Release of Sediment-CO_2 from bottom Trawling

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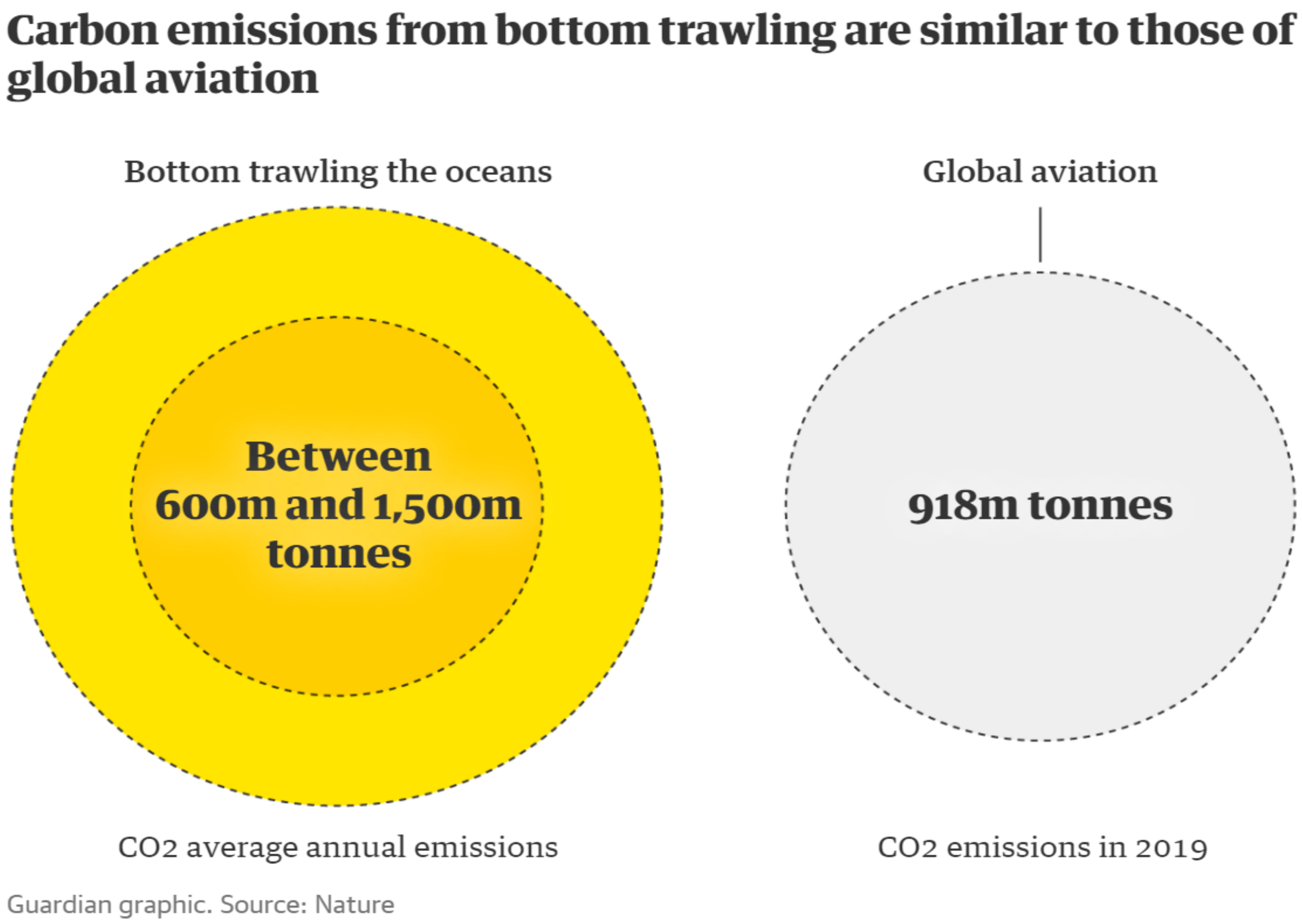
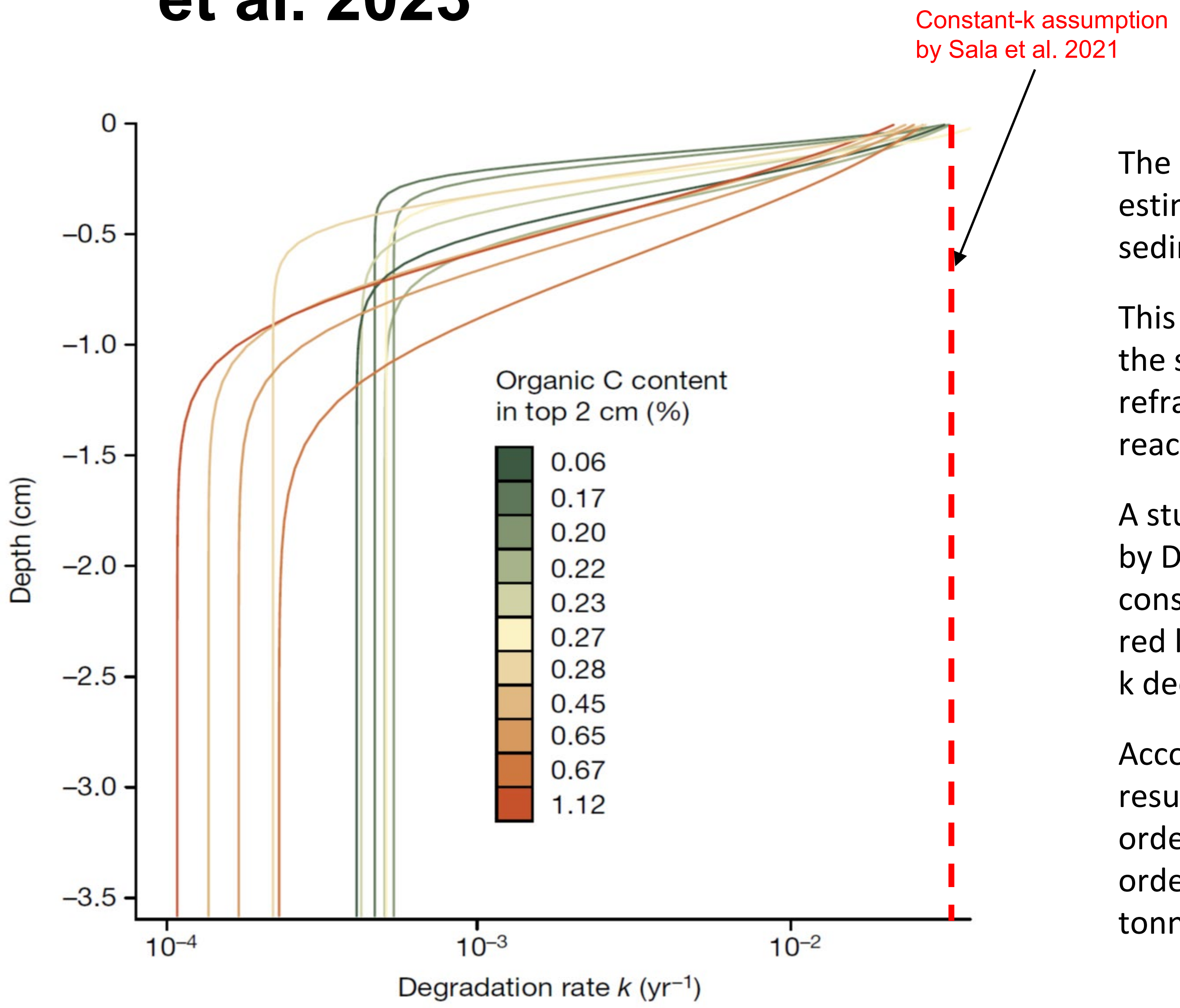
Structure and content of presentation

1. Global sediment CO_2 emission according to Sala et al. 2021
2. Criticism of the Sala et al. approach by Hiddink et al. 2023
3. Other studies of trawling impacts on sediment carbon
4. CO_2 from fossil fuel and energy use in bottom trawling
5. Scaling of the different carbon footprint components of bottom trawling
6. Summary and Conclusions

Sala et al. 2021: global sediment-related carbon emission from trawl fisheries



Key criticism in the response by Hiddink et al. 2023



The model in Sala et al. uses a single reactivity value (*k*) estimated for highly reactive organic carbon (OC) at the sediment surface and applies it to bulk sediment.

This assumption ignores that typically a large component of the sediment consists of deeper positioned recalcitrant and refractory carbon, which is known to have a much lower reactivity.

A study of OC degradation rates at 11 sites in the North Sea by De Borger et al. (2021) shows that the assumption of a constant high surface *k* across all sediment depths (dashed red line) deviates significantly from current knowledge; that k decreases exponentially with depth.

According to Hiddink et al. this erroneous *k* assumption results in an upward bias in the estimated CO_2 release by 2-3 orders of magnitude. Lowering the Sala et al. estimate two orders of magnitude gives a range of **5.8** to **14.7** million tonnes of CO_2

Other Studies (Experimental and site-specific)

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REVIEW

The impact of mobile demersal fishing on carbon storage in seabed sediments

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Abstract
Subtidal marine sediments are one of the planet's primary carbon stores and strongly influence the oceanic sink for atmospheric CO_2. By far the most widespread human activity occurring on the seabed is bottom trawling/dredging for fish and shellfish. A global first-order estimate suggested mobile demersal fishing activities may cause 0.16–0.4 Gt of organic carbon (OC) to be remineralized annually from seabed sediment carbon stores (Sala et al., 2021). There are, however, many uncertainties in this calculation. Here, we discuss the potential drivers of change in seabed sediment OC stores due to mobile demersal fishing activities and conduct a literature review, synthesizing studies where this interaction has been directly investigated. Under certain

A recent review of 49 studies directly investigating sediment OC stocks after trawling disturbances revealed mixed results (Epstein et al. 2021):

- *61% of studies reported no sign effect*
- *29% reported lower OC stocks*
- *10% reported higher OC stocks,*

These mixed results reflect the spatial variability and the complexity of the process - but provide some support to the mechanism of trawling induced emission of sediment CO_2.

CO_2 from fuel and energy use in bottom trawling

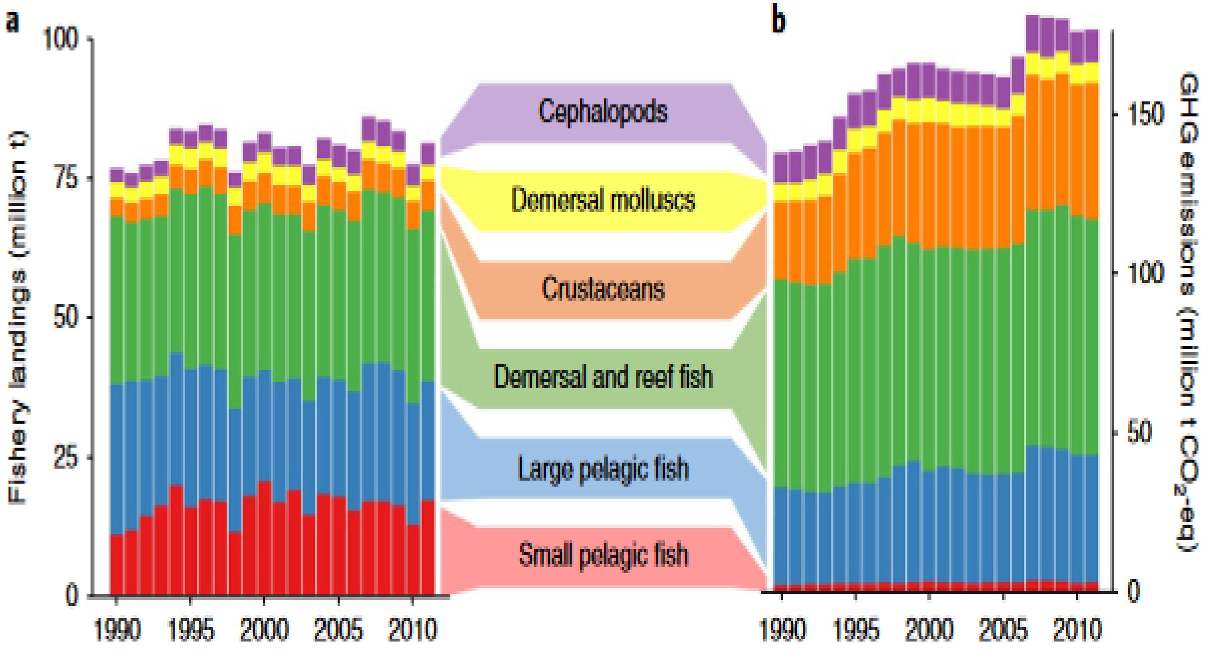
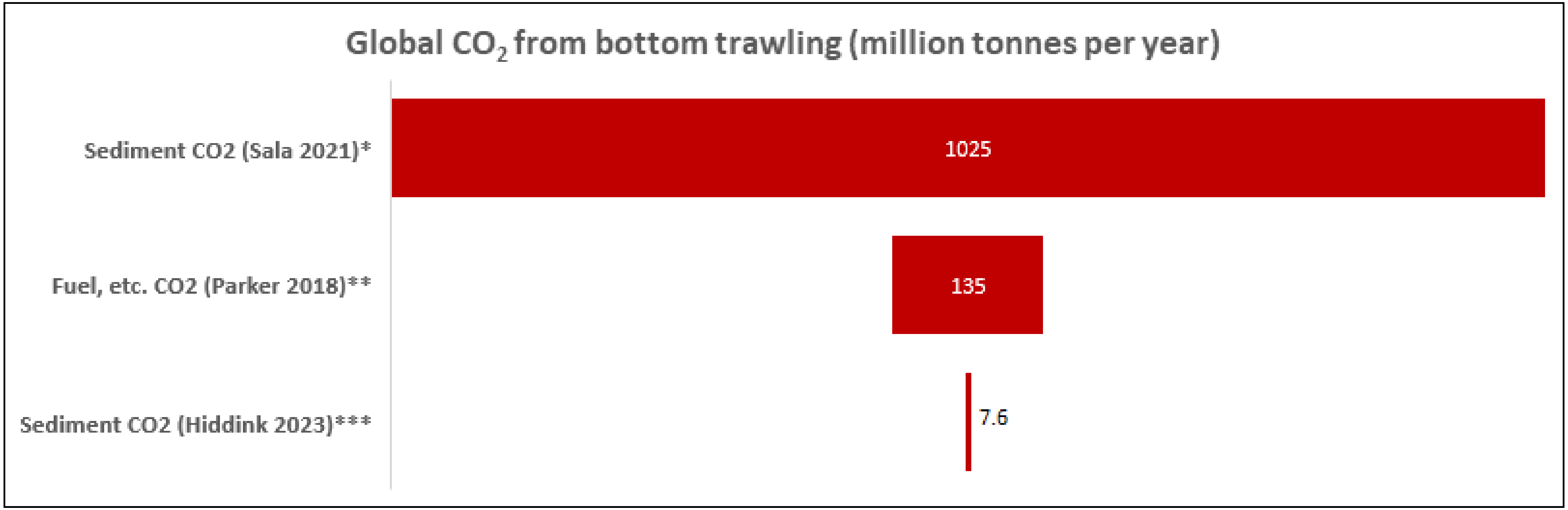


Fig. 2 | Global marine fishery landings and GHG emissions for 1990-2011 categorized by species groups. a, Global marine fishery landings. **b**, Global GHG emissions from marine fisheries.

- Global emission of **179 million t** CO_2-equivalents annually from all fishing (both passive and active gears)
- Estimate of **135 million t** from all fishing for demersal species.
- These estimates cover all non-sediment related emissions (fossil fuels generally contribute most)
- Difference in climate footprint between demersal (large) and pelagic (small) fish and shellfish capture when related to catch weights.

Scaling of the carbon footprint components



- *Middle of the range estimated by Sala et al. 2021 of 0.58–1.47 (Pg yr^{-1}). 1 Petagram (Pg) = 1 gigaton = 1000 million tonnes*

** *The estimate from Parker et al. 2018 is in CO_2 equivalents and includes all demersal fisheries (passive and active) and all non-sediment related emissions*

*** *Middle of the range estimated by Sala et al. 2021 (0.58–1.47 Pg yr^{-1}) after downscaling by two orders of magnitude based on Hiddink et al. 2023*

Summary and Conclusions

- The mechanism of increased emission of sediment-CO_2 caused by bottom trawling has been timely flagged by Sala et al. 2021.
- However, their approach is based on poorly substantiated assumptions of carbon reactivity and uncertain maps of sedimentary carbon stocks, and according to Hiddink et al. (2023), the global CO_2 emission estimates are several orders of magnitude too high.
- Overall, the use of fossil fuels is likely a substantially bigger source of atmospheric CO_2 in bottom trawl fisheries than sediment-related emissions.
- In some marine areas sediment-CO_2 can likely be a substantial component of the total carbon footprint of bottom trawl fisheries (areas with high organic carbon content, high reactivity of the organic carbon, and low primary production in the water column).

Thank you for listening

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