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Bacterial growth response to copepod grazing in aquatic ecosystems

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The growth rate response of bacterial communities to the potential increase of dissolved organic matter (DOM) produced by the copepod *Acartia tonsa* was assessed in experiments conducted in three stations representing three contrasting aquatic environments (coastal embayment, shelf and ocean). Bacterial assemblages were inoculated in filtered seawater where *A. tonsa* had previously grazed. Utilization of DOM over time was evaluated after the addition of bacterial inoculums as the biomass changes in both 'control' and 'copepod' treatments. In the embayment and ocean a high bacterial growth was observed in the treatments with seawater where copepod were feeding. Additional field measurements of bacterial, primary production and zooplankton biomass support the idea that bacterial communities living in oceanic environments can be efficient to utilize the newly available substrate. Copepods play a key role not only as conveyors of carbon up through the classical food-web, but also generated significant amounts of bacterial substrate in the microbial loop food-web.

INTRODUCTION

The significance of bacterioplankton in the cycling of organic matter in coastal and oceanic food webs has received considerable attention during the last decade (Azam, 1998). There is increasing evidence that the microbial food web is a fundamental and almost permanent feature in both oligotrophic and eutrophic marine systems (Vargas & González, 2004a,b). However, only half the high demands of dissolved organic matter (DOM) for heterotrophic bacteria in the microbial food web can be directly ascribed to the release of organic carbon from phytoplankton (Nagata, 2000).

Zooplankton act not only as consumers of an important fraction of the primary production (PP) and as nutrient regenerators, but also play an active role in the cycling of prey carbon into DOM (Peduzzi & Herndl, 1992). Marine copepods may constitute up to 80% of the total zooplankton biomass (Verity & Smetacek, 1996), and they are a key group in the energy transfer through pelagic food webs. An important percentage of the carbon grazed by copepods (~25 to 50%) may not be transferred directly to upper trophic levels, but may go directly to the microbial food web through the production of DOM (Møller, 2005). Copepods contribute to the pool of DOM through different mechanisms, such as, excretion, leakage from faecal pellets and sloppy feeding (Nagata, 2000). Therefore, it seems that copepods can play an important role influencing bacterial production (BP) in marine ecosystems through the production of alternative DOM sources, especially when copepods are feeding on long-chain forming cells (Møller, 2005), which typically occur in highly productive coastal regions (Vargas & González, 2004a).

Recent studies have shown differences in the ability of bacterial communities to utilize available substrate sources (e.g. Peduzzi & Herndl, 1992). In the present study we aimed to assess the effect of the grazing activity of *Acartia tonsa* on the biomass response of oceanic and coastal natural bacterial communities. Due to the potentially small changes in the DOM pool (against the large DOM background) produced by the addition of a small number of copepods, the potential utilization of DOM was evaluated as bacterial biomass changes over time in simple batch incubations. The added bacterial assemblages were treated as a total community and no effort to distinguish among neither species, nor functional groups were made.

MATERIALS AND METHODS

Study area

The study was carried out at a coastal area in the northern Humboldt Current System (HCS) off Mejillones Peninsula, Chile (23°S). Experiments were carried out at three stations representing an embayment (Station 1), shelf (Station 2) and ocean (Station 3) environment (Figure 1A). The first two sets of experiments took place during a research cruise between 5 and 20 April 2001 onboard the RV 'Abate Molina'. These experiments were conducted at two anchor stations, in an oceanic (80 n.m. from the coast) and shelf (5 n.m.) station (Figure 1A). The last experiment was conducted during 6 and 7 December 2002 during a field campaign onboard the RV 'Purihaalar' at a station located in Mejillones Bay (23°S 73°20'W; Figure 1A). The embayment and shelf stations were located close to