

Promoting community-led monitoring of taonga species and freshwater health through eDNA metabarcoding



OUR LAND
AND WATER

Toitū te Whenua,
Toiora te Wai

National
Science
Challenges

Presented by
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MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND



agresearch
āta mātai, mātai whetū



Mauri Oho
Hononga taiao | Huinga mauri-ora
By connection with nature, all life is rejuvenated



WILDERLAB



PŪHORO
He Waka Eke Noa



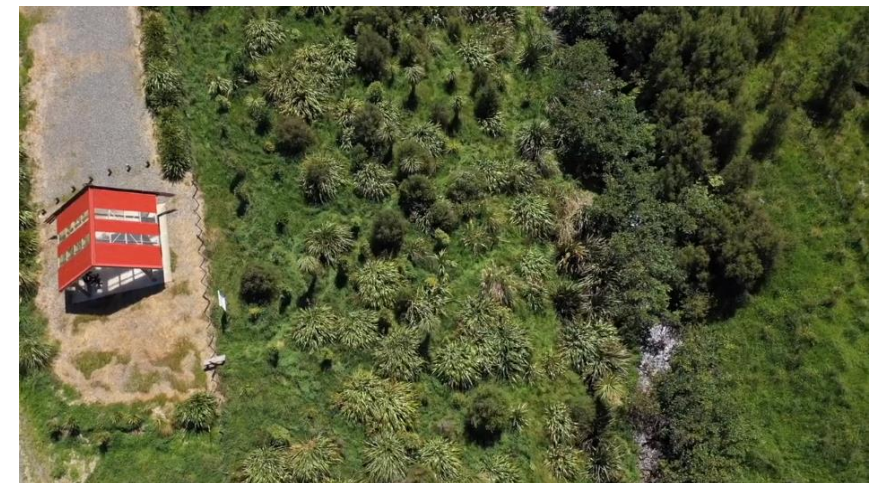
Upper catchment community

- Māori environmental groups, Rākautātahi marae, and Te Miro organic dairy farm.
- Regular water quality monitoring around dairy farm including *E.coli* monitoring.
- Community native plant nursery - riparian planting with eco-sourced plants.
- Mana whenua terrestrial monitoring and deployment of traps for pest management.
- Culturally significant upper bush area with Ngāmoko Whare for Mātauranga.
- Field site for Pūhoro STEMM internships and also primary school workshops.



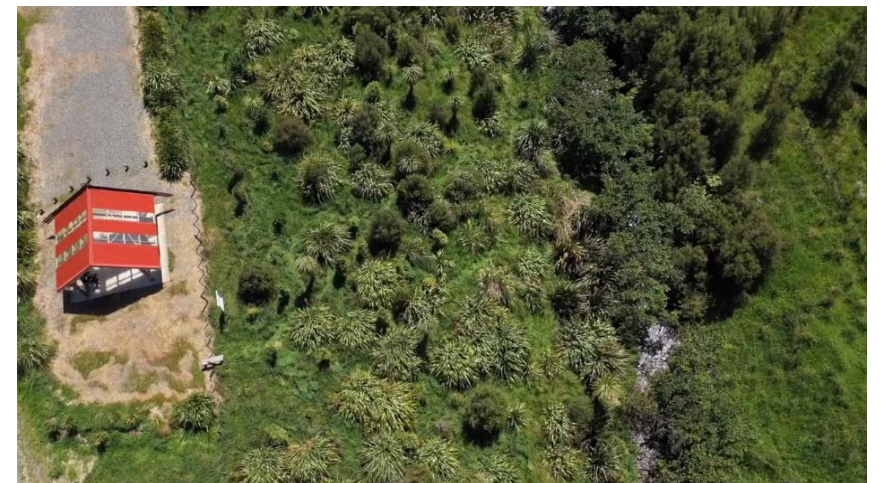
Project objectives...

- Increase commitment to action in water restoration by demonstrating a more meaningful approach of assessing ecosystem health in the agricultural sector.
- Providing new opportunities for mana whenua to reconnect with the environment and taonga species.
- Discover a fuller picture of biodiversity and ecosystem health to communicate to the wider community.
- Provide examples of positive engagement and storytelling in the agricultural sector, promoting community connectedness and resilience.



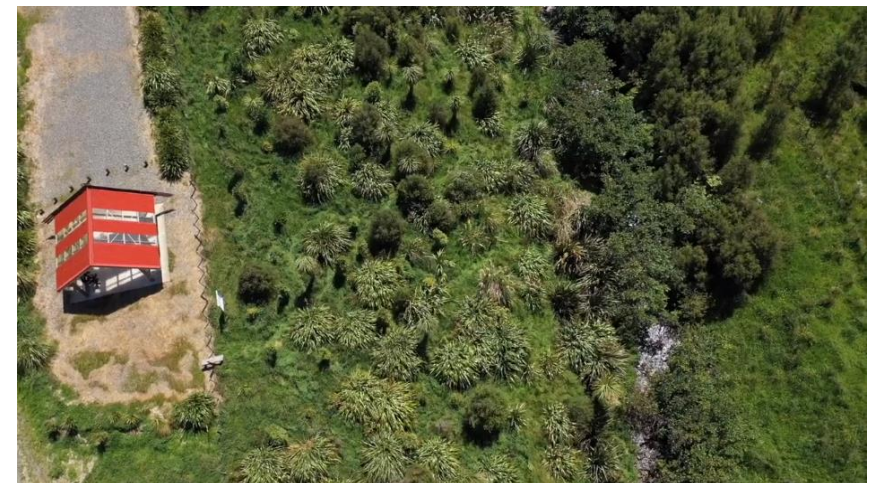
Key focus areas...

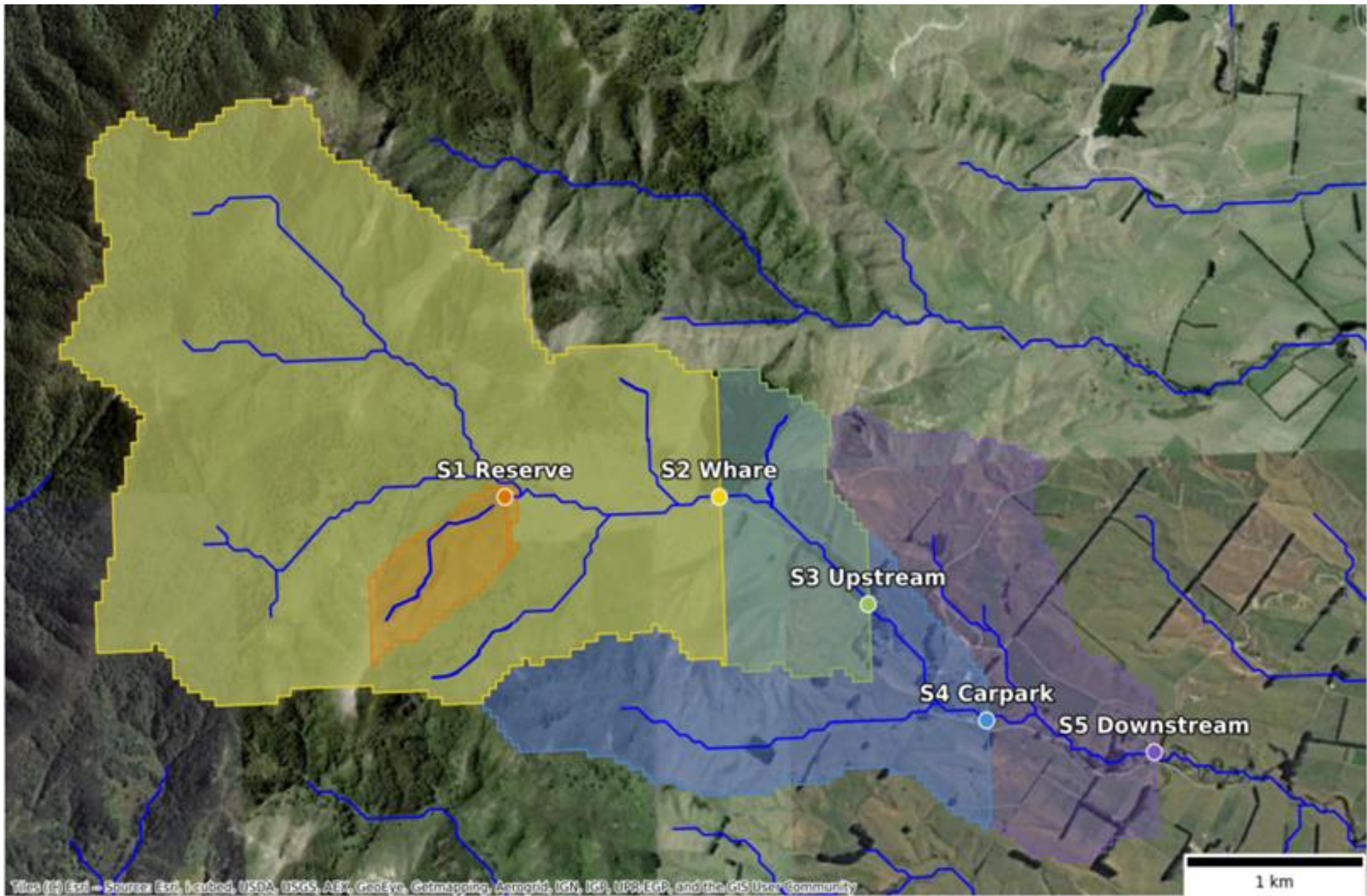
- Biodiversity, pest, and taonga species present
- Physical water quality parameters
- Ecological health (TICI score)
- Links between TICI and physical water quality
- Links between *E. coli* levels and eDNA from known faecal sources
- Exploring resilience post disturbance (Cyclone)
- Building community capacity, capability and reconnection



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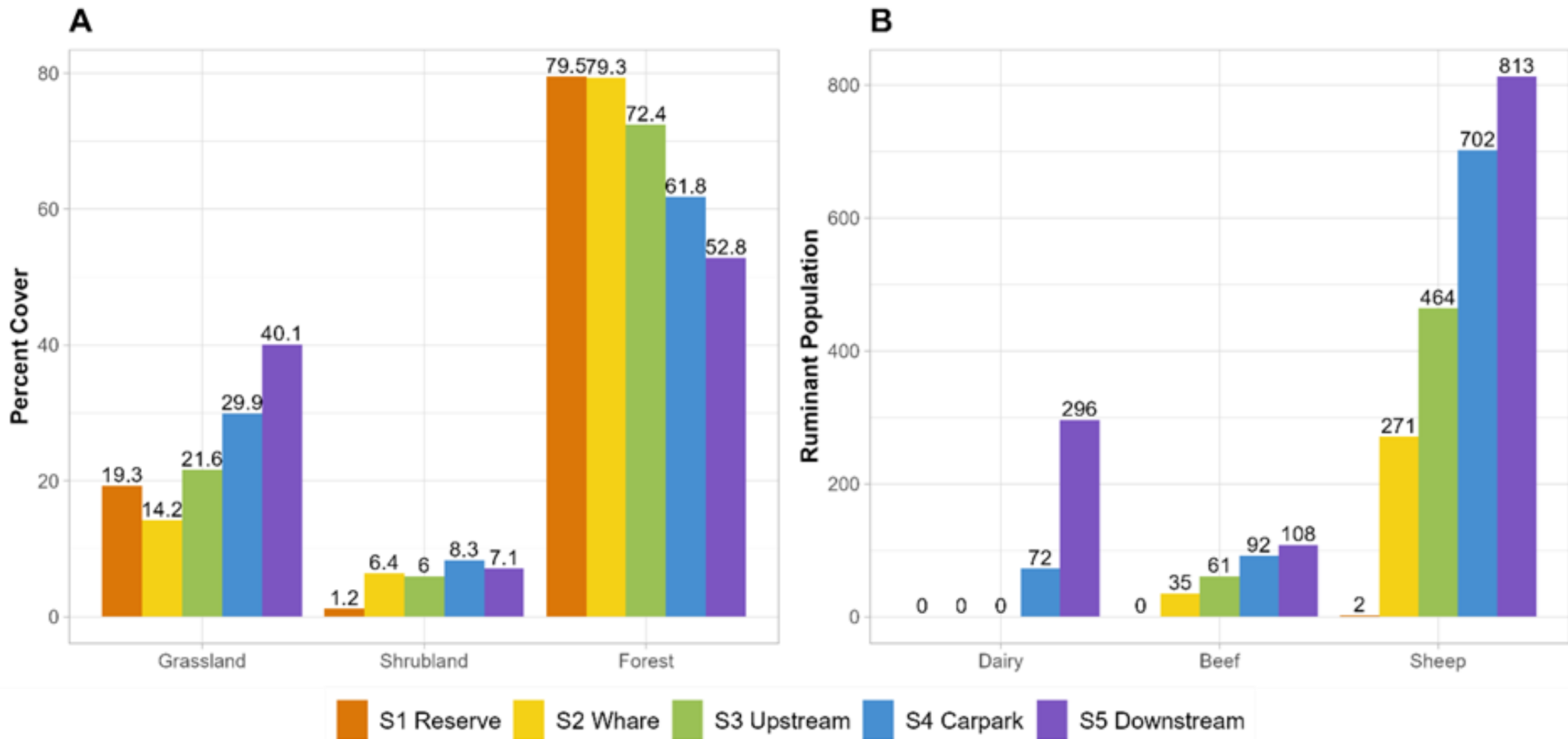
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Time (4) Erd - Source: Erd, Lebed, USDA, USGS, AET, GeoEye, Geomapping, AeroGRID, IGN, IGA, UPR/EGP, and the GIS User Community

Landuse and livestock data



Sampling

- Rigorous bi-monthly testing of eDNA and physical water quality parameters Dec 2022 – Feb 2024.
 - *E. coli*, and 10 physico-chemical attributes – N, P, turbidity, pH, conductivity etc.
- 6-rep standardised eDNA sampling at each site using 13 metabarcoding assays targeting across the tree of life.
 - 3x 16S, 3x CO1, 2x 18S, 2x 12S, 1x trnL, 1x rbcL, 1x cyt-B.
- Sampled consistent to the local maramataka (Māori lunar calendar).

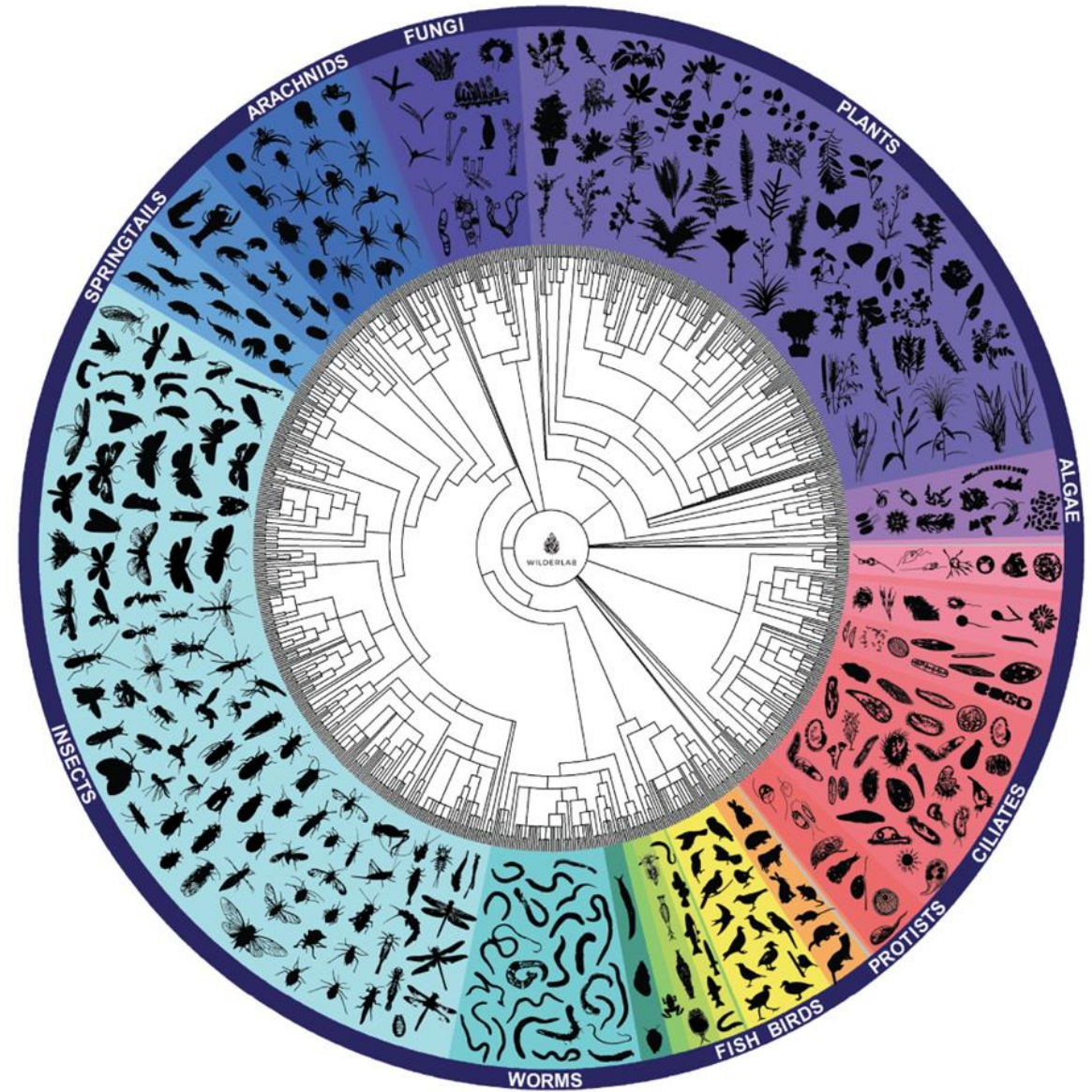


Biodiversity detected

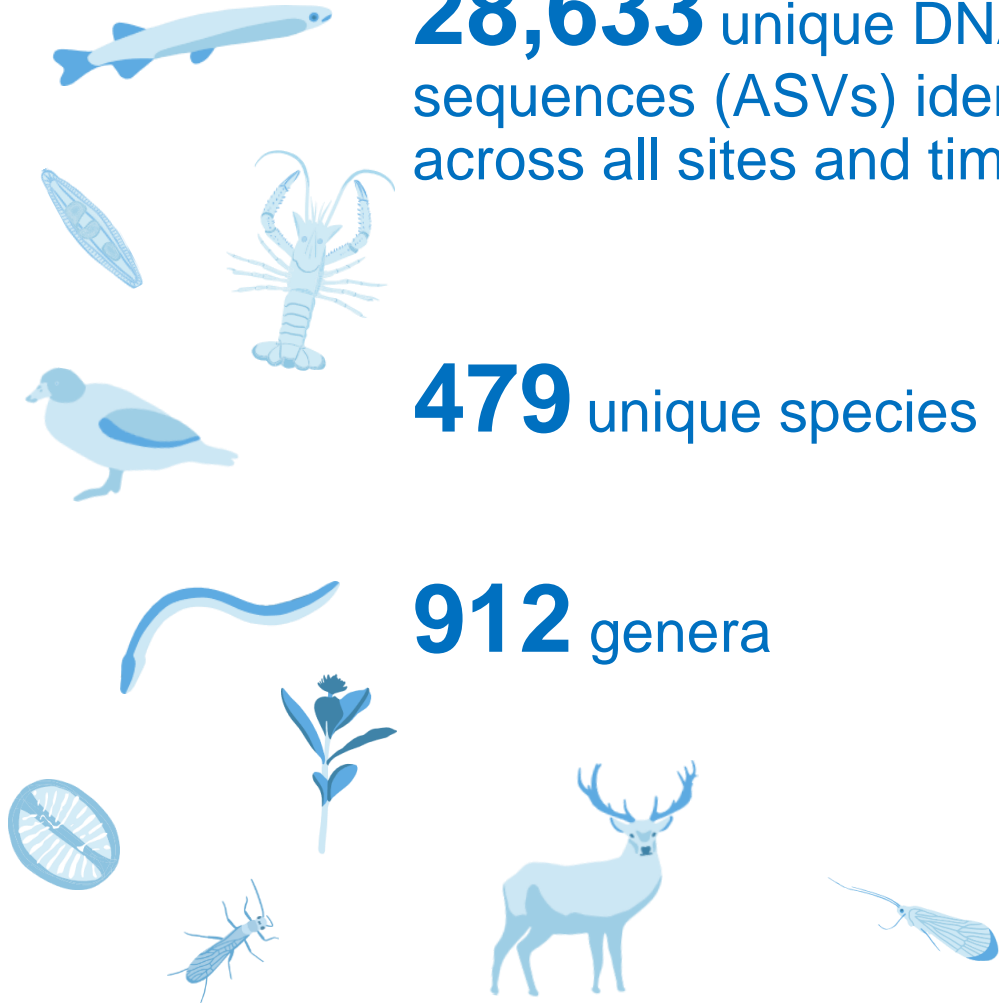
28,633 unique DNA sequences (ASVs) identified across all sites and timepoints.

479 unique species

912 genera



Wheel of life depicting a portion of biodiversity detected across all sites and all time points.



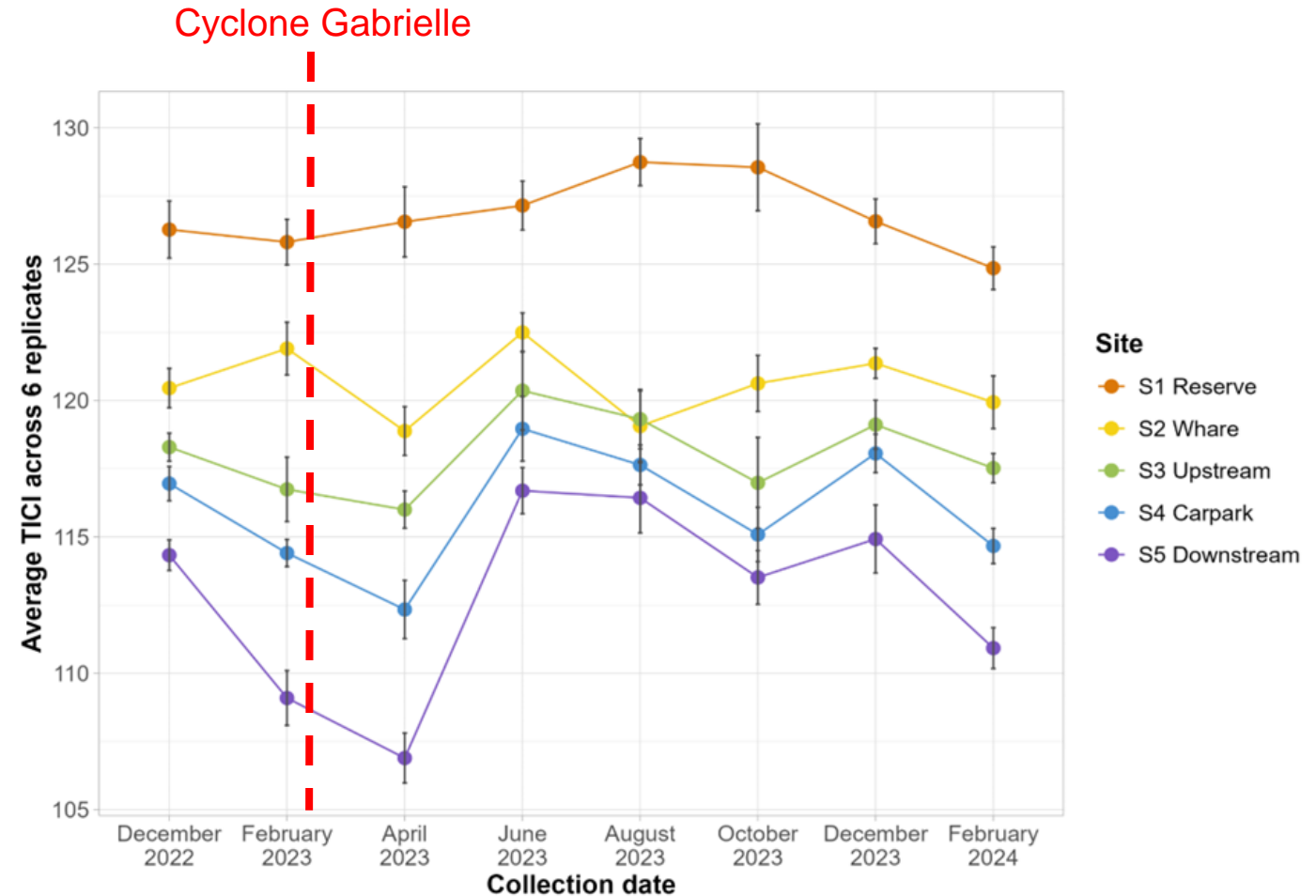
Taonga species detected

- Whīo
- Cockabully / Kaharore bully
- Kōkopu / Dwarf galaxias
- Kōura / freshwater crayfish
- Longfin and shortfin tuna / eels
- Ruru / morepork
- Tūī
- Kereru
- Pīwakawaka / Fantail
- Kōtare / Kingfisher
- Kōtukutuku / tree fuchsia
- Harakeke
- Māhoe
- Mānuka
- Miro
- Makomako / wineberry
- Hangehange
- Putaputawētā / marbleleaf



Taxon-independent community index (TICI)

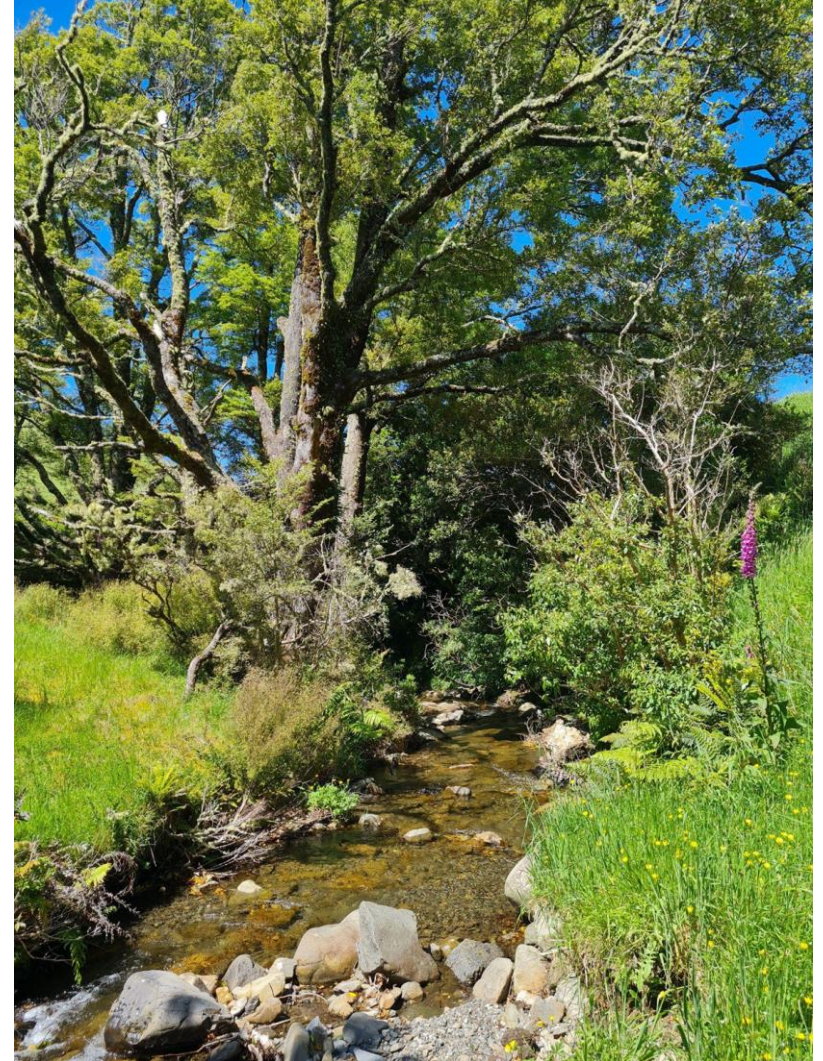
- TICI is made up of 3000 indicators found in NZ river environments across the tree of life (8 metabarcoding assays).
- Consistent decreases in average TICI scores downstream.
- Lowest score detected at S5 in April post Cyclone.
- S1 reserve showed least impact/greatest resilience during and after Cyclone.
- Average number of detected TICI indicators per sample ranged from 195 - 616.
- Low variability between 6-replicate samples (max 1.66 sd +/-).



Read original TICI paper here: *Wilkinson SP, Gault AA, Welsh SA, Smith JP, David BO, Hicks AS, Fake DR, Suren AM, Shaffer MR, Jarman SN, Bunce M. (2024). TICI: a taxon-independent community index for eDNA-based ecological health assessment. PeerJ.*

TICI score relationships with water quality

- Used stepwise regressions to consider influence of water quality attributes on TICI scores.
- Conductivity, total nitrogen, nitrate, pH, turbidity, and *E. coli* were found to be best predictors of average TICI score ($R^2 = 0.94$, $Adj-R^2 = 0.92$).
- Suggests TICI is sensitive to changes in water quality in close proximity sites – a big positive for on-farm and rural monitoring.
- Future studies should explore this further ($n=1!$)



Community outcomes

- Team field days brought the community together to foster new partnerships through a shared vision for the catchment.
- Enhanced community capability, capacity, and connections to support long-term resilience.
- Mana enhancing kaitiakitanga, looking after the waterway and ecosystem in a safe and non-invasive way.
- Reconnection, deepening sense of attachment and responsibility to the waterway.

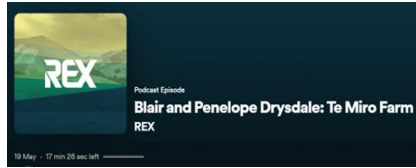


Continuing the kaupapa!

- Using the data to continue school events and community days.
- Deep dive into unique dataset taking a holistic view across taxa taking an ecosystem structure, function and connectivity approach.
- Dr. Rose Collis: Kia Niwha Leader Fellowship comparing terrestrial and freshwater communities using eDNA collected from spiderwebs.
- Journal article under review.



Communicating the kaupapa!



eDNA reveals awa's secrets

Environmental DNA identified native and exotic species of fauna and flora in a culturally significant high-fescue.

When the results came in on when subtle environmental changes, genetic analysis can be used to measure diversity within the landscape.

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Read more comms here 😊



Collaborators

Taiao Ora Contracting – Arapera Paewai, Hineatatu Dorset

Te Miro Farm – Penelope, Blair, Billie, Joe Drysdale

AgResearch – Adrian Cookson, Marie Moinet, Rose Collis

Mauri Oho – Erana Mōtū, Pigg, Jenny Mauger, Lilia Wakefield,
Taranaki Nepe Apatu

Wilderlab – Amy Gault (formerly), Susan Welsh, Shaun Wilkinson

Massey University – Adrian Cookson, Hone Morris

Pūhoro STEMM Charitable Trust – Navarone Watson, Mosiah
Igatia, Izzy Rewiri-Wharerau, Leland Ruwhiu, Jasmine Gavas,
Cody Garton



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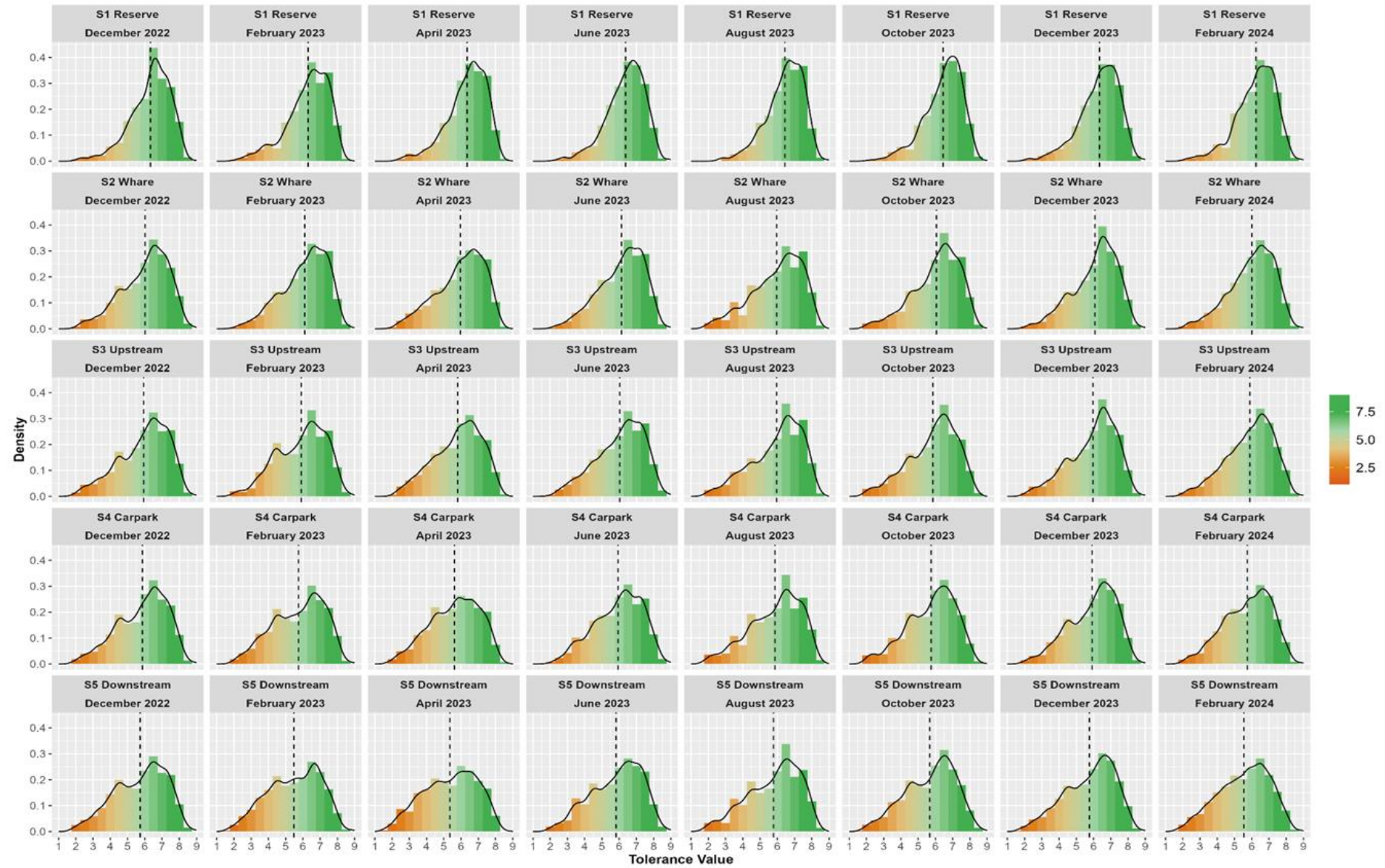
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A photograph of a small, clear stream flowing through a dense, lush forest. The water is shallow and clear, revealing numerous smooth, grey rocks of various sizes. Sunlight filters through the thick canopy of green trees and ferns, creating dappled light on the water and the surrounding foliage. The overall atmosphere is serene and natural.

Ngā mihi nui!

TICI indicator values detected across sites and through time



The increased prevalence of low-value TICI indicators in the lower sites was sufficient to consistently reduce their averaged TICI scores despite likely overlap in DNA from upstream.