REVIEWER #1

General comments:

Díaz-Astudillo et al. use a 26 hours of acoustic data over a submarine canyon to provide another example of the importance of these topographical features in marine ecosystems. I commend the authors on their work. I think that is an interesting contribution and I have no specific comments on the validity of the methods or results. Overall, I think the manuscript is good, but I have two major comments that I would like the authors to address.

R: We are thankful for the positive opinion on our work.

Specific/Technical Comments:

1) A majority of the text is verbose, making the text difficult to get through. I would encourage the authors to read the text aloud, or move any extraneous text to the supplement (while important, the extensive description of the wind/upwelling conditions and accompanying figures at the start of the results comes to mind) to consolidate the text to make it easier for the reader to understand your main points. I would also suggest that the authors reduce the number of figures and should take the time to thoroughly proofread the manuscript (ie make sure all abbreviations are consistently used throughout and verbs are in the correct tense).

R: We appreciate this comment and agree on the text needing revision. We re-read the whole text and modified the sections that were too verbose. We also moved the description of the atmospheric conditions and river discharge to the Supplementary Material to shorten the Results section. We checked all abbreviations (with emphasis on NS, SS, ET and WT) to assure their consistent use.

2) The authors put a lot of weight in their results, suggesting that they have discovered a potential fourth mechanism for submarine canyons facilitating food web focusing using just over a day's worth of data. I think both mechanisms 3 (interaction of DVM and abrupt topographies) and 4 (canyon mediated retention) are valid, but the fourth mechanism is not new. The Hudson et al 2022a, b papers (in MEPS [cited already] and JGR Oceans) illustrate both of these mechanisms. These mechanisms differ slightly than those described here (ie, the Antarctic krill are not being 'blocked' from migrating, or if they are, it was not considered as a focusing mechanism), but the overall concepts are the same. I would encourage the authors to combine these two mechanisms into a single section in which they describe how BBC retains zooplankton and then describe the ecological implications in a different section.

R: We appreciate this comment which has made us reflect on the Discussion and delve deeper into these ideas. The papers by Hudson et al. 2022 does present a retention mechanism that involves the topography of a submarine canyon, however, the retention mechanism is directly associated with the formation of a subsurface eddy inside the canyon. The interaction of krill DVM with the retentive eddy is the mechanism that increases particle residence time within the Palmer Deep Canyon (Hudson et al. a and b). We did not find evidence in the hydrographic profiles nor in the currents of the formation of and eddy during our study, so the mechanism we describe is fundamentally different that the one in Hudson et al. 2022 a and b. We did find currents with opposed direction in one wall with respect to the other, but the flows changed in direction several times within the 26 h of our study, which is not consistent with the presence of an eddy. Additionally, we didn't see evidence of isopycnal doming which is another indicator of the presence of and eddy (we have included this in the Discussion). We have improved the Discussion section to support the hypothesis of the interaction of DMV with topography and alternating currents.

Furthermore, there is a lot of weight put on these results (ie, suggesting a "new" mechanism) on 26 hours worth of data, which included only 2 zooplankton samples. We always want more data, and I still think that the study is strong with this limited dataset, but I think this needs to be addressed in the discussion and should include a brief (~1 paragraph) discussion of the limitations of this study.

R: We appreciate the reviewer's acknowledgment that our study is strong even with limited data. We agree with the reviewer that maybe too much emphasis was put in the suggestion of a potential new mechanism. We toned down the emphasis put in a potential new mechanism, and we now propose a variation of a previously known mechanism involving currents, DVM, and topography, following the suggestions of both Reviewer 1 and 2. We also included several lines about the limitations of our study throughout the Discussion section. Finally, we wish to clarify that we presented results on 8 zooplankton samples collected on 2 strata during day and night. To make this clearer, we included a Supplementary Table 2.

You performed this sampling study after a period of upwelling winds; discuss how you might expect this mechanism to change under different conditions. What if there hadn't been upwelling winds prior to your sampling event? If this mechanism is tied to upwelling winds, is it truly a different mechanism?

R: Thank you for the suggestion. We have included the potential change in the Results under downwelling conditions in the Discussion (lines 294-298).

REVIEWER #2

This is an interesting study based on a very small dataset consisting of 16 transects with a shipboard 150khz ADCP and 4 zooplankton tows over the course of 26 hours. Although the dataset is limited in spatial and temporal extent the authors' analysis provides some interesting insights into biophysical processes in a canyon within an upwelling regime.

R: We are very thankful for the positive opinion on our work, and we appreciate all the comments and suggestions that helped us improved it. Below you will find our answers to all your comments.

I think the authors are describing a mechanism for zooplankton accumulation in the canyon not just retention? This concept with in the literature context of canyon funneling of zooplankton should be included in the scope of the paper.

R: Thank you for the comment. We improved our discussion to include zooplankton aggregation, and not just focus on retention. We have incorporated a description on how DVM interacted with topography to aggregate zooplankton. Nonetheless, it is our understanding that canyon funneling refers to the process by which sediment, nutrients, and other materials are transported downslope from continental shelves and slopes, into the deep ocean, mainly by deep currents or gravity-driven flows (for example, https://doi.org/10.1016/0079-6611(65)90028-5, https://doi.org/10.1016/j.marpetgeo.2014.02.016, and references therein). This is fundamentally different from the mechanism we are evidencing (which involves asymmetric currents and DVM). Thus, we believe that including canyon funneling as a concept could confuse the readers.

It would be helpful to include a dashed line marking local sunrise and sunset in all figures that display time and all figures should be bigger

R. Thank you for the suggestion. We have now indicated the time of sunrise and sunset in Figures 3, 6, 9 and S6.

Conceptually my biggest concern is the use of the term topographic blocking , which is actually quite specific and well defined in the long history. Topographic blocking specifically refers to vertical migrators whose sunrise descents are blocked by seafloor with depths shallower than their preferred daytime depths. The authors' data does show some evidence for this at WT with what my best guess is for local sunrise (both sunrise and sunset times need to be explicitly stated in the text and marked in

figures). Eg discussion ~l272. I think canyon funneling - where currents advert and accumulate animals at the canyon head should be explicitly discussed and relevant literature included new and old (eg greene et al 1988). This second type of topographic blocking is not topographic blocking but rather physical aggregation through advection toward the seafloor. Overall time needs to be examined in more detail for the biological analysis and interpretation. Sunrise and sunset are important and will dramatically influence the density and distribution on zooplankton in the canyon. As is, the times of sunrise and sunset are not even explicitly mentioned.

R. We appreciate this comment as it points out an important topic in our paper. As the reviewer indicates, we have some straightforward evidence for topographic blocking at some specific moments during our sampling. We have described this phenomenon with detail in the Discussion. We still want to point out topographic blocking as a possible mechanism for zooplankton aggregations in this canyon, even knowing our dataset is limited. Regarding canyon funneling, we discarded this mechanism because is mainly associated with bottom currents and may cause some confusion. Our results shows that zooplankton aggregations were mostly present in mid-depth and surface layers.

Line specific comments

Figure 1 the color scheme for the bathymetry map is very confusing. There should not be two whites in one gradient. I suggest a single yellow to white gradient for land and a single gradient from white to dark blue for the seafloor. The cross canyon - rofilemis very useful. I would suggest adding the approximate locations of the zooplankton sampling stations.

R. Thank you for the suggestion. We modified the color scale of Figure 1. Please note that the location of the zooplankton sampling stations were already indicated in Figure 1.

L96 casts not transects?

R. After reviewing the sentence, we confirm that transects was correct, as a total of 14 transects were carried out.

L98 cite supply table 1

R. We cited Supplementary Table 1 as the Reviewer suggested.

Section 2.4 Small fish with swim bladders will also scatter at 153khz - these results are not only for zooplankton.

R. The Reviewer makes a good point with this observation. Fish with swim bladders do scatter at frequencies between 100-200 kHz, and part of the signal might come from them. Nonetheless, research shows that both individual target strength and volume backscatter strength of fish with swim bladders is higher than smaller fluid-like organisms, at the used frequency (150 kHz), and that fish usually scatter ar lower frequencies (eg. doi.org/10.1093/icesjms/fsp262, doi.org/10.1121/10.0000594). Our methodology, which includes filtering all Sv higher than -40 dB re $1m^{-1}$, assures we are getting mostly signal from zooplankton and micronekton. However, we can't assure there is no signal coming from other groups, so me included the following in section 2.4: "Although this methodology does not completely filter the signal of bigger scatterers, such as small fish with swimbladders, it does reduce their contribution the total volume backscattering strength."

L156 mark these 3 layers with dashed lines in all relevant plots for easy reference

R: We included horizontal lines in Figure 7.

Section 2.5 more details needed. Why not include a metadata ramble for the zooplankton sampling, location, depth, time, length of tow, volume sampled, biomass etc. were there 4 samples or 2?

R. Thank you for your suggestion. We included details about the biological sampling in the new Supplementary Table 2.

How can you get 2 depth discrete samples? Did the Tucker trawl have 2 nets or 2 cod ends such that one was closed at a specific depth? How was sampling depth monitored? Were two separate casts done to sample the different depths? How did you avoid sampling on the way down and up? Opening and closing nets?

R. The Tucker Trawl net has the potential to sample 2 strata in 1 tow, as it has 3 nets that open and close with a trigger mechanism. The net is towed to the maximum depth (in this case, 100 m) with the first net open. That provides an integrated sample that was not used in this study. Then, a trigger mechanism is activated with a drop messenger to close the first net and open the second. Once the second net is open, we begin towing the net upward to cover the first stratum. The trigger mechanism is activated again once we hit the target depth (in this case, 50 m), so the second net closes and the third opens. We then tow the third net to the surface to collect the sample for the 2^{nd} stratum. These details are not included in the Methodology because it is standard procedure when using a Tucker Trawl net.

L179 the 1025 'isopycnal' add isopycnal

R. “Isopycnal” was added as the Reviewer suggested.

Fig 5 caption would suggest defining positive cross shore direction and along shore direction in caption (onshore and equatorward)

R. The caption was improved to include the interpretation of positive/negative velocities in both axes.

Figure 6 p values and correlation values referenced but not shown in figure or written in text. These should be added

R. We apologize for this mistake. An earlier version of Figure 6 had the p- and rho-values for the correlations, but they got lost during figure editing. We uploaded an updated version of Figure 6.

Suppl fig 5 is very useful but needs times, WT/ET labels, sunrise and sunset marked or identified in some way, NS/SS identified.

R. We acknowledge this figure was lacking some labels and appreciate the suggestion. Even though Supplementary Table 1 had some of the information (such as each transects time), we included a label in the title of each subplot to identify which were WT or ET transects. Additionally, we marked those transects that took place near sunset and sunrise. We also indicated in the caption that, for all transects, the left side is the northern slope, and the right side is the southern slope.

It looks like in WT transects there is some evidence of sunrise accumulations of scatterers over the canyon walls. This would be evidence for topographic blocking as mentioned in the discussion. Because topographic blocking is specifically mentioned, these observations should be included in the text.

R. Than you again for this suggestion. We included these observations as evidence for topographic blocking in the Discussion.

L226 which results? Also a 1m tucker trawl likely would not do very well catching fishes but that doesn’t mean that they aren’t contributing to the sound scattering.

R. We improved the section to clarify our point. We tried to evidence that the differences in zooplankton abundances estimated from the nets showed the same pattern that the Sv. That is, that higher abundances were found in the southern slope of the canyon in both the standardized abundances and the Sv. Regarding the comment on the potential fish scattering, as we said in a previous comment, we acknowledge that the signal might have some contribution from other scatterers, including small fish, but this should be minimal considering the frequency and the methods used to avoid signal from bigger scatterers.

It would be useful to combine figures 7 and 10 in order to be able to look at currents and mean sv side by side, especially given the authors arguments that the currents are structuring the zooplankton distribution.

R. While we acknowledge the usefulness of merging Figures 7 and 10, we chose to keep them separate to maintain the logical flow of the Results section. Presenting them sequentially (first currents and volume backscattering strength) allows the reader to follow our reasoning from dynamic physical processes to their relationship with the acoustic observations. Merging them would necessarily imply to change the structure of the results.

Figure 8 add NS and SS as well as dashed lines for the 3 depth layers referenced. Consider

R: We appreciate the suggestion. We included labels to point out the northern and southern slope (NS and SS), as well as horizontal lines to indicate the vertical layers used for the later analyses, in what now is Figure 7.

Figure 9 could be very useful with just a few changes: color code the times in a logical way - make all the nighttime transects blues/greens and the daytime transects reds/yellows then you will see that there is an interesting temporal pattern in these data! There are interesting changes in how topography influences sv over time - this may also strengthen the topographic blocking argument and should be added to the results in l232

R: Thank you for your comment and suggestion. We changed the color scheme in a way that all daytime transects are red/yellow, and nighttime transects are blue/green.

L240 was the fact that sv are on a log scale taken into account before averaging

R: Thank you for pointing this out. As in other studies (see for example Fielding et al. 2004 doi:10.1016/j.icesjms.2003.10.011, Benoit-Bird and Waluk 2020 doi:10.1121/10.0000594, among others) we calculated the geometric mean of the MVBS to provide relative changes through time and depth. This procedure considers that the MVBS is a logarithmic measure of backscattering cross-section per unit volume. We have included this detail in the Methods section.

L245 I disagree with this Interpretation. SS of WT has a 20m thick layer during the day that greatly expands in thickness during the night

R: Thank you for sharing your point of view. Although we had explained that the layer got wider during the night, we improved the line to make it clearer, following the Reviewer suggestion. The line now goes: “The SS of the WT showed a layer of ~20 m width with high Sv values that deepened during the day, and became shallower and increased in width (up to ~100 m) during the night (Fig.10 B)”.

L284 seems odd to have references here -is this not the data presented in this manuscript? Mackas 2005 was not in BBC for example.

R: Thank you for pointing that out. We acknowledge that the line was confusing. We improved it to make it clear that the references are there to prove that the groups we found are known to be strong migrants.

L285 don't the data presented here show this? One thing that was missing is the specific link over time between zooplankton layers and currents. What does your data tell you about how a migrating zooplankton in each of the 3 layers is adverted around the canyon over the 24 hrs? Where did a zooplankton who vertically migrated but was advected in the horizontal by the currents end up? Was there evidence for a funneling effect and a net transport into the inshore /canyon head direction? Were they advected in a circle and so were effectively retained ? How about a non migrating plankton at each depth. Making these points with given animal depths at different times and DVM behavior would make the biophysical connection explicit

R: We really appreciate this comment. We explicitly linked zooplankton Sv at certain depths and layers with currents at the same time and depth. We have now incorporated scenarios for difference cases, to provide direct evidence for topographic blocking and retention.