Project: AFI 2/34

LATITUDINAL CLINES IN PHYSIOLOGICAL CAPACITIES AND UPPER LETHAL TEMPERATURE LIMITS IN ANTARCTIC MARINE INVERTEBRATES

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Location: Rothera station

Rationale:

Antarctic marine invertebrates live at one end of the temperature continuum for life in the worlds' oceans. The Southern Ocean is generally characterised by low but stable temperatures and many species have correspondingly narrow temperature ranges for survival, typically -2° to 5°C, they are stenothermal. This stenothermality makes animals more vulnerable to even modest environmental warming and the Southern Ocean may be the first to see large losses of species in response to environmental change. However, even within the Southern Ocean lower latitudes experience a larger annual temperature range than higher latitudes. Sea temperatures at South Georgia can reach 4°C during the summer and populations from this latitude (54°S) may have increased flexibility of response to temperature to cope with this. Comparisons of physiological flexibility to elevated temperature in populations from across a latitudinal cline will be used to evaluate the vulnerability of species to environmental warming. Both short term and long term acclimations will be used to assess rates of adaptation and vulnerability.

Logistics:

This season relied very heavily on the support of the wintering dive team at Rothera to collect specimens. The marine assistant also maintained the acclimated animals during the winter.

Highlights:

Limpets (*Nacella concinna*):

Limpets from South Georgia, Signy and Rothera were acclimated for 3 months at 3°C by the Rothera Marine Assistant, Paul Mann. There was no apparent physiological adaptation of limpets to 3°C, acclimated animals experienced high mortality and had reduced ability to cope with elevated temperature.

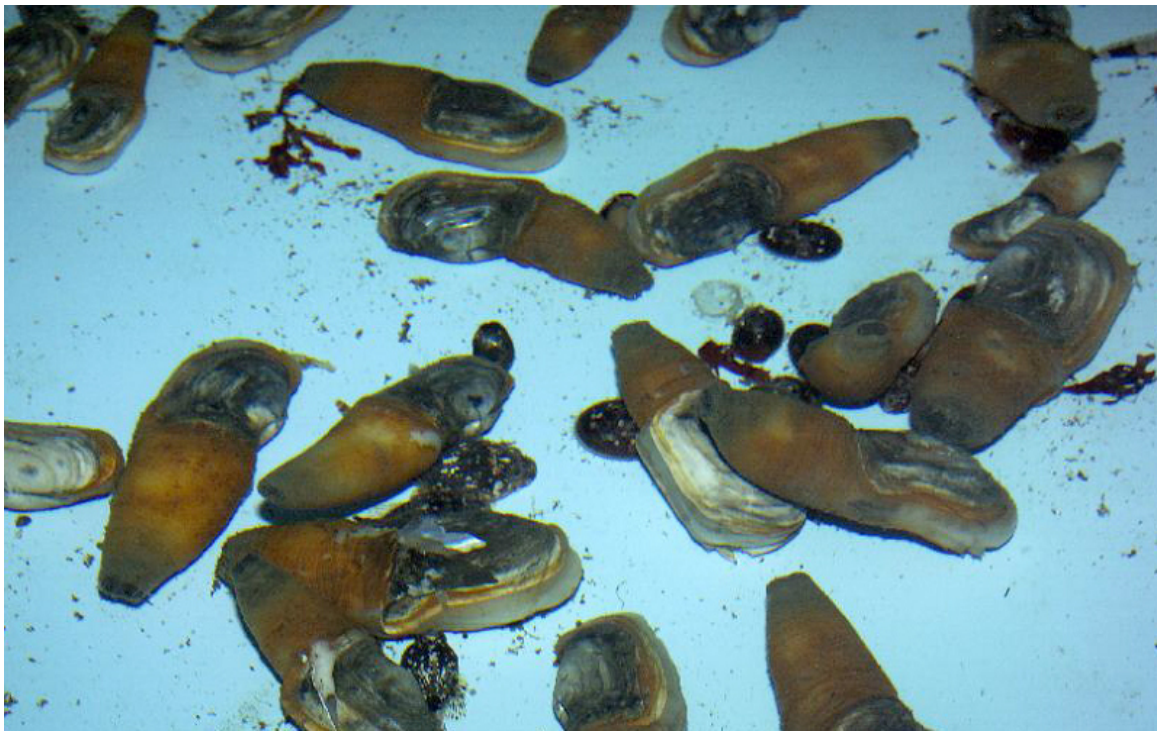
During summer months limpets move from the sub-littoral (shallow sea) to the littoral zone (the inter-tidal) at Rothera. Comparisons of the metabolic flexibility of limpets soon after the inter-tidal zone became available (one week after the sea ice broke out) with those that had potentially colonised the inter-tidal for six weeks (late summer) were used to investigate limpet's acclamatory ability. Small physiological differences between littoral and sub-littoral limpets may indicate a degree of separation of limpet populations.

Clams (*Laternula elliptica*):

Clams collected during summer 2004/5 from Signy and Rothera were unable to survive at 3°C. A further group of Rothera animals were collected by the wintering dive team and these survived at 3°C, although the mortality rate was high. The acclimated Rothera clams showed the same response to elevated temperature as non-acclimated clams, indicating a lack of physiological flexibility.

The stenothermal nature of clams and their inability to acclimate to temperature suggests that they follow an alternate low energy life style. The energetics of clams was further investigated to produce an annual energy budget which will help us understand the physiology of stenothermality and explain the importance of winter dormancy.

Clams (*Laternula elliptica*) Image from the BAS image collection



Limpets (*Nacella concinna*) Image from the BAS image collection