Research at the James: ***Overwintering aggregation site markers in lady beetles***

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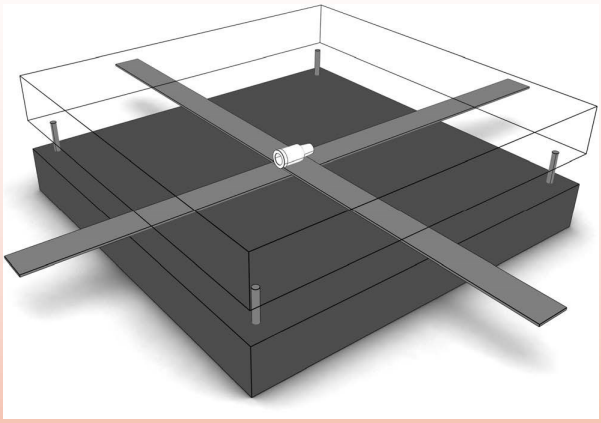
Lady beetles (*Hippodamia convergens*) form overwintering aggregations at revisited montane microsites far removed from their summer foraging grounds. These dense aggregations and overwinter sites are commonly found in sheltered hibernacula that are used repeatedly many years. Although the seasonal occurrence of these aggregations is well known, the stimuli responsible for the attraction of beetles to traditional shelter sites are not fully understood. Orientation responses to visual and altitudinal features of habitat can explain the arrival of migrants to the general overwintering macrosite, however, the research conducted by Christopher centered on identifying the role that pheromones play in the accumulation of individuals in inconspicuous hibernacula microsites.

The hypothesis was that pheromones on the legs of beetles were deposited by users of the hibernacula and acted as attractants to beetles arriving to these areas to overwinter. Analyses of the chemical compounds in leg components of beetles contained hydrocarbons that could contribute to overwintering aggregations. Additionally, a common defensive allomone, 2-isobutyl-methozypyrazine (IBMP) also acted as a possible aggregation pheromone.

In order to test the possible influence of these pheromones on aggregation behavior, Christopher used a series of lab and field experiments. In the laboratory experiments, beetles collected from the James Reserve were given a choice to select between control areas and treatment areas where beetles had actively walked before.



Field tests involved placement of artificial hibernacula, in this case, cement tile "sandwiches" with one tile flush with the soil surface and an upper one forming a roof (see diagram to left). Each setup had two wooden stakes laid perpendicular to each other with a rubber septum placed at the junction. Treatment setups consisted of the septum treated with IBPM and the sticks with lady beetle foot extracts.

Results in the laboratory and in the field indicated that *n*-tricosane (C_{23}) , a cuticular hydrocarbon contributed to the formation and longevity of overwintering aggregations. IBMP also affected aggregation behavior but may be more effective at maintaining aggregations at novel microsites, especially when presented in conjunction with C_{23}. More details of this study can be found in the following articles.

Wheeler, C.A. and R.T. Cardé. 2013. Defensive allomones function as aggregation pheromones in diapausing ladybird beetles, *Hippodamia convergens*. Journal of Chemical Ecology 39: 723-732.

Wheeler, C.A. and R.T. Cardé. 2014. Following in their footprints: cuticular hydrocarbons as overwintering aggregation site markers in *Hippodamia convergens*. Journal of Chemical Ecology 40:418-428.