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Contribution of heterotrophic bacteria for degradation process of organic carbon in the ocean

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Proliferation of phytoplankton is the most important events that stimulate, upkeep and sustain all the biochemical processes in the oceanic ecosystems. This event contributes largely to biological pump facilitating carbon dioxide sequestration in the ocean. About half of the photosynthetically produced organic matter is consumed by heterotrophic microorganisms in the surface layers. Active growth and proliferation of these heterotrophs facilitate the build-up of biomass that is available to higher trophic levels via microbial loop. In addition, heterotrophic mineralization of organic matter in the surface layers is pivotal for recycling inorganic nutrients. Therefore, the interactions between phytoplankton and heterotrophic bacteria are central to the carbon cycle in the ocean.

The advent of culture-independent molecular approaches has facilitated the phylogenetic description microbial communities in the ocean. Several investigations during the last three decades, have described marine microbial communities through sequencing of phylogenetic marker genes directly from the environmental DNA samples. In addition, total bacterial production has been routinely measured by the incorporation of radiolabeled substrates. Yet, the fundamental questions that persist are 1) which phylogenetic groups account for total bacterial production? and 2) what is the relative contribution of each? Answers to these are substantially important to our understanding of the food web dynamics and biogeochemical cycles in the ocean.

To answer these questions, I have developed a novel method, named bromodeoxyuridine immunocytochemistry-fluorescence in situ hybridization (BIC-FISH) which method enable to measure the phylotyp-specific bacterial growth without using radiolabeled tracers. This combined method of two different techniques can measure single-cell activity or growth rate and, can identify its phylotype. The BIC is a technique to detect BrdU-incorporating (therefore actively growing) cells with the use of fluorescently labeled antibody. In this presentation, I introduce the interaction between heterotrophic bacterial and spring diatom blooms in the western North Pacific Ocean, and discuss about ecological roles of heterotrophic bacteria for degradation of organic matters produced by phytoplankton in the ocean.

Keywords: Marine bacteria, Community structure, Phytoplankton, Ocean carbon cycle