Linking thermal tolerance traits to distribution limits in Australian alpine grasshoppers

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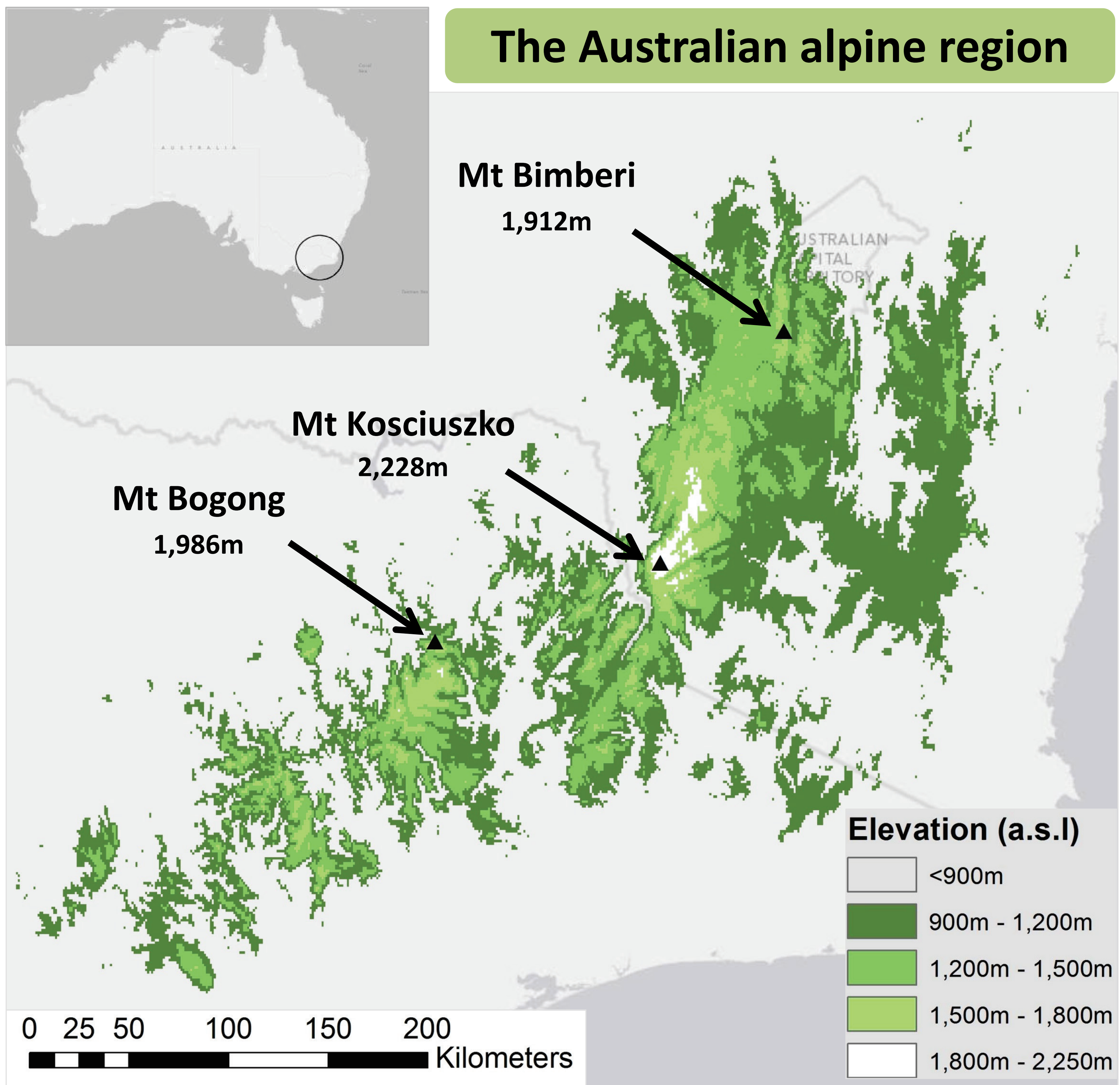
Background

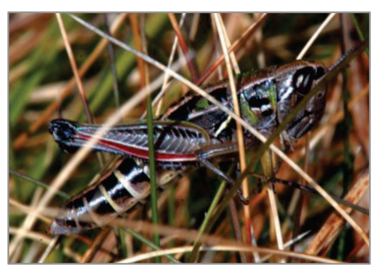
- Alpine ecosystems are highly threatened by climate warming. Alpine regions are warming more rapidly than low elevation areas[1] and stand to lose a disproportionate habitat area in the future[2]. Australia's alpine areas cover only 0.15% of the continent[3], and alpine species have little scope for upward distribution shifts.
- Understanding the factors limiting species distributions is necessary to predict their response to rising temperatures. Temperature decreases rapidly with elevation[4] and is thought to play an important role in delimiting species' ranges. Thermal adaptation is predicted to drive patterns of thermal tolerance that reflect experienced environmental conditions.
- Phenotypes able to cope with rising temperatures might already exist if there is local adaptation along environmental gradients[5].
- Four Australian alpine-endemic grasshopper species (*Kosciuscola* genus) occupy different altitudinal ranges. This study will examine inter- and intra-specific patterns of thermal tolerance in the *Kosciuscola*.

The Australian alpine region



The *Kosciuscola*

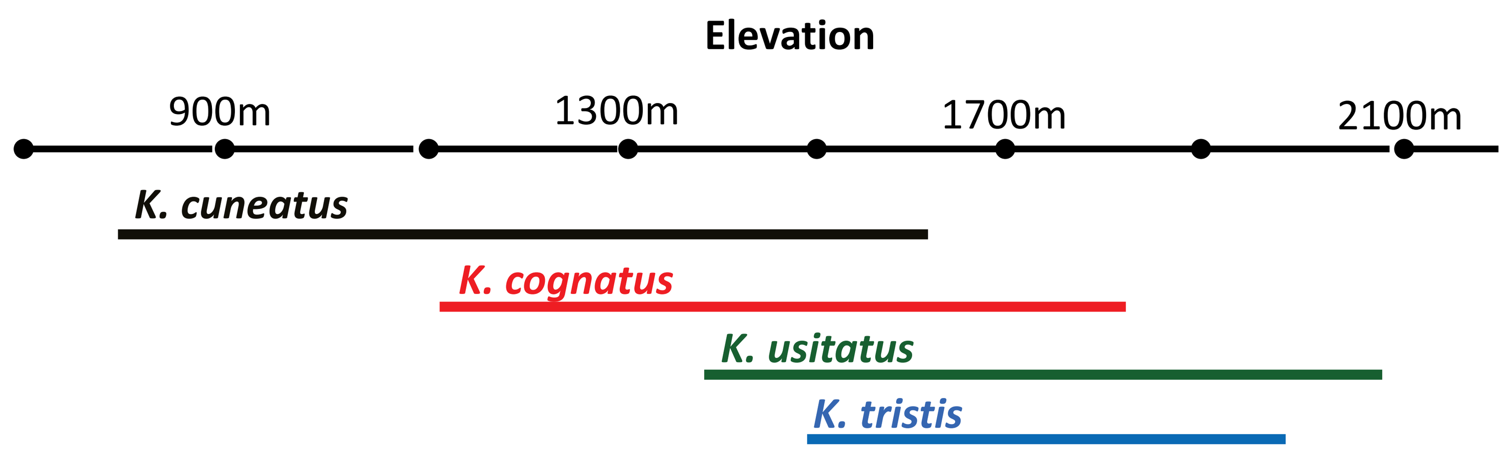
K. cuneatus



K. cognatus

K. usitatus

K. tristis



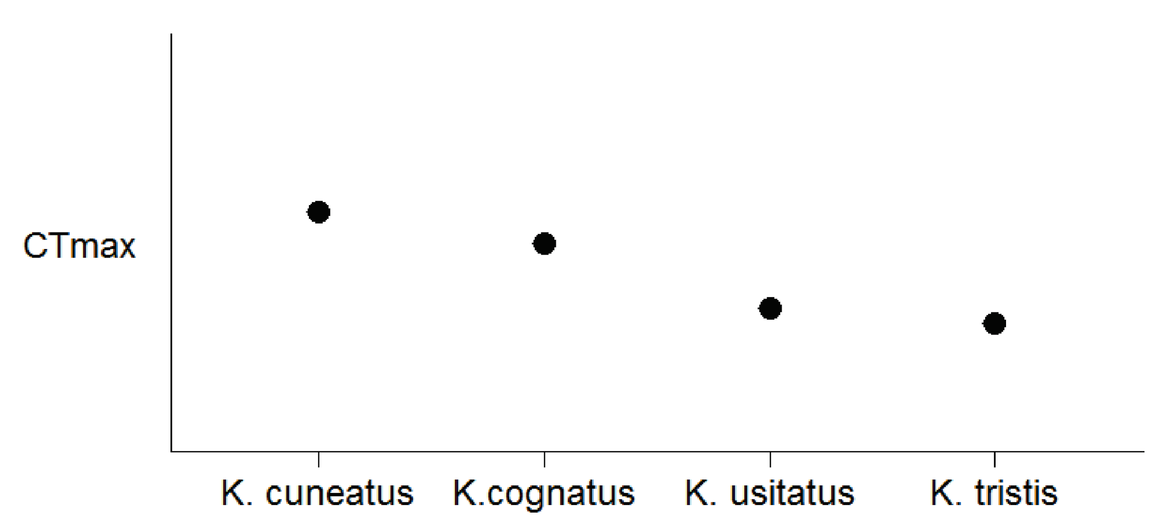
1. Inter-specific differences in thermal tolerance

Method

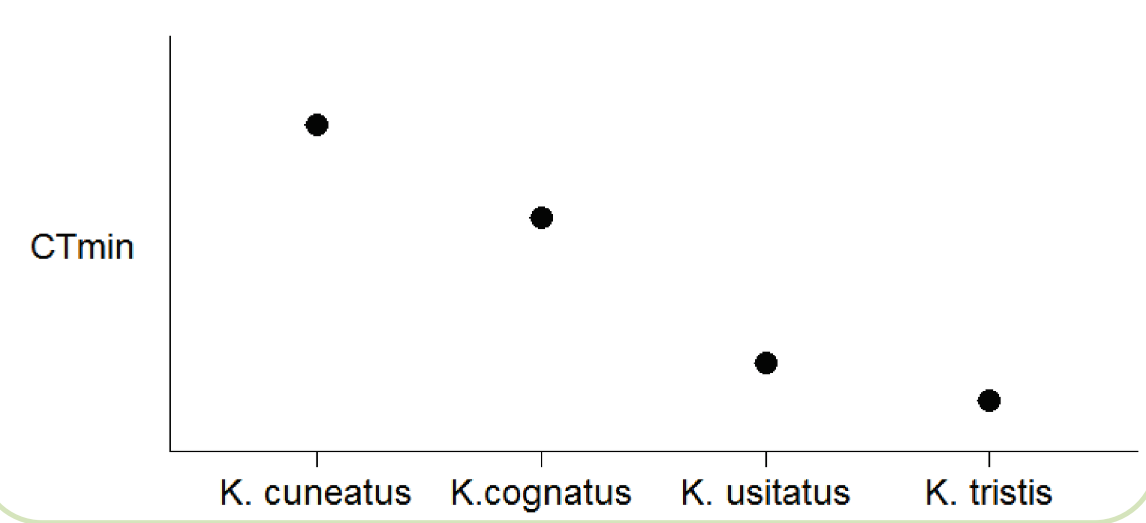
For each species, measure the temperatures where *activity* ceases by exposing individuals to temperatures that are first decreased, then increased at a constant rate.

Predictions

(a) Upper thermal limits



(b) Lower thermal limits



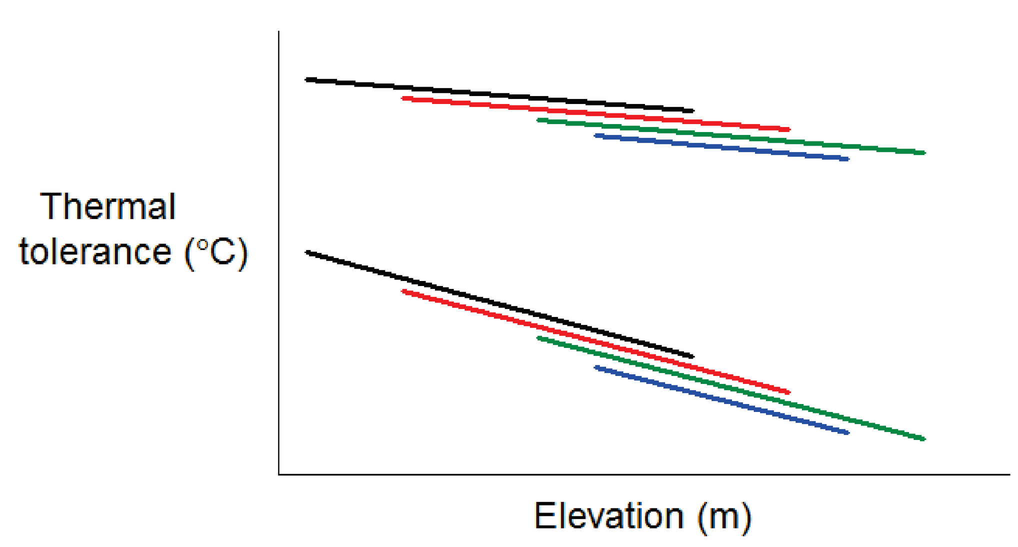
2. Local adaptation in thermal tolerance

Method

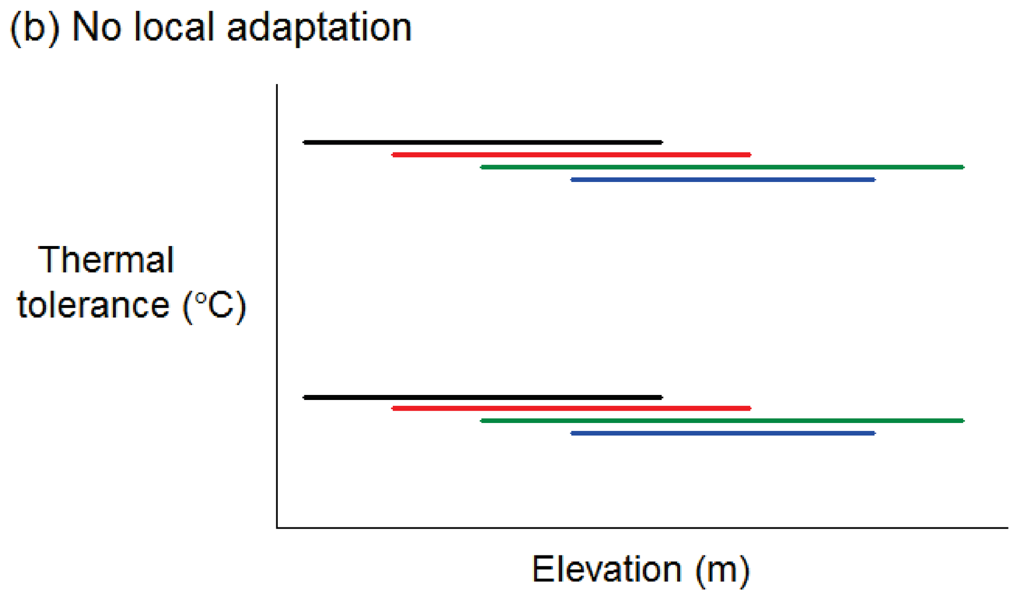
Measure upper and lower thermal limits for populations at the top, middle and lower edge of a species' range, with and without acclimation to a common environment.

Predictions

(a) Local adaptation



(b) No local adaptation



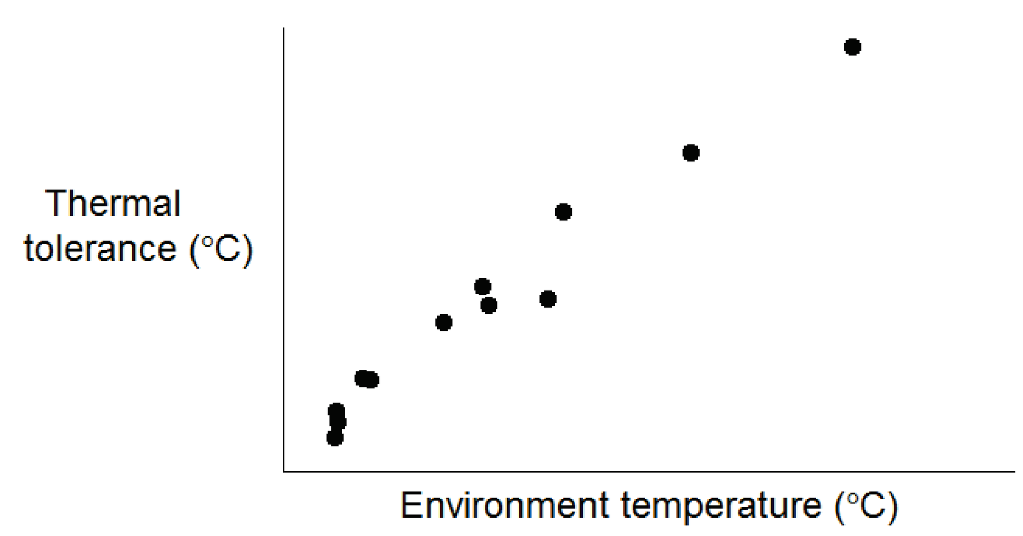
3. Linking thermal tolerance to distribution limits

Method

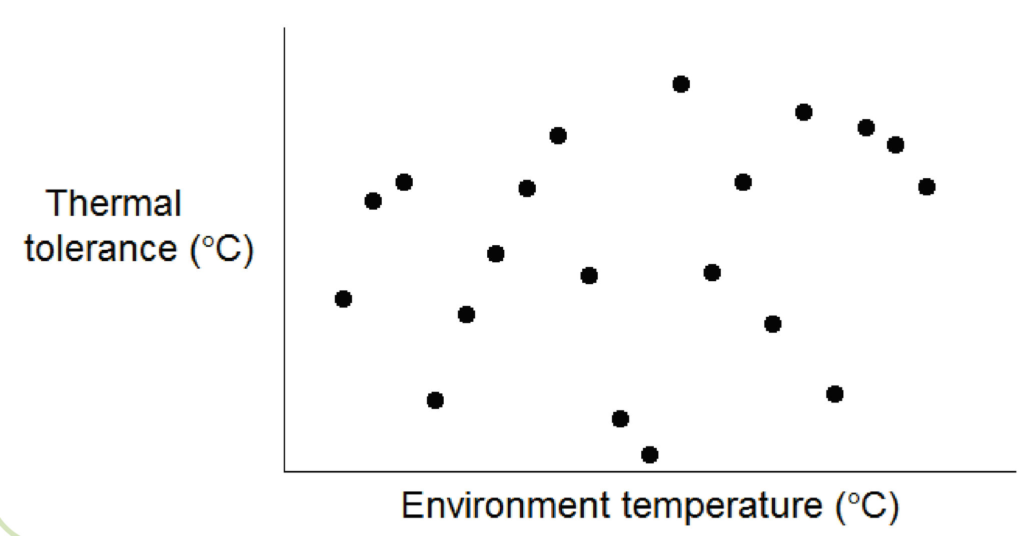
Measure near-ground temperature at range edges. Test for an association with thermal tolerance traits.

Predictions

(a) Thermal tolerance drives range limits



(b) Other factors drive range limits



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