Official vs. Reconstructed Fisheries Catches and their Impacts on Marine Ecosystems

Daniel Pauly
Sea Around Us
University of British Columbia

1st FisherMan Regional Conference
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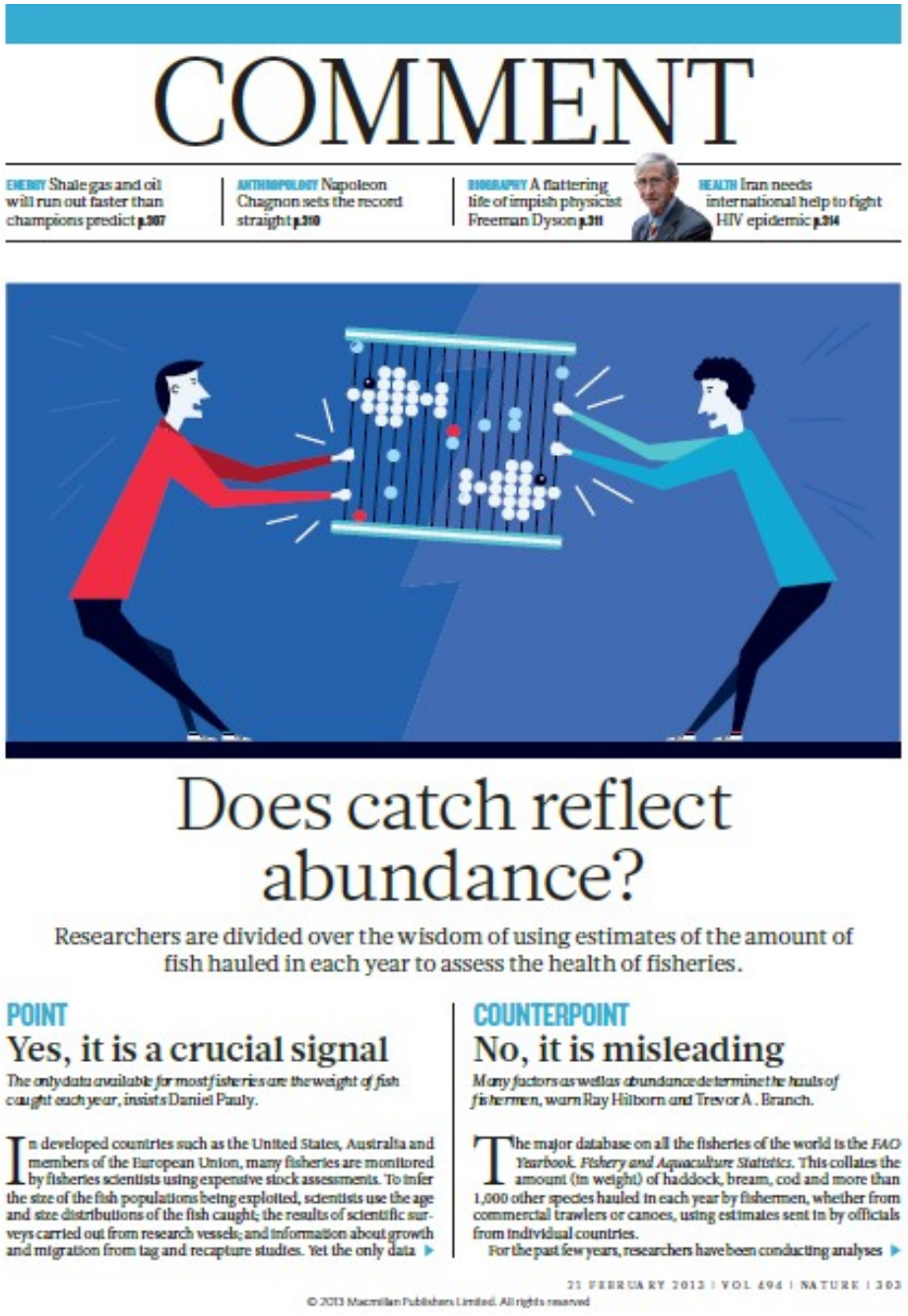
One major issues of fisheries is that we not only do not know precisely what they catch and where, but that some argue we don't need to know fisheries catches.

Yet, fisheries catches quantify our strongest interactions with the oceans…



COMMENT

ENERGY Shale gas and oil will run out faster than champions predict p.307 | ANTHROPOLOGY Napoleon Chagnon sets the record straight p.310 | BIOGRAPHY A flattering life of impish physicist Freeman Dyson p.311 | HEALTH Iran needs international help to fight HIV epidemic p.314

DENIS DARZACQ

Does catch reflect abundance?

Researchers are divided over the wisdom of using estimates of the amount of fish hauled in each year to assess the health of fisheries.

POINT

Yes, it is a crucial signal

The only data available for most fisheries are the weight of fish caught each year, insists Daniel Pauly.

In developed countries such as the United States, Australia and members of the European Union, many fisheries are monitored by fisheries scientists using expensive stock assessments. To infer the size of the fish populations being exploited, scientists use the age and size distributions of the fish caught; the results of scientific surveys carried out from research vessels; and information about growth and migration from tag and recapture studies. Yet the only data ▸

COUNTERPOINT

No, it is misleading

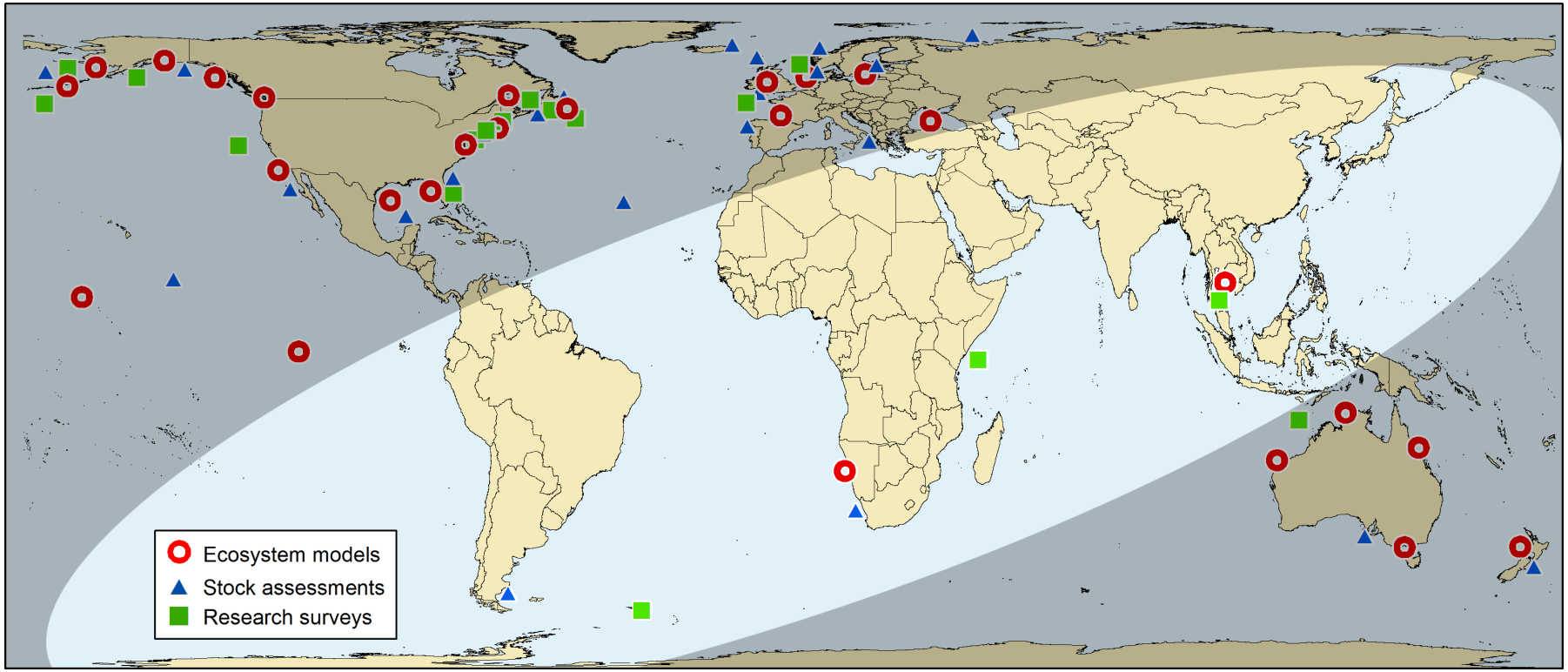
Many factors as well as abundance determine the hauls of fishermen, warn Ray Hilborn and Trevor A. Branch.

The major database on all the fisheries of the world is the *FAO Yearbook. Fishery and Aquaculture Statistics*. This collates the amount (in weight) of haddock, bream, cod and more than 1,000 other species hauled in each year by fishermen, whether from commercial trawlers or canoes, using estimates sent in by officials from individual countries.

For the past few years, researchers have been conducting analyses ▸

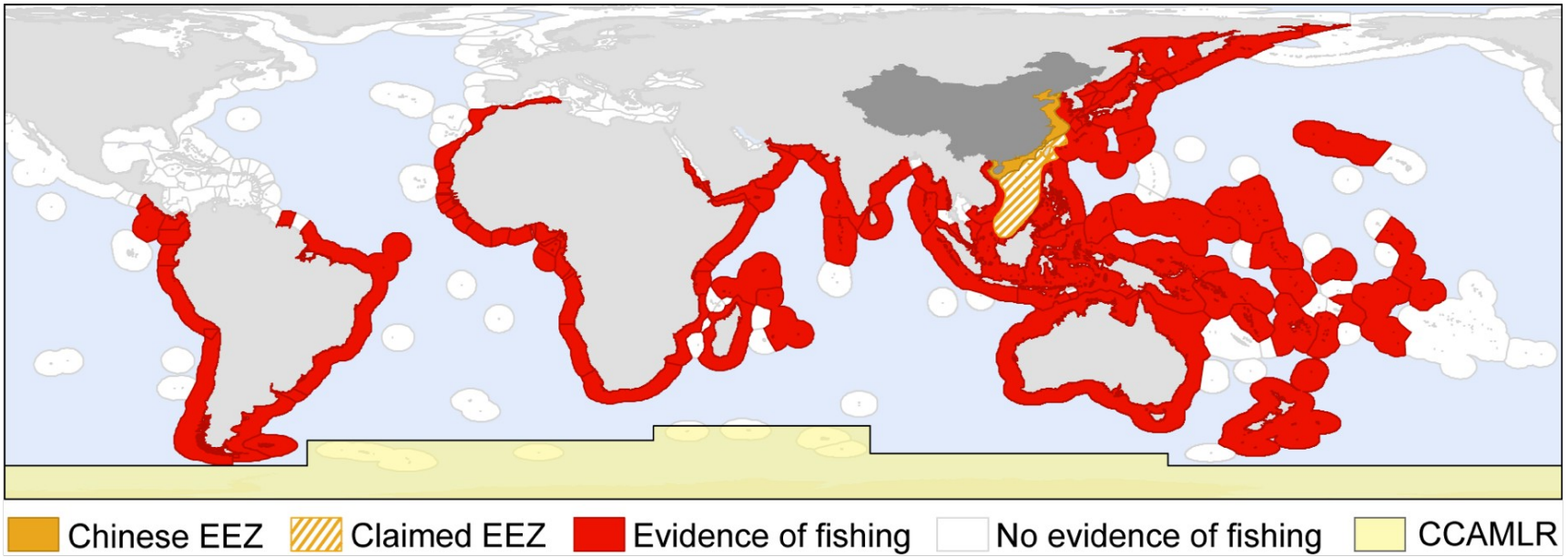
21 FEBRUARY 2013 | VOL 494 | NATURE | 303

Extent of the geographic bias in ‘global’ studies of fisheries status published by *Science*

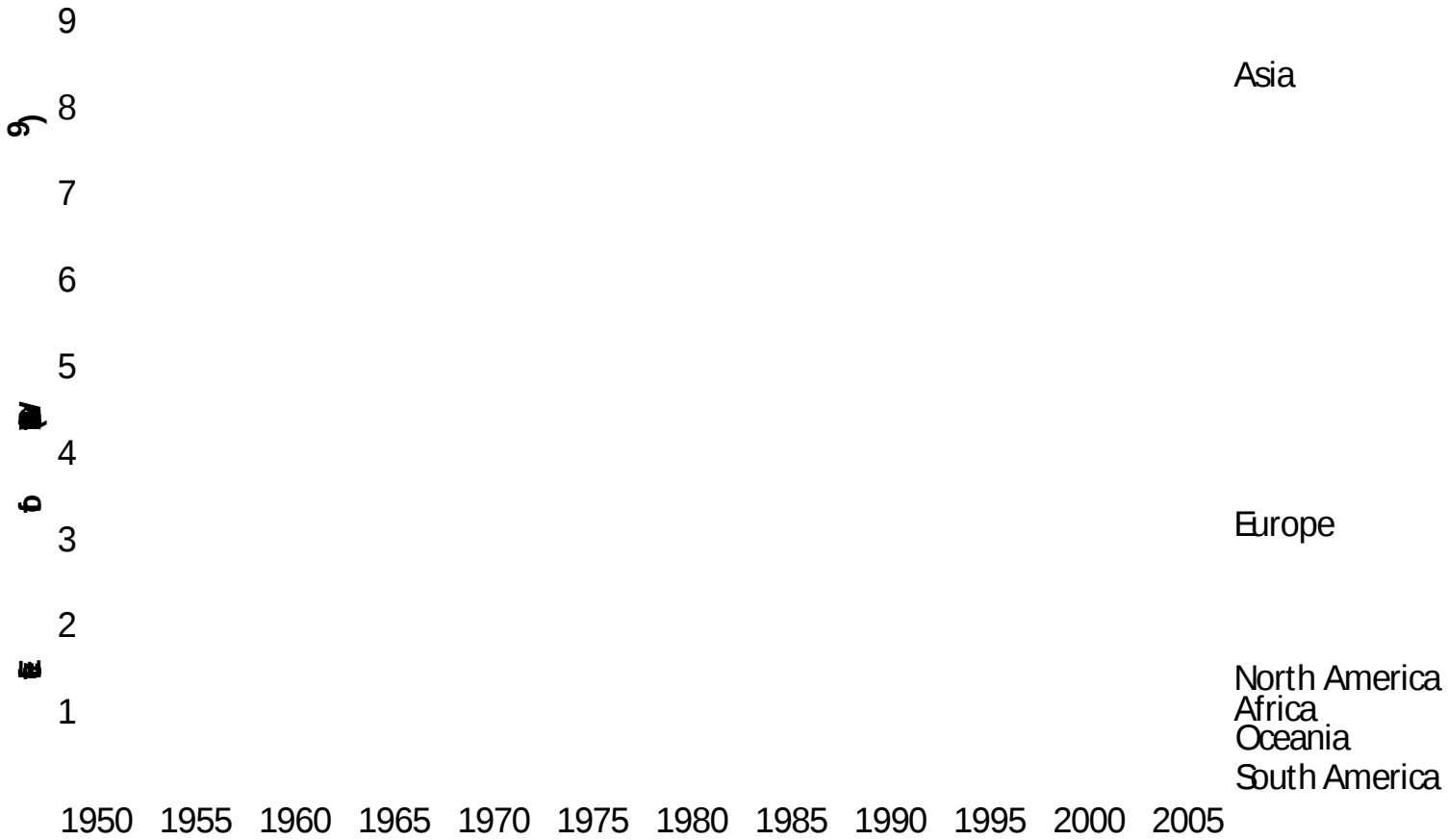


Based on an article by Worm, Hilborn et al. (Science, 2009)

Fisheries vessels from the People Republic of China operated in the EEZs of 93 countries in 2000-2000s



This is another reason why the non-US and non-EU world needs to be included in discussions about global fisheries: the growth of ‘effective’ fishing effort.



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

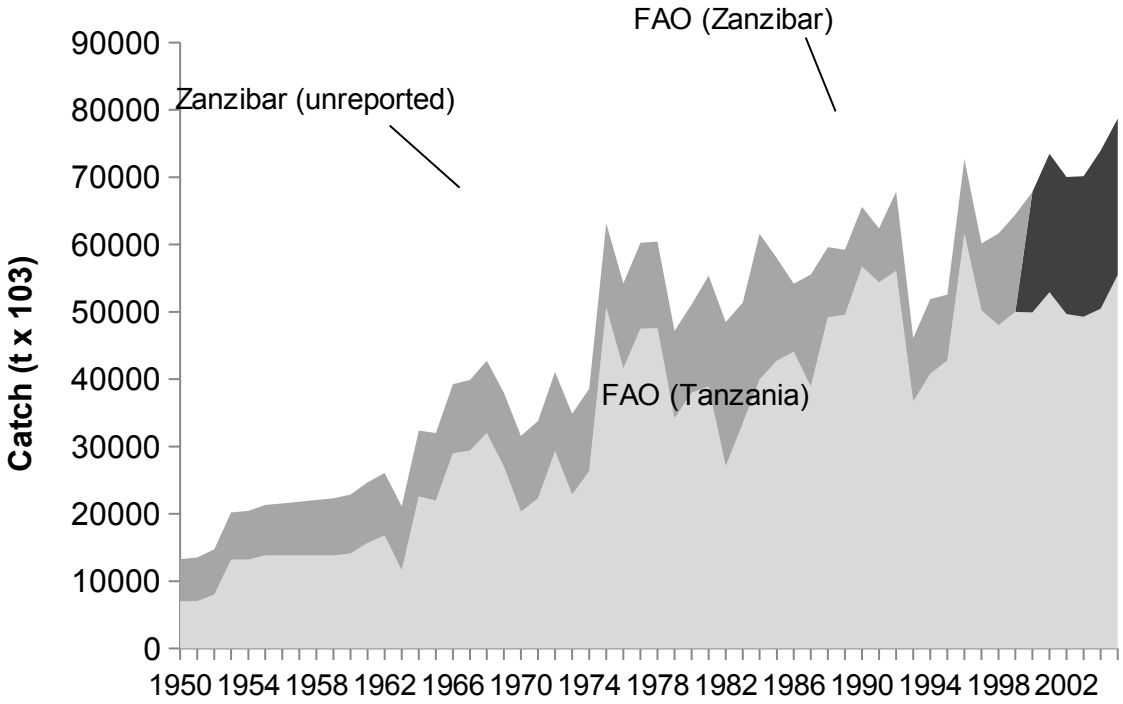
Official fisheries catches, as submitted by member countries to FAO are incomplete.

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

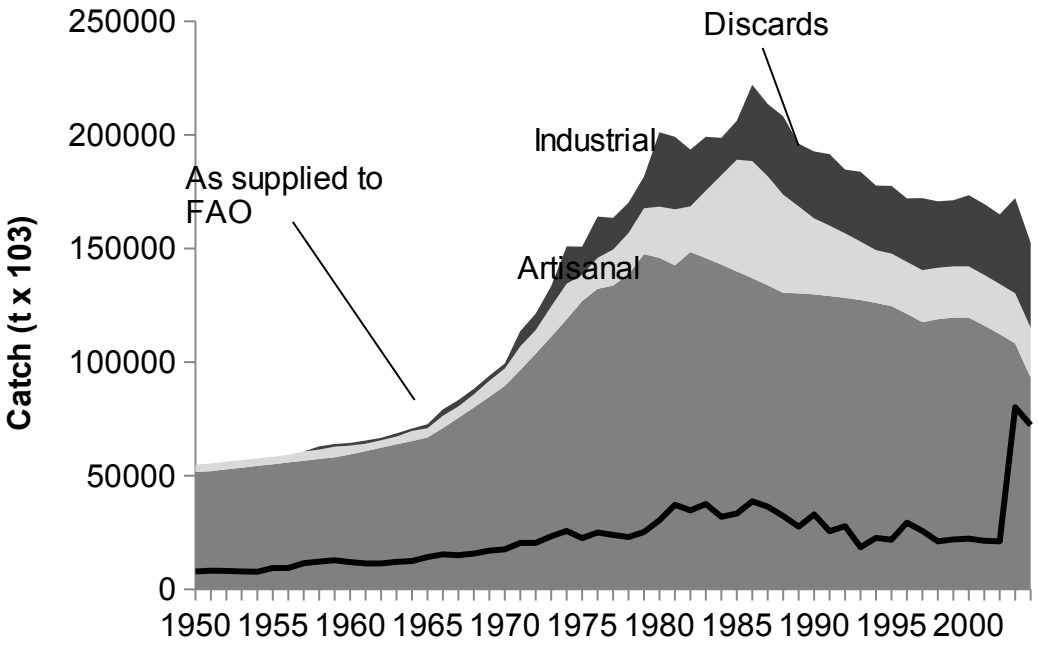
(ii) zero is never a good estimate for a positive number that is not precisely known.

Unreported artisanal catch from Zanzibar



FAO data for Tanzania covers only mainland Tanzania prior to early 2000s. Catches for Zanzibar were not included in FAO data until 2000 and were therefore reconstructed in the 1950-1999 time period. (Discovered by student after 1 week of work in Tanzania)

Mozambique: local to country-wide expansion

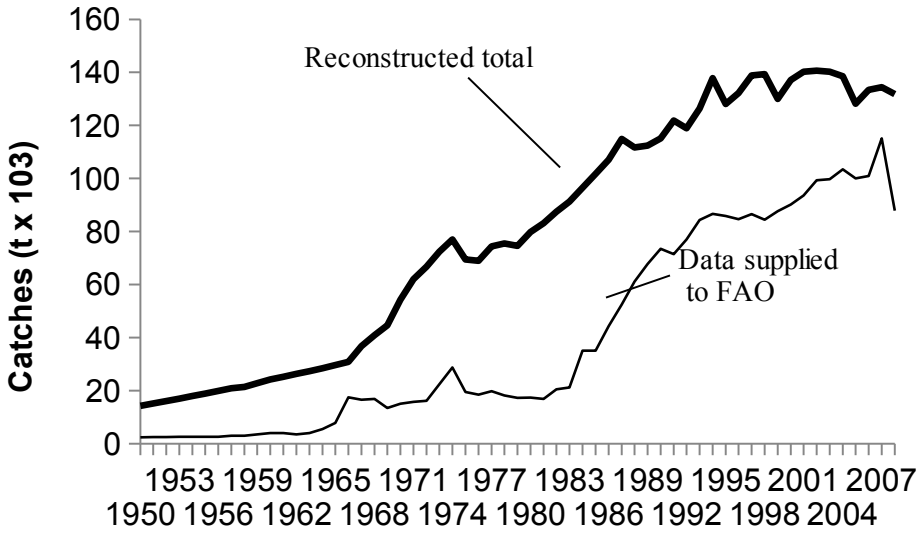


Mozambique, despite being an impoverished country, has an excellent system for estimating artisanal catches. However, estimates only account for 115 out of 540 landing sites, and completely miss two provinces, and most fishers.

(Jacquet *et al. Afr. J. mar. Sci.* 2010)

Madagascar: changes in reporting protocol

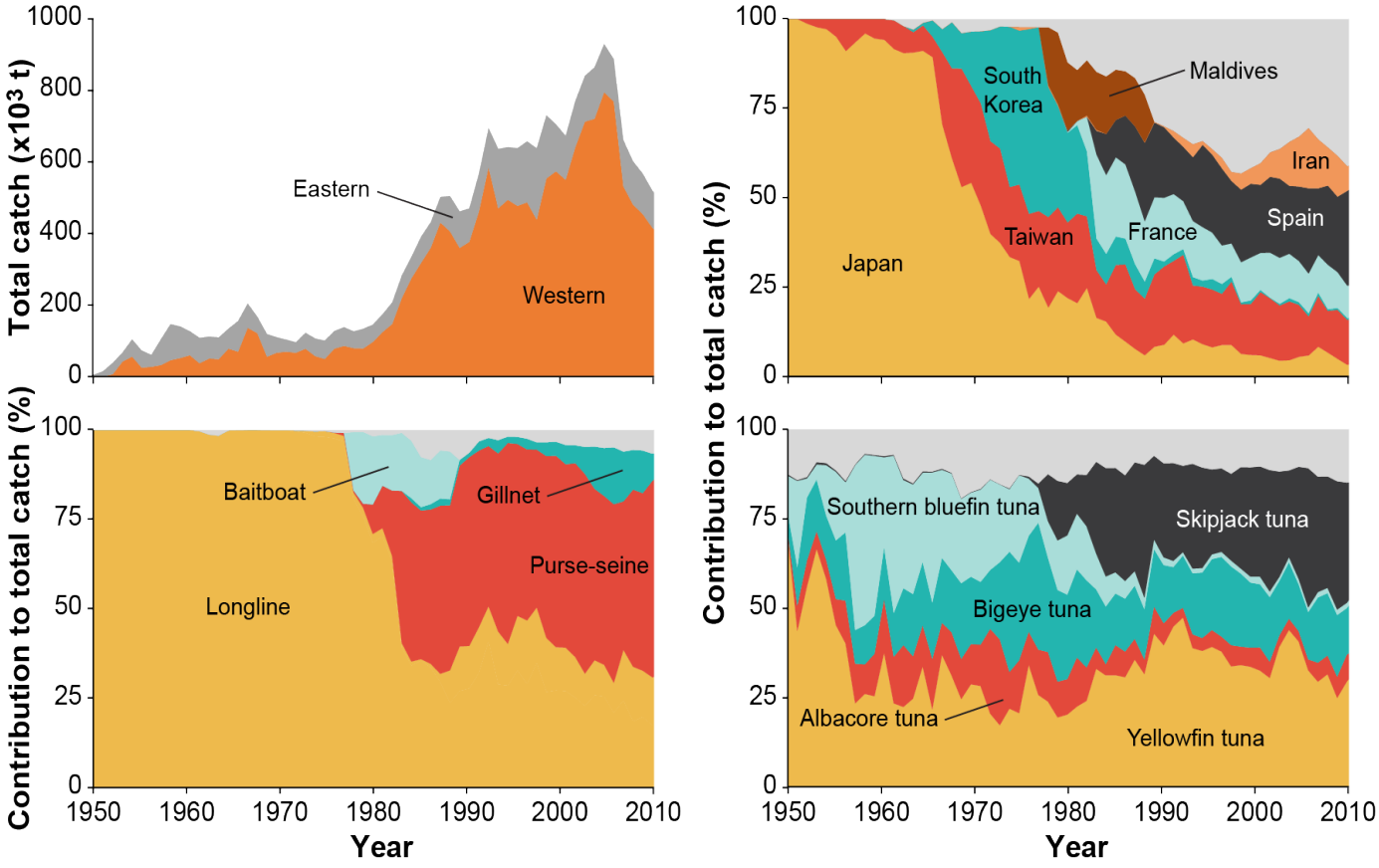
The sudden increase in the catch data supplied to FAO in the early 1980s is probably due to a change in reporting protocol. (Estuarine catches reported as inland catches in the early period, after which they were reported as marine catches, without retroactive adjustment).



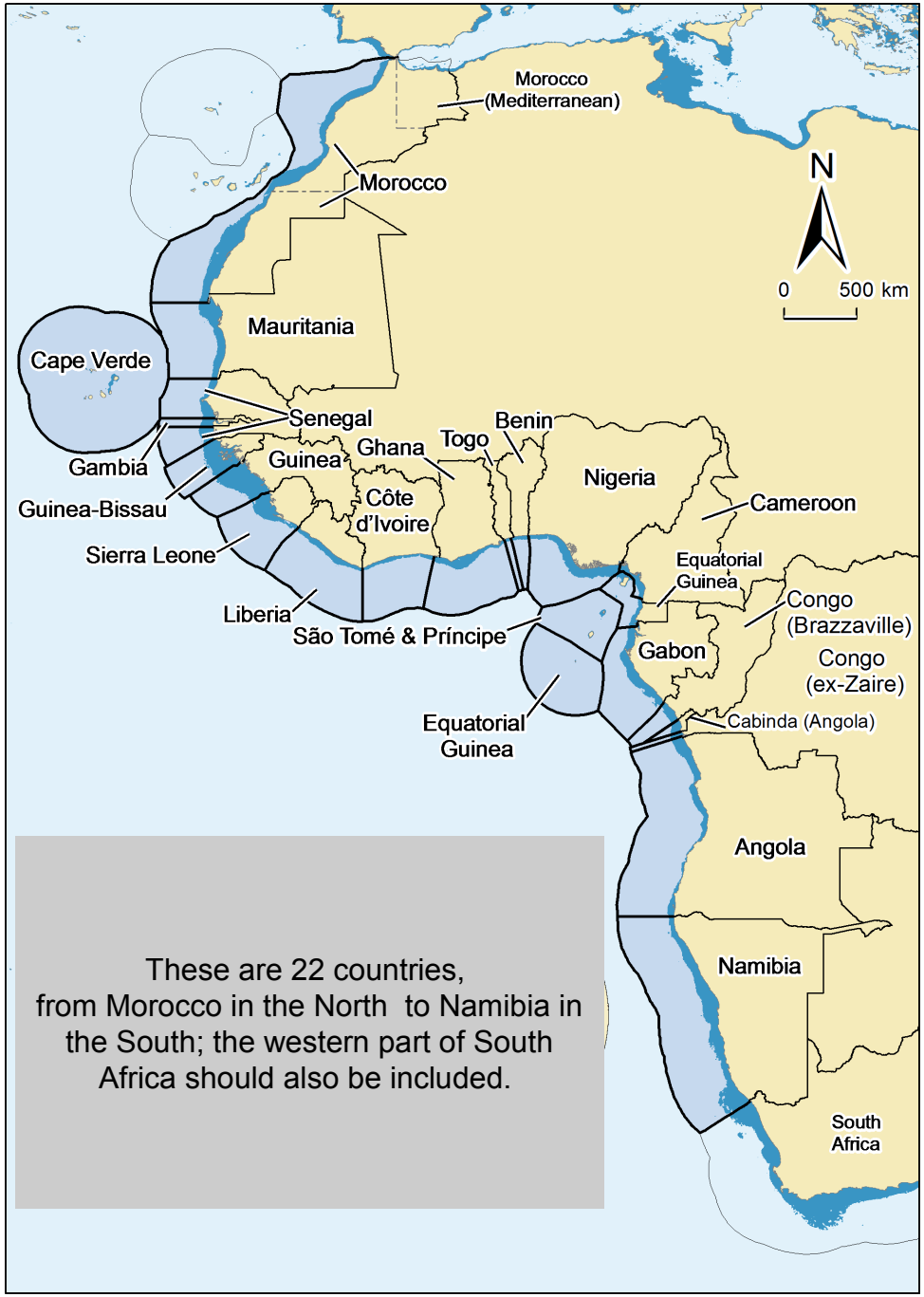
Le Manach *et al.* (*Marine Policy,* 2011)

We are currently working with Blue Ventures (an NGO) and staff of the Malagasy Ministry of Fisheries to verify and update our preliminary analysis

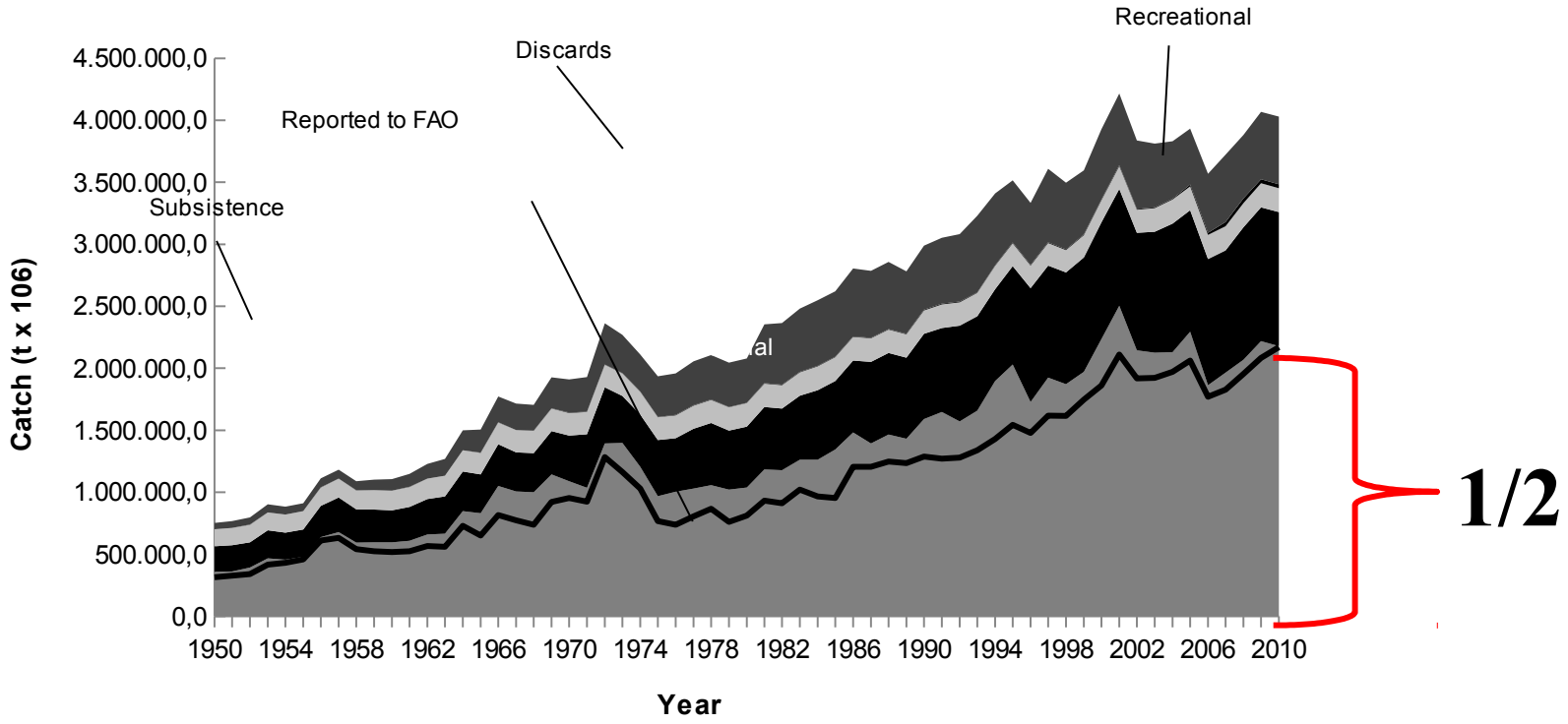
The major trend in Western Indian Ocean marine fisheries is for coastal countries to start their own fisheries for large pelagic fishes, thus competing against foreign fisheries which are already past their peak…



Now let's look at the countries in West Africa, as defined on this map.

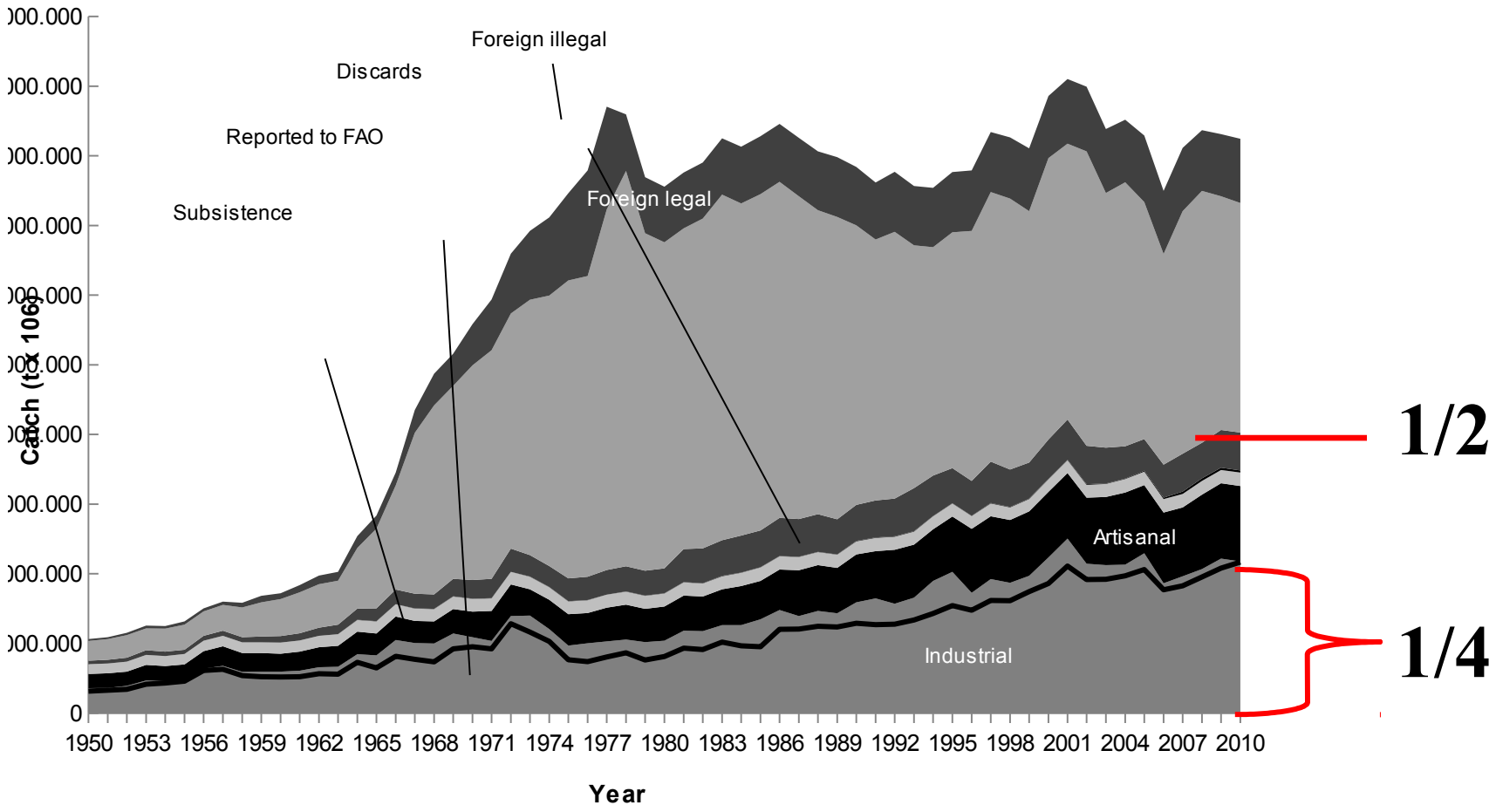


Total reconstructed catches for West Africa: domestic



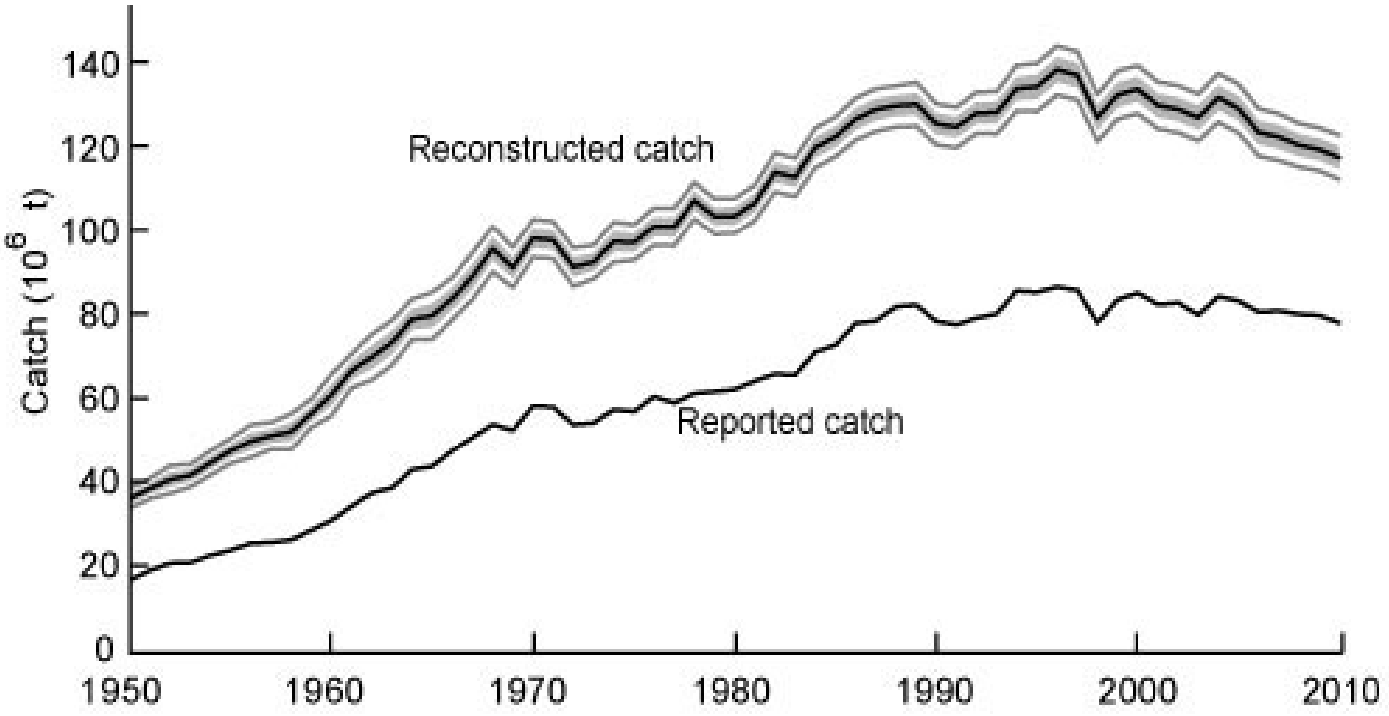
Belhabib *et al.* (*Environmental Development, in press*)

The major issue in West African marine fisheries in the pressure exerted by legal and illegal foreign fleets, which prevents the development of national fisheries



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

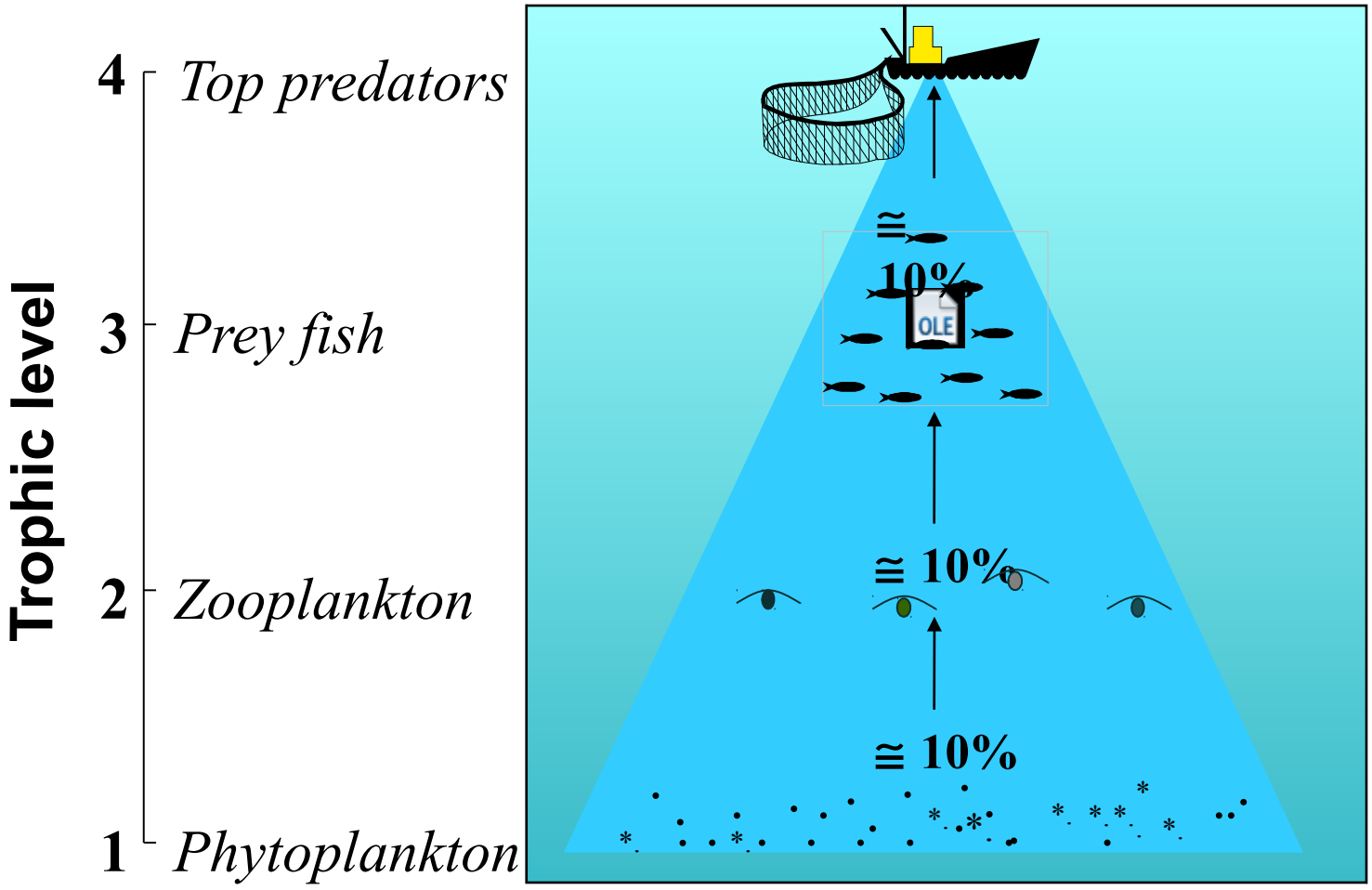
The reconstructions confirm that the world catch is declining; this trend is more marked that in the officially reported catch…



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

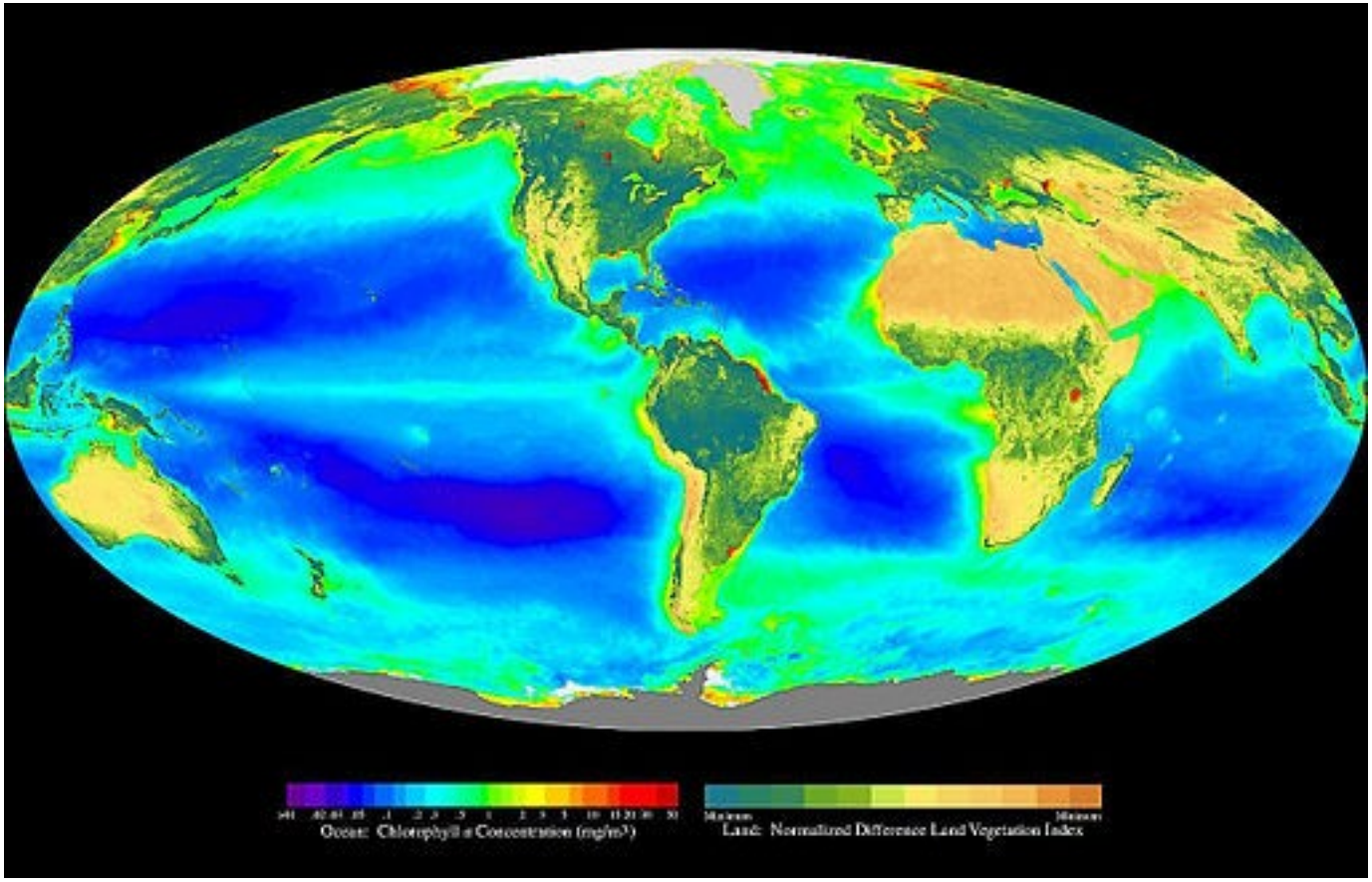
You can get details of the catches (landed or discarded) of all maritime countries of the worlds, by sector (industrial, artisanal, subsistence, recreational), by countries and by taxon at www.seaaroundus.org

Now recall that ecosystem fluxes move up ‘trophic pyramids,’ and each species tends to have its own trophic level…



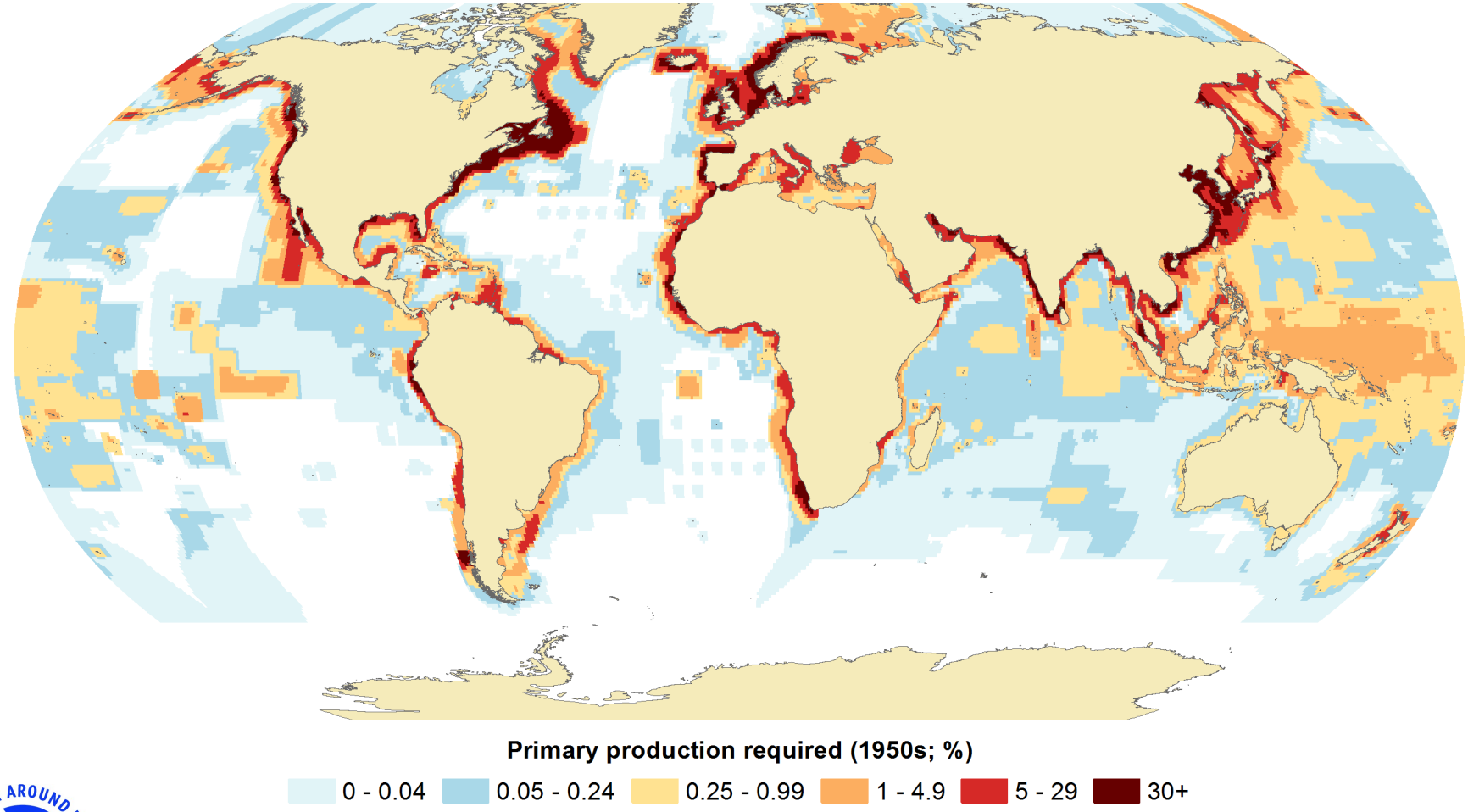
Pauly and Christensen (*Nature,* 1995); trophic levels from FishBase and SeaLifeBase

Now 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…



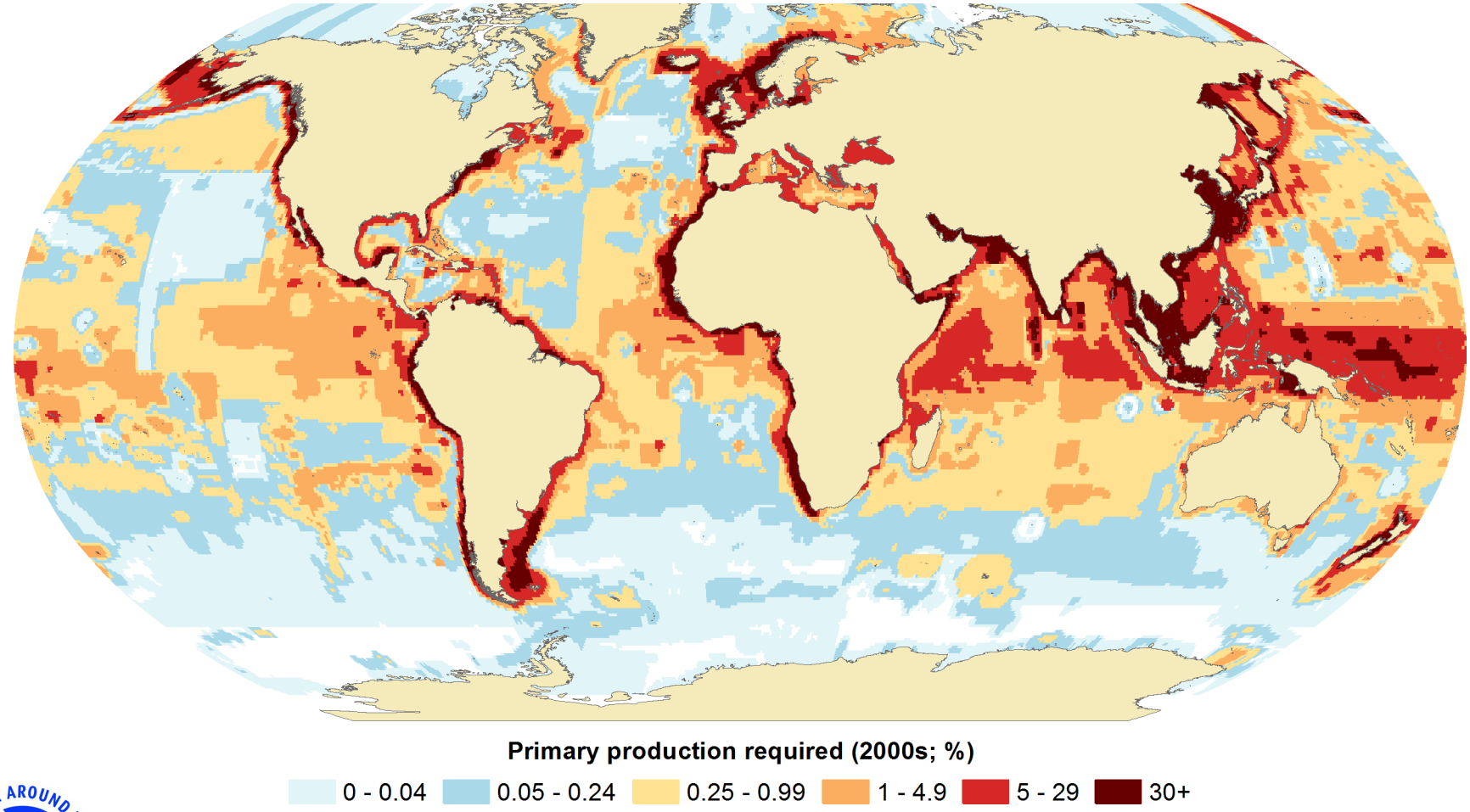
SeaWiFS data, NOAA

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



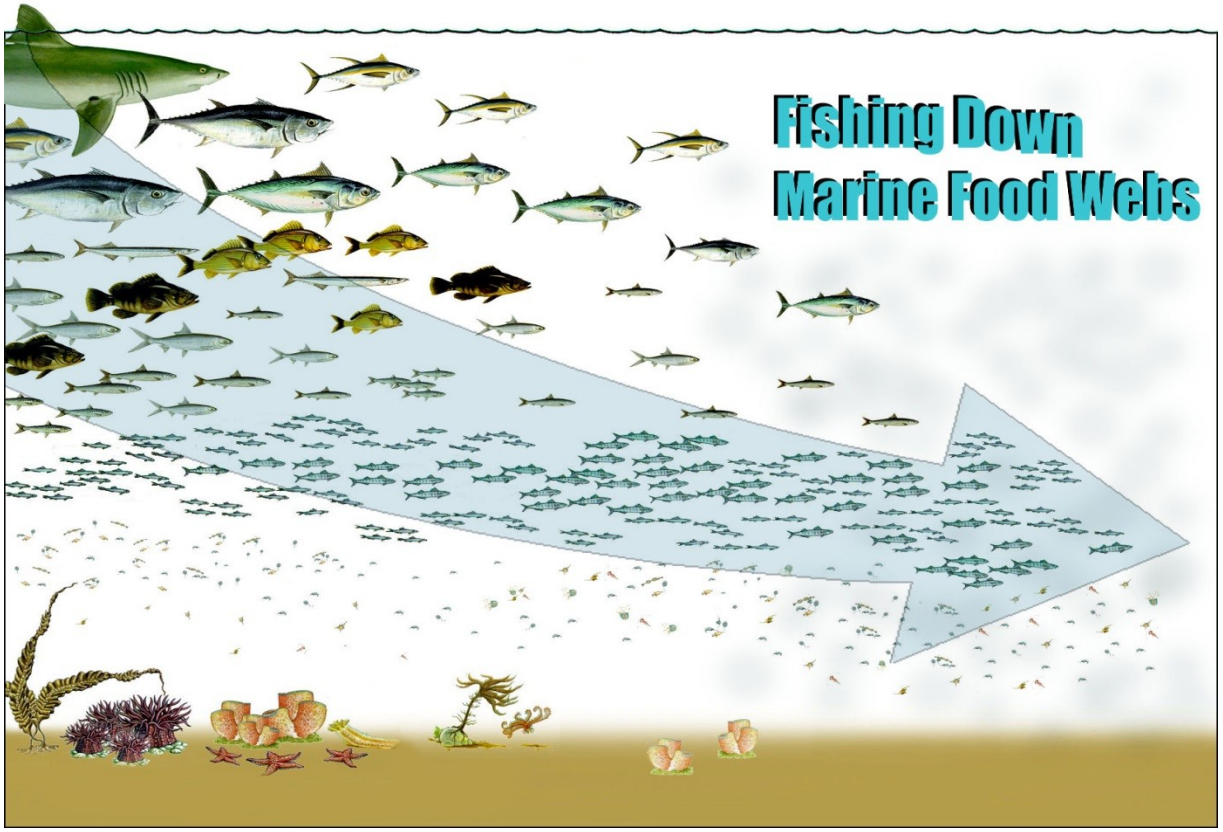
see www.searoundus.org

…and in the 2000s…



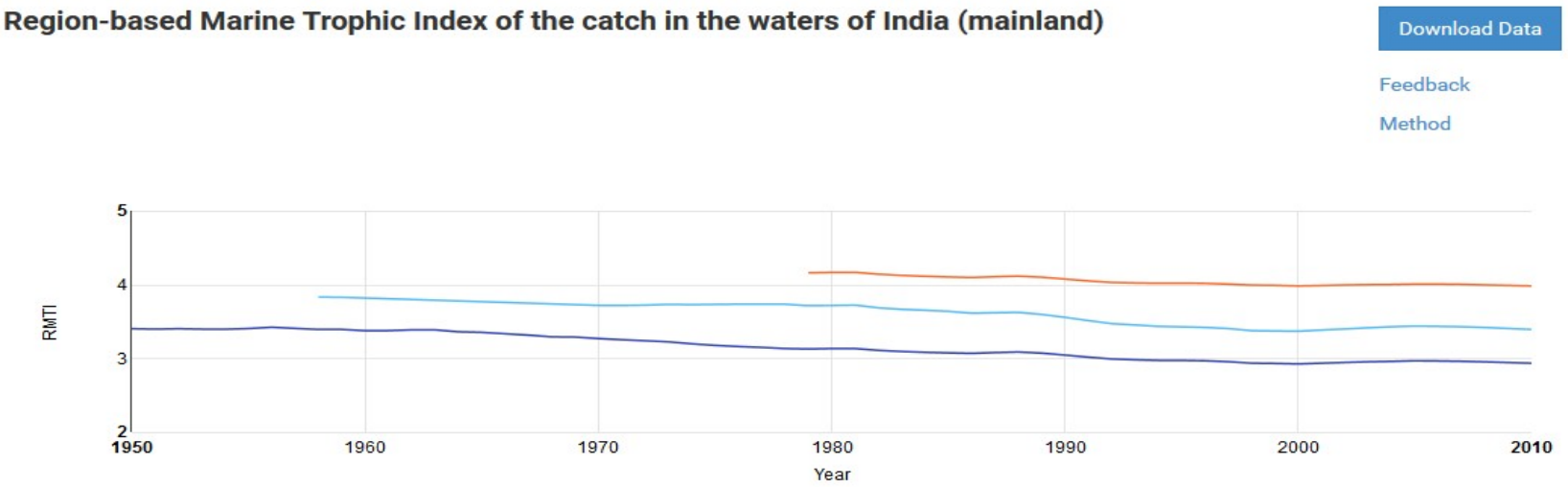
see www.searoundus.org

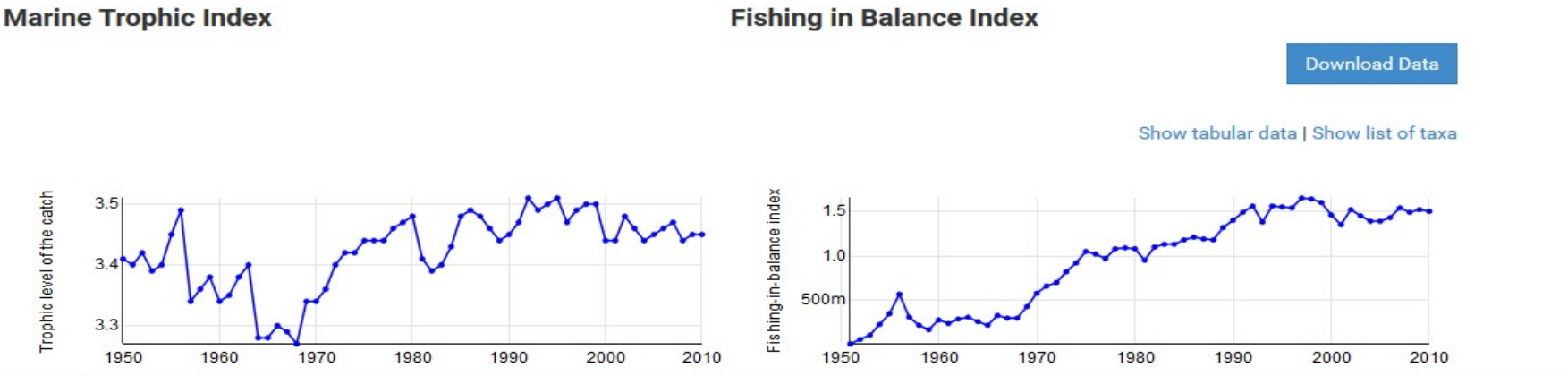
All this fishing causes a phenomenon now know as ‘Fishing down marine food webs’



see www.fishingdown.org

Now, ‘Fishing down’’ can be shown to occur even when it is masked by the offshore movements of fleets…

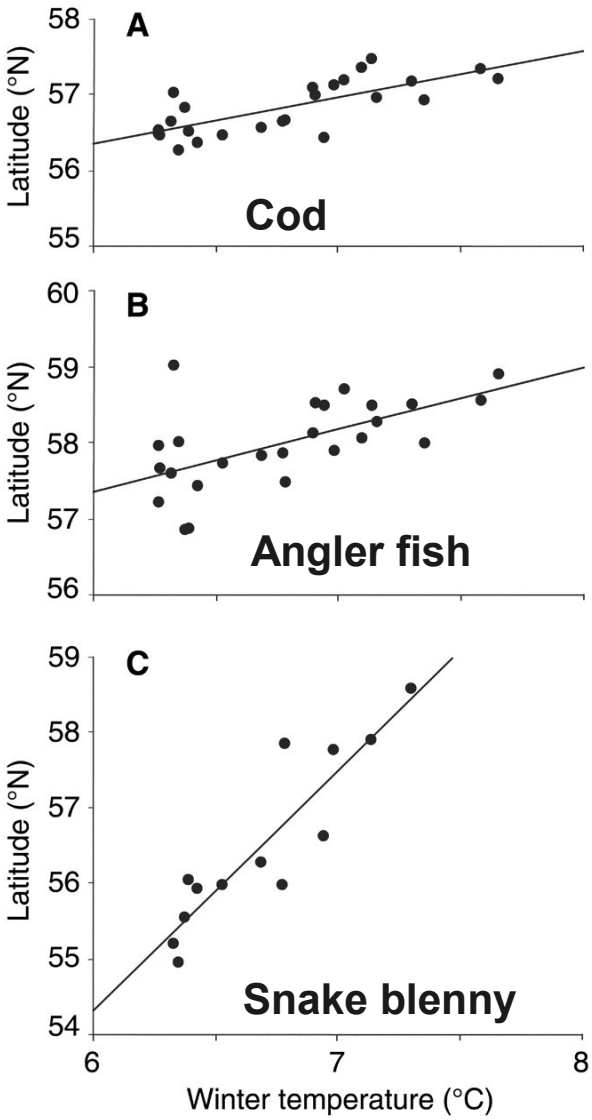


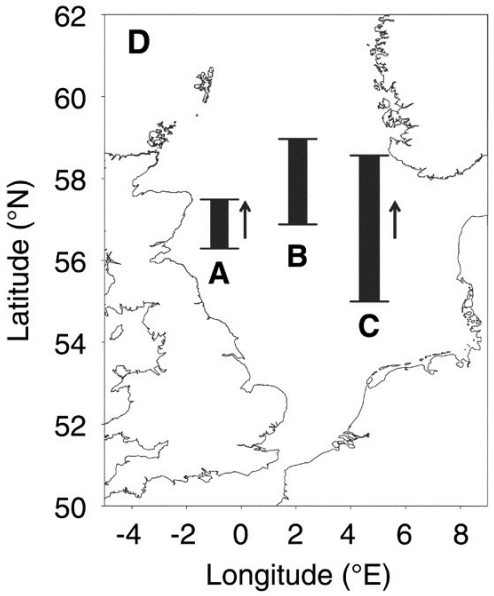


See Kleisner et al. (2014, MEPS)

Observed climate-induced shifts in distribution ranges

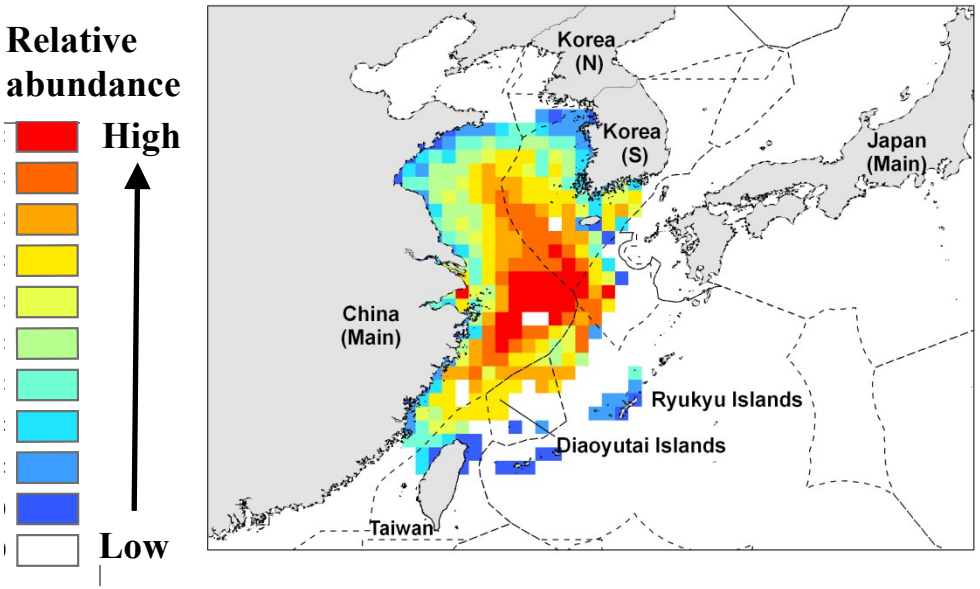
Poleward shifts in distribution ranges of marine species, e.g., in the North Sea (Perry *et al. Science,* 2005).



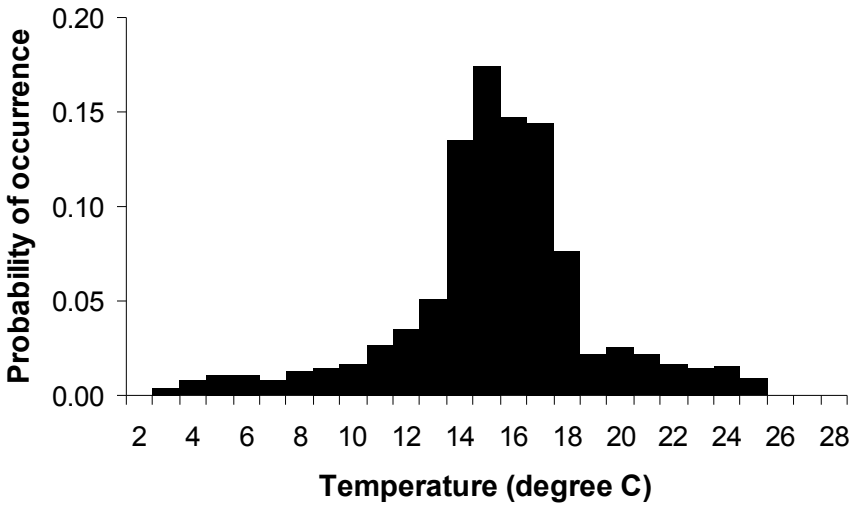


Simulating poleward shifts using temperature-abundance profiles inferred from distribution range maps derived from FishBase and SeaLifeBase…

Small yellow croaker
(*Larimichthys polyactis*)



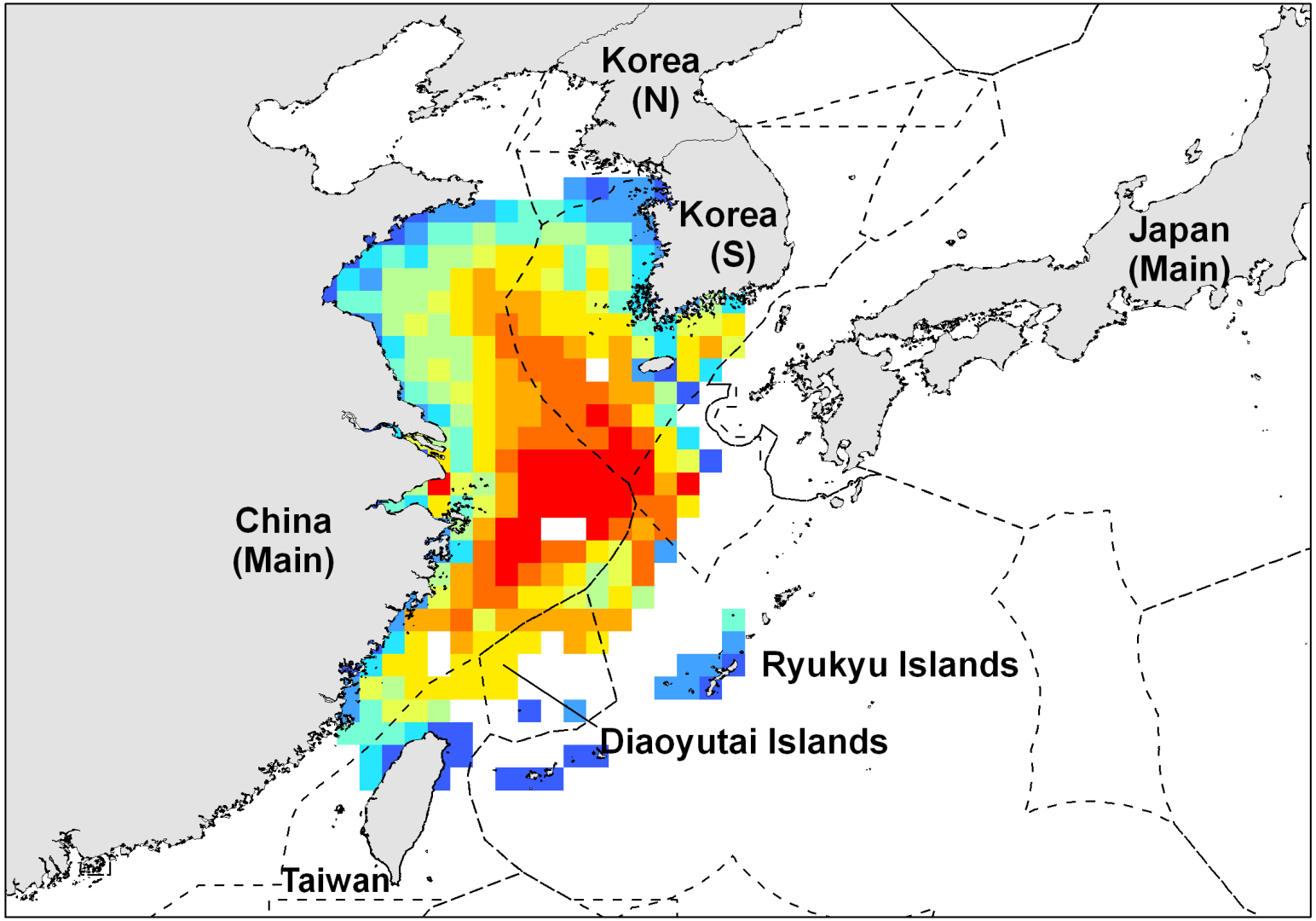
Probability of occurrence by water temperature



Cheung, et al. (*Marine Ecology Progress Series 2008*).

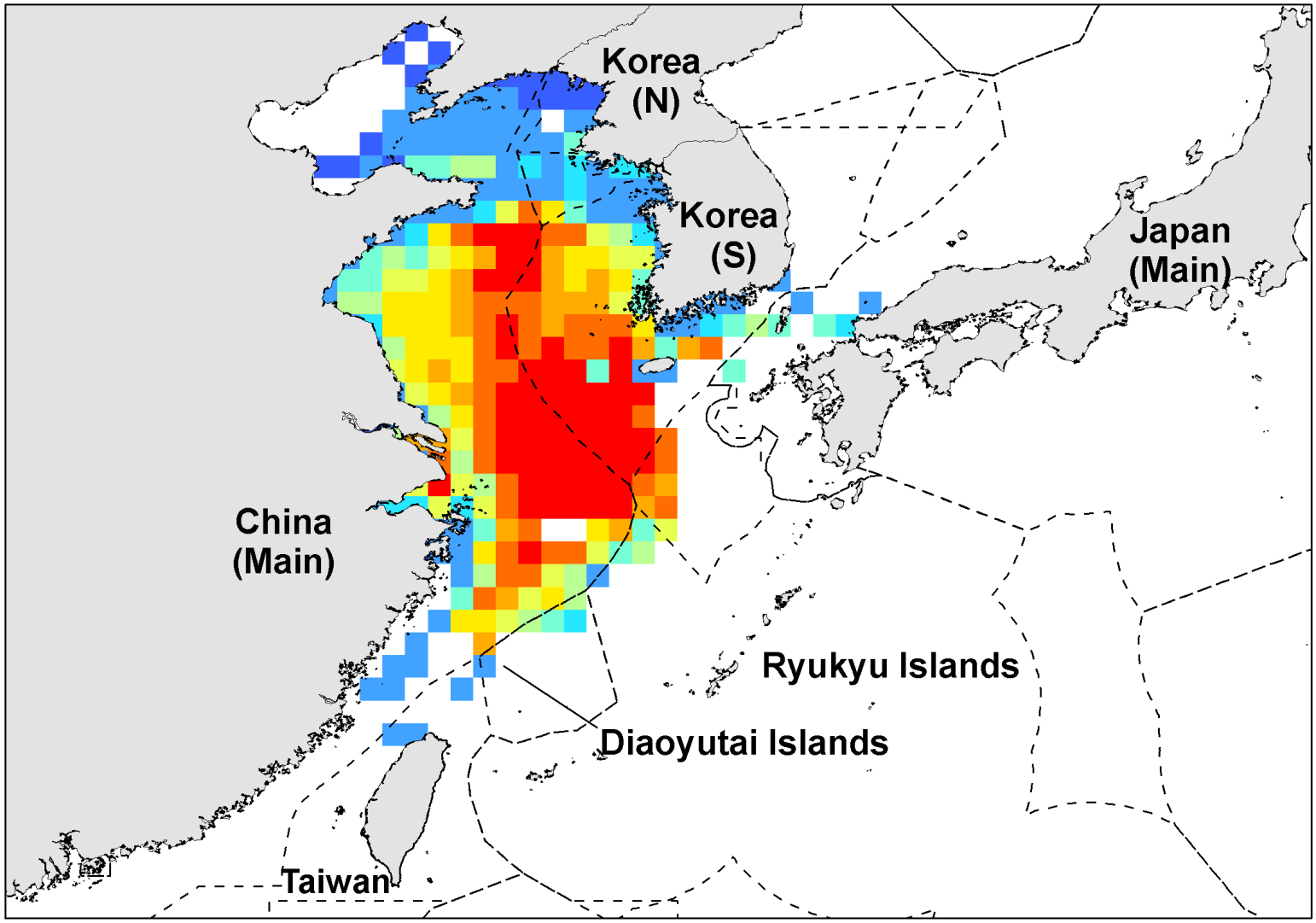
Small yellow croaker

Year 0

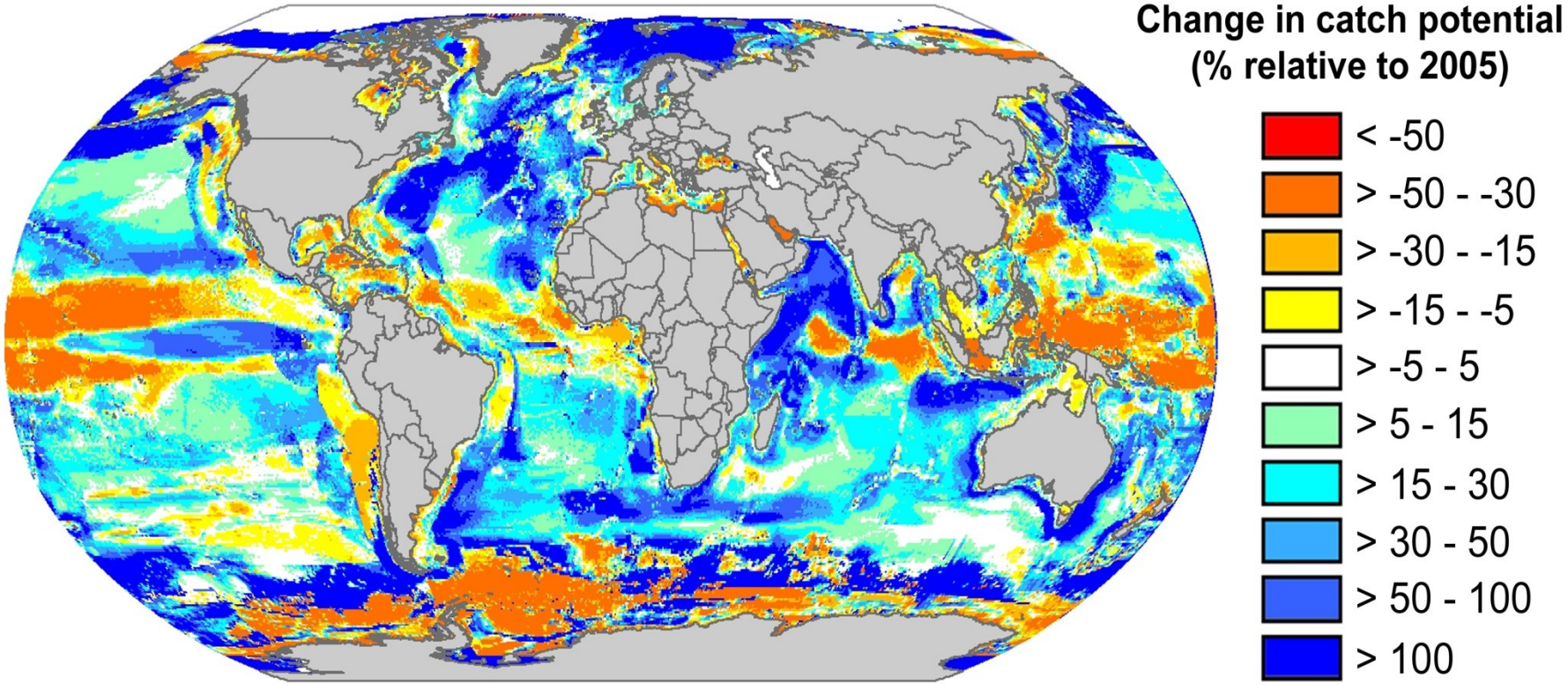


Small yellow croaker

Year 30

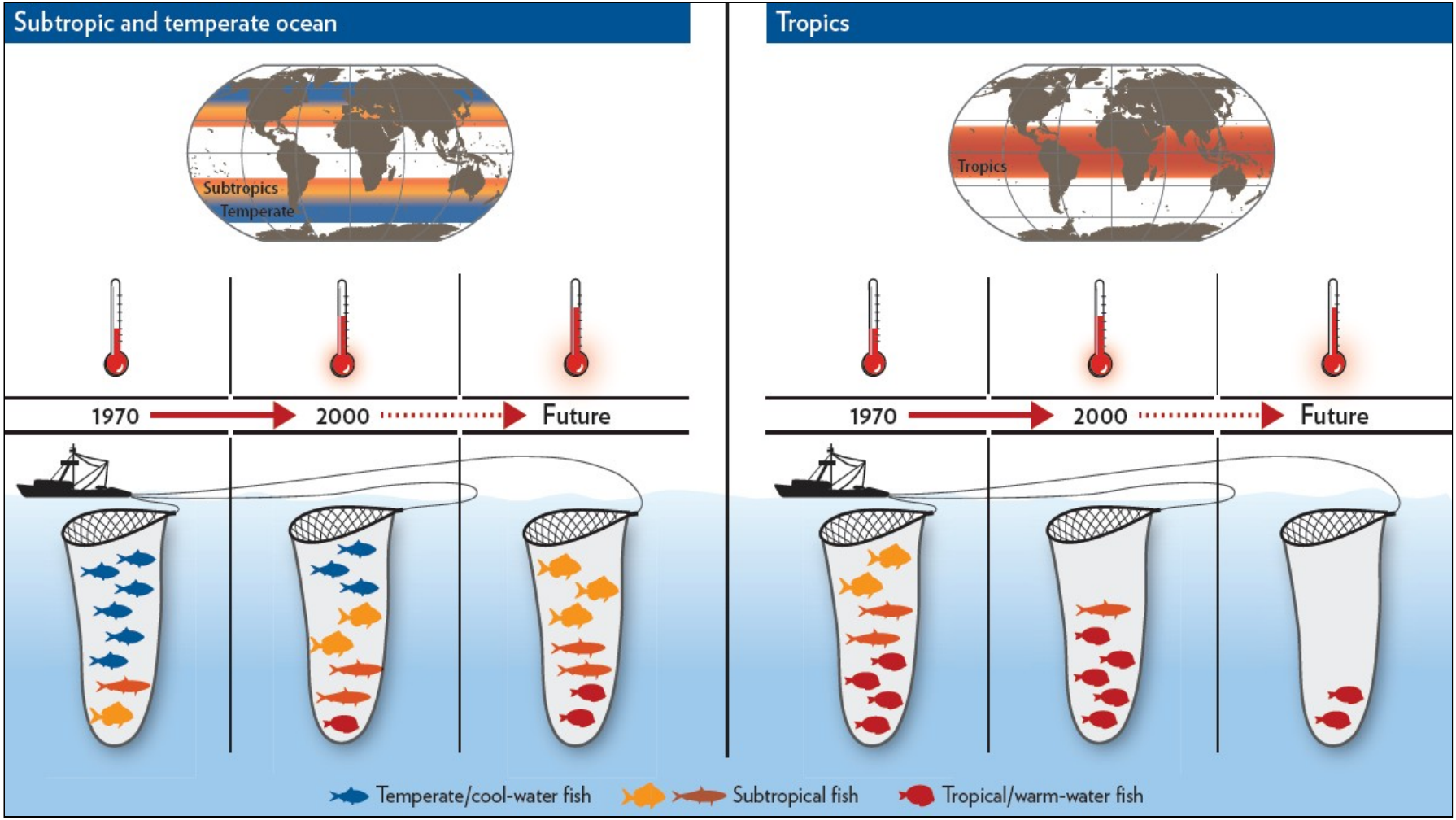


Projected change in catch potential in 50 years



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)

Overall, fisheries researchers and marine science educators in the Western Indian Ocean region will benefit from using data and tools from the following free websites, which cover their countries:

FishBase: an online encyclopedia of all fishes (www.fishbase.org), which also contains an online course in ichthyology;
SeaLifeBase: similar to FishBase, but for non-fish vertebrates, and invertebrates (www.sealifebase.org);
Sea Around Us: a website which contains detailed catch time series and fisheries status indicators for all maritime countries and territories of the world (www.seaaroundus.org)
Fishing down: a website devoted to the fishing down phenomenon (www.fishingdown.org)

Happy research!

Acknowledgements…

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THE PEW CHARITABLE TRUSTS

THE PAUL G. ALLEN FAMILY FOUNDATION

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- Thanks to all members of the *Sea Around Us,* past and present…

… sorry, I ran out of pictures….

and thanks to many other colleagues

SEA AROUND US

visit us at **www.seaaroundus.org**