

Quantifying the effect of radio transmitter attachment on bumble bee flight and behavior

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Radio telemetry has become a useful tool for insect studies, but the ratio of transmitter weight to insect body weight remains a limiting factor. Guidelines for transmitter application to invertebrates are generally borrowed from other taxa, and the assessment of transmitter effects has been limited to observations of whether or not a study insect continues to fly and forage. We methodically evaluated the impacts of transmitter attachment on flight mechanics and foraging behavior of queen buff-tailed bumble bees (*Bombus terrestris*) using a wind tunnel, high-speed camera, and large outdoor flight arena. We detected changes in wingbeat frequency, stroke angle, and body angle associated with transmitter attachment, and corresponding changes in flower handling time. This represents a major first step towards new guidelines for telemetry of insects, particularly load-carrying Hymenoptera.

