Effects of experimental greenhouse warming on phytoplankton and zooplankton communities in fishless alpine ponds

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ABSTRACT: The impacts of global warming on aquatic ecosystems are expected to be most pronounced at higher trophic levels in cold-water environments. Therefore, we hypothesized that warming of fishless alpine ponds would suppress large-bodied consumers (e.g., cladocerans, copepods) and stimulate fast-growing microorganisms (e.g., phytoflagellates, rotifers), thereby altering the community composition and total abundance of zooplankton and phytoplankton. This hypothesis was tested using three blocks of four experimental mesocosms (1000-liter capacity) that were located next to alpine ponds in Banff National Park, Canada. Each block received unfiltered pond water and sediment from a pond following ice out in June 2000. A warming treatment (control vs. 3.6° C warmed) was achieved by controlling the ventilation of greenhouse canopies that were suspended over each of the mesocosms. By the end of our 50-d experiment, warming significantly suppressed total zooplankton biomass because large cladocerans (*Daphnia pulex*) declined while rotifer (*Keratella cochlearis*, *Conochilus unicornis*) abundance increased during the second half of the experiment. In contrast, warming did not affect total phytoplankton biomass but significantly altered community composition by favoring phytoflagellates (*Mallomonas*, *Synura*, *Trachelomonas*) over larger filamentous green algae (*Mougeotia*, w). Warming did not significantly increase dissolved nitrogen and phosphorus concentrations. Therefore, warmer growing conditions and reduced grazer biomass best explained the increased abundance of more edible, fast-growing phytoflagellates in the warmed mesocosms. Our findings support the hypothesis that moderate warming can destabilize plankton dynamics, thereby potentially reducing the reliability of water quality and food resources for higher trophic levels (e.g., planktivorous fish) in shallow cold-water ecosystems.