Dear Referee #1,

We warmly thank you for the constructive and helpful comments you provided in order to improve our manuscript. We took most of your remarks into consideration and hope this latest version of the manuscript will satisfy you.

Each of your comment has been answered in blue characters in the following document.

Kind regards,

Julie Meilland, on behalf of all co-authors.

N.B: the line numbers provided in our response corresponds to the line numbers of the edited manuscript (track change).

General comments:

The manuscript entitled "Population dynamics and reproduction strategies of planktonic foraminifera in the open ocean" by Meilland et al. examined the presence, pattern and extent of synchronised reproduction and ontogenetic vertical migration of planktonic foraminifera, the phenomena which have long been discussed since the earliest study of this taxon and always controversial with evidence both in favor and against on. Their finding suggested the presence of synchronised reproduction and ontogenetic vertical migration, superimposed on the large fraction of the population that does not follow the canonical trajectory. The manuscript is well-written, and carefully discussed with adequate data analysis and statistics. This study has fundamental importance not only to help us understand the population dynamics of planktonic foraminifera but also their sedimentary assemblages; what is recorded and how to extract the canonical trajectory from fossil samples.

It was my great pleasure to review this manuscript. I recommend publication after the authors address the issues I have outlined below.

We thank the referee for this positive evaluation of our research.

Major points:

1. Size measurement protocols

It would be helpful to have a representative series of images showing the size measurement (image processing) procedure, maybe in the supplement. Is it possible to automatically extract shell outline even for specimens with densely radiated spines? Does the "minimum diameter" mean minimum Feret diameter?

To allow the reader understand our segmentation procedure, we now provide images of it using the example of *G. glutinata* in Figure S1. We also added a sentence in the section 2.2. to specify what the "minimum diameter" corresponds to (L.213 to 215). More details are also provided in our reply to the referee's second comment in the "Minor points". Among the species analysed, only *G. ruber ruber* has spines and the vast majority of them were broken

during the sampling and throughout samples preparation (picking of the specimens and positioning on customed slides for the size measurements). The shell outline provided for *G. ruber ruber* therefore does not include the spines.

2. Effective digit

What is the error range of the size measurement and the effective digit? In Table A1, some are shown with two decimal places (e.g., 113.99, 790.89). Please align the number of digit after the decimal point based on the effective digit.

The absolute accuracy is of 0.6 µm that one can round up to an error range for the size measurement of 1 µm for a single measurement (i.e. per specimen). We added this information in section 2.2., L. 214 to 215. We therefore agree that the digit in Table A1 should not remain and we removed it where needed.

3. Size class intervals

I think the size class intervals used here are fine, but how did you determine the interval (or the number of category). Here the size of G. glutinata alone is divided into 6 (but in Figure 6 the largest class omitted), whereas the others are 7.

We decided to choose size classes that encompassed the same relative range of distribution namely from 100 µm (minimum mesh diameter) to the largest specimen found without increasing the number of classes significantly per species and without introducing empty classes. In Figure 6, the largest size class of *G. glutinata* is not represented as the relative mean abundance of specimens observed in 200-200 µm is very low (<0.5%) and would not allow for a correct estimation of the relative mortality.

4. Calculation of abundances

Did you used a flow meter for the calculation of towed water volume or just used the net aperture area and towed depth? Please specify. If the latter, it is calculated on the assumption that the extent of net clogging is similar among nets.

The multinet was equipped with a flow meter and allowed us to directly determine the volume of filtered water for each net (L171 to 172).

5. The data under 100um

It is rather surprising that the estimated minimum size of maturity in G. glutinata is smaller than 100um. As is written in the text, a large proportion of specimens is smaller than 100um and hence excluded from the analysis for calculation of residuals and mortality. I understand why the authors hesitate to use the smaller size classes since the net mesh was 100um. Although, as I wrote above, if the towed water volume is not calibrated using a flow meter, the net clogging is regarded as the same in this data analysis in the first place. In any case, it is worthwhile to show, in the supplement, the data smaller than 100um and include in the mortality figure and residual figure. I would recommend including it, at least for G. glutinata.

We appreciate the Referee's suggestion but without having a precise idea of the representativeness of the fraction of individuals caught by the net below 100 µm size, we would feel uncomfortable presenting these data in details.

6. Background population that does not follow the canonical trajectory

One of the importance of this paper is that they clearly showed that a large population does not follow the canonical trajectory. Then, do you think the background population succeeds in reproduction without synchronizing time and space, or they are just the "leak" of canonical population and less likely to succeed in reproduction (such as abortive migration in fish)? You mention in the abstract that "reproduction might have occurred continuously", so the former would be your idea, I suppose. Then how? Does it contradict the Weinkauf et al. (2020) emphasizing that spatial and temporal synchronization is inevitable for maintaining of the population?

We indeed think that the background population could succeed in reproduction without synchronizing on a large scale but within patches (more information about patchiness in Siccha et al., 2012 and Meilland et al., 2019) and/or using asexual reproduction. The first hypothesis could be the result of an event or situation that would trigger gametogenesis locally. We do not think this contradict the work and hypothesis formulated in Weinkauf et al., 2020 (still in discussion) but rather that the "truth" sits in between and that population dynamics in planktonic foraminifera most likely is the result of various triggers and reproduction modes.

Minor points:

Line 96: Takagi et al. 2020 ---> Maybe Takagi et al. 2019?

Indeed, we corrected the citation L.97.

Line 203: the minimum diameter ---> Did you used the Feret diameter? Please specify because there are many ways to measure diameter.

The minimum diameter here refers to the "minor axis length" which corresponds to the length (in pixels) of the minor axis of the ellipse that has the same normalized second central moments as the region, returned as a scalar. We now specify it L.213.

Line 284: 114.5 ---> Referring the Table A1, the original number is 114.38. Since the others are rounded to integer, it should be 114 here.

Corrected

Line 345: method section (2 d) ---> ? (the same "2.d" is in the caption of Figure 7)

We replaced "(2 d)" by the section it referred to in the methods (2.3.).

Line 392: Because of the overproduction of gametes per individual, the mortality in planktonic foraminifera is expected to be very high among the smallest size class ---> It should be so. But it sounds that gametes are the initial population of planktonic foraminifera which is not true (zygotes are the initial smallest class of population). How about saying like "Because the zygotes (youngest individuals) are overproduced per individual even with the limited rate of reproductive success (a mean of 21 zygotes per individual in the entire population, Weinkauf et al., 2020), the mortality in planktonic foraminifera is expected to be very high among the smallest size class".

We agree and we rephrased using the referee's sentence suggested.

Line 409: studies size range ---> studied size range

Done

Line 423: Tâ and Salinity ---> temperature and salinity

Done

Line 459: manypopulations ---> add a space

Done

Line 481: this OVM pattern ---> the ascending OVM pattern

Done

Line 503: This theory corroborates ….. et al., 2021) ---> Are there any papers of this kind for warm water species? Since these studies are on cold water, non-symbiotic species, and more directed on the ocean acidification topics, it would be better to cite something else.

We know about the paper of e.g. Marshall et al., 2013 on *T. sacculifer* and *G. ruber* however, we still think that the citations we used, even if on *G. bulloides* and *N. pachyderma*, are the best suited ones to discuss increasing shell density with size and depth the way we intend to.

Line 516: the properties of fibrillar bodies hypothesised to help foraminifera maintain their vertical position ---> Indeed the function of the fibrillar bodies has been speculated to be linked to the function of buoyancy. However, recently, LeKieffre et al. (2020) suggested that the fibrillar bodies are the organelle for organic matter synthesis and storage prior to chamber biomineralization. So this possibility can be deleted.

We would prefer to keep this hypothesis as the paper from Le Kieffre et al., 2020 does not fully exclude a potential motility role of the fibrillar bodies.

Figure 4: Are the whiskers shown in broken lines? It is better to use normal (full) line which is easier to see.

We replaced the broken lines by full lines in Figure 4.

I hope my comments above would be helpful.

Very much so! We warmly thank you for the time devoted to our manuscript.