Museomics and Population Genomics of the (not so) Mountain Katydid Reveal Extensive Cryptic Diversity

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Who is the mountain katydid, *Acripeza reticulata*?

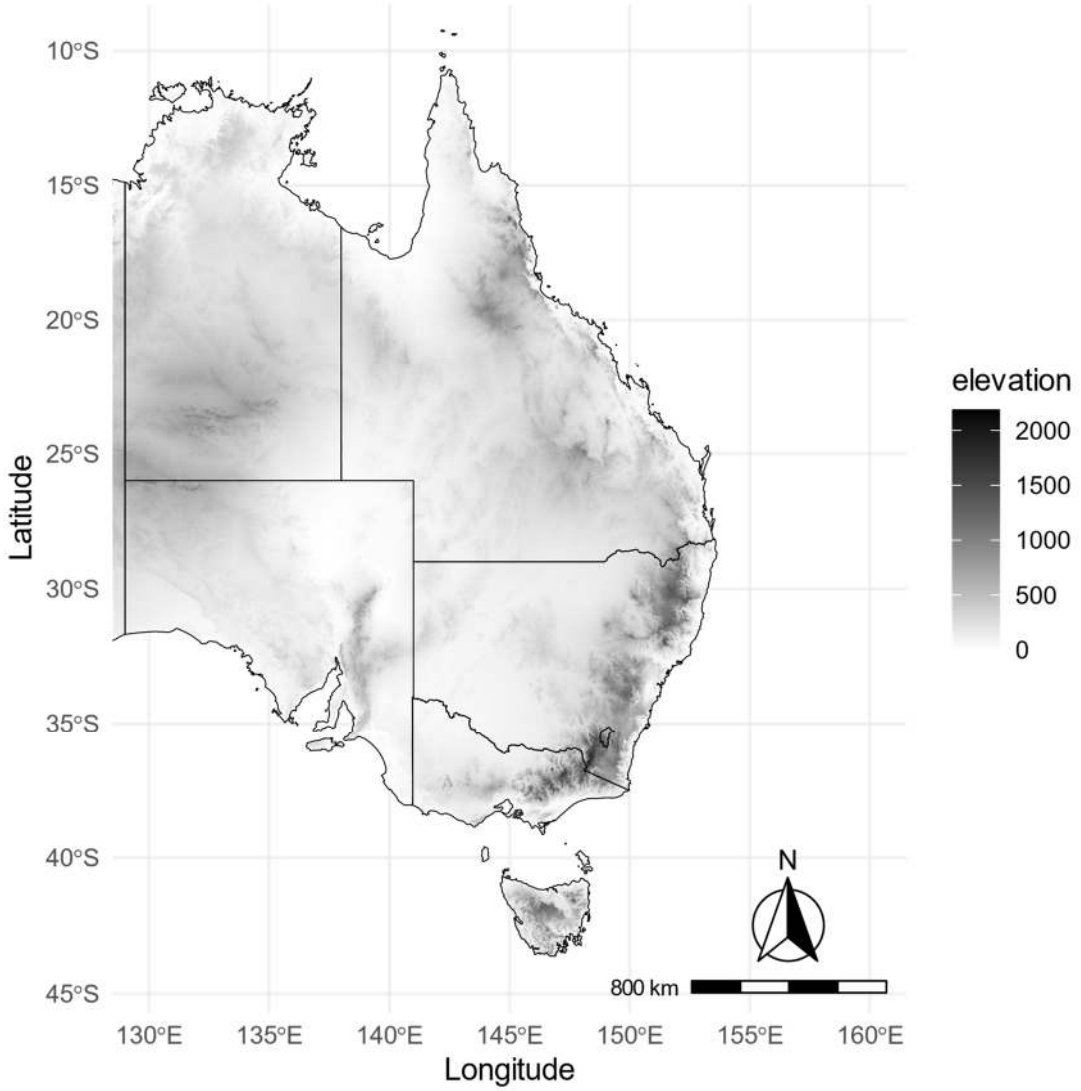
- Monotypic genus in Phaneropterinae

- Sexually dimorphic
  - Males resemble typical katydid
  - Females likened to large gumnut or wombat poo
    - Large and flightless

- Deimatic displays
  - Females perform colourful startle display when disturbed
  - Also secrete toxins to deter predators

iNaturalist: reiner

Why are they not-so mountainous as their name implies?



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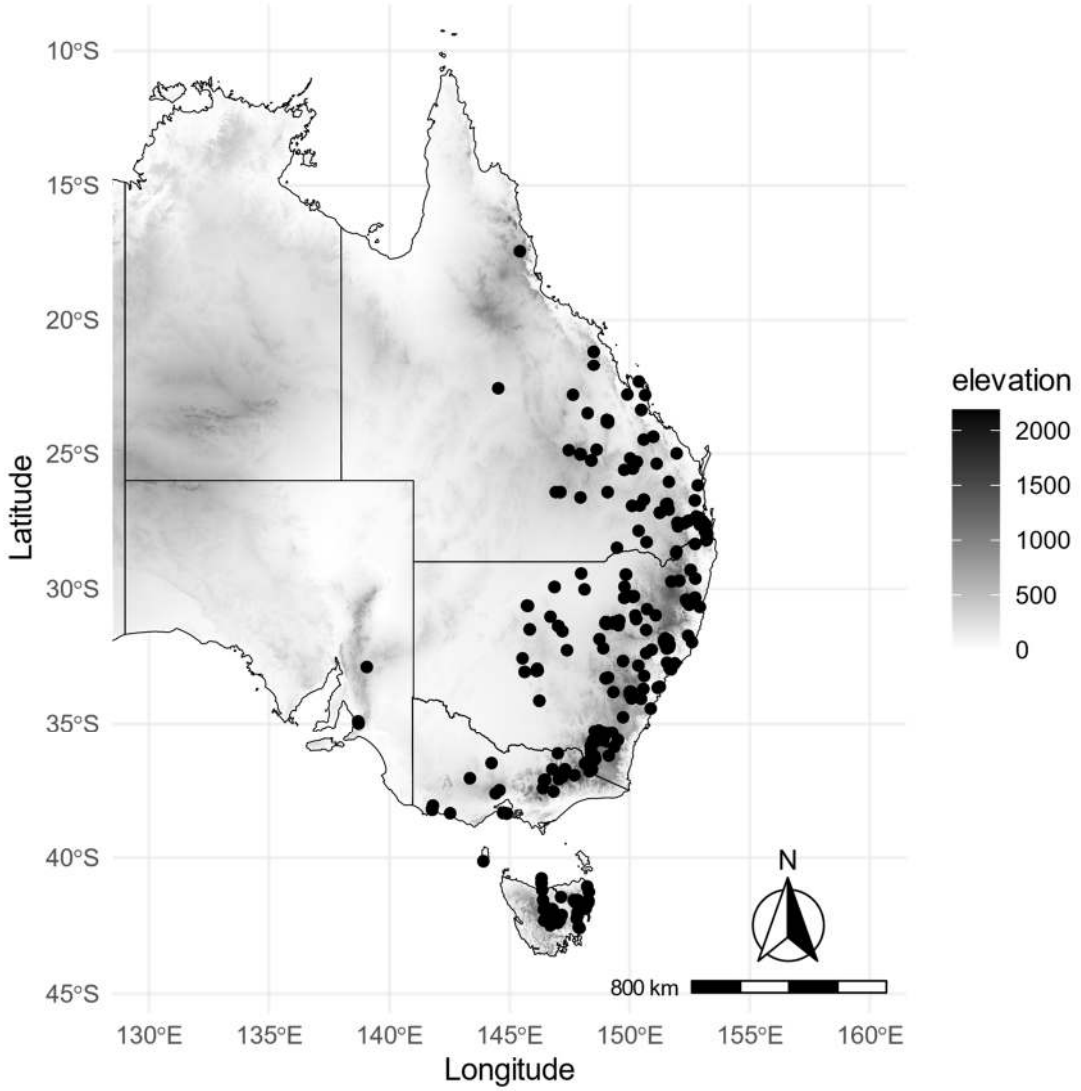
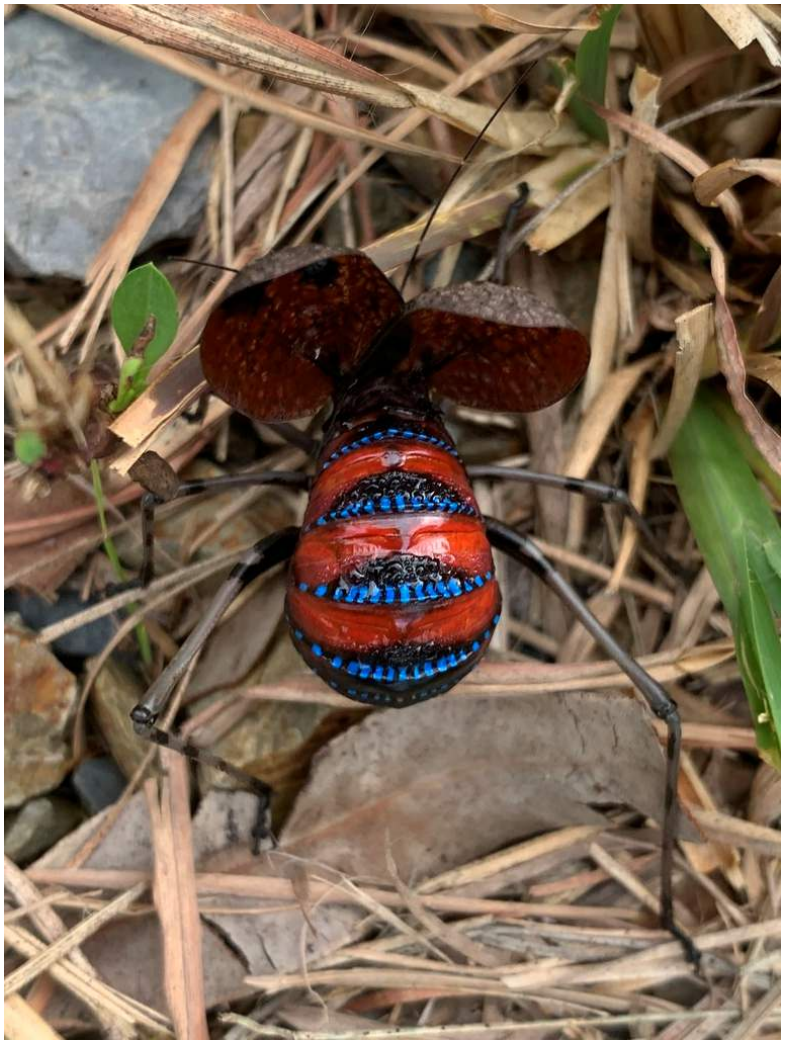


Australian biogeography and exploring *Acripeza* diversity

Bryant & Krosch 2016

Why study the population genomics of the Mountain Katydid?

- Enigmatic, large, well collected
  - Substantial material in collections
- Exudes sequestered toxic chemicals from plant secondary metabolites
- Broad distribution spanning all biogeographic barriers
- Noticeable morphological and acoustic variation
  - (Umbers personal observations)
- One species could represent a cryptic species complex!
- Of conservation concern
  - Females are flightless
  - Habitat could be lost in alpine regions

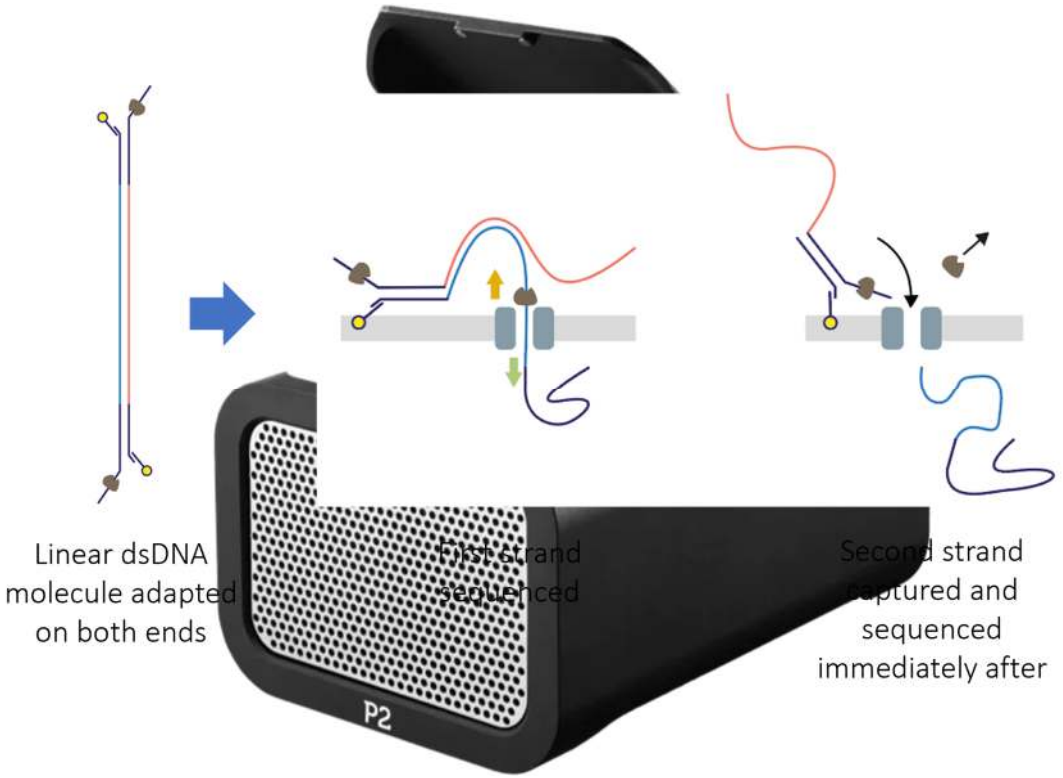


iNaturalist: kbenkendorff

Draft genome of *Acripeza*

- Orthopteran genomes notoriously large and tricky to assemble!

- Oxford Nanopore PromethION
  - Three flow cells
  - 230.24Gb sequenced
  - 56.86M reads
  - Read N50: 10Kb
- Dorado basecalling for duplex reads
- Filtered reads with FiltLong:
  --min_length 1000 --keep_percent 80
- Assembled with Flye
- Haplotigs purged with purge_haplotigs
- Cleaned with blobtoolkit

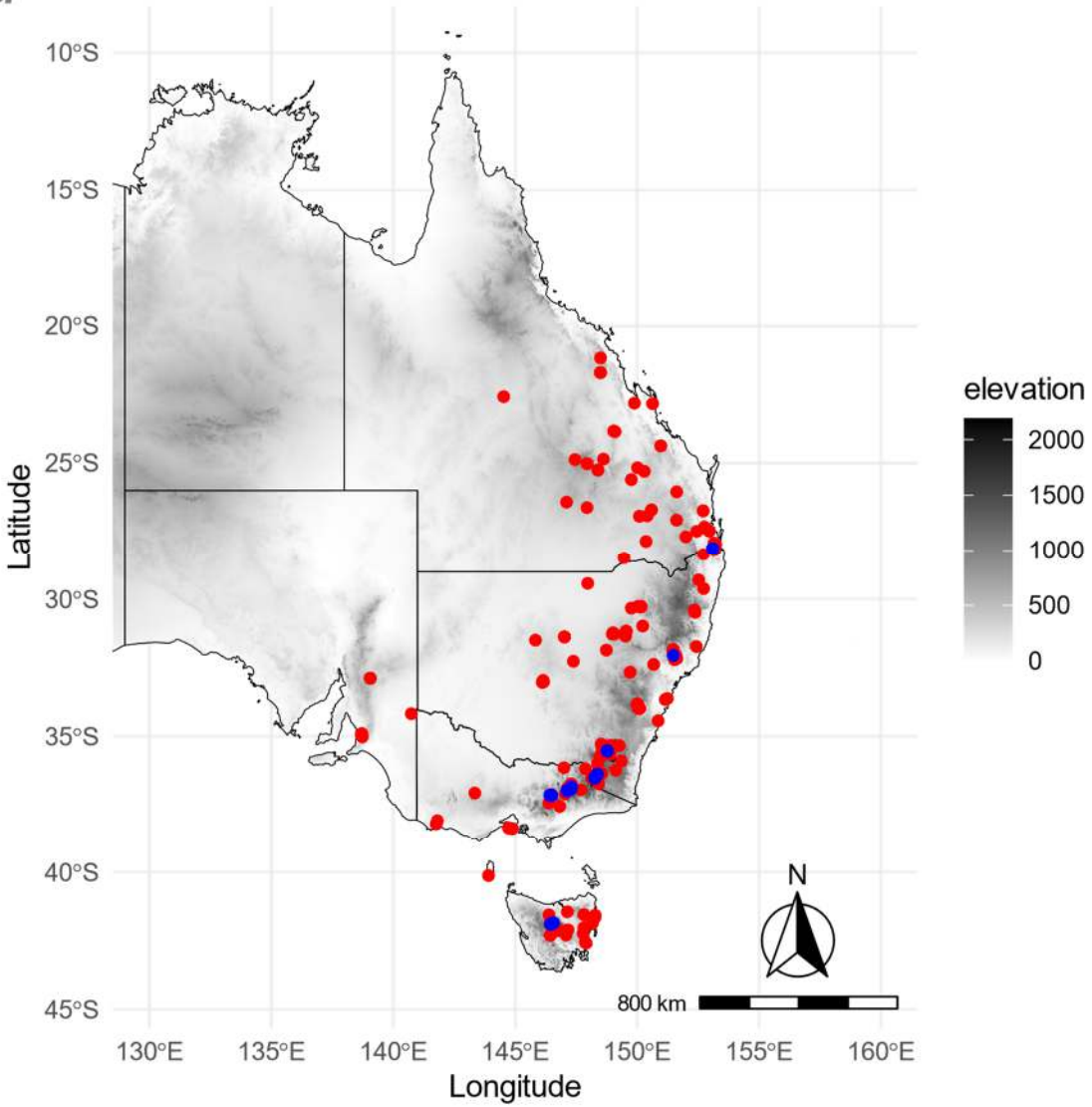


Draft genome of *Acripeza*

Summary Stats	N50 (Kbp)	L50 (K)	Largest conitg (Mbp)	Length (Gbp)
	431.9	1.8	8.984	3.153

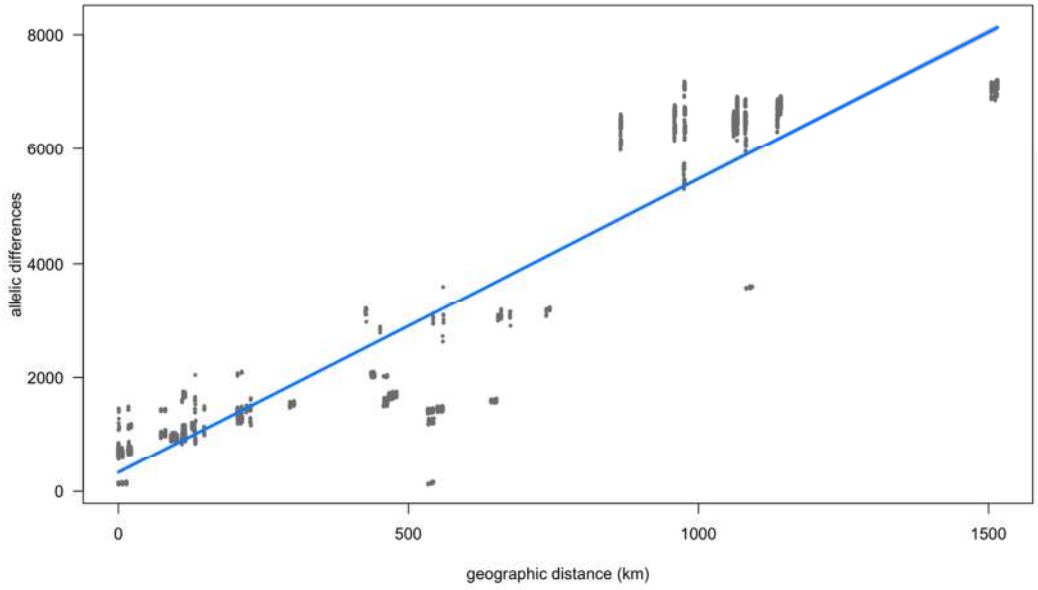
Population genomics of *Acripeza*

- Fresh material:
  - Field collected
  - 94 samples
  - 13 sites
- Museum material:
  - 239 samples
  - >35 sites (clustered)
  - DNA extracted with McCoy's Magic Buffer
- Diversity Arrays DArTseq 1.0 genotyping
  - SNPs filtered with Diversity Arrays and dartR2
  - Fresh SNPs: 7,393
  - Museum SNPs: 189
- Analyses:
  - Genetic diversity metrics
  - Population clustering (PCA/DAPC)
  - Phylogenetics
  - Spatial autocorrelation
  - STRUCTURE-like
    - snmf and tess3r

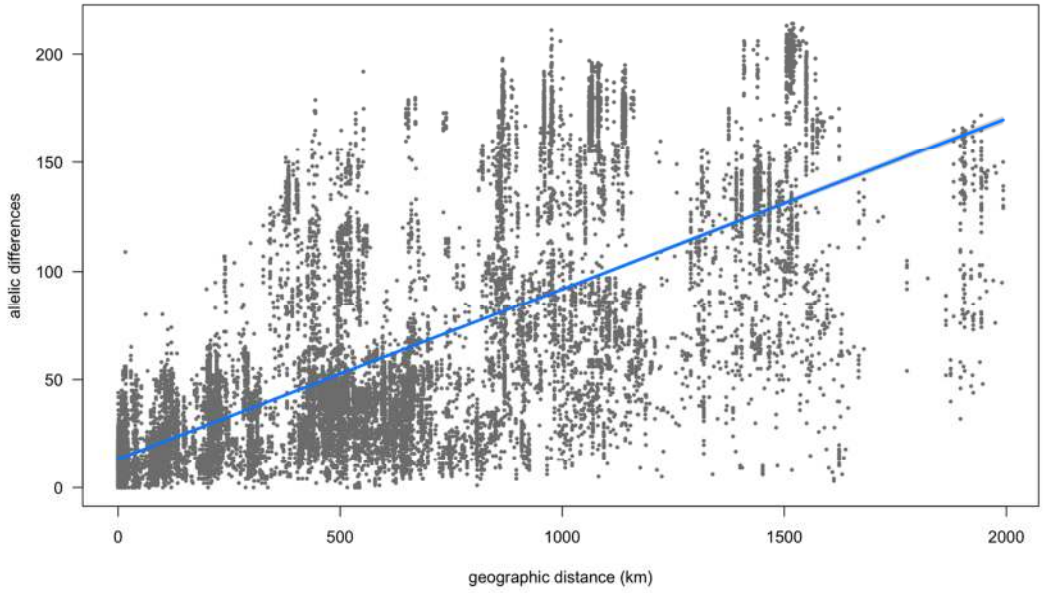


Genetic diversity is spatially autocorrelated

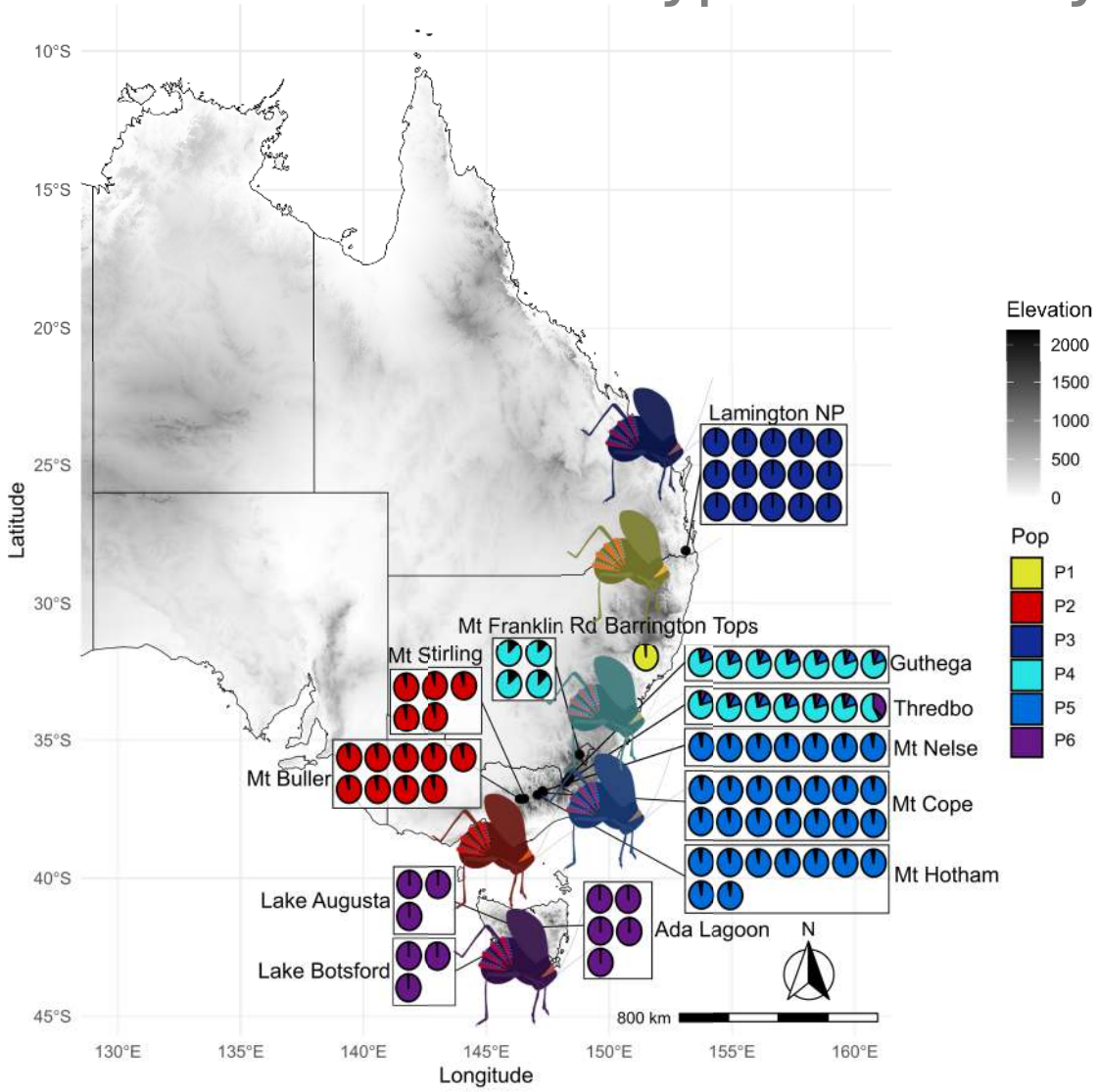
Fresh



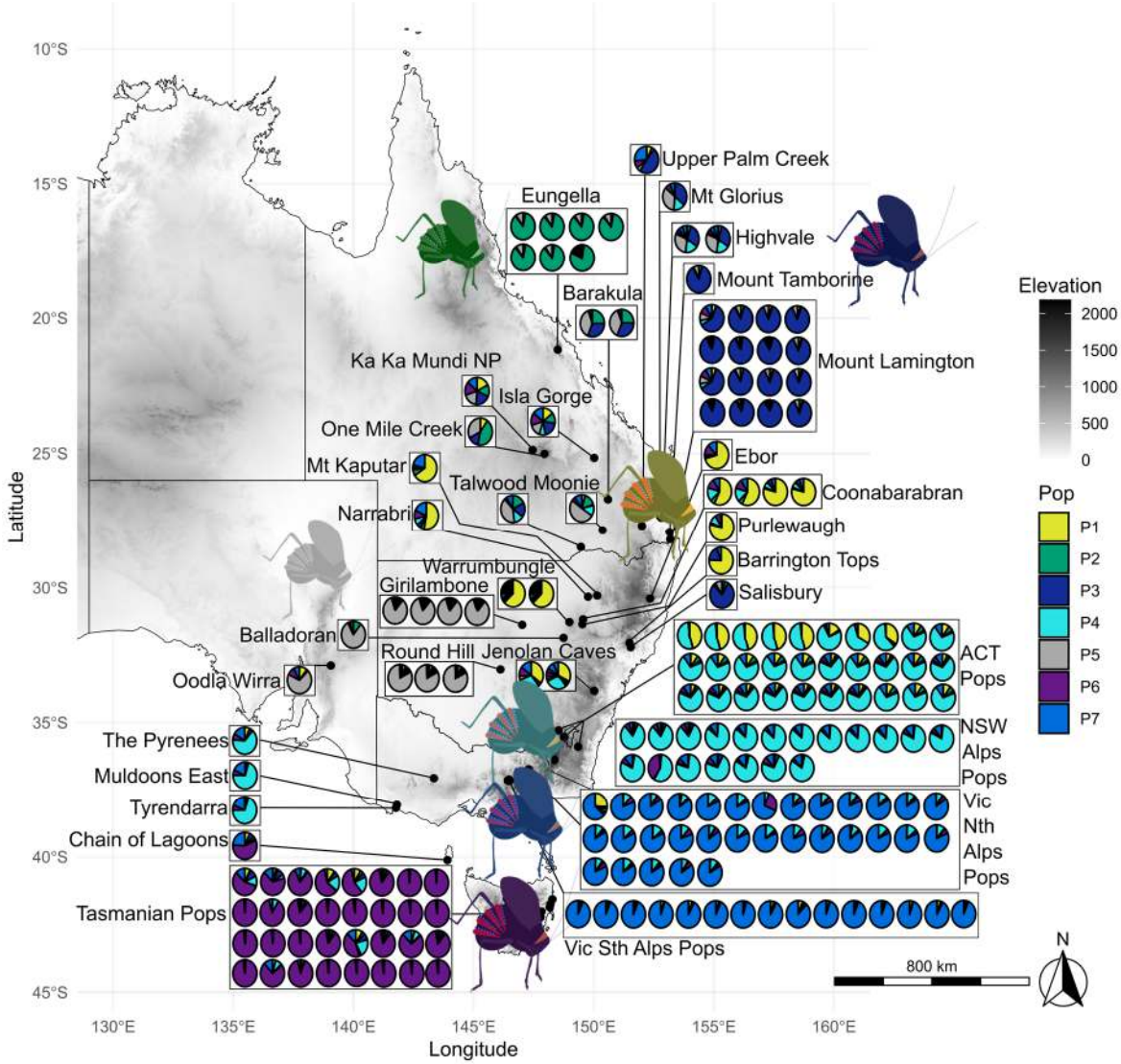
Museum



Fresh samples indicate extensive cryptic diversity

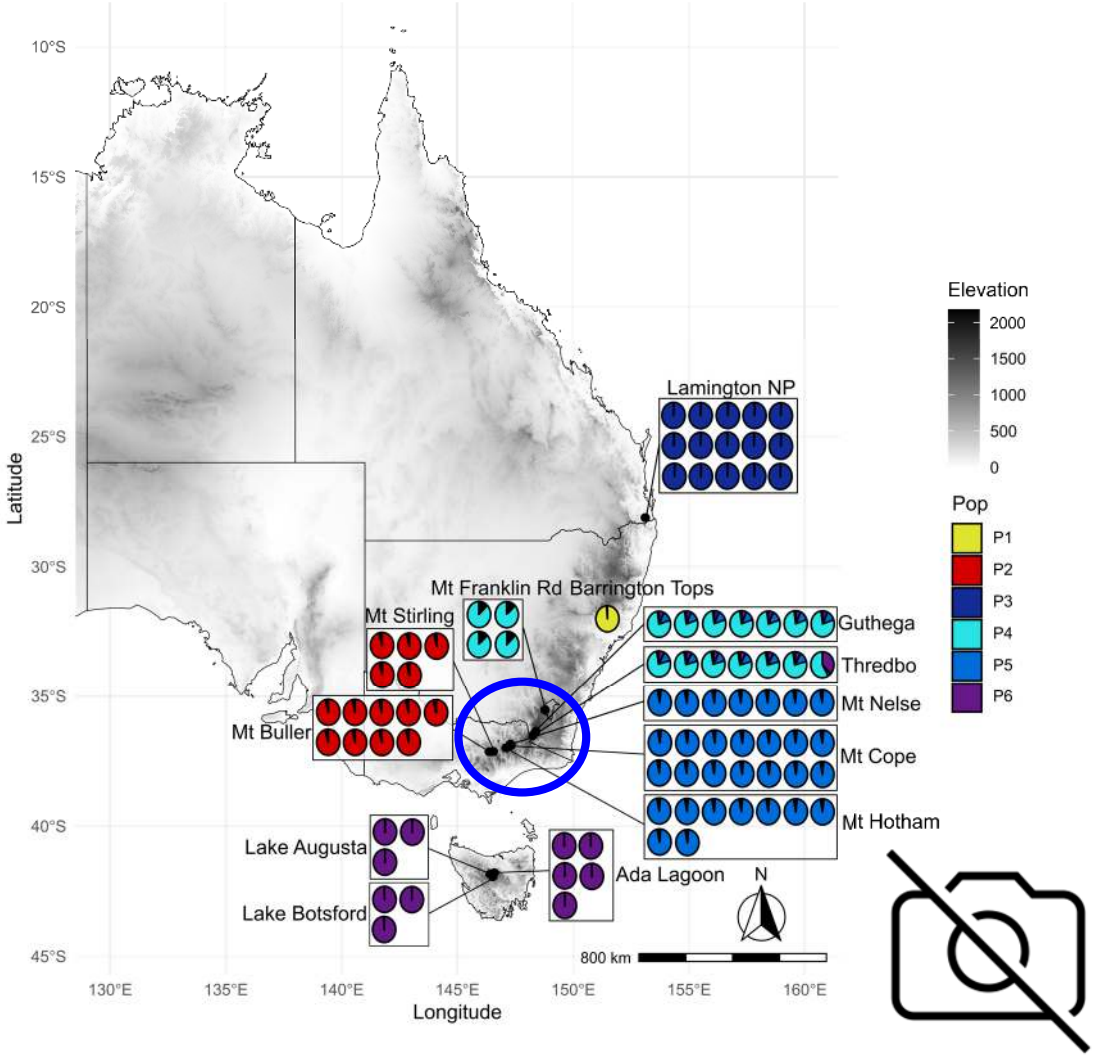


Museum samples identify biogeography drives genetic divergence



What does this mean for the future of *Acripeza reticulata*?

- Comparative genomics
  - Colouration and deimatic displays
  - Toxicity and chemical defence
- Substantial genetic diversity throughout the range of the species
  - Little gene flow between populations (fresh material)
- Potential cryptic speciation
  - Anywhere between 5 – 7 species of *Acripeza*
  - Taxonomic revision needed!!
- Substantial Alpine diversity
  - Potentially three species
  - Alpine regions home to many short range endemics
    - eg. 5 species of *Kosiuscola*
  - These new alpine species could be of significant conservation concern



The importance of collections for genomics research

- Increasing power of sequencing technologies
  - Throughput: ↑
  - Cost: ↓
  - **Input requirements: ↓**
- Collections are treasure-troves of biodiversity
  - Time machines into the past
  - Reduce the requirement to collect new material for research
- This study highlights:
  - The significance of well-curated and comprehensive collections
  - The applicability of collection material for high-throughput genomics
  - The utility of these approaches for any species

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