PreSens
PRECISION SENSING

Scientific Paper:

Ecology (2020), 101(3), e02942

Do differences in developmental mode shape the potential for local adaptation?

L. L. Jupe[1], D. T. Bilton[1,2], and A. M. Knights[1]
[1]Marine Biology and Ecology Research Centre, School of Biological and Marine Sciences, University of Plymouth, Plymouth, UK
[2]Department of Zoology, University of Johannesburg, Johannesburg, Republic of South Africa

Abstract:

Future climate change is leading to the redistribution of life on Earth as species struggle to cope with rising temperatures. Local adaptation allows species to become locally optimized and persist despite environmental selection, but the extent to which this occurs in nature may be limited by dispersal and gene flow. Congeneric marine gastropod species (*Littorina littorea* and *L. saxatilis*) with markedly different developmental modes were collected from across a latitudinal thermal gradient to explore the prevalence of local adaptation to temperature. The acute response of metabolic rate (using oxygen consumption as a proxy) to upramping and down-ramping temperature regimes between 6 °C and 36 °C was quantified for five populations of each species. The highly dispersive *L. littorea* exhibited minimal evidence of local adaptation to the thermal gradient, with no change in thermal optimum (T_{opt}) or thermal breadth (T_{br}) and a decline in maximal performance ($_{max}$) with increasing latitude. In contrast, the direct developing *L. saxatilis* displayed evidence of local optimization, although these varied idiosyncratically with latitude, suggesting a suite of selective pressures may be involved in shaping thermal physiology in this relatively sedentary species. Our results show that the biogeography of thermal traits can differ significantly between related species, and show that interpopulation differences in thermal performance do not necessarily follow simple patterns that may be predicted based on latitudinal changes in environmental temperatures. Further research is clearly required to understand the mechanisms that can lead to the emergence of local adaptation in marine systems better and allow improved predictions of species redistribution in response to climate change.

Keywords: adaptive differentiation, climate change, divergent natural selection, gene flow, marine invertebrate, metabolic rate, species distribution, thermal tolerance