Bacterial utilization of organic carbon produced by Arctic copepods

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Bacterial activity produces roughly half of the carbon dioxide resulting from biological processes in the sea. With support from The James M. and Ruth P. Clark Arctic Research Initiative, we sought to determine if organic matter produced by zooplankton, specifically by copepods, would be converted to carbon dioxide and to quantify the amount of carbon dioxide produced. Our original hypothesis was that copepods would produce organic matter that caused increases in bacterial oxygen consumption compared to controls with no copepods. Prior to this project, there was no information quantifying carbon dioxide production by bacteria using organic carbon originating from copepods.

The experiments to test our ideas were conducted on the USCGC *Healy* during November and December of 2011. Copepods were collected with ring nets, sorted by species, and incubated at *in situ* temperatures. At the conclusion of the initial incubation, the water was gently siphoned to remove the copepods and placed into glass bottles equipped with oxygen sensors. These sensors permit monitoring of oxygen concentrations inside the glass bottles without the need to open the bottles. The experiments were run multiple times and in none of the cases did we observe a significant effect of copepods on bacterial respiration (see example of data in Figure 1). Thus, contrary to our expectations, the presence of the copepods did not increase bacterial respiration rates.

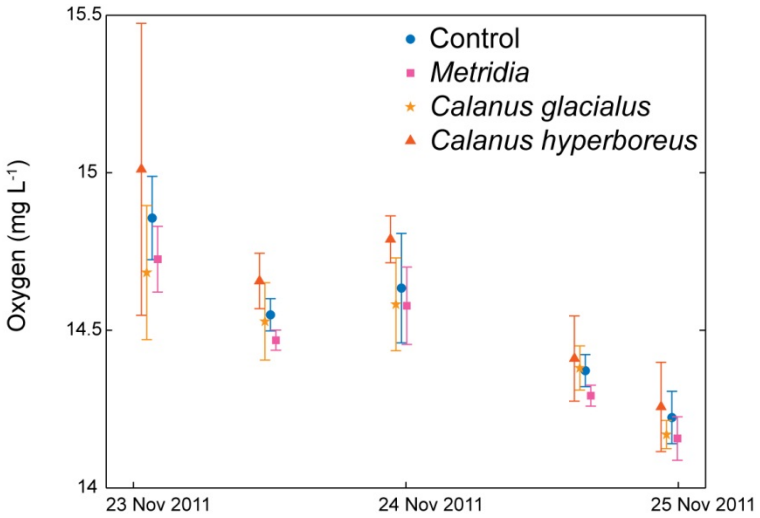

Figure 1. Measuring oxygen consumption rates after incubations with different species of copepods compared to a control. Oxygen consumption can be converted to carbon dioxide production, and is thus a measure of the amount of organic matter that bacterial cells are converting to carbon dioxide.

Given our initial results, we extended our research efforts to consider how zooplankton may impact the composition of organic matter available to the bacterial community. We used ultrahigh resolution mass spectrometry to examine the composition of dissolved organic matter released by lobate ctenophores. The organic matter released by the ctenophores had twice as many protein-like and lipid-like compounds compared to the controls. Furthermore, higher numbers of all compounds were found in the treatments with ctenophores, most notably the compounds containing carbon, hydrogen, oxygen, and nitrogen were prevalent in the treatments with ctenophores. These results indicate that ctenophores have a significant impact on the composition of dissolved organic matter which render it distinct from bulk seawater.

Ultimately, understanding differences in the amount and rate of bacterial carbon dioxide production in the Arctic has important ramifications for understanding the regional and global carbon cycles. While the project has resulted in a different path from its original inception, Longnecker has submitted an NSF proposal to continue investigating the impact of jelly-plankton on the composition of dissolved organic matter. We are grateful to the Clark Arctic Research Initiative for funding to begin this project.