

Fisheries and Global Warming: Impacts on Marine Ecosystems

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CEBios
**Biodiversity and Development:
a global heritage**
Brussels, November 26, 2015



What are the major problems for marine biodiversity at the dawn of the 21st century?

I would argue that they are, in decreasing order of importance:

- 1) Ever-expanding marine fisheries, whose impacts on marine life are still widely underestimated;
- 2) Global warming, whose effects on fisheries have already kicked in;
- 3) Pollution, whose impacts on marine life were long overestimated, and which only now begins to live to its reputation.



we won't deal with ocean acidification (too discouraging)

Official fisheries catches, as submitted by member countries to FAO are incomplete.

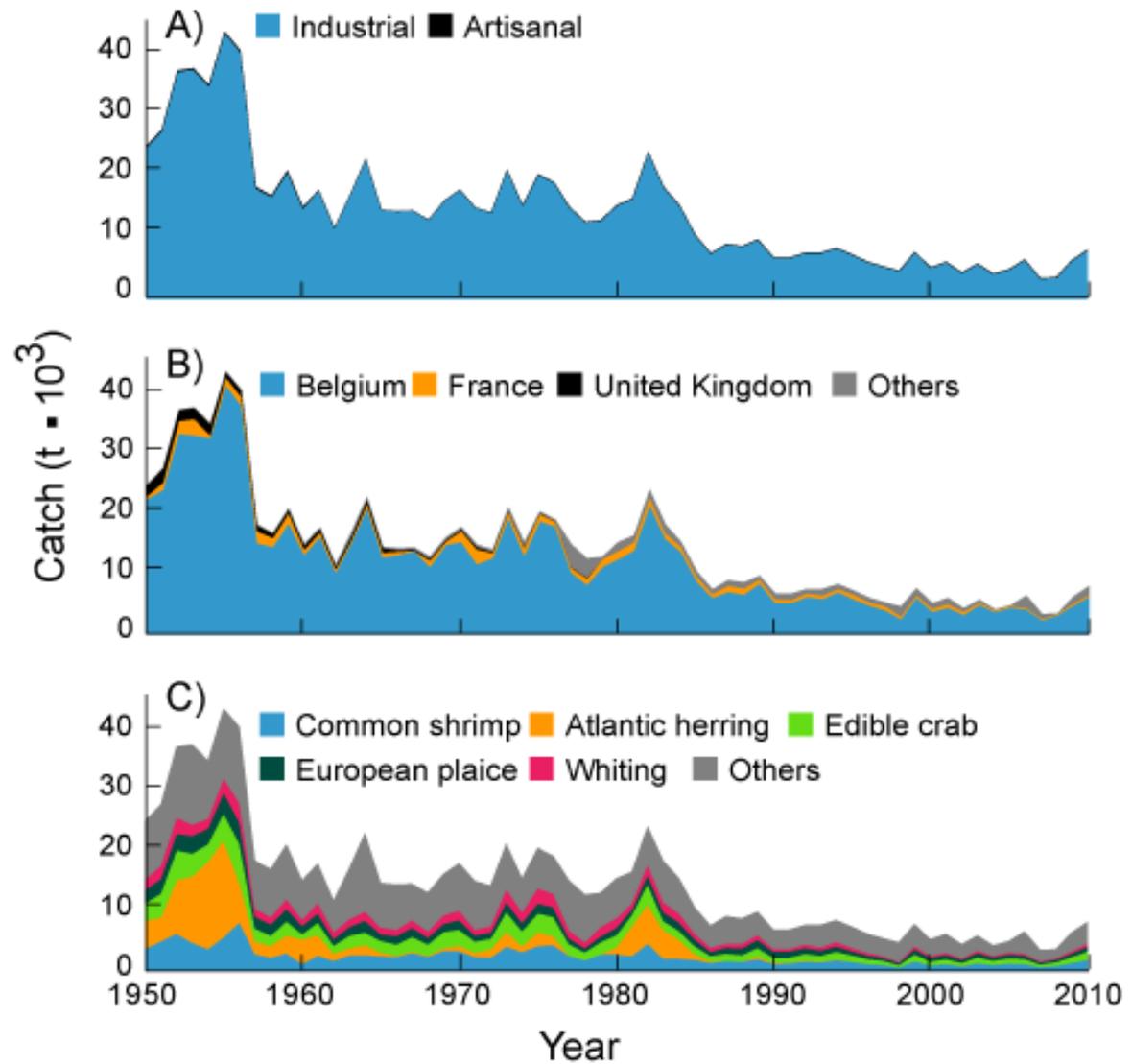
We addressed this by doing ‘catch reconstructions’, i.e., bottom-up re-estimation of total catches for all countries of the world, based on the principles that:

- (i) every fishery casts a “shadow” on the society in which it occurs, and
- (ii) zero is never a good estimate for a positive number that is not precisely known.

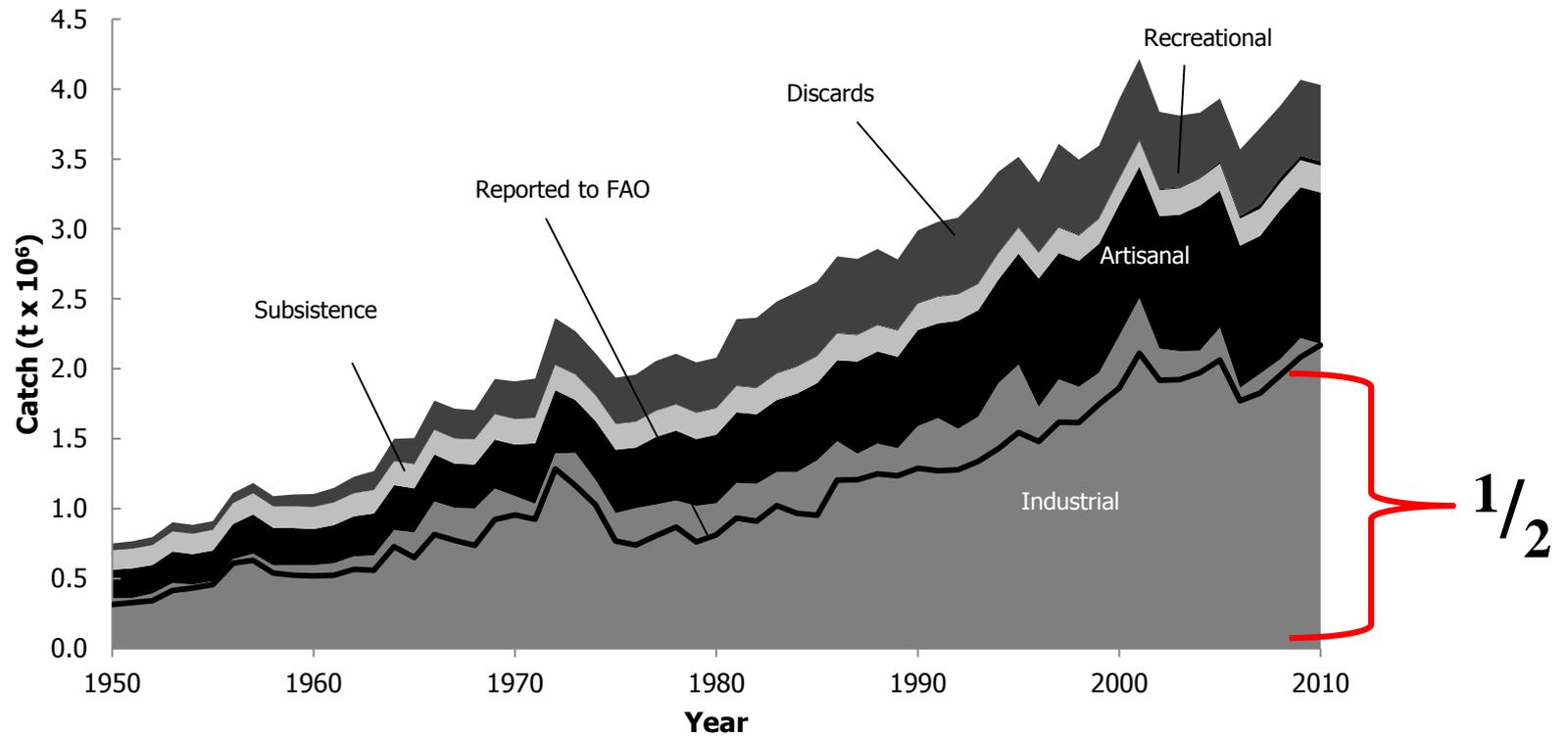


see www.seaaroundus.org

The example of Belgium

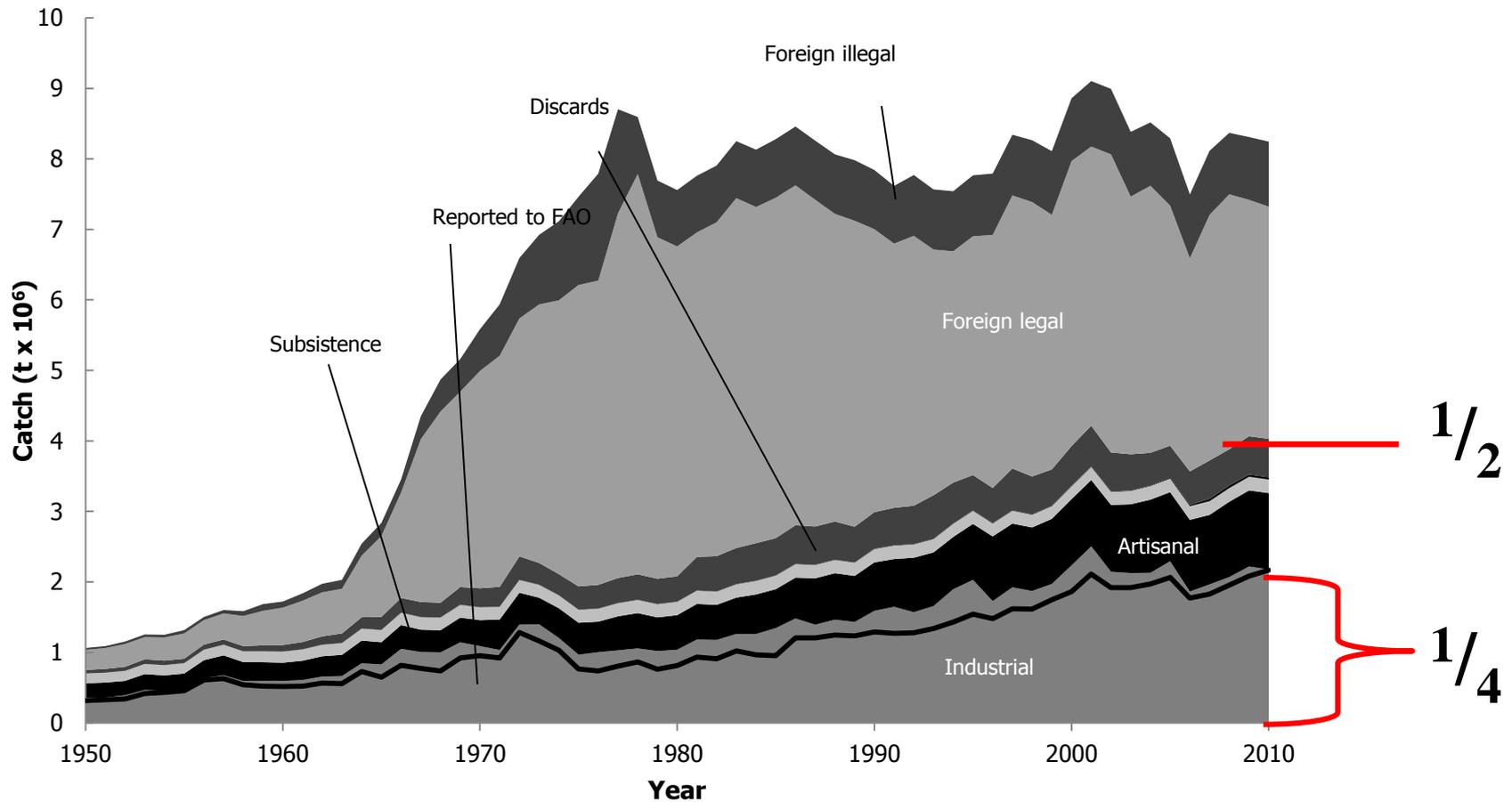


Total reconstructed catches for West Africa: domestic



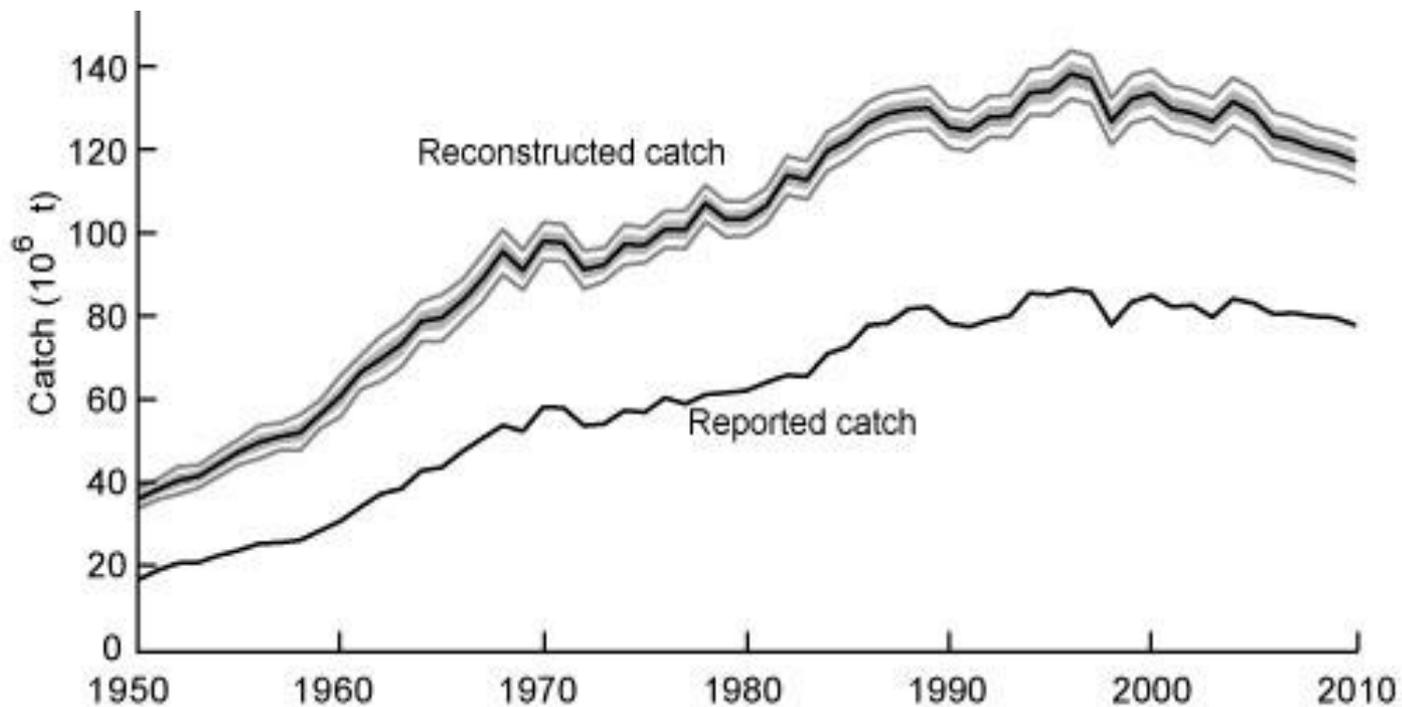
Belhabib *et al.* (*Environmental Development*, in press)

Total reconstructed catches for West Africa: domestic & foreign

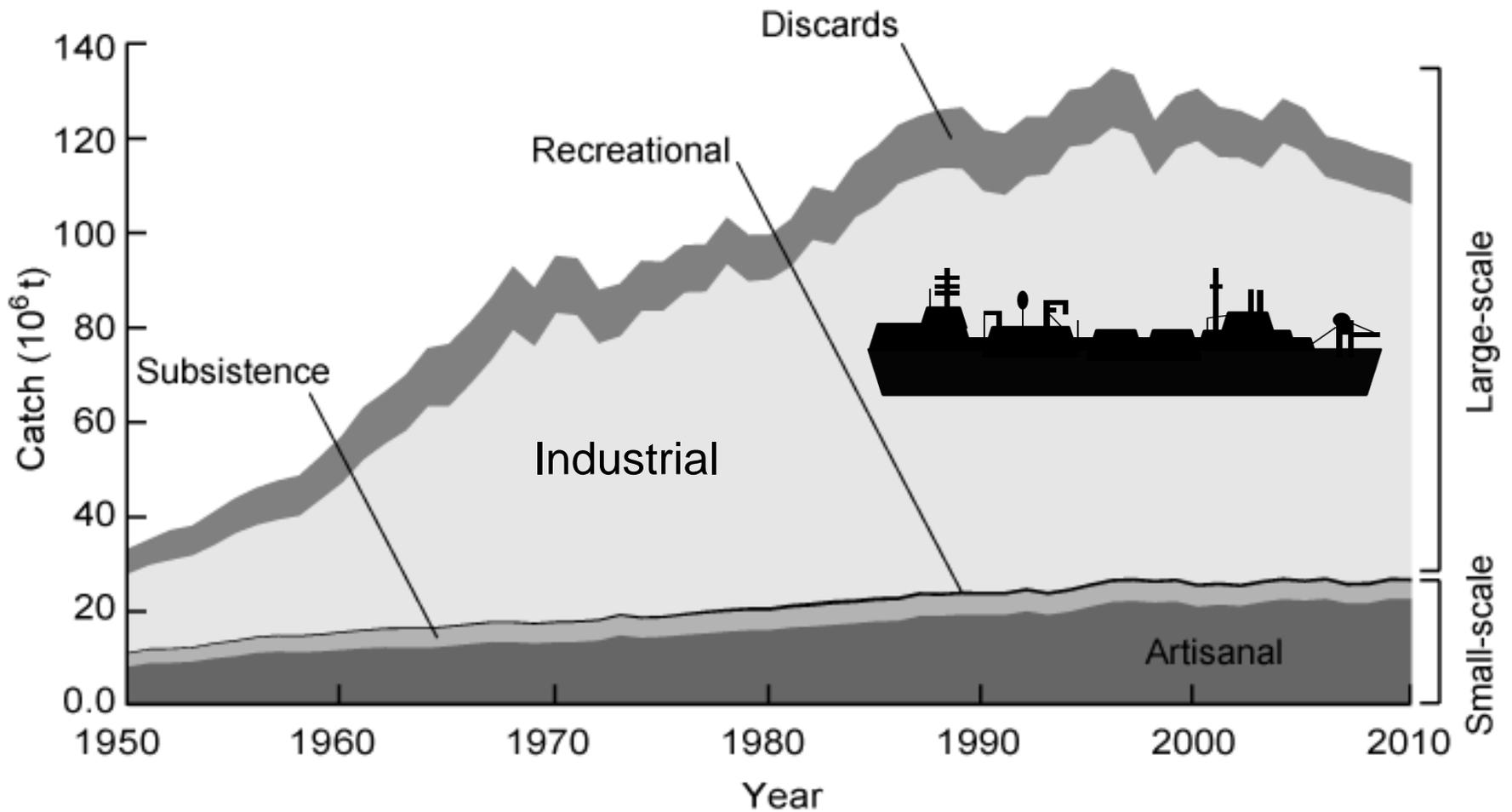


Belhabib *et al.* (*Environmental Development*, in press)

The reconstructions confirm that the world catch is declining; this trend is more marked than in the officially reported catch...

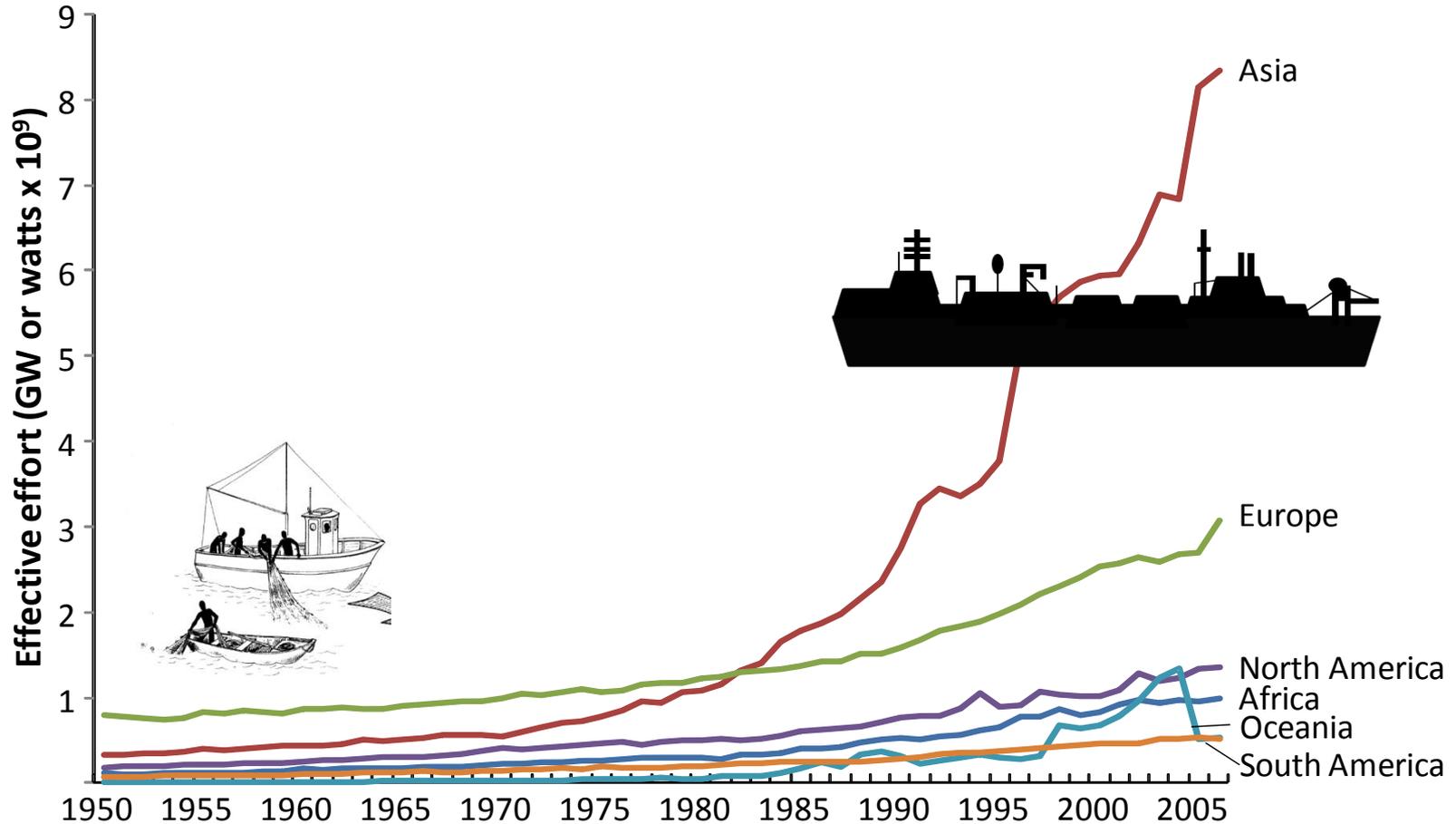


Pauly and Zeller (*Nature Communication*, in press)



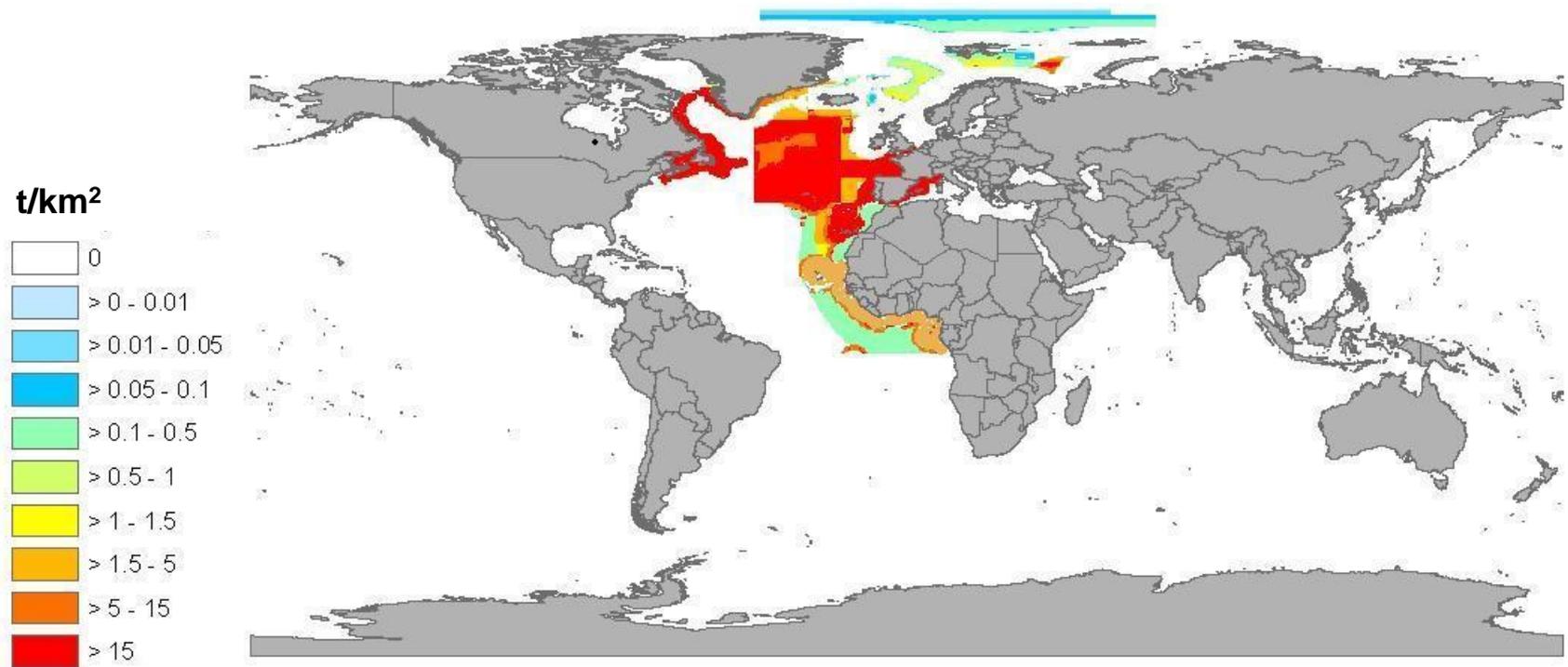
Pauly & Zeller (*in review*; do not disseminate)

The decline of industrial catches is not surprising, given the growth of 'effective' fishing effort ...



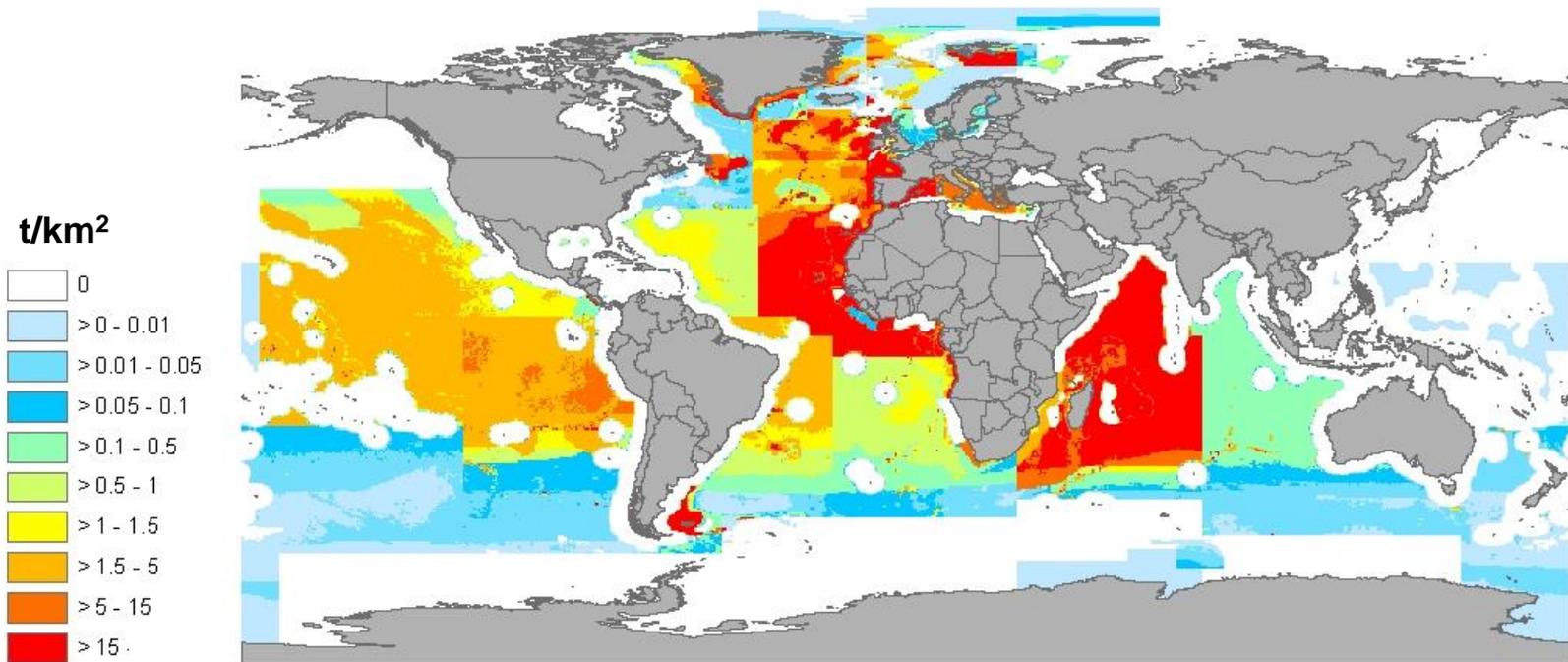
Anticamara et al. (*Fisheries Research*, 2011)

This issue was long masked by fisheries expansion, here illustrated by mapping the catch of Spain in the 1950s...



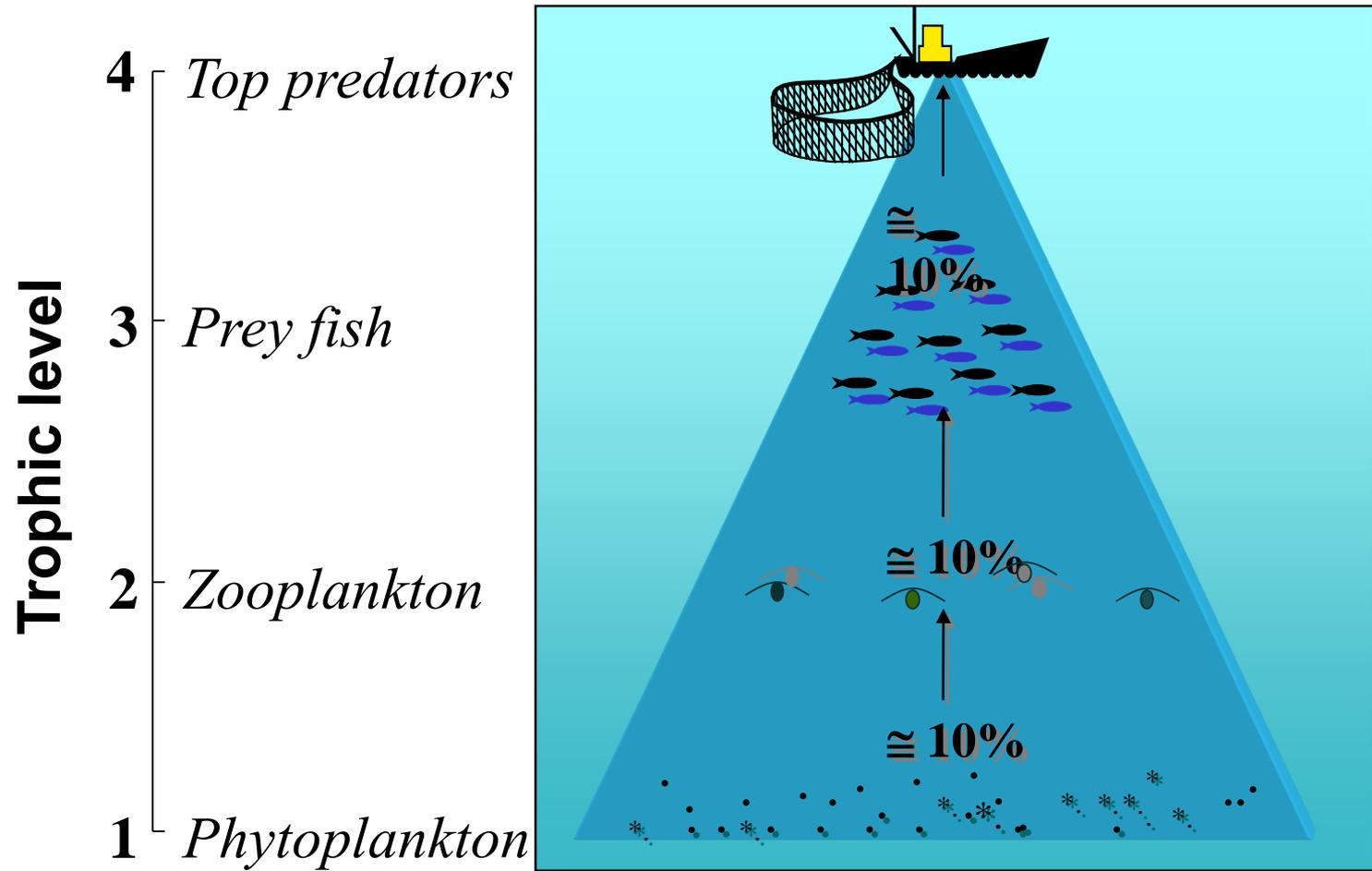
see www.searoundus.org

...and from 2000-2004 (remember: Spain!)



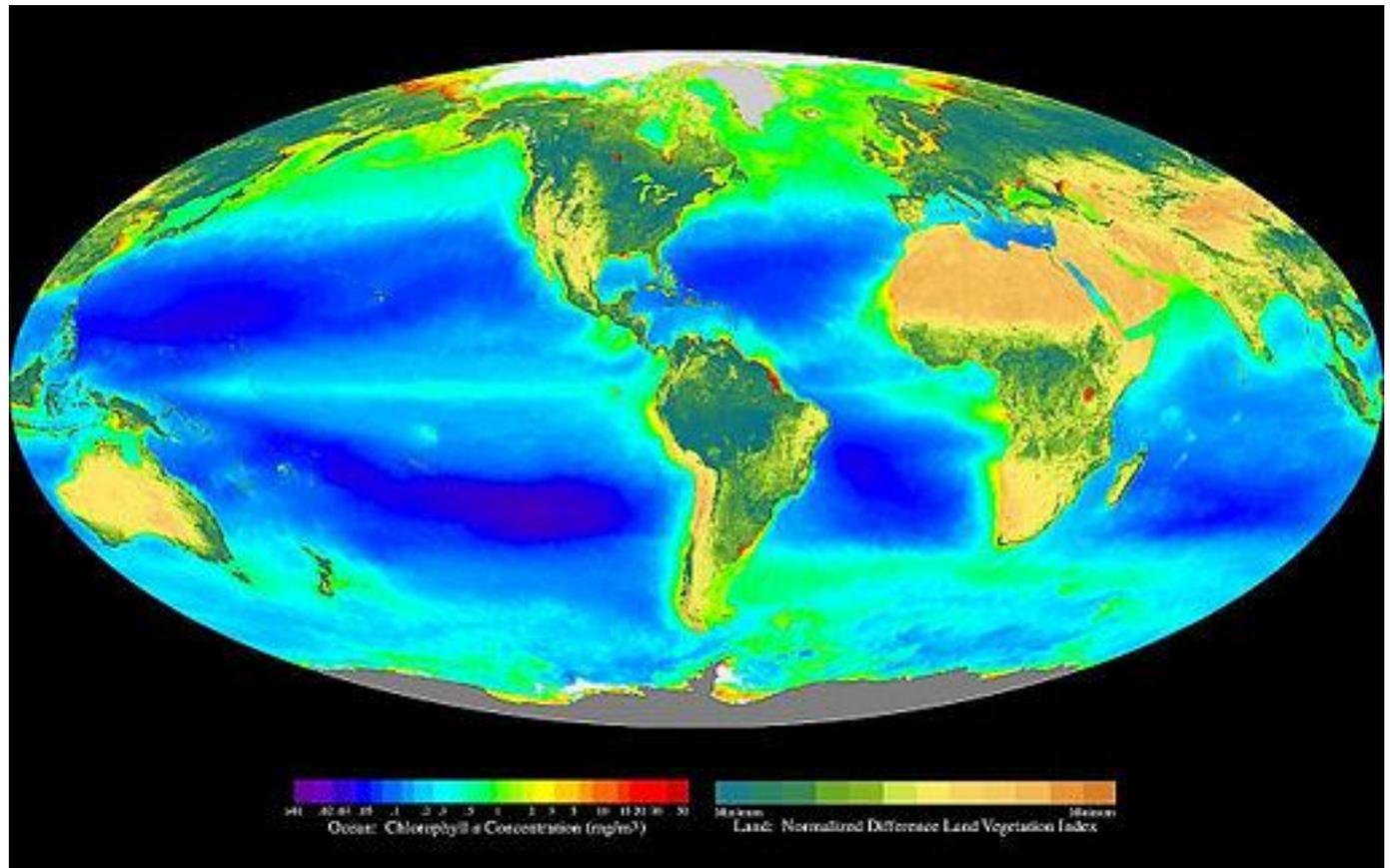
see www.searoundus.org

Now recall that ecosystem fluxes move up 'trophic pyramids,' and each species tends to have its own trophic level...



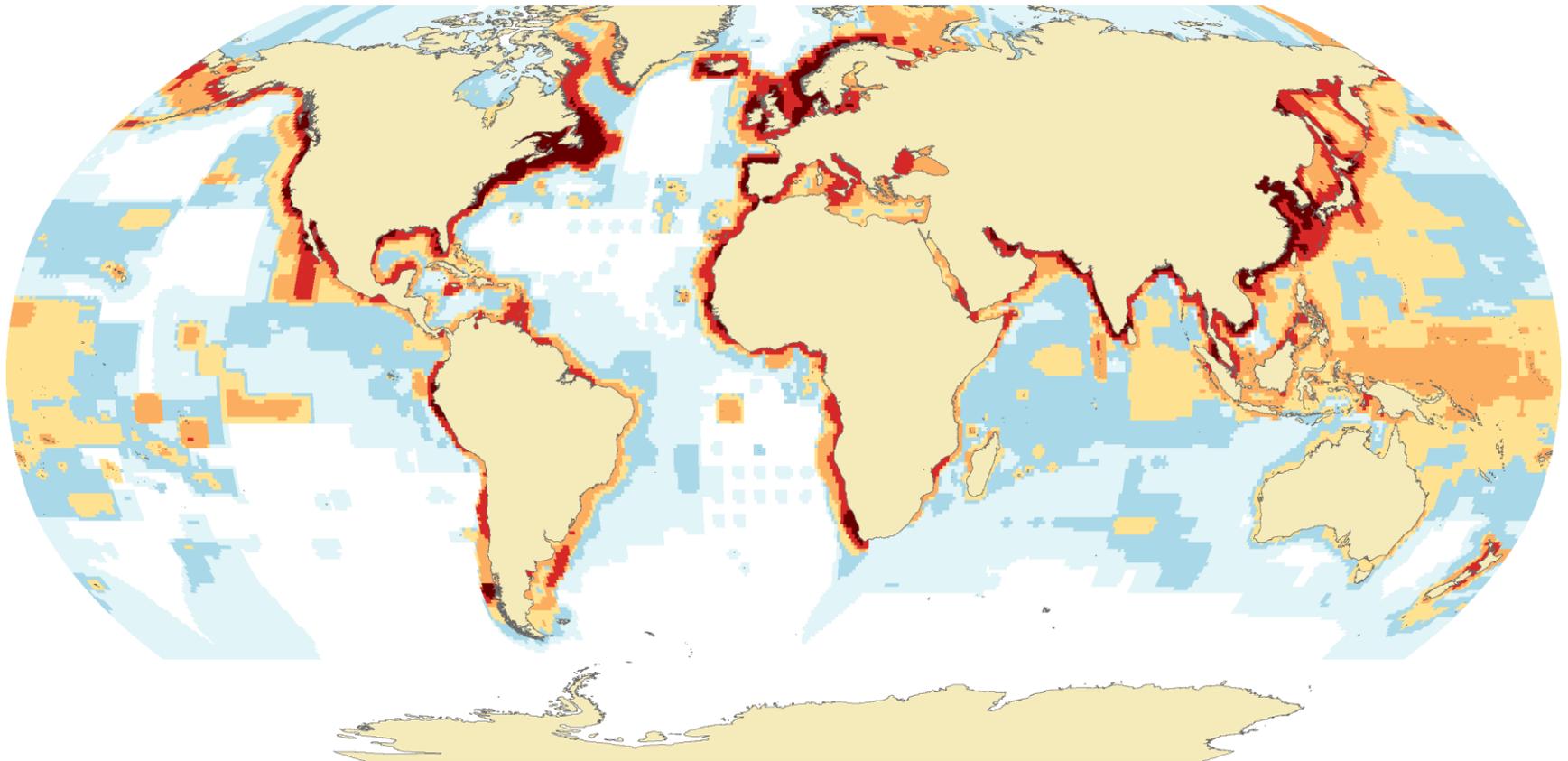
Pauly and Christensen (*Nature*, 1995)

We know (from satellite data) the primary production of the ocean, which is usually high in coastal waters, and very low in the 5 central gyre of the oceans...

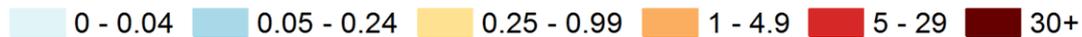


SeaWiFS
data, NOAA

We can thus map the footprint (or 'seafoodprint') of fisheries onto the world ocean, here in the 1950s...

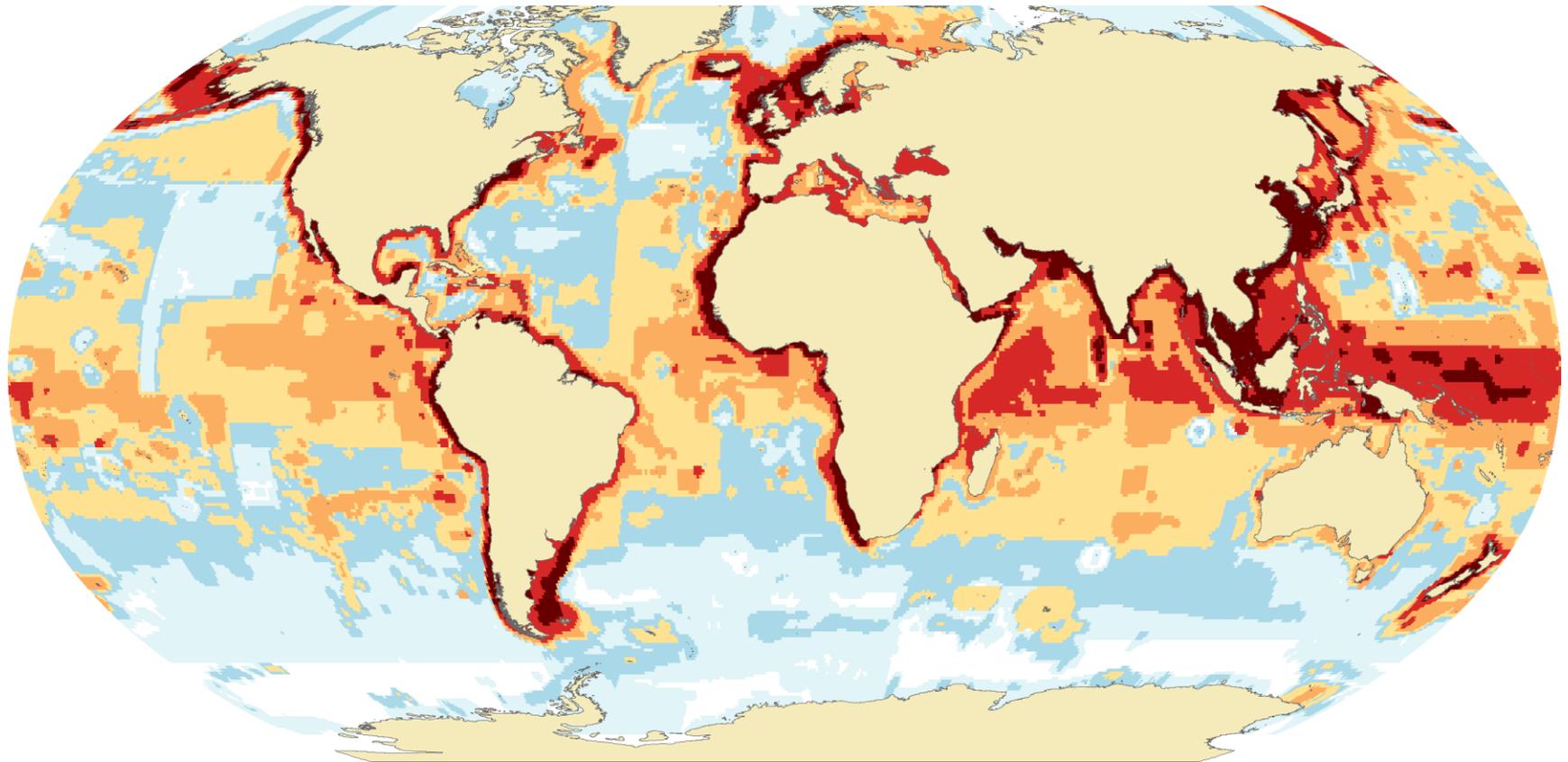


Primary production required (1950s; %)

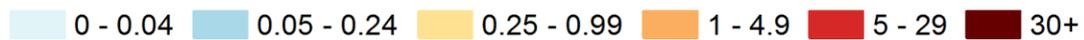


see www.searoundus.org

...and in the 2000s...

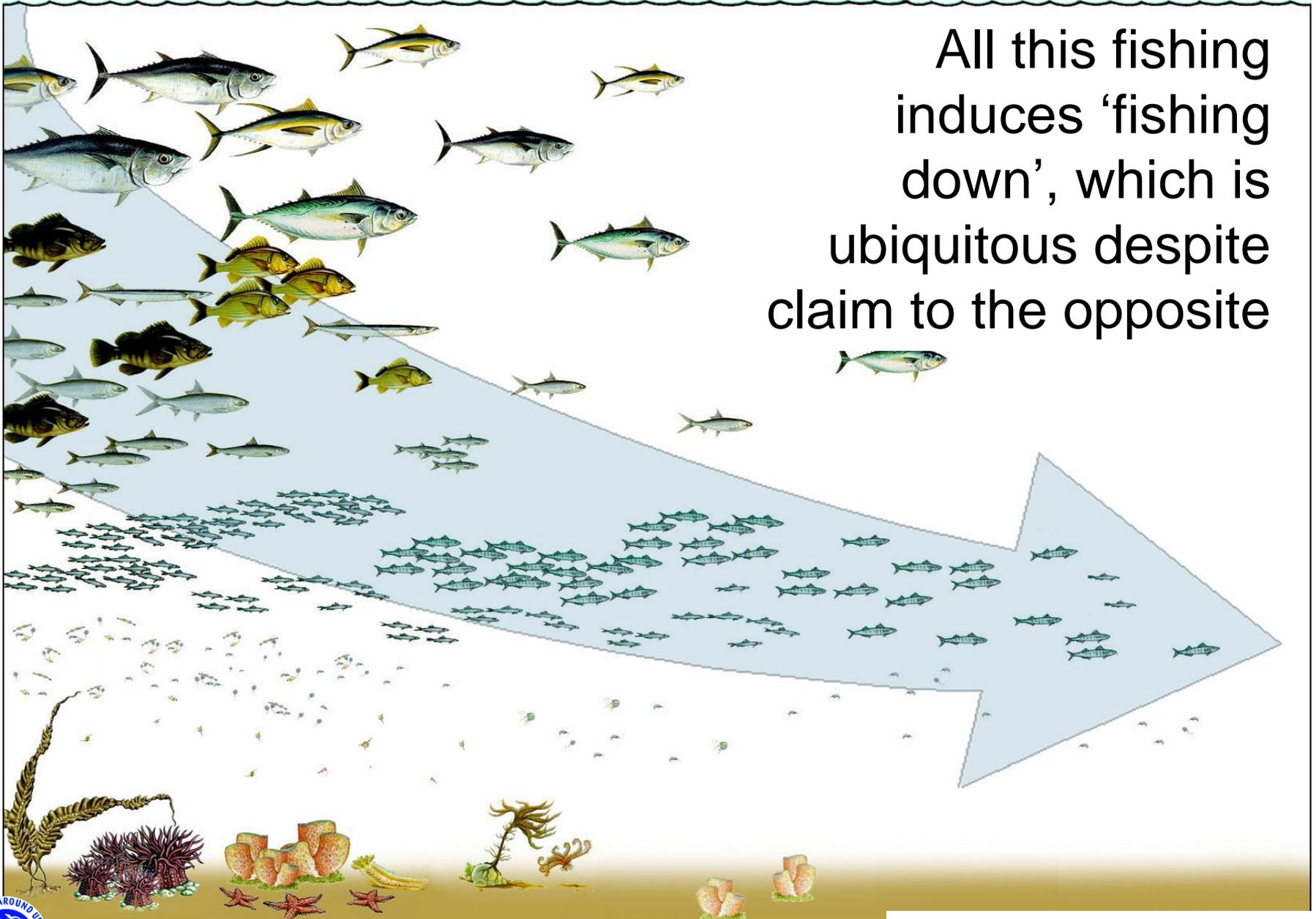


Primary production required (2000s; %)



see www.searoundus.org

All this fishing induces 'fishing down', which is ubiquitous despite claim to the opposite



see www.fishingdown.org

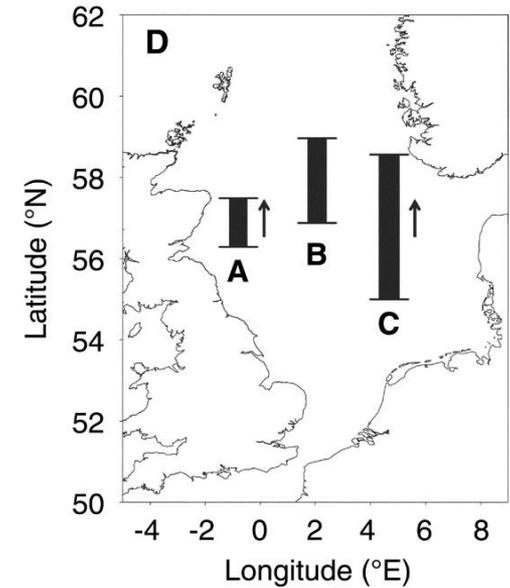
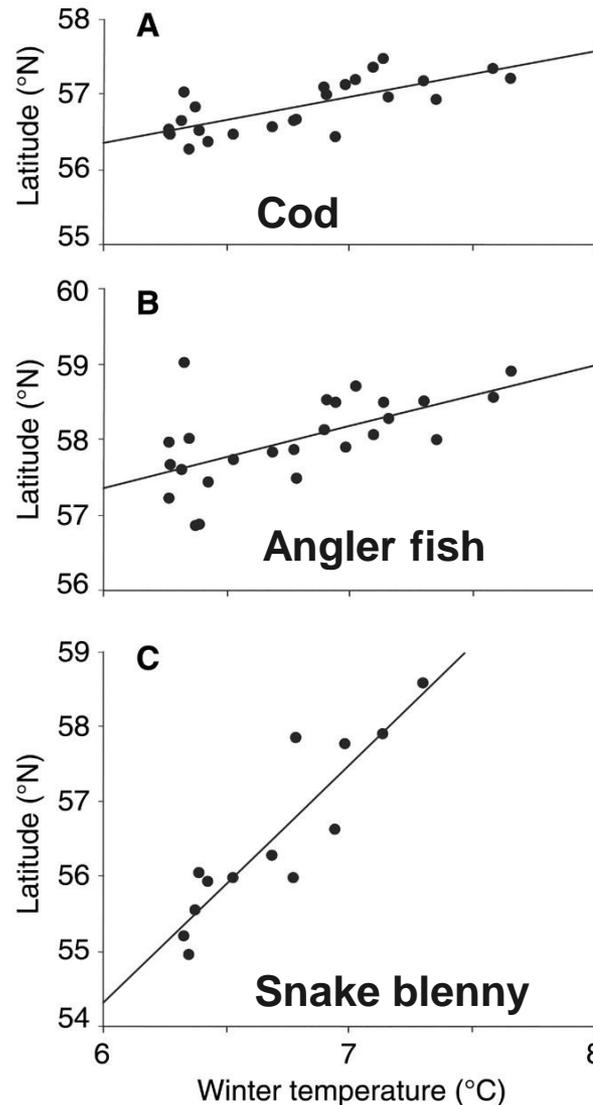


If you don't watch out, this can be where 'fishing down' ends (as here in China)



Observed climate-induced shifts in distribution ranges

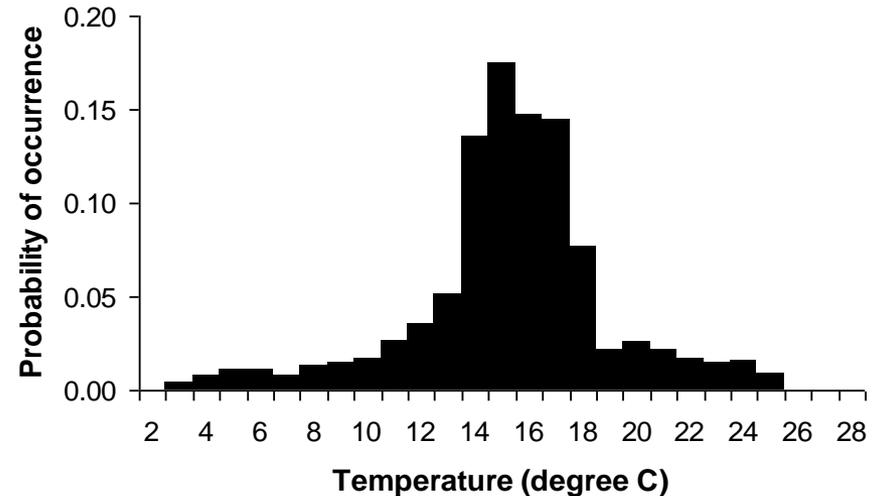
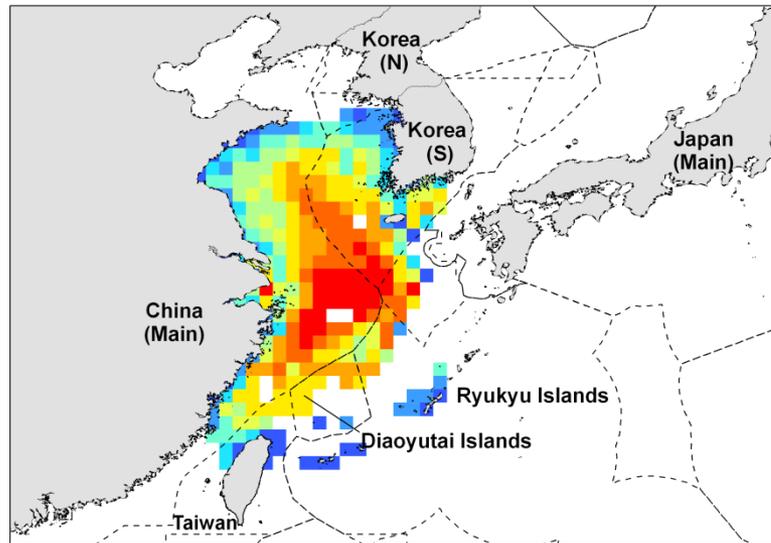
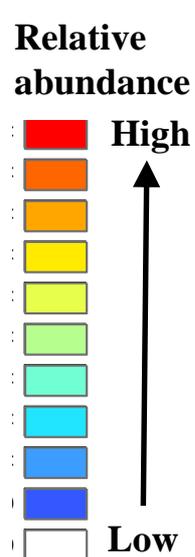
Poleward shifts in distribution ranges of marine species, e.g., in the North Sea (Perry *et al. Science*, 2005).



Simulating poleward shifts using temperature-abundance profiles...

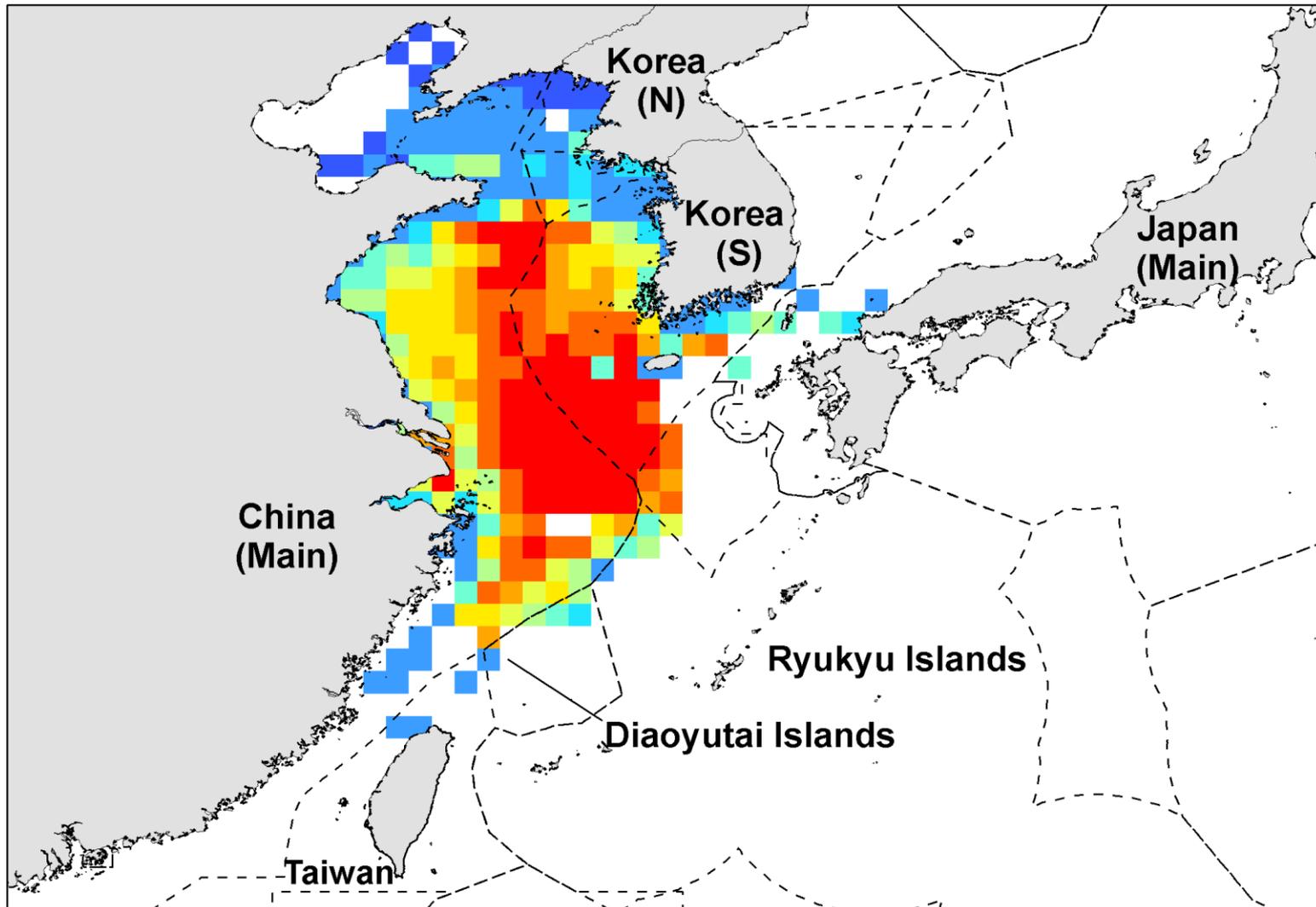
Small yellow croaker
(*Larimichthys polyactis*)

Probability of occurrence by
water temperature

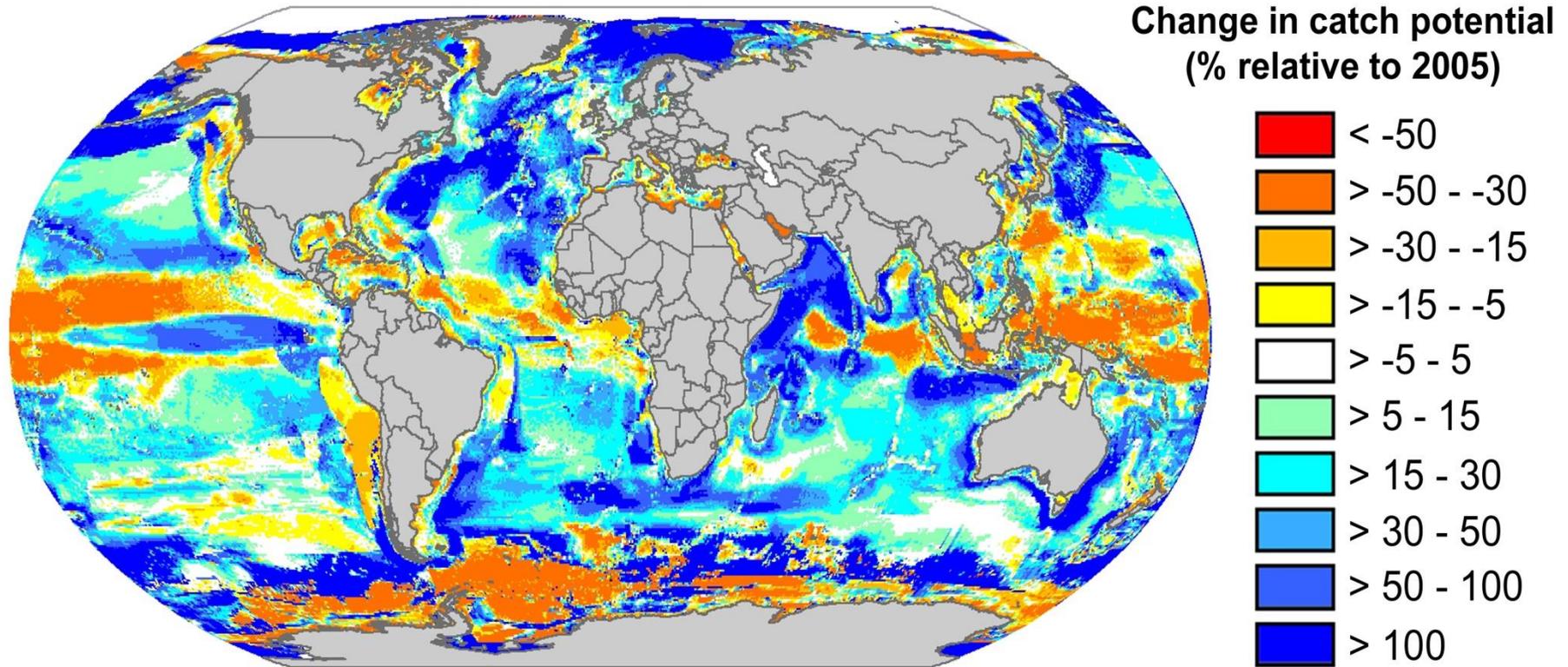


Small yellow croaker

Year 30



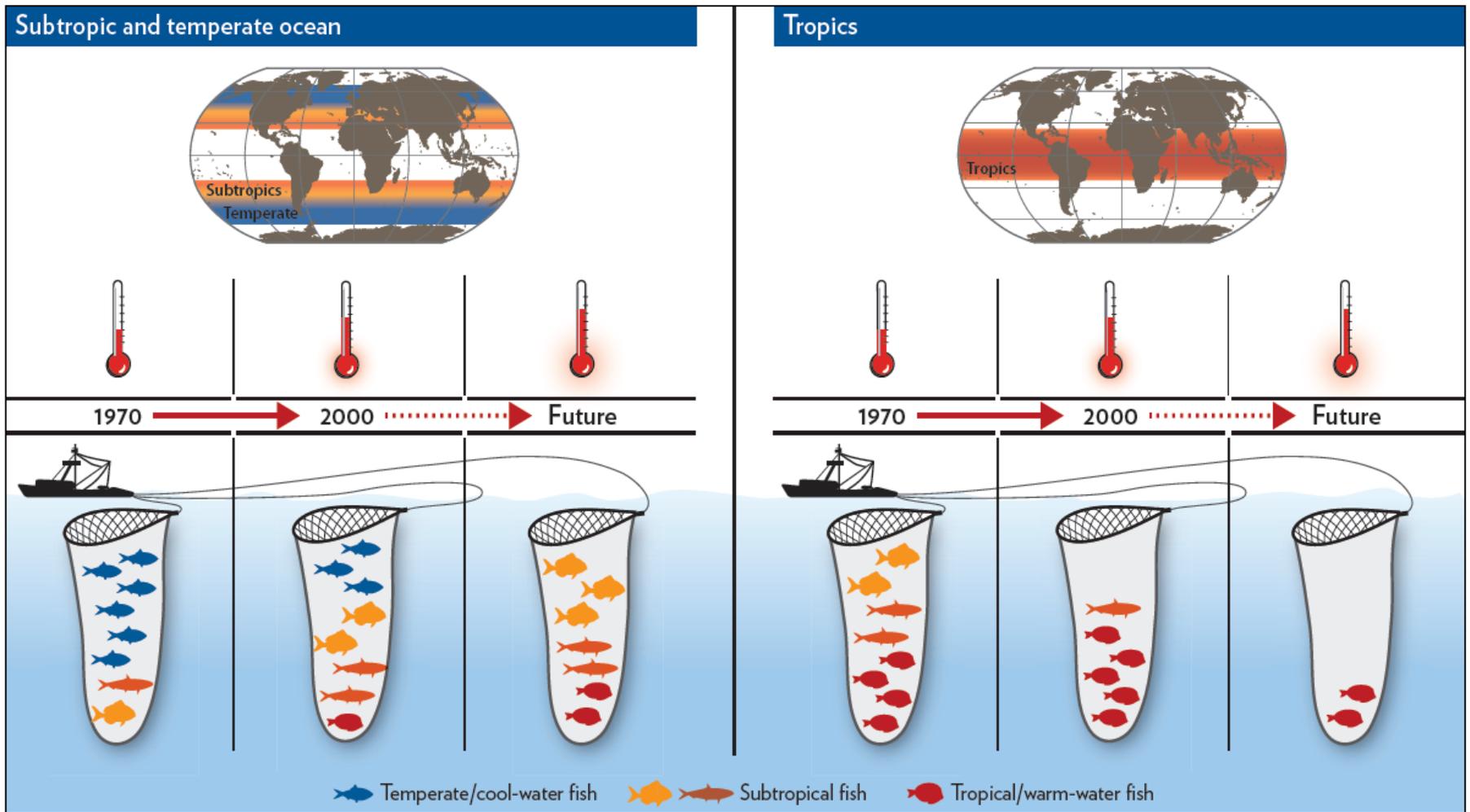
Projected change in catch potential in 50 years



Cheung, Lam, Kearney, Sarmiento, Watson, Zeller and Pauly (*Global Change Biology*, 2009); see also IPCC, 5th Assessment, Summary for Policy Makers

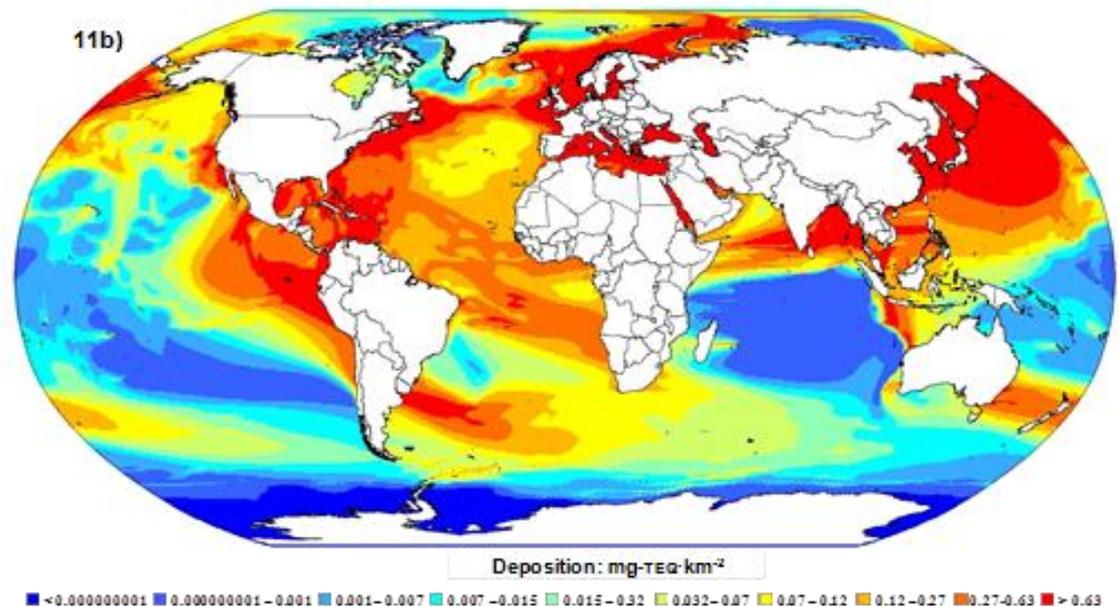
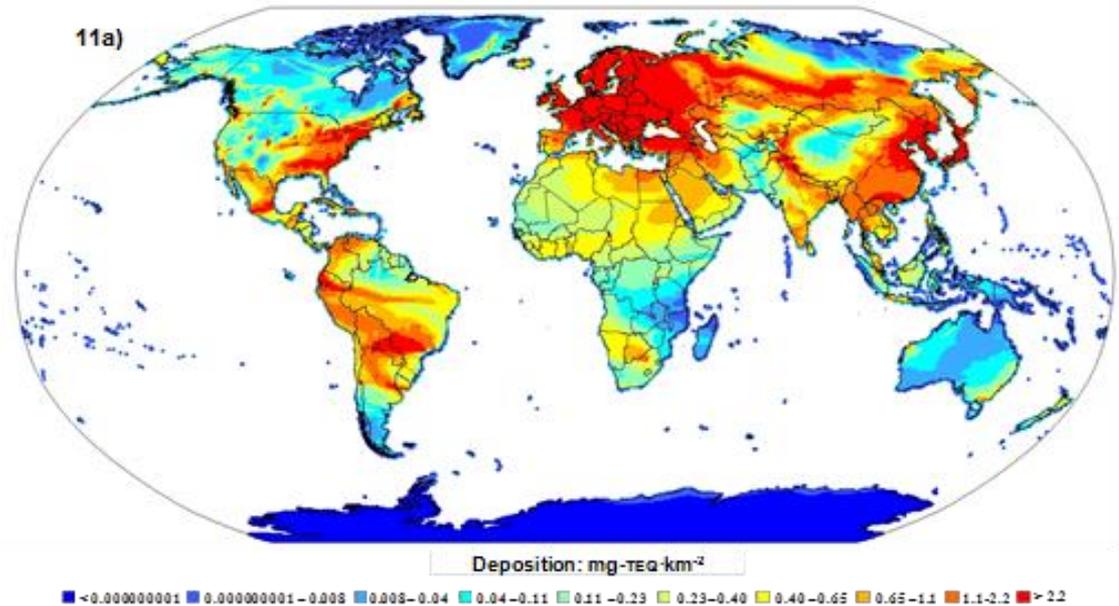


In summary:



Cheung, Watson and Pauly (*Nature*, 2013)

Marine pollutants take several forms; one of them are persistent Organic Pollutants (POPs), such as dioxin, whose land and ocean deposition we modeled as an input to food-web based models...



Plastic pollution is an emerging issue, caused in part by fisheries, strongly affecting seabirds and marine mammals



A final comparison...

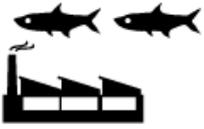
This graph highlights the crucial role of small-scale fisheries, so far neglected. Indeed, we would achieve most stated aims of fisheries management plans (particularly their social aims) by dedicated access arrangement for small-scale fisheries.



Fisheries benefits

Large-scale

Small-scale

Fisheries benefits	Large-scale	Small-scale
Annual landings for human consumption	 about 60 million tonnes	 about 27 million tonnes
Annual catch discarded at sea	 10 million tonnes	 Almost none
Annual catch for industrial reduction to fishmeal and oil, etc.	 26 million tonnes	 Almost none
Fuel used per tonne of fish for human consumption	 5-20 tonnes	 2-5 tonnes
Number of fishers employed	 about 1/2 million	 about 12 million
Government subsidies (billions of USD)	 25-30 billion USD	 5-7 billion USD



Acknowledgements...

- Thanks to The Pew Charitable Trusts and the Paul G. Allen Family Foundation for support



THE PAUL G. ALLEN
FAMILY FOUNDATION

- Thanks to other funding sources: FAO, US Western Pacific Fisheries Management Council, EU-Parliament, UNEP, BOBLME, MAVFA Foundation, Rockefeller Foundation, WWF
- Thanks to all members of the *Sea Around Us*, past and present...



... sorry, I ran out of pictures....

and thanks to many other colleagues

visit us at www.searounds.org

