

## **Gastropod embryos tolerate thermal stress...or not**

Briana Seapy, Tufts University

Zippay ML, Hofmann GE. 2010. Physiological tolerances across latitudes: Thermal sensitivity of larval marine snails (*Nucella* spp.). *Mar. Biol.* 157: 707-714.

Intertidal organisms are arguably the most environmentally stressed subset of marine species. Their odd-choice of habit subjects them to an array of weather-related extremes. Given recent research that predicts a gradual increase in oceanic and atmospheric temperatures, forthcoming climate changes may further test the upper limits of tolerance of these intertidal species to increasing environmental stress. Because intertidal organisms are already living on the edge, they will likely be the first indicators of climate-change marine hardship and are therefore crucial study subjects. Past intertidal research has focused primarily on adult stages and stressors such as waves, and desiccation, however the study of *larval* stages and *thermal* exposure has been largely overlooked. Historically, larval stages exhibit greater vulnerability to extremes than their adult counterparts and larval survivorship dictates locations of adult populations, therefore it is imperative to study the upper limits of thermal-tolerance of larval populations in order to predict future species distribution and identify intensifying environmental threats to entire intertidal populations.

Researchers Mackenzie Zippay and Gretchen Hoffman (2010) tested the thermal tolerance of embryos of the intertidal marine gastropod, *Nucella ostrina* (dogwhelk), at 7 West Coast field sites (U.S.) in order to determine the physiological response to thermal environmental stress as a function of geographic location. To ascertain the relationship between thermal tolerance and latitudinal distribution, researchers collected egg capsules from 7 mid-to-high intertidal zones in July 2006 along the Pacific West coast and across 13 degrees of latitude. Egg capsules were stored in seawater tanks at temperatures corresponding to their source waters (10-19 °C); the embryos then faced 1 hour of experimental exposure in a scintillation vial to an array of temperatures ranging from 13 to 34.5 (lethal) °C. Three trials of 5-8 egg capsules, each containing 5-22 advanced veliger larva, were exposed to each experimental temperature; this process was repeated for every latitude. Researchers quantified tolerance by finding the LT50 of each collection site, or the temperature at which 50% of the

embryos died due to heat exposure. The embryos were considered dead if they did not show ciliary movement upon egg-capsule dissection after the 1-hour exposure period.

Dogwhelk embryos from lower latitudes tolerated heat stress better than their counterparts from higher latitudes. Specifically, the LT50 for the highest latitude was 30.1 °C where as the LT50 for the lowest latitude was 33.9°C. The collection sites in-between the highest and lowest latitudes further supported the idea that dogwhelks from higher latitudes have higher thermal sensitivity; the range of collection sites demonstrated a strong linear trend whereby the LT50 temperature decreased as latitude increased (figure 3). The apparent relationship between differential levels of thermal tolerance of *Nucella ostrina* and their latitudinal location suggests that physiological responses to environmental stresses may be a function of biogeographical location.

Although Zippay and Hoffman identified a strong trend in thermal-tolerance as it relates to geographical location, they employed ecologically irrelevant temperatures in their experiments rendering them immaterial at least for the immediate future. In general, the larvae espoused a surprising tolerance to heat instead of an anticipated vulnerability. Originating in water temperatures of 10-19 °C, all embryonic populations withstood water temperatures up to 30°C before experiencing substantial mortality. Air temperature can feasibly reach the high temperatures used in the study, but water temperature will not see such extremes in the near future. In light of this, future researchers should focus their attention on realistic embryonic exposure; they should couple heat stress and desiccation stress to get a better idea of the compounded threat to larvae survivorship. Also, the researchers investigated the responses to single exposures of only 1 hr. It would be very interesting to consider the effects of multiple exposures of varied durations on embryonic mortality.

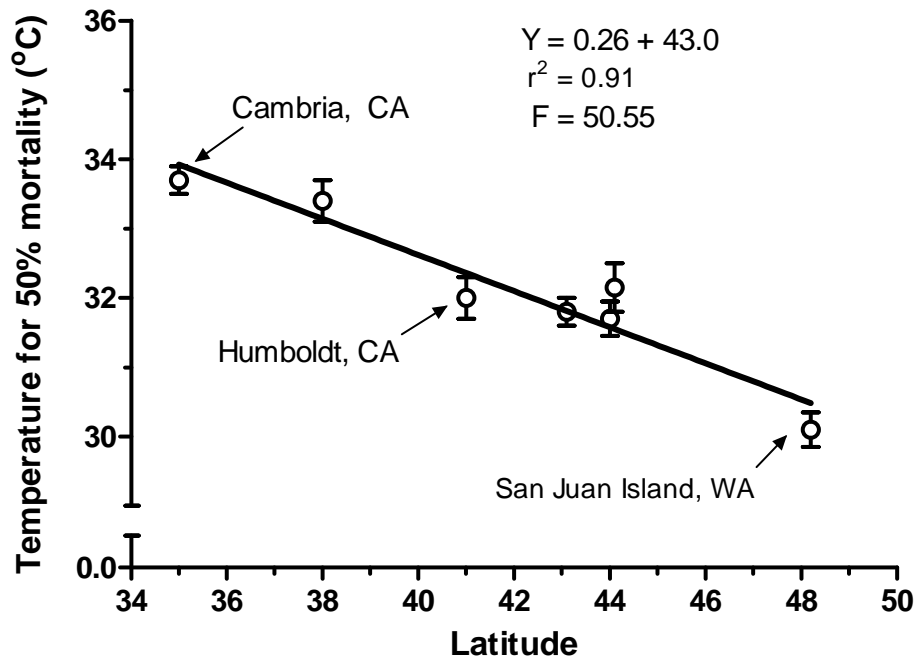


Figure 3. Tolerance to elevated temperatures for embryos of the intertidal gastropod *Nucella ostrina* collected from 7 locations along the west coast of the U.S. Embryos were exposed to elevated temperatures for 1 hr, and mortality was determined 24 h later. Error bars show the 95% confidence interval about the mean. (Modified from Zippay and Hofmann, 2010)