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Evolutionary constraints on physiology confound range shift predictions of two nacellid limpets

Simon A. Morley[1], Jorge M. Navarro[2,3], Alejandro Ortíz[2,3], Camille Détrée[2,3], Laura Gerrish[1], Caludio González-Wevar[2,3], Amanda E. Bates[4]
[1]British Antarctic Survey, Natural Environment Research Council, Cambridge, UK
[2]Instituto de Ciencias Marinas y Limnológicas, Facultad de Ciencias, Universidad Austral de Chile, Valdivia, Chile
[3]Centro FONDAP de Investigación de Ecosistemas Marinos de Altas Latitudes (IDEAL), Valdivia, Chile
[4]Department of Ocean Sciences, Memorial University of Newfoundland, St John´s A1C 5S7, Canada

Abstract:

Physiological comparisons are fundamental to quantitative assessments of the capacity of species to persist within their current distribution and to predict their rates of redistribution in response to climate change. Yet, the degree to which physiological traits are conserved through evolutionary history may fundamentally constrain the capacity for species to adapt and shift their geographic range. Taxa that straddlemajor climate transitions provide the opportunity to test the mechanisms underlying evolutionary constraints and how such constraints may influence range shift predictions. Herewe focus on two abundant and shallow water nacellid limpets which have representative species on either side of the Polar front. We test the thermal thresholds of the Southern Patagonian limpet, Nacella deaurata and show that its optimal temperatures for growth (4 °C), activity (-1.2 to -0.2 °C) and survival (1 to 8 °C) are mismatched to its currently experienced annual sea surface temperature range (5.9 to 10 °C). Comparisons with the congeneric Antarctic limpet, N. concinna, reveal an evolutionary constraint on N. deaurata physiology, with overlapping thermal capacities, suggesting that a cold climate legacy has been maintained through the evolution of these species. These physiological assessments predict that the South American range of N. deaurata will likely decline with continued warming. It is, however, one of the first species with demonstrated physiological capacity to successfully colonize the cold Southern Ocean.With the expected increase in opportunities for transportwithin high southern latitudes, N. deaurata has the potential to establish and drive ecological change within the shallow Southern Ocean.

Keywords: evolutionary constraint, niche conservation, cold climate legacy, macrophysiology, climate transitions, redistribution