Ecological and evolutionary responses to insectivory in an agro-ecosystem

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The mosaic agricultural landscape in south-central Texas represents extremes in disturbance and in plant and animal ecology. In this setting, heavily influenced by strong anthropogenic activities, we investigate the effects of predation by Brazilian free-tailed bats (Tadarida brasiliensis) on agricultural pest insects (corn earworm, Helicoverpa zea and others) on ecosystem structure and function as well as the evolutionary consequences of insectivory in the system. Due to introductions of non-native species and the homogenization of biota often resulting from plant monocultures over vast areas, ecological processes such as competition, herbivory, and predator-prey interactions in agricultural systems can no longer rely on the constraints of evolutionary history. Insectivorous birds and mammals prey heavily on insects emerging from crop fields, even though the control of the insects generally relies largely on pesticide applications or use of transgenic varieties of crop. Even when conventional agronomic methods for pest control are effective, natural predation on these insects may be important, even vital, to ecosystem function in the disturbed environment. Insectivory may be essential as traditionally envisioned (e.g., predation on insects reduces damage to crops), or in less obvious ways. For example, insects that survive direct pesticide application and are eaten by predators tend to be those most resistant to the pesticide. Predation by natural predators may thus retard the evolution of pesticide resistance, and subsequently enhance the function of perturbed systems by diminishing the frequency of required spraying and the need for new pesticides. In this way, disturbance may in fact enhance the ecological importance of these predators by investing natural predators with altered ecological and evolutionary functions. As another example, current pest management strategies involving Bt - modified crops of corn and cotton employ non-Bt plantings as refugia for populations of susceptible insects thereby maintaining gene pools of susceptible populations with the goal of retarding the evolution of Bt resistance. This strategy remains controversial because of its paradoxical encouragement of pest

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population survival. In this case, natural predators, drawn by aggregations of susceptible insects, may decrease the efficacy of this management strategy.

We are developing a landscape model that describes the temporal and spatial dynamics of the bat-insects interaction. This presentation will indicate the progress made employing an individual based approach to describe the ecological interactions, the agro-economics, and the evolutionary implications of insectivory in the system. The individual and population bat models will be discussed; the coupling of the insect and insectivores in a specific spatial setting will be developed and analyzed.

References

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