

Evaluating the sustainability and environmental impacts of trawling compared to other food production systems

JOURNAL ARTICLE

Evaluating the sustainability and environmental impacts of trawling compared to other food production systems

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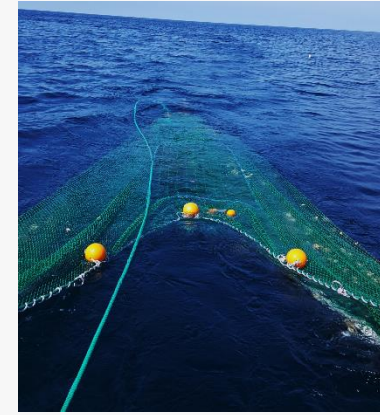
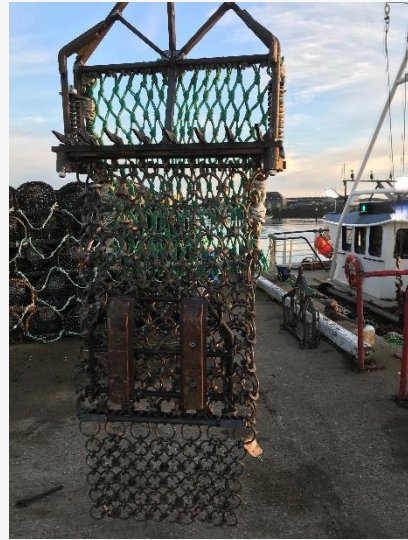
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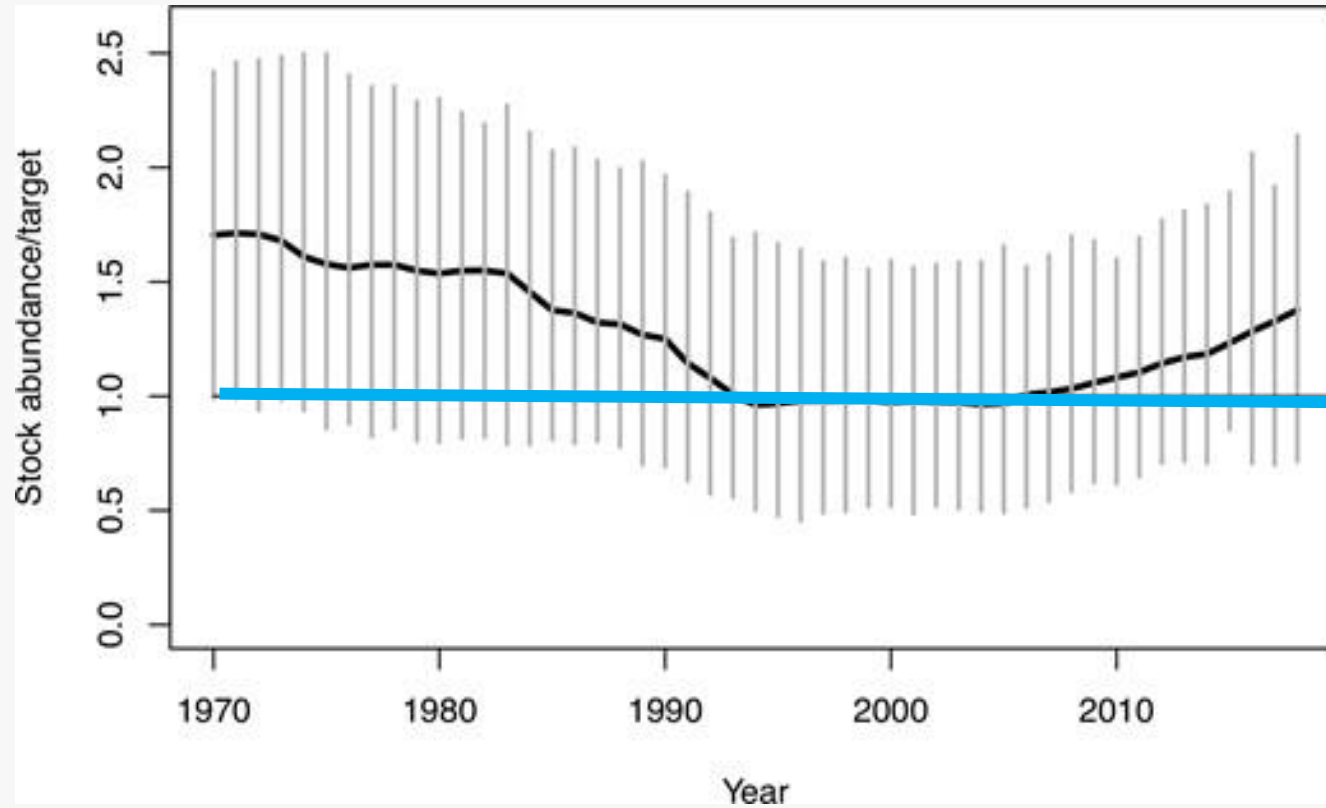
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Bottom trawling accounts for 26% of global marine fisheries catches

(Steadman *et al.*, 2022)

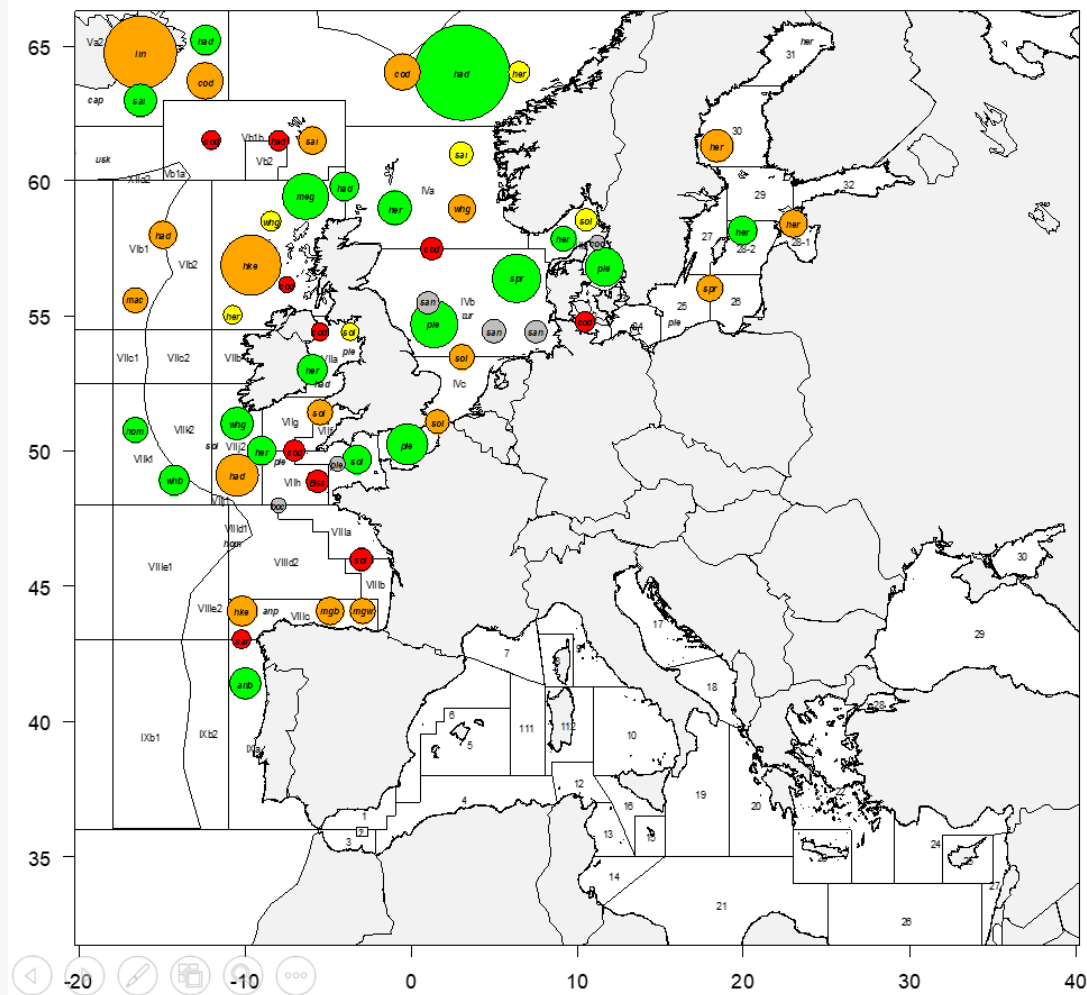


Bottom trawling: otter, beam
and scallop dredges, seines



The abundance trend in global groundfish stocks relative to management targets (solid black line). In most cases, management targets are based on achieving maximum sustainable yield. Vertical bars show the range of 50% of the stocks, with 25% being below and 25% above. The blue horizontal line shows where the stock abundance is equal to the management target. Redrawn from Hilborn *et al.* (2021).

- Well managed fisheries are sustainable
- 70% of adult fish are free and wild



SSB
biomass

● Sustainable

● Recovering

● Declining

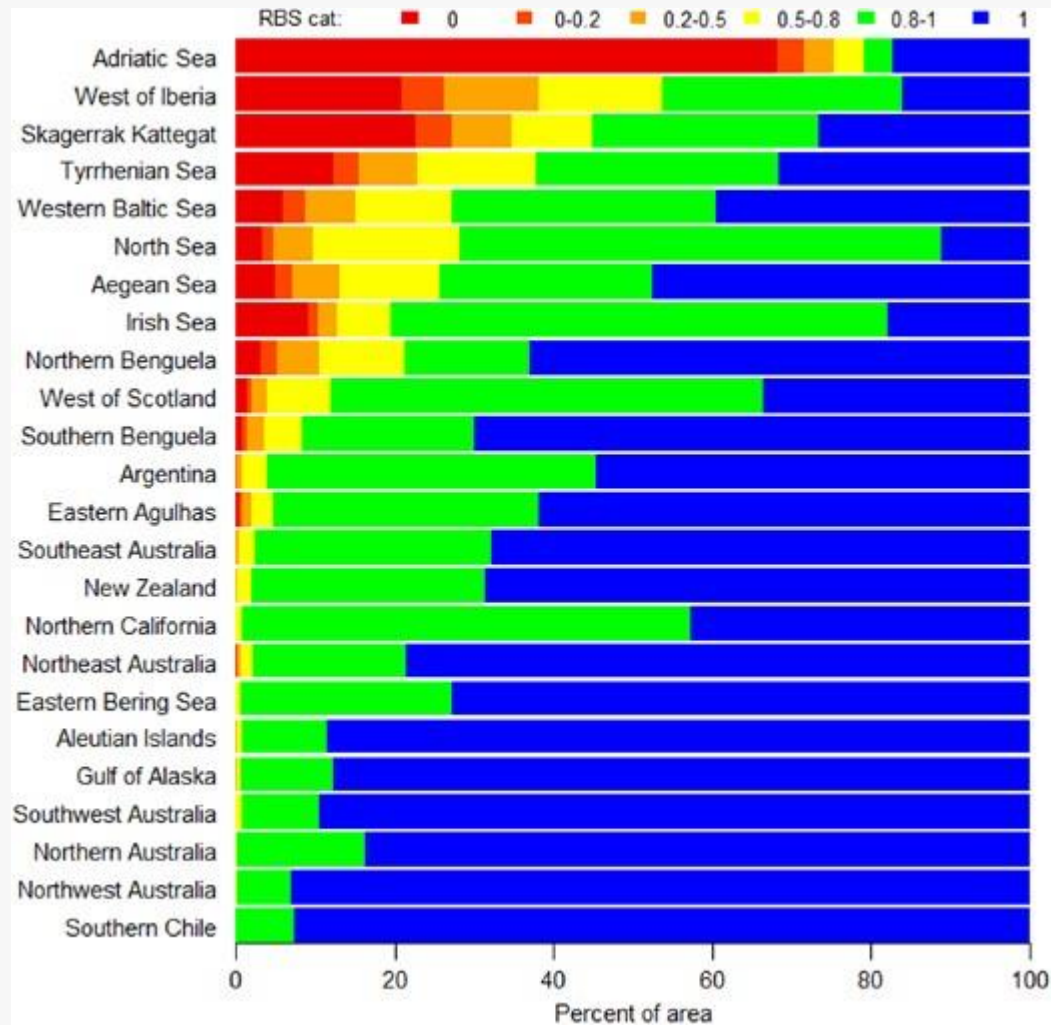
● Overfished

**Steady reductions in fishing pressure
have greatly improved the sustainability
of most NE Atlantic fisheries**

**The entire opposite is true for the
Mediterranean**

Fernandes et al. 2017

**NE Atlantic fisheries show
large improvements in SSB**



Depletion level (RBS) of benthic flora and fauna in different regions of the world where data on trawl effort and sediment type are available. Data from Pitcher *et al.* (2022).



The majority of shelf seas are not adversely affected by trawling

Table 1.
 Mean discard rates and 95% confidence bound (CI) for different fishing gears from Pérez Roda *et al.*, 2019 (Table B1).

Gear Category	Mean percent discarded	95% CI
Purse seine	5%	3.9–5.6%
Longline, pelagic	7%	5.8–9.4%
Pole-and-line	9%	6.4–14.4%
Handline	10%	1.9–44.2%
Gillnet, pelagic (driftnet)	12%	7.4–19.0%
Otter trawl, midwater	12%	8.2–18.2%
Longline, bottom and pelagic	13%	11.0–16.4%
Pots	17%	12.1–22.2%
Gillnet, surface and bottom	17%	8.8–32.9%
Trawl, pair, midwater	19%	3.3–73.0%
Trolling lines	20%	6.8–49.8%
Longline, bottom	24%	18.0–31.1%
Gillnet, bottom	26%	19.8–33.8%
Otter trawl, bottom	31%	28.5–60.0%
Trawl, otter twin	44%	28.5–60.0%
Trawl, beam	46%	37.7–53.8%
Trawl, pair, bottom	48%	14.1–87.8%
Trawl, shrimp	55%	50.0–59.6%



Discards rates are high for trawl gears but can be reduced

Table 2.
 The average, minimum, and maximum amount of fuel used to capture one MT (litres per MT) of fish for different gear types and the amount of carbon released per kilogramme (Kg) of fish wet weight landed (Kg CO₂ per kg landed). Data source is Parker and Tyedmers (2015).

Gear	Liters of fuel per MT landed			Kg CO2 per Kg landed		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Surrounding nets	252	8	659	0.68	0.02	1.78
Dredges	506	15	1 822	1.37	0.04	4.92
Pelagic trawls	667	36	2 475	1.80	0.10	6.68
Gillnets	604	199	2 162	1.63	0.54	5.84
Divers	951	585	1 472	2.57	1.58	3.97
Hooks and lines	1 032	47	4 985	2.79	0.13	13.46
Bottom trawls	1 722	65	17 300	4.65	0.18	46.71
Pots and traps	3 014	331	9 474	8.14	0.89	25.58

Gear efficiency in food production per CO₂

Table 3.
Kg CO₂ per kg of processed product from life cycle analysis.

Food type	Kg CO ₂ /kg
Corn	0.10
Wheat	0.23
Rice	0.33
Tofu	0.60
Potatoes	0.80
Alaska pollock fishery	0.83
Alaska bottom-trawl fishery	1.17
Isle of Man scallop fishery	1.73
New Zealand hoki and ling	2.24
Chicken	2.28
Pork	2.92
Impossible Burger	3.50
Bottom-trawl fisheries average	4.65
Farmed Salmon Norway	5.50
Beef	19.20

Data sources: crops and livestock from Poore and Nemecek (2018); Pollock from Zhang *et al.* (2022); Alaska bottom trawl converted by ratio of fuel used in pollock fishery (Fissel *et al.*, 2016); scallop fishery (Bloor *et al.*, 2021); Impossible Burger (Khan *et al.*, 2019); New Zealand (Mazzetto and Ledgard 2023,); Norwegian farmed salmon (Ziegler and Hilborn, 2023).

Seafood mostly out-performs
other forms of food production

Trawl fisheries produce a significant amount of global seafood production

When well managed, trawl fisheries have small environmental footprints on seabed and other ecosystem components

Bycatch remains an issue but technology can improve this issue

Trawl fisheries are less polluting than other forms of protein production



Take home messages