***Data assumptions***

*Mysis incorporation*

*Mysis* was treated as part of the PSS, as *Mysis* are considered to feed primarily on pelagic phytoplankton and zooplankton during their nightly ascent into the pelagic zone (Johannsson et al. 2001). However, multiple studies have found they also feed on sedimented material and benthic invertebrates when residing on the bottom during the day (Parker 1980; Johannsson et al. 2001; Sierszen et al. 2011). If *Mysis* biomass is also supported by benthic production, the PSS slope we calculated would also include some energy transfer through the benthos and therefore be too shallow. On the other hand, not including *Mysis* in BSS would make these slopes steeper. In either case, benthic mysid feeding should not affect the PBSS slope, as PBSS incorporates both pathways. Another issue is that mysid biomass may be underestimated if part of the population remains on the bottom at night when we assessed mysid abundance in the water column. Some mysids stay on the bottom at night, at least in Lake Ontario (Johannsson et al. 2003), and will therefore not be included in nighttime water column tows. That this proportion can be substantial, especially for larger individuals, have been shown in Lake Champlain (Euclide et al. 2017; O’Malley et al. 2018).

*Small zooplankton below 20 m*

We assumed that small zooplankton (nauplii, veligers, rotifers) were limited to the sampled 20 meters of the water column; clearly, some of these animals will be in deeper water. We have limited information on the distribution of these animals in the water column. In two years (2013 for Lake Ontario and 2015 for Lake Michigan) the abundance of veligers in the surface mixed layer was compared to the metalimnion and the hypolimnion down to 100 m during summer. Volumetric densities of veligers in these studies were an order of magnitude lower in the metalimnion and hypoliminion (~0.2 veligers∙m-2) than in the epilimnion (~7.5 veligers∙m-2), lending support to our assumption. However, we recognize that the number of small zooplankton are likely biased low. Note that we also do not report any information on ciliates.

*Benthos*

We do not have data on benthic animals smaller than 500 µm (harpacticoid copepods, ostracods, nematodes). Including smaller benthos would undoubtedly affect the slope of the BSS. However, we do not believe these animals would contribute substantially to the PBSS. Densities of harpacticoid copepods on the bottom of Lake Ontario can reach ~14,000 individuals∙m-2 (Connolly, Cornell University, unpubl. data), which is ~10% of the abundance of pelagic copepods at these stations (~160,000 individuals∙m-2). Since these types of copepods have similar body sizes, the effect of excluding harpacticoids on the size spectra should be relatively small. Even so, we note that the meiobenthic communities of Laurentian Great Lakes are largely unknown.

*Phytoplankton abundance in DCM*

Because each DCM sample represented a water grab from a specific depth, we had to assume that the DCM consisted of the algae encountered at the depth of the peak chlorophyll, and that phytoplankton biomass in the deep and mixed layers were proportional to the chlorophyll measured in that layer. Chlorophyll is a commonly used index of phytoplankton abundance even though the chlorophyll to carbon ratio is highly variable in phytoplankton. Chlorophyll to carbon ratios are likely higher at the DCM than in the mixed layer due to photoacclimation, which would lead to an overestimate of the phytoplankton biomass in the DCM. Photoacclimation is greater in lakes Superior, Michigan, and Huron, than in lakes Ontario and Erie (Scofield et al. 2020) which would shallow the slope (less phytoplankton biomass) in the upper lakes compared to Ontario and Erie. This assumption should have less effect on height.

*Picoplankton and bacteria.*

We do not have counts of phytoplankton smaller than 2 µm, and thus smaller picoplankton are excluded from our analyses. Picoplankton may be an important component of the phytoplankton, especially in the more oligotrophic lakes (Munawar et al. 2010; Twiss et al. 2012; Carrick et al. 2015). The inclusion of picoplankton would extend the size range of our size spectra and possibly affect the slopes and heights of the PSS and PBSS. However, the data we have included would likely still dominate the slope and height calculations. Addition of picoplankton and bacteria sized organisms, while interesting, is not simple because these organisms are not routinely collected and measured for weight in the Great Lakes monitoring programs. Their abundances are also highly variable across time, which makes it difficult to appropriately quantify biomass; inclusion of bacteria in size spectra analyses is still rare (Blanchard et al. 2017).

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