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Ocean Science Discussions

Interactive comment on "Fine-scale vertical structure of sound scattering layers over an east border upwelling system and its relationship to pelagic habitat characteristics" *by* Ndague Diogoul et al.

Anonymous Referee #2

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Diogoul et al. present an interesting survey of sound-scattering layers on the continental shelf of Senegal. They found that SSLs were thicker, deeper, and denser offshore of the upwelling front, and assessed the influence of several environmental covariates on the location and density of the layers. These results are valuable, as SSLs are ubiquitous but generally under-described features of the world's oceans, and the wide shelf off of Senegal makes this easter-boundary upwelling system different from other better-studied systems, e.g. off the west coasts of the Americas. The authors have also presented a good review of the literature, both for this system and SSLs in upwelling

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systems in general.

While I believe the information presented is valuable and worth sharing, the manuscript has a number of serious issues which need to be addressed before publication. Some major points are as follows:

1. The authors do not identify the constituent animals of the SSLs. I realize this is often difficult or impossible when acoustic data are collected opportunistically, and that raw backscatter contains valuable information even when it cannot be attributed to specific animals or converted to biomass. However, it is extremely difficult to interpret these results without knowing at least broadly what kinds of animals are present. The authors need to provide more information on the likely sources of backscatter, even if it is only based on previous studies in this area.

2. Some of the methods and results need to be described in more detail. In particular, the acoustic analysis and methods used to extract and measure the scattering layers are not sufficient. The statistical models are also not described in enough detail.

3. Some of the conclusions are not supported by the data presented. For instance, the authors refer to turbulence and advective transport, which were not measured. The lack of information on the sound-scattering species also makes parts of the discussion quite vague, reading more like a broad literature review rather than a specific discussion of the physical/biological processes likely to be at play in this particular instance. One finding which needs better explanation is the apparent reverse diel migration (up during day, down at night). One possibility which needs to be considered is cross-shore diel migration (see comment and suggested reference below).

4. Several of the figures need revision (see specific comments at end).

Minor comments, questions, and line edits follow below.

47: “entire mid-trophic level” Not necessarily. There can be a large “jelly web” that is not visible to echosounders, depending on their frequency. See e.g. Choy et al.

(2017), https://doi.org/10.1098/rspb.2017.2116 72-89: This is a good overview of the literature, but I think the term “SSL” is used a little too broadly here. The authors should make it clearer that “SSL” is not a biological classification, and that animals making up SSLs can be all kinds of different things, with correspondingly different biological, physiological, and ecological needs. 90-91: Please clarify what is meant by “fine-scale” (m, 10s of m, etc.) 106: The term “radial” in this context is not standardâĂŤplease replace with “transect” or “transect line” 111: What parasite? 112: “Offset” implies the data were shifted 10 m in space. I believe you mean that you discarded data from the upper 10 m? 121: Replace “extracted” with “removed.” 122: A threshold of -70 dB at 38 kHz, as you say, is typical for fish surveys, but studies of smaller animals often use a threshold lower than -75 dB, which will eliminate backscatter from most zooplankton at this frequency. I’d like a little more explanation of how you selected this threshold.

Also, it appears from Figure 2 that the acoustic data were binned at coarser resolution than the raw data from the EK60. Is this the case? If so, what are the dimensions of the integrated cells?

128: Replace “security” with “safety” 141: This link is no longer functional. Are these data available somewhere else? 147-150: Please include a reference or hyperlink to the Matlab code in the body of the paper. Is there a reason it needs to be password-protected instead of, say, posted publicly on GitHub? Even though the code is shared, the algorithm you used for detecting SSLs and extracting their descriptors still needs to be described in more detail. This is a non-trivial problem and different approaches can yield different results. 163-167: Move this explanation up to come before the preceding paragraph. The goal of an analysis should be described before the software used to accomplish it. 168: Just say “Inshore-offshore variability.” 169: Use past-tense verbs, i.e. “were” instead of “are” 177-180: Please describe the statistical modeling in more detail here. I found it hard to figure out exactly what was being modeled/predicted and how. 209-210: “SST revealed and advection...” It is not clear to me how SST reveals advection here. 211: Please make sure all verbs in this paragraph are past-tense.

Also, this section might read better if it was organized by zone, rather than by variable. 216: I assume these are sigma-t values? Please clarify. 233-234: I assume “depth” here refers to bottom depth? Some of the wording is a bit unclear, for instance “below 29 m depth.” Does this mean “at locations seaward of the 29 m isobath,” or “at locations where bottom depth was less than 29 m?” 238-240: These two sentences are confusing to meâĂŤplease clarify. If the difference was not significant, why report it? 242-255: This section reads like a string of numbers. It should be revised to emphasize concise verbal descriptions of the result, with the effect sizes and p-values either incorporated into the descriptions or reported parenthetically to support the verbal descriptions. 269: “the model” there were actually several models, correct? This section needs more detail–the descriptions here and the tables to not include all the information referred to (for instance, the actual response variable and effect sizesâĂŤwhose variance is being explained?) 290-331: This section contains a lot of background information which would probably fit better in the introduction. Overall, I think it could be tightened and shortened considerably. 305: “surface divergence” Was this measured, or just inferred? 333-351: I think some of these explanations need more consideration (or more explanation). Again, “SSL” is not a biological descriptor, and depending on the animals which are scattering the sound they may react in many different ways to physical forcings. 338-339: What evidence is there that rapid advection causes low residence times? Are you sure the scattering animals are even planktonic? 343-344: Different animals can respond totally differently to different physical forcings. Urmy and Horne (2016) found that SSLs moved up and probably offshore during upwelling, but in the same ecosystem SSLs can actually intensify during upwelling as krill and anchovies swarm more closely (Benoit-Bird et al. 2019, https://doi.org/10.1029/2018GL081603) 351: Couldn’t the SSLs be thicker and deeper farther offshore because there is more room in the water column? 364-365: One explanation for this phenomenon might be diel horizontal migration. See for instance:

Benoit-Bird, K. J., Au, W. W. L., Brainard, R. E., and Lammers, M. O. 2001. Diel horizontal migration of the Hawaiian mesopelagic boundary community observed acousti-

cally. Marine Ecology Progress Series, 217: 1–14.

378-379: Again, the term “SSL” is being used quite broadly here. Without some reference to the actual animals making up a particular SSLâĂŤeven in broad taxonomic or trophic termsâĂŤit is hard to talk informatively about particular environmental influences. 392: If DO is relatively high everywhere, does it require this much discussion? 415: “primarily a function of temperature...” I would say light is at least as important as temperature, especially for migrating animals. 418-419: On the previous page, you said DO had only a limited influence on the SSLs’ positions? 445-446: The authors did not measure either turbulence or advection, so I don’t think this assertion in the concluding paragraph is supported.

General comment for all heatmap-style figures: please redo these with perceptually-uniform colormaps (such as the “parula” colormap which is now the default in Matlab). As-is, these figures will not reproduce well in black and white, and will be difficult for colorblind readers to interpret. Even in color, the uneven luminance introduces artifacts which make interpretation more difficult. For instance, in Figure 1, temperatures of 19.5, 20.5, and 22.5 all have similar brightness values, and the red-to-green color ramp in the middle of the scale will be very difficult for red-green colorblind readers to interpret.

Figure 2: How were the acoustic sections in the top panels selected? The first one is more than 12 hours long, while the second is only 3 hours. It would be helpful on both of these to show a distance scale, as well as periods of light and dark. Also, the red lines indicating the station locations are difficult to see, especially in part (a). Figure 4: This figure is a repeat of Figure 1 and can be deleted. Figure 5: It would be really valuable to add a fifth column with average backscatter to this figure. Figure 6: This figure is very difficult to read, and should be redone it in a different format. I would suggest making three subplots, one for each transect (“radial”). Each of these subplots would have bottom depth or distance offshore on the x-axis, and depth below the surface on the y-axis. Mean layer depth at each station would then be plotted as

a point, with the size of the point proportional to the layer's NASC. Error bars/whiskers above and below each point would give a visual indication of its thickness. Points could be colored differently to show if they were recorded in daytime or nighttime.

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