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Body size and food web structure: testing the equiprobability assumption of the cascade model

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Abstract The cascade model successfuly predicts many patterns in reported food webs. A key assumption of this model is the existence of a predetermined trophic hierarchy; prey are always lower in the hierarchy than their predators. At least three studies have suggested that, in animal food webs, this hierarchy can be explained to a large extent by body size relationships. A second assumption of the standard cascade model is that trophic links not prohibited by the hierarchy occur with equal probability. Using nonparametric contingency table analyses, we tested this "equiprobability hypothesis" in 16 published animal food webs for which the adult body masses of the species had been estimated. We found that when the hierarchy was based on body size, the equiprobability hypothesis was rejected in favor of an alternative, "predator-dominance" hypothesis wherein the probability of a trophic link varies with the identity of the predator. Another alternative to equiprobabilty is that the probability of a trophic link depends upon the ratio of the body sizes of the two species. Using nonparametric regression and liklihood ratio tests, we show that a size-ratio based model represents a significant improvement over the cascade model. These results suggest that models with heterogeneous predation probabilities will fit food web data better than the homogeneous cascade model. They also suggest a new way to bridge the gap between static and dynamic food web models.

Key words Food webs · Body size · Cascade model · Contingency tables · Kernel smoothing