Author response to RC3, Guillaume Bernard

The article authored by Kindeberg *et al.* presents the results of a study aiming at exploring the role of seagrass meadows and associated biodiversity for carbon cycling at different stages of restoration process. The article, through the deployment of various techniques allowing for the measurement of oxygen and dissolved carbon fluxes as well as associated sediment and biodiversity components characteristics during the productive season, provides very interesting, and potentially important, results for a better understanding of seagrass ecosystems metabolism and functional effects of restoration actions. The article is well written and data analyses as well as subsequent interpretations are appropriate and convincing. I therefore only made a few comments/questions for the authors, listed below:

We thank Dr. Bernard for his helpful review. We are especially grateful for the reviewer pointing out that lack of information on fauna traits, and we have tried to amend this in the revised version. Please see our detailed response to each of the comments below.

-l157-178: Please give more information about the temporal sampling strategy. This temporal deployment strategy can indeed be deduced for EC measurements in figure 2, but this must be presented and justified already in the Methods section. Along the same line, have the BC deployments been carried out simultaneously (or kind of) with EC ones?

We have added a new Table S1 that outlines the timing and duration of EC and BC deployments. We have also added shaded areas to an updated Fig. S2 (previously S1) that indicates when BC incubations occurred. Indeed, incubations were performed during EC deployments.

L213: Please specify what does exactly below ground biomass mean. All roots and rhizomes? Only living ones?

We have added the following sentence to section 2.3.1: “Seagrass belowground biomass including live and dead roots and rhizomes were collected using sediment cores (see below)”.

L220: In line with my just above comment, have the visible root fragments also been removed for the POC measurements? It must be specified because it can have implications for the carbon pools calculations in the case where only living roots and rhizomes would have been quantified as below ground biomass.

Yes, indeed. We have clarified that we removed all visible roots and rhizomes and rephrased the sentence so that it is clear that all core slices including those used for POC were included.

L256: please precise what does “absolute fluxes” mean. Averages of the three replicates?

Because photosynthesis-derived DIC and O2 fluxes have opposite signs (following the equation of photosynthesis) we have used the absolute values. We have updated the sentence to clarify what is meant: “We calculated the photosynthetic (PQ) and respiratory (RQ) quotients from the average absolute fluxes (i.e. the magnitude of the flux, excluding the direction) in transparent and dark chambers, respectively, as […]”

L281: please introduce in the text the traits that have been chosen, and potentially the rationale for these choices relative to the research question. Were they all explicitly linked to carbon and organic matter cycling?

We have added the following sentence: “The selection of functional traits was based on direct connections to carbon cycling including feeding mode, bioturbation mode and whether the species is calcifying. Indirect, general traits included movement mode, living habit and environmental position. This selection process resulted in 25 trait modalities from which we constructed a traits-by-species matrix assigning each species to specific trait modalities (refer to Table S4). Species can exhibit multiple trait modalities, depending on life history and environmental conditions. To address this, and to avoid a disproportionally large influence by generalist species on functional diversity, we used fuzzy coding (Chevenet et al., 1994) whereby species comprising multiple trait modalities were assigned a score between 0 (no association) and 3 (full association), with the total sum of each trait always being 3..”

We have also updated Table S4 to reflect this and updated the fuzzy coding for Calcareous/Non-calcareous to also include crustaceans with low $CaCO_3$ that were previously assigned 0. We changed the values of FRic and FEve in Table S6 accordingly but these minor changes did not affect any conclusions.

Figure 2 and lines 353-384: Figure 2 shows that flow velocities varied across studied patches. What are the implications of these differences for the surfaces (areas) of the footprint from which fluxes are integrated? Were these footprint areas comparable across patches? How did they coincide with the surface of the studied patches themselves?

In theory, the size and shape of the EC footprint is independent of the horizontal flow velocity, because in the model by Berg et al. (2007), the horizontal velocity scales with the vertical. We have added discussion on flow velocity variability, also in response to comments put forward by Reviewer 2.

L387-388: It is not clear whether this absence of significance also apply for below-ground biomass or not. It is important to precise this because, as shown in the table 2, BG core is clearly higher in the 7 yr meadow compared to either 3 yr and Nat. Along the same line, please indicate in the table the significant differences when there are, to help the reader.

According to one-way ANOVA, BG core is not significantly different between sites ($F_{2,15}$=2.79; p=0.09) although the site mean of 7 yr indeed is higher. The within-site variability is so large that it exceeds the between-site variability. We have added an asterisk to indicate significance in Table 2 showing that only the number of reproductive shoots exhibited a statistically significant difference between sites ($p<0.05$).

L438: bioturbation modes must be presented earlier, i.e. in the method section, see my comment above about traits.

We have clarified the functional traits in the Methods section (see our comment above) and specified the different modalities in the Table S4: “Feeding modes are suspension feeder (SuspFed), surface detritivore (SurfDet), burrowing detritivore (BurrDet), Predator (Pred), grazer/herbivore (GrazHerb) and omnivore (Omni). Bioturbation modes are biodiffusors (Biodiff), upward conveors (Upconv), downward conveyors (Downconv), surficial modifier (Surfmod), Regenerator (Reg) or not relevant (NotRel). Living habits are free living (Free), burrow dwelling (BurrDwell), tube dwelling (TubeDwell) or attached (Attach).”

References

Berg, P., Røy, H., & Wiberg, P. L. (2007). Eddy correlation flux measurements: The sediment surface area that contributes to the flux. *Limnology and Oceanography*, *52*(4), 1672-1684.