

Interactive comment on “Short-term temporal variations of heterotrophic bacterial” by G. Mével et al.

G. Mével et al.

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Answer to Anonymous Referee #3

Answers to referee #3 are reported point by point. Changes in the text are located by the number of the corresponding line in the revised version of manuscript (together with number of the corresponding line in the original manuscript (BG numbers), when necessary):

Answer to general comments:

Answer to general comments from “This work provides a considerable amount of measurements...” to “...also this effort in the abstract.” A sentence has been added in the revised version of the manuscript on Page 2, lines 16-17 (BG Page 1900, line 17) “In the mesopelagic layers, bacterial abundance and production linearly decreased with

depth, except some production peaks between 400-750 m.”

Answer to general comments from “In the results section the obtained data...” to “...included as well in Lemée et al. 2002 (page 1913 line 15)?” The results presented here are related to our previous work in March and June 2003 in the same zone (Ghiglione et al. 2007). As pointed out by the reviewer, it is interesting to compare these data apart from one year and we agree that it may confuse the reader about the origin of the samples. The relation between our previous investigation at the DYFAMED site (Ghiglione et al. 2007) and this study has been clarified on Page 4 line 24 to page 5 line 12 (BG page 1902, lines 15 to 25): “The vertical and temporal dynamics of heterotrophic bacteria (Van Wambeke et al., 2001; Lemée et al., 2002; Tanaka and Rasoulzadegan, 2004; Mistic and Fabiano, 2006) and the contribution of particle-attached bacteria (Turley and Stutt, 2000; Harris et al., 2001) have already been reported in the NW Mediterranean Sea. In a previous study, we have shown that the contribution of attached bacteria to total bacterial activity can reach until 83% under mesotrophic condition, then reinforcing the biogeochemical role of this fraction in the cycling of particulate organic carbon in the NW Mediterranean Sea (Ghiglione et al., 2007). However, the temporal scales at which bacterial abundance and production vary through the water column are still missing. A companion paper (Ghiglione et al., 2008) explored the community composition of the bacterioplankton along the depth gradient with molecular biology tools but do not investigate the effect of episodic events because of methodological considerations. In this study, we provide a large set of data on the vertical (0-1000 m) and temporal (from hour to week scales, during 5 weeks) dynamics of total vs. particle-attached bacterial abundance and activity under summer-autumn transition at a site very close to the JGOFS-DYFAMED station in NW Mediterranean Sea.” To make this point even clearer, references to this article and how samples were compared have been added: -Page 5, lines 12-14: “The seasonal pattern was investigated by comparison with results previously obtained at the station DYFAMED (Ghiglione et al., 2007).” -Page 13, lines 1-3 (BG page 1908, line 10): “The results we obtained during the September-October 2004 sampling period were compared to those obtained for

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two previous cruises conducted at the same site in March and June 2003 (Ghiglione et al., 2007) (Table 1).” -Table 1 legend (page 37, lines 4-5; BG page 1926): “March and June 2003 data originated from previous cruises at the station DYFAMED (see Ghiglione et al., 2007).” - Page 18, line13 (BG Page1913, line15) Lemée et al. 2002 has been removed.

Answer to general comments from “Bacterial Production (TBP) was measured with...” to “... reasonable to compare TBP, free-living and particle-attached bacterial activity.”

We agree with reviewer that using the same method (filtration method) for all samples is more reasonable to compare TBP and ABP. However, in the present study (on the contrary to Ghiglione et al. 2007) the high frequency sampling involved the centrifugation method for routinely estimate TBP in all samples because it is more rapid, more economical and substantially reduces the amount of radioactive wastes. And, on the other hand, the centrifugation method is unusable for ABP estimate in size-fractionated samples because it is better to filter samples after incubation and this involve relatively large volumes. To make these points clearer, two sentences have been added in the text: -Page 10, line 12 (BG page 1906, ligne 20): “The production in $<0.8 \mu\text{m}$ fraction was always smaller that the total production.” -Page 10, lines 17 to 20 (BG Page 1906, ligne 26): “The TBP measured in 84 subsurface samples by using the both methods showed no significant difference (mean TBP= 22.52 ± 5.50 and 20.01 ± 4.85 ngC l⁻¹ h⁻¹ with centrifugation and filtration methods, respectively).”

Answer to general comments about the P index: P index has been defined and the way to find the information about calculation of this index has been improved in the Materials and methods section on Page 6, lines 16-22 (BG page1903, ligne15): “Low salinity water masses (LSW) percentage in the water column was depicted by the P index, based on average salinity S in the 40-70 m water layer, according to the following formula: $P \text{ index} = (S_{\text{max}} - S(\text{sta})) / (S_{\text{max}} - S_{\text{min}})$; S(sta) is the average salinity in the 40-70 m layer, S_{min} is that of the water taken as reference for dessalted water (coastal waters in our case), S_{max} is that of the salinity waters without anomaly (see

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<http://www.obs-vlfr.fr/proof/vt/op/ec/peche/pec.htm> - data DYNAPROC log & basic files - for more detailed explanation).”

Answer to specific comments:

-Page 3, lines 2-5 (BG Page 1900, lines 22-25): the sentence has been changed into: “At concentrations ranging between 104-106 cells ml⁻¹, marine bacteria represent the most abundant and biogeochemically important organisms in the oceans. On-half of oceanic primary production on average is channelled via bacteria into the microbial loop (Azam et al; 1983; Cole et al. 1988).”

-Reference has been added on Page 3, line 17 (BG 1901, line 12): “(www.nsf.gov/bio/pubs/awards/mo03.htm)”

-Page 6, lines 5-6 (BG Page 1903, line 5): “... at an offshore station (28 miles offshore, 43°25′N, 8°00′E) located near the permanent DYFAMED station (43°25′N, 07°51′E)...”

-(BG Page 1908, lines 18-19): This sentence has been modified on Page 13, lines 11-13 (BG Page 1908, lines 18-19): “Total Bacterial Abundance (TBA) generally increased from surface to the DCM and decreased below, with maximal values observed at the surface waters at the end of the two studied periods (JD 269-273 and JD 286-289) (Fig 1).” There is no more contradiction with the sentence Page 1911, line 9 (BG).

-Page 18, line 25 (BG Page 1914, line 2): “phytoplankton nutrients” has been changed into “nutrients from phytoplankton origin”

-Page 19, lines 2-6 (BG Page 1914, lines 4-8): the sentence “In our study...(Van Wambeke et al 2002).” have been removed. In Material and Methods section, the sentence have been replaced on Page 9, lines 1-4 (BG Page 1905, lines 14-15): “Heterotrophic bacterial biomass (BB) was calculated by using a carbon content per cell of 15 fg C cell⁻¹ generally used in oligotrophic ecosystems (Fukuda et al., 1998; Caron et al., 1999), and conversion factors taking into account photoacclimatation were used to

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evaluate the autotrophic biomass (Van Wambeke et al., 2002)..

-The paragraph has been changed on Page 19, lines 9-21 (BG Page 1914, line16): “For the entire study period, we found a significant correlation between 0-150 m integrated bacterial biomass and Chla concentration ($R=+0.44$, $p<0.05$, $n=54$) but this relation was more significant in the 40-80 m layer ($R=+0.67$, $p<0.01$, $n=54$) compared to 0-20 m layer ($R=+0.13$, $p<0.05$, $n=54$). In a same way, bacterial abundance and bacterial production measured into the Chla maximum layer (40-80 m) were also strongly linked during the whole sampling period ($R=+0.65$, $p<0.01$, $n=162$), whereas no significant relation was observed in the surface mixed layer (0-20 m). These results showed vertical variations of bacterial dynamics and suggest that bacterioplankton living in the Chla maximum layer was regulated by C-compounds derived from phytoplankton activity. In addition, linear regression analysis calculated in the 40-80 m layer between integrated BB and Chla concentration ($Y=0.24X+5.25$, $R^2=0.65$, $n=54$) showed a slope <1 suggesting that bacterial responses to resource availability tend to be attenuated by predation or viral pressure (Ducklow and Carlson, 1992; Dufour and Torreton 1996; Weinbauer et al; 2003).”

-The sentence has been completed on Page 19, line 8-9 (BG Page 1914, lines 11-20): “For the entire studied period, Chla concentration was low (from 0.16 to 0.40 mg m⁻³ in the upper 150m) and we...”

-The results of the BB-BP linear regression analysis have been clarified on Page 19, lines 17-19 (BG Page 1914, line 19): “In a same way, bacterial abundance and bacterial production measured into the Chla maximum layer (40-80 m) were also strongly linked during the whole sampling period ($R=+0.65$, $p<0.01$, $n=162$), whereas no significant relation was observed in the surface mixed layer (0-20 m).”

-Page 19, line 21 (BG Page 1914, line 21): “Christaki et al. 2004” has been changed into “Weinbauer et al., 2003”. The reference “Christaki et al. 2004” has been removed and replaced by “Weinbauer, MG, Christaki, U, Nedoma J and Simek, K.: Comparing

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the effects of resource enrichment and grazing on viral production in a meso-eutrophic reservoir. *Aquat. Microb. Ecol.*, 31, 137-144, 2003.”

-Page 21, lines 1-3 (Page 1915 line 12), a sentence have been added: “This observation suggests that these desalted waters were characterized by a lower bacterial populations compared to surrounding waters.”

-Page 25 lines 8 to 14 (Page 1918, line 27), a sentence have been added:: “Such discrepancy could be due to differences in the studied systems (mainly in the size, nature and concentration of particles) or in protocols used to measure total bacterial production and to separate attached bacteria from free-living cells. In mesopelagic waters, the contribution of the attached fraction to the total bacterial production was generally low (less than 2%), except in some occasion (maximum of 18% at 500 m depth), but without any relation to exceptional increase of total bacterial production described above.”

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