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Discussions

Interactive comment on "Global distribution of pteropods representing carbonate functional type biomass" *by* N. Bednaršek et al.

Anonymous Referee #1

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GENERAL COMMENTS This paper presents a compilation of the abundance and biomass data from the literature and online databases for pteropods, including gymnosomata, euthecosomata and pseudothecosomata. This global distribution of pteropods was then converted to carbon biomass. As the first paper meta-analysis estimating global and seasonal patterns in the distribution for these animals, it is a valuable contribution to the literature. The reported results are not riveting, but do point to areas of the ocean, seasons and depth strata which need better sampling while suggesting some interesting trends in latitudinal and depth distributions. In particular this information is timely in regards to concerns about the potential implications for changing carbon cycling for planktonic zooplankton as a result of anthropogenic impact, especially the calcifiers who may be particularly sensitive to ocean acidification. However, the data set associated with the article was not accessible by me on PANGEA so I

am unable to assess the format and usefulness. (Specifically the error was "The user logged in is not allowed to download files of dataset doi:10.1594/PANGAEA.777387 - please login with another user name!")

This dataset is unique, useful and relatively complete. I have some major concerns about the method for biomass estimations and a potential alternate method of assessment (see specific comments). It would be useful to know how easily data could be added to the database as the number of publications focusing on pteropods has increased sharply over the past few years and it will be useful to include this new data as it becomes available.

SPECIFIC COMMENTS Page 319, Line 19: The external shell is present in some pseudothecosomes (Peraclididae have a shell), it is only absent in the advanced forms. The most defining characteristic of this group is the fusion of the swimming plate.

Page 327, second paragraph: Similar multi-year life cycles have been documented for Arctic gymnosomes (Boer et al, 2005) and may contribute to residual biomass as well.

One of my concerns is that after an initial discussion of the differences between gymnosomata, euthecosomata and pseudothecosomata – which are substantial – the authors subsequently refer to all samples as pteropods. These groups differ in their contribution to carbon export through extensive differences in mucous and shell production as well as differing in trophic level. Although this paper is just a summary of the broad results provided by the database, it would be useful to have a sense of what degree of information is available at a lower taxonomic level, particularly as many previously published papers and datasets do a poor job of differentiating between groups and identifying to a species or even family level. Furthermore, if this dataset is ever going to be used to attempt to approximate global euthecosome and pseudothecosome aragonite contributions, there will need to be greater differentiation between groups (at a family level).

The method of biomass conversion is not robust since it applies the shell length

to dry weight conversion of Limacina helicina to all other "shelled" pteropods. Within the euthecosomata and the aragoinitc pseudothecomomata (Peraclididae) there are extensive differences in shell shape at a subfamily level which leave the conversions patently inaccurate across the shelled species. I feel a better way to get at the basic differences in shape, which would vastly improve the uncertainties previously mentioned, would be to apply simple geometric estimations of wet weight for different pteropod types, similar to the methods employed by the GLOBEC project which estimate wet weight in relation to shell length assuming a density of 1 for different pteropod families. (The guide for this can be found at: http://globec.whoi.edu/software/digi_prog/WHOI_Silhouette_DIGITIZER.htm on the last three pages). Then you could convert the wet weight to dry weight using the equations of Davis and Wiebe (1985) or other sources.

The authors state that there are no other known shell size to dry weight conversions, but there is a graph relating the size of the shell of *Cavolinia tridenta* to animal mass in Gilmer 1974 which illustrates my further concerns about abundance to carbon conversion. This group of pteropods grows in shell size very rapidly prior to gonadal development, then through the rest of its adult life appears to continue growing only in its soft parts. The length of the shell does not change although the mantle area (body) of the animal does increase in size. I am unsure how this growth method would be incorporated into the estimates of biomass. This has been mentioned by other authors for various other genera of the Cavoliniidae family (summarized in Van der Spoel and Dadon 1999). Here they state that further adult growth occurs through the thickening of the shell and some growth at the edges. Changes in shell thickness may further confound the biomass estimates. Furthermore, juvenile forms of the Cavoliniids species are markedly different in shape from their adult counterparts. Often they are not included in counts because they are overlooked or unidentifiable by the uninitiated. I recognize that having the biomass conversions for each species and stage is an impossible over-complication of the dataset and note that the authors do acknowledge the deficiency, suggesting that until each shell group is appropriately measured, there

does not appear to be a way to rectify the conversion. However, a bit more discussion which would clarify the magnitude of the assumptions being made would be helpful for data users who are not familiar with the animals. This dataset is likely to be used heavily by non-biologists or even by people who are unfamiliar with the variation in pteropods, and it is important to include more a full explanation of variability and hence the uncertainty in this paper since it stands as the gateway to the dataset.

Finally, it is unclear how the biomass of the unshelled (all gymnosomata and some pseudothecosomata) are estimated. I would like methodological explanation of the biomass conversion from abundance counts for these non-shelled individuals.

TECHNICAL CORRECTIONS

Pg 318 Line 5: no comma before "in order"

Pg 318 Line 16: The "most" is unclear at first glance – perhaps should read "the greatest proportion of which (42%)..."

Pg 321 Line 1: should read "PFTs"

Pg 322 Line 16: should read "converted it. . ."

Pg 322 Line 17: should read "biomass values were. . ."

Pg 323 Line 11: should read "the coiled"

Pg 327 line 5: should read "lifestyle" for internal consistency

Davis, C.S., Wiebe, P.H., 1985. Macrozooplankton biomass in a warm-core Gulf Stream ring: Time series changes in size structure, taxonomic composition, and vertical distribution. JOURNAL OF GEOPHYSICAL RESEARCH 90, 8871-8884.

Gilmer, R.W., 1974. Some aspects of feeding in thecosomatous pteropod molluscs. Journal of Experimental Marine Biology and Ecology 15, 127-144.

Van der Spoel, S., Dadon, J.R., 1999. Pteropoda. In: Boltovskoy, D. (Ed.), South

Atlantic Zooplankton. Backhuys Publishers, Leiden, The Netherlands, pp. 649-706.

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