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TITLE: Warming induces shifts in microzooplankton phenology and reduces time-lags between phytoplankton and protozoan production

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ABSTRACT:

Indoor mesocosm experiments were conducted to test for potential climate change effects on the spring succession of Baltic Sea plankton. Two different temperature (?0 °C and ?6 °C) and three light scenarios (62, 57 and 49 % of the natural surface light intensity on sunny days), mimicking increasing cloudiness as predicted for warmer winters in the Baltic Sea region, were simulated. By combining experimental and modeling approaches, we were able to test for a potential dietary mismatch between phytoplankton and zooplankton. Two general predator?prey models, one representing the community as a tri-trophic food chain and one as a 5-guild food web were applied to test for the consequences of different temperature sensitivities of heterotrophic components of the plankton. During the experiments, we observed reduced time-lags between the peaks of phytoplankton and protozoan biomass in response to warming. Microzooplankton peak biomass was reached by 2.5 day °C?1 earlier and occurred almost synchronously with biomass peaks of phytoplankton in the warm mesocosms (?6 °C). The peak magnitudes of microzooplankton biomass remained unaffected by temperature, and growth rates of microzooplankton were higher at ?6 °C (??0 °C = 0.12 day?1 and ??6 °C = 0.25 day?1). Furthermore, warming induced a shift in microzooplankton phenology leading to a faster species turnover and a shorter window of microzooplankton occurrence. Moderate differences in the light levels had no significant effect on the time-lags between autotrophic and heterotrophic biomass and on the timing, biomass maxima and growth rate of microzooplankton biomass. Both models predicted reduced time-lags between the biomass peaks of phytoplankton and its predators (both microzooplankton and copepods) with warming. The reduction of time-lags increased with increasing Q10 values of copepods and protozoans in the tritrophic food chain. Indirect trophic effects modified this pattern in the 5-guild food web. Our study shows that instead of a mismatch, warming might lead to a stronger match between protist grazers and their prey altering in turn the transfer of matter and energy toward higher trophic levels.

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