

## ***Interactive comment on “Changes in population depth distribution and oxygen stratification explain the current low condition of the Eastern Baltic Sea cod (*Gadus morhua*)” by Michele Casini et al.***

**Anonymous Referee #2**

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The study examines data sets of oxygen concentration, cod catch across sites and depth and cod condition factor in the Baltic sea across forty years. During this period hypoxic areas have increased, and cod body condition has decreased. Importantly cod are increasingly found in low oxygen waters. An important finding is that lifetime exposure to low oxygen correlates to body condition on an individual level.

The paper is interesting, and the patterns are convincing. Inevitable any conclusions drawn from parallel changes in two or more metrics without a test will be speculative. Nevertheless, I think the authors do a good enough job of highlighting hypoxia as a con-

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tributor to decreasing cod condition. However, I think the description on confounding effects and other contribution factors could be improved. For example, although hypoxia may well contribute greatly to low growth of cod in the current system the drivers of a decrease in condition are the triggers of a change in depth distribution and the cause of low oxygen.

Furthermore, there is no description of any statistical analysis. Mostly the patterns are “analyzed” by eye and described in the results chapter (related note referring to figures as you describe results). This approach may occasionally be valid – and the patterns described are convincing enough - but at least some sort of quantification of the size of effects across time should use when describing them (reduced from  $x$  to  $x$ ). A statistic test is used for the otolith data, but this is not included in the methods.

The results from the otolith analysis is interesting yet this part of the paper is referred to as an afterthought throughout the paper. I think this analysis warrants increased value, both by adding to the introduction enough background material to allow readers to evaluate the validity of the methods on know of any prior findings and in the a fuller description of methods including how the otoliths were selected.

26+28: Is “processes” the right word? 100: What is the sample size? 101: is this data stable once entered, or is it subject to change? In the last case, a date of retrieval would be handy to include. 105: there are different ways to measure ‘total length’, maybe explain in more detail how it was done in this study. 107: why is SD26-28 chosen and not for example not 29? 108/109: why is the subdivision of big and small cod made and why those specific lengths? What happens with fish between 29 and 40 cm? 109: Quarter 4 also includes part of the winter. Why not mentioning the exact months instead of season or quarter 4? 117: why are those class divisions different from row 108? 135: it is later explained, but I would rather put here the  $<0.8$  (Eero et al 2012), explaining the ‘very low’ con-dition 160-191: I see many statements as ‘more’ and ‘lower’ and ‘deeper’, but it is very descriptive, and I miss actual numbers in some places and statistical tests to prove these statements. Also, how many data points were

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retrieved, how big was the sample size? 171: which depth? 186: The oxygen layers are almost the same, but not totally. I understand this is because they are weighed with the SD-specific distribution of the cod, but I think it makes things clearer if you write somewhere that this means that it differs between the big and the small cod (it took me a while to understand). 267: I miss a note about that it is not 100% sure that the cod are actually in those low oxygen waters, because that was not directly measured. However, the additional otolith results make it very plausible that this is the case. 273: Was there a way to directly link otolith chemistry with body condition? (e.g. from the same individual?) Why do you think the overlap between cod and oxygen layers is oscillating? (why is the oxygen stratification oscillating?) 475/476/481/486: you use here the whole word 'subdivision', while in the previous description (472) you already used SD 490 post-2000? This is differently described throughout the text.

Figure 3: Is there a possible explanation for the high condition in 1996 in SD25

Figure 6: 2000 onward is called 'post 2000' in the text. Why are there squares in the boxes

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