POBI-D-19-00274

Phenological Responses of the Arctic, Ubiquitous and Boreal Copepod Species to the Long-Term Changes in the Annual Seasonality of the Water Temperature in the White Sea

Polar Biology

Dear Dr. Usov,

Thank you very much for submitting your manuscript for publication as Original Paper in Polar Biology.

First of all, please excuse the overly long duration of the editorial processing of your submission. This is primarily because it was extraordinarily difficult to solicit three peer reviews, which is usually the number of evaluations I prefer to base my decision on for a ms submitted as Original Paper. As unfortunately becoming more and more usual nowadays, a number of potential reviewers have declined my invitation, for several reasons, mostly because they would have not been able to look at this paper within a due time (a trend that seems to be unfortunately even amplified by the ongoing COVID-19 crisis and its manifold constraints for our working lifes). In such cases, we had to look for alternative referees, which added to the overall processing time. Moreover, some colleagues accepted my invitation to review your ms but did not submit their evaluation within the deadline. And then, most importantly, the ms got somehow stuck in the editorial processing of the Editorial

Manager. As a consequence, the peer review took unfortunately longer than usual.

As usual for manuscripts submitted for publication as Original Paper, your paper has been evaluated by three peer reviewers. All reviewers basically agree that your study addresses intriguing research questions and, hence, could make a valuable contribution to our understanding of an actual scientific topic with polar relevance. As your ms provides novel and scientifically interesting information, they conclude that it generally deserves publication in Polar Biology. They are also advising, however, that a revision of your manuscript is needed before it could be finally accepted. Many comments are rather minor, in the sense that they primarily address possible improvements of the presentation of your work (starting with the need of a thorough language improvement, as all three reviewers pointed out) but do not question the very approach of your study or call for sampling further data. However, there are also some general comments on your work, which require more in-depth

modifications of your ms. Overall, considering all remarks and suggestions adequately and comprehensively would certainly result in a major revision of your ms (see below).

Based on the largely unanimous recommendations of all three reviewers, I arrive at this decision: The manuscript would generally merit publication in Polar Biology but it is not acceptable in its current form. Although there is major work to undertake, I believe, however, that there is enough substance to warrant an opportunity to resubmit your ms after major revision, which has to adequately address both the reviewers' comments and my general remarks (see below).

The reviewers (and me as the editor) provide you with extensive guidance as to how to revise the manuscript. First and foremost, please note that EACH of the REVIEWERS' COMMENTS, as well as each of my GENERAL REMARKS ON FORMAT ISSUES, has to be adequately addressed by either incorporating the suggestions in the revision or providing brief but reasonable rebuttals in case you do not agree with them. Most importantly, you should pay particular attention to any MAJOR or GENERAL comments or concerns, the proper addressing of which may require either profound revisions of your ms (and possibly also further sampling and/or analysis work) or particularly well-founded rebuttals (see also my GENERAL RESUBMISSION REMARKS below on how to draft your response).

If you are prepared to undertake the work required, I would be pleased to reconsider my decision and eventually accept a revised manuscript for publication in Polar Biology.

The referees' comments and my editorial remarks can be found at the end of this email or can be accessed by following the provided link.

When revising your work in the light of the referees' and my recommendations, please keep in mind that reviewers and editors generally provide great input into the improvement of the manuscripts and thus secure a strict quality control for Polar Biology. As most authors afterwards agree with, the referees' comments, as well as the editor's general remarks on format issues, usually contribute substantially to strengthening the submissions.

We ask for your revised manuscript within two months, meaning that your revision is due by 06 Feb 2021.

To submit your revised manuscript, go to http://pobi.edmgr.com/ and log in as an Author. You will see a menu item called 'Submissions Needing Revision'. You will find your submission record there.

This is your login information:

Your username is: Nikolay\_Usov

If you forgot your password, you can click the 'Send Login Details' link on the EM Login page.

Thank you for your cooperation. I hope you will find the comments to be of use to you and am looking forward with interest to receiving your revised manuscript.

Best regards,

Dieter Piepenburg

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Editor In Chief

Polar Biology

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CHIEF EDITOR'S GENERAL RESUBMISSION REMARKS

Please carefully consider the referees' reviews and editor's remarks in the revision

of your manuscript. When resubmitting the revised version of your manuscript, please

pay due attention to the following points to advance its speedy editorial processing:

A) Together with your revised manuscript, please also provide a detailed RESPONSE.

Like the manuscript, this response should be uploaded as a Word file.

Please note that there is a distinct difference in the manner your response will

be treated in the processing of your resubmission, depending on the decision on

your previous submission:

1) In case the decision was "Acceptable after MINOR revision" or "Acceptable after

MAJOR revision", the editor will send your revised ms and response only on rare

occasions to a/the referee(s) for re-evaluation - e.g., in case MAJOR REVISIONS

of your previous submission were required upon a referee's explicit request

and/or if his/her comments were particularly severe (you would be notified

about this in the editor's cover letter (see above)).

- In all other cases, for an expeditious editorial processing of your submission,

the referees will not see your responses anymore, and the editor will decide

solely by examining your revisions and responses, without asking for further

advice from the referees.

- Therefore, you are advised to keep this in mind when phrasing your responses

and help to ensure that the accordance between the changes of your ms and the

reviewers' suggestions or the reasons for your rebuttals are sufficiently

transparent to the editor, and he/she can decide without the need of further

reviews.

2) In case the decision was "REJECT and ENCOURAGE TO RESUBMIT", a second peer-

review round is compulsory. Therefore, your revised manuscript, as well as your

response, will be sent again to the reviewers who will re-evaluate your paper.

Some of these referees will have already been involved in the previous review

round, because we preferably invite those referees for another review, as it

seems appropriate that the resubmission would also be examined by the referees

of the original submission, because these are particularly suited to evaluate

whether the critical flaws of the ms have been properly addressed in the course

of the revision and, hence, the revised paper now merits publication in Polar

Biology. Please keep this in mind when phrasing your response.

In any case, in your response you should state point-by-point which changes you

have made in response to the reviews and where and why you have refused to follow a

particular suggestion. Note that the manner of how your response is phrased will

largely determine how long the evaluation of your resubmission will take.

Therefore, we strongly recommend adhering to the following guidelines:

- Please address EACH of the reviewers' remarks or suggestions STEP-BY-STEP, by

either incorporating it in your revision of the ms or, in case you disagree

with it, concisely explaining your reasons in a rebuttal.

- Please do ALSO respond explicitly to all FORMAT issues that I asked you to

pay special attention to in the revision of your manuscript (see CHIEF EDITOR'S

GENERAL REMARKS ON FORMAT ISSUES below).

- As a general rule, your responses should be as comprehensive as necessary and

as succinct and lucid as possible. Accordingly, please phrase your responses

in a manner that it is as easy and fast as possible to evaluate how and where

you incorporated a comment in your revised ms or why you did not adopt it.

- For a speedy processing of your revised ms and your response, we strongly

recommend to adhere to the following procedure:

Your response should comprise a COMPLETE POINT-BY-POINT LIST briefly describing

how each comment or suggestion was addressed. Each list item should comprise

-- a VERBATIM QUOTE the referee's/editor's ENTIRE COMMENT (including, if appli-

cable, the page and line numbers in your original ms, which it refers to),

-- followed by your response, starting with the word "REPLY", in which you

briefly describe

--- the action taken to address the comment by changing the ms in response

to the suggestion (if applicable, including a verbatim quote of the

modified text, preceded by page and line numbers in the revised ms)

or

--- why you disagree with the comment and, hence, did not change your ms.

- Do NOT respond with very general statements, such as "Almost all suggestions

have been considered" or "The text has been changed", and ultra-short point-by-

point replies like "OK" or "DONE". They are not helpful, since they will make

the evaluation of your revision more difficult and time-consuming than necessary

and thus inevitably lead to a delay in the final decision of your submission.

- MOST IMPORTANTLY, please pay PARTICULAR attention to any general and severe

criticisms that call for either profound revisions (more thorough than just

fixing typos, modifying formats and/or improving style) or particularly

well-founded rebuttals.

B) In addition to a revised 'clean' ms ("Revised Manuscript", without any indications

of revisions), please also submit an ANNOTATED VERSION of the ms ("Marked Manuscript"),

in which the changes you made are clearly indicated (e.g., by using Word's track

changes or otherwise high-lighting modified text passages) so that it is easy to

check where and how you accepted the reviewer's/editor's suggestions and changed

the text accordingly and where you did not.

Please DO NOT upload a clean PREVIOUS version of your manuscript, as this would be

easily confused with your clean REVISED manuscript.

C) 1) In case the decision on your ms was "Acceptable after MINOR revision" or

"Acceptable after MAJOR revision", please resubmit the files in the order "Response",

"Marked Manuscript" and clean "Revised Manuscript" (comprising text, tables and

figures in separate files).

2) In case the decision on your ms was "REJECT and ENCOURAGE TO RESUBMIT", please

attach the "Response" and the "Marked Manuscript" as separate files and as

"Electronic Supplementary Material".

D) In general, I'd sincerely recommend to thoroughly and carefully PROOF-READ your

ENTIRE ms (title, headings, main text, reference list, tables, figures, table

and figure legends, and Electronic Supplementary Material, if supplied) prior to

resubmission to rectify as many minor formal flaws as possible.

E) When revising your ms, please strictly adhere to ALL FORMAT REQUIREMENTS of Polar

Biology, as described in the detailed Submission Guidelines

(https://www.springer.com/journal/300/submission-guidelines).

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CHIEF EDITOR'S GENERAL REMARKS ON FORMAT ISSUES

In the revision of the ms, please pay special attention to the following format issues AND refer explicitly to them in your response, explaining briefly how you addressed these issues in your revision:

1) MAJOR LANGUAGE ISSUES: I agree with the reviewers' remark that your manuscript suffers from major language problems. The English is generally in need of being improved throughout the ms, and the necessary amendments should be certainly more thorough than only incorporating the changes the reviewers explicitly suggested - as examples - in their reviews. There are numerous grammatical/spelling flaws and stylistically awkward phrasings in the ms.

- After acceptance the ms would indeed be finally copy-edited in Springer's production department. However, this is not an extensive language editing but these final refinements are rather meant to be mere 'finishing touches' of an almost ready manuscript. In general, it is the authors' collective responsibility to submit a ms that is written in correct standard grammatical English (see https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Editorial%20Procedure).

- Therefore, I'd recommend, in accordance with the reviewers, that you should CAREFULLY copy-edit and proof-read the ENTIRE ms prior to resubmission with the help of an anglophone colleague or any other person proficient in scientific English.

- In case this is not possible, I'd strongly suggest seeking advice from a professional scientific editing service, e.g., those recommended in the Submission Guidelines (https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_English%20Language%20Editing).

- Please note that colleagues who are not authors but helped in revising the language of the ms should be thanked in the acknowledgements.

- The utilization of a professional editing service should be explicitly indicated in the cover letter and demonstrated by including a certificate of the service.

2) AUTHOR CONTRIBUTIONS: Please provide a short description of the contributions made by each listed author (please use initials). This statement will be published in a separate section in front of the Acknowledgments. For example:

"AM and DB conceived and designed research. AM and BB conducted experiments/field work/... .

GR contributed new reagents or analytical tools. AM and GR analyzed data.

AM wrote the manuscript. All authors read and approved the manuscript."

See also Polar Biology's Submission Guidlines at https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Author%20Contribution%20Statement.

3) ACKNOWLEDGMENTS: In case referees have agreed to be named (instead of staying anonymous), I'd recommend expressing your thanks to them (by giving their names) in the Acknowledgments.

4) CONFLICTS OF INTEREST: Please add a declaration on any conflicts of interest (even in case there are not any), under a section entitled “Compliance with Ethical Standards” that is placed before the References.

5) REFERENCE LIST COMPLETENESS: According to our experience, the creation of a complete and formally correct REFERENCE LIST is a cumbersome task. Therefore, please check meticulously whether EACH citation is included in the reference list (and vice versa).

6) CITATIONS AND REFERENCES FORMATS: A random non-exhaustive check of the running text and literature list suggests that in-line citations AND reference entries do NOT exactly comply with the format requirements of Polar Biology (see Submission Guidelines at https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_References for details). I'd like to ask you to comprehensively and meticulously check the entire text and literature list and rectify all non-compliant citations and entries, respectively, paying CAREFUL ATTENTION to EVERY minuscule detail (e.g., heed punctuation rules (i.e., check absence and presence of dots, commas, semicolons and blanks), always use correct journal abbreviations, do not give journal issue numbers, etc.).

7) NUMBERING OF COMPOUND FIGURES: In general, the individual figures in a compound figure should be numbered using a combination of an Arabic number (for the compound figure as a whole) and running lower-case letters for the individual figures (e.g., 1a, 1b, 1c, etc.) (see also Submission Guidelines at https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Artwork%20and%20Illustrations%20Guidelines for more details on this matter).

8) LEGENDS: Figure and table legends/captions have to explain the components of the table or figure. They should be comprehensible without referring to the main text or other legends/captions. Therefore, please give each legend a self-explanatory title and do not use any undefined abbreviations in the legends. Moreover, please take care that ALL symbols, abbreviations, etc. that are used in a table or figure are explained in the legend or in footnotes (the latter should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body). Identify any previously published material by giving the original source in the form of a reference at the end of the caption.

9) COLOR FIGURES: Please note that, while color figures are free of charge for the online publication, you have to pay for them in the printed version (flat fee of 950 Euros/1150 US Dollars, irrespective of the number of color figures). If black and white will be shown in the print version, make sure that the main information will still be visible, as many colors are not distinguishable from one another when converted to black and white (a simple way to check this is to make a xerographic copy to see if the necessary distinctions between the different colors are still apparent). You might also consider substituting all colors by shades of gray (see Submission Guidelines at https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Artwork%20and%20Illustrations%20Guidelines for more details on this matter).

10) WRITING OF 'ARCTIC': Following the arguments put forward by Kingsley (2005), the word ‘Arctic’ should be capitalized throughout the entire manuscript (title, headings, text, tables, figures, legends), except when being written otherwise in the titles of References. Accordingly, it is recommended to also capitalize other geographic terms, e.g., ‘Antarctic’, ’sub-Arctic’, ‘sub-Antarctic’, ‘high-Arctic’, ‘high-Antarctic’, etc., consistently throughout the entire manuscript (again, except in References).

[Quote from Kingsley MCS (2005) 'Arctic' or 'arctic'? Arctic 58:321: "‘Arctic,’ therefore, is best capitalized in all uses, both substantive and attributive, that refer to the Arctic itself. The lower-case can then be usefully reserved to distinguish the metaphorical use which means no more than ‘very cold’".]

11) SCIENTIFIC TAXON NAMES: Please double-check the proper use of taxon names throughout the entire ms (title, headings, text, legends, tables, figures, reference list).

- When using the binomial nomenclature of naming species, please make sure the \_SPECIES\_ and \_GENUS\_ names are always \_ITALICIZED\_ in print. Moreover, verify that they are written out as full names (e.g., \_Homo sapiens\_) in the Title, the first time they are used in the Abstract, and the first time they are used in the body of the paper, as well as in each table legend or each figure caption. Thereafter, in the body the names should be abbreviated as the first letter of the genus name (capitalized) and the complete specific epithet (e.g., \_H. sapiens\_). As an exception, the genus names should be written in full (a) where they form the first word of a sentence or (b) when only the genus name is used or (c) if several genera with the same initials can lead to confusion or (d) in headings.

- The abbreviation "sp." should be used when the actual specific name cannot be specified. The abbreviation "spp." (plural) indicates "several species". Please note that these abbreviations must NOT be italicized.

- Scientific names of taxa higher than genus (i.e., family, order, class, phylum or division, and kingdom) should be capitalized (e.g., Ophiuridae, Copepoda, Arthropoda, etc.). In case of animals, plants and unicellular eukaryotes, these higher taxon names should NOT be italicized, while in case of fungi, bacteria and viruses, they are - as genus and species names - to be placed in italic font.

- English VERNACULAR NAMES of species and higher taxa may be used in addition to scientific names. For the convenience of the journal’s international readership, both common AND scientific name should be given together when the common name is used the first time in the title, abstract, main text or table/figure legends of a manuscript. Lower-case initial letters are used for each part of the common names of species, genera, families and all other taxonomic levels (e.g., crabeater seal, blue whale, mountain maple, zebra, bacteria), except where they contain a proper name (e.g., Greenland shark, Przewalski's horse, Amur tiger). If common English names are derived from scientific taxon names, e.g., “cetaceans” for members of the infraorder Cetacea, they are not capitalized. [Contrary to these general rules of spelling for mammals, insects, fish, and other life forms, the International Ornithologist's Union (IOU) recommends that the words of an official common bird name begin

with capital letters, e.g., Chinstrap Penguin.]

12) SOME GENERAL FORMAT RULES:

- UNITS: Please always use internationally accepted signs and symbols for units, preferably

SI units. For a transition period, and as an exception to this general rule, commonly used

scientific units not included in the International System of Units may be used, e.g. "L"

(for "liter") instead of "dm^3", or “min” instead of “minute”.

Specifically, please note that salinity should be quantified using the Practical Salinity Scale

(PSS). Since PSS is a dimensionless quantity, salinity figures should be given either without

any unit or with a 'unit' called "psu".

- RATIOS: Please use negative superscripts instead of “/” or “per ...” for ratios (e.g.,

"kg m^-2" instead of "kg/m^2").

- EXPONENTS: Exponents have to be always written as superscripts (e.g., "m^2").

- LITER: The capital letter “L” must be used for “liter”.

- HYPHENATION: When using a number and a unit of measure to make a qualifying adjective, put a

hyphen between them, e.g., “300-μm sieve” or “1-L bottle”.

13) DECIMAL PLACES: In many scientific manuscripts, values are reported too many (or, less often, too few) decimal places, resulting in spurious (or lack of) precision and misleading presentation. Therefore, I'd advise you to check the number of decimal places of all values you present throughout your entire manuscript (text, tables, figures, appendices), to make sure that they are reported with an appropriate degree of precision (= number of decimal places). For ease of comprehension and simplicity, round to a reasonable extent. Be consistent with regard to the numbers of decimal places for all values of the same variable throughout the entire manuscript (including tables and figures).

14) STATISTICS: Describe statistical methods in sufficient detail to allow a knowledgeable reader with access to the original data to reproduce and verify the reported results.

With regard to the reporting of your statistical findings, adhere to the following format guidelines:

• Use the same font for the same mathematical or statistical symbol in the ENTIRE manuscript (not only the text but also in equations, tables, figures, legends).

• \_ITALICIZE\_ all statistical symbols used in your ms, either uppercase for, e.g., the \_F\_ statistic of ANOVA and the \_H\_ statistic of the Kruskal-Wallis test, or lowercase for, e.g., \_n\_ (sample size), \_df\_ (degrees of freedom), \_t\_ statistic of the \_t\_ test, \_r\_ (correlation coefficient) or \_p\_ (significance level), etc.

• Report means and standard errors/standard deviations with their associated sample size, e.g., "35.09 ± 0.07 km (\_n\_ = 15)". When standard deviation/error is shown in an illustration, n should be given as well.

• Report statistical tests with a consistent format throughout the ms, e.g.;

… (Paired \_t\_ test, \_t\_24 = 3.33 [with "24" denoting the df, written as subscript number], \_p\_ = 0.0091)

… (Chi-square test, \_X\_22 = 0.47 [with "22" denoting the df, written as subscript number], \_p\_ = 0.5783)

… (ANOVA, \_F\_1,25 = 8.56 [with "1,25" denoting the df, written as subscript numbers], \_p\_ = 0.0350)

… (Kruskal-Wallis test, \_H\_25 = 123.7 [with "25" denoting the df, written as subscript number], \_p\_ = 0.0010)

… (Spearman rank correlation, \_r\_s = 0.601, \_n\_ = 33, \_p\_ = 0.0233)

• Report exact \_p\_-values (of course rounded), but when the values become very small to express, then \_p\_ < 0.0001 (three zeros one) should be taken as a boundary. The more precise values should be given, e.g., for the above something like \_p\_ = 0.0350, \_p\_ = 0.0020, \_p\_ = 0.0005, etc.

15) ELECTRONIC SUPPLEMENTARY MATERIAL (ESM): Please make sure that for any additional information (in appendix tables, figures, spreadsheets, video, audio, etc.), which you may add to your revised ms as Electronic Supplementary Material (ESM) in response to the referees' and/or editors' comments, the text makes specific mention of the ESM as a citation, similar to that of 'regular' figures and tables. Please refer to the ESM file(s) in the text as “Online Resource #”, e.g., “... additional data are given in Online Resource 1”, "... as shown in the animation (Online Resource 2)", etc. Please name the ESM files consecutively, e.g. “ESM\_1.pdf”, “ESM\_2.mpg”, etc. See Submission Guidelines at see https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Electronic%20Supplementary%20Material for more details on this matter.

16) FILE FORMATS: Please make sure that text, tables and figures of the revised ms will be submitted as appropriate EDITABLE source files (this is necessary to be released to production), e.g., text and tables in Word (NOT Excel!), WordPerfect, RTF, TXT, or TeX (if your paper is in LaTeX, we also require the style files), figures in TIFF, GIF, JPEG, EPS, Postscript, PICT, Excel and PowerPoint. See Submission Guidelines at https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Artwork%20and%20Illustrations%20Guidelines, for more detailed information on Artwork and Illustrations Guidelines.

Moreover, please note that uploading PDF files (except for ELECTRONIC SUPPLEMENTARY MATERIAL (ESM); see https://www.springer.com/journal/300/submission-guidelines#Instructions%20for%20Authors\_Electronic%20Supplementary%20Material) will cause delays should your ms be finally be accepted for publication.

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REVIEWERS' COMMENTS

Reviewer #1 (Eric Goberville):

The manuscript by Usov and colleagues, entitled "Phenological Responses of the Arctic, Ubiquitous and Boreal Copepod Species to the Long-Term Changes in the Annual Seasonality of the Water Temperature in the White Sea" investigated long-term phenological changes in the seasonal cycle of zooplankton species in the White Sea in relation to changes in sea surface temperature. By combining data from a long-term monitoring survey performed in Chupa Inlet since 1961 and time series numerical analysis, they examined possible changes and/or shifts in the timing of seasonal events. Their study reveals that a shift in the seasonality of water temperatures may have affect the phenology of the five zooplankton species. Despite clear changes in the timing of phenological events, no significant alteration in species abundances was found, but for Acartia spp. Based on their results, several explanations are proposed to substantiate the resilience of zooplankton species to environmental

changes.

Climate warming has been especially severe in the Arctic - where the average temperature has increased 0.4°C per decade, i.e. two to three times higher than the global average rate - and projections suggest that this region will be ice free in the summer as early as 2050, which could increase the rate of warming. As a result, major changes in plankton communities are expected with ensuing consequences on higher trophic levels. In that sense, this study is of high interest in order to better understand the relationships between changes in environmental conditions - especially water temperatures - and possible effects of plankton communities. However, I have some comments, suggestions, but also reserves which may be useful for helping to strengthen the paper. I believe that substantial improvements are required to this manuscript before it can be reconsidered for publication in Polar Biology. I hope these comments are of help.

General comment

First, and even if I am not a native English speaker, I would suggest that the authors get editing help to clarify some sentences and parts of their ms. The text is not always fluent and there are some shortcomings in the language. The structure of the paper may also be improved for clarification in order to help the reader: e.g. some steps in the 'Material and Methods' section are referred to 'see below' which makes difficult to understand how were performed the analyses and to identify their "flowchart". By clarifying this point, the authors would allow other researchers to re-use their numerical approach in another context.

Abstract

In the Abstract, the results are presented but not the methodology nor the approach that the authors have used. I suggest that the authors clearly mention how they have assessed their conclusions, e.g. by applying time series analysis on long-term monitoring data. I also suggest to better identify the context of their study (i.e. climate warming in the Arctic)

Introduction

The 'Introduction' section might be improved with a stronger background/state-of-the-art about the warming conditions in the Arctic, the origin of the main influential drivers and a better description of the (already documented) consequences of climate warming on both environmental conditions and changes in both the spatial distribution and phenology of species. More attention should be devoted to discuss the ecological context. In the current version of the ms, some sentences are too vague. The structure of this section should also be improved in order to gain clarity, e.g. by displacing some sections. Here, just some examples:

Line 38-39: "Recent climate change, manifested through the temperature rise, has been proved the most intensive in high latitudes, especially in the Northern Hemisphere": how many degrees? What are the main evidences of current changes in abiotic conditions? In this section, other important information is given by the authors, but further in the ms (e.g. from lines 88-99) and it might be better to present this general context in a first - detailed - paragraph before the presentation of phenological changes in plankton species. I therefore suggest to present first how climate warming has impacted this Arctic region in order to focus, in a second step, on the topic of this study, i.e. phenological changes in plankton communities. The highlight must be done on phenological changes documented in comparable regions, not in temperate ecosystems.

Line 57-58: "Calanus finmarchicus CI abundance peak". Please, clarify "CI"

Line 73-75: "Planktonic organisms are indispensable component of marine trophic webs […] entire food chain and food web". I fully agree, but this idea has (nearly) been mentioned in the following sentence: "may lead to the trophic mismatch between consumers and their food, e.g. between zoo- and phytoplankton".

Line 81: "[…] the "signal" and the "noise" […]". Please clarify what is the meaning, for non-statisticians, of "signal" and "noise" and why it is important, when investigating long-term changes, to focus on the signal component of a time series. More than registering the parameters of interest, we especially need long-term time-series to identify both the trend and the cyclical component from stochastic events such as the "noise" inherent to the sampling strategy or the influence of local and punctual drivers.

Line 84-87: "The monitoring of the zooplankton in the White Sea performed at the White Sea Biological Station of Zoological Institute, Russian Academy of Sciences, meets most of them (COPEPOD. Interactive Time-series Explorer METABASE, 2018)". I would suggest to give here more information about this time series such as its length (see Line 97) and the monitored parameters (e.g. Seas surface temperature, zooplankton abundances, etc…); while avoiding any redundancy with the 'Material and Methods' section.

Line 96-97: "This, in turn, can have negative consequences for pelagic communities": what are the current - already observed - consequences at an ecosystem scale? What are the main consequences on higher trophic levels (e.g. fish, seabird…)? This sentence is too vague.

Material and Methods

Line 112-123: I would appreciate more information about the survey and the sampling site. The first part about the sampling site is more devoted to give information about were the location of the sampling site and about gaps in the time series while information about the ecological context is overlooked (general hydrodynamical features for example). Gaps in the time series might be displaced in the presentation of the sampling scheme. I think it could be important to give more details about the sampling site to better understand how the environment act on species dynamics. About the sampling scheme, and if applicable, a bit more detail about the consistency of the time-series might be helpful (possible changes in both the sampling strategy and/or how species are counted).

Line 122-123: "We used approximating models for calculation of phenological indices, which allowed us to fill in the gaps (see below)". I would suggest to avoid "see below" as it is quite counterintuitive to find where the information is in the section.

Line 151-177: As the paper - and this section - is quite long, I would suggest to resume this paragraph by means of a table.

Line 178-212: This is not clear whether the authors have used the full dataset or an average over the layer 0-25m nor why they used the layer 0-25m for the CCA and the total water column 0-65m for the phenological analysis.

Line 188: "Long-term averages of each studied variable". Please, clarify here the meaning of "long-term averages"; the use of a 'climatology' could be more adapted.

Line 213-256: this part of the 'Material and Methods' section is quite long and could be easily resumed by means of a figure such as the one used in Mackas et al. 2012 (their Fig. 4 in "Changing zooplankton seasonality in a changing ocean: Comparing time series of zooplankton phenology"; 10.1016/j.pocean.2011.11.005). I would appreciate more information about how was assessed the quality of the logistic models.

Line 257-267: The winter NAO and the AO are indices about large-scale hydroclimatological processes but are not environmental parameters; "ice disappearance" is a proxy of change in climate conditions.

Line 268-284: This is more a personal point of view, but I found that using too many abbreviations in a paper makes it hard to read and I would therefore suggest to avoid their use; especially when abbreviations are not extensively used (e.g. TPD and SpSD are used once in the main text). If essential, I would suggest to use more easily interpretable abbreviations.

Line 286: In a general comment, I would suggest to provide a sketch diagram in order to better understand the different steps and how these steps are interconnected (or not).

Line 289: "Filling in missing values". Did the authors controlled for possible biases when 'modelled' data were estimated? This step could be considered as a data pre-treatment. When missing data are re-estimated, it could be useful (and more robust) to use sensitivity analysis approaches in combination with the numerical analyses to avoid possible biases.

Line 294: "Analysis of the long-term dynamics of the studied parameters". I do not understand why the authors want to estimate linear trends instead of estimating trends over time by finding the best fit in the long-term dynamic of each parameter, or by using alternative methods such as the modified Mann-Kendall trend test or the Spearman's rank correlation coefficient. If the main reason is to use the residuals from this analysis for the part devoted to "Relationship of the abundance of the species and its phenological indicators" (Line 344-368), it is required to check whether the assumptions associated with each linear regression model are met (normality, no auto-correlation, homoscedasticity) by examining the residuals.

Line 322: "Factors, influencing phenology". I would suggest to present how the CCA works and the different steps of this analysis before explanations about the 'phenological' and 'predictor' matrices.

Line 325: "key events of each planktonic species". Please clarify here the meaning of 'key events'.

Results

Line 371: "Seasonal dynamics: temperature and zooplankton species abundance". Following my previous suggestion about species, it could be easier and informative to resume all information in a Table with, for each species, information about both their abundance peak and the dates of phenological events. Because of the pre-treatment procedure applied to fill missing values, could these values be biased?

Line 409-464: Because the significance of the trends might be related to the selection of the method (linear regressions) and because this method could be strongly impacted not only by autocorrelation (a potential biased related to temporal autocorrelation has been considered by the authors well) but also by outliers (see, for example, Fig. 4A and B with the exceptional event in the early 1970s), I would suggest to strengthen the results by using another way of calculating trends.

Line 426: "Long-term dynamics: factors influencing phenology timing". In line with my comment about species, a table that resumes changes in the timing of environmental and climate events would be helpful for the readers. As mentioned above, I wonder in what extent these results could be impacted by the data pre-treatment. I would suggest, if the authors decide to not perform sensitivity analysis, to provide more information about missing values in the time series (i.e. at the end of the time series, at the beginning, all along the time period, etc…).

Line 426: "[…] since they displayed high variance inflation factor". Please, clarify how this was assessed.

Line 445: "The whole model was statistically significant (Table 1a) and explained 40.9% […] It accounted for 14.6% of total inertia". I would suggest to comment more about the meaning of these percentages. The authors should explain better if the percentage of explained variance is high enough to be confident about the robustness of the results. Is the CCA influenced by the high variations in both Acartia and Microsetella abundances that we can observed early 2010s we compared with the previous years?

Line 466: "Relationship of the abundance of the species and its phenological indicators". I would suggest to the authors to explain here why they focused only on the "start-of-season date" without consideration for the other phenological events. Note that I do not understand why the authors did not evaluate the statistical significance of the Royama's correlation coefficients.

Discussion

The 'Discussion' section provides important information about the state-of-the-art and the background of climate change effects on the Arctic region and I would suggest to displace some information in the 'Introduction' in order to strengthen this section (see my general comment about the 'Introduction').

I would suggest the authors to comment in the discussion about the relevance of comparing long-term changes in both abundances and phenology of species identified at a fine taxonomical level (e.g. Temora longicornis, Calanus glacialis) with Pseudocalanus spp. and Acartia spp. possible 'pools' of several species. Was A. longiremis the dominant species all over the time period, from 1961 onwards?

Some interesting comparisons could also be performed with Fanjul et al. (2018; https://doi.org/10.1016/j.csr.2018.03.009) that documented seasonal changes in zooplankton species across a latitudinal gradient in the Northeast Atlantic Shelves Province and that revealed the key influence of phytoplankton biomass and meroplankton species on changes in zooplankton seasonality.

Line 616. "The opposite trends in dynamics of Oithona and Microsetella abundance deserve special attention, because trophic niches of these species overlap". Could the authors clarify and substantiate this statement by reordering this paragraph to establish a clearer link with the explanations they provide in the following sentences? Because of two distinct patterns, I wonder if this distinction is related to an overlap between trophic niches or only an effect of changes in the habitat suitability of the species; or a combination between both.

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Reviewer #2 (Sakina-Dorothée Ayata):

1) General comment:

This article presents the seasonal dynamics and long-term trends of the dominant copepod species of the White Sea, using data collected monthly (or every ten days) from 1961 to 2018. Although the study is mostly descriptive, the topic is of high interest for the readers of Polar Biology, but also for any scientist interested in zooplankton ecology.

The introduction is easy to follow and presents clearly all the needed information. Additional references may be added in the first paragraph and some information (provided later, such as the years of beginning and of end of the times series or the sampling frequencies) could also be provided in the introduction.

In the method section, the authors present in details the environmental and biological data they have used and the statistical methods they have applied. The presented datasets are of high quality and highly valuable and interesting, as the scientific community needs such long-term time series to document the on-going changes occurring in marine (especially polar) ecosystems. The statistical analyses applied to the datasets are globally adequate and correctly performed (see specific comments on the analysis of long term dynamics). The question of the accessibility of the biological data is not mentioned (it could for instance be available through an open access repository such as www.PANGAEA.de or IOBIS.org). Similarly the R code used for statistical analysis does not seem to be openly accessible, as it is more and more the case (through an online platform such as GitHub).

The result description might be a bit long but it well describes the results presented in the figures and tables.

The discussion is clear, puts the results into perspectives compared to other related work, and nicely provides hypotheses for explaining the observed results (e.g. competition among species). However, I also wonder how the way the species reproduce and spend the winter season may affect the seasonal dynamics that you are observing. This aspect should also be discussed (see specific comments).

The conclusion is also clear.

Finally, although I am not a native English speaker myself, it seems to me that the language could be improved all along the manuscript (see examples below).

Therefore, I recommend minor revisions prior to publication in Polar Biology. Please see my specific comments below.

2) Specific comments:

2.1) Introduction:

References should be added to the sentences of lines 41-42, line 45, and line 47-48. Several references to the work of Gregory Beaugrand (CNRS) and his colleagues on zooplankton temporal dynamics could also be relevant at the end of the first paragraph. See for instance here:

https://scholar.google.fr/citations?user=NfH1FlgAAAAJ&hl=en&oi=sra

Line 98: please specify here the time period (1961-2018) and sampling frequency (at least monthly) of the time series.

2.2) Methods:

Regarding the time series analysis, the seasonal effect should be removed before testing the long-term trend, but it seems that it is not the case here. The seasonal effect could for instance be removed using a Seasonal and Trend decomposition using Loess (or STL; Cleveland et al. 1990). This can be performed in R using the stlplus package (Hafen, 2016) for instance. Then, I would have rather used the Generalized Least Squares (GLS) method to test the significant of the trends, rather than a simple linear regression, in order to take into account the auto-correlation of the residuals, that usual prevent the use of a linear regression on a time series. The GLS can for instance be performed using the nlme package in R (Pinheiro et al., 2018). To do this, the level of auto-correlation can be determined using a partial auto-correlogram of the residuals of a simple linear model. The applicability of a linear model also needs to be verified (normality and homoscedasticity).

Other comments on the methods:

- Lines 268 to 284: this list of abbreviations could go in a Table. Otherwise, you need to list them within sentences with verbs, e.g. "The main phenological events mentioned above are:...", "The species abbreviations are:..." and "For the environmental parameters the abbreviations are:..."

- Line 344: which version of the vegan package did you use?

- Line 367: "We did not evaluate statistical significance of the Royama's correlation coefficients": why?

Cited references:

Cleveland, R.B., Cleveland, W.S., McRae, J.E. and Terpenning, I., 1990. STL: A seasonal-trend decomposition. Journal of official statistics, 6(1), pp.3-73.

Hafen, R. (2016) stlplus: Enhanced Seasonal Decomposition of Time Series by Loess. R package version 0.1.5. https://CRAN.R-project.org/package=stlplus.

Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D. & R Core Team (2018) nlme: Linear and Nonlinear Mixed Effects Models. R package version 3.1-131.1. https://CRAN.R- project.org/package=nlme.

2.3) Results:

- Fig. 2: The standard errors seem very low for such long time-series, especially for the temperature. It is normal?

- Fig. 3: I suggest to either transpose the x and y axes to have the Julian days along the x axis as in the Fig. 2, and/or to add the mean values of the 5 phenological events of 3A on 3B with lines.

- Fig. 4 and 5: Find a way to better highly the significant trends (p<0.01), for instance using red lines instead of blue lines?

- Fig. 6: what are the small dots? Indicate it in the figure legend. You could also number them and indicate for each number/dot to what it correspond in the legend.

- Table 1: I ma not sure that Table 1 is necessary. Personally, I do not show these values when I perform a CCA in a manuscript. I just indicate the global significance of the analysis (p-value and % of constrained variances) in the text if the results.

- For the description of Fig. 6, a general sentence indicating the main result of the CCA (i.e. what appends along CCA1) is missing. For instance: "The main factor affecting the copepod temporal/seasonal dynamics was the date of summer end in the previous year, inducing an earlier seasonal timing for Oithona and a later seasonal timing for Microsetella."

- Line 469: would it be possible to estimate a p-value here (cf. corresponding comment in the Methods section).

2.4) Discussion:

- Line 490: a reference is missing here.

- Line 521: " Unfortunately, we cannot either prove, or refute this for the White Sea population, since no long-term data on phytoplankton abundance are available by now": would it be possible to have access to chlorophyll estimates from remote sensing (satellites)? Nobody has sampled/estimated chlorophyll or phytoplankton concentration here in the last 60 years?

- Line 553: why a footnote? This could be added in the main text.

- Line 646: you use the term "traits": give a definition. Do you mean "functional traits" sensu Violle et al. (2007) or Litchman et al. (2013) or Kiørboe et al. (2018). See references below. You should also give some examples of the traits you have in mind here (to be included in future studies).

- In this section, it seems that a discussion on the impact of the species reproduction strategies on their phenology is missing. How could the temperature and the food availability affect the reproduction success to the different species? What about the way the species reproduce and spend the winter season?

Kiørboe, T., A. Visser, and K. H. Andersen. 2018. A trait-based approach to ocean ecology. ICES J. Mar. Sci. 75: 1849-1863. doi:10.1093/icesjms/fsy090

Litchman, E., Ohman, M.D., & Kiørboe, T. 2013. Trait-based approaches to zooplankton communities. J. Plankton Res., 35, 473-484. doi:10.1093/plankt/fbt019

Violle, C., Navas, M.-L., Vile, D., Kazakou, E., Fortunel, C., Hummel, I., and Garnier, E. 2007. Let the concept of trait be functional! Oikos 116, 882-892. doi:10.1111/j.0030- 1299.2007.15559.x

2.5) Conclusions:

- Line 676: You mention "other factors" but please be more specific: which ones?

3) Minor comments:

Here are a few examples of sentences for which the English could be improved (but it would have to be checked by a native English speaker, which I am not):

- Line 22: replace "The shifts of about..." by "Shifts of about..."

- Last sentences of the abstract: I suggest to reverse the order of the two last sentences and to write for the last sentence: "Indeed, interspecific interactions between ubiquitous species may influence..."

- Line 41: replace "seasonality" by "strong seasonality".

- Line 46: replace "because of short life cycle" by "because of their short life cycle".

- Line 50: "earlier" than what?

- Line 51: use "Zooplankton" or "Mesozooplankton" instead of "Planktonic animals".

- Line 54: replace "more than a half of studied species" by "more than half of studied species".

- Line 56: replace "during period" by "during the period".

- Line 58: replace "2 month" by "2 months".

- Line 60: replace ". The duration" by "and the duration" (merge the two sentences into one).

- Line 63: replace "early by" by "earlier by".

- Line 68: replace "trophic objects" by "food items" or just "food".

- Line 72: replace "next trophic level" by "upper trophic levels".

- Line 75: replace "lead to the changes" by "lead to changes".

- Line 75: replace "food chain and food web" by "food web".

- Line 104: replace "was not" by "has not been".

- Line 109: replace "lead to the changes" by "lead to changes".

- Line 122: replace "animal" by "copepods". Same comment for line 137.

- Line 140: replace "in a following" by "in the following"

- Line 142: replace "a number of individual per one cubic meter" by "the number of individual per cubic meter".

- Line 151: replace "of the six" by "of six".

- Lines 153 and 155: brackets are missing for the references of the species description?

- Line 165: replace "Genus Acartia is presented" by "The genus Acartia is represented".

- Line 168: replace "low" by "lower".

- Line 169: replace "to open sea" by "to the open sea".

- Line 169: replace "this species appeared" by "this species appears".

- Line 170: remove the comma before "than".

- Line 170: remove the sentence "Thus, speaking about timing of appearance of these species, we mean first of all A. longiremis".

- Line 172: replace "in warm period of year" by "during the warmest period of the year".

- Line 173: replace "the dormant eggs" by "dormant eggs".

(I'll stop here)

Addition minor language changes and/or typos appearing later in the document:

- Line 203: remove "4°C,"?

- Line 205: write instead "temperature in May-June and in July-September".

- Line 324: remove ";"

- Line 348: replace "more" by "a more".

- A bracket is missing line 352.

- Line 353: replace "require" by "requires".

- Line 656: replace "Main" by "The main".

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Reviewer #3:

Some general comments

Several parts should be to re-arranged, e.g., introduction and material and methods and discussion, and shortened (introduction and discussion), the aim of the study should be introduced more clearly at the end of the discussion. Statements are often unspecific, making it difficult to understand relate to the study, as several species were investigated.

There are several grammatical incorrections, especially regarding the correct use of articles, please let somebody proofread the manuscript.

The introduction misses some of the major information that needs to be introduced, e.g., what species does the study focus on and why? The former is only mentioned in Material and methods. It can also be significantly shortened as there are several redundancies. E.g., the paragraph on phenological changes of calanoids can be shortened.

Line 77-83 has several repetitions.

Line 43: do you mean the magnitude of temperature fluctuation?

Line 45: what is the timing of different events? Be more specific what you mean by listing them, e.g., onset of phytoplankton bloom, retreat of ice cover, appearance of zooplankton organisms, start of reproduction of main copepod species, timing of max. biomass…

Line 84: there are actually quite some time series on zooplankton in the North Atlantic, see your referred website, but only few in the Arctic.

Line 95: what is meant by events?

Line 98: delete theoretically

Line 105-106: as mentioned above, please delete: Though some preliminary analysis was done in the work, mentioned above ….

Line 107 onwards: this hypothesis has been mentioned and apparently proven several times above. Instead better formulate what the aim of the study is, what species are you working on, why did you chose those species? If you are focusing on calanoids, Oithona and Microsetella, why? Please explain the importance of the species you have chosen in the Arctic food web (dominate biomass of plankton? By what? Abundance? Important food source what species?...)

Material and methods

Line 188: sampling took place every 10th day. Does that mean it was the same julian day every year, as suggested by figure 2? Otherwise, how did you combine days?

Line 121-122: you chose only spring and summer data for your calculations? By this you omitted important data, e.g. winter abundance that could explain recruiting patterns in spring, e.g. especially for Calanus glacialis. Please comment why you think this does not affect your analysis and interpretation

Line 135: what is abundant and less abundant? How many individuals are counted in total in the subsamples (give a range, please)? 10 ind per species would be very little for abundant ones, then what does ‘less abundant’ mean?

Line 159: Please change to ‘The genus Pseudocalanus…’

Line 151-177: This paragraph does not belong into the Material and Methods section. Much of that information would be important to have in short in the introduction, some parts will likely have to be mentioned in the discussion

Line 195 and 200: what id the difference between the 3°C spring threshold and the 0-5°C spring period defined by the steepest increase in temperature?

Line 224 onwards: you considered different developmental stages for the different species and genera, but only Calanus C1-3 is shown, while no results are shown for other developmental stages. Was this only to evaluate the beginning of their development? Otherwise it would be confusing, why CI Pseudocalanus would represent the whole season. Please explain or clarify

Line 225: which boreal and ubiquitous species? Also, they are not better represented in the 200µm net because they are boreal, but because of their size.

Line 248: why was it not possible to find some events by the proposed algorithm, please explain

Results:

Figure 2: please correct spelling Pseudocalanus

Line 410: long term trends in phenology were not significant: what do you mean? Start of developmental season? End? Long term abundance? Because either has species that show significant trends, please refer to the specific event (a, b, c?)

Line 443 onwards: doe you mean 40.0% of the variability was explained by the model? Inertia is a very unusual word, please use the common expressions when referring to the CCA model and axis

CCA: when analysing the factors influencing phenology, why did you remove all the factors from the CCA? I would suggest including the different events, start spring, end spring…. Into the CCA as it is usually done to display the correlations, even if no correlation between events and abundances can be established instead of omitting the data

Discussion

The discussion very often confusingly shifts from one topic to another and then back again, e.g., from phenological shifts to different species, to T and chl influence, to abundance, back to phenology and phytoplankton. Also, the different species are discussed back and forth.

I would suggest reordering the discussion- and by this a lot of redundancy can be avoided and the discussion can be shortened – 1 paragraph on penological shifts, one on changes in abundance. One synthesis if necessary. Within those paragraphs species with the same response to an environmental driver should be discussed together – an accompanying graphic would help. The beginning of each paragraph could be a hypothesis or the major finding for phenological changes and changes in abundance.

Line 477: which trend was observed, increase in T, please mention it

Line 481 onwards: changes were higher than in Northern Hemisphere – please clarify, with respect to T increase?

Line 486: again, be more specific, shift towards earlier time

Line 497: any indications of earlier phytoplankton blooms? If yes, please refer to it, if not, please mention that no studies suggest it or have been made

Line 506: Staying in the 10-25m depth range for Calanus copepodites with a chl. max in 10m surely does not equal slow development and starvation – especially not when sampling took place every 10 days. There is a lot of information missing. Vertical migration possible, maybe with day/night differences? Phytoplankton, change in composition related to changes onset in spring? Also, could the difference in disappearance of Calanus copepodites and prolongation of season be related not only to earlier recruitment and but also to changes in recruitment span?

Line 529: timing of Pseudocalanus development shifted in which direction? Be more exact, as above and also below when referring to the changes in phenology and shifts

Line 536: tendency in what?

Line 542: what is meant by center of gravity timing?

Line 566: trend in dynamics of beginning-of-season of Microsetella norvegica was significant – do you mean earlier appearance of copepodites in the water column?

Line 572: ‘the temperature is not the main trigger of the beginning of the active development of this species. This is indirectly confirmed by its cosmopolitan distribution (OBIS, 2019)’ – this is completely unrelated. The cosmopolitan distribution would rather be related to a large potential to adapt to different environmental conditions – eurythermic and euryhaline species and omnivory or unselective feeding

Line 586: ‘the warmer the earlier’ – what was the reason responsible for this trend, earlier development? Faster development? Difference between species recruiting from resting or diapausing eggs vs. those overwintering as CIV/V?

Line 602: I do not understand the sentence, a species either shifts in phenological events or is resilient. If it is resilient then it does not synchronize with shifts in the environment

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There is additional documentation related to this decision letter. To access the file(s), please click the link below. You may also login to the system and click the 'View Attachments' link in the Action column.

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\*\*Our flexible approach during the COVID-19 pandemic\*\*

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