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# High thermal tolerance in high elevation species and laboratory-reared colonies of tropical bumble bees

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## Abstract

1. Bumble bees are key pollinators with some species reared in captivity at a commercial scale, but with evidence of population declines and with alarming predictions under climate change scenarios. While studies on the thermal biology of temperate species are still limited, they are entirely absent from the tropics where the effects of climate change are expected to be greater. 2. Herein we test if tropical bumble bees' lower (CTMin) and upper (CTMax) critical thermal limits decrease with elevation and if the stable optimal conditions used in laboratory-reared colonies reduces their thermal tolerance. 3. We assessed changes in CTMin and CTMax of four species at two elevations (2600 and 3600 m) in the Colombian Andes and of laboratory-reared individuals of B. pauloensis. In addition, we examined the effect of body size and compiled information on bumble bees' thermal limits from the literature to assess potential predictors for broad-scale patterns of variation. 4. CTMin decreased with elevation while CTMax did not. CTMax was slightly higher (0.84 °C) in laboratory-reared than in wild-caught bees while CTMin was similar. CTMin decreased with increasing body size while CTMax did not. Latitude is a good predictor for variations in CTMin while annual mean temperature and extreme monthly temperatures are good predictors for both CTMin and CTMax. 5. The stronger response in CTMin with increasing elevation supports Brett's heat-invariant hypothesis. Tropical bumble bees appear to be about as heat tolerant as those from temperate areas, suggesting that other aspects of climate besides temperature (e.g., water balance) might be more determinant environmental factors for these species under global warming. Laboratory-reared colonies are adequate surrogates for addressing questions on thermal tolerance and global warming impacts.

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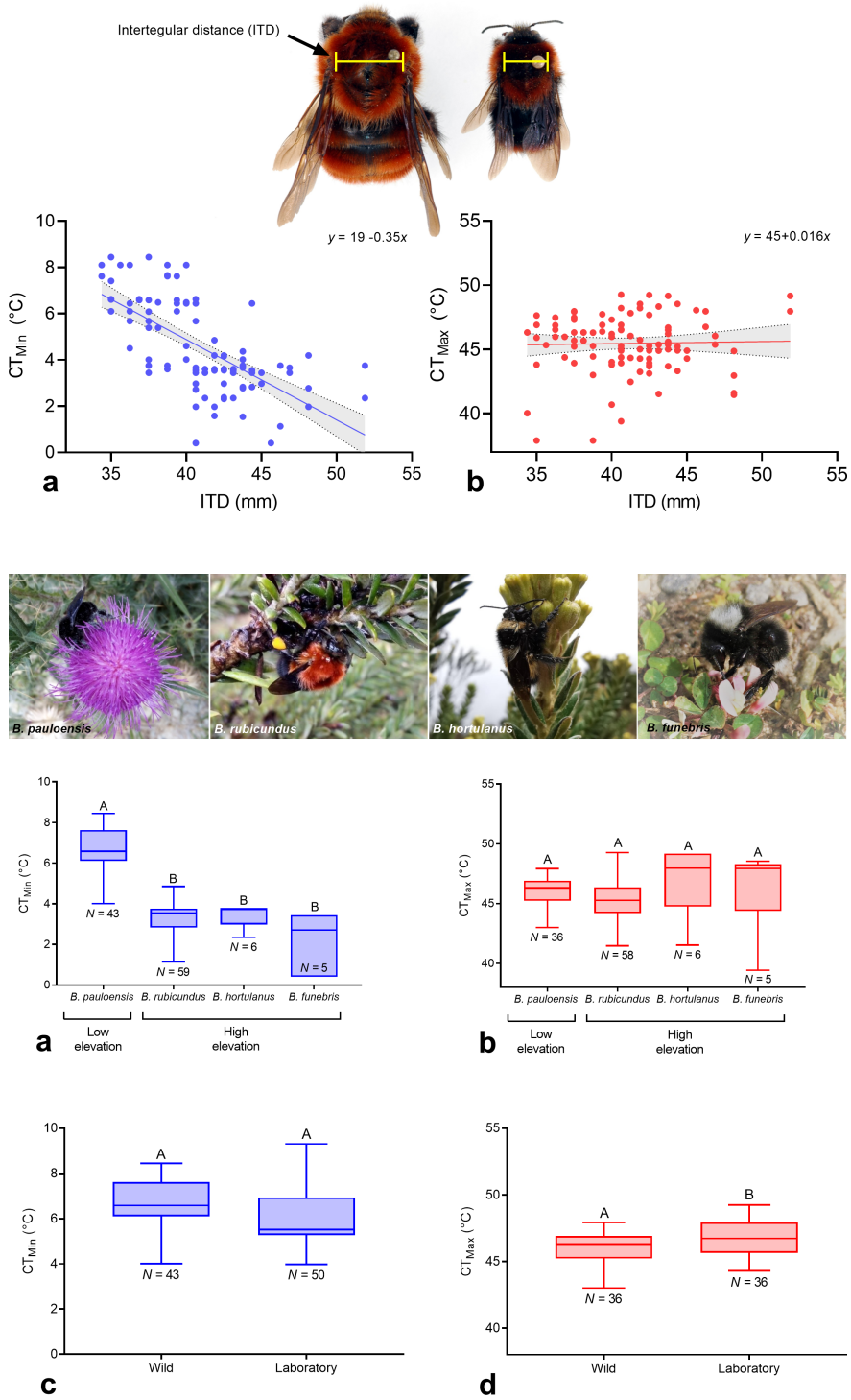

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