Review of manuscript bg-2020-17: "Persistent effects of sand extraction on habitats and associated benthic communities in the German Bight"

General comments:

This paper intends to investigate the effects of historic and recent intensive dredging on habitats and benthic fauna in the German Bight in a dredging area near Sylt. This is a follow-up paper of Mielck et al 2018 where the focus was on morphological changes due to sand extraction for beach nourishment. This definitely is of scientific value and interest in the field of effect studies and increasing demand of sand for both industrial purposes and coastal protection.

However, I had to find out myself that this was a 'follow-up' study and really needed to read the Mielck paper to get better insights in this study and understand the situation of the area. At least, this could have been better referred to. Furthermore, the way it is written and presented now, especially the discussion adds little value compared to the previous study. Although, in itself, it really is a different study and could add interesting new scientific insights. But therefore, this manuscript has to be thoroughly reworked with focus on the new aspects i.e. defining the different habitats related to the dredging history of the sites and characterizing the benthic communities related to these habitats. The introduction should therefore at least make a clear referral to the previous study and the conclusions of that one. Moreover the manuscript should better introduce the available knowledge on the topic of impact of sand extraction on benthic habitats since too few references have been cited, while already quite some literature is available and this would situate the study in a broader perspective. Objectives should also be better delineated to make clear what the main aim of this exact study was. This could also help maybe to explain the unconventional way of benthic sampling i.e. very small sample volume used for species identification compared to volume used for sediment analyses.

Results are too vague and too descriptive. Extra multivariate analyses should be done to characterize communities. Maybe acoustic data together with sediment data could be used in a PCA and these PCA results (=axis scores) can in their turn be used in the faunal analyses so that acoustic data are really used to determine benthic communities? This study would really benefit from a better combination of both datasets, since this is its strength. While in the current version of the manuscript, these two datasets are treated as separate entities.

Discussion is too superficial and adds very few new insights compared to the previous paper as well as said above. Plus it thus not really discuss the results of this study. I also do not agree with the conclusion made. The historic dredging actually caused a loss of habitat in my opinion. You even get a change in EUNIS habitat, so regeneration to the original habitat, without human intervention, will not be possible in that sense you cannot speak about regeneration/recovery. This could be discussed in the light of the MSFD, D6 seafloor integrity C1 habitat loss. See also specific comments for some extra input in the discussion that could lift it up to an interesting contribution for the scientific community. Also here, quite some literature is already available to put your results in a wider perspective but only very few references have been used. Looking into the existing body of literature and putting your results in this wider perspective would give more body to the discussion.

To conclude, the manuscript cannot be published in the current version, thorough revision is needed of all sections and some new analyses need to be done to make this a valuable contribution.

Specific comments in chronological order:

Introduction

L30-31: ‘current’ with references from 2010 is somewhat outdated in my opinion. I would suggest to check ICES WGEXT reports where recent figures are yearly reported for NE Atlantic countries. Latest report has figures from 2018 even making a distinction between extraction for coastal protection and for industrial purposes, see https://www.ices.dk/community/groups/Pages/WGEXT.aspx

L30-42: very few references while quite some papers have been published on these topics so would be good to support these lines with extra references. Just naming a few: Le Bot et al 2010, Foden et al 2009, Kubicki et al 2007, Van Lancker et al 2015, also in cooperative research report of ICES WG on extraction a lot of references are incorporated in chapter on ecological impact of sand extraction (http://ices.dk/sites/pub/Publication%20Reports/Cooperative%20Research%20Report%20(CRR)/CRR330.pdf)

L64-66: refine/rephrase your objectives – maybe better in the form of hypotheses, research questions?

L70 and further: this part should be moved to acknowledgements

Study area

L74: make ‘study area’ a section under M&M

L75 - Fig1: Please include location of reference area(s) plus add information (best in a more detailed zoom) on e.g. geological layers, bathymetry and past and ‘recent’ dredged areas on the map, so it is more in line with the information provided in study area paragraph

L78: water depths between 14 and 30 m, is this natural depth range or does this include extraction pits already? Confusing, I would suggest to report ‘natural’ depth

L79: would be good to add cumulative amount of sand that has been extracted since 1984

L82: what type of dredging is done? Static or trailer dredging?

L83: typo add IS derived

L84: ‘prevails’ strange wording, better ‘takes place’?

Material and methods

L94 ‘all-over’ replace by ‘over-all’, ‘high-resolute’ replace by ‘high resolution’

L95-96: Please put transects and location of grab samples on a map.

L95: These 55 transects were done for both multibeam and sidescan? Simultaneously or on different days? Please provide information on this in M&M section. Also not clear how long survey was, all in one week, several days throughout January? January can be quite heavy weather and shallow area so weather can have influence on measurements, certainly when spread over several days. Info needed.

L111: please add what focus is of 330 kHZ and what of 1MHz sonar

L126: very unconventional way of sampling benthos, very small samples for macrobenthos…I would expect the other way around big enough subsample for sediment and main sample for benthos? Why was this done this way? Clear justification is needed

L129-130: class 0 control, is this really control, undisturbed conditions?? What about indirect/secondary impacts? Can you be certain that these are not at all affected by the dredging?

Results

L140: replace ‘excavation’ by ‘extraction’ – try to be consistent throughout the manuscript

L141: how do you know they are only partially refilled? What was depth after cessation of extraction? What is depth now? Please support your statements with numeric data.

L141-145: in text, you mention letters a, b, c , d but these are not indicated on figure2. Please make sure that your figures and text match. – actually these are results from a previous study so delete here? Or clarify, since now it is confusing because you refer to/compare with earlier published study and description of these dredging pits is not the aim of this study.

L146-147: please define what is high, intermediate and low backscatter

L156-157 – Fig4: would be good to have delineation of different dredging zones cf. old, new ones this would make interpretation of the maps more clear.

L162: on which results this statement is based? Data in results are needed to support this? E.g. multivariate analyses or cluster analyses.

L163-165: ? would think this is a result that should be under habitat mapping? This is ground truthing of your sidescan results

L166-170: unclear – is there a difference between undisturbed and control? First time mentioned in the paper. Please rephrase.

L174-177: idem as comment above, please use multivariate analyses to back up these statements with SIMPER to demonstrate which species are making the difference between the groups

Discussion

L190: okay, low sedimentation rates but how does the mud comes in? Do these pits not act as traps for mud?

L191-193: this is for the first time you mention the earlier study with which you compare the 2019 measurements – this causes the reader to be very confused all the way throughout the paper. Should be made clear from the beginning, even in introduction results of previous study should be situated.

L212: is this a successional state? In my opinion, this is just an altered habitat which will never recover to the old state and reach a different equilibrium or has already reached it in the historic dredging pits. I would call this physical loss of benthic habitat (cf. MSFD descriptor 6 C1) due to dredging, even at the EUNIS level. For more background information see reports on this topic http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/Fisheries%20Resources%20Steering%20Group/2019/WKBEDPRES2/WKBEDPRES2_Report_2019.pdf + related info. Very weak discussion regarding the benthic results/benthic habitats. This is focus of the paper but it fails to add body to this topic while it actually should be the main part of the discussion. Combining the acoustic data with the biological data, is the interest of this paper.

L213-214: what are these habitat types? Where do you find which one? How related to dredging history? This is what should be discussed? Which habitat type, you found where and what are the indicator species for this type of habitat? As said above, this should be focus of discussion.

L216: do you want restoration? Naturally, it will probably not be possible? So if you want restoration maybe mitigation through human intervention is needed? Or if not, leave it like it is, other suggestions? What would be frequency needed for monitoring, yearly, every 5 years? Every 10

years? As you suggest, rate of infilling is very slow so why put money in a monitoring study where you already know the result? Wouldn't it be better to put the money in other research questions or mitigation measures or 'working with nature' designs? Or studies to prevent this happening again with the ongoing dredging? I am just putting forward some ideas, topics that could be included in the discussion and that would give it more scientific value. Now the discussion is too superficial, it could be lifted up by going more into depth in the main topics of your study.