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Physics and body size constrain predator functional response

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Abstract Text:

Background/Question/Methods

Functional response (i.e., the relationship between prey abundance and predator

consumption rate) is known to constrain the feasibility of predator-prey interactions. Since the pioneer work by Holling, several models of functional responses were proposed. Many studies have shown that functional response is strongly affected by the body size of the predator and that of the prey.

But, the role played by the surrounding medium has not really been explored in the context of predator-prey interactions. Hence, living organisms are constrained by the physical properties of the surrounding medium. These properties affect the way organisms move and interact with each other. Since predation usually implies motion, these factors create mechanical constraints acting on predators. These constraints are size-dependent.

The present study investigates how physical factors from the medium can constrain the functional response according to the ecosystem considered (e.g., aquatic, terrestrial). Hence, we built a model in which species motion and species interactions are constrained by physical properties of the medium and biological traits (e.g., metabolism). As key physical factors of the medium, we consider gravity, medium density, body density, and medium viscosity. These factors, in relation with body size, constrain the functional response of the predator.

Results/Conclusions

Preliminary results show that the model is able to predict several species traits related to predation such as species-specific speed. More importantly, the model is able to predict attack rate and handling time, which are key features of a functional response. Model predictions fit data remarkably well, for a large number of species across different ecosystems.

The real novelty of this approach is that it merges size-related biological and physical constraints within classical predator-prey systems. Therefore, properties of the functional response emerge from traits measured at the individual level. Most parameters in the model are related to predator and prey sizes, a trait that is commonly measured. Thus, the model offers a unique opportunity to investigate the strength of predator-prey interactions within different habitats, and provides novel insights on the size-structure of food webs.

Topic Selection:
Predation And Predator-Prey Interactions

Title:
Physics and body size constrain predator functional response

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Preferred Presentation Format:
Oral

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