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Correlates of miniaturization in Neotropical stingless bees

Meghan Duell, David Roubik, William Wcislo, Brian Smith, Jon Harrison

When a species evolves extremely small body size with respect to close relatives, is said to be miniaturized. This condition is found throughout the animal kingdom but we do not have a sufficient understanding of the physiological mechanisms responsible or their functional consequences. Evolution towards miniaturized body size has occurred in at least 11 separate genera of stingless bees with species ranging in size over three orders of magnitude. These miniaturized species were originally identified using unique characters, such as wing structure and size, to pinpoint costs inherent to small body size, though actual costs are difficult to quantify. We observed foraging behaviors of over 15 species of Neotropical stingless bees in the Panama and Colon provinces of the Republic of Panama before collecting them and removing their brains to determine if major differences in foraging regimes correlate with body size, head size, and brain structure. We also examined wing size and structure to determine whether wing characteristics are behaviorally limiting to miniaturized bees. Tiny bees had relatively larger heads but smaller thoraxes and abdomens relative to larger bees. Relative wing size varied greatly among miniaturized species. One interpretation of these data is that miniaturized bees may over-invest in the brain to maintain behavioral capacity, at the expense of flight and transport capabilities. However, wing size does not impose the same costs on all small bees. We found that bees of all sizes collected displayed similar foraging strategies, suggesting that miniaturized stingless bees might not be behaviorally limited by the physiology of small size in terms of foraging abilities.