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Interactive comment on "Biogeography and community structure of abyssal scavenging Amphipoda (Crustacea) in the Pacific Ocean" *by* Tasnim Patel et al.

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The authors conducted a species inventory of larger scavenging abyssal amphipods found in two major basins of the Pacific and compare species diversity patterns between these two sampled regions. The results are of particular interest as they show that the impact of mining may result in a reduced diversity of scavenger amphipods. Furthermore, they demonstrate that the currently designated Areas of Particular Ecological Interest may have to be revised, which is crucial information for future environmental impact and monitoring studies.

However, the context and interpretation of the results are not well situated in current

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literature. The works on deep-sea amphipods that the authors have consulted are restricted to references dating back to the nineties, whereas a significant amount of work has been published in recent years on deep-sea amphipods. Older views on dispersal and connectivity have been challenged by Havermans & Smetacek (2018), including updated discussions on biogeography and barriers to dispersal. In this context, I would also suggest to include, where possible, more information on the ecological roles of the species found. Of several species, an update on their feeding ecology has been given in the aforementioned review, and it would be of particular interest if the authors could compare also the type of scavengers between the different regions: e.g. omnivores with more specialized carrion feeders. This, combined with information on the productivity of the regions, would improve the discussion in view of the emphasis on bottom-up factors influencing species diversity of amphipod scavengers.

Recent molecular studies have also brought ample information on dispersal and connectivity of genera such as Eurythenes (Havermans et al.) and Paralicella (Ritchie et al.). These works would be better suited than the older works as they would place the discussion in a much more relevant framework. Also recent work on shallow-water scavenger amphipods is interesting in this context (Seefeldt et al. 2017), where one particular species dominated an area impacted by sedimentation from glacier retreat. Hence, particular species may be more flexible and a comparison with the dominant species found here in the disturbed abyssal region may be particularly interesting.

Introduction

Why not refer directly to the abyssal deep sea at the start of the introduction (as normally the deep sea includes also the bathyal zone). Moreover, since this paper exclusively refers to depths below 3500m, I would leave out fishing as an exploitation of resources in the abyss (Line 98), as this is not relevant for abyssal fauna. I would rather extend in this paragraph on presenting the region studied as one of interest for deep-sea mining. For the CCZ this is mentioned in the methods, but it is not clear whether the DISCOL area is as well situated in an area where nodules occur and po-

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tential deep-sea mining activities have been considered. This information is needed to grasp the context of your recommendations.

Line 108: The authors state that knowledge on the biogeography of Amphipoda is still limited but to underpin this, references from the sixties and the nineties are cited that are no longer up to date. With molecular studies we have now a much better view on the actual species distributions. Therefore I suggest to consult recent literature and discuss these findings. For Eurythenes (the most species-rich genus found by the authors in this study), recent studies have shown that some species are unique to particular habitats whilst others widespread. This already indicates the presence of a unique deep-sea fauna that may be impacted by anthropogenic activities.

Material and Methods

Some information is missing. Was the bait mixture used exactly the same at the different localities? Which were the deployment times for each station? I suggest to add sampling dates and deployment times to Table 1. Particularly the latter are needed to interpret the subsequent results.

The authors mention that all pelagic amphipods were omitted from their studies. These “pelagic” amphipods were certainly swarming or feeding on the bottom - many hyperiids are known to do so (Vinogradov) and to my belief several of those may spend a part of their life cycle near the seafloor. It would be interesting to present these findings of the remaining amphipods, as this fauna may well also be impacted by seafloor disturbances, and therefore I do not see the straight differentiation the authors make between the so-called “benthic" species (which actually are bentho-pelagic), and “pelagic” species. The species studied here are indeed not entirely benthic: Eurythenes can be found thousands of meters above the seafloor. I have recently deployed pelagic baited traps, attempting to catch scavengers in the water column, however as the traps could not be kept immobile due to wave action, it was impossible for scavengers to enter the traps. Therefore, I am convinced the pelagic species the authors refer to, were not

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caught on the way up to the surface, but entered the trap when it was still positioned on the seafloor and must be spending part of their life in this habitat.

Results

Results and Figure 2. It is not clear to me which species are referred to under Eurythenes spp. nov, that were shared between the basins. E. sp 1 and 3 are not discussed in the text. I suggest to clarlify this in the results part. Did you find consistent differences with the specimens of the so-called “aff.” species (e.g, gryllus and sp. 2)? As mentioned before, information on deployment times are missing (line 317) Which trap station had the longest residence time? The only information given is that for the CCZ it was twice as long (only in line 478). It would help to interpret the results in the light of findings showing different species arriving at different times after deployment. Therefore this bias could have influenced the results not only in abundances but also the part of the scavenger guild that has been attracted.

Discussion

What is known about the current speeds in the different areas? This could heavily influence the directionality and reach of the odour plume that attracted the scavengers to the bait and therefore current data may be needed to interpret the differences between sites.

In the discussion, references are limited to older studies (e.g. line 457) whereas we know so much more now about the true distributions deep-sea amphipods due to studies combining morphology and genetics. An updated discussion on biogeography in view of these recent works is needed. Both Eurythenes as well as Paralicella have been studied now with molecular markers which would be of relevance here.

How can you update the bathymetry of species that are listed as aff. gryllus etc? I would leave these out until further morphological and molecular investigations allow to confirm the preliminary identification.

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Line 540-541: Not only in polychaetes (reference cited) but also for deep-sea amphipods this has been shown (e.g. vertical species segregation in deep-sea canyons, on seamounts and in trenches). The paragraph on dispersal and connectivity also lacks a comparison with recent studies.

As shown in a population genetic study of Paralicella, species can be widespread over thousands of km but gene flow and hence dispersal may be restricted between particular geographic populations. Hence the statement in Line 549 that dispersal occurs over more than 3000 km cannot be confirmed here and this sentence needs to be rephrased.

Line 552-559: The likelihood of passive vs. active dispersal has now been revised by Havermans & Smetacek 2018. Arguments are given that amphipods being carried with currents is unlikely as they need to swim upcurrent to detect an odour plume and locate food. Therefore, most amphipods (not only lysianassoids) are able to swim upcurrent. The reference cited here for swimming speeds does not refer to abyssal amphipods as mentioned, therefore I would refer to Ikeda et al. or Laver et al. who conducted ample work on swimming speeds of lysianassoids. This would be of more relevance here than the argument used by the authors in Line 556-557. Bottom currents are horizontal and therefore swimming upwards into the water column does not prove that amphipods can swim upcurrent. In the same line, the extremely sluggish currents of the abyss, in particular in these regions, are very unlikely to carry along large dispersive amphipods, mentioned in line 565-566 (see also reference cited above for more discussion). This part could be omitted or rephrased. I suggest to rather discuss the species diversity in view of the feeding resources available in the different regions as well as the different topographic features detected that could promote accumulation of sinking particles and food falls in certain regions more than others, and hence allow a more diverse scavenging guild.

Line 511-518. In the recent study of Eurythenes, sills and ridges have been shown not to be adequate barriers for dispersal of deep-sea amphipods. However, particular

conditions linked to seamounts have been pointed out to have promoted differentiation, a link to these findings may be appropriate here.

Line 524-525: confirming the findings of Havermans et al. 2016 and Ritchie et al. 2017 on abyssal and hadal amphipods respectively.

Line 614: cryptic amphipod species have also been found in the deep sea, which would be more relevant than comparing with terrestrial or freshwater studies mentioned here.

Line 523: the recent review mentioned before demonstrates that feeding opportunities may not be so erratic at all as previously emphasized. In this view also, there may well be a much wider scope of food for scavengers to thrive on than the POC or whale falls mentioned in line 599. Monitoring of different types of food falls could give much more information on the scavenger diversity.

Finally, in line 608 as well as before the authors classify the scavengers studied as benthos but it is well known that several of the species here are bentho-pelagic. Therefore I would change this throughout the manuscript. This actually makes it even more interesting, because if mining activities can impact bentho-pelagic species,not bound to the seafloor for food supply, it will be even more so for the true benthic amphipods, which would be less mobile and dispersive and could less easily recolonize affected habitats.

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