

## The Buzz on Honeybee Energetics: Mismatches between Models and Measurement

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With a few exceptions, the measurement of field metabolic rate (FMR) in free-ranging insects has proven impossible thus far. Here we provide a review of the use of radio-isotopic turnovers to measure metabolic rate ( $VCO_2$ ), and confirm that  $VCO_2$  of the Honeybee *Apis mellifera* was significantly predicted by  $^{86}Rb\ k_b$  ( $r^2 = 0.57$ ,  $p = 0.002$ ), and conformed to expectations for an ectothermic species. The mass of honey solution consumed was significantly related to  $^{22}Na\ k_b$  ( $r^2 = 0.48$ ,  $p = 0.008$ ). We applied these calibrations to the study of free-ranging worker bees in landscapes with different levels of anthropogenic disruption. There were unexpected differences in FMR and food intake between the two different landscape contexts. Honeybees in deforested landscapes probably foraged less and depended upon stored resources during our study. We conclude that radio-isotopic techniques can be particularly useful for estimating FMR of insects. The use of such techniques can inform ecophysiology-based questions on ecosystem function, productivity and conservation and land management that have previously been beyond reach in insect systems.