**Biogeosciences**
Discussions

# *Interactive comment on* "Major constrains of the pelagic food web efficiency in the Mediterranean Sea" *by* L. Zoccarato and S. Fonda Umani

**L. Zoccarato and S. Fonda Umani**

luca.zoccarato@phd.units.it

âĂć This manuscript analysed more than 80 dilution experiments carried out in many Mediterranean sites at the surface and in the meso-bathypelagic layers. At least to me, I think all chapters need a throughout revision. ANSWER: We thanks the reviewer for this criticism, we completely reviewed our manuscript.

âĂć Because the authors can estimate grazing and growth rates of pico- and nanoplankton by using dilution method, I did not find any results or discussion about growth rates. ANSWER: The growth rates were used to compute the potential production rates. In the new version of the manuscript the ratio between ingestion rates and potential production represents the ingestion efficiency.

âĂć Furthermore, the authors must be showed the production rates of pico- and nanoplankton in C-budget (Fig. 9). ANSWER: We are afraid that the graph will become too messy.

âĂć I would appreciate if authors invest a bit more work in a clear and attractive presentation of their results. E.g. Fig. 9 is of interest but with the current design not very convincing. ANSWER: We rewrote the results and hopefully we make them more focused and concise.

âĂć To me, I think this paper has not been well characterized as of yet, so I strongly encourage the authors to reanalyze their data and make the appropriate modifications to the manuscript. This manuscript needs to be addressed and the results and discussion rewritten to focus on the new analysis. ANSWER: We thanks the reviewer for his suggestion, as we said, we reviewed the whole manuscript and we also partially reanalysed the data.

Specific Comments: âĂć P.4366, Abstract: You did not describe the important results and findings in the abstract. You showed this study analyzed with dilution experiments at the surface and meso-bathypelagic layers, I cannot find the important results about these depths, Please reword this paragraph in the Abstract. ANSWER: We changed the abstract as follow: "In this study, we analyzed more than 80 dilution experiments carried out in many Mediterranean sites at the surface that covered a wide range of trophic conditions, and in the meso-bathypelagic layers. Our major aim was to test the hypothesis that picoplankton, and particularly heterotrophic prokaryotes, are pivotal in sustaining not only nanoplankton but also microzooplankton energy requirements at all considered trophic states. Our results highlighted as bacterivory was the major pathway of organic carbon in oligotrophic and meso-eutrophic environments. Microzooplankton mostly fed directly or indirectly (through nanoplankton exploitation) on picoplankton. In eutrophied conditions herbivory was the main trophic pathway, however heterotrophic picoplankton represented a not negligible source of carbon. In this condition we assessed the lowest food web efficiency possibly because of con-

sumers' satiation, which translated in an excess of autotrophic biomass available for export or transfer to higher trophic levels. Food web efficiency was higher in meso-eutrophic and oligotrophic conditions where the major pathway was bacterivory. In the meso-bathypelagic layers we assessed only nanoplankton predation on heterotrophic picoplankton. Also in this case food web efficiency, nevertheless the diluted environment, was relatively high. Nanoplankton seemed able to efficiently exploit the available HP biomass."

âĂć p.4367, please delete the first paragraph (lines 2-6). I think it's not necessary to describe the "class food web". Furthermore, to me, I think this paper in "Introduction section" has not been well characterized as of yet, there were too many paragraphs (14 paragraphs) in this section. Please reword these paragraphs (reduce to 3-4 paragraphs) in the Introduction. ANSWER: We completely rewrote the introduction to avoid well obvious information, improve the logical flow of the topics and better focus the readers on the aim. Please, see the new manuscript.

âĂć Most important to me, what is good hypothesis in your study? ANSWER: We reformulated our hypothesis as follow: "To test the hypothesis that picoplankton, and particularly heterotrophic prokaryotes, are pivotal in sustaining not only NP but also MZP energy requirements over a wide range of trophic conditions, we compared the results of more than 80 dilution experiments (Landry and Hasset, 1982) carried out in the entire Mediterranean Sea."

Methods: âĂć p. 4371, Line 8. (-0.5 m). Rephrase: (0.5 m depth). p.4372, line 26. ….., mean concentration of the prey…… Rephrase: ….., mean concentration of the prey (Cm)……. In the method section, the authors can estimate growth rates of bacteria……using dilution experiment (MZP) and dilution experiment (HNF), however, authors did not clear show the detail about how to estimate the growth rates of bacteria in which dilution experiments? ANSWER: We thanks the reviewer for these suggestions, we made all these changes.

Results âĂć p.4374-4375, First paragraph in Results. What is the seasonal range of Chl a and Primary production in the surface waters? To me, I did not agree the author's analysis, showed the values of Chl a concentrations divided into 3 trophic conditions. Such as, I always think that the value of 61.93 $\mu$g C L-1 can be considered eutrophic, not mesotrophic. It is unfair to say that. Furthermore, there are different factors controls on the Chl a values in surface and meso-bathypelagic layers. Is a spatial or seasonal distribution of Chl a in Fig. 2? Ambiguity of data presentation and interpretations also make readers confusing. ANSWER: We thanks the reviewer for the criticism, we changed that paragraph as follow: "Figure 2 shows the biomass of all primary producers and the chlorophyll a values assessed at the surface per each sampling event. We arbitrarily divided the increasing biomass values into three major groups: the first one with values for total autotrophic fraction < 6.44 $\mu$g C L-1 that we consider representative of oligotrophic conditions (mean chl a 0.22 mg L-1); the second one that can be consider meso-eutrophic with an autotrophic total carbon < 61.93 $\mu$g C L-1 and mean chl a of 0.60 mg L-1 and the last one which can be considered very eutrophic (or eutrophied) with biomass largely exceeding 100 $\mu$g C L-1 and mean chl a of 2.60 mg L-1. Groups presented significant differences among them (one-way Kruskal–Wallis test was highly significant, p-value < 0.0001)."

âĂć p.4375, line17. Considering only prey's biomass,………Considering prey's biomass for which size of grazers??? ANSWER: We are sorry for the misunderstanding, we change that paragraph as follow: "Considering only preys' biomass for microzooplanktonic consumers (HP, AP, NP, MPP), in oligotrophic and meso-eutrophic conditions NP and picoplankton …"

âĂć p.4375, line28. In oligotrophic conditions NP and HP manly supported MZP……Rephrase:..In oligotrophic conditions NP and HP "mainly" supported….. ANSWER: We are sorry for the mistake, we fixed it.

âĂć Furthermore, if effects of "trophic cascades" in MZP dilution grazing experiments were there the ingestion rates was under- or overestimated in this study? ANSWER:

We expanded the concept as follow: "We are aware that results of MZP dilution experiments include the effect of viral lysis (Parada, 2007; Fonda Umani et al., 2010; Di Pol et al., 2013) and the mortality due to NP predation (e.g. Stoecker et al., 2013). To partially solve this latter problem we performed parallel experiments to estimate the predation of NP alone. We can expect three different models of interaction: i) only NP graze on picoplankton, therefore the ingestion rates calculated in NP experiments are the same obtained in the MZP experiments; ii) MZP grazing on NP reduces the ingestion calculated for NP alone; iii) MZP directly feed on picoplankton, and consequently ingestion rates obtained for MZP experiments are higher than for NP experiments (Fonda Umani and Beran, 2003)."

âǍć p.4376, line11. What is "grazing efficiency"? The authors did not show the detail about "grazing efficiency" in the Methods section. ANSWER: We thanks the reviewer for the criticism, we added a description on the ingestion efficiency in the methods: "The ingestion efficiencies of MZP and NP were calculated for each prey by dividing the ingestion rate by the corresponding preys' potential production estimated respectively in the MZP and NP dilution experiments. Potential production is considered a good proxy for primary production (Calbet and Landry, 2004)."

âǍć In addition, what is unit of "grazing efficiency" in Fig. 3? Is $\mu$g C L-1 d-1/$\mu$g C L-1 for the unit of "grazing efficiency" in your study?? To me, it is better to show the ratio of grazing rates to growth rates. ANSWER: We really appreciated this suggestion and we changed how we estimate the ingestion efficiency. Now it is the ratio of ingestion rate over the potential production. Consequently we change the figures, the description in the results section and the discussion.

âǍć Could you shorten your results, it is too long to read clearly. I think this paper has not been well characterized as of yet, so I strongly encourage the authors to reanalyze their data and make the appropriate modifications to the manuscript. The paper should be about 50% of its current length in the RESULTS part. ANSWER: Reviewing the ms we rewrote the results. We made them shorter and hopefully more focused.

âǍć Furthermore, I must to say the results and discussion rewritten to focus on the new analysis, again. ANSWER: We reviewed and rewrote the ms making new analysis. Please see the new manuscript.

Please see the posted new version of the manuscript.

Interactive comment on Biogeosciences Discuss., 12, 4365, 2015.