Color-Mediated Thermoregulation and Latitudinal Distribution of North American Snakes

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Quantitative studies of correlation between snake coloration patterns and their latitudinal distribution is lacking despite the importance it poses for ectotherms coping with climate change. Anecdotal evidence suggesting higher latitude snake varieties exhibit darker coloration than southern counterparts prompted research to quantify the existence of a latitudinal gradient of snake pigmentation in eastern North America and to determine if differences in color patterns affected thermoregulation. Correlation between coloration and latitude was determined by plotting pixel luminosity data from digitally scanned snake species images against their northernmost latitudinal occurrence. Snake models, textured and painted to match color patterns of snake species occurring at various latitudes had internal temperatures measured while subjected to incandescent and natural sunlight sources. The mean luminosity of southern varieties at 62.6% exceeded northern species at 28.2% ($p<.05$). Within taxonomic groups, a negative correlation between latitude and luminosity ($R^2 = 0.51\text{-}0.99$) was observed ($p<.05$). Mean maximum temperatures of northern species models was 17.7 oC higher than southern counterparts ($p< .05$). Results demonstrate a latitudinal gradient within taxonomic groups, with darker coloration predominating in northern latitudes. Heating model data support color-mediated thermoregulation; explaining latitudinal gradients in snake coloration, as increased temperature of darker varieties would enhance thermoregulation facilitated by radiation in ectotherms living in cooler high latitudes. Relationships between coloration and distribution of taxonomic groups dependent upon color-mediated thermoregulation suggest snakes are vulnerable to threats posed by climate change.