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Biogeosciences Discussions

Interactive comment on "Temperature dependence of Arctic zooplankton metabolism and excretion stoichiometry" *by* M. Alcaraz et al.

Anonymous Referee #1

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General comments

This paper describes a study on possible changes to stoichiometric ratios of C/N, C/P, and N/P of zooplankton in a warming Arctic. As the primary tool to do this, the authors use metabolic rates of respiration, N-release, and P-release from different locations in the Greenland Sea with different temperatures. The results show that increasing temperature may change the stoichiometric ratios. Since release of N and P from zooplankton cover a substantial part of the demand for primary production, this would impose significant changes in the plankton community in the future. The paper, which is of high scientific quality, addresses an important issue of global change. The scientific methods and assumptions are valid but the paper suffers a little from lack of method description and the many references to methods in previous papers. However, the principal conclusion regarding the influence on plankton ecology of the changing zooplankton metabolism is well founded in the results.

Specific comments

One major concern is that it seems that this paper treats results from an original paper already published in Polar Biology (Alcaraz 2010, Pol Biol 33: 1719-1931). If this is so, the present paper is more of a review, and it should as such include data from several sources (Ikeda et al. 2001, Mar Biol 139: 587-596 is a good example). A major revision would therefore be needed. If the study is indeed based on new data I suggest minor revisions.

The study has been conducted in both polar surface water, Atlantic water, and mixed water. This introduces a potential problem relating to variations in other variables than temperature. As I see it, one primary concern is a possible bias induced by differences in prey concentration and composition among stations. For instance, respiration rate may increase 3-fold when prey concentrations increase from 20 to 500 μgC L-1 (Thor et al. 2002 JPR 24: 293-300). There is also a 3-fold difference caused by feeding on different phytoplankton prey (same study). Judging from Lasternas and Agustí 2010 (Pol Biol 33: 1709-1717) phytoplankton composition was dominated by Phaeocystis pouchetti at most stations north of Svalbard. However, one might hypothesize that the phytoplankton community composition would be different at the southern stations in Atlantic water. This would alter metabolic rates considerably and potentially change stoichiometric ratios. Moreover, of the northern-most stations, station 27 stands out in particular, showing a dominance of diatoms rather than Phaeocystis. It seems that this was also where the highest temperature was found (6.56 ïĆřC; according to Alcaraz et al 2010). Although the different data points in the present paper are not appointed to stations one may suspect that data from station 27 are plotted at the highest temperature in figure 2. If this is true, the regressions may indeed be biased by different phytoplankton composition among stations. This bias could have been avoided by acclimating individuals from the same location to different temperatures and then mea-

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Interactive Comment

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sure metabolic rates.

Another point to be made is that the development of metabolic rates during ocean warming may not be controlled entirely by the dependence of present biochemical reaction rates on temperature as is implied in this paper. Global warming is a gradual process slow enough to allow adaptation in the affected populations. Such adaptation may alleviate temperature effects, and we may exaggerate responses when basing conclusions on short-term physiological measurements. However, by sampling different stations in different temperature regimes (with populations potentially adapted differently), the authors may incidentally have included evolutionary effects in their measured metabolic variables. Nevertheless, the problem still remains that metabolism may have been influenced by phytoplankton composition differences. The optimal solution would be reciprocal transplant or common garden experiments where individuals from several different locations would be treated to a range of identical temperatures. Such an approach would enable us to evaluate if the observed physiological differences among locations are due to phenotypic plasticity in the measured traits, different evolutionary adaptations, or a combination of both. This would allow a better prediction for the warmer future.

I have no comments on language or the overall presentation of the text.

Interactive comment on Biogeosciences Discuss., 9, 7443, 2012.

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