THÜNEN

Fact check

Does the Western Baltic need different management?

In a recent publication[1], a team of authors from the GEOMAR Helmholtz Centre for Ocean Research in Kiel and the German Federal Agency for Nature Conservation presented a trophic, i.e. food chain-based, model of the western Baltic Sea. It serves as the basis for a new fisheries management approach, which the authors propose, should be applied in the Baltic Sea in place of the existing one.

The implementation of the model is an impressive achievement. However, the chosen approach is not suitable for comparing the different management approaches for marine fish stocks. Moreover, it shows that in a direct comparison of the proposed Ecosystem-Based Fisheries Management (EBFM) with the current legally prescribed management approach of Maximum Sustainable Yield (MSY), hardly any improvements in stock status are achieved. At the same time, however, far less fish can be taken when EBFM is applied.

The thesis

If the management of the Western Baltic were to be changed to an ecosystem-based fisheries management, fish stocks and the harbour porpoise population could recover and stabilise by 2050. The EU's current management approach, on the other hand, only contributes to a further deterioration of the situation.

1. The model

The authors have compiled large amounts of individual information. For the first time, they have modelled the food fluxes for the entire ecosystem of the western Baltic Sea. This hard work can contribute to a better understanding of the ecosystem and the impact of fisheries.

To model their data, the authors use the software "Ecosim with Ecopath" (EwE). This application is well established and is also used for aquatic ecosystems, but it has limitations[2]: "Ecopath" is based on balance equations, so it requires that the respective ecosystem is considered to be largely closed. This means, for example, that the animals hunt and forage their food exclusively in this area. However, this restriction is problematic for a small ecosystem like the western Baltic Sea, which is closely connected to neighbouring areas through inflows and outflows as well as animal migrations. An example: The herring of the western Baltic Sea is identified by the authors as one of the key species. In summer, however, the fish migrate to Kattegat, Skagerrak and the eastern North Sea to feed. Therefore, they import massive amounts of energy into the system with their return to the western Baltic Sea during the winter month. However, as far as can be seen this essential fact is neither considered in the model nor discussed in the publication, although it should have a significant influence on the results. Other questionable stipulations in the model are the definition of the sprat stock in the area under consideration, the definition of juvenile, i.e. not sexually mature cod, and the assumption that fishing effort always remains the same, even if catches drop drastically. The assumptions on food relationships in the model are thus just as untrustworthy as important input data.

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[1] Scotti M, Opitz S, MacNeil L, Kreutle A, Pusch C, Froese R (2022) Ecosystem-based fisheries management increases catch and carbon sequestration through recovery of exploited stocks: The western Baltic Sea case study. Front. Mar. Sci., 05 October 2022, https://doi.org/10.3389/fmars.2022.879998

[2] É. E. Plagányi & D. S. Butterworth (2004) A critical look at the potential of Ecopath with ecosim to assist in practical fisheries management, African Journal of Marine Science, 26:1, 261-287, DOI: 10.2989/18142320409504061

2. Comparison of fisheries management approaches

Instead of just publishing the model and the limitations of its usability, the authors use the model to compare different fisheries management approaches. To this end they bring their own management approach into play, which they call Ecosystem-Based Fisheries Management (EBFM) and recommend the use of this approach for the fish stocks of the western Baltic Sea infuture. The reason: only through this approach can dwindling stocks such as cod and herring, but also harbour porpoises, recover in the area. However, the comparison is unsuitable for several reasons:

The comparison is made primarily with the so-called Business as Usual approach (BAU), which is supposedly applied by the EU. However, this BAU approach does not exist. Instead, fish stocks in the EU are managed according to the Maximum Sustainable Yield (MSY) approach. For the BAU approach, the authors calculate the mean value of fishing mortality for the years 2015 to 2019 and extrapolate it into the future. Since 2015, however, the fishing mortality of all major commercially exploited fish species in the western Baltic Sea has decreased significantly. For the Western Baltic herring stock it has since been halved, and for cod all directed fisheries have been closed. Therefore, the BAU scenario reflects neither the current nor the management approach currently aimed for, but one from a time when catch levels were set far too high for the western Baltic Sea. If the current (2022) fishing mortalities were used as BAU, the recovery period would roughly correspond to that of the EBFM approach.

Also, the authors' EBFM approach is not an established scenario based on objective criteria or scientific consensus. Rather, the target fishing mortality rate (FMSY) was arbitrarily reduced by a large amount.

It is surprising that the authors mainly compare the BAU and the EBFM approaches and not the EBFM and the MSY approaches as legally defined framework of the EU. In addition, there is also the ICES (International Council for the Exploration of the Sea) management approach[3]. This body, which governs fishing recommendations to the EU Commission, uses the Pretty Good Yield (PGY) concept[4]: this calculates ranges of fishing mortality that allow 95 per cent of maximum sustainable yield. Instead of comparing apples with oranges - i.e. a forward-looking, theoretical concept with backwards-looking reality - it would have been perfectly possible to compare apples with apples. Interestingly, the authors' own results show that the modelled recovery periods and equilibrium biomasses for the years 2050 and 2100 hardly differ between the MSY and EBFM approaches. Of course, it is trivial to realise that biomasses are slightly higher at much lower fishing pressure, but fishing yields are significantly lower in the EBFM approach.

3. The harbour porpoise

Only for the development of harbour porpoises is an advantage of the EBFM approach discernible. However, the results for this species are not very credible. There are several reasons for this:

The authors assume that the harbour porpoises live in the western Baltic Sea and that up to 30 percent of their prey are juvenile cod. But since there are not enough juvenile cod in this area, they have to assume that the missing food is eaten outside this area. Otherwise, the model does not work. This assumption contradicts scientific findings: porpoises need to eat almost continuously to meet their energy needs[5]. They would starve if they kept migrating back to an area with insufficient food. Moreover, harbour porpoises are food opportunists,

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[3] ICES (2020) ICES and Ecosystem-based management. ICES Strategy. https://doi.org/10.17895/ices.pub.5466

[4] Hilborn R (2010) Pretty Good Yield and exploited fishes, Marine Policy 34 (1): 193-196, https://doi.org/10.1016/j.marpol.2009.04.013.

[5] Wisniewska, D. M., Johnson, M., Teilmann, J., Rojano-Donate, L., Shearer, J., Sveegaard, S., Miller, L. A., et al. 2016. Ultra-High Foraging Rates of Harbor Porpoises Make Them Vulnerable to Anthropogenic Disturbance. Curr Biol, 26: 1441–1446.

they eat what is available[6]. If there is less cod, they feed on herring. If there is less herring, they eat other fish species.

Scotti et al. rightly discuss that the data for harbour porpoises is so poor, especially compared to seabirds, that this species should have been grouped with the other marine mammals. However, since the species receives special public attention and is the focus of conservation efforts and fishing restrictions, it was considered separately. Unfortunately, this does not make the results more robust, but rather makes them more speculative.

Finally, the delimitation of the harbour porpoise populations is confusing to the point of being wrong: at one point in the publication, it is claimed that the harbour porpoise population of the western Baltic Sea is threatened with extinction and can only survive because there is an influx of animals from the Belt Sea population. First of all, this representation would contradict the definition of separate populations. Secondly, it is wrong, because the animals in the western Baltic Sea belong predominantly to the Belt Sea population[7]. Incidentally, the harbour porpoises of the western Baltic Sea - unlike those of the central Baltic Sea, which also occur in the eastern parts of the western Baltic Sea in winter - are not acutely threatened with extinction[8].

4. Carbon sequestration

Last but not least, the additional storage of climate-damaging carbon is cited as an important argument for the conceived EBFM approach. The authors' equation is relatively simple: more animals eat more and thus produce more faeces. These end up as particulate carbon compounds on the seabed and are permanently bound there. The problem is that what applies to the deep sea does not apply to the Baltic Sea. The western Baltic Sea in particular is a shallow-water ecosystem in which both carbon[9] and nutrients[10] are hardly ever deposited.

5. Conclusion

As useful and impressive as the compilation of an ecosystem model for the western Baltic Sea by Scotti et al. is, the chosen approach is unsuitable for a robust comparison of the different management approaches for marine fish stocks. Good scientific practice requires a review of the model and a fact-based comparison of fisheries management options. Even in the authors' calculations it becomes clear that in a direct comparison between the management determined by EU law (MSY) and the authors' EBFM approach, there is no clear advantage for the "new" system – but it will result in much lower fishing yields.

Remark: We deleted a single sentence in the conclusion on Dec 2nd, 2022 i, as this appeared to have caused misunderstandings.

[6] Andreasen, H., Ross, S. D., Siebert, U., Andersen, N. G., Ronnenberg, K., and Gilles, A. 2017. Diet composition and food consumption rate of harbor porpoises (Phocoena phocoena) in the western Baltic Sea. Marine Mammal Science, 33: 1053–1079.

[7] Carlén, I., Thomas, L., Carlström, J., Amundin, M., Teilmann, J., Tregenza, N., Tougaard, J., et al. 2018. Basin-scale distribution of harbour porpoises in the Baltic Sea provides basis for effective conservation actions. Biological Conservation, 226: 42–53.

[8] HELCOM Red List Marine Mammal Expert Group (2013)

[9] S Blomqvist, U Larsson: Detrital bedrock elements as tracers of settling resuspended particulate matter in a coastal area of the Baltic Sea. Limnol. Oceanogr., 39 (4) (1994), pp. 880-896

[10] Savchuk OP (2018) Large-Scale Nutrient Dynamics in the Baltic Sea, 1970–2016. Front. Mar. Sci. 5:95. doi: 10.3389/fmars.2018.00095