Peer Community In
Evolutionary Biology

Is thermal plasticity itself shaped by natural selection? An assessment with desert frogs

Wolf Blanckenhorn

Department of Evolutionary Biology and Environmental Studies, University of Zurich -- Zurich, Switzerland
Correspondence to Wolf Blanckenhorn (wolf.blanckenhorn@uzh.ch)

Open Access

doi: 10.24072/pci.evolbiol.100048
Published: 19th Mar. 2018

Cite as: Blanckenhorn W. 2018. Is thermal plasticity itself shaped by natural selection? An assessment with desert frogs. Peer Community In Evolutionary Biology, 100048 doi: 10.24072/pci.evolbiol.100048

A recommendation – based on reviews by Dries Bonte and Nadia Aubin-Horth – of

Bacigalupe L, Gaitan-Espitia JD, Barria AM, Gonzalez-Mendez A, Ruiz-Aravena M, Mark Trinder M and Sinervo B. 2018. Natural selection on plasticity of thermal traits in a highly seasonal environment. bioRxiv 191825, ver. 5 peer-reviewed by Peer Community In Evolutionary Biology. doi: 10.1101/191825

It is well known that climatic factors – most notably temperature, season length, insolation and humidity – shape the thermal niche of organisms on earth through the action of natural selection. But how is this achieved precisely? Much of thermal tolerance is actually mediated by phenotypic plasticity (as opposed to genetic adaptation). A prominent expectation is that environments with greater (daily and/or annual) thermal variability select for greater plasticity, i.e. better acclimation capacity. Thus plasticity might be selected per se.

A Chilean group around Leonardo Bacigalupe assessed natural selection in the wild in one marginal (and extreme) population of the four-eyed frog Pleurodema thaul (Anura: Leptodactylidae) in an isolated oasis in the Atacama Desert, permitting estimation of mortality without much potential of confounding it with migration [1]. Several thermal traits were considered: CTmax – the critical maximal temperature; CTmin – the critical minimum temperature; Tpref – preferred temperature; Q10 – thermal sensitivity of metabolism; and body mass. Animals were captured in the wild and subsequently assessed for thermal traits in the laboratory at two acclimation temperatures (10° & 20°C), defining the plasticity in all traits as the difference between the traits at the two acclimation temperatures. Thereafter the animals were released again in their natural habitat

and their survival was monitored over the subsequent 1.5 years, covering two breeding seasons, to estimate viability selection in the wild. The authors found and conclude that, aside from larger body size increasing survival (an unsurprising result), plasticity does not seem to be systematically selected directly, while some of the individual traits show weak signs of selection.

Despite limited sample size (ca. 80 frogs) investigated in only one marginal but very seasonal population, this study is interesting because selection on plasticity in physiological thermal traits, as opposed to selection on the thermal traits themselves, is rarely investigated. The study thus also addressed the old but important question of whether plasticity (i.e. CTmax-CTmin) is a trait by itself or an epiphenomenon defined by the actual traits (CTmax and CTmin) [2-5]. Given negative results, the main question could not be ultimately solved here, so more similar studies should be performed.

References

[1] Bacigalupe LD, Gaitan-Espitia, JD, Barria AM, Gonzalez-Mendez A, Ruiz-Aravena M, Trinder M & Sinervo B. 2018. Natural selection on plasticity of thermal traits in a highly seasonal environment. bioRxiv 191825, ver. 5 peer-reviewed by Peer Community In Evolutionary Biology. doi: https://doi.org/10.1101/191825

[2] Scheiner SM. 1993. Genetics and evolution of phenotypic plasticity. Annual Review in Ecology and Systematics 24: 35–68. doi: https://doi.org/10.1146/annurev.es.24.110193.000343

[3] Scheiner SM. 1993. Plasticity as a selectable trait: Reply to Via. The American Naturalist. 142: 371–373. doi: https://www.journals.uchicago.edu/doi/10.1086/285544

[4] Via S. 1993. Adaptive phenotypic plasticity - Target or by-product of selection in a variable environment? The American Naturalist. 142: 352–365. doi: https://www.journals.uchicago.edu/doi/abs/10.1086/285542

[5] Via S. 1993. Regulatory genes and reaction norms. The American Naturalist. 142: 374–378. doi: https://www.journals.uchicago.edu/doi/abs/10.1086/285542

Appendix

Reviews by Dries Bonte and Nadia Aubin-Horth: https://doi.org/10.24072/pci.evolbiol.100048