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Interactive comment on "Restoration of the Baltic Proper by decadal oxygenation of the deepwater" *by* Anders Stigebrandt

A Stigebrandt

anders.stigebrandt@marine.gu.se

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The author wants to thank Andreas Bryhn for his comments that led to inclusion of new text and new references in the manuscript.

Andreas Bryhn: My main objection to the manuscript is that the general lack of long-term effects on P leakage of artificial oxygenation in lakes has not been addressed in the paper. P load, hypoxia/anoxia and P leakage are correlated, but the causal connections are being debated. Even if sediments are oxygenated, there may be a certain sediment depth where there is anoxia and where P can be transformed from particulate forms to dissolved forms and subsequently leak out into the water column. Thus, there may beneficial short-term effects from oxygenation that may be counteracted and vanish at a later point. See, e. g., Conley, D. J., Bonsdorff, E., Carstensen,

J., Destouni, G., Gustafsson, B. G., et al., 2009. Tackling Hypoxia in the Baltic Sea: Is Engineering a Solution? Environ. Sci. Technol., 2009, 43 (10), pp 3407–3411. Hupfer, M., Lewandowski, J., 2008. Oxygen controls the phosphorus release from lake sediments – a long-lasting paradigm in Limnology. International Review of Hydrobiology, 93: 415–432.

Author: Possible long-term effects regarding the internal P load are now mentioned as one of the remaining important tasks for a complete EIA for restoration of the Baltic Sea by oxygenation of the deepwater.

Manuscript changes: p.7., l.26: replace "as briefly reviewed" with "e.g. "Conley et al. (2009) and the brief review".

p.8., l. 2/4, The two sentences are rewritten as follows: "Keeping the deepwater oxygenated will permit colonization of the deep bottoms of the basin which will increase the food supply to e.g. cod. It will also stop leakage of phosphorus from the earlier periodically anoxic bottoms as discussed above." After this the following text is added. " An important task for the EIA is to investigate if increasing leakage of P from sediments may be a long-term effect like it has turned out to be in some artificially oxygenated lakes (Hupfer and Lewandowski, 2008; Katsev and Dittrich, 2013). However, it should be stressed that nobody has shown that lake experience of P leakage is applicable to marine environments with deepwater salinity >10 as in e.g. the Baltic proper."

p.9, l. 19: the following reference is added: "Conley, D. J., Bonsdorff, E., Carstensen, J., Destouni, G., Gustafsson, B. G., et al., 2009. Tackling Hypoxia in the Baltic Sea: Is Engineering a Solution? Environ. Sci.Technol., 2009, 43 (10), pp 3407–3411."

Andreas Bryhn: Instead of oxygenation, nutrients may be abated further, and the most effective and cost effective options should in that case be applied first. For instance, it has been estimated that improved sewage treatment may reach 80% of the P target in the Baltic Sea Action Plan (and 70% of the N target). See Hautakangas et al. (2014): http://link.springer.com/article/10.1007/s13280-013- 0435-1#/page-1.

Author: I appreciate but do not share your opinion in this matter. Experience from the last 40 years has shown the eutrophication has increased in spite of large reductions of the external P supply. We know that an increasing internal P supply is the reason for this. The logical conclusion would be that one should try to decrease the internal supply. In my manuscript I suggest that this may be done by oxygenation of the deep bottoms. It is certainly true that the probability of getting long lasting results of a restoration will be higher the smaller the external load is. Thus, in my opinion one should do both oxygenation and decrease the external supply of P.

Manuscript: no change is undertaken.

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