Thermal adaptation and temperature stress resistance in butterflies

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Understanding how organisms adapt to complex environments lies at the very heart of ecology and evolutionary biology. Against this background we have investigated thermal adaptation using altitudinal clines and environmental manipulations. I will demonstrate pronounced effects of developmental and adult temperature environments on cold and heat stress resistance, while effects of food stress were negligible. I will further demonstrate altitudinal variation in life-history and stress resistance traits, with high-altitude animals showing e.g. increased cold- but decreased heat-stress resistance, but little variation in the expression of stress-inducible heat-shock proteins in response to different ambient temperatures as opposed to low-altitude butterflies. Using allozyme markers, I will next show that high- and low-altitude populations are genetically differentiated to a remarkable degree, which is basically caused by variation at a single locus, PGI. Finally, I will demonstrate that PGI genotype significantly affects growth patterns and cold stress resistance. The PGI genotype dominating in high-altitude populations showed patterns consistent with those found in high-altitude animals. Thus, PGI is likely to contribute significantly to thermal adaptation in the butterfly species investigated.