Bacterioplankton processes at the Iberian shelf

Helena M. Galvão, Ana Barbosa & Carlos S. Rocha

U.C.T.R.A., Universidade do Algarve, 8000 Faro, PORTUGAL

Abstract

To estimate the importance of bacterioplankton processes in the energy fluxes at the Iberian shelf, the 3-D structure of bacteria distribution will be described as well as its seasonal variation. Bacterial processes will be estimated on board two cruises this summer where bacterial production with incorporation of ^{14}C-leucine and the fraction of respired 1eucine will be routinely measured in OMEX II reference transects. Large bottle experiments will be set up in one cruise to measure DOC uptake and resultant increase in bacterial biomass.
Preliminary results in bacteria distribution of samples collected during Charles Darwin 110b cruise (January 1998) indicated a decrease in bacteria biomass at the surface with distance from the coast, as well as decreasing trend from North to South. Vertical profiles at two deep stations (P1000 & P2800) suggested different bacterial assemblages in deeper Mediterranean waters.

Introduction

Advances in microbiological techniques developed in the last two decades have permitted more precise estimates of standing stock and activity of bacterial populations in the sea (eg. Hobbie *et al.,* 1977; Fuhrman & Azam, 1982; Kirchman, *et al.,* 1985). Thus, it is now possible to assess accurately the importance of bacteria in marine ecosystems and, in particular, the role of the "microbial loop" as a dynamic sink for carbon in the oceans. Recent technological progress in marine chemistry also have enabled more sensitive quantification of oceanic DOC pools (eg. Sharp *et al.,* 1994). It is now possible to obtain direct measurements of bacterial growth efficiencies using growth experiments where DOC uptake and increase in bacteria biomass are followed. This study aims to achieve an integrated approach where different components on the "microbial loop" will be measured simultaneously by different partners in transects off the coast of Vigo.

Methods

Total bacteria number (TBN) and mean cell volume (MCV) will be determined using acridine orange direct counts with epifluorescence microscopy (Hobbie *et al.,* 1977). Biomass calculation will be determined as a non-linear function of cell volume according to Simon and Azam (1989). Bacterial production will be quantified using the incorporation of ^{14}C - leucine as described in Kirchman *et al.* (1985; 1986). This method has the advantage of circumventing problems associated with other techniques using incorporation of ^{3}H-thymidine and ^{3}H-leucine to measure bacterial production. Bacterial respiration will be measured as the respired fraction of ^{14}C-leucine after incubation for bacterial production (unpubl. method). Bacterial growth efficiency will be assessed using dilution/filtration experiments where the increase in bacterial biomass will be followed as well as the decrease in total DOC (Carlson and Ducklow, 1996).

Results

Table 1 (Annex 1) lists bacterial data (MCV, Mean Carbon Content per cell, TBN and Biomass) obtained from 30 samples collected during Charles Darwin cruise 110b in January 1998.

Discussion

Preliminary results obtained during this winter cruise (CD 110b) revealed very small bacterial mean cell volume (0.20 μm^3 average), as well as total bacteria number (0.30 $X10^6$ bac/ml). There was a decreasing trend in biomass in surface waters away from the coast and from North to South transect lines. Vertical profiles at two stations (P1000 & P2800) suggested different bacterial assemblages in deeper Mediterranean waters with larger mean cell volume (see Table 1) and higher frequency of dividing cells (unreported data).

References

Carlson C.A and Ducklow H.W. 1996. Growth of bacterioplankton and consumption of dissolved organic carbon in the Sargasso Sea. Mar. Ecol. Prog. Ser. 10: 69-85.

Fuhrman J.A. and F. Azam. 1982. Thymidine incorporation as a measure of heterotrophic bacterioplankton production in marine surface waters: evaluation and field results. Mar. Biol. 66: 109-120.

Hobbie J.E., Daley J.R. and S. Jasper. 1977. Use of Nuclepore filters for counting bacteria by epifluorescence microscopy. Appl. environ. Microbiol. 33: 1225-1228.

Kirchman D.L., Knees E. and R.E. Hodson. 1985. Leucine incorporation and its potencial as a measure of protein synthesis by bacteria in natural aquatic systems. Appl. environ. Microbiol. 49: 599-607.

Kirchman, D.L., Newell S.Y. and R.E. Hodson. 1986. Incorporation vs. biosynthesis of leucine: implications for measuring rates of protein synthesis and biomass production by bacteria in marine systems. Mar. Ecol. Prog. Ser. 32: 47-59.

Sharp, J.H., Benner R., Bennett L., Carlson C.A., Fitzwater S.E., Peltzer E.T. and L.M. Tupas. 1994. Analyses of dissolved organic carbon in seawater: the JGOFS EqPac methods comparison. Mar. Chem. 48: 91-108.

Simon M. and F. Azam. 1989. Protein content and protein synthesis rates of planktonic marine bacteria. Mar. Ecol. Prog. Ser. 51: 201-213.

ANNEX 1

Table 1. Bacterial mean cell volume (MCV), mean carbon content per cell (MCC), total bacteria number (TBN) and biomass from samples taken in CD 110b (January 1998).
N & S lines: non-toxic underway supply at surface; P line: vertical profiles at 4 stations.

Station	Depth	MCV (μm^3)	MCC (fg C/bac)	TBN ($X\ 10^6$ bac/ml)	Biomass (µg C/l)
N100	**4m**	0.020819	8.706807	0.2523	2.196727
N220	**4m**	0.016969	7.805806	0.298	2.32613
N700	**4m**	0.023117	9.451364	0.302	2.854312
N1600	**4m**	0.020078	8.606058	0.228	1.962181
N2000	**4m**	0.019039	8.279587	0.295	2.442478
N2300	**4m**	0.017664	7.963777	0.262	2.08651
N3100	**4m**	0.016798	7.430562	0.274	2.035974
N3300	**4m**	0.015829	7.436205	0.245	1.82187
S1000	**4m**	0.019905	8.524151	0.305	2.599866
S2000	**4m**	0.015445	7.331405	0.458	3.357783
S2250	**4m**	0.016498	7.624017	0.467	3.560416
S2550	**4m**	0.031723	10.71658	0.36	3.857968
S2600	**4m**	0.021495	8.829913	0.357	3.152279
P100	**10m**	0.018516	8.084088	0.582	4.704939
P100	**25m**	0.018393	7.444443	0.256	1.905778
P100	**48m**	0.0191	8.139585	0.77	6.267481
P100	**67m**	0.018604	8.139625	0.305	2.482586
P100	**95m**	0.015578	7.521424	0.315	2.369249
P200	**8m**	0.022425	8.869068	0.317	2.811495
P200	**25m**	0.016565	7.648627	0.319	2.439912
P200	**52m**	0.02232	8.737888	0.324	2.831076
P200	**76m**	0.01241	6.588489	0.308	2.029255
P200	**101m**	0.016578	7.449097	0.271	2.018705
P200	**175m**	0.017701	8.007186	0.282	2.258026
P1000	**9m**	0.016406	7.661242	0.342	2.620145
P1000	**29m**	0.016703	7.559434	0.35	2.645802
P1000	**52m**	0.015139	7.446975	0.343	2.554313
P1000	**78m**	0.023745	9.431417	0.361	3.404741
P1000	**102m**	0.016134	7.620464	0.352	2.682403
P1000	**201m**	0.023978	9.136977	0.115	1.050752
P1000	**296m**	0.021797	8.659471	0.904	7.828161
P2800	**7m**	0.019016	8.401547	0.28	2.352433
P2800	**81m**	0.01865	8.214833	0.287	2.357657
P2800	**125m**	0.018656	8.135747	0.282	2.294281
P2800	**155m**	0.013994	7.027733	0.178	1.250937
P2800	**486m**	0.025166	9.197698	0.092	0.846188
P2800	**635m**	0.023846	9.22271	0.049	0.451913