

Supporting Information for ”Mixed layer depth promotes trophic amplification on a seasonal scale”

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1. Sensitivity studies

To assess how food chain length affects trophic amplification, we purposely modify the predator diet and thus food chain length in sensitivity runs with model CROCO-BioEBUS. We perform simulations LZOO and SZOO in which we remove the linkage between small phytoplankton and mesozooplankton or the linkage between large phytoplankton and

microzooplankton, respectively. Both LZOO and SZOO simulations have the same set-up as the reference simulation except for altered zooplankton diet preferences through parameter settings (Table. S1).

A comparison with the reference study (Fig. S3a), of the run where we remove the linkage between small phytoplankton and mesozooplankton (Fig. S3b) or the linkage between large phytoplankton and microzooplankton (Fig. S3c), shows that the food chain length, FCL, lengthens or shortens, respectively. The dominant role of predator-prey encounter efficiency due to mixed layer dilution is not affected by such a deliberate change in the food chain length (Fig. S4), which agrees with what was previously found by D'Alelio, Libralato, Wyatt, and d'Alcalà (2016).

References

- D'Alelio, D., Libralato, S., Wyatt, T., & d'Alcalà, M. R. (2016). Ecological-network models link diversity, structure and function in the plankton food-web. *Scientific Reports*, *6*(1), 1–13. doi: 10.1038/srep21806
- Stock, C., & Dunne, J. (2010). Controls on the ratio of mesozooplankton production to primary production in marine ecosystems. *Deep Sea Research Part I: Oceanographic Research Papers*, *57*(1), 95–112. doi: 10.1016/j.dsr.2009.10.006

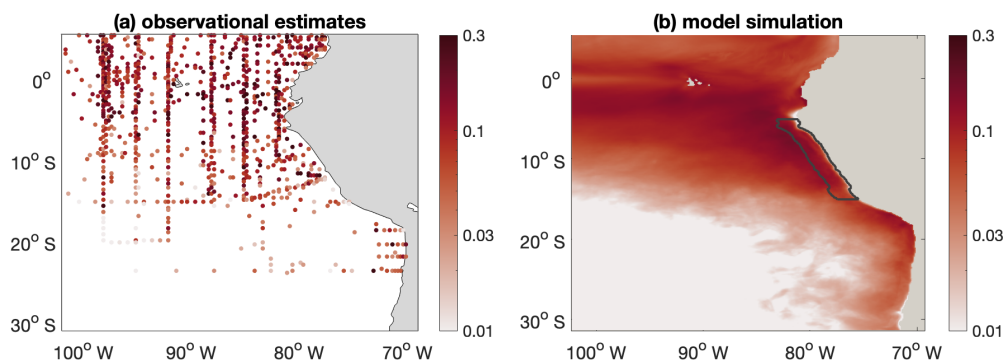


Figure S1. Annual average spatial distribution of the food chain efficiency based on (a) observational estimates (derived from COPEPOD and MODIS temperature and productivity data (calculated the same way as in Stock and Dunne (2010)) and (b) model simulation. The black lines highlight the focus region)

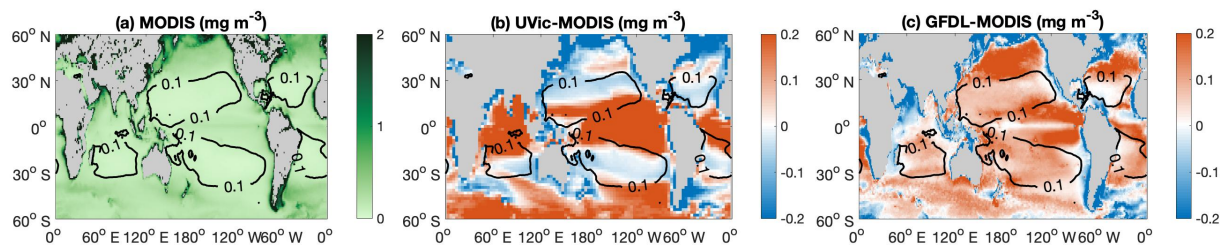


Figure S2. Maps of (a) annual-mean surface chlorophyll concentration from MODIS; and simulated bias of the (b) UVic-model and (c) GFDL-model. Black contour lines in the three panels indicate the observational biome threshold (MODIS surface chlorophyll concentration equaling 0.1 mgm^{-3}).

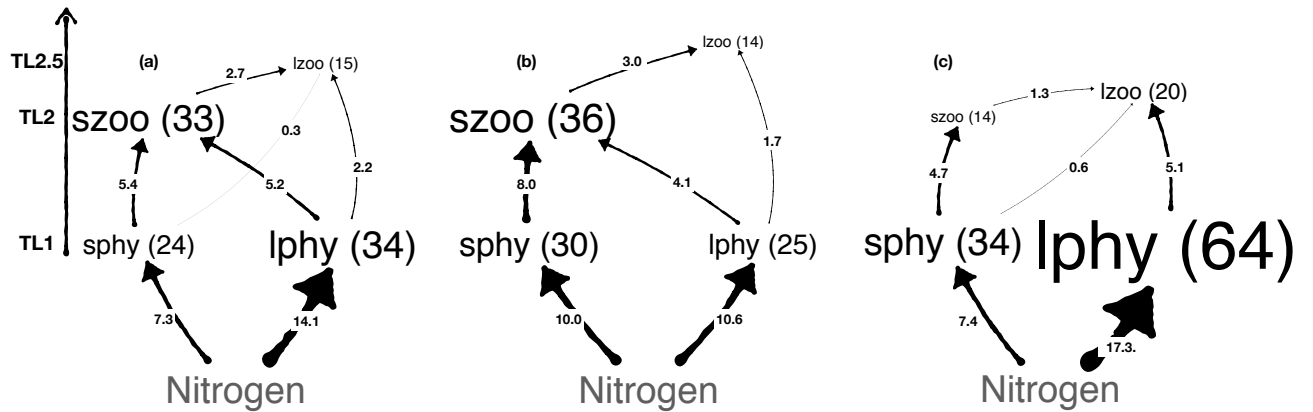


Figure S3. Food web structure of (a) reference simulation (b) LZOO simulation (removal of small phytoplankton - mesozooplankton link) and (c) SZOO simulation (removal of large phytoplankton - microzooplankton link). All variables shown are integrated over the water column. The plankton groups are shown in the unit of mmol N m^{-2} . The fluxes are shown in the unit of $\text{mmol N m}^{-2}\text{d}^{-1}$

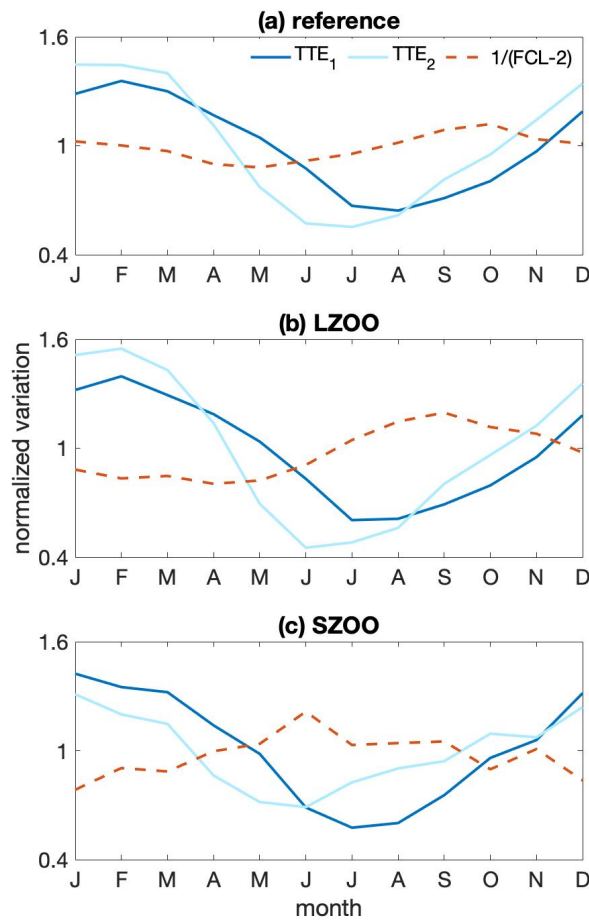


Figure S4. Normalized seasonal variation of trophic transfer efficiency (TTE) between trophic level 1 and 2 (TTE₁, light blue) and trophic level 2 and 3 (TTE₂, dark blue) along with the reciprocal of the food chain length (1/(FCL-2), red) over the water column within the focus region based on (a) reference simulation (b) LZOO simulation (removal of small phytoplankton-mesozooplankton link) and (c) SZOO simulation (removal of large phytoplankton-microzooplankton link).

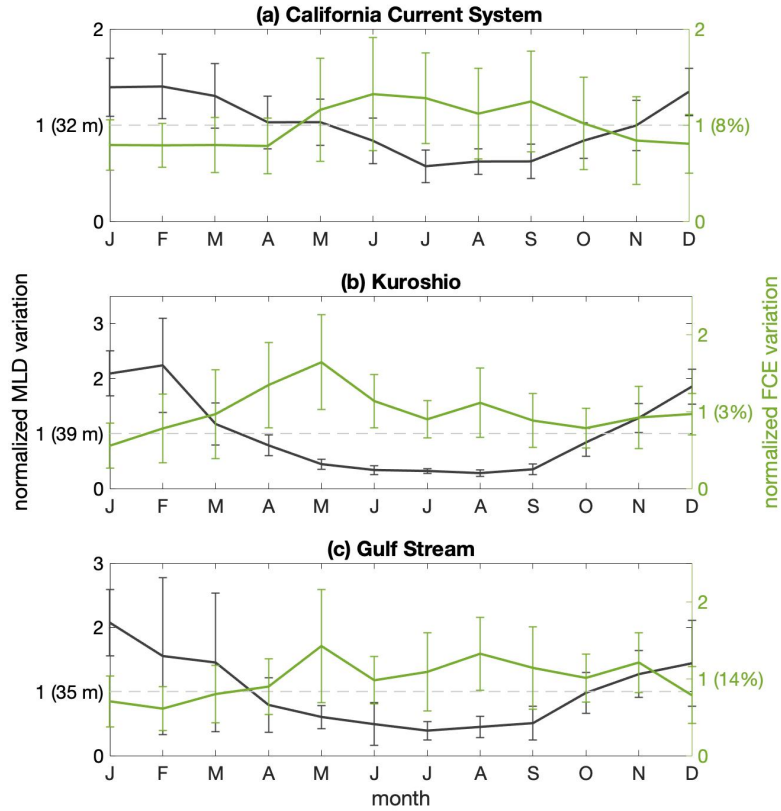


Figure S5. Average observational estimates of seasonal cycles of normalized MLD (black) and food chain efficiency(FCE, the ratio of net mesozooplankton production to primary production; green) for (a) California Current System; (b) Kuroshio and (c) Gulf Stream. Values in brackets indicate the absolute values of annual means. Error bars indicates the standard deviation.

Table S1. Adjusted diet preferences in sensitivity runs

Sensitivity studies	reference	LZOO	SZOO
Preference of Z_S for P_S	0.65	0.65	1
Preference of Z_S for P_L	0.35	0.35	0
Preference of Z_L for P_S	0.1	0	0.1
Preference of Z_L for P_L	0.4	0.5	0.4
Preference of Z_L for Z_S	0.5	0.5	0.5