

# The environmental footprint of fisheries

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Halpern et al.<sup>1</sup> estimated environmental pressures of producing alternative foods using four indicators—greenhouse gas emissions, freshwater use, habitat disturbance and nutrient pollution—and compared the total environmental pressure of different foods. They found that capture fisheries had among the highest environmental pressures despite the fact that fisheries use no freshwater and produce no nutrient pollution, and most of this pressure came from habitat disturbance. However, their metric for habitat disturbance for fisheries was totally different from that used for livestock and agriculture, and if a similar metric had been used, the estimated environmental pressure for capture fisheries would have been much lower. Unlike agriculture, which replaces natural ecosystems largely with monocultures of crops, capture fisheries can be sustained in natural ecosystems whose structure and function are largely intact.

Halpern et al.<sup>1</sup> relied on life-cycle assessments with mapping the extent of the activities to estimates of the greenhouse gas, water and nutrients, and correctly note that wild-caught fish have very little use of freshwater or release of nutrients. However, as there is no accepted measure of habitat disturbance, they defined their own metric. For agriculture, they “defined disturbance as the proportion of native plants and animals displaced by agricultural activities within a region, and this pressure is reported in units of ‘equivalent km<sup>2</sup>’, which incorporates both the occupancy area and a measure of disturbance.” This seems like an appropriate measure for agriculture, which removes essentially all the plants and the higher trophic levels that depend on them.

But when evaluating fisheries, they said “Ideally, we would directly estimate ... the proportion of biomass removal through fisheries; however, these data are unavailable.” Instead, Halpern et al.<sup>1</sup> measured fishing pressure in two ways. One half is measured as the catch of fish divided by the net primary production, and they scaled their measurement of fishing pressure so that the most intense fisheries were assumed to have a score of 1 on this half of the disturbance pressure. The second half of their disturbance pressure is based on benthic disturbance by bottom-tending fishing gears. So for fishing gears that do not contact the bottom, their method implies that a fishery with a score of 0.5 would be eliminating half of the ecosystem biomass. While global estimates of the proportion of biomass removed by fishing is not available at the spatial scale used by Halpern et al., it is available for many ecosystems, and this allows us to evaluate whether the method used by Halpern et al. is comparable to their measure for agriculture. Almost all fisheries remove a very small fraction of the biomass of

marine ecosystems. Using the data from 26 marine ecosystems in ref. 2, fish constitute only 18% of the biomass of marine ecosystems; most of the biomass of marine ecosystems is found in trophic levels 1 and 2, which are almost never removed by fisheries. Thus, even if 50% of all fish were removed every year, the ‘disturbance pressure’ calculated the same way as agriculture would be only 9% and for most fisheries would be much lower.

Two-hundred fourteen marine ecosystems that constitute most of the global fish production have evaluated the abundance of fish and other biota and fishery removals using EcoPath and/or EcoPath with Ecoism<sup>3,4</sup>, and these would provide the data needed to calculate the ‘proportion of biomass removal through fisheries.’ Such an analysis would provide a much lower measure of fisheries pressure than estimated by Halpern et al.<sup>1</sup>

Halpern et al. rightly point out that what is of real concern is the impacts of food production, but then they argue that mapping pressures as done in their paper is a necessary step to understand impacts. This is certainly not true for understanding the impacts of fishing on marine ecosystems. There is an extensive body of empirical data and model analysis on the impacts of fishing<sup>5–7</sup> that does not need intermediate measures of pressure as proposed by Halpern et al.<sup>1</sup>

While Halpern et al. made an admirable attempt to map environmental pressures of food production, their results should not be used to compare the environmental pressure of capture fisheries with other food sources.

## References

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### Competing interests

R.H. receives research funding from many groups that have interests in fisheries outcomes, including environmental NGOs, foundations, governments and fishing industry groups.

### Additional information

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