

Talmy et al. “Killing the predator: impacts of top-predator mortality on global-ocean ecosystem structure”

This is a nice, concise paper analyzing the effects of two variants of a plankton food web structure, with two types of losses (linear and quadratic) for the top predator in the modeled food web. Here, the predators are microzooplankton, but I believe the results are extensible to a case where there is one microzooplankton and one mesozooplankton. In Talmy et al., the authors show that the “diamond” food web structure, where one zooplankton feeds on two phytoplankton, results in a marine ecosystem with less dynamic range between the gyres and the poles in phytoplankton carbon, as well as less co-existence in community composition. Simultaneously, the quadratic losses in the top predators results in a phytoplankton to zooplankton biomass relationship that better represents recent observations. I believe This paper is written in a clear and consise way, but one major criticism is its lack of robust engagement in other mechanisms that may contribute to variations in community co-existence, Z:P ratio, and phytoplankton carbon. Further, while the authors do cite other publications (Ward et al. 2012, Dutkiewicz et al. 2020) that list parameter values, it was very difficult to evaluate the performance of the model without a list of parameter values.

Thank you for these constructive comments. We appreciate the suggestions to better engaging with existing literature and to provide parameter values. We are in the process of running some targeted simulations to investigate a subset of these interesting questions. We specify these details below.

Therefore, my recommendations are:

- List out in the appendix all the ecosystem-relevant parameter values used in the model

We are preparing a detailed set of tables reporting the allometric rules and parameter choices, that we will be sure to include in our revised manuscript.

- Can the authors engage a bit more robustly in the discussion, other strategies that modelers use to modify zooplankton grazing in a diamond food web structure that may also result in improvements in the two main metrics (dynamic range between gyres and poles in phytoplankton carbon, community co-existence):

- 1.For example, many biogeochemical models utilize either different maximum grazing rates for zooplankton depending on the prey type, OR use a prey selectivity factor to modulate grazing. For the former, BEC/MARBL (Moore et al. 2004, Long et al. 2021) uses different maximum grazing rates for a single “adaptive” zooplankton to mimic the effect of multiple zooplankton in a single zooplankton class. For the latter, there are multiple examples of this strategy within the biogeochemical models, e.g., PISCES (Aumont et al. 2015), and COBALT (Stock et al. 2014), though those two models also have multiple zooplankton types so it may be slightly harder to compare with a single zooplankton type. However, mathematically, the effect of both these strategies would be similar.

In the parallel food chain, the larger zooplankton feeding on the larger phytoplankton has a lower maximal growth rate. In response to reviewer 1’s comments, we are conducting sensitivity studies to explore whether our solutions are modified drastically depending on grazer growth rates. This does not directly address the reviewer’s comments but is a related concept.

We will also be sure to add text to our Discussion raising the potential to explore the impact of adaptive predation on predator-prey scaling as an exciting future direction, citing the literature mentioned here.

2. On grazing, values for the zooplankton maximum grazing rates and the grazing half-saturation constant are amongst the least well constrained parameters in food web models, and variations in these parameters have an enormous impact. Rohr et al. 2022 (Progress in Oceanography) shows this quite nicely in a robust analysis, along with evaluating differences in the grazing functional form itself (Holling type II or type III functional responses). It would be nice if the authors could engage a bit more in the discussion regarding whether modelers would be able to compensate for the lack of a second zooplankton (e.g., in the diamond food web model) by modulating maximum grazing rates and grazing half-saturation constants.

It is interesting that Rohr et al. (2022) rely on a Holling Type-III functional response to stabilize oscillatory dynamics, in a system with linear zooplankton mortality. Out of curiosity, we plan to run some simulations with a Holling Type-III response and linear closure, to see if this also can explain linear predator-prey scaling. Regarding mimicking a second zooplankton in the diamond food-web, we will be sure to cite the relevant literature, and point to this as an exciting avenue for future study.

3. Lastly – prey switching is a major issue that is only mentioned in passing in the discussion. It would be nice to see a more robust discussion – do the authors think that modifications in the switching form would result in substantial changes in the modeled ecosystem, and why? There are a lot of approaches towards switching, as laid out extensively in Gentleman et al. (2003), but models typically use just one or two forms (e.g., Stock et al. 2008 Journal of Marine Systems has addressed this quite nicely in a simple system). In my opinion, a more than cursory treatment of this topic would be important in this paper.

We recognize that we can engage more fully with the large body of literature describing different approaches to prey switching and appreciate the suggestion from this reviewer to do so. Out of curiosity, we have begun running some simulations contrasting two well-known forms of switching - passive vs. active - following guidelines of Gentleman et al. (2003) and Vallina et al. (2014). Early results suggest that active switching promotes coexistence among small and large phytoplankton in the diamond food-web, but does not strongly impact predator-prey scaling, total planktonic carbon, and carbon export. We will be sure to discuss these findings in the context of the wider range of options available for prey switching, and the potential for future studies exploring the impacts of these on predator-prey biomass scaling relationships.

4. Other parameters that may additionally modulate phytoplankton carbon in food web models that aren't addressed include the fraction of phytoplankton and zooplankton losses that go to dissolved organic matter vs. particulate organic matter, which may influence the recycling rate and strength of the microbial loop. Lastly, variations in the relative nutrient uptake rate of the different phytoplankton may also result in more or less differences in the phytoplankton carbon between the gyres and the poles.

We are conducting sensitivities to phytoplankton size, which will modify nutrient affinities (through allometry). Also, we have conducted sensitivities to the POM-DOM partitioning (referred to in our model as an 'export fraction'). Results show that, when modified over a reasonable range, the average predator-prey scaling is sensitive to this number, but the scaling relationship is not. If there is space in our revisions, we will include these results.

Other than these points, I found the manuscript written quite clearly, with compelling figures and nice presentation. With a more robust discussion addressing a range of these additional points listed above, this manuscript would make a nice addition to the literature.

We thank this reviewer for the careful reading of our manuscript, and their helpful suggestions. We anticipate our manuscript will be much improved as a result.