EEB 485 Discussion 05: Indirect Effects and Food Webs

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Petchey, O. L., A. P. Beckerman, J. O. Riede, and P. H. Warren. 2008. Size, foraging, and food web structure. Proceedings of the National Academy of Sciences of the United States of America 105:4191-4196.

Summary: Petchey et al. assess the ability of allometric relationships in predicting food webs in their 2008 paper. Their model is based around optimal foraging theory, which deals with how predators choose their diet in order to maximize their rate of energy intake. The study's model is based on allometry, which refers to how an organism's structure and function changes with size. The authors parameterized an allometric model that is based on five phenomenological rules: 1) there is an ordering of species based on size, most consumers feed only on smaller organisms; 2) a consumer's resource occupies a contiguous section of niche space; 3) some consumers are able to feed a limited amount above their ordered set; 4) consequently, diets depend on their position in the ordered set; 5) gaps may be found in the section of niche space occupied by a consumer. The authors use their model to predict specific consumer-resource interactions, or links. They compared a ratio model and a power model of predator handling time, with the ratio model predicting a greater number of links in all but one of the systems examined. In total 15 ecosystem food webs were included in the study. All food webs came from previously studied literature; they encompass terrestrial, marine and freshwater systems.

Links between consumers and resources were predicted correctly 5-65% of the time, depending on the system. The most accurately predicted food webs were desert and freshwater systems, while the lowest percentage of links were predicted in parasitoid systems. Petchey et al. concluded that allometry can be an accurate way to predict the structure of food webs in some communities, though flexibility in the distribution of links can still exist. Other factors aside from body size, such as morphology and chemical defenses, could be added to future iterations.

Pre-Discussion Questions:

1. The percent of links predicted correctly ranged from 5% in some ecosystems to 65% in other systems. Which ecosystems would be best suited for this model? Which wouldn't?
2. The authors state that their model is distinct from other models in that it is "deterministic, whereas previous models are stochastic" (pg. 4194). What do they mean by this, and do you think it significantly affects their results (either positively or negatively)?
3. This paper compares ratio handling time functions and power handling time functions, but the two functions behave differently. Why is this? Why would you expect one to be a better fit over the other?