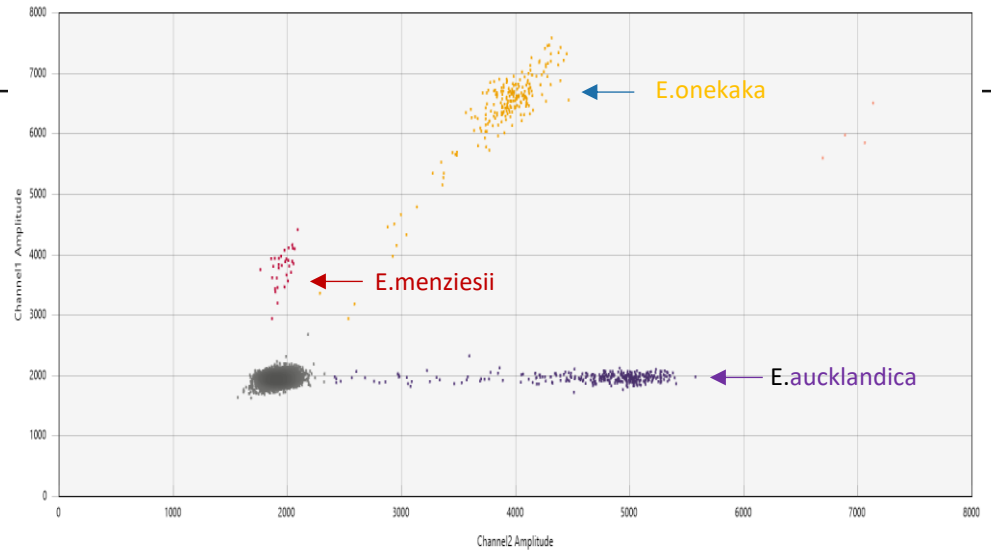
ORIGINAL ARTICLE

Development of a triplex droplet digital polymerase chain reaction assay for the detection of three New Zealand native freshwater mussels (*Echyridella*) in environmental samples

Konstanze Steiner[1] | Niamh Dyer[1] | Charles K. Lee[2] | Marcus J. Vandergoes[3] | Susanna A. Wood[1]

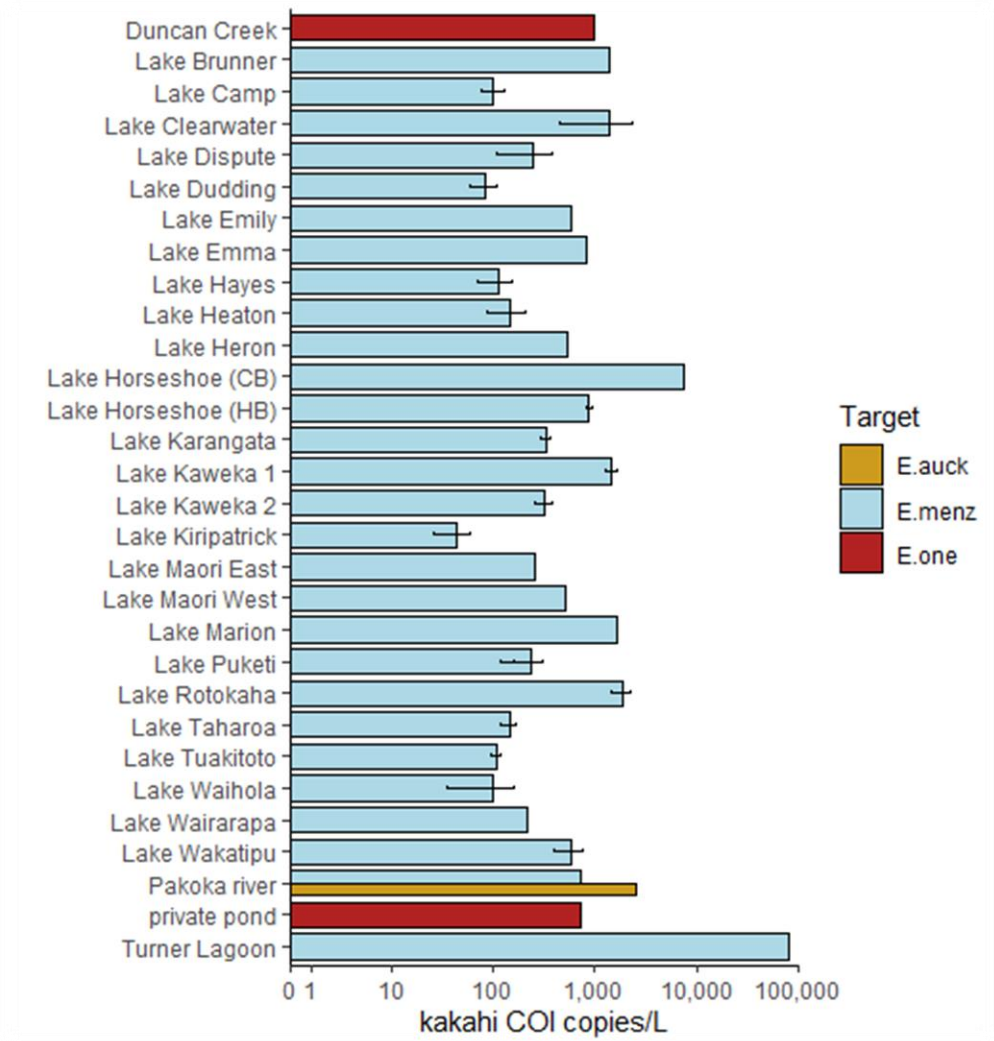
Using Droplet digital PCR to detect and differentiate three kākahi species simultaneously

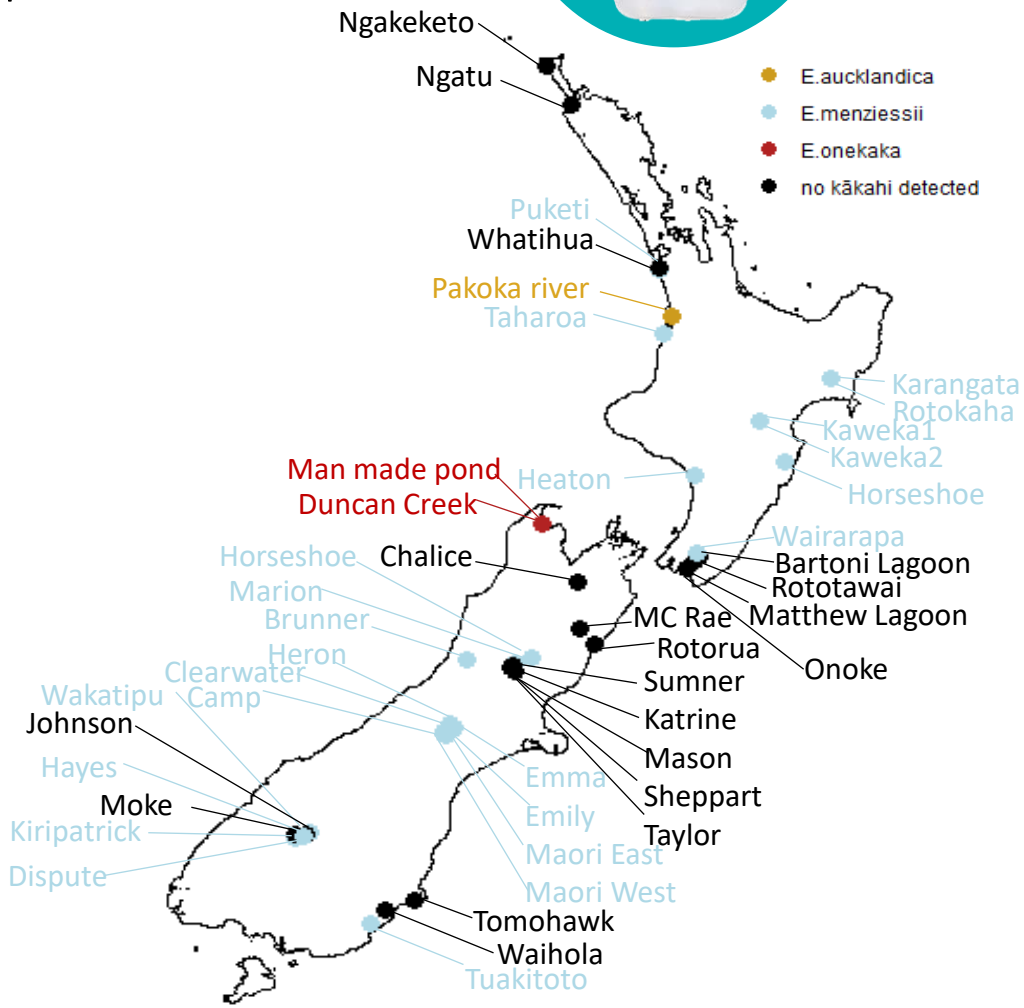


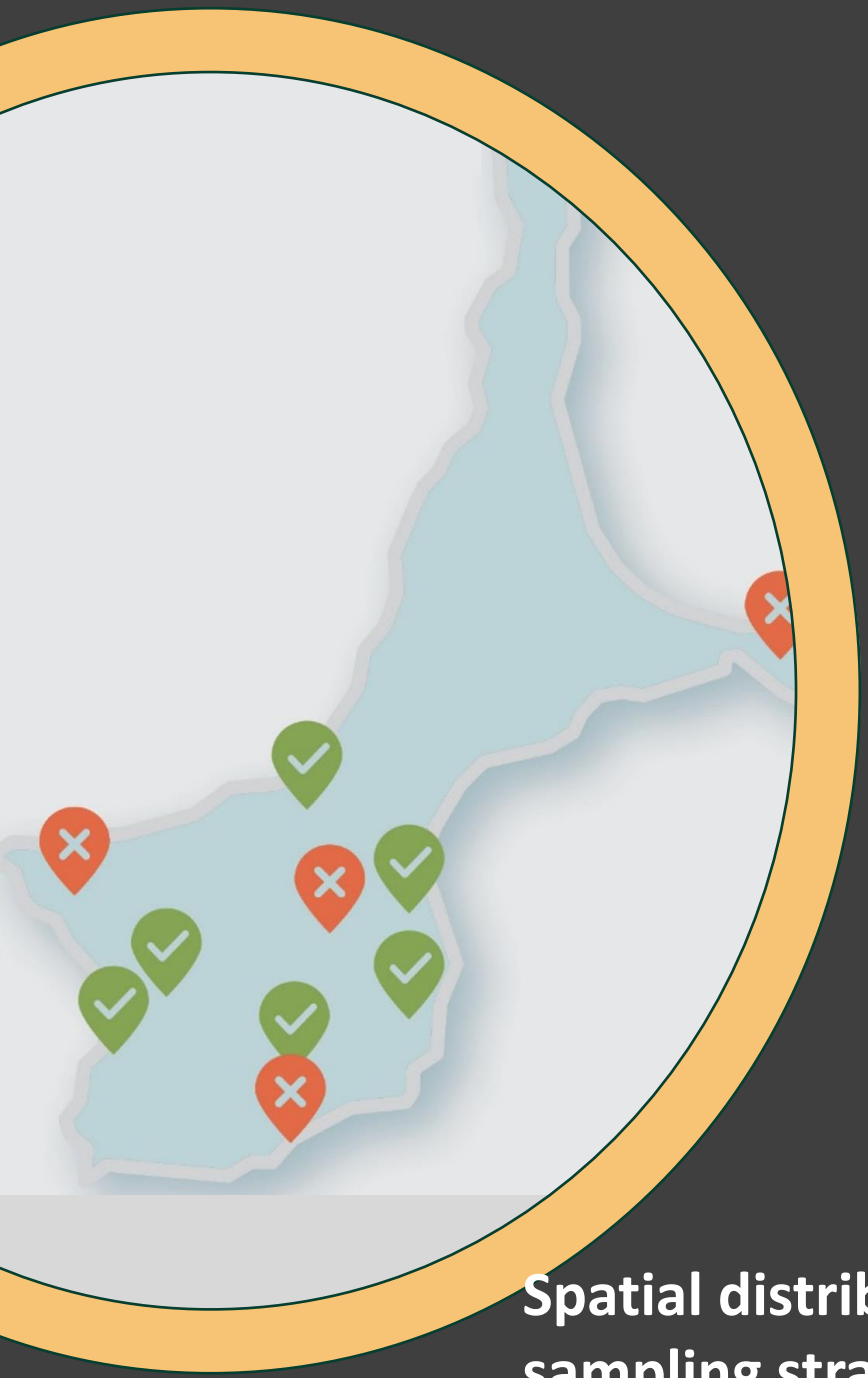


Kākahi eDNA can be detected in water

- Detection in environmental samples –water







Spatial distribution and sampling strategy

Assay development

Historical distribution

Kākahi eDNA projects

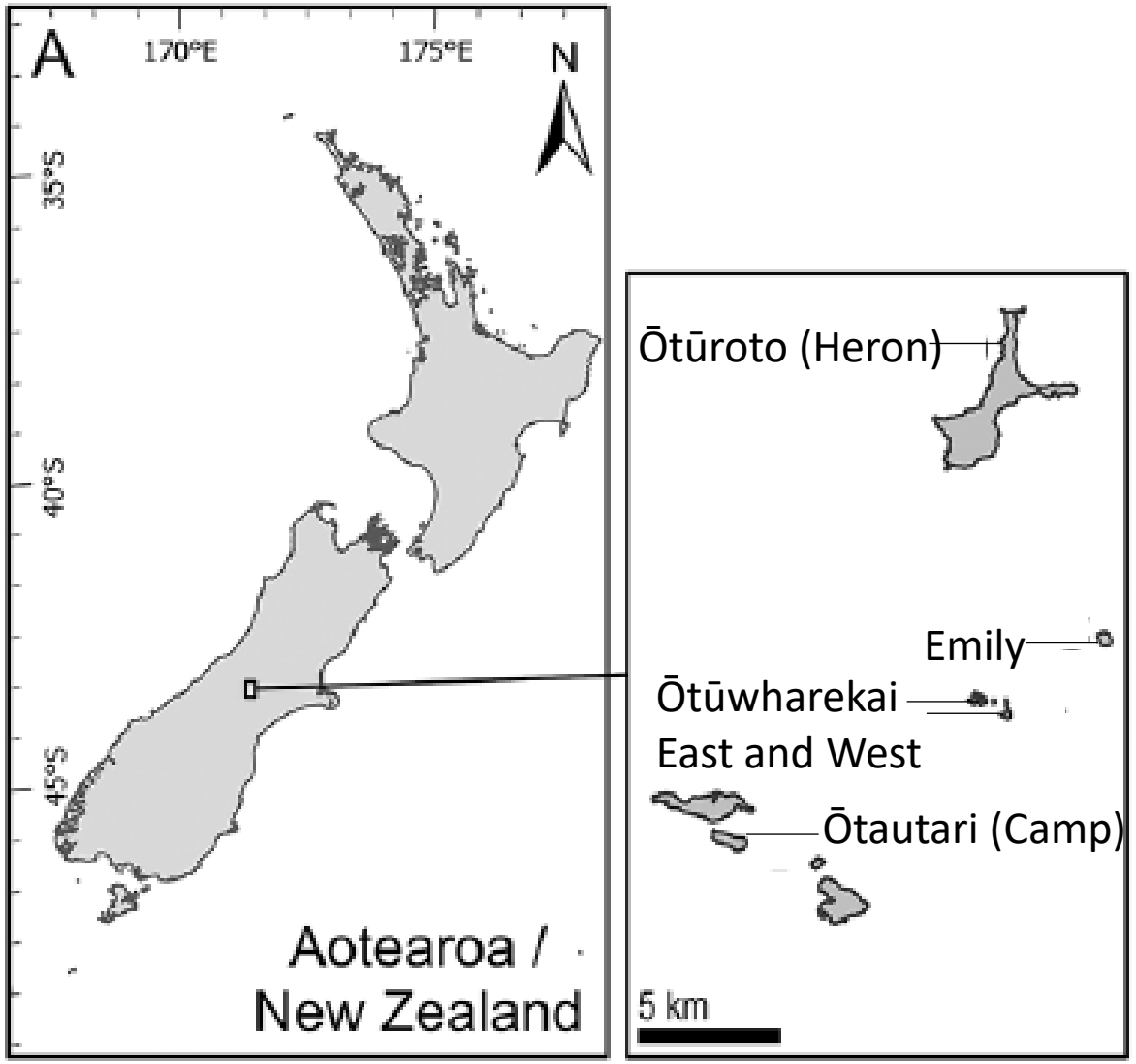
Heterogenous distribution of kākahi (freshwater mussel *Echyridella menziesii*) environmental DNA in 5 New Zealand lakes of differing size and geomorphology

Konstanze Steiner[1,10], Tom Drinan[2,11], Anastasija Zaiko[1,3,12], Tracey Burton[4,13], Susan J. Clearwater[5,14], Michael G. Stocker[6,15], Michael McMillan[7,16], Tina K. Bayer[8,17], Marcus J. Vandergoes[9,18], and Susanna A. Wood[1,19]

Spatial distribution and sampling strategy

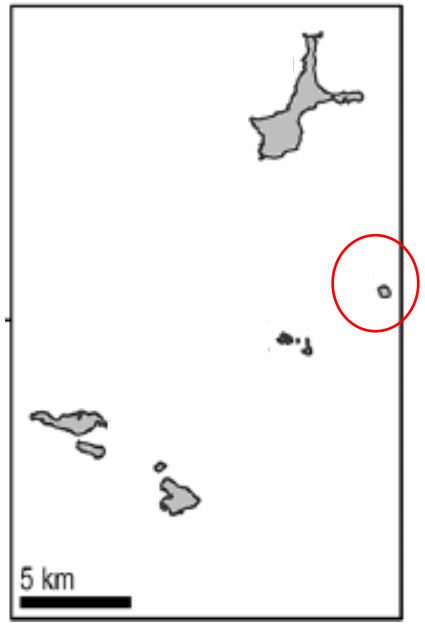
- Distribution of kākahi eDNA in lakes
- Relationship between kākahi eDNA and kākahi populations
- Detection probability of kākahi eDNA

Spatial Distribution of kākahi eDNA in lakes

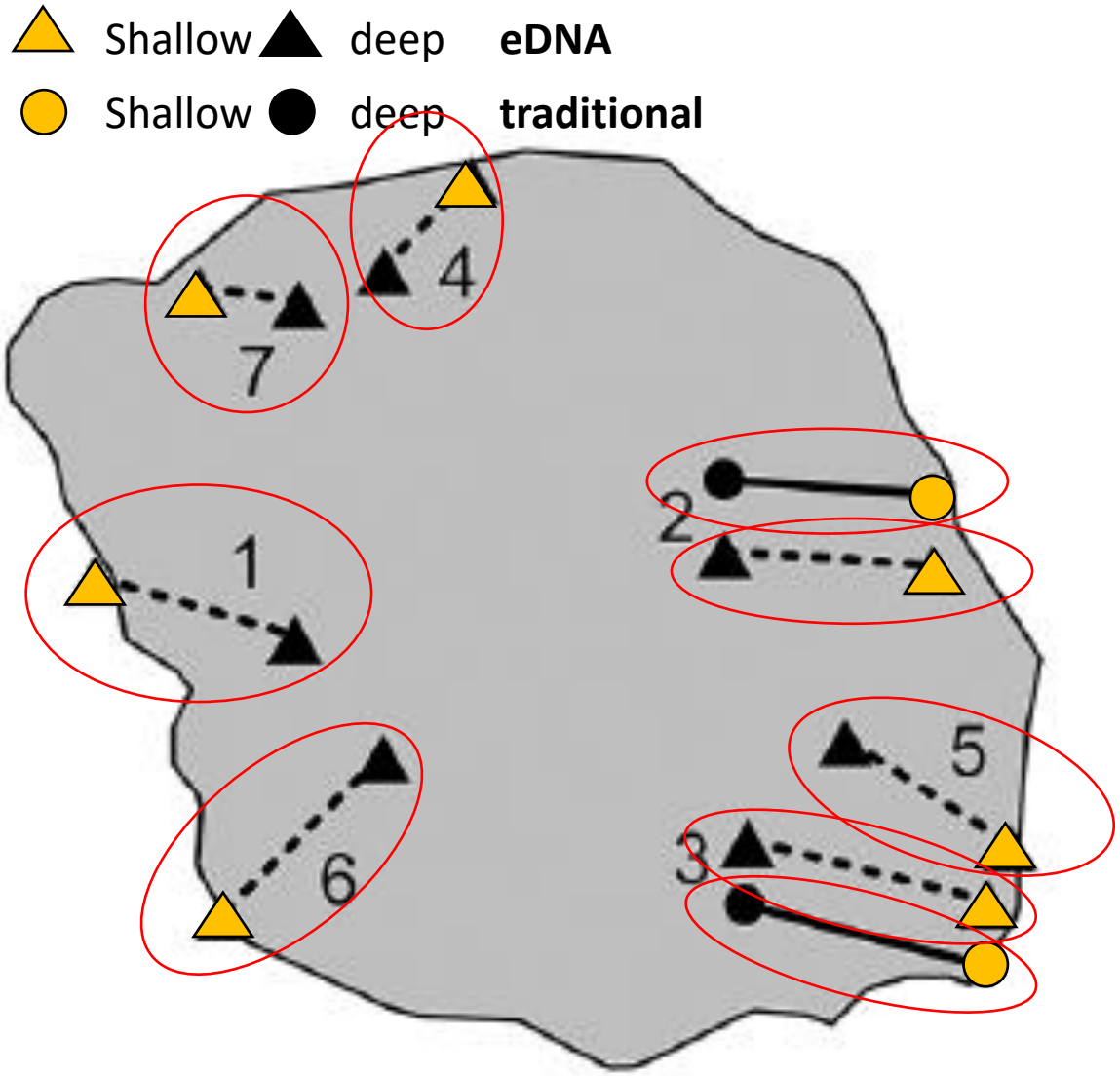


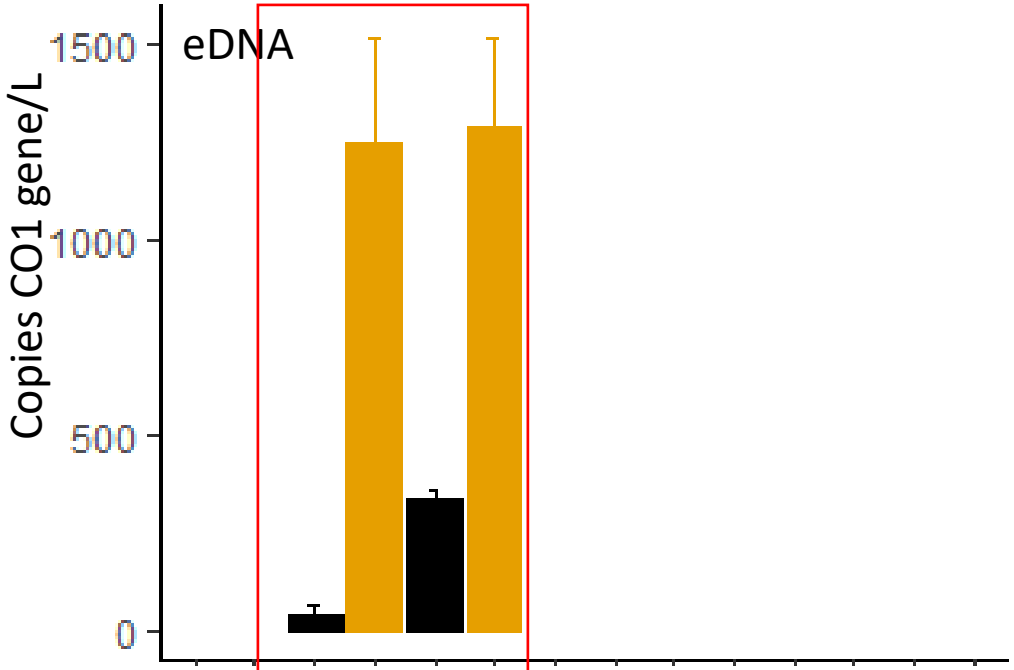
kākahi eDNA in Lake Emily

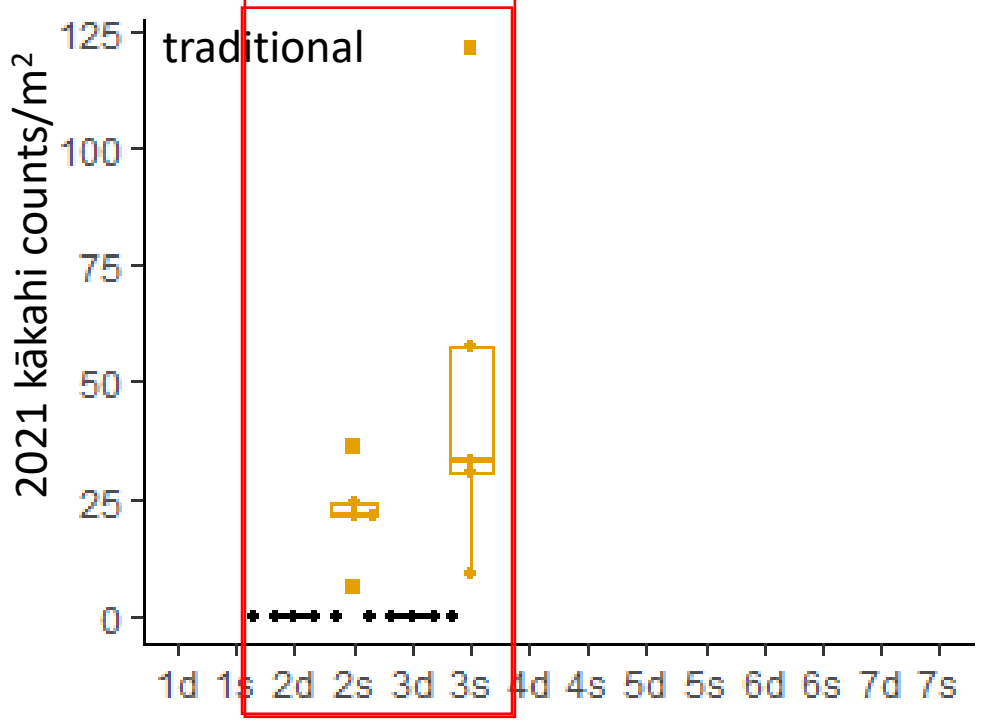
20ha
2.3m deep



kākahi eDNA in Lake Emily is not well distributed

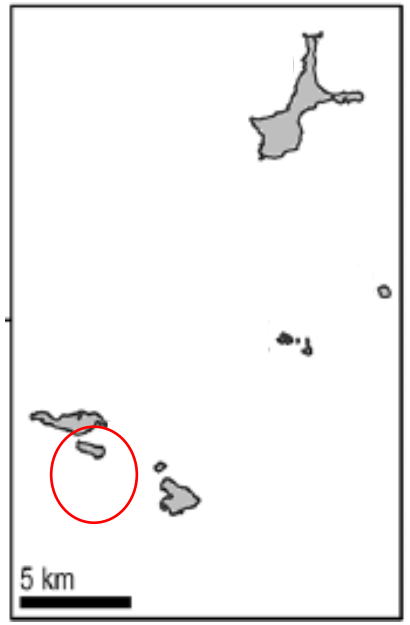






kākahi eDNA in Lake Ōtautari

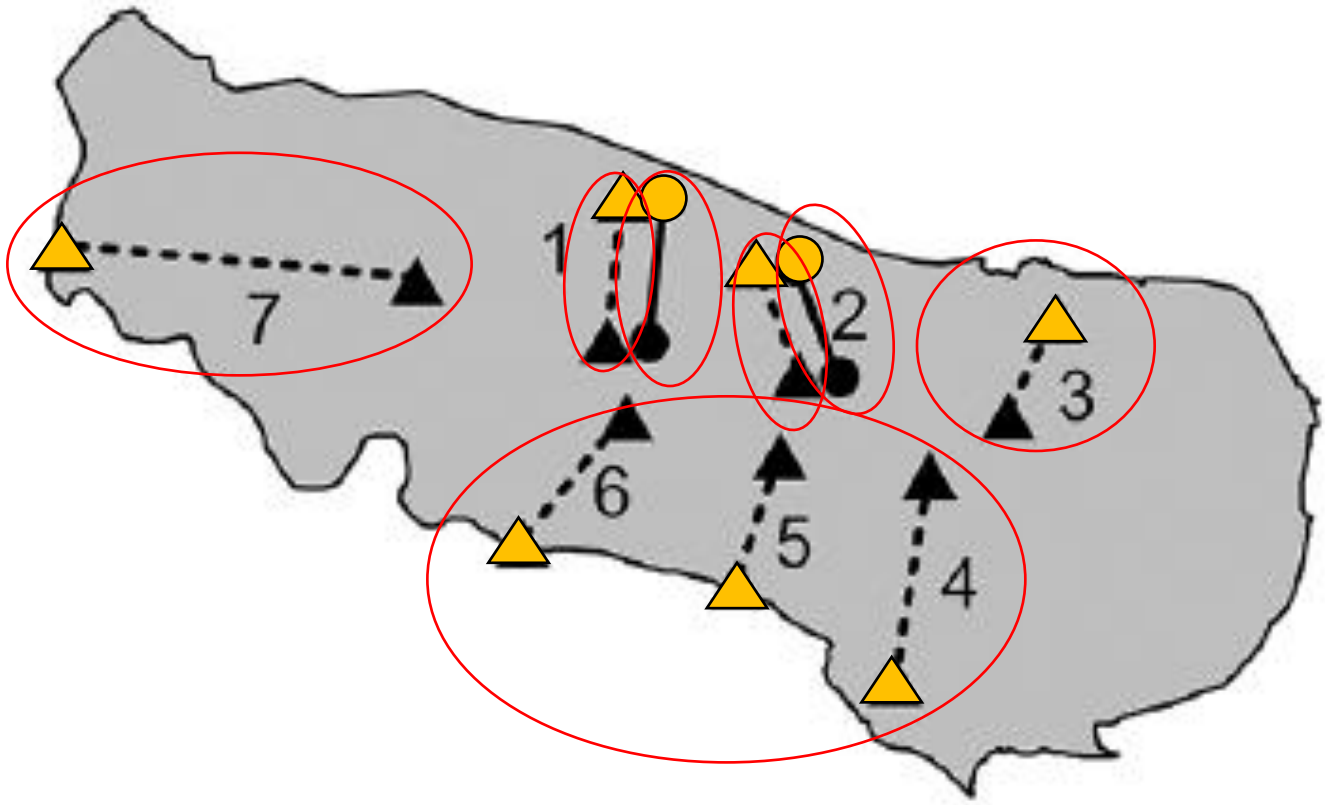
44ha
20m deep

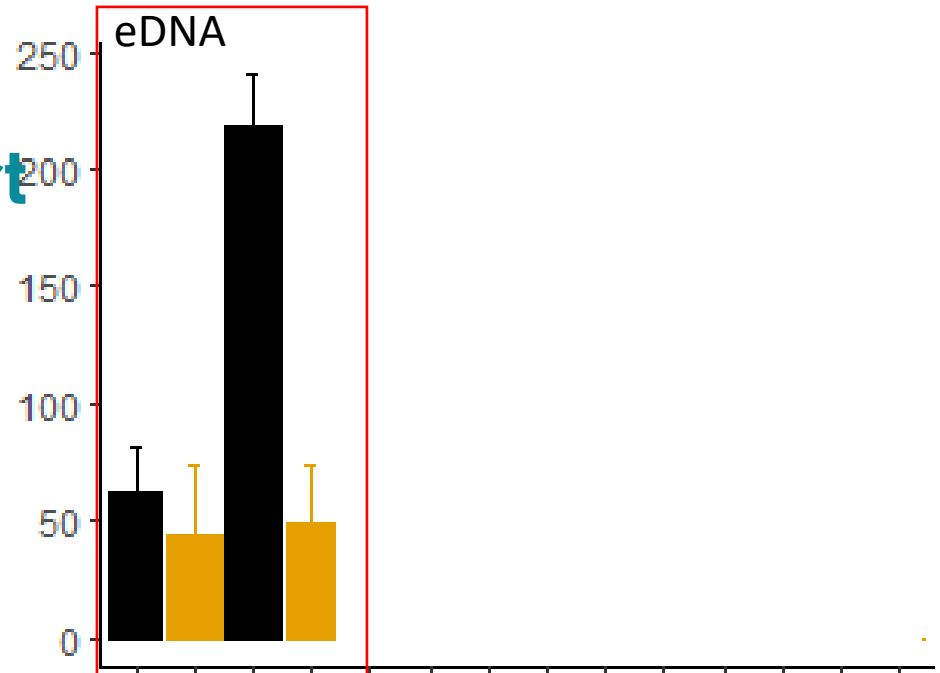


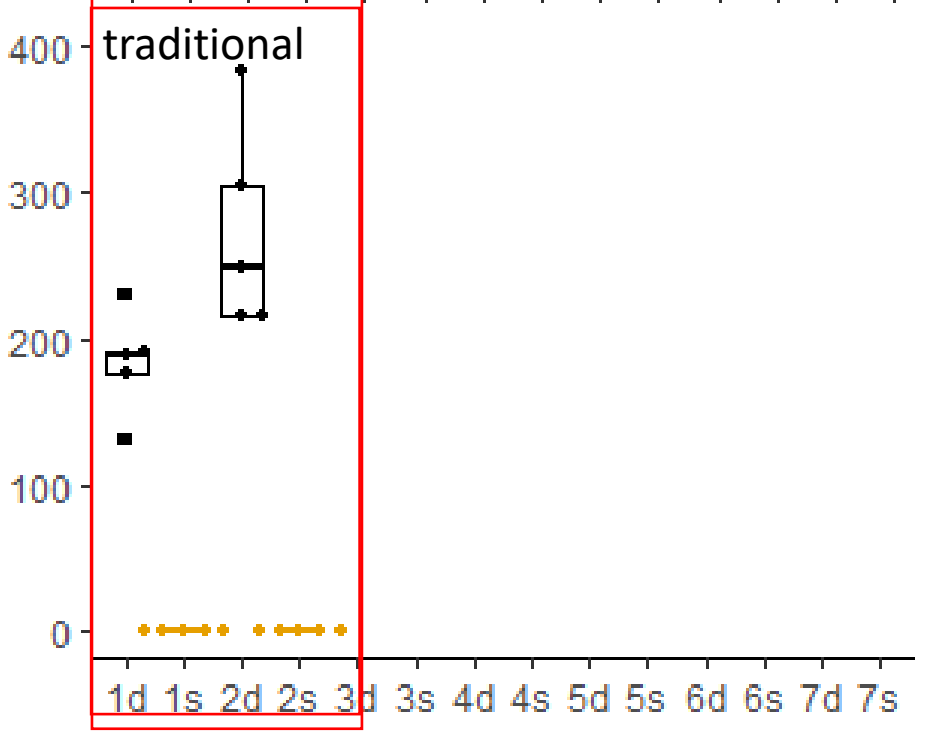
kākahi eDNA in Lake Ōtautari shows limited horizontal transport

Shallow deep **eDNA**

Shallow deep **traditional**







kākahi eDNA in Lake Ōtautari

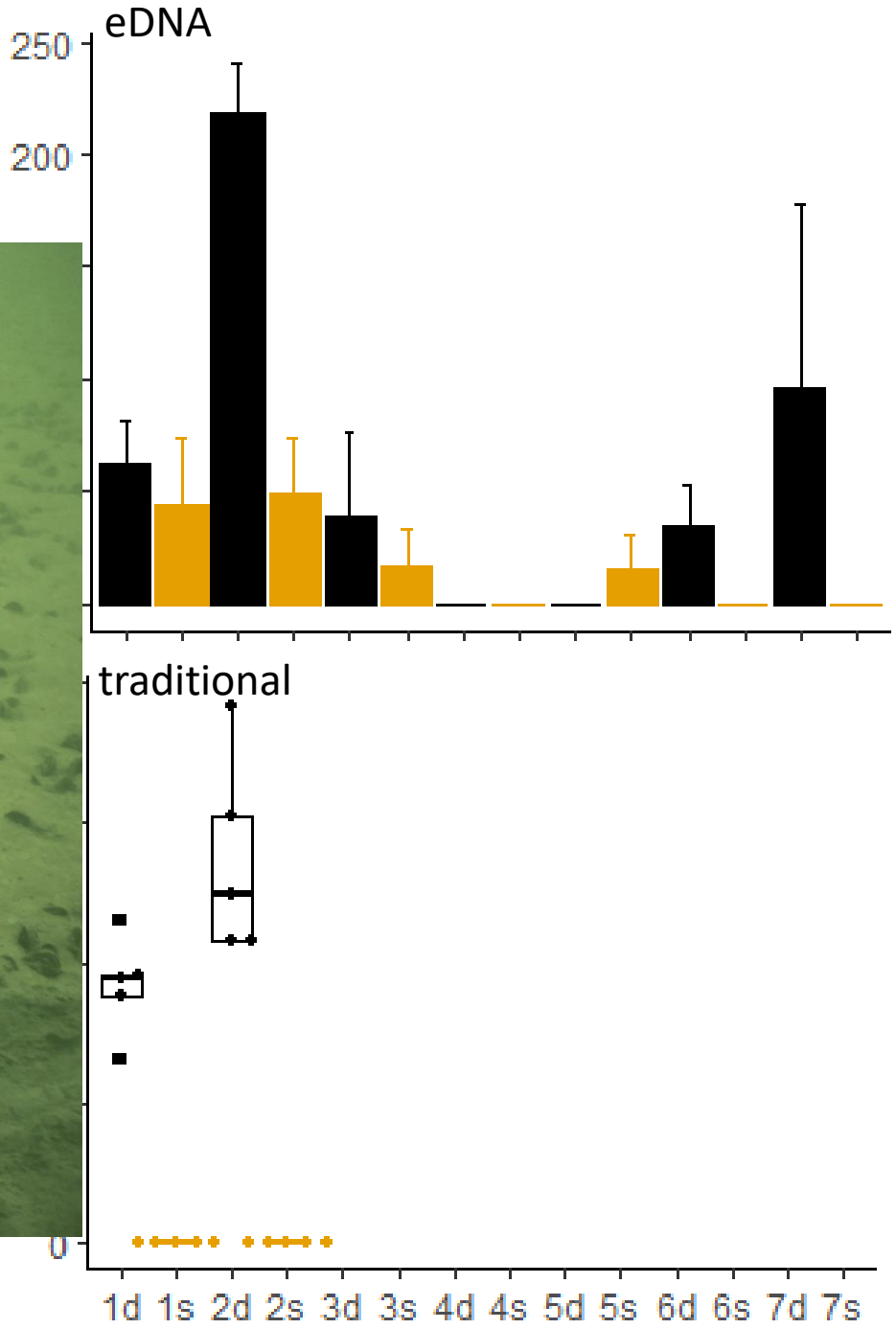
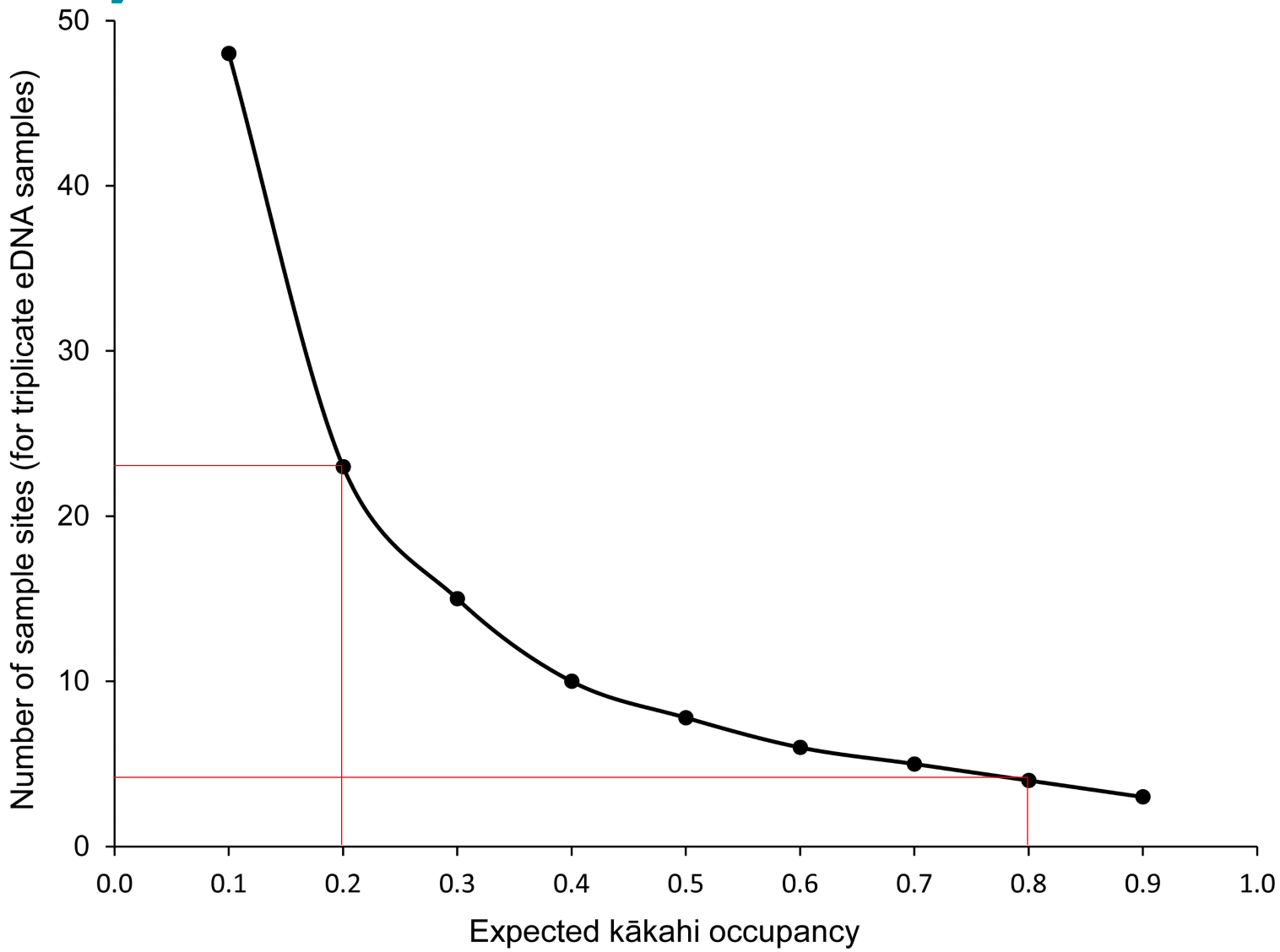
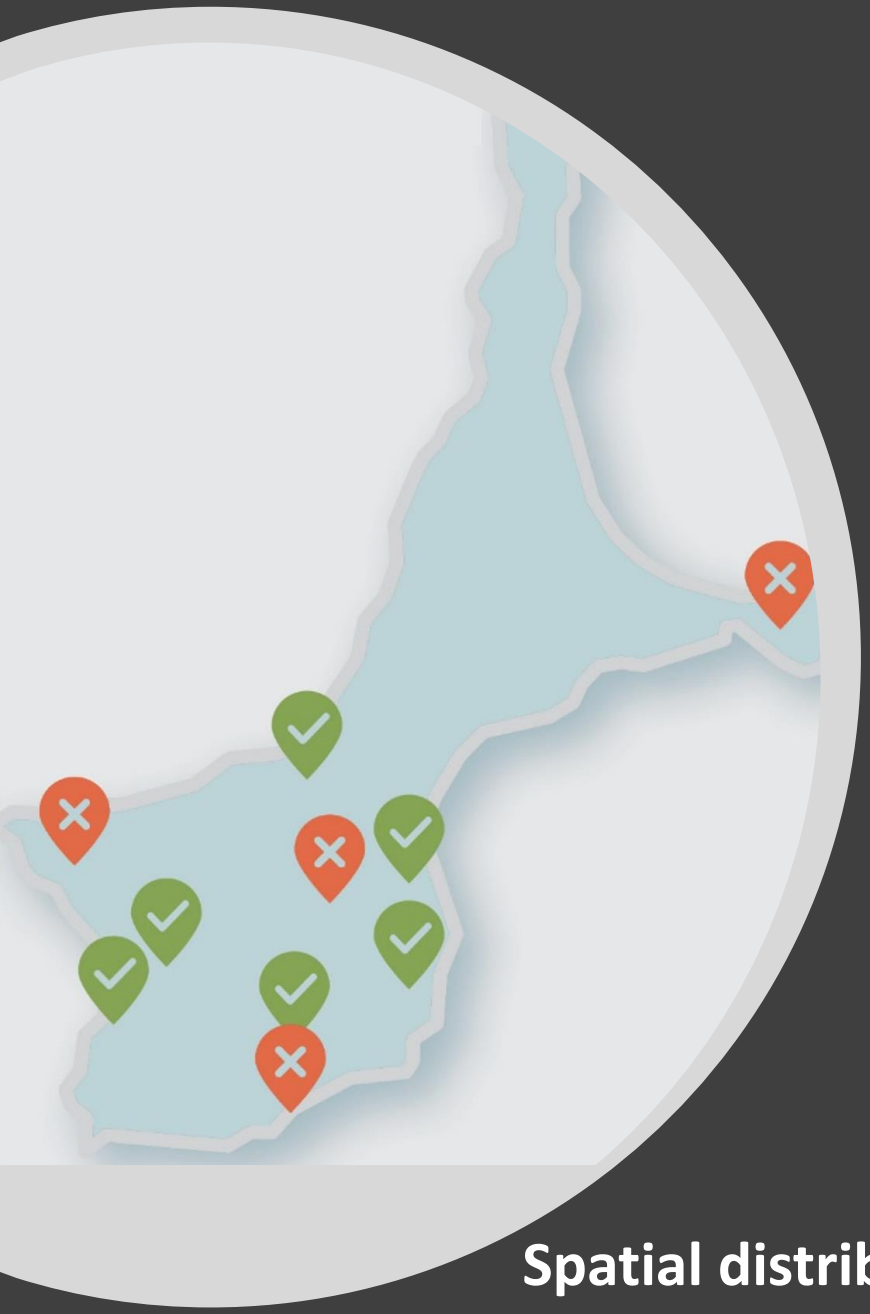


Photo Credit: Tracy Burton

What sampling effort is needed to reach 99% detection probability?





Spatial distribution and sampling strategy

Assay development

Historical distribution

Kākahi eDNA projects

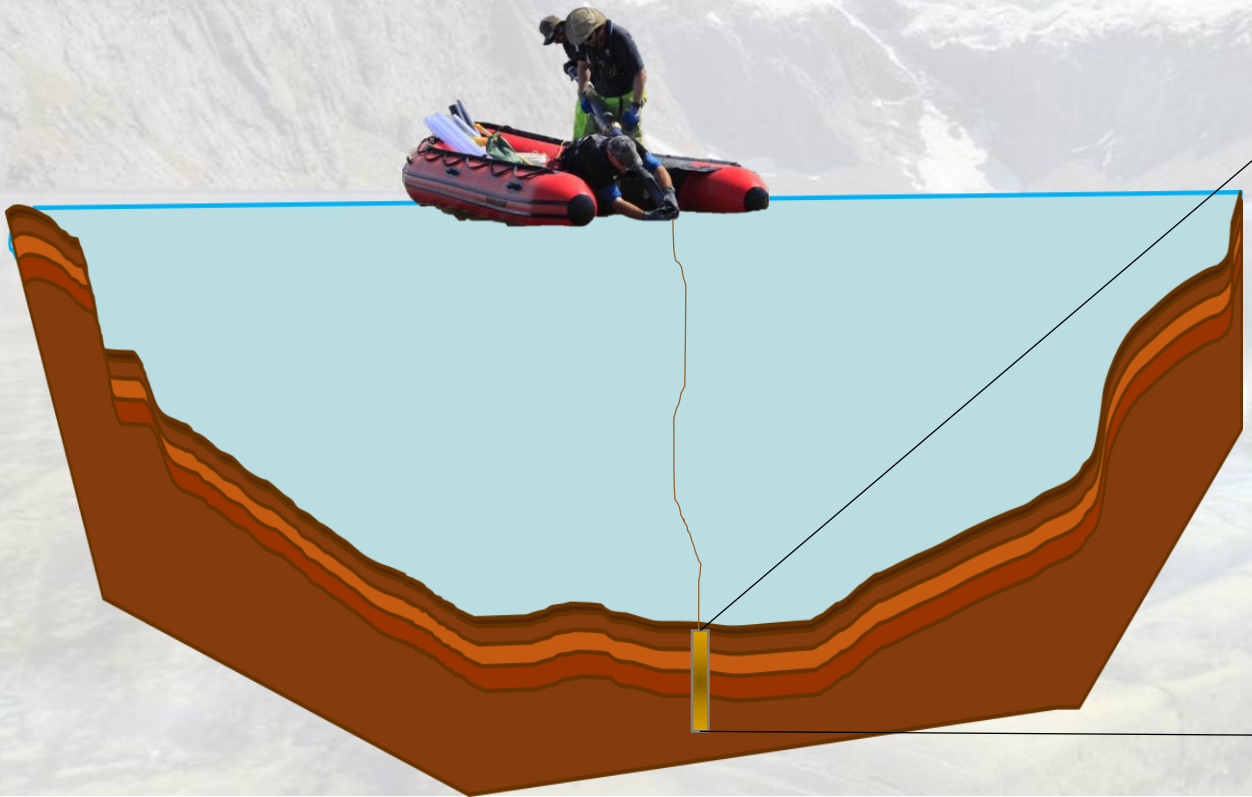
- Limited historical knowledge → can this help understand reasons for decline?
- New insight into unususal kākahi distribution

Exploring the historical presence of kākahi (freshwater mussel) in lakes using sedimentary ancient DNA

Jacob Thomson-Laing[a], Konstanze Steiner[a*], Georgia Thomson-Laing[a], Channell Thoms[b,c] Jamie D Howarth[d], Marcus J Vandergoes[e], Adelaine Moody[d], Xun Li[e], Lizette Reyes[e], Jenny Dahl[e], Susanna A Wood[a]

Historical distribution

Sediment cores – historical distribution

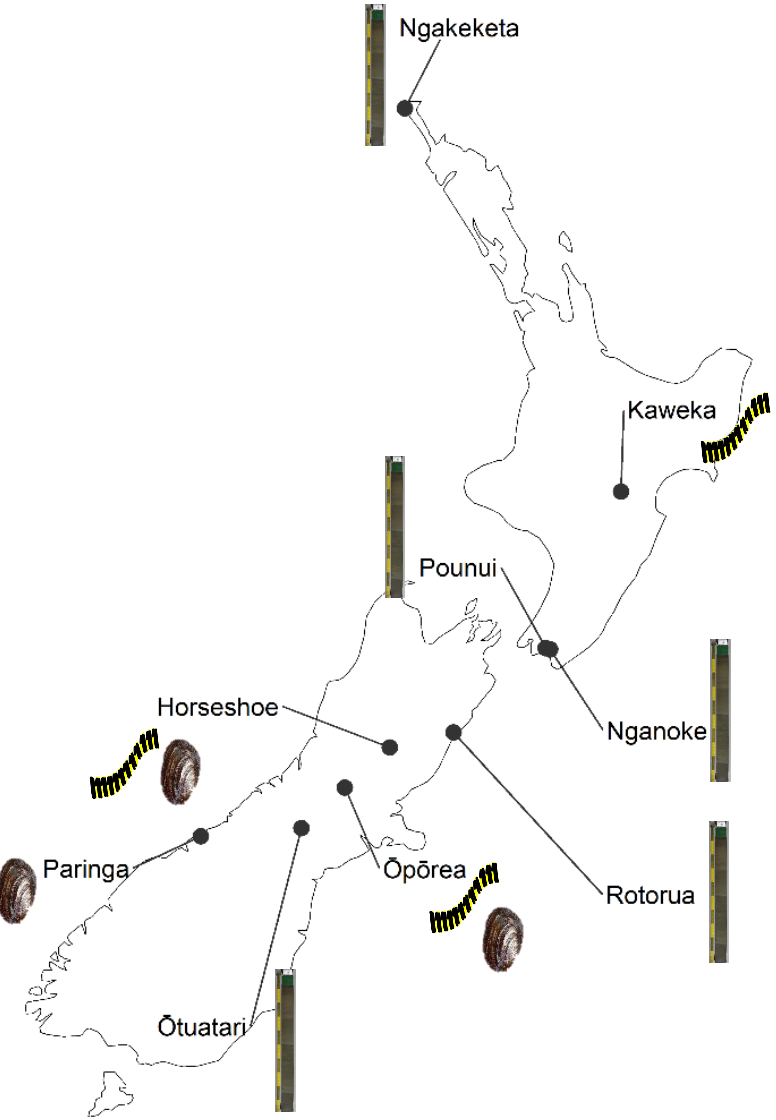


Post European

Evidence of Māori settlement

Pre-human

kākahi eDNA in sediment cores

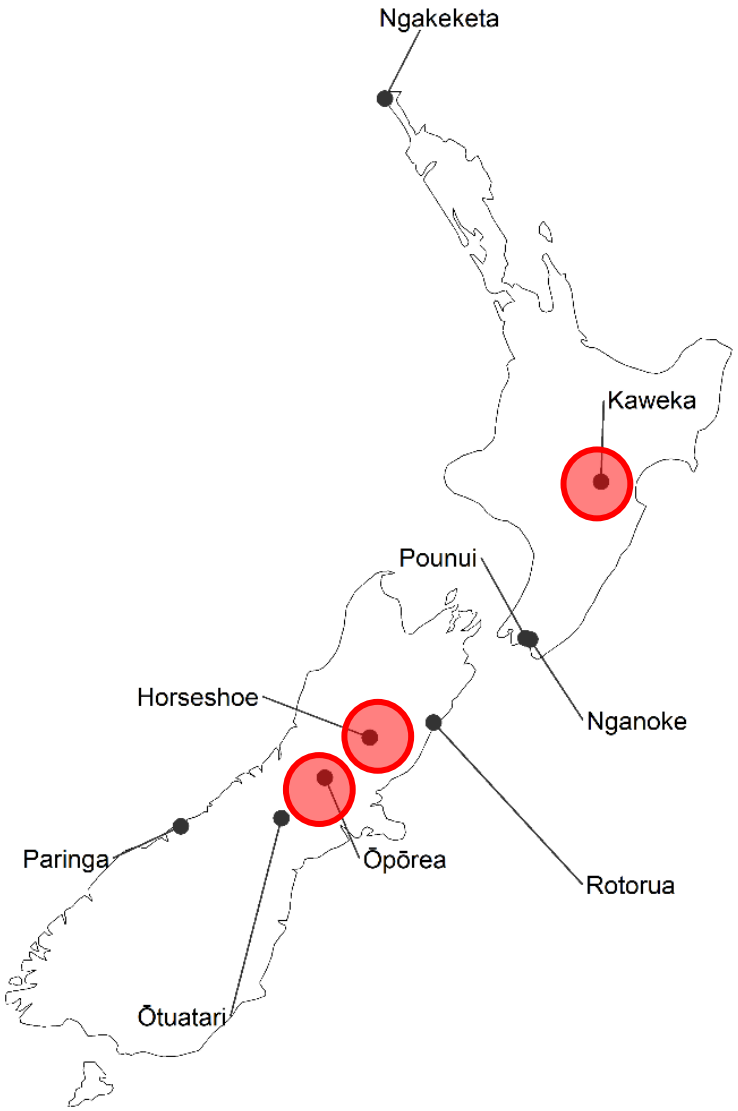


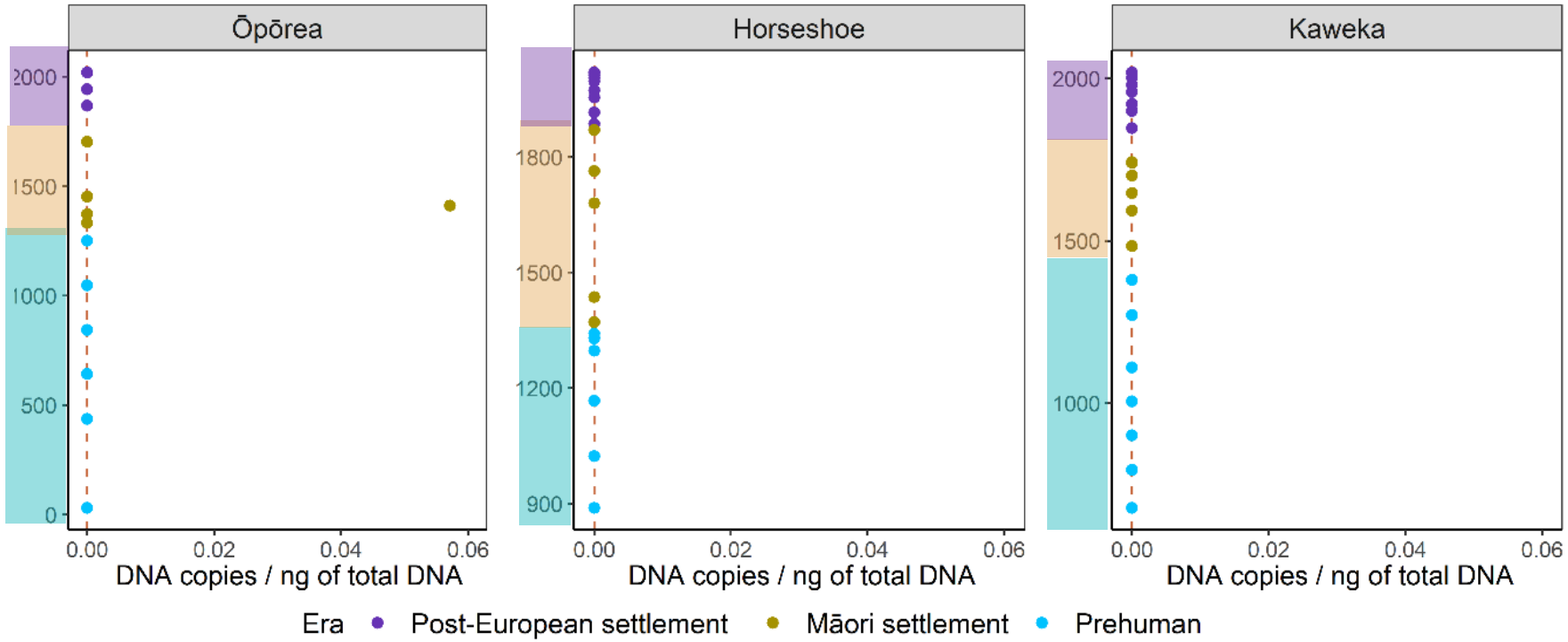
Kākahi confirmed through previous monitoring

eDNA in water samples

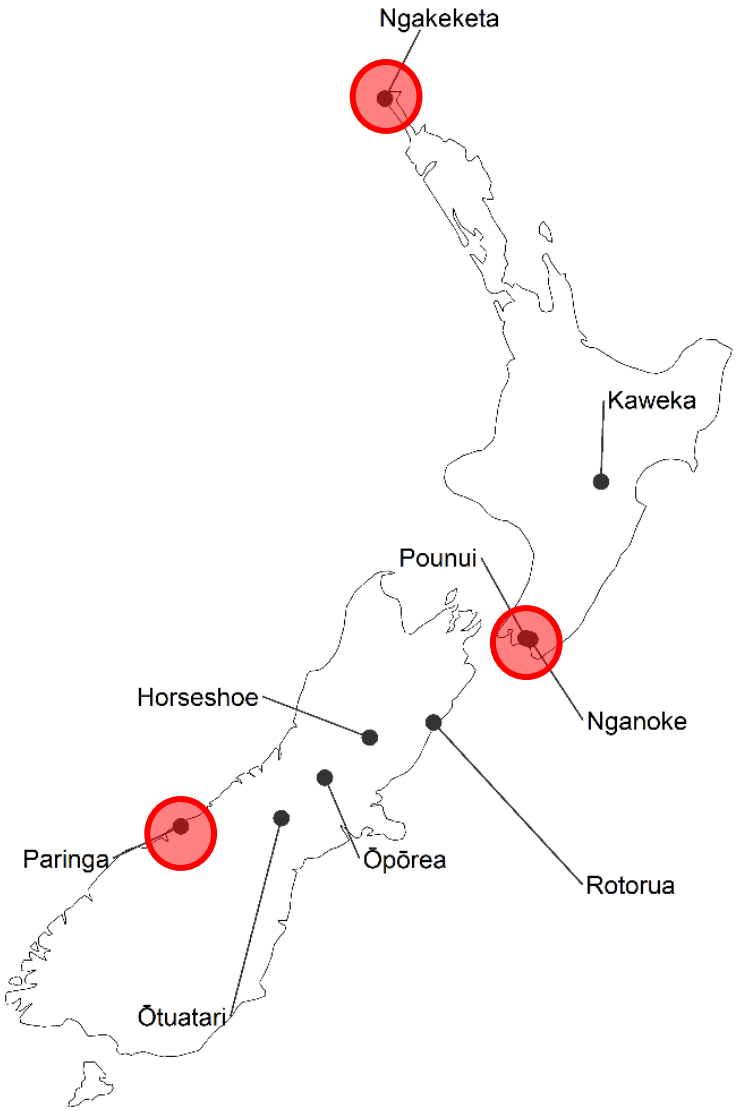
Mussel shells found in core

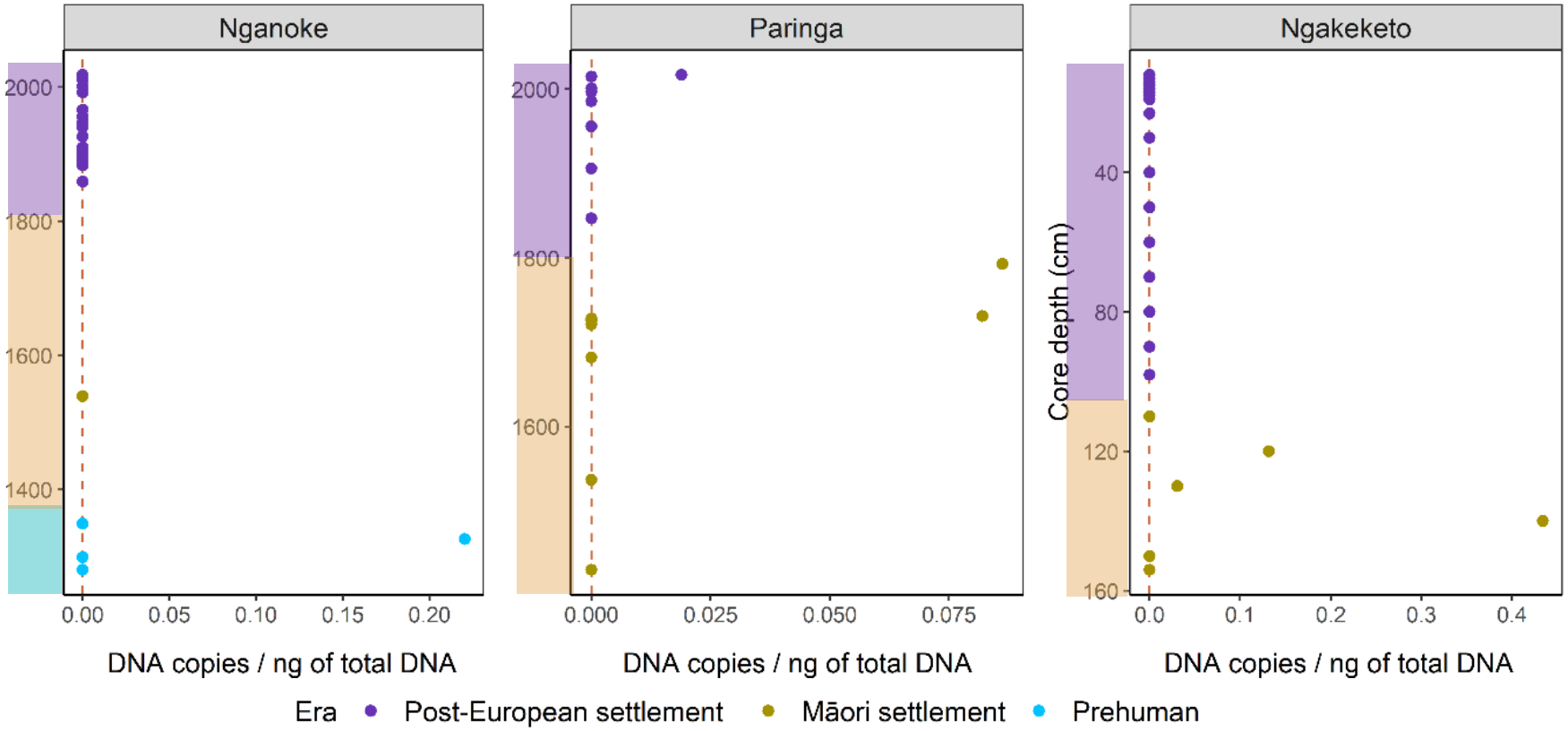
In 3 cores, kākahi eDNA could not be detected



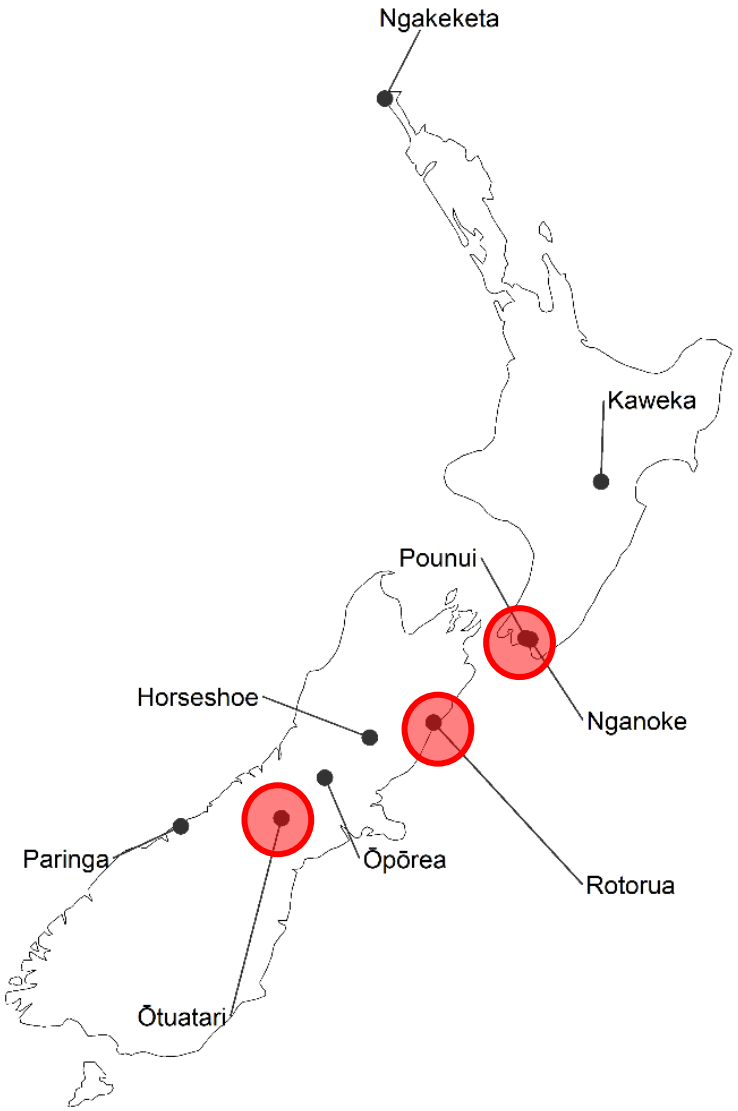


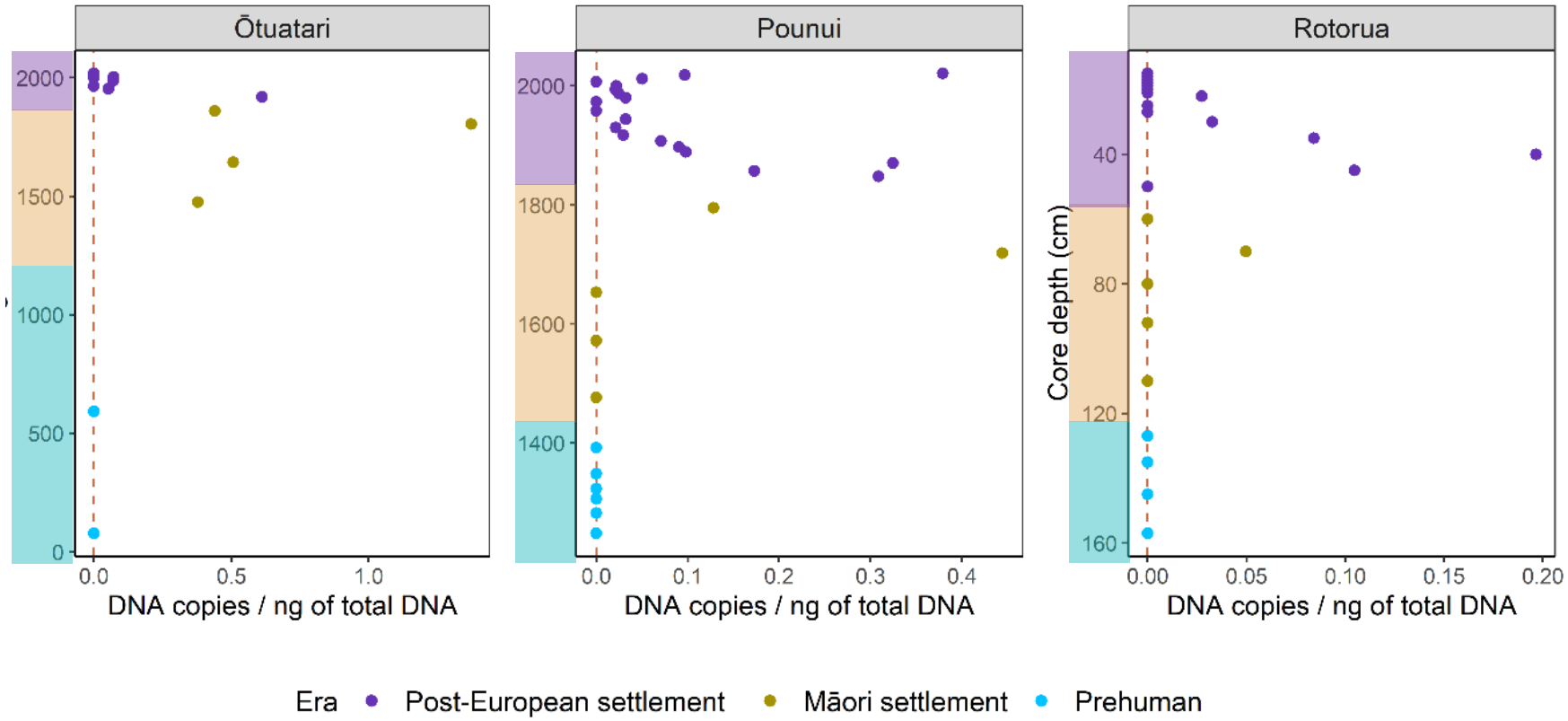
In 3 cores, kākahi eDNA was detected at low levels



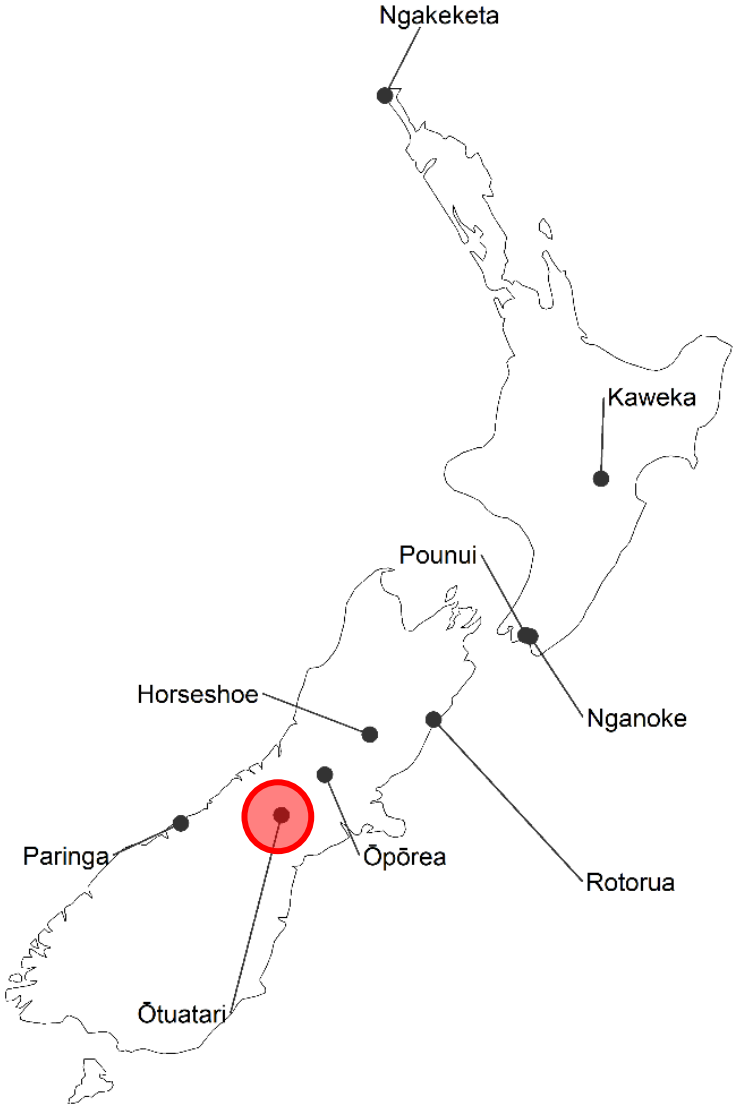


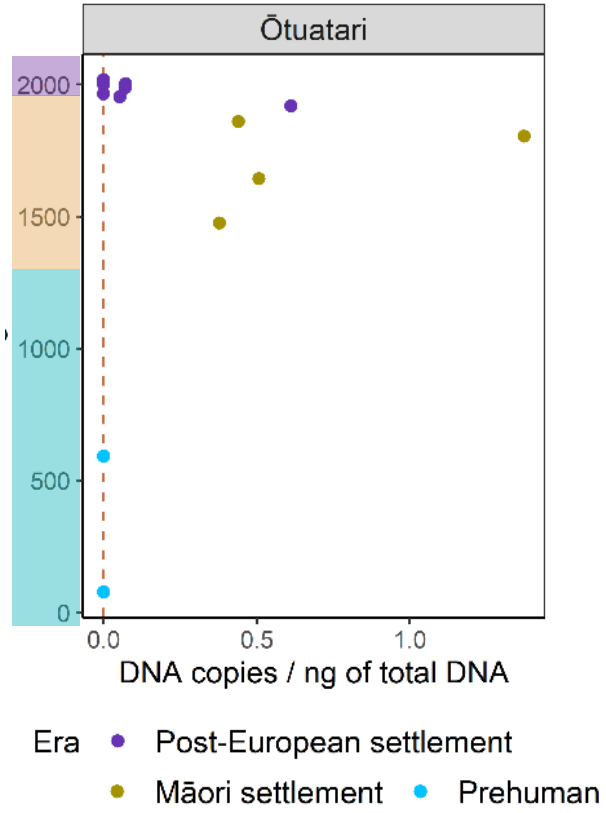
High kākahi eDNA detection in 3 cores – an opportunity to explore history of lakes



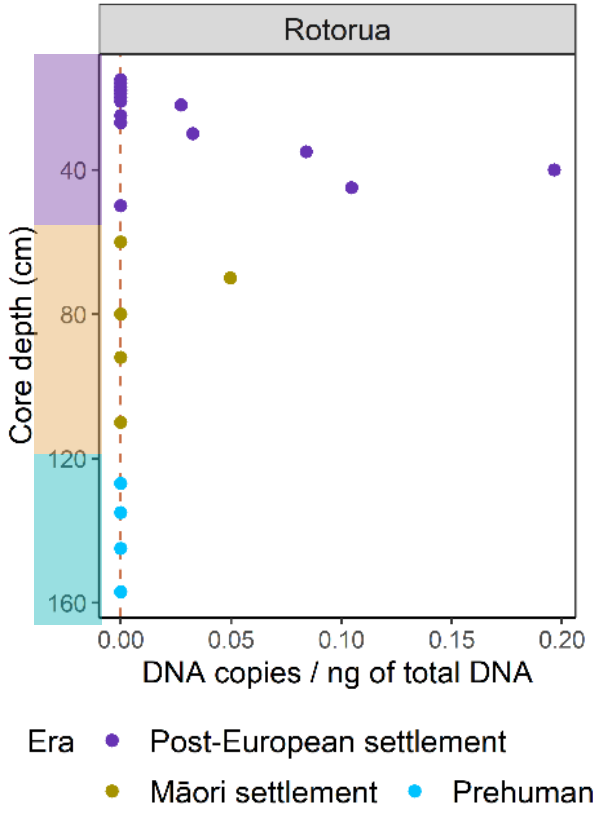


kākahi eDNA in Lake ōtuatauri – translocation or has it always been there?





kākahi eDNA in Lake Rotorua – decline due to recent cyanobacterial blooms?



eDNA is a great tool to explore spatial and historical distribution

! but also has some limitations

- **Individualize sampling strategy for research question, water body and species**

- **interpretation of data needs to be done carefully**

Kākahi

Kōura

Tuna

Photo Credit: Konstanze Steiner, Bruce Green, Taniwha | New Zealand Geographic

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