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Interactive comment on "Stimulation of microbial nitrogen cycling in aquatic ecosystems by benthic macrofauna: mechanisms and environmental implications" *by* P. Stief

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Stief presents an overview of benthic N cycling in aquatic environments and a review of the role of animals on N reaction pathways and fluxes. The paper begins with a qualitative review focusing on ecosystem engineering, grazing and symbiosis and then presents a quantitative evaluation of the influence of animals on N reaction pathways and fluxes based on a large number of, mainly laboratory, studies culled from the literature. The paper ends with a section on nitrous oxide emissions.

Overall, I found this to be an interesting contribution, and I particularly value the quantitative assessment and the effort required. There are many uncertainties remaining

concerning the magnitude of the animal effect, some of which could be better clarified. Yet, the overall trend is clear, although not particularly unexpected (higher release of ammonium and uptake of nitrate). This synthesis makes the paper quite exceptional, although I have to admit that this I am not aware of any others which have attempted to provide the same level of detail. If such a review exists already, it should be cited, clarifying the new aspects generated in the current manuscript.

I recommend the manuscript for publication. Perhaps the following comments would help to improve it.

1) Section 3.1 deals exclusively with processes occurring in sediments and solute exchange across the sediment water interface. This text and Fig. 3 provide no new information to what has been given already in section 2. The theoretical considerations should either provide more balance toward the 4 animal-microbe interactions in fig. 2, or be removed altogether. In my opinion, section 3.1 and Fig. 3 are superfluous and detract from the flow of the paper. Fig. 3 is anyhow uninformative and recycles information already contained in Figs 1 and 2.

2) Section 3.2.1. More information is needed on the procedures used to perform the laboratory experiments and how the laboratory controls were performed (i.e. defaunation). It would be great to include in Fig. 4 the water depth where the sediments were sampled. Significant differences in sediment reactivity (e.g. ammonium production rates) between experiments on the same class of organisms (Fig. 4) could bias the interpretation of the fluxes and the inferred impact of the organisms on fluxes. This caveat should be mentioned more clearly and, if possible, normalized. I would also like to see Fig. 4 modified to better indicate the animal-microbe interactions in fig. 2. This should be straightforward to do.

3) Section 4 is not well integrated into the manuscript. Why is nitrous oxide given its own subsection? What is the justification? Are nitrous oxide fluxes of comparable magnitude to ammonium? Please provide numbers. More effort is needed to integrate

this section into the rest of the manuscript since at the moment is seems a bit orphaned in its current position.

Specific comments

1) P11787, L14-18: suggest rephrase to: Thus, benthic mineralization of PON and microbial nitrogen conversions eventually produce either dissolved inorganic nitrogen (DIN) that partially diffuses back into the water column where it fuels primary production or dinitrogen that is biologically unavailable to most organisms and is thus lost to the overlying water.

2) P11787, L19: nitrification is also a recycling reaction, since it converts ammonium to nitrite to nitrate. Coupled nitrification-denitrification is, however, a DIN sink.

3) L28: Compounds toxic to which organisms? Certainly not microorganisms.

4) P11790, L8: Clarify here the meaning of 'density-driven'.

5) The two sentences on L13-16 appear to be contradictory. Density-dependent stimulation of N cycling is stated in both examples.

6) L24: Clarify how CO2 stimulates nitrification, since N and O2 are typically limiting the rate of nitrification. Has this been shown experimentally?

7) P11791, L11-13: The rate of solute exchange is arguably the most important factor.

8) P11792, L20. The bivalve are not used in shellfish farming, they are the cultivated species.

9) P11803: suggest changing 'Essence' to 'Synthesis'.

10) Table 1: If the stimulation factor for nitrate was only calculated for cases in which the nitrate flux was directed into the sediment, why is the maximum absolute change positive?

11) Fig. 1. All solutes can potentially be transported up and down by diffu-

sion/bioturbation and irrigation, not just nitrate and nitrogen.

12) Fig. 4. The reference list is not indicated by numbers. The units should be written as μmol m-2 h-1.

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