THE EFFECTS OF MESOSCALE EDDIES ON MICROBIAL COMMUNITIES IN THE NORTH PACIFIC: RESULTS FROM THE FIRST AGOURON COURSE IN MICROBIAL OCEANOGRAPHY


BACKGROUND

In 2006, the Agouron Institute, in cooperation with the University of Hawaii and the Center for Microbial Oceanography: Research and Education (C-MORE), launched an inaugural summer course in microbial oceanography. This course allowed 12 students to apply the dynamic and fundamental role marine microbes play in shaping ocean ecology and biogeochemistry. A highlight of the course was two one week cruises aboard the R/V Kilo Moana. Here, we present results from those cruises.

STUDENT RESEARCH CRUISE FOCUS

Mesoscale eddies introduce spatial heterogeneity and temporal variability, affecting the biota of the regions where they form and decay. Eddies are associated with upwelling and downwelling, thus enhancing or suppressing productivity by changing nutrient and light availability. Students of the inaugural Agouron Institute Microbial Oceanography Course investigated anticyclonic and cyclonic eddies near the Hawaiian Islands in July, 2006. The class measured microbial activity such as primary productivity, bacterial productivity, and nitrogen fixation; biomass through chlorophyll, ATP, and particulate matter; and community diversity through high pressure liquid chromatography (HPLC). The Hawaii Ocean Time-series (HOT) station ALOHA and control stations outside the eddies provided comparative background measurements to determine the effects of the eddies on microbes in this open ocean environment. In general, activities, biomass and to a lesser extent diversity were enhanced within the eddies. Direct measurements of microbial communities within eddies are crucial to determine the contribution of these episodic events to production in the open ocean. This study also displays the importance of using field experience to teach methods in microbial oceanography.

PHYSICAL REGIME AND METHODOLOGY

At all stations, temperature, salinity, density, nitrate, chlorophyll a and dissolved oxygen profiles were measured in order to assess the physical and biological characteristics of each location.

Biomass

By all measures (e.g., particulate carbon (PC), phosphorus (PP), ATP and the ubiquitous photosynthetic pigment chl a) biomass concentrations were higher in the center of the cyclonic eddy relative to either the anticyclonic eddy station or the control station. When chl a distributions are viewed in density space, it is apparent that the upward displacement of isopycnals have brought denser, higher biomass waters into the upper water column, where increased photon fluxes could fuel photosynthetic growth.

ACTIVITY

Contrary to the expectation that microbial and photosynthetic activity would be highest in the center of the cyclonic eddy, with the exception of N fixation rates which were in fact highest within the cyclonic eddy, depth integrated rates of the photosynthetic incorporation of 14C by primary producers was maximal at the anticyclonic station and there were no significant differences between measures of bacterial production (either protein or DNA synthesis).

DIVERSITY

The diversity of the photosynthetic community was assessed during this course via HPLC quantification of taxon-specific pigment abundance. These data were only collected and analyzed for the second cruise (AG2) however this did allow us to explore a potential shift in community composition along a cross-section of this eddy formation. While, we found no significant differences between depth integrated abundance of major taxa along this transect, general increases in Prochlorococcus, prymnesiophytes and pelagophytes were observed at the center of the cyclonic eddy.

SUMMARY AND FUTURE

The Agouron summer course exposed students to a wealth of field and lab techniques as a way of preparing them for a career in microbial oceanography. From these hands-on cruises, we were able to explore the impact of mesoscale features on the abundance, distribution and productivity of different features of the North Pacific subtropical gyre. The 2007 Agouron summer microbiology course is being held June 25th - August 3rd. The application deadline is March 16th.

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