Evaluating the effect of wind-driven patchiness on trophic interactions between zooplankton and phytoplankton

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ABSTRACT: We measured spatial patterns of zooplankton and chlorophyll concentration (a proxy for phytoplankton) with continuous sensors along horizontal transects that were repeatedly sampled (n = 150) under varying wind conditions throughout a growing season in two basins (Sou Arm and Annie Bay) of Lake Opeongo, Ontario, Canada. Spatially explicit in situ simulations that included activity costs associated with feeding were used to examine the effects of chlorophyll patchiness on the energy gain in different zooplankton communities. Simulations were repeated for several zooplankton size classes (small, large, and bulk) and two communities (all copepods ar all cladocerans). For each simulated combination, a spatial energetic differential (SED) was estimated by contrasting the energy that zooplankton could gain using observed spatial patterns in chlorophyll and water temperature with the energy they could gain using uniform concentrations of chlorophyll and water temperature. Large zooplankton showed the greatest SED range across all communities, from a decrease of 8% to a maximum increase of 20%, assuming relatively low costs associated with feeding activity. Small zooplankton had the narrowest SED range. Zooplankton energy gain is sensitive to both the degree of zooplankton-chlorophyll spati overlap and energetic costs associated with zooplankton feeding activity. SED values as high as 485% can occur under plausible estimates of activity costs. Wind-driven increases in spatial overl between predator and prey can be large enough to substantially alter planktonic trophic interactions.