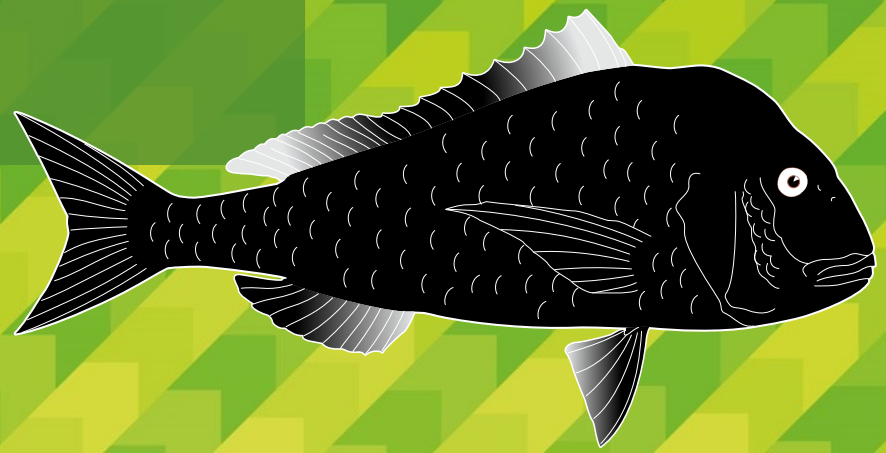
Sabetian, A*, Hegg, J., Campbell, M., Zhang, J., Raby, H., Reid, M., Tromp, M. Furey, L., Ash, E., White, L., Walter, R., Lilkendey, J.

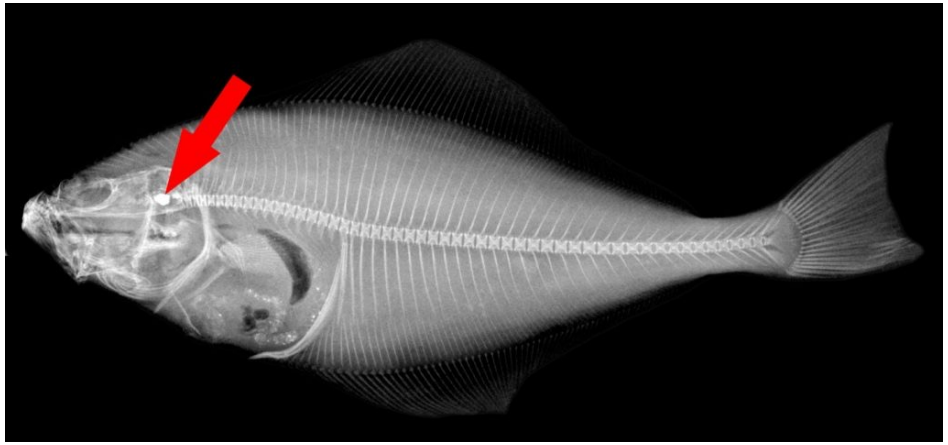
Department of Environmental Science,
Auckland University of Technology

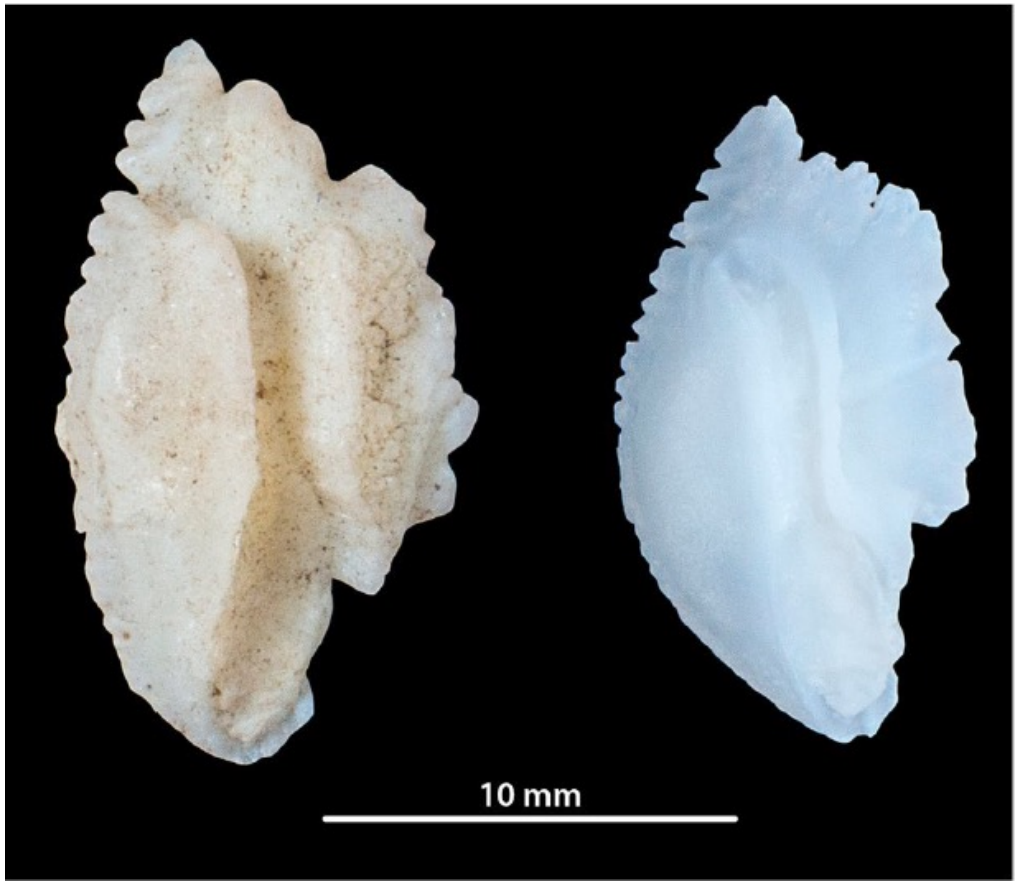
AUT
TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Unveiling Movement Patterns Across Habitats and Time; Insights from Continuous Otolith Microchemistry Data

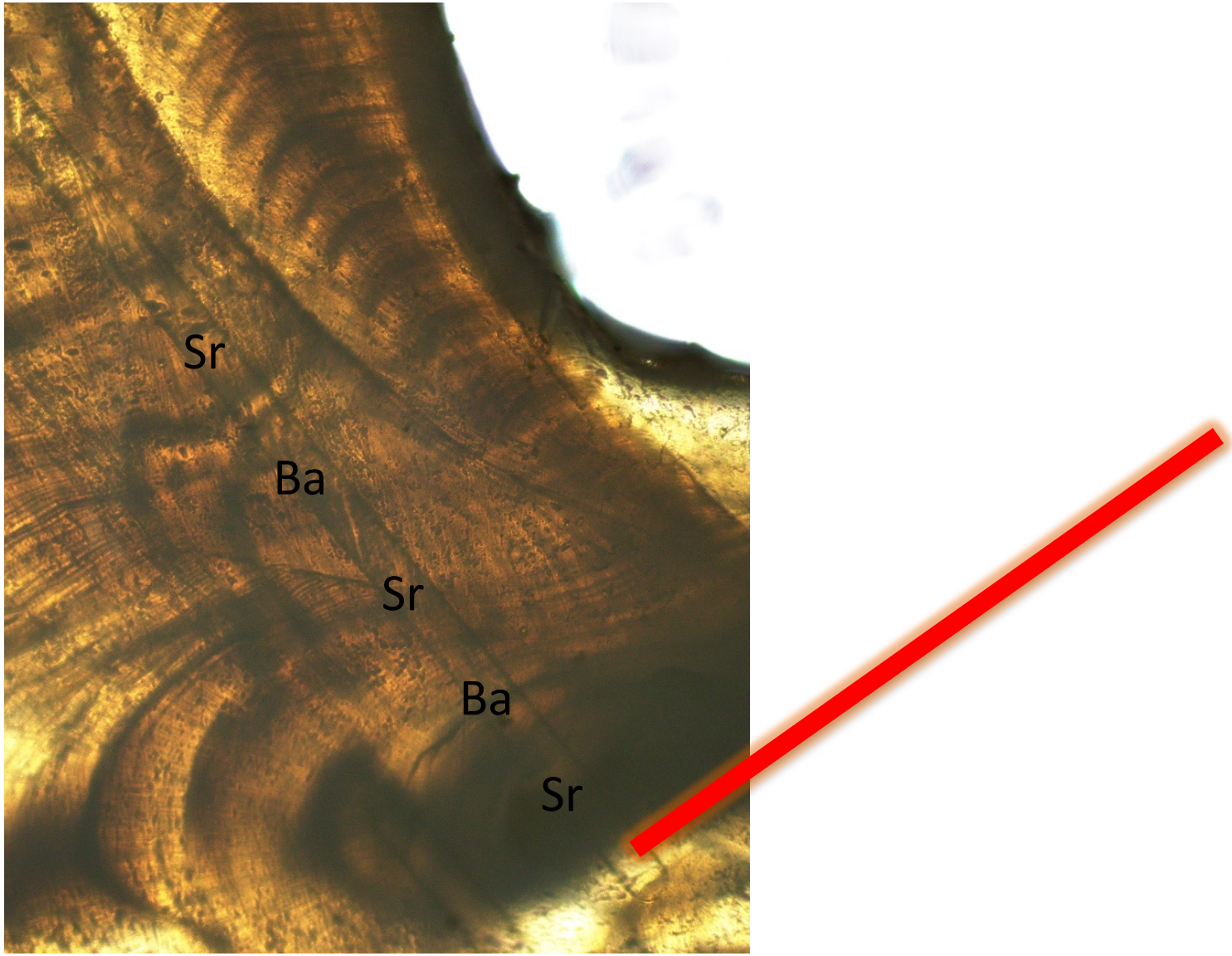


Otoliths are biological chronometer

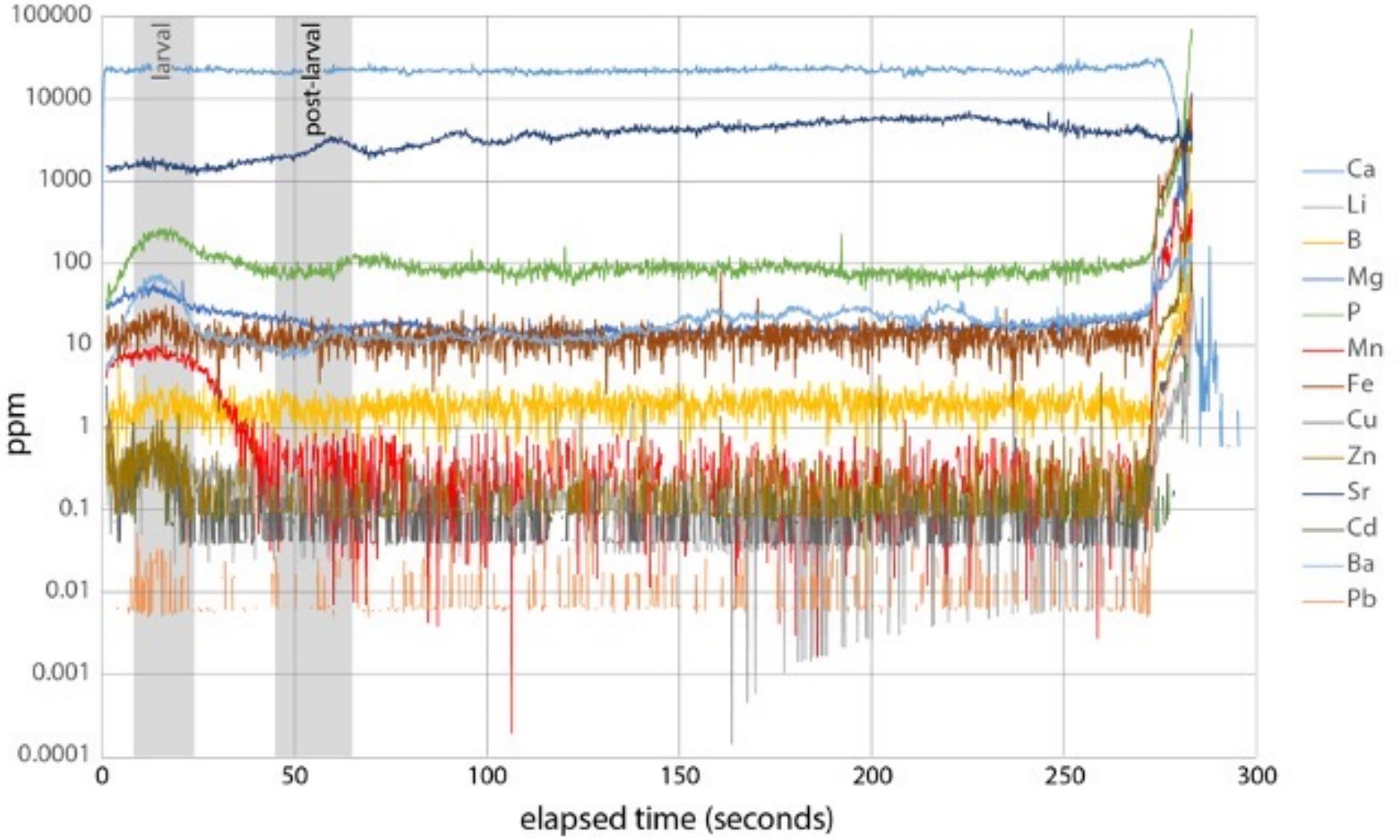




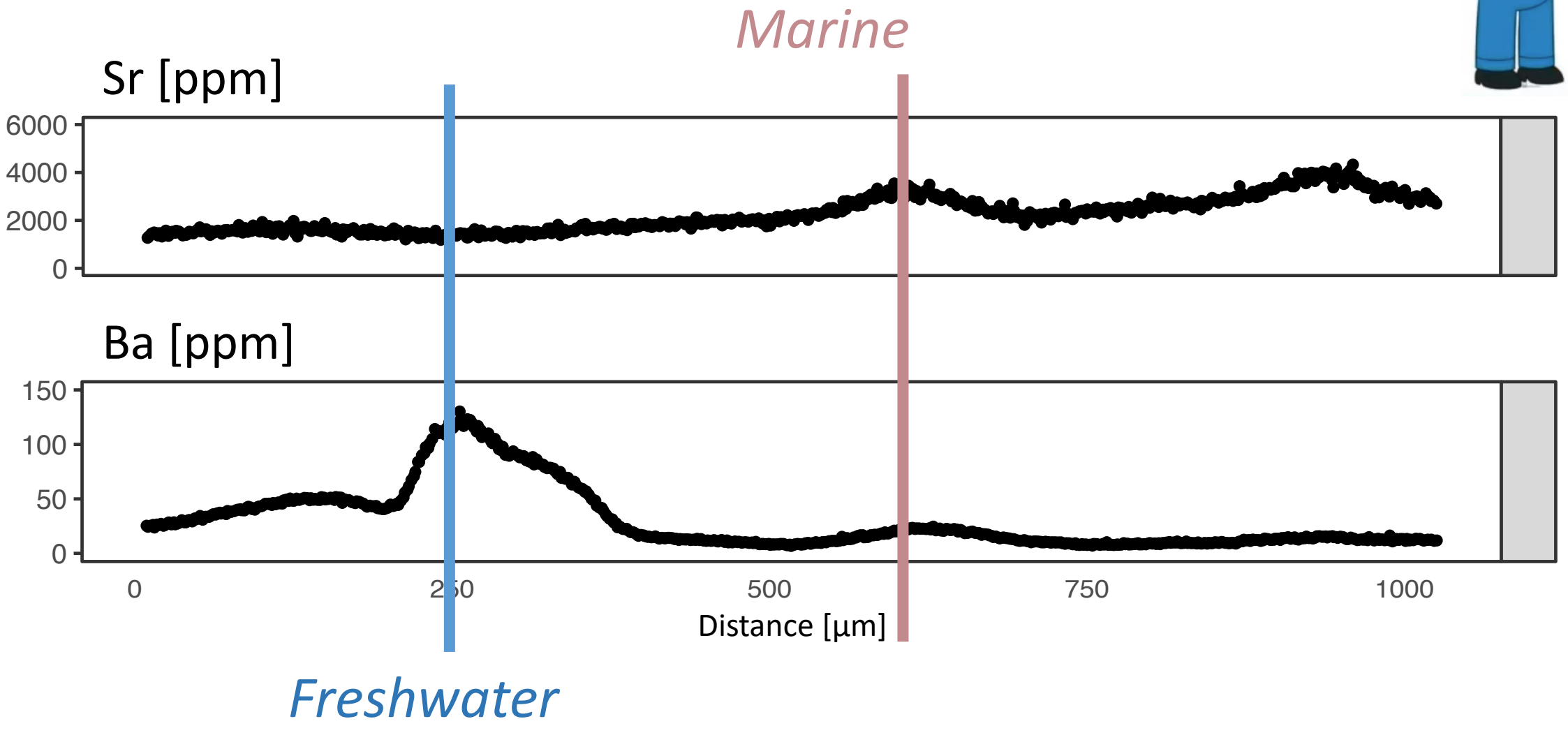
Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)



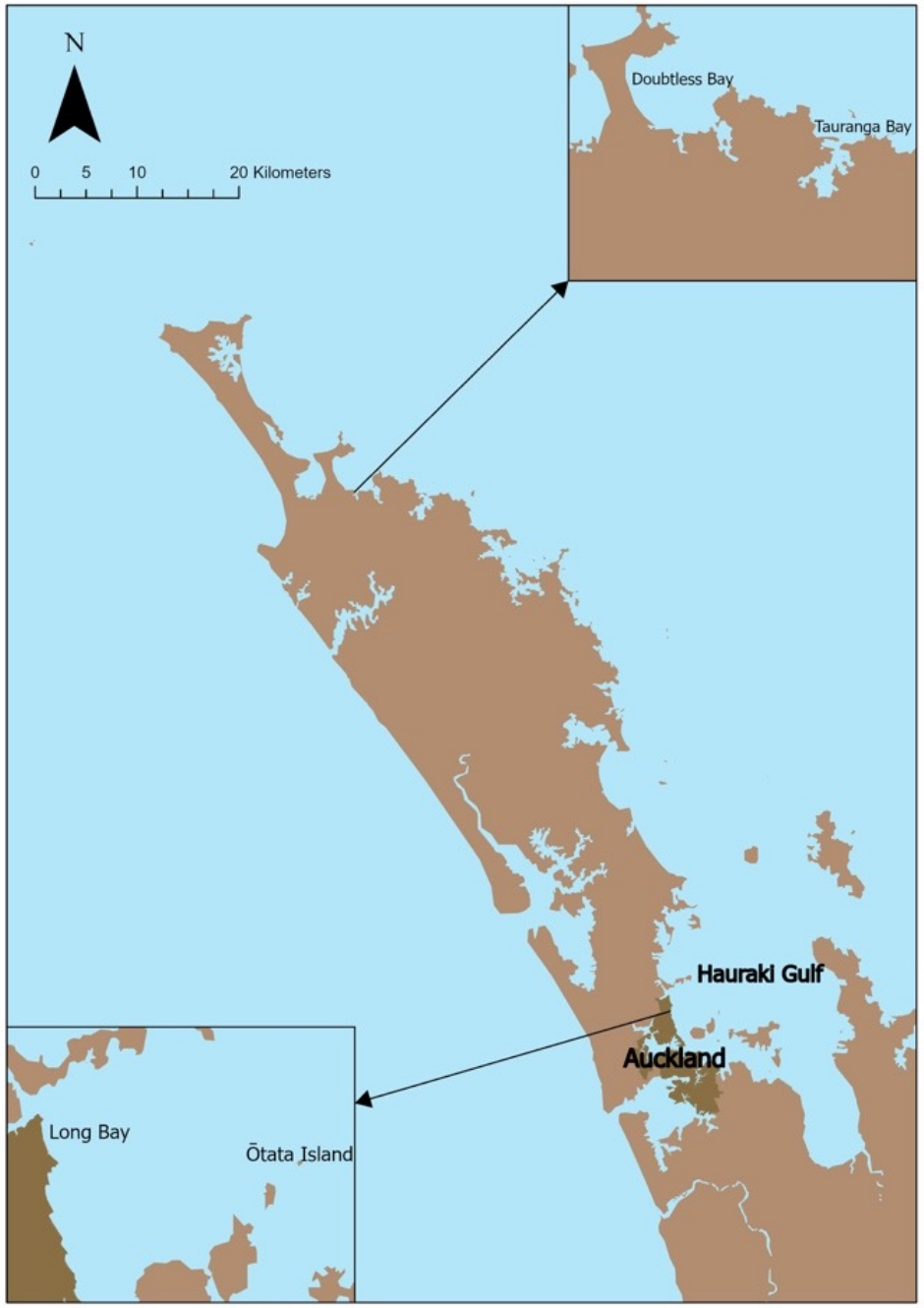
Time-series data



Traditional otolith chemistry analysis is



- We analysed archaeological and modern otoliths spanning entirety of human existence in upper north island of NZ



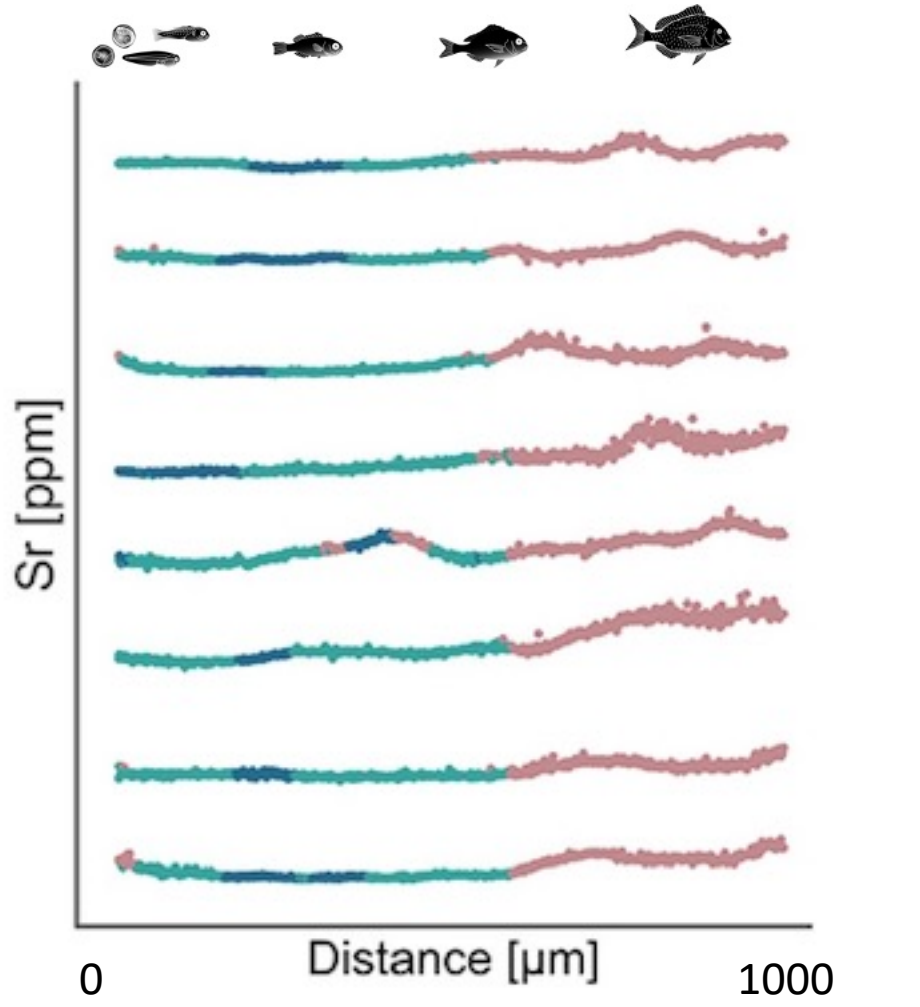
Behavioural Change Point Analysis (BCPA)

- By combining Behavioural Change Point Analysis (BCPA) with k-means clustering, we were able to cluster otolith element time-series into three distinct “behaviours”.

- *Riverine*: Ba (18.2 ± 0.3 ppm) Sr (1,717 ± 5 ppm);
- *Estuarine*: Ba (8.01 ± 0.11 ppm) Sr (1,767 ± 4 ppm);
- *Marine*: Ba (9.38 ± 0.13 ppm) Sr (2,603 ± 6 ppm).

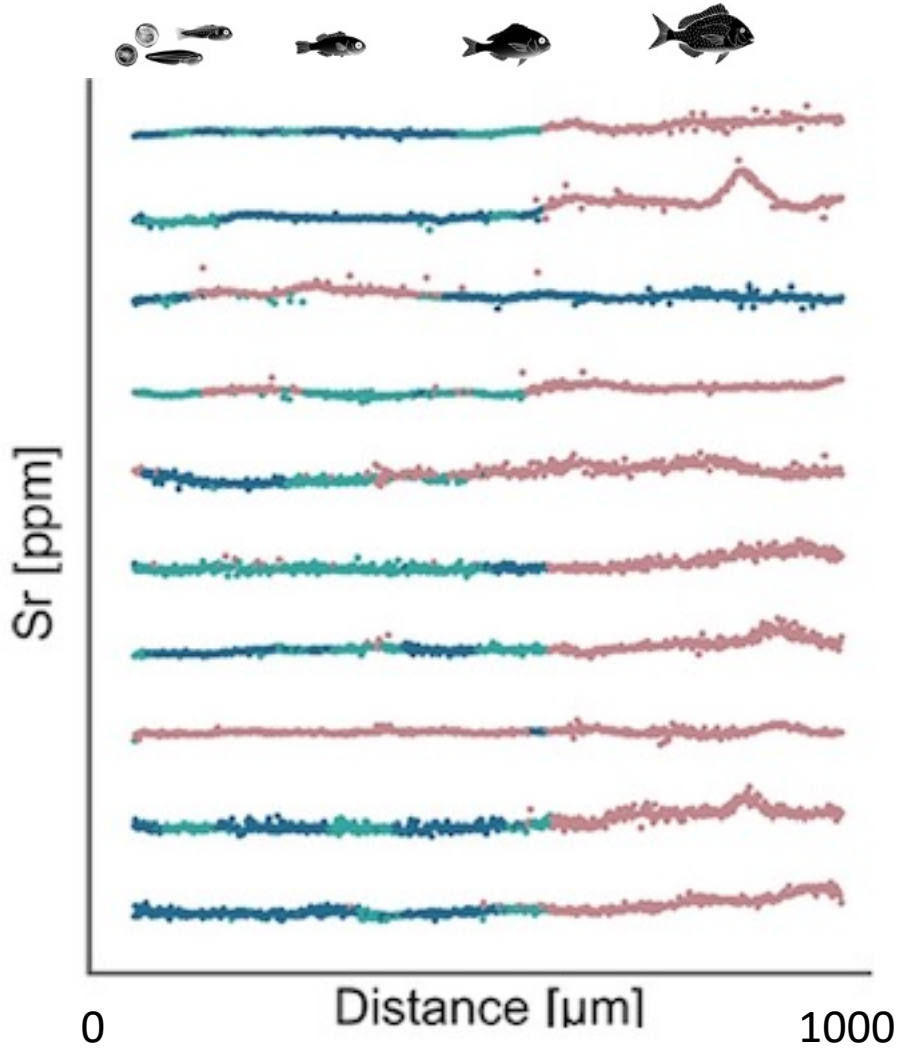
Estuarine, Riverine, Marine

Archaeological



Synchronised cluster succession

Present Day



Stochastic cluster succession

Ecological Indicators 131 (2021) 108225

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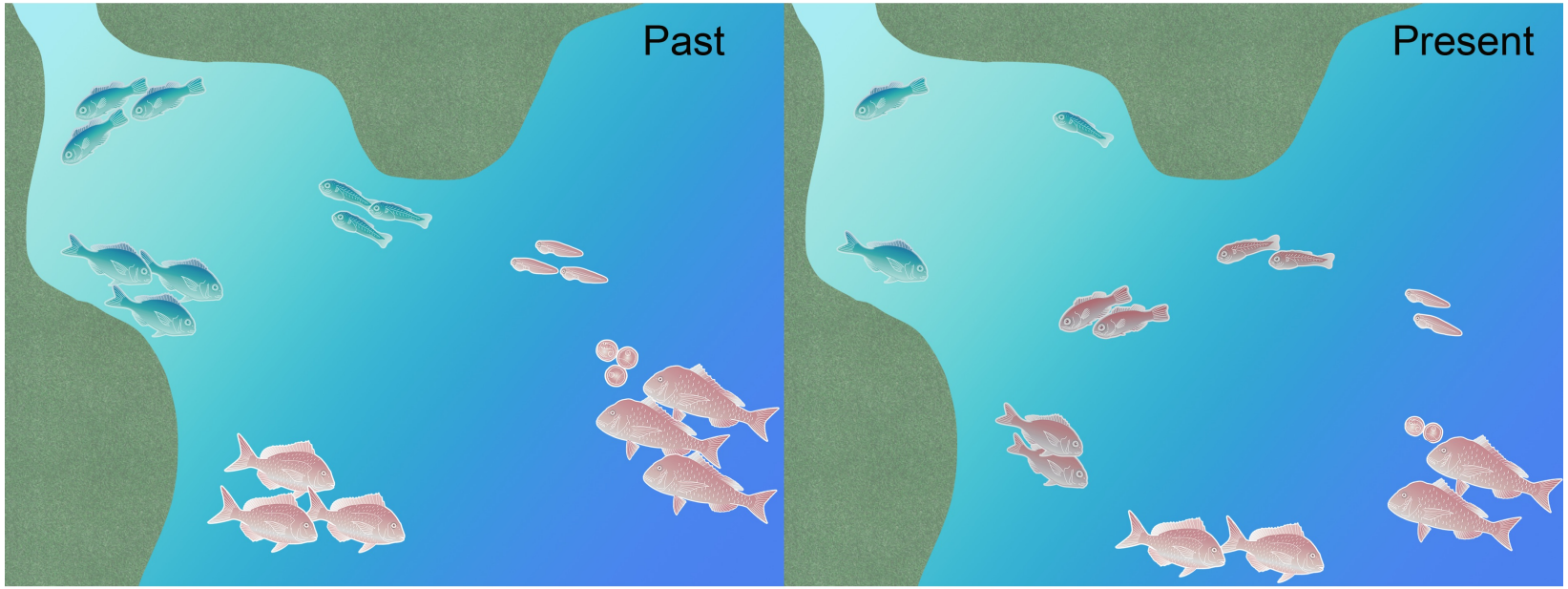
journal homepage: www.elsevier.com/locate/ecolind

Original Articles

Fish nearshore habitat-use patterns as ecological indicators of nursery quality

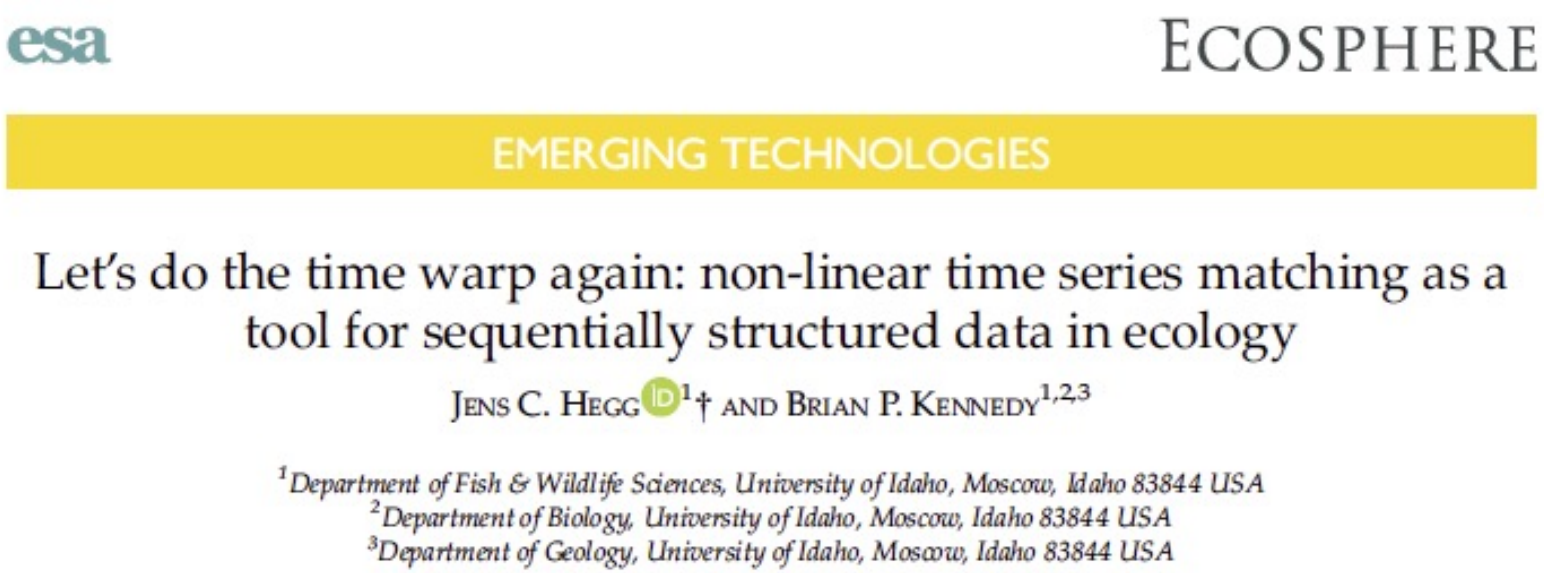
Armagan Sabetian [a,*,1], Jingjing Zhang [a], Matthew Campbell [b,c], Richard Walter [d,e], Hamish Allen [a,f], Malcolm Reid [g], Kavindra Wijenayake [h], Julian Lilkendey [a,1]

[a] School of Science, Auckland University of Technology, New Zealand
[b] Anthropology Department, University of Auckland, New Zealand
[c] CFG Heritage Ltd, New Zealand
[d] Southern Pacific Archaeological Research, School of Social Sciences, University of Otago, New Zealand
[e] School of Social Sciences, University of Queensland, Australia
[f] Research and Evaluation Unit, Auckland Council, New Zealand
[g] Centre for Trace Element Analysis, Department of Chemistry, University of Otago, Dunedin, New Zealand

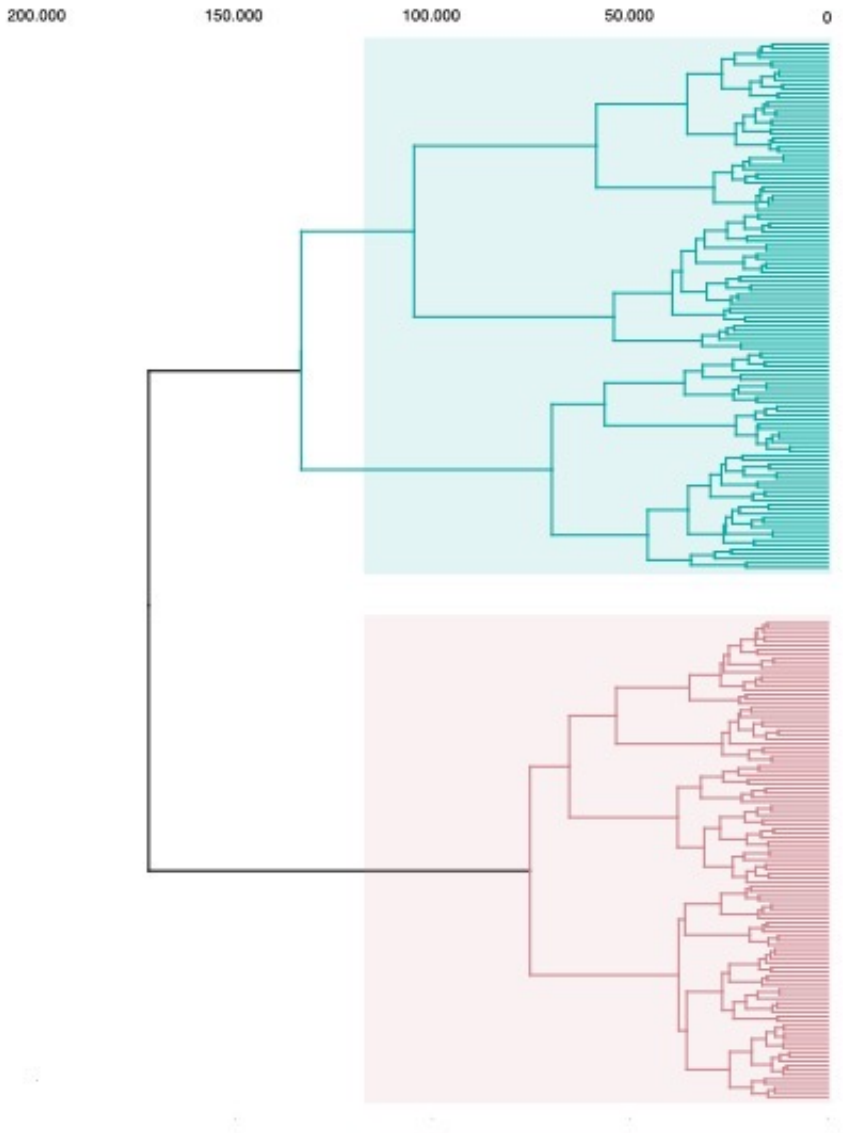


Dynamic Time Warping (DTW)

- Originally developed for recognition of speech patterns in 1951
- Has become a popular time series analysis tool
- Can be applied to microchemistry time series

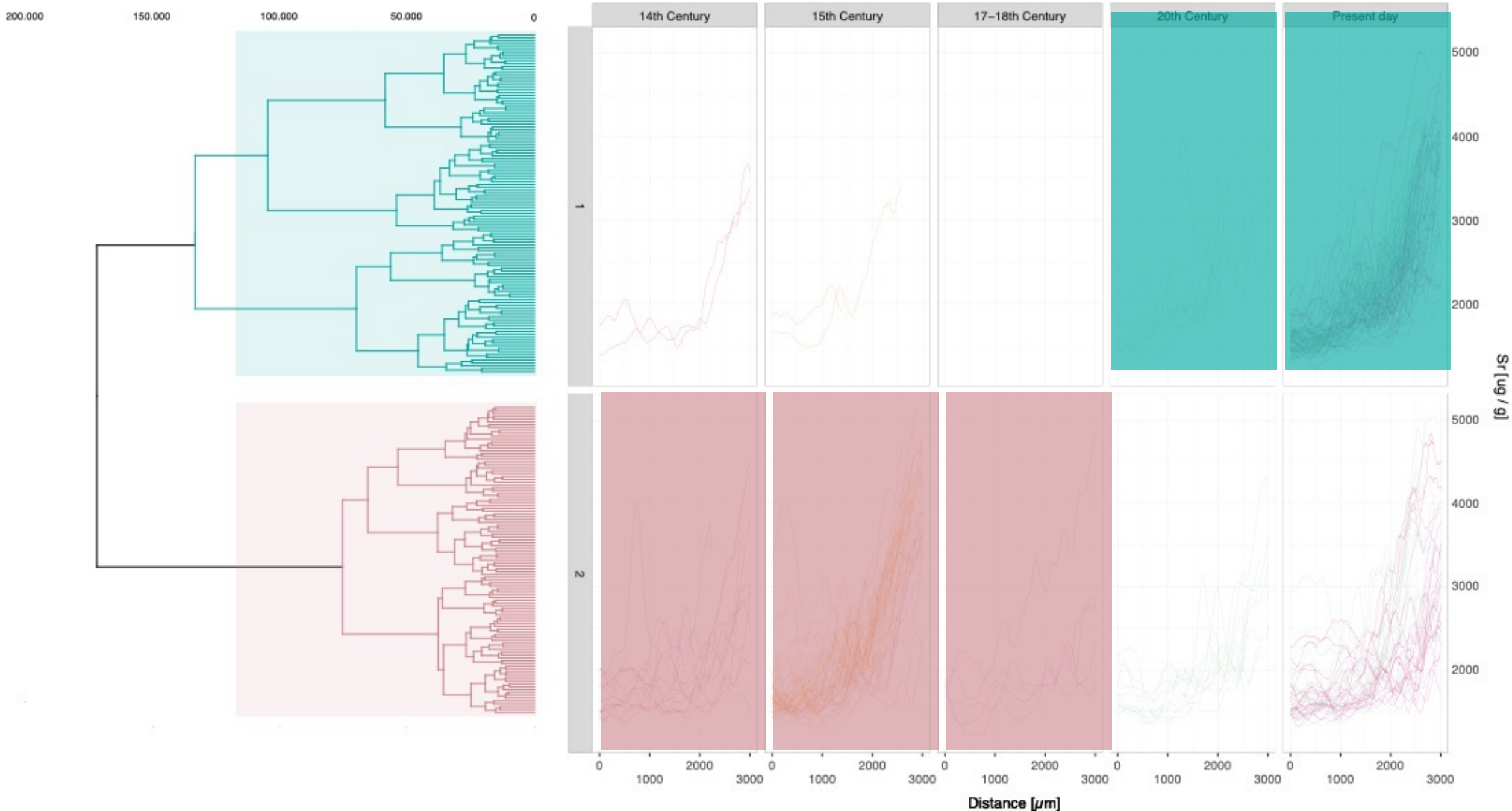


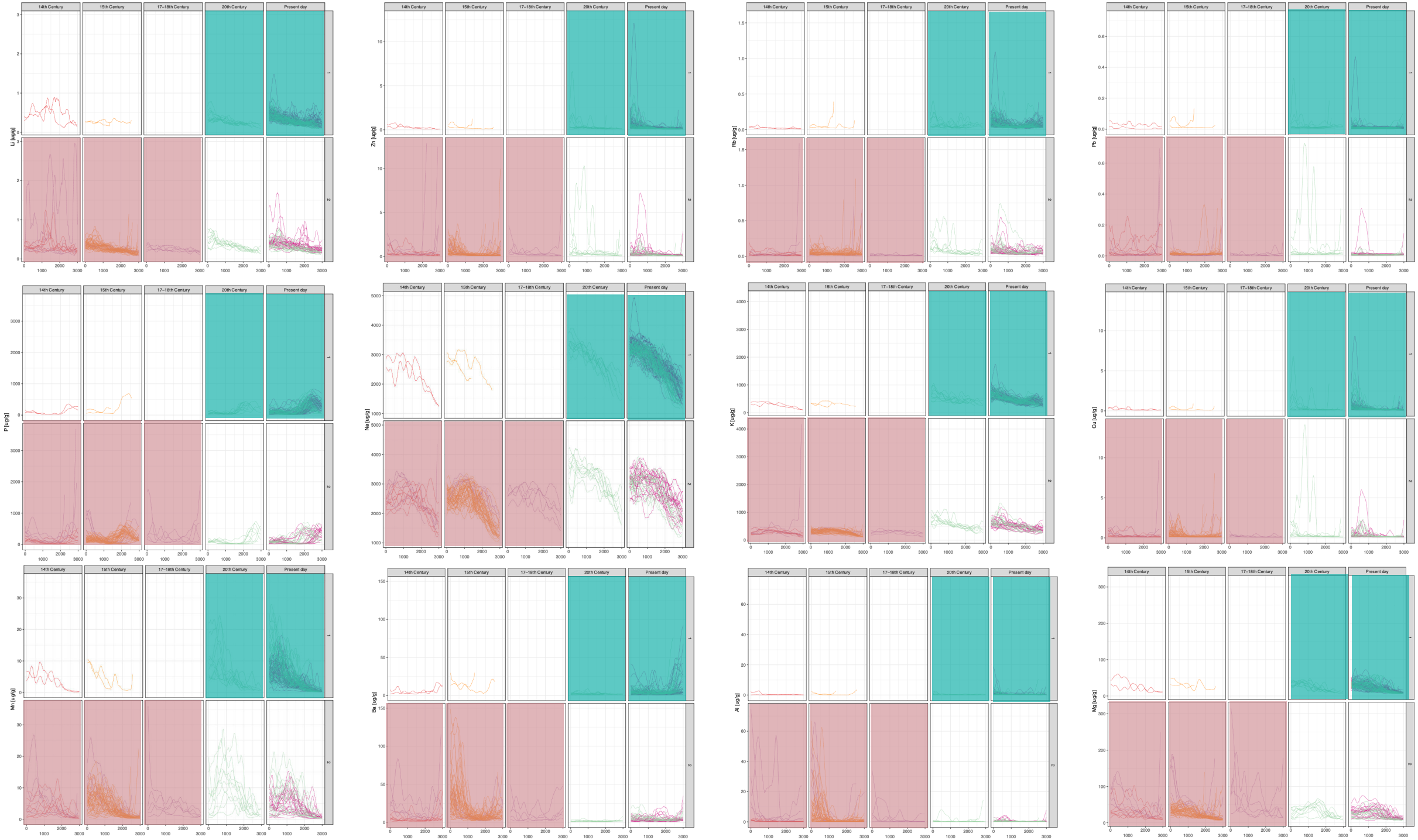
Hierarchical dendrogram showcasing the clustering of snapper otolith chemical profiles using DTW



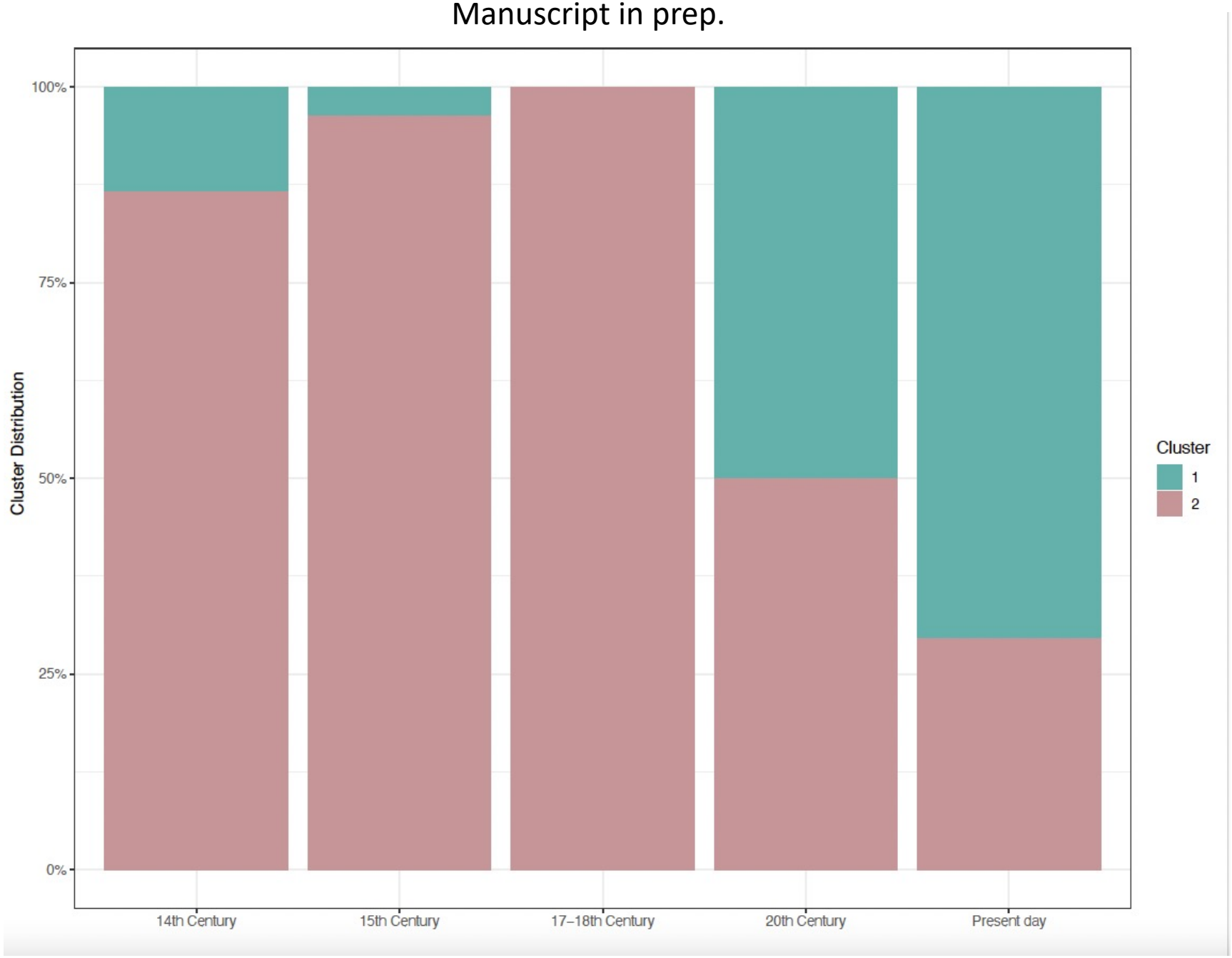
Modern

Archaeological


200.000
150.000
100.000
50.000
0
14th Century
15th Century
17–18th Century
20th Century
Present day
1
2
5000
4000
3000
2000
0
1000
2000
3000
Sr [ug / g]
Distance [μm]


14th Century
15th Century
17–18th Century
20th Century
Present day
Li [ug/g]
Zn [ug/g]
Rb [ug/g]
Pb [ug/g]
P [ug/g]
Na [ug/g]
K [ug/g]
Cu [ug/g]
Mn [ug/g]
Ba [ug/g]
Al [ug/g]
Mg [ug/g]
1
2

Manuscript in prep.



Proof of concept

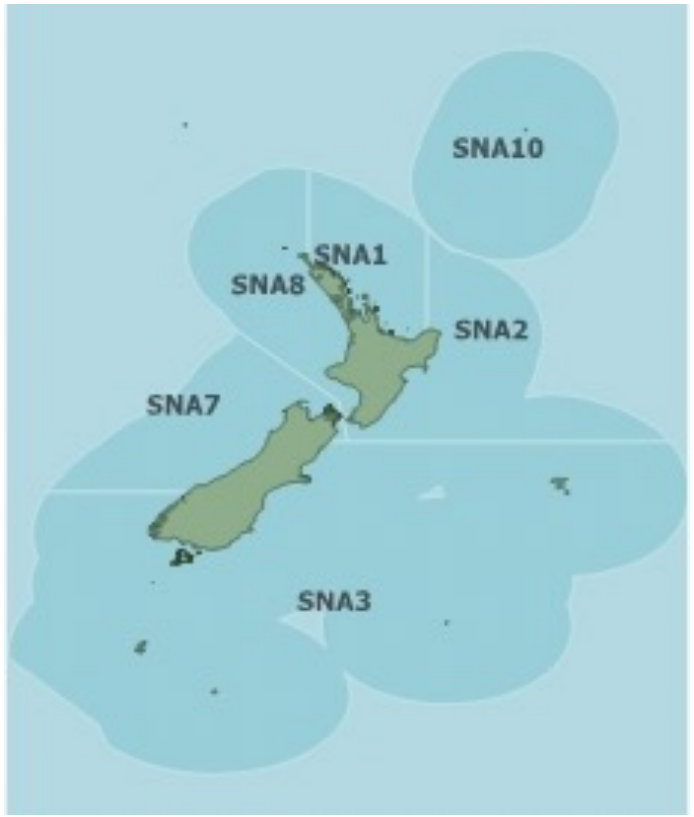
- Our advanced time-series analysis and machine learning approach can unlock new fine-scale information from otolith chemistry.

Implications

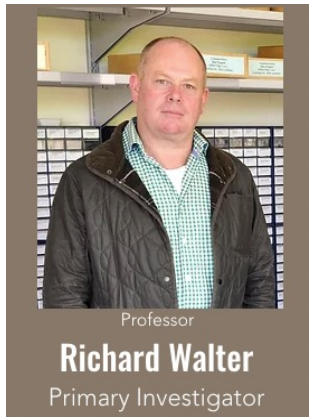
- A window into the shifting baseline of disrupted nursery habitat-use?

Implications

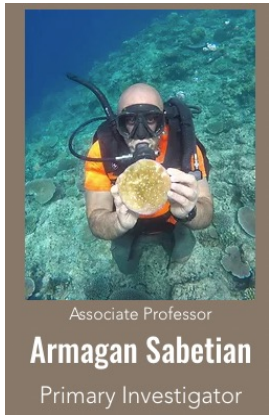
- Can we reconstruct fine-scale movement patterns across snapper's entire lifetime?
- Infer mixing of different stocks?



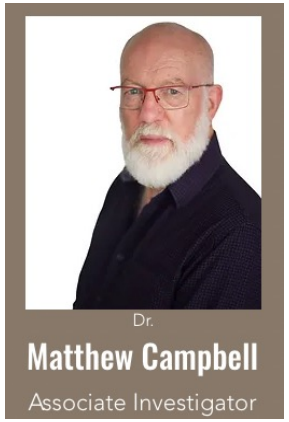
Our interdisciplinary team of expert archaeologists, marine scientists, analytical chemists, and data scientists.



Professor
Richard Walter
Primary Investigator



Associate Professor
Armagan Sabetian
Primary Investigator



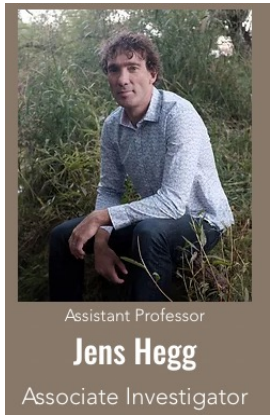
Dr.
Matthew Campbell
Associate Investigator

Dr.
Jingjing Zhang
Associate Investigator

Dr.
Julian Lilkendey
Associate Investigator

Dr.
Monica Tromp
Associate Investigator

Dr.
Malcolm Reid
Associate Investigator



Assistant Professor
Jens Hegg
Associate Investigator

https://www.aotearoa-sclerochronology.com/