Adaptive Foraging and Food Web Topology

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Ecological studies of direct and indirect interactions in food webs usually represent systems as unique configurations such as keystone predation, exploitative competition, trophic cascades, or intraguild predation. Food web dynamics is then studied using model systems that are unique to the particular configuration. In an endeavor to develop a more unified theory of food web structures and functions, we explore model systems in which a consumer species forages adaptively on two resource species along a gradient of environmental productivity and predation mortality. We explore the nature of trophic interactions under three different assumptions about what constitutes a resource and the spatial distribution of resources. We first examine a consumer (herbivore) feeding on two resources (plants) that are distributed randomly in the environment. We extend this to the case in which each plant resource occurs in a discrete patch. Finally, we examine a variant of the patch selection case in which the consumer (an omnivore) feeds within and among 2 trophic levels. Our modelling shows that single systems of predators, adaptive herbivores and resources can display food chain and food web topologies under different levels of productivity and predator abundance. For example, adaptive omnivory causes the exploitative competition, linear food chain, and multitrophic level omnivory to be displayed by a single system. Thus, different food web topologies, normally thought to be unique configurations in nature, can be different manifestations of the same dynamical system. This suggests that tests for top-down or bottom-up control by manipulating predator abundance or nutrient supply to resources could be confounded by topological

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shifts in the system itself.