The trophic role of marine pelagic ciliates and heterotrophic dinoflagellates in arctic and temperate coastal ecosystems: A cross-latitude comparison

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ABSTRACT: We compared seasonal studies of ciliates and heterotrophic dinoflagellates conducted in Disko Bay (West Greenland, ~69° N) and the Kattegat (Denmark, ~56° N). In both systems, ciliates and heterotrophic dinoflagellates were important components of the plankton. Their biomass was minute in the winter (October to April) in Disko Bay compared to the Kattegat, but from May to August/September, the biomass and composition of the ciliate and heterotrophic dinoflagellate assemblages were similar in the two systems. The seasonal biomass pattern was unimodal and bimodal for Disko Bay and the Kattegat, respectively. To evaluate top-down versus bottom-up control, experimentally derived maximum estimates of protozooplankton growth rates and copepod predation capacities from the study sites were applied to biomass data. This analysis showed that the effect of copepods was significant but that ciliates and heterotrophic dinoflagellates could effectively exploit prey during periods when top-down pressure was relaxed. In Disko Bay, a high copepod biomass in spring is primarily caused by migration of an overwintering copepod population from deep waters into the photic zone prior to the spring bloom. We suggest that "regulation windows" for the protozooplankton are present even during the spring bloom when copepods occur at their peak levels because of food saturation. Bottom-up regulation occurred during the winter and occasionally when copepod predation pressure relaxed, but it was difficult to separate food limitation from the effect of temperature. Multiple regression analysis supports the notion that ciliate and heterotrophic dinoflagellate biomass changed seasonally according to both top-down and bottom-up regulation, as well as to temperature control. Protozooplankton growth estimates were also used to calculate the fraction of primary production processed by the ciliates and heterotrophic dinoflagellates. When assuming complete algivory, 32-55% and 20-60% of the annual primary production was consumed by ciliates in Disko Bay and the Kattegat, respectively. Furthermore, because heterotrophic dinoflagellates were found to be as important grazers as ciliates in both systems, it was concluded that protozooplankton at high latitudes are also important in the cycling of primary production and should be considered if carbon and nutrient cycling in these systems is to be understood.

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