Dynamic bacterial and viral response to an algal bloom at subzero temperatures

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ABSTRACT: New evidence suggests that cold-loving (psychrophilic) bacteria may be a dynamic component of the episodic bloom events of high-latitude ecosystems. Here we report the results of an unusually early springtime study of pelagic microbial activity in the coastal Alaskan Arctic. Heterotrophic bacterioplankton clearly responded to an algal bloom by doubling cell size, increasing the fraction of actively respiring cells (up to an unprecedented 84% metabolically active using redox dye CTC), shifting substrate-uptake capabilities from kinetic parameters better adapted to lower substrate concentrations to those more suited for higher concentrations, and more than doubling cell abundance. Community composition (determined by polymerase chain reaction/DGGE and nucleotide sequence analysis) also shifted over the bloom. Results support, for the first time with modern molecular methods, previous culture-based observations of bacterial community succession during Arctic algal blooms and confirm that previously observed variability in pelagic microbial activity can be linked to changes in community structure. During early bloom stages, virioplankton and bacterial abundance were comparable, suggesting that mortality due to phage infection was low at that time. The virus-to-bacteria ratio (VBR) increased 10-fold at the height of the bloom, however, suggesting an increased potential for bacterioplankton mortality resulting from viral infection. The peak in VBR coincided with observed shifts in both microbial activity and community structure. These early-season data suggest that substrate and virioplankton interactions may control the active microbial carbon cycling of this region.

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