Decisions by wolf spiders and carnivorous plants

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Motivation: Recent empirical work suggests that for wolf spiders may compete with sundews, small carnivorous plants, for insect prey. The key to a competitive effect is the draw-down of insect abundance resulting from predation, but is this likely to happen in nature? The draw-down seems to hinge on decisions by sundews concerning the attraction and capture of prey—and by wolf spiders concerning their movement along gradients of sensory cues and their resulting locations relative to sundew patches.

Research Questions: Under what conditions can the predators reduce insect densities enough to influence sundew nutrient levels and spider feeding rates? What contribution must sundew insect attractants (color and possibly airborne chemicals) play to generate realistic spatial patterns of predators and insects? Should spiders also respond positively to the sundews' insect attractants?

Methods: We constructed a spatially explicit computer simulation model in MATLAB to generate spatial distributions, feeding rates, and sundew nutrient concentrations. With the model, we examined the tendency for sundews to form patches, for spiders to collect near sundews, and for insects to be more or less abundant in the immediate vicinity of their predators. We also tracked sundew population dynamics and attractant distributions and simulated movements of spiders and insects along gradients.

Results: We found that spiders and sundews substantially reduced each others' access to insect prey under only a restricted set of conditions; in some circumstances, spiders actually tended to benefit from the sundews' ability to attract prey, especially when spiders responded to the attractant as well as to the prey directly. Attract effects made it easier for us to mimic the kinds of spatial distributions found in field data.

Discussion: We also have a simpler, non-spatial model of this system (to complement the simulation model and to mimic some laboratory experiments) that solves the game between predators for optimal prey-capture effort. Both models allow us to make testable predictions about this interaction through the decisions made by the predators. This study initiates a new collaboration among the lead author (soon to be a doctoral student in statistics), two biologists, and entomologists to develop a deeper understanding of the basis for and implications of these contingent decisions in nature.