Wayne M. Getz
Dept. Environmental Science, Policy and Management
University of California at Berkeley, CA 94720-3114, USA
e-mail: getz@nature.berkeley.edu

A Biomass Flow Approach to Population Models and Food Webs

The dominant differential equation paradigm for modeling the population dynamics of species interacting in the framework of a food web retains at its core the basic prey-predator and competition models formulation by Alfred J. Lotka (1880-1945) and Vito Volterra (1860-1940) nearly nine decades ago. This framework lacks a trophic-level-independent formulation of population growth leading to ambiguities in how to treat populations that are simultaneously both prey and predator. Also, it does not fundamentally include inertial processes needed to account for the response of populations to fluctuating resource environments. Here I present an approach that corrects both these deficits and provides a unified framework for accounting for biomass transformation in food webs that include both live and dead components of all species in the system. This biomass transformation formulation (BTW) allows for a unified treatment of webs that include consumers of both live and dead material—both carnivores and carcassivores, herbivores and detrivores—and incorporates scavengers, parasites, and other neglected food web consumption categories in a coherent manner. I trace how BTW is an outgrowth of the metaphysiological growth modeling paradigm and provide a general compact formulation of BTW in terms of a live/dead/deficit-stress three-variable differential equation formulation for each species in the food web. I then illustrate the application of this new paradigm to provide insights into two-species competition in variable environments and discuss application of BTW to food webs that incorporate parasites and pathogens.