

Dear Editor,

We finished the revision of the manuscript according to the questions and advices of the four reviewers. The following are the details of our responses (in blue color) to questions and advices of every reviewer.

The work of reviewers help improve the quality of the manuscript. We thank the thoughtful advice of the reviewers and hope the revision successfully answered the questions.

Best wishes

Wuchang Zhang

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Reviewer #2 (CC1): The data in this paper are obtained through the accumulation of several scientific cruises, which is very precious and rare. The differences in abundance, biomass, diversity and size spectrum of pelagic ciliate among the five temperature zones were demonstrated through measured data, in addition to the differences between latitudes, the data also showed differences in the vertical patterns of planktonic ciliate abundance, biomass and size structure in the five temperature zones, which is of great value for understanding the global distribution of pelagic ciliate.

1) The analysis on biotic-abiotic interplay is also very meaningful, but the current analysis results in 3.4 are somewhat confused. The main reason is that it is not necessary to show the abiotic factors controlling the spatial variation of ciliates within each temperature zone, because these results are determined by the range of sampling stations in each temperature zone, and are independent of the comparison between the five temperature zones. Thus, the content of part 3.4 and the corresponding discussion needs to be adjusted. I suggest that PCA focus on analyzing the relationship between the dominant species in the five temperature zones and various abiotic factors.

Response: In order to delete confusion, we moved previous “Figures 5–6” into present “Figures S8–S9” (Supplementary material) accordingly in revised manuscript. Meanwhile, we deleted several sentences to better exhibiting the biotic–abiotic interplay. Regarding the PCA analysis, we want to find out the role of environmental factors played in ciliate composition (both ciliate abundance and species richness) in each temperature zone. The relationship between the dominant species in the five temperature zones and various abiotic factors might be have minimal correlation due to the range of sampling stations in each temperature zone. Consequently, the strategists we have adopted were compared the internal correlation among each temperature zone.

2) Lines 149-150: "At 200 m depth, temperature and Chl a peaked in the TZ and North Frigid Zone (NFZ), respectively, deviating from salinity patterns, which exhibited high values in both the TZ and NFZ" The expression of this sentence is not

clear, modify it to make it clearer.

Response: We revised this sentence accordingly in lines 149–150 in revised manuscript.

Lines 149–150: At 200 m depth, temperature peaked in the TZ and Chl *a* peaked in the North Frigid Zone (NFZ), contrasting with salinity patterns, which displayed high values in both the TZ and NFZ (Figure 2 and Figure S1).

3) Lines 142-144: The vertical distribution of chlorophyll *a* in SAZ is not described.

Response: We added the vertical distribution of Chl *a* in SAZ in lines 150–152 in revised manuscript.

Lines 150–152: Vertically, both temperature and Chl *a* declined in the NFZ and Sub-Arctic Zone (SAZ) (surface-peak pattern), while salinity increased from the surface to 200 m layers across all regions (Figures S1–S3).

4) Lines 170-171: "Vertically, the large (> 50µm) and small size-fractions exhibited an inverse distribution characteristic across five temperature zones" The meaning of this sentence is not clear, modify it to make it clearer.

Response: We revised this sentence accordingly in lines 170–172 in revised manuscript.

Lines 170–172: Vertically, the relative abundance of the large size-fraction (>50 µm) exhibited a decreasing trend, whereas the small size-fraction displayed an increasing trend across the five temperature zones (Figures S5).

5) Lines 209-240: The large differences in the relationship between biological and abiotic organisms in different temperature zones may be mainly caused by the difference in the selection of sampling areas, rather than the fundamental differences between temperature zones.

Response: We hold the similar viewpoint that the large differences in the relationship between biological and abiotic organisms in different temperature zones may be mainly caused by the difference in the selection of sampling areas, rather than the fundamental differences between temperature zones. Therefore, the strategists we have adopted were compared the internal correlation among each temperature zone at specific sampling depth (0, 50, 100, and 200 m). In Figure S10, we just want to find out the linear relation between ciliate and each environmental factor at all sampling depth among each temperature zone.

6) Lines 278-279: "the general trend of steeper slopes at the surface compared to the 200 m layer across all regions suggests a community size shift influencing carbon flux efficiency towards higher trophic levels" It is difficult to understand the relationship between the half sentence before and the half sentence after "suggest", and additional explanation is needed.

Response: In order to make this sentence more clear, we added an additional explanation accordingly in lines 269–272 in revised manuscript.

Lines 269–272: Furthermore, the consistently steeper slopes at the surface compared

to the 200 m layer across all regions (Figure 3) suggest: (1) a depth-dependent shift in pelagic ciliate community size structure, and (2) greater accessibility of prey for meso-/macro-zooplankton in surface waters compared to the 200 m layer, thereby influencing carbon flux efficiency to higher trophic levels (Stukel et al., 2024).

7) Lines 291-292: “the steeper slopes observed in the abundance size spectra in the bipolar seas compared to the tropical, temperate, and sub-Arctic seas might reflect a prevailing trend towards miniaturization”also, it is difficult to understand the relationship between the half sentence before and the half sentence after "might reflect", and additional explanation is needed.

Response: At present, we find out the phenomenon that the steeper slopes observed in the abundance size spectra in the bipolar seas compared to the tropical, temperate, and sub-Arctic seas, but to be honest, it’s hard for us to explore the explanation. Thus we deleted this sentence **in revised manuscript**.