LONGITUDINAL AND VERTICAL TRENDS OF BACTERIAL PRODUCTION AND HIGH AND LOW NUCLEIC-ACID BACTERIOPLANKTON CELLS IN MEDITERRANEAN SEA

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Abstract
The cytometric characteristics (Size Scatter and Green Fluorescence) and abundances of HNA (high nucleic acid) and LNA (low nucleic acid) bacterioplankton cells were examined in the frame of a Transmediterranean cruise held in summer 2008. LNA and HNA group showed remarkable distribution following vertical, chlorophyll and bacterial production gradients.
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In the last decade there has been an increasing documentation on the relationship between key bacterioplankton groups and their role in the heterotrophic bacterial production. Mediterranean Sea being strongly stratified and P limited during a large part of the year, P limitation of heterotrophic bacterial production is not uncommon. In the frame of French (BOUM : biogeochemistry from oligotrophy to ultra-oligotrophy of the Mediterranean Sea) and EU programs (SESAME: Southern European Seas, Assessing and Modelling Ecosystem changes) we examined bacterial production over different basins, with the attempt to focus on the role played by high and low nucleic acid groups (HNA and LNA groups, respectively) in relation to surrounding biogeochemical conditions. Most studies dealing on HNA and LNA after flow cytometry analysis focused mainly on their abundance distribution. Investigations using ^{3}H-leucine labelling coupled to cell sorting technique, since the pioneer study by Servais et al (1999), suggested the importance of HNA group to sustain bacterial production, these cells being not only larger but also more active per unit cell than LNA cells. However, in oceanic areas, the role of LNA to sustain a large part of bacterial production has been also evidenced [1], [2] et [3]. Flow cytometry allows also determination of other HNA and LNA group characteristics: Size Scatter (SSC) and green fluorescence (FL). Recently, it has been suggested that interactions within these two groups could be highly dynamics [1] and partly explained by the relationships between the cytometric characteristics of these 2 groups. However, although these 2 fractions are ubiquitous in aquatic systems, little is known about their distribution in the oligotrophic to ultraoligotrophic Mediterranean Sea, and nothing about their cytometric characteristics. Both HNA and LNA abundances increased with bacterial production, however the slope of increase of HNA being lower than that of LNA, the percentage of HNA slowly decreased when bacterial production increased (Figure 1). The cytometric characteristics of these 2 groups exhibited different types of relations according vertical distribution of chlorophyll, notably distinct groups emerged for layers above the deep chlorophyll maximum (dcm), below the dcm and for deep layers (-250 m). ^{3}H-leucine labelling coupled to cell sorting enabled us to reveal the distribution of high and low nucleic acid groups within heterotrophic bacterioplankton in terms of leucine assimilation and response to amendments, as well as the potential of some cyanobacteria to assimilate organic compounds. HNA cells responded drastically after nitrogen+phosphorus enrichments by both increasing their abundance, their contribution in term of total abundance but also their per cell activity, with a final contribution of total BP reaching 86%, demonstrating its zymogenous-type behaviour. However for in situ steady state conditions of oligotrophy, HNA cells exhibited large variability of per cell activity according to the cell size, the low size HNA group exhibiting the same per cell activity than LNA cells. LNA cells were abundant within the surface layers (41 to 74 % of abundances) and their bulk activity could be responsible of up to 65 % of the total bacterial production.

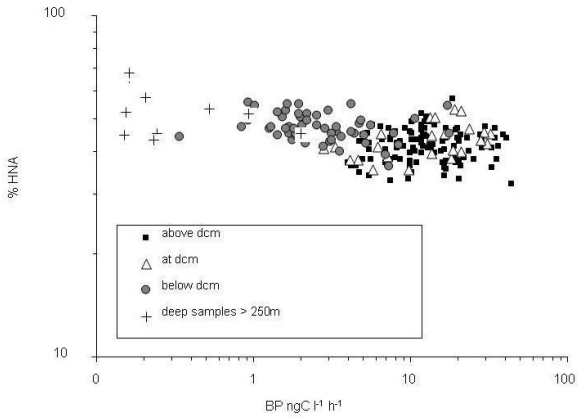

Fig. 1. Relationship between the proportion of HNA cells and the bacterial production over vertical and horizontal gradient in the Mediterranean Sea. Distinct groups were identified according vertical distribution of chlorophyll a

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