We thank the reviewer for the thorough and constructive review of our manuscript "Species richness and functional attributes of fish assemblages across a large-scale salinity gradient in shallow coastal areas". The assessment and comments are very helpful, and we agree with the suggested changes and needed clarifications/elaborations to improve the manuscript. Please find our specific responses below.

General comments

Concerning the general comments, we agree it benefits the clarity of the manuscript to remove the offshore data, given that only for one sub-basin there was enough data to conduct the statistical (rarefaction-extrapolation) analysis of fish species richness. Regarding the specific comment concerning the title, i.e. that only coastal but not offshore areas were mentioned, this was solved by excluding the offshore data, following the reviewers suggestion.

We agree that the potential factors influencing fish SR should be mentioned already in the introduction. We therefore revised the following sentence in the introduction to include that aspect: "*The species composition of fish in the Baltic Sea is regulated by salinity as well (Olsson et al., 2012; Pekcan-Hekim et al., 2016), even though other factors, such as temperature or habitat complexity, might also influence large-scale patterns of fish SR in estuaries (Vasconcelos et al., 2015; Schubert et al., 2011).*"

Further, we added two new discussion paragraphs where we discuss additional factors, specifically cumulative human pressure and habitat complexity (please see P21/L436 to P22/L455).

We agree that further detail, explanation and clarification would benefit section 2.3, "Analysis of species richness data", and conducted a careful major revision of that section to better elaborate and clarify the statistical terms and methods (please see P6/l155 to P7/L188). In working on these revisions, we noted an unfortunate error in that the values of sample coverage had been incorrectly termed inventory completeness in the initially submitted manuscript (table and text). We corrected this, better explained the terms (following the reviewers suggestion), and included the values of inventory completeness (besides sample coverage) in Table 2.

We agree as well that a more detailed discussion of the fish functional characteristics and changes across the geographic gradient was warranted, and therefore expanded and revised the respective discussion section in response to the reviewers comment (please see P22/L468 to P23/L492).

Specific comments

We thank the reviewer for pointing out the needed technical corrections and suggestions for improving tables, and followed all of them.

Reflecting the revisions conducted to the manuscript we further slightly revised and adapted the Abstract.

We thank the reviewer and Editors for their efforts with this work, and are looking forward to hear from you about our manuscript.

Yours sincerely,

Birgit Koehler and co-authors

We thank the reviewer for the thorough and constructive review of our manuscript "Species richness and functional attributes of fish assemblages across a large-scale salinity gradient in shallow coastal areas". The assessment and comments are very helpful, and we overall agree with the suggested changes and needed clarifications/elaborations to improve the manuscript. Please find our specific responses below.

1) Manuscript structure, tables and figures

The reviewer suggests the salinity map to be shown only once in the manuscript. We agree and, to accomplish this while maintaining the necessary information, we moved Figs. 4-6 into the Supplement, and instead lifted the previous Figs. S2 and S3 into the manuscript. These show the relationships between functional groups and salinity as bi-plots, with regression lines when significant. At the same time, we completed these correlation figures by including all functional groups, where we previously (i.e. in the Supplement) had only included a subset of groups. This will facilitate complete overview over the found relationships when most of the previous maps were moved to the Supplement. By these changes, the number of figures in the manuscript was reduced from previously six to five. Further, the acronyms of the sub-basins, which are given in the bar-plots of Fig. 3, are now defined in the figure legend. We also followed the reviewers suggestion to place a larger-scale map for reference into the maps showing the Baltic Sea.

Moreover, we moved Table 3, which gives the observed, standardized and estimated Shannon and Simpson Diversity, as well as Table 4, which gives regression information for relationships between Shannon and Simpson Diversity with salinity and temperature, from the manuscript into the Supplement. These revisions accommodate the comment that the three estimates (std, obs, est) are, for the more common species, very similar. Fig. 2 still shows both the values (referring to Table S5) and relationships with salinity (referring to Table S6). By these revisions, the number of Tables in the manuscript was reduced from previously five to three. Also, the tables as such have become considerably simpler following the exclusion of the offshore data, as suggested by the reviewer.

In Table 2, i.e. for species richness, we would like to keep all three estimates (i.e. std, obs and est), as these differ more than for ShD and SiD since the rare species are included. One of our central messages, i.e. that fish SR decreased about three-fold from highest to the lowest salinity, is based on SR_{std}. It is also relevant to compare SR_{est} with e.g. total observed SR (i.e. based on incidence data plus presence observations). For these reasons we would also like to keep Table 2 in form of a Table, such that the precise values (and error estimates) can be directly compared. To accommodate the reviewers comment, we better explained the three different estimates (obs, std and est) in section 2.3, "Analysis of species richness data". In short, the purpose of the standardised estimate is to enable accurate comparisons among areas in spite of differing sample sizes and inventory completeness. The purpose of the estimated SR is to extrapolate to a likely number of species in an area, if inventory was continued. The complementarity of the different estimates is discussed in the last sentence of the first discussion paragraph, and in the second paragraph of the discussion.

2) Coastal resident vs. migrating species

Since the marine migrating and visiting species are part of the coastal fish assemblage during parts of the year, and depend on coastal areas during parts of their life cycle, we included them in the statistical analyses. The mix of resident and mobile fish species indicates the dynamic nature of certain coastal areas, and their connectivity with the open sea. We agree with the reviewer that inclusion or exclusion of marine migrating and visiting fish species in the analyses does affect how the inventory completeness (IC) turns out, but find that including them results in a more complete representation of SR. In response to this comment, we added

a note in the respective Methods section (Sect. 2.3) which details that both resident and migrating/visiting species were included during calculation of IC (P7/L175), and added discussion on this aspect (P20/L374 to P20/L376).
We further agree with the reviewer that a lower or higher proportion of marine migrating and visiting species would influence the estimate of IC, and that changes in this proportion over time would affect the IC estimate. Adding such a temporal perspective would be interesting to follow up in a future study, but was not included in this large-scale spatial study where we merged monitoring data from many years to obtain as accurate as possible spatial comparisons within the limits of available data. It is important to note, though, that the sample coverage (SC) in our study, i.e. the inventory completeness of the more common species, is not strongly affected by the incidence frequency of rare species, and was very similar across sub-basins (Table 2). Since SR_{std} and SR_{est} depend on SC they are rather robust against changes in the proportion of (more rarely present) migrating/visiting vs. resident species, and hence against including or excluding migrating and visiting species. In response to this reviewers comment, we added discussion on this aspect (P22/L445 to P22/L449).

3) Offshore data

We agree that it benefits the general clarity of manuscript to exclude the offshore data, particularly given that only one sub-basin had enough data to conduct the statistical (rarefaction-extrapolation) analysis of fish SR. Further, as the reviewer assumed, data from the BITS survey carried out in the Baltic Sea were indeed not included due to a lack of data for shallower depths (i.e. <30 m).

4) Discussion on other drivers

We agree with the reviewer, and included two new discussion paragraphs on the potential influence of other drivers, particularly on cumulative human pressure and habitat complexity (please see P21/L436 to P22/L455).

5) Discussion on functional attributes (traits)

We agree that the fish functional characteristics and their changes along the salinity gradient warranted more detailed discussion, that the statement on benthic-pelagic coupling needed to be clarified, and that it will be interesting to couple the discussion to ecosystem processes. To meet these comments, we revised and expanded the respective discussion paragraphs (please see P22/L468 to P23/L492).

Concerning the other comments:

- L32: We refer to species richness, and clarified the statement accordingly (P2/L30-33).
- L49: We added “on average” to accommodate the fact that certain regions experience less intense water cycling, while the general trend is an intensified hydrological cycle.
- L78: This comment does not anymore apply since offshore areas were, upon suggestion from the reviewer, removed from the manuscript.
- L116: In separated ecosystems, such as islands or lakes, SR usually increases with area (“species-area relationship”). However, such separation is not the case for our coastal sub-basins here. While the studied sub-basins are hydrographically distinct, with water exchange being separated to a certain degree by shallow sounds or sills, they are still connected. Based on this reviewers comment we realised that giving the size of the shallow coastal areas in table and Methods may cause confusion in this regard. We therefore removed these values, which are also not used further in the

study, leading to simplification of tables (as suggested would be useful by the reviewer).

- L128: We revised the respective text part (P3/L130-134).
- L139: We revised this part to better explain the motivation for the chosen cutoff (P5/L135 to P6/L142). The cutoff was essentially based on that we found that sub-basins with less than one hundred fish species incidences had too little data for statistical analysis. During revision in response to this comment we realized an additional aspect that needed to be clarified in the manuscript. Specifically, while we extracted all available data from the database covering nearly five decades as stated in the manuscript (1975-2021), only one sub-basin had annual samplings during all those years, while most sub-basins had data from 17+ years, and a few sub-basins had data from less years (i.e. 4 and 9 years, excluded from statistical analysis based on that, see above). We edited the text accordingly, and added a new Supplementary Table detailing for which years fishing data was available per sub-basin (new Table S2).
- L110-147: The incidence data is official, quality-controlled survey data for which species are correctly identified by taxonomic specialists. As an additional double-check of uncommon species we used the HELCOM list of macro-species in the Baltic Sea. Concerning the "observation databases", where e.g. citizens can report species observations and which hence are less reliable, we did a careful cross-check where unreasonable occurrences were considered falsely identified and discarded. We elaborated the respective text pieces to clarify these aspects, please see section 2.2.
- L167: The comment made us realise that this text part could be confusing since the rarefaction-extrapolation method is called "Chao Richness method", and the used R-function has the same name but includes several different calculations. We conducted a major revision of Sect. 2.3 to accommodate this and other comments on it.
- L170: We suggest to clarify that the observed values were standardised to the minimum SC. The purpose of SR_{std} is to allow for accurate comparisons between sub-basins, given that all standardised values give SR for the same SC, hence representing an estimate which is not biased by how completely the compared areas were sampled. During revision, we noted an unfortunate mistake in that "sample coverage" (SC) was erroneously called "inventory completeness" (IC). This is now corrected, and better explained in the revised Sect. 2.3. We agree with the reviewer that SC was high and very similar across sub-basins, varying between 98.5-99.9%, and hence in the case of this study did not strongly influence the obtained values. The correction is still needed for accurate, unbiased comparisons between sub-basins, and we therefore find it important to keep the standardisation in the manuscript rather than moving it to the Supplement. However, we understand the need of presenting the data and results more clearly, especially in the Tables. For this aim, we excluded the offshore data, which considerably simplified text and tables, and reduced the number of tables and figures in the manuscript (as suggested by the reviewer, and please see above for details). To further accommodate this reviewers comment and the comment above we also conducted a major revision of Sect. 2.3.
- L222: This comment does not apply anymore following omission of the offshore data, as suggested by the reviewer.
- L237: This part was changed, because we realized during revision that we had by mistake interchanged the terms inventory completeness and sample coverage. Now, inventory completeness shows a larger variation, and we would like to refer to Table 2 rather than translating the percentages into species numbers.

- L250: Extrapolation is recommended up to maximally twice the actual sample size for SR (Chao et al., 2020). We now included this information in the respective methods section (Sect. 2.3), and in the legend of Fig. 1.
- Table 3. We moved this table to the Supplement (please also see above). A graphic illustration of the trends across the salinity gradient is available in Fig. 2, and, for ShD and SiD, the observed values are very similar to the standardized and estimated values, given that the missing species represent rare species. Hence, for study sites with high SC, the observed ShD and SiD are already largely unbiased estimates. To further accommodate the reviewers general comment that the manuscript contained too many tables and figures we also moved Table 4 to the Supplement (please see above).
- Table 5. We now included the number of observations in Table 3, and in the legend of Table S6.
- Previous Figs. 4-6. We agree it was redundant to repeat the salinity map repeatedly in these figures. We moved previous Figs. 4-6 to the Supplement, and instead lifted previous Figs. S2 and S3 to the manuscript. These figures directly show the relationships between functional groups (on habitat use and vertical distribution) and salinity.
- L372: Mora et al., 2008 applied rarefaction-extrapolation methods similar to the one used in our study, but used different statistical models. Appeltans et al. 2012 based their IC estimates on a statistical model based on historical rates of species description. While the methods differ more or less from the one we used the estimated property is the same, i.e. IC as the proportion of observed to total species, which motivates our comparison in spite of methodological variation.
- L379: We rewrote this sentence to clarify which ratio we mean, moved it to the Results (end of Sect. 3.5), but also took it up as discussion point in this place. We rewrote to "calculated based on data presented in Table 2" to make clear that the ratio is not given in the Table, but that the values needed to calculate it are found there.
- L394: We understand that this statement could be confusing, and rewrote it accordingly (P20/L393 to P20/L396).
- L400-414: We now added more information on this aspect already in Sect. 2.2 (P5/L130-134).
- L400: We changed accordingly.
- L417: We edited the sentence accordingly (P21/L414-416).
- L440: We agree and removed the statement with a lag-period.
- L460: We suggest that this may not be the optimal place to add reference to the phytoplankton trend, since we here focus on prey items of benthic fish. However, we are referring to this study in the introduction.
- L463: We agree that this wording could be improved, and rewrote it (P23/L486-487).
- L483-484: This is an interesting question, i.e. what the net effect of simultaneous warming and upper layer freshening on fish SR may be. Given that we did not study warming, however, we did not include further discussion on potential implications at this point.

We thank the reviewers and Editors for their efforts with this work, and are looking forward to hear from you about our manuscript.

Yours sincerely,

Birgit Koehler and co-authors