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Evaluating the effects of ocean warming and freshening on the physiological energetics and transcriptomic response of Antarctic limpet *Nacella concinna*

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Abstract:

In the Southern Ocean, warming and freshening are expected to be prominent signals of climate change and the reduced ability of Antarctic marine organisms to cope with changing environmental conditions could challenge their future survival. The Antarctic limpet *Nacella concinna* is a macroinvertebrate of rocky ecosystems, which occurs in high densities in the shallow subtidal zone. Subtidal individuals were exposed to a combination of temperatures (1, 4, 8, 11, 14 °C) and salinities (20 and 30 psu) for a 60-day period. A drastic increment in mortality was observed with seawater warming, showing that *N. concinna* is highly stenothermal, with limited ability to survive at temperatures warmer than 4 °C, although there was some degree of acclimation at 4 °C and ambient salinity (30 psu). This study confirmed the stenohaline characteristic of this species, with mortality reaching 50% and lower scope for growth at low salinity (20 psu) even at the control temperature (1 °C). At the sub-cellular level, limpets' low tolerance to out-of range salinity is illustrated by the activation of cell remodelling processes whereas the down-regulation of chaperones proteins and plasma membrane ATPase suggest that under the combination of warming and freshening *N. concinna* experiences a severe level of stress and devote much of its energy to somatic maintenance and survival. The drastic effect observed can be explained by its subtidal origin, an environment with more stable conditions. The surviving individuals at 1 °C and lowered salinity (20 psu) were either more tolerant or showing signs of acclimation after 60 days, but the combination of warming and freshening have a greater combined stress. Projections of climate change for end of the century for this part of the Antarctic can, therefore, result in a significant diminution of the subtidal population of *N. concinna*, affecting ecological interactions and diversity of the food web.

Keywords: warming, freshening, acclimation, physiology, gene expression, *Nacella concinna*