

July 5, 2021

Frontiers in Ecology & Evolution
*New Perspectives and Emerging Directions in Predator-Prey Functional Response Research:
Homage to C.S. Holling (1930-2019)*

Dear Dr. Hossie & Dr. Murray,

My co-author, Daniel Stouffer, and I are pleased to submit our manuscript, entitled “*Geometric complexity and the information-theoretic comparison of functional-response models*” to consider for publication in the Frontiers Research Topic that you are editing. We thank you for inviting us to submit our work to this Research Topic.

As you know well, the literature contains thousands of functional-response experiments, each seeking to determine the relationship between a given predator’s feeding rate and its prey’s abundance. In parallel, dozens of functional-response models have been proposed, each developed to encapsulate aspects of the variation that exists among predator and prey biologies. The motivation to identify the “best” model on the basis of the data is strong given the frequent sensitivity of theoretical population-dynamic predictions to model assumptions. To this end, the use of information-theoretic criteria, like AIC and BIC, to rank models by their relative performance has come to be considered the preeminent way for achieving this goal in a principled manner.

Our submission seeks to help clarify the statistical and epistemological challenges that remain, showing how *model flexibility* influences inferences of model performance as it relates to the attainment of biological truth and predictive ability. Model flexibility is a previously unconsidered form of model complexity relating to a model’s mathematical structure rather than its number of parameters.

The Fisher Information Approximation criterion we use to quantify model flexibility allows us to compare, explain, and contextualize how model flexibility differs among a large (near exhaustive) compilation of single-prey functional-response models over an encompassing range of conceivable experimental designs. Our study, which is (to our knowledge) the first to introduce the Fisher Information Approximation to the ecological literature, reveals (1) the large differences in model flexibility that exist among functional-response models, that (2) there is no experimental design that can minimize these differences across all models, and that (3) even the qualitative nature by which some models are more or less flexible than others is reversed by changes in experimental design. We discuss how these design-dependent differences in model flexibility should alter the interpretation of studies performed in the past, but also why we may consider flexibility to be a desirable property of models rather than a hindrance to inference.

We hope you consider our submission a valuable addition to the Research Topic and look forward to the reviewer’s feedback. (We also welcome suggestions of additional models to include in our analyses.) On behalf of my co-author, I thank you for your consideration.

Sincerely,



Mark Novak