62.5

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ALTITUDINAL VARIATION OF WING SHAPE IN THE ANDEAN PASSERINE *ZONOTRICHIA CAPENSIS*

A challenge common to both engineered and biological volant forms is flight at high altitudes, where the density of air is low relative to that at sea level and thus compromises the lift capacity of airfoils. However, little is known about the role of high altitudes/hypodense atmospheres as selective forces shaping the morphology or aerodynamic properties of biological flyers. This research focuses on population-level variation in flight-related morphology of the passerine *Zonotrichia capensis* sampled over a relatively large altitudinal gradient along the Western Peruvian Andes. Collections were made at three elevational zones: low (0-1800 m), mid (2100-2400 m) and high (3000-4200 m). Body mass, wing loading, and aspect ratio did not differ significantly among the altitudinal groups. Low elevation birds had significantly shorter wingspans than either medium or high elevation birds. Thin-plate Spline/Relative Warp Analysis was used to compare wing planform shape independently of size. Relative warp 1 showed variation in the distal half of the wing and in the trailing edge at the wing base. High and low elevation birds were not significantly different from each other, yet mid elevation birds were significantly different than those from both high and low elevations. The leading edges of wings from mid elevation birds possessed greater aft sweep and a relatively less elliptical wing tip. Furthermore, wings from mid elevation birds showed an increased curvature at the transition of the trailing edge and the wing root. These findings suggest that, for this species, selective pressures on flight morphology maybe more strongly influenced by habitat type, and possibly predation risk, than by atmospheric pressure.

50.4

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THE ENERGETIC CONSEQUENCES OF PREY SPECIALIST AND GENERALIST POPULATIONS OF THREE SPECIES OF GARTER SNAKE (*THAMNOPHIS ELEGANS, T. COUCHII* AND *T. ORDINOIDES*).

North American garter snakes (*Thamnophis* spp.) represent a unique study system because of their diverse diets and habitats, both within and among species. For example, the Western Terrestrial garter snake, *T. elegans*, exists in two geographically isolated populations in northern California: a coastal population with a specialized diet of slugs and an inland population with a generalized diet of fish, anurans, mice and leeches. The difference in prey preferences between the two populations is congenital, heritable, and ontogenetically stable. To test whether or not the coastal slug eaters have an energetic advantage over the inland generalists when digesting slugs, we have shown that the snakes from the specialized coastal populations assimilate more energy from a slug diet than do the generalist snakes. Recently, we have included an interspecific comparison between garter snake species considered to be dietary specialists on slugs (*T. ordinoides*) and fish (*T. couchii*). We have designed similar feeding experiments with these species as for the two populations of *T. elegans*. Using the inland population of *T. elegans* as the dietary generalist, we tested the hypothesis that dietary specialization of garter snakes is accompanied by increased assimilation efficiency when digesting specialized prey types compared to that of generalist garter snakes. This study was supported by NSF grant IBN 9727762 to A.F.B and J.W.H. and by NSF grant IOB 0445680 to J.W.H.

76.1

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PHYSIOLOGICAL EVOLUTION AND AGING IN GARTER SNAKES

A primary theory on the evolution of senescence purports that different rates of aging may have evolved as part of a suite of co-evolved life-history traits involving trade-offs in energy allocation. Specifically, energy allocated to early growth and reproduction results in less energy for somatic maintenance and repair. Thus response to stresses, whether external or internally derived is less efficient in organisms that divert energy to other functions. Natural populations of garter snakes are the study subjects for this evolutionary ecological study of aging as it relates to oxidative stress. The garter snakes in this study are either fast growers or slow growers; this difference in growth phenotype is due to genetic differences between the two phenotypes. Slow growers have resultant long lifespan (median lifespan = 8 years); fast growers have shortened lifespan (median = 3 years). Mitochondrial oxygen consumption, P:O ratios, and H_2O_2 production are compared between the two phenotypes to test the hypothesis that differences in metabolism and free radical production result from different mitochondrial efficiency between the two genotypes.

S9-1.4

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THE PHYSIOLOGICAL ECOLOGY OF OVERWINTERING MONARCH BUTTERFLIES

Monarch butterflies (*Danaus plexippus* L.) are extreme specialists in their selection of overwintering sites in Mexico. Up to a billion butterflies, produced in a breeding range covering 87 million hectares in eastern North America, converge into massive aggregations on a handful of hectares high in Mexicos transvolcanic range. Energetics and thermal constraints interact to restrict the butterflies winter habitat selection. Although in the tropics, monarch colonies form at elevations of 3000m and higher, where nectar availability is greatly limited and where they are subject to winter storms from the north. The butterflies, therefore, must rely on lipid reserves accumulated during their migration for their metabolic requirements, and they must avoid freezing or chill injury during and after storms. We are combining ecophysiology, climatology, GIS and remote sensing to increase our understanding of the monarch butterflys overwintering requirements and the characteristics of the habitats they select. Potential habitat varies in suitability: sites that are too warm will cause the butterflies to burn their lipid reserves, and other sites will increase risks of freezing. We are comparing the microclimate in sites where butterflies do and do not form colonies, and comparing rates of lipid depletion and risks of freezing in colony sites with different microclimates. We are using GIS models to integrate these data. Both illegal logging and climate change are diminishing the amount of suitable wintering habitat for the monarch butterfly. The spectacular migration is at great risk.