Special Report

OXYGEN UPTAKE IN TRANS-ISTHMIAN AND LATITUDINALLY DISTANT POPULATIONS OF FOUR COGNATE PAIRS OF BRACHYURA EXPOSED TO CYCLIC VARIATION IN TEMPERATURE

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The emergence of the Isthmus of Panama subdivided the amphi-American biota and thereby set the stage for allopatric speciation. In the present study, Pacific and Atlantic populations of 4 cognate pairs of crabs were used to discern whether exposure to different thermal regimes in habitats, in the putative absence of gene flow, has resulted in physiological divergence. Populations that are potentially subject to the influence of gene flow were also used; these were populations of the Atlantic Panama cognate that occur in Belize and Florida. Decreases in water temperature occur periodically in Pacific Panama and Florida but not in Atlantic Panama or Belize.

Populations were laboratory acclimated to control temperature for two weeks. Crabs were then subjected to acute temperature changes consisting of four 24 h periods of control or experimental temperature at constant salinity (1080 $\pm$ 1.64 mOs/kg H_2O). Thus, crabs acclimated to control conditions were subjected to decreased or increased temperature for 24 h, returned to control temperature for 24 h, again subjected to decreased or increased temperature for 24 h, and returned to control temperature for 24 h. Control temperatures were 28 C for Panama and Belize and 21 C for Florida crabs. Experimentally decreased temperatures (21 C, Panama and Belize; 14 C, Florida) were 7 C lower than the respective control temperature. Experimentally increased temperatures (35 C, Panama and Belize; 28 C, Florida) were 7 C higher than the respective control temperature. Measurements of oxygen concentration (mg $O_2 \cdot l^{-1}$) in the seawater surrounding each crab (n=6) were made at the beginning and end of the 1st hour and at the beginning and end of the 24th hour of each 24 h cycle of temperature manipulation. Oxygen concentrations were measured by inserting a shielded self-stirring oxygen probe (YSI 5720; YSI Temperature/Salinity Compensated Dissolved Oxygen Meter 58) through a sealed port in the top of each respiration chamber.

Patterns of weight specific oxygen uptake rate (mg $O_2 \cdot$g ash-free dry $wt^{-1} \cdot h^{-1}$) demonstrated the following. 1) In Pachygrapsus and Cataleptodius, Pacific Panama and Florida populations were less sensitive to cyclic exposure to decreased temperature than were Atlantic Panama or Belize populations. The same was observed in Uca from Pacific Panama but not in Panopeus. These results indicate that, in most of the genera tested, exposure to temperature decreases in habitats has resulted in divergence. 2) During cyclic exposure to elevated temperature, Pacific Panama and Florida populations of Uca and Panopeus appeared to be more sensitive to increased temperature than populations from Atlantic Panama or Belize. These results support the hypothesis that adaptation to an environment that includes naturally occurring periods of reduced temperature results in reduced compensation during exposure to elevated temperature. 3) In Pachygrapsus and Cataleptodius, populations from Pacific Panama and Florida were not more sensitive to increased temperature than populations from Atlantic Panama and Belize. The latter results would not support the stated hypothesis. Overall, results indicate that these populations have diverged in accord with thermal regimes experienced in their natural habitats; these results do not distinguish whether observations are due to environmentally-induced phenotypic variation or to genotypic variation. This study was performed at the MDIBL and Smithsonian Institution laboratories in Panama, Belize and Florida. Supported by the Whitehall Foundation.