

## **An East-West Comparative Study of Lower Trophic Level Pelagic Ecology in the Subarctic Pacific Ocean**

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PICES has designated the subarctic zone of the Pacific Ocean as its focal interest for fisheries management and ocean ecology. Oceanic sectors of this region have been conclusively shown by the SERIES and SEEDs iron-fertilization experiments to have iron-limited production at least part of the year, which explains in a general way their “high-nitrate, low-chlorophyll” (HNLC) character. Unanswered questions remain about lower trophic level production throughout the region. We ask that PICES assist in promoting observational studies to answer these questions.

First, west and east sectors differ in the seasonal sequence of production events. In much of the western gyre, represented by Site H studied by Japanese scientists, there is a strong April–May phytoplankton bloom after water column stabilization, followed by an iron-limited production regime through summer and autumn. In the east, iron-limitation is continuous, but the same spring period of water column stabilization sustains a sharp increase in primary production rates without a phytoplankton stock increase. Fully exploring the contrast between these ecosystems, particularly the difference in natural (unaugmented) iron availability to phytoplankton, requires comparative examination of the two oceanic sectors during their spring transition periods, preferably in the same year.

Second, the eastern sector with continuous iron limitation shows approximately 6-10 day oscillations in phytoplankton stock ( $\sim 0.15$  to  $0.5 \mu\text{g chlorophyll L}^{-1}$ ) and ammonia. As phytoplankton stock goes down, ammonia goes up, then the reverse. The upper limit for the typical nanophytoplankton may be set by iron availability (not directly nitrogen, since nitrate is always  $6 \mu\text{M}$ ); whereas there is no clear idea of what sets the lower limit, why phytoplankton stocks do not go lower. Microheterotroph (protozoan) grazing is coupled to this cycle, certainly causing the periodic recycling of nitrogen. Some feature of that grazing, possibly protozoans eating each other when phytoplankton becomes scarce, could regulate the low points of the cycle. Understanding these rapid oscillations of HNLC trophic relations will be best approached through time series analysis of phytoplankton, nutrients and grazers during the spring transition when the system goes through its greatest variation in overall productivity.

Third, the spring transition in both ecosystems supports the annual growth periods of four species (three *Neocalanus* spp. and *Eucalanus bungii*) of interzonal migrating copepods, the main contributors to subarctic mesozooplankton biomass, during the spring transition. In the west they can feed on the abundant diatom production of the spring bloom. In the east they are more food-limited, primarily eating protozoa and reaching smaller sizes at their entry to diapause (with associated descent to depth, the so-called interzonal migration). Comparative west and east studies of their growth rates would show the differential effects of high versus low food abundance for these species. Newly developed, biochemical estimators of growth rate, tools not available to earlier studies, would facilitate the comparison.

All of these objectives, and others as well, could be achieved by comparative expeditions during the spring transitions in the western and eastern Subarctic Pacific gyres, preferably in the same year. These would be long cruises, probably 50 or more days, possibly of two legs each. Scientists from Asia would most readily mount the western one, workers from Canada and the U.S.A. undertake the eastern one. The necessary levels of cooperation and communication to achieve fully comparable studies in each area can be greatly facilitated by PICES. Therefore, we respectfully request that the Biological Oceanography (BIO) committee endorse this project and recommend it to the attention of the Governing Council. We are still searching for an excitement-generating name for this project and will forward it to BIO soon. Groups of scientists on the respective sides of the ocean will develop programs for their regions, sustaining communication between the groups. We propose to initiate this communication with a workshop to examine all of the basic issues in the spring of 2005, looking toward actual expeditions in 2007 or 2008. We also ask that BIO endorse this workshop, for which we will seek support from national funding agencies.