



Challenges for critically engaged young ocean researchers

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Structure of the talk

- What is biodiversity?
- Principal pressure factors
- Research in support of implementing international commitments
- Some sources & invitation to act

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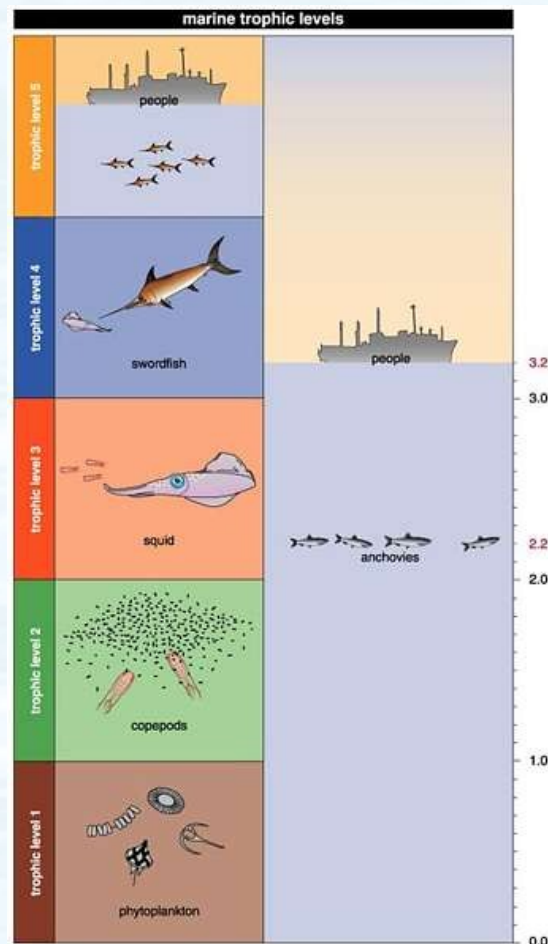
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Biodiversity

The 1992 United Nations Earth Summit in Rio de Janeiro defined "Biodiversity" as

"the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part : this includes diversity within species (genetics), between species and of ecosystems"

Each species belongs to an ecosystem



- At the basis are primary producers transforming solar energy into organic matter – we already use >25% of the total
- All other organisms in successive trophic levels are consumers – Transfer rates average 10%, but upwelling systems have much lower ones
- Schematic representation with the Peruvian anchovy fishery to the right

Science searches for general principles rather than *ad hoc* interpretations

- Fish & other gill-breathing organisms have growth patterns constrained by the gas-exchange surfaces as bodyweight increases to the power of 3 (Pauly, 1979)
- Cold water contains more dissolved O₂
- The same species thus achieves higher max. size in cold water than in warmer water – expected effects for climate change
- Some 25 years ago, experts estimated the existence of 20,000 species of fish
- Today, 32,000 species are documented at: www.fishbase.org
- >7,000 fish species are used by humans
- >123,000 marine organisms (non-fish) of >250,000 estimated, are documented in www.sealifebase.org - lots remains to be done

Tropical waters are particularly species rich...



Parablennius gattorugine
Ceanruán Rocach • Tompot Blenny

P. Ryan

- Interactions between species are multiple; species' biomasses are smaller in tropical than in temperate waters
- The centre of marine biodiversity is Indonesia
- Big specimens enhance productivity – e.g. through iron fertilisation in Antarctica (Nicol *et al.*, 2010)

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Pressure: pollution (1)



- Abandoned nets continue **ghost fishing**, e.g. marine mammals, birds and reptiles
- **Chemical products** (non-point agricultural pesticides, industrial discharges, sun shields ...) accumulate along the foodweb and have effects we are only starting to understand
- Five gyres of **plastic pollution** threaten marine life

Pressure: pollution (2)



Home About Eutrophication Interactive Map Resource Library Gallery News & Events

Interactive Map of Eutrophication & Hypoxia



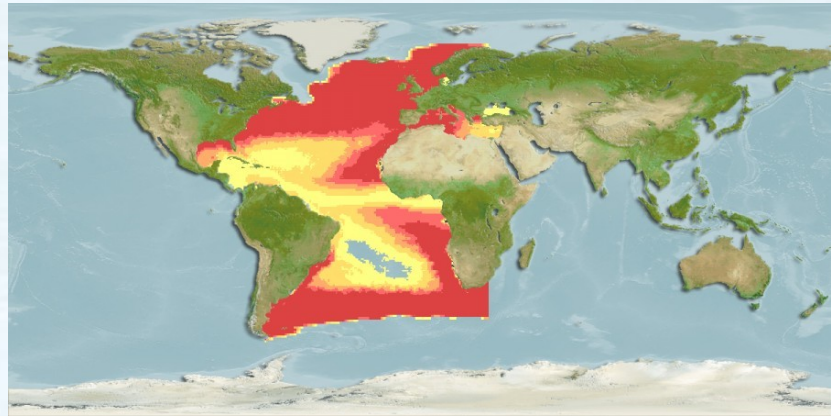
Fertilisation, particularly of semi-enclosed seas (e.g. Gulf of Mexico, Baltic, Black Sea), through agricultural run-off and insufficiently treated household effluents introduces excess nitrogen and phosphorous leading to **eutrophication** which in turn provokes plankton blooms and eventually hypoxia.

WRI compiled information on 228 sites around the world

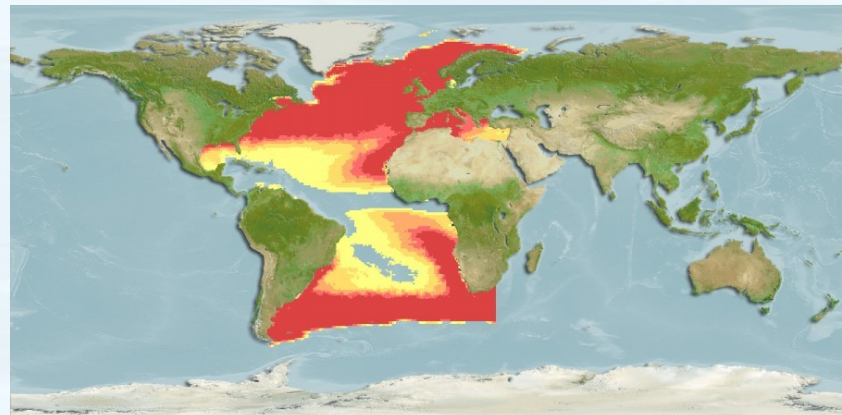
Acidification of the oceans is still poorly understood but happening, affecting particularly species with calcareous exoskeletons

Climate change

- **Climate change** is expected to affect poleward expansion of distribution ranges and potentially increased catches, but reductions in tropical areas – distribution of winners and losers
- **Reduced dissolved oxygen** will lead to increased stress for gill-breathing organisms



Bluefin tuna – present distribution



Bluefin tuna – estimated distribution in 2050

Invasive species



- 84% coastal zones have at least one **invasive species**
- 57% of marine species documented as invasives are considered harmful, e.g. the ctenophore (*Mnemiopsis leidyi*) introduced in the 1990s in the Black Sea; Chinese mitten crab (*Eriocheir sinensis*) in the US.
- **Pathways**: deliberate, accidental e.g. through ballast water of ships, escapes from aquaculture etc.

Humans

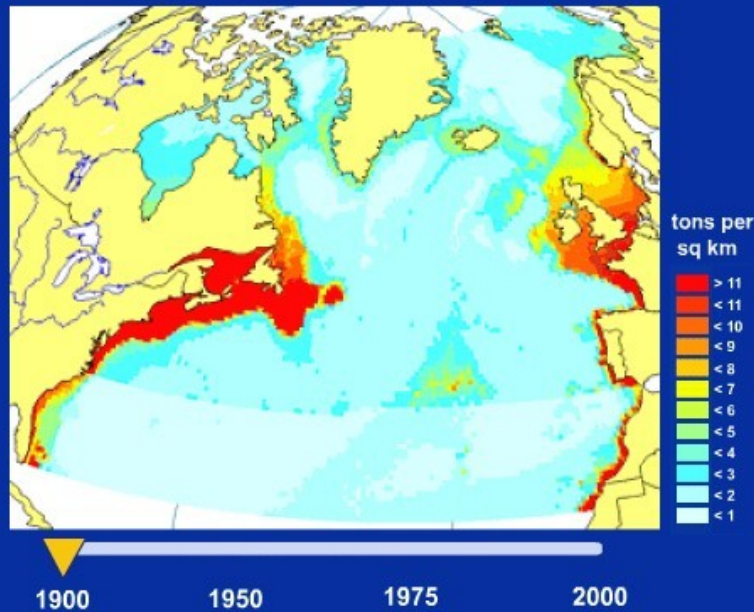


Gambian coast in 1980s;
today urbanisation and
tourism create conflicts
about access to coastal
lands and the sea

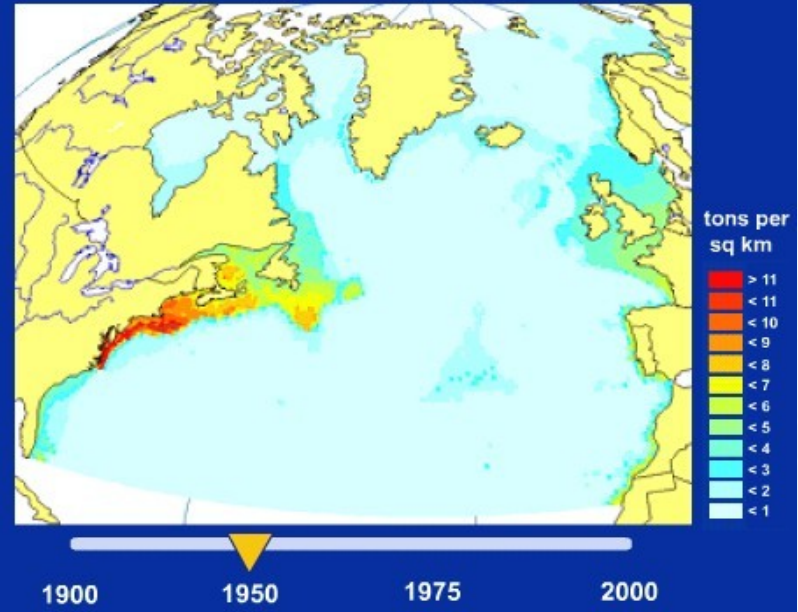
- We are **almost 7 billion humans**
- Many European citizens live comfortable lives, but to generalise this to all, it would take 4 Earths;
- In comparison, >1 billion people are not properly nourished
- Nobody 'planned' poverty and climate change – the tyranny of small decisions

Effects of overfishing on the biomasses of big fish (1)

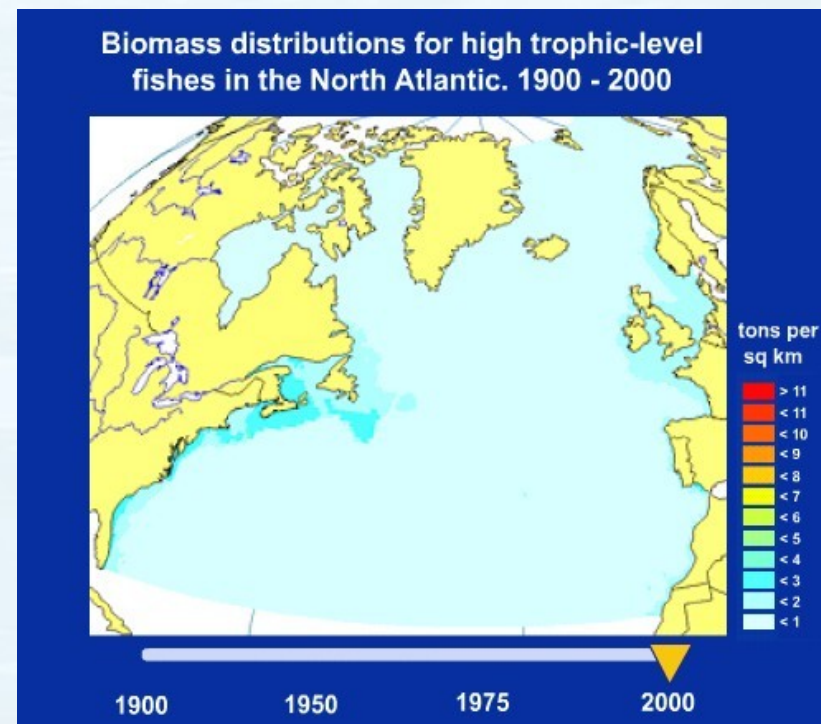
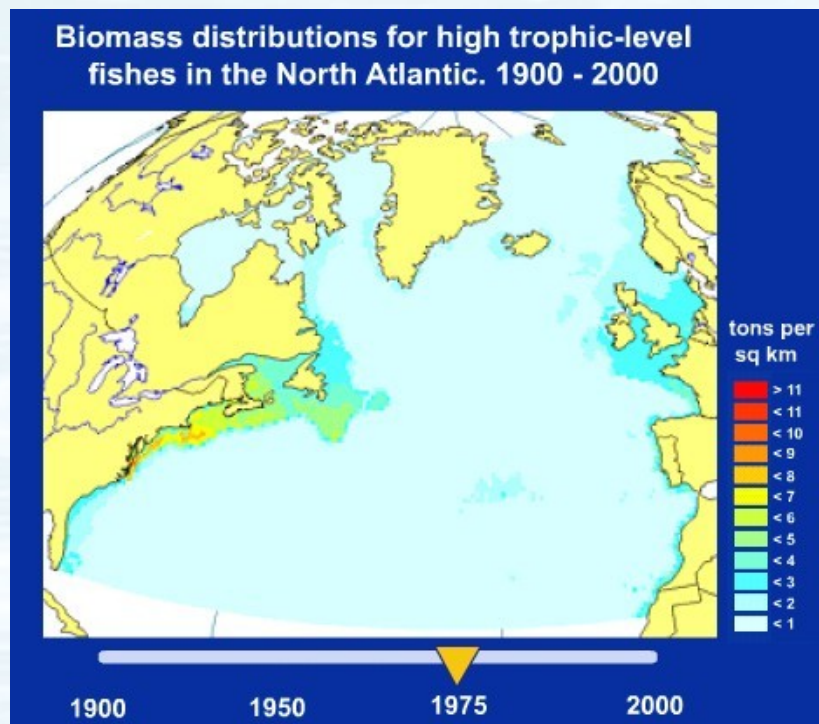
Biomass distributions for high trophic-level fishes in the North Atlantic. 1900 - 2000



Biomass distributions for high trophic-level fishes in the North Atlantic. 1900 - 2000

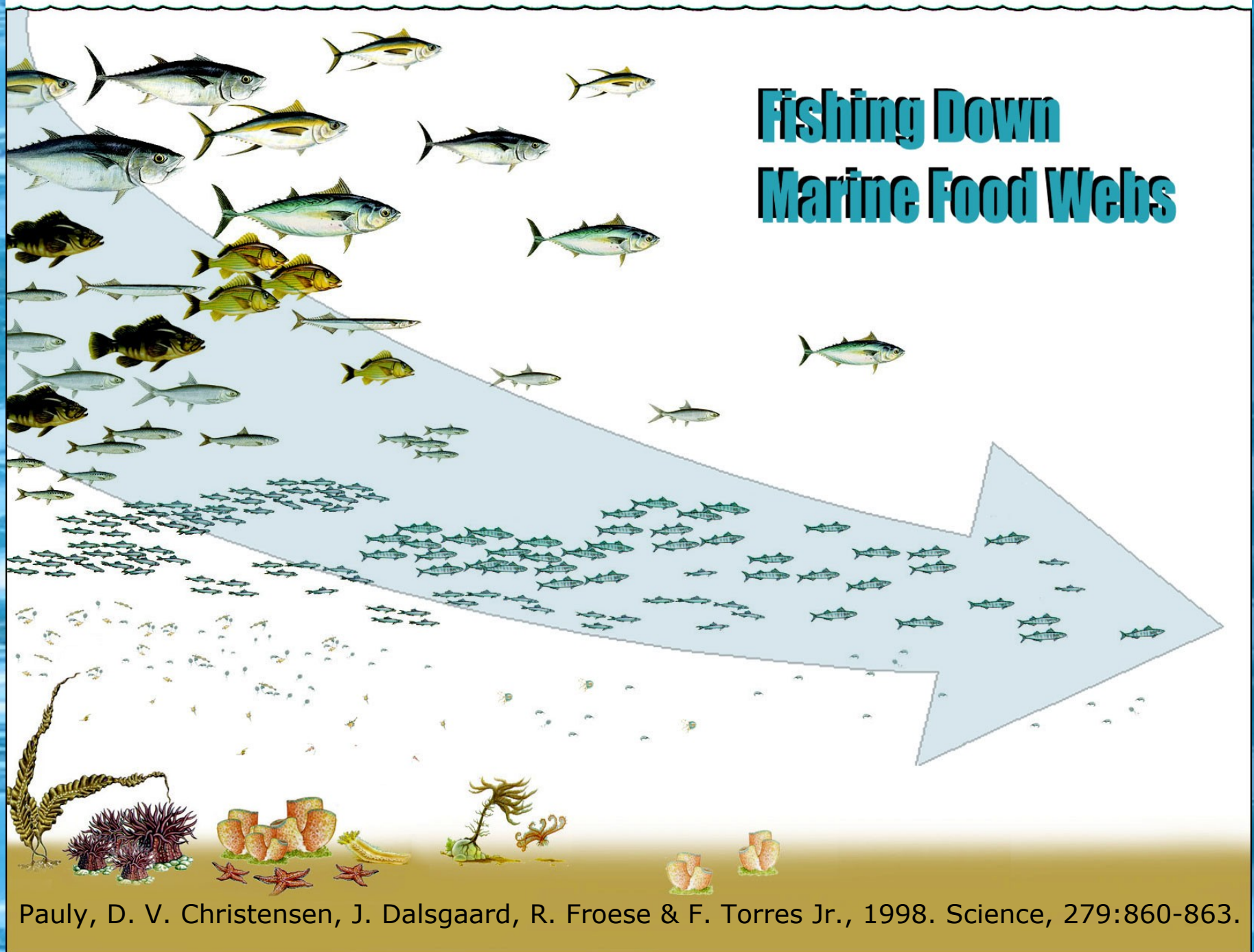


Effects of overfishing on the biomasses of big fish (2)



Christensen *et al.*, 2003. Hundred-year decline of North Atlantic predatory fishes. *Fish and Fisheries*, DOI: 10.1046/j.1467-2979.2003.00103.x

Fishing Down Marine Food Webs



Pauly, D. V. Christensen, J. Dalsgaard, R. Froese & F. Torres Jr., 1998. *Science*, 279:860-863.

Overfishing



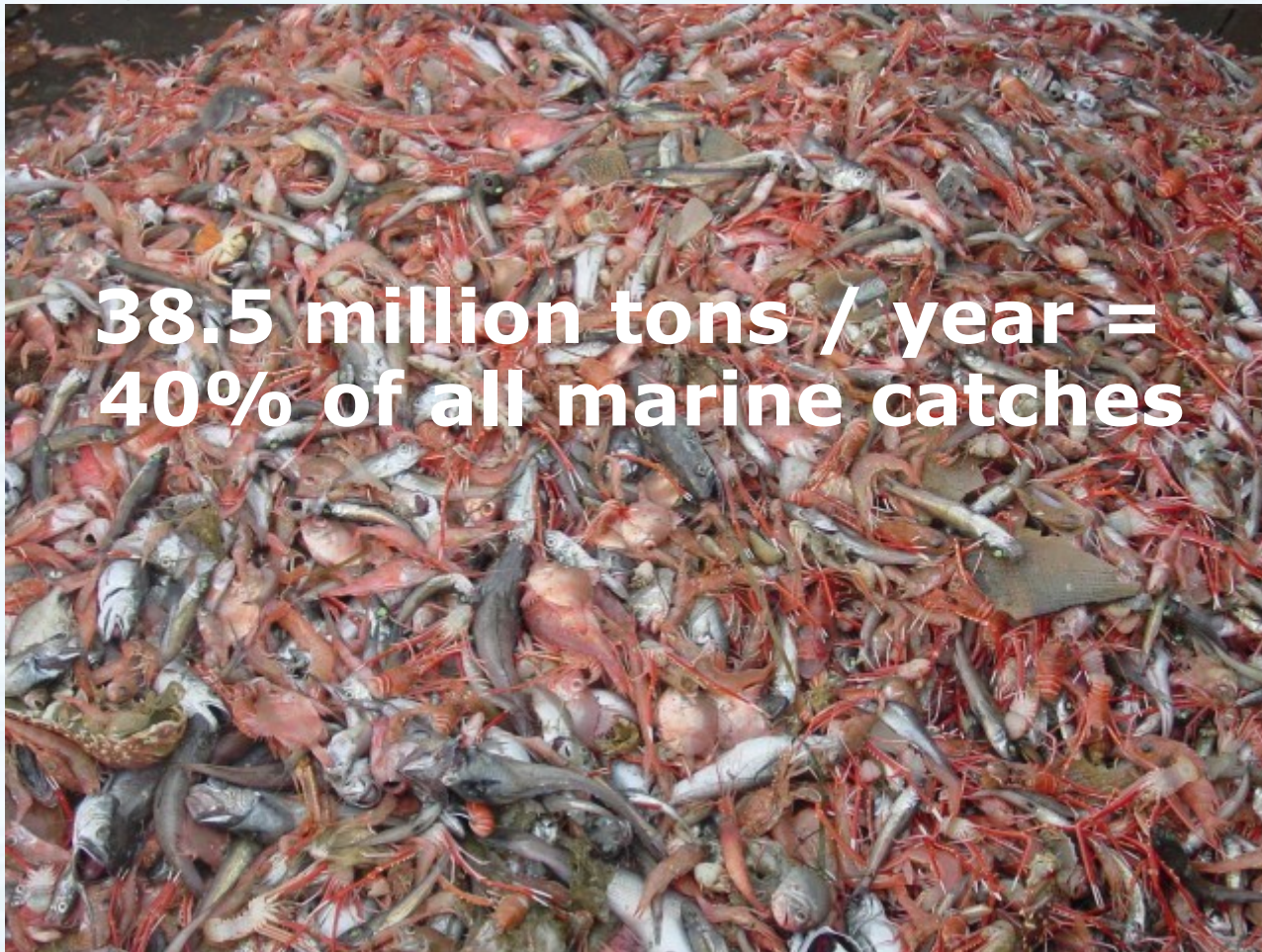
At current trends the fisheries we know will be gone by 2050 (Worm *et al.* 2006, Science DOI: 10.1126/science.1132294); many are gone already.

Namibia, a country in Southwest Africa, had an estimated **15 million tons of fish biomass** which could have sustained good catches.

Overfishing led to the collapse of this resource, now Namibia has an estimated **12 million tons of jellyfish** and much less fish (3.8 million tons) to go around.

Lynam *et al.*, 2006. Jellyfish overtake fish in a heavily fished ecosystem. *Current Biology*, 16(13):R492-R493.

By-catch [and discards]



**38.5 million tons / year =
40% of all marine catches**

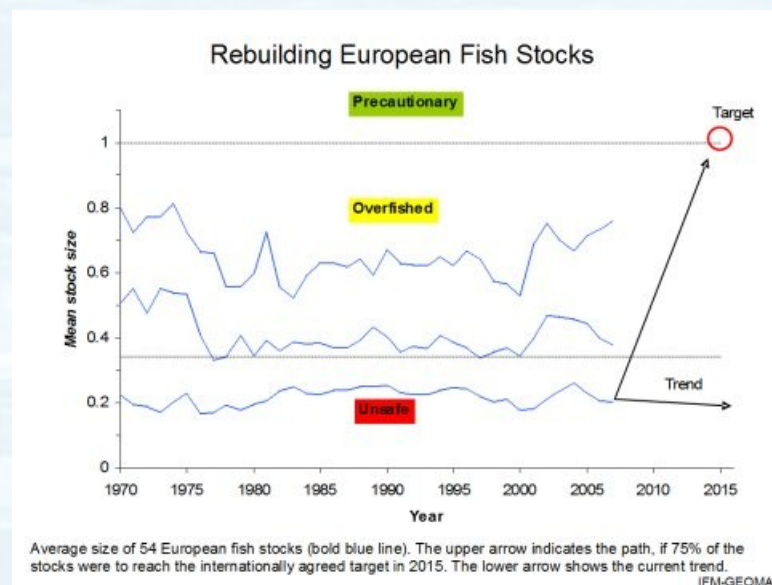
DAVIES RWD, *et al.*, 2009. Defining and estimating global marine fisheries bycatch. *Marine Policy*, doi:10.1016/j.marpol.2009.01.003

53 countries (96% of global fisheries) do not respect the Code of Conduct for Responsible Fisheries adopted 1995



Pitcher, T., D. Kalikoski and G. Pramod (eds.), 2006. updated April 2008. Evaluations of compliance with the FAO (UN) Code of Conduct for Responsible Fisheries. UBC, *Fish.Centre Res.Rep.*, 14(2):76 p.

Europe risks missing objective of rebuilding stocks by 30 years and already imports 60 % of its needs



Froese, R. and A. Proelß. 2010. Rebuilding fish stocks no later than 2015: will Europe meet the deadline? *Fish and Fisheries* 11:194-202. DOI: 10.1111/j.1467-2979.2009.00349.x

Perverse effects (1)



Trawling & other non-selective active fishing methods destroy habitat in addition to being very energy-intensive;

Invertebrate catches have increased 6x since 1950 – 34% are collapsed or closed – 53% harvested with habitat destroying methods.

Overcapitalisation of the fleets drive fishing further 'south' and 'deeper down' with times from peak to collapse shrinking

Perverse effects (2)

Watson & Pauly, 2001 revealed in *Nature* massive **misreporting** by China for global fisheries statistics compiled by FAO:

Correcting for the error, **global catches thus decline** by about 300,000 tons/yr since the early 1990s – contrary to official statements of increases

Taking into account latest estimates of bycatch and discards etc, the decline is around 700,000 tons/yr.

Yet

\$34 billion subsidies/yr, particularly by Asian and European governments, constitute as a major obstacle to sustainability.

FAO reports a **global fishing fleet of 4.3 million vessels**, half of which is motorised and 75% based in Asia, but Europe has the highest % of boats >24 m LHT

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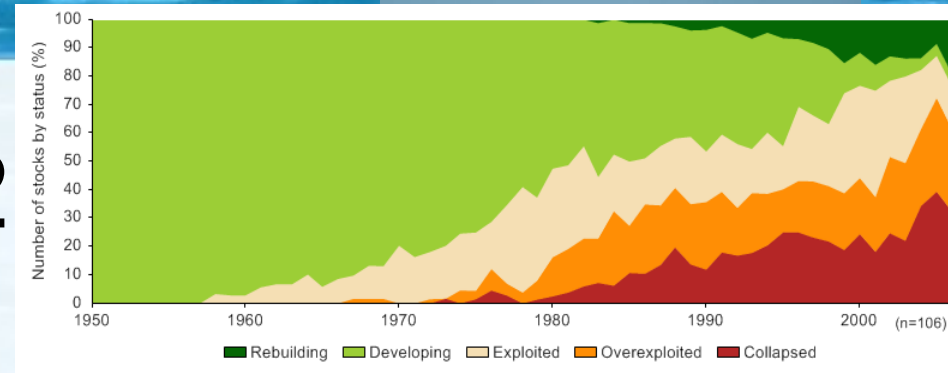
Supporting action - 1



Objective: minimum impact fisheries

- Replace destructive & non-selective gear by passive, selective & energy-efficient gear
- Stop deep-sea fishing
- Favour artisanal fisheries respectful of the environment which generate jobs
- Re-invent a marine culture in the modern context, with specific knowledge and respect for nature, people and food

Supporting action - 2



Objective: Rebuild marine ecosystems and protect biodiversity

- Establish and enforce marine protected areas on 10% of the oceans, currently, 1%
- Discourage aquaculture of carnivores
- The Johannesburg Plan of Action, adopted by Heads of State in 2002, mandates networks of marine protected areas by 2012
- Research MPAs: where, how big, transitions

Supporting action - 3



Objective: Abolish perverse incentives

- Subsidies for fuel, fishing agreements, modernisation of fishing boats etc. are estimated at global level to be in the order of 34 billions \$/year (Asia and Europe leading)
- Subsidies for safety at sea are, of course, acceptable

Supporting action - 4

Objective: Don't eat babies!



In some European fisheries, up to 80% of catches are juveniles.

If this continues, resources will diminish further, and so will employment – contrary to expedient political justifications.

Use of fish rulers to empower everybody to determine minimum size of reproduction should be developed and promoted.

Supporting action - 5

Objective: Engage! Cooperate!

Nancy Baron insists in *Nature* (Dec. 2010) on the imperative of scientists to engage more with the public.

Here is late Stanford University climatologist Stephen Schneider's view: "Staying out of the fray is not taking the 'high ground'; it is just passing the buck."



Together

Objective: International solidarity

We have one Earth – meet your peers elsewhere, their conditions and aspirations; join forces with ecologists, other marine scientists, economists & other social sciences, lawyers, artists, practitioners for non-destructive use of the oceans, International commerce, tourism & media link us – why not think together about alternative ways of living and consuming, reducing climate change, clandestine immigration and hardship, but rather travel of ideas, cooperation and solidarity?



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Some sources & an invitation to act

INCOFISH – reconciling multiple demands on coastal zones
– much to do - www.incofish.org

FishBase – fill gaps at - www.fishbase.org

SealifeBase – fill gaps at - www.sealifebase.org

Mundus maris – Sciences and Arts for Sustainability
collaborate? - www.mundusmaris.org

Johannesburg Plan of Implementation -

http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm

The climate and biodiversity challenges -
www.unfccc.int/2860.php and www.cbd.int/

A resource efficient 'green' Europe -

http://ec.europa.eu/environment/index_en.htm

Thanks for your attention!

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