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Temporal and spatial stability of bacterioplankton biomass and productivity in an atoll lagoon

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ABSTRACT: Spatial and temporal variations of bacterioplankton biomass, production and growth rates were investigated 6 times from 1991 to 1994 in Tikehau lagoon (Tuamotu, French Polynesia). The water column was homogeneous from the surface to the bottom (20 m) at the reference station but some horizontal variations were detected, with biomass and production increasing from the reef-flat spillways (oceanic water inflow) to the main part of the lagoon and decreasing from the relatively eutrophic shore (near the village) to the main part of the lagoon. However, both of these perturbations were limited to the immediate vicinity of these areas. Diel fluctuations of bacterial biomass and growth rate were slight (coefficient of variation, CV < 20%) and showed no significant pattern. Day-to-day variations recorded over periods of up to 20 consecutive days appeared also to be limited (CV < 25%). A significant correlation between wind and total abundance of bacteria in the water column suggested that these day-to-day variations may be in part explained by wind, probably inducing resuspension of sediments. No significant pattern appeared from comparison of the 6 cruises spread over different seasons. Cruise averages differed slightly from each other, with CV for all cruises averaging 34, 10 and 41% for bacterioplankton biomass, production and growth rate, respectively. Tikehau lagoon appears to be a very stable ecosystem for bacterioplankton processes and therefore differs strongly from other reef water column systems. This untypical stability might be explained by the long residence time of water (170 d), the strong stability of the oceanic surrounding water (South Pacific Gyre), the weak seasonality of primary producers and the limited inputs from corals, bordering islands and sediments.

KEY WORDS: Bacterioplankton · Bacterial production · Thymidine incorporation · Leucine incorporation · Atoll lagoon · Pacific Ocean

INTRODUCTION

The development of epifluorescence microscopy and tracer approaches has led to a better understanding of the contribution of heterotrophic bacterioplankton to the cycles of energy and matter in various pelagic ecosystems. Heterotrophic bacteria are recognized to play a key role in most of the aquatic systems studied and particularly in oligotrophic waters where efficient recycling processes are crucial. This is consistent with the increase in the bacterioplankton to phytoplankton biomass ratio from eutrophic to oligotrophic systems (Cho & Azam 1990, Dufour & Torréton 1996).

Coral reefs areas are characterized by fast and efficient nutrient recycling processes and low standing stocks and inputs of new nutrients (Crossland & Barnes 1983). Understanding the production and fate of detritus is thus of great importance for the comprehension of the processes governing these ecosystems. The determination of bacterial production of biomass and heterotrophic activity represents an attractive shortcut to integrate the detrital fluxes coming from the wide variety of potential sources in coral reefs environments (Ducklow 1990).

Using the average surface area of 99 atolls (Stoddart 1965), Kinsey & Hopley (1991) calculated that the 425 atolls on the earth would represent 115000 km^2 and thus 19% of the total area (617000 km^2) covered by coral reef ecosystems (Smith 1978). Atoll and island lagoons often represent large bodies of oligotrophic water where heterotrophic bacterioplankton may constitute a large proportion of total carbon, nitrogen and phosphorus. Knowledge of bacterioplankton dynamics

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