

# Glacial refugia of the New Zealand stick insect, *Clitarchus hookeri* (White)

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## BACKGROUND:

The Last Glacial Maximum (LGM) occurred in New Zealand from 34,000 to 17,650 years ago and had a discerning effect on NZ biota. The current distribution of several terrestrial species may be a result of this glacial period. However, the effects of LGM on invertebrate species are much less well known.



## AIMS:

- What is the biogeographic history of *Clitarchus hookeri*?
- What were the locations of its glacial refugia?

## STUDY ORGANISM:

- Endemic to New Zealand
- Wide distribution
- Ecological generalist
- Cold-temperature sensitive
- Facultative parthenogen



*Clitarchus hookeri*

## HOW?

Reconstructing the biogeographic history of *C. hookeri*, using phylogenetic relationships and geographic distribution.

## METHODS:

Combination of phylogeographic analysis with ecological niche modelling (ENM). This offers independent estimates of spatial location and glacial refugia.

### 1 Phylogeographic analysis

- Using mitochondrial DNA (mtDNA) – cytochrome *c* oxidase subunit I gene (COI)
- Reconstruct phylogenetic relationships between *C. hookeri* haplotypes (including 2 undescribed species).

### 2 Ecological Niche Modelling

- Using 133 presence records as distribution data (field surveys + museum records) and climate data
- Generated using Maxent to show the geographic distribution now and during LGM.

## RESULTS:

- (1) Higher levels of genetic diversity in northern populations of North Island. This is congruent with the ecological niche modelling. Geographic parthenogenesis is also demonstrated.

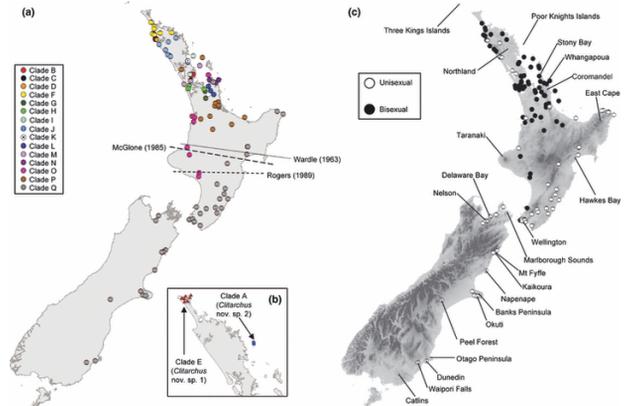


Figure 1. Geographic distributions of mitochondrial DNA clades in (a) *Clitarchus hookeri* and (b) undescribed species of *Clitarchus*. (c) Distribution of sampled bisexual and unisexual populations. The position of the Taupo line is shown in (a).

- (2) Geographic distribution of *C. hookeri* has substantially expanded since LGM.

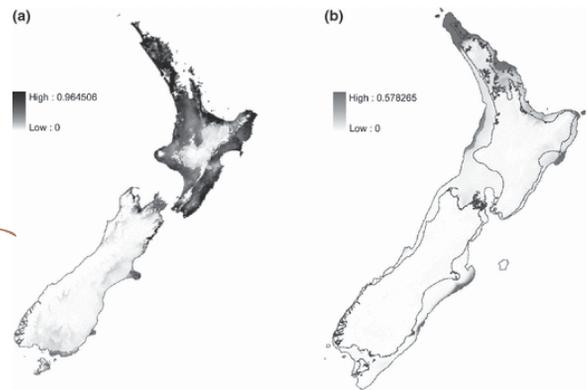


Figure 2. ENM projections of (a) the current distributions of *C. hookeri* and (b) the distribution of *C. hookeri* during the LGM. Grey areas show land surmised to be within the niche of *C. hookeri*. The shading intensity is proportional to the probability of presence in a given area.

## CONCLUSION:

*C. hookeri* was restricted to several glacial refugia located in the upper North Island and the east coast of the South Island during the LGM. Phylogeographic analysis shows a higher level of genetic diversity in the locations of predicted glacial refugia. **This suggests geographic distribution was majorly reduced during the LGM, but populations then expanded and colonised after the glaciers retreated.**