Overview of sustainability science (with emphasis on fish and fisheries)

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Outline of talk

- Overview of sustainability science using fish and fisheries as an example;
- Importance of sustainability science for fisheries use and ocean ecosystem conservation;
- Elements of sustainability in fisheries;
- What to do?

Overview

Sustainability science

- Origins of sustainability science traced to the Brundtland Report: WCED (1987):
  - development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs”.
- But there is a longer history …

“The Earth and the fullness of it belongs to every generation, and the preceding one can have no right to blind it up from posterity” (Adam Smith, 1766 Lecture on Jurisprudence).

Photo: NASA

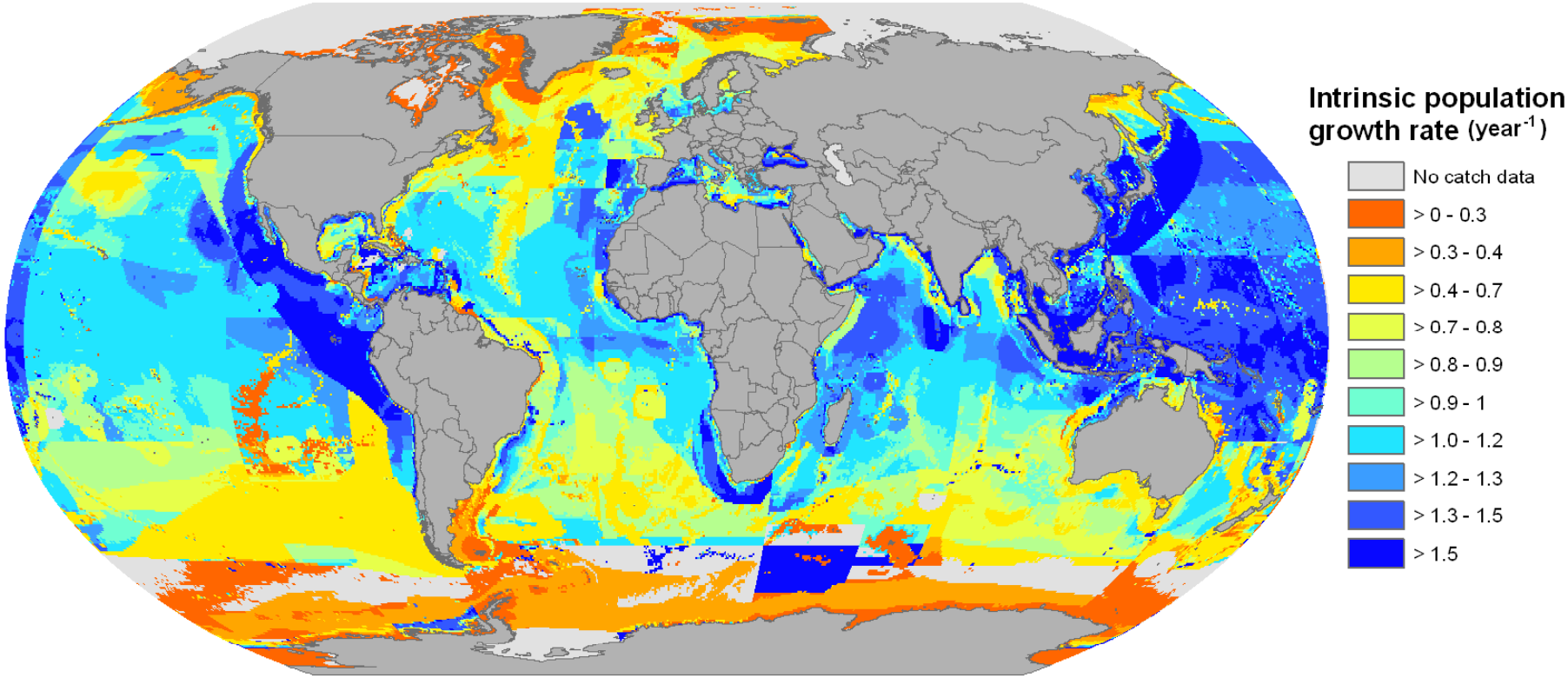
Sustainability science

- The challenge of sustainable development is the reconciliation of society's development goals with the planet's environmental limits over the long term:
  - Fish protein;
  - Jobs and income;
  - Profits.

Sustainability science

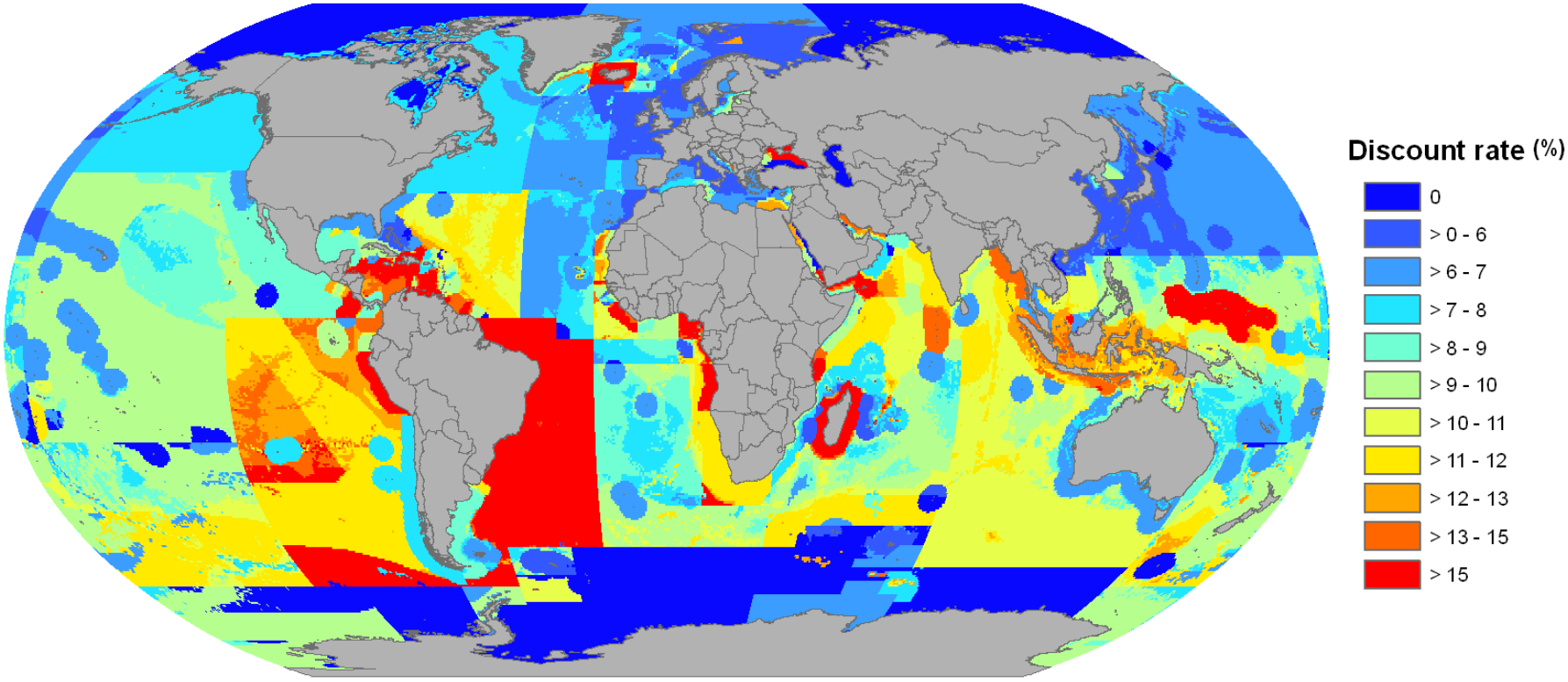
- Sustainability science focuses on the dynamic interactions between nature and society – in our case, the interaction between fish & fishers.

Intrinsic growth rate as indicator of vulnerability



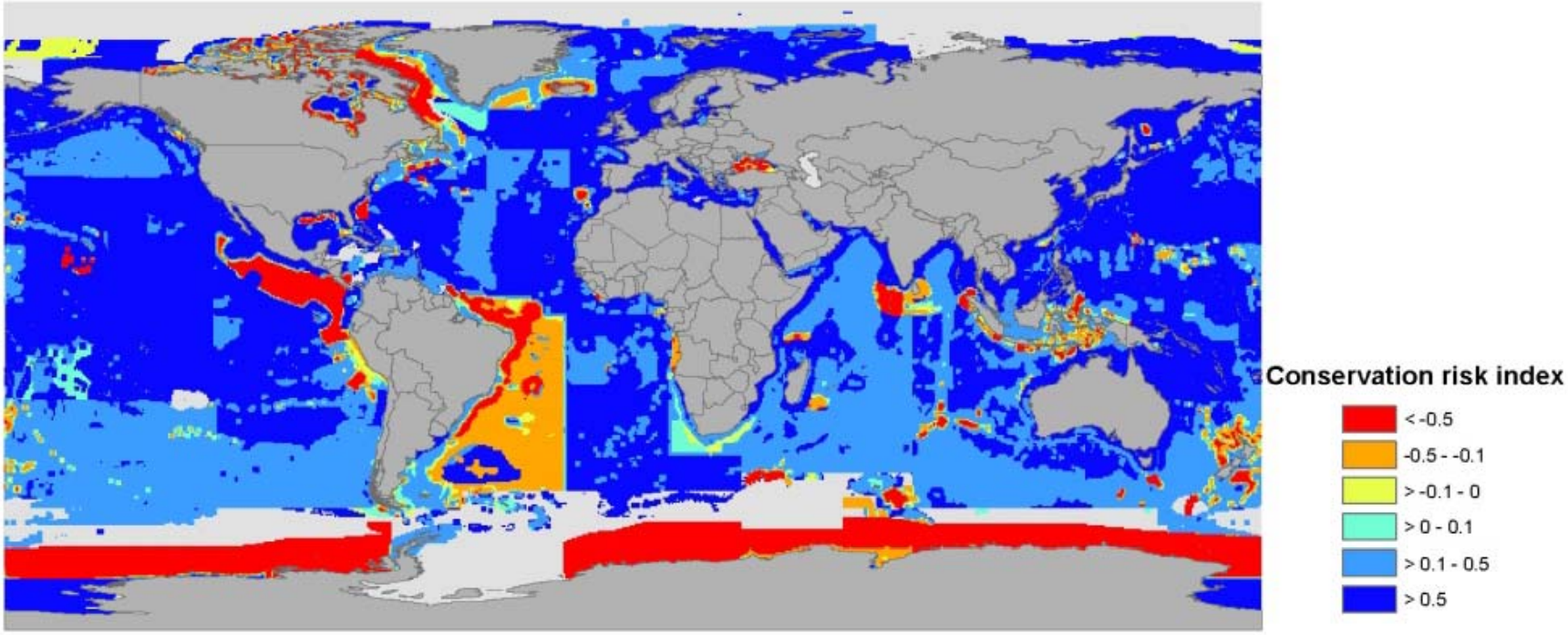
Sumaila, Cheung et al. (in prep.)

Official discount rates as indicator of vulnerability



Sumaila, Cheung et al. (in prep.)

Conservation indices for demersal fish species, globally

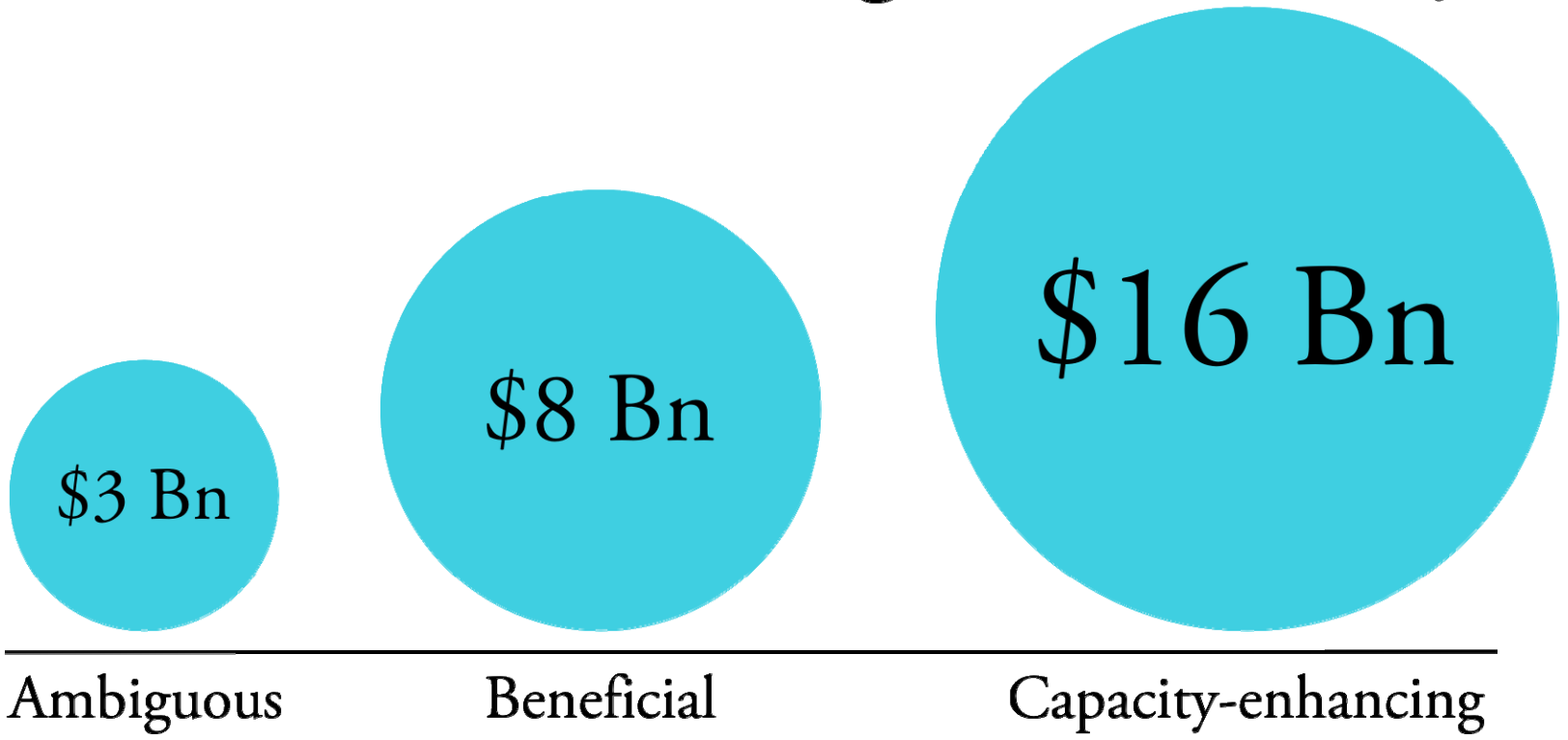


Sumaila, Cheung et al. (in prep.)

Sustainability science

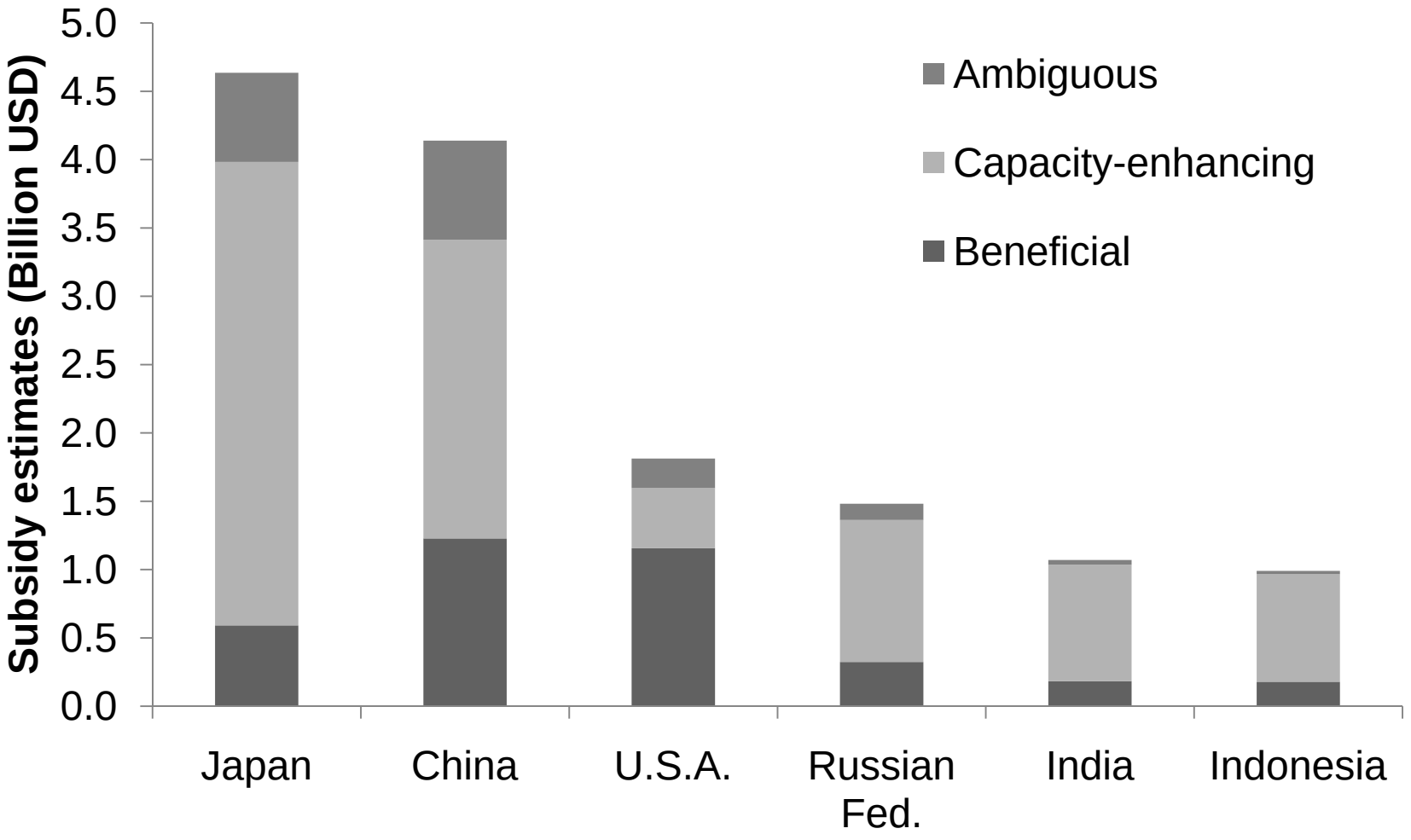
- Sustainability science gives attention to how social change shapes the environment and how the environmental change shapes society;
- Example: fisheries subsidies: payments by governments to fishing sector.

Subsidies in the global fishery



Sumaila et al. (2010)

Subsidies by major fishing nations

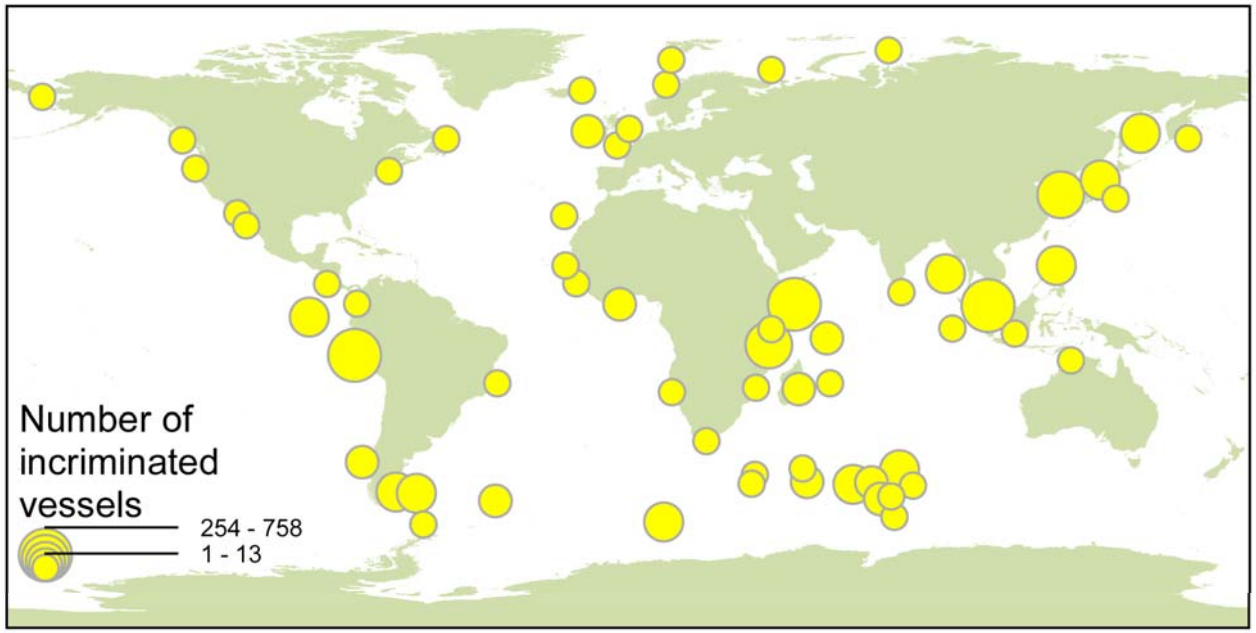


Sumaila et al. (2010)

Sustainability science

- Sustainability science is problem-driven, with the goal of creating and applying knowledge in support of decision-making for sustainable development;
- Example illegal fishing.

Number of incriminated vessels fishing illegally between 1980 and 2003



Sumaila et al. (2006)

Costs and benefit aspects of risks inherent in IUU activity

Arresting Country	Fishery	Expected Revenue (USD)	Expected Penalty (USD)	Total Cost (USD)	Total Cost / Expected revenue
Australia	Patagonian toothfish	504 000	87 000	526 091	1.04
Japan	Crab	38 256	1 483	31 131	0.81
Mexico	Shrimp	22 060	1 091	16 428	0.74
Russia	Alaska pollack	8 818	234	4 539	0.51
Mauritius	Patagonian toothfish	352 000	480 000	786 667	2.23

Sumaila et al. (2006)

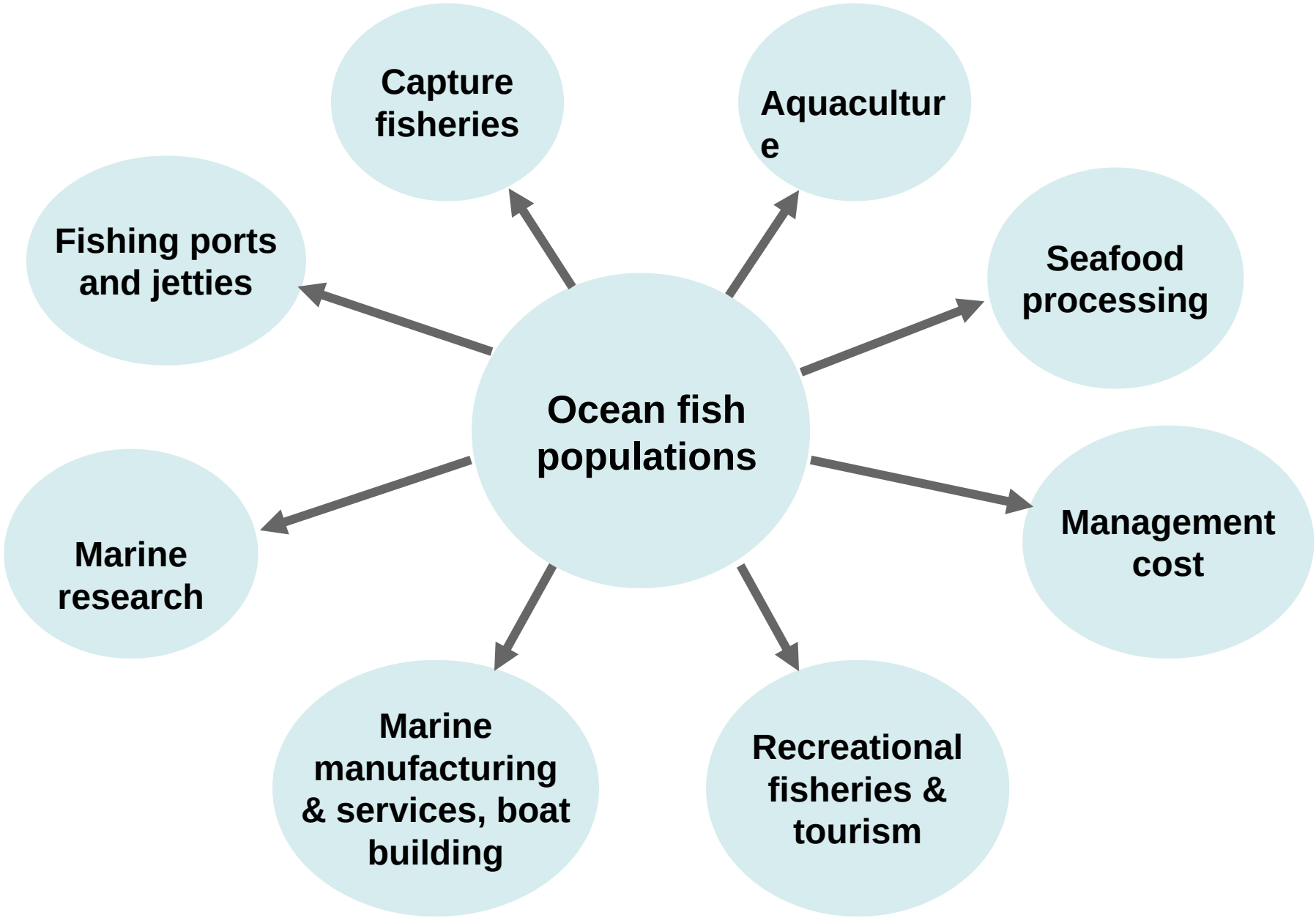
Sustainability science

- Sustainability science is grounded in the belief that for the knowledge of nature-society interaction to be truly useful, they have to be ‘co-produced’ through close collaboration between scholars and practitioners;
- Example this meeting.

NRC (1999); Clark and Dickson (2003)

Importance

Ocean fisheries activities



Input – output results

- Fisheries are a primary or ‘base’ industry
  - Source of resources out of which much economic activity grows.

- How much economic activity throughout the economy is sourced from fisheries output?

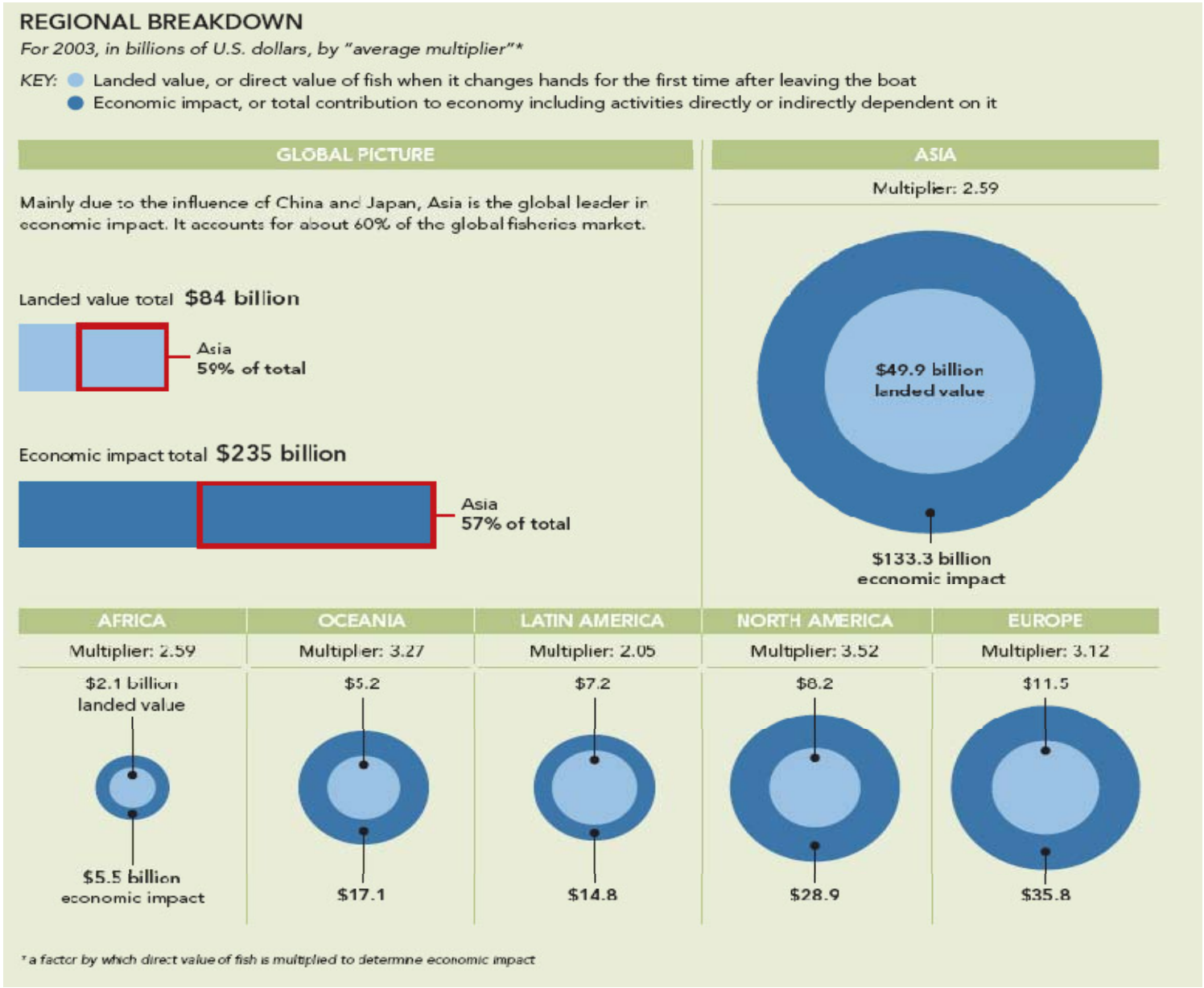
Dyck & Sumaila (2010)

Economic impact of world fisheries output

	Landed Value ($ billions)	Economic Impact ($ billions)	Average Multiplier
Africa	2	5	2.59
Asia	50	133	2.67
Europe	11	36	3.12
S. & C. America	7	15	2.05
N. America	8	29	3.52
Oceania	5	17	3.27
World Total	84	235	2.8

Dyck & Sumaila (2010)

Total Economic Impact of Global Fisheries by region



Income effect of world fisheries output

	Landed Value ($ billions)	Income Effect ($ billions)	Average Multiplier
Africa	2	1	0.62
Asia	50	35	0.71
Europe	11	9	0.76
S. & C. America	7	4	0.56
N. America	8	10	1.22
Oceania	5	4	0.73
World Total	84	63	0.75

Dyck & Sumaila (2010)

Income effects by region

$63 billion

Amount of household income worldwide produced annually through the fisheries sector

Of household income in the world economy ...

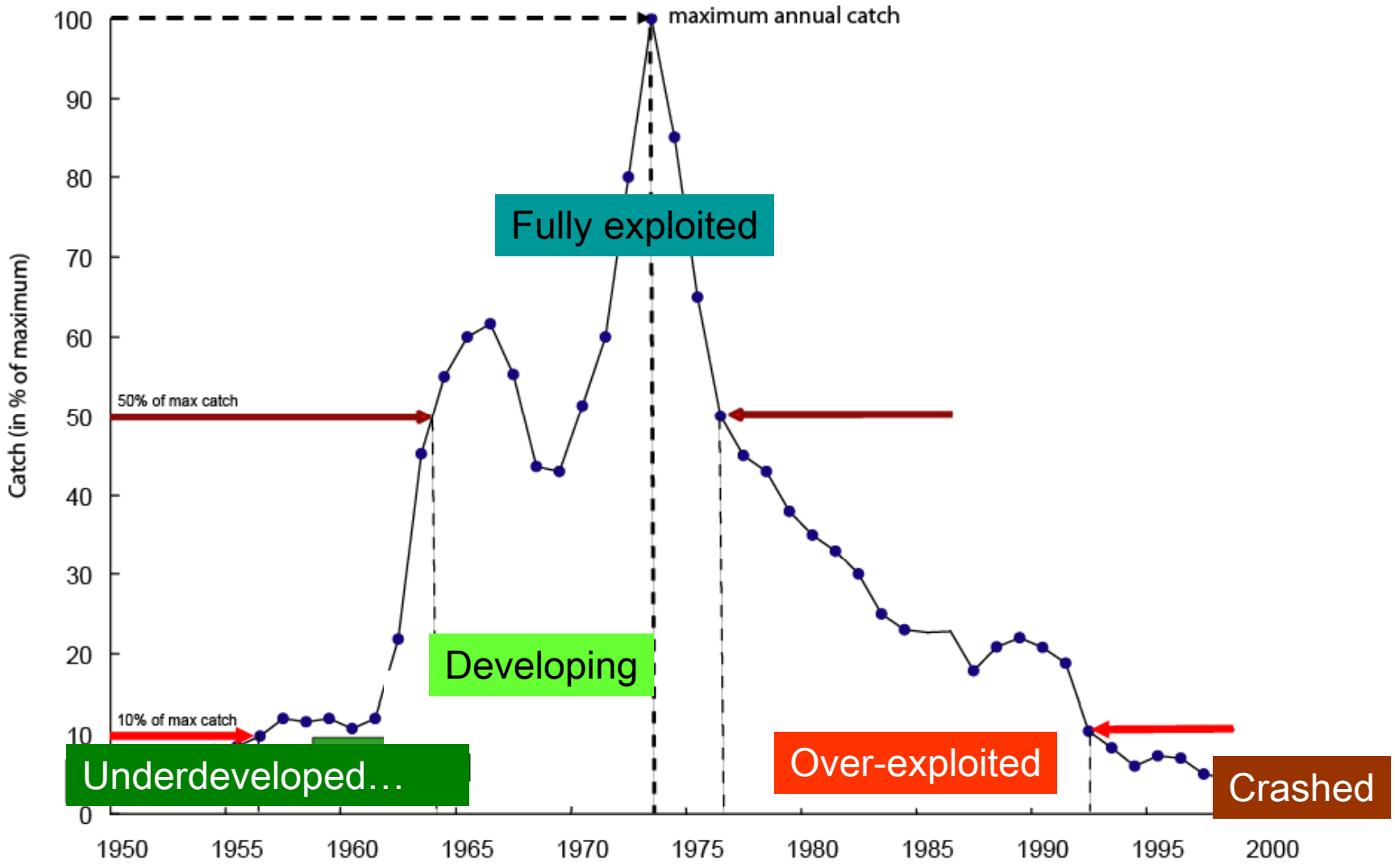
every $1 of landed value ...

... supports 75 cents in additional income.

Asia leads globally in total income supported by the *marine* fisheries sector. More than **55%** of household income from marine fisheries is earned in Asia.

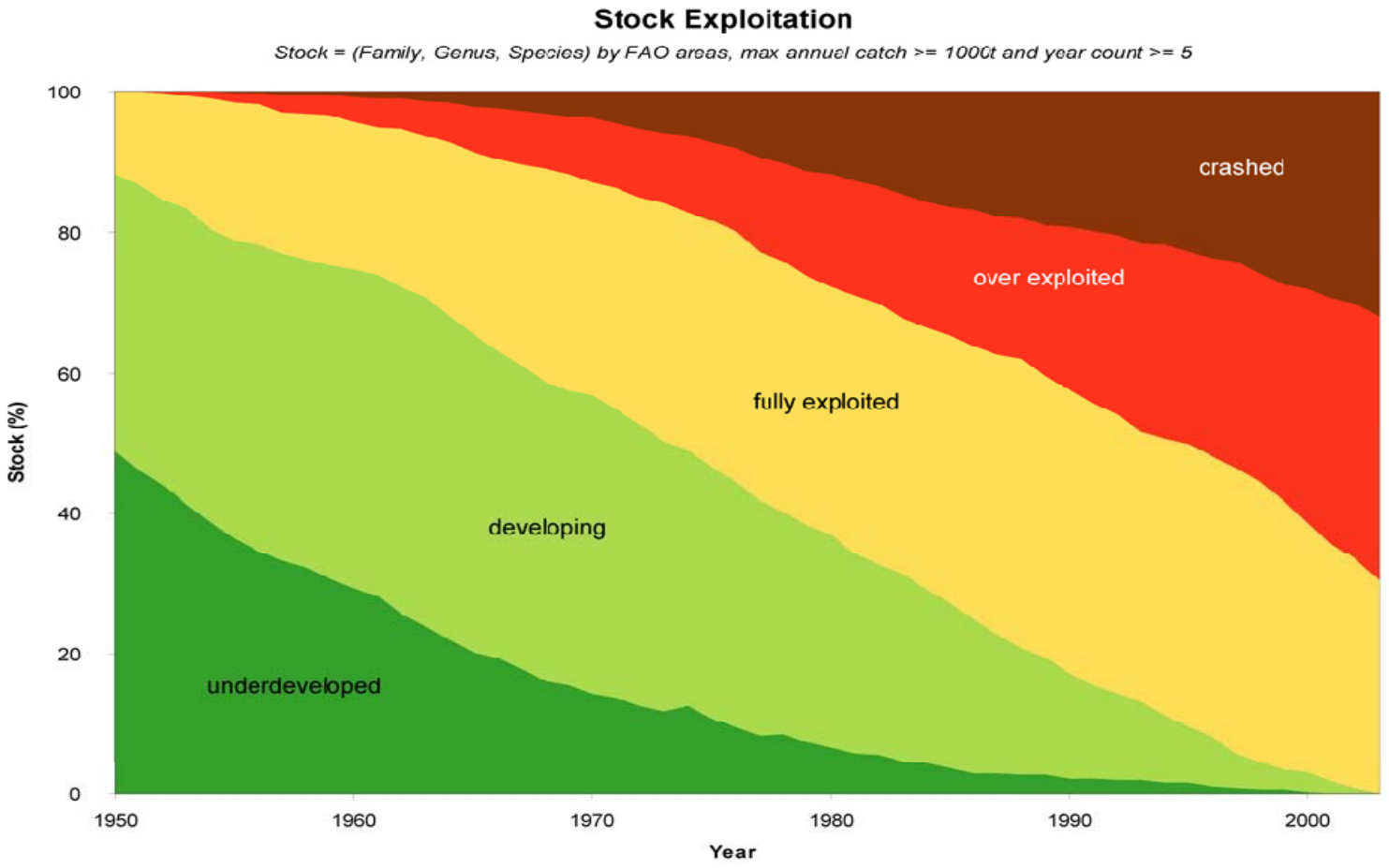
For North America, an increase in fisheries output of $1 results in more than $1 of household income among workers in fisheries-related activities, which is the highest in the world.

We can define the state of a fish stock …



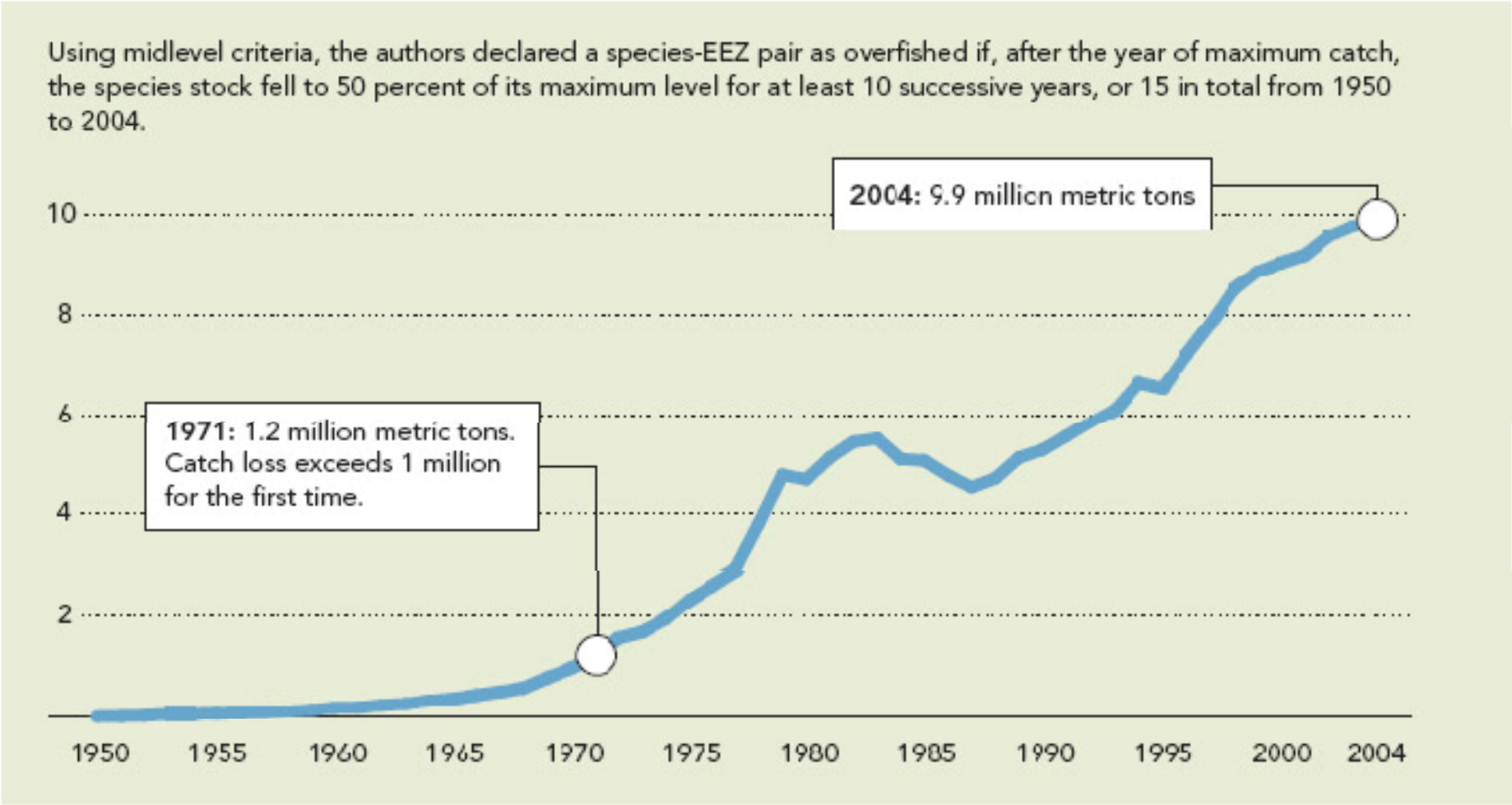
Now let's apply these definitions to the global FAO catch statistics…

Overfished stocks, globally



Source: Froese and Pauly (2004)

Global Potential Catch Loss (in million metric tons)



Srinivasan et al. (2010)

Potential Catch Losses by Region (in million metric tons)

Srinivasan et al. (2010)

Catch Loss Impact on Global Undernourishment Levels

If the waters of countries with undernourishment levels greater than 5 percent had not been overfished, the additional fish catch in 2000 could have fed 20 million people, many of them in the world's poorest nations. With better management, the authors found catches in the low-income, food-deficit countries might have been 75 percent greater on average.

NUMBERS OF PEOPLE AFFECTED

In 2000, the number of undernourished people in low-income, food-deficient countries whose food deficit could have been offset by the potential catch loss from their countries' waters (or in Angola's case, their neighbors' waters).

Note: Areas that may not be visible on this map include Kiribati, the Gaza Strip, Seychelles, Maldives, Bermuda, Sao Tome and Principe and Mauritius.

** Because the loss calculated for Namibia exceeded its annual food deficit by a factor of ~11, the authors applied the remainder toward the food deficit of its neighbor to the north, Angola.*

Srinivasan et al. (2010)

Food security implications of overfishing

- Our analysis shows that eliminating overfishing could create food to avert undernourishment for about 19 million people worldwide;
- Most of these people from countries with very high level of undernourishment in their populations (Liberia, Sri Lanka, Grenada, Guatemala).

Srinivasan et al. (2010)

Elements

Elements of sustainability in fisheries

- Recognize that there are limits to the amount of fish that the ocean can provide;
- Acknowledge that rebuilding overfished stocks is needed so they can deliver maximum sustainable yield through time for the benefits of all generations;

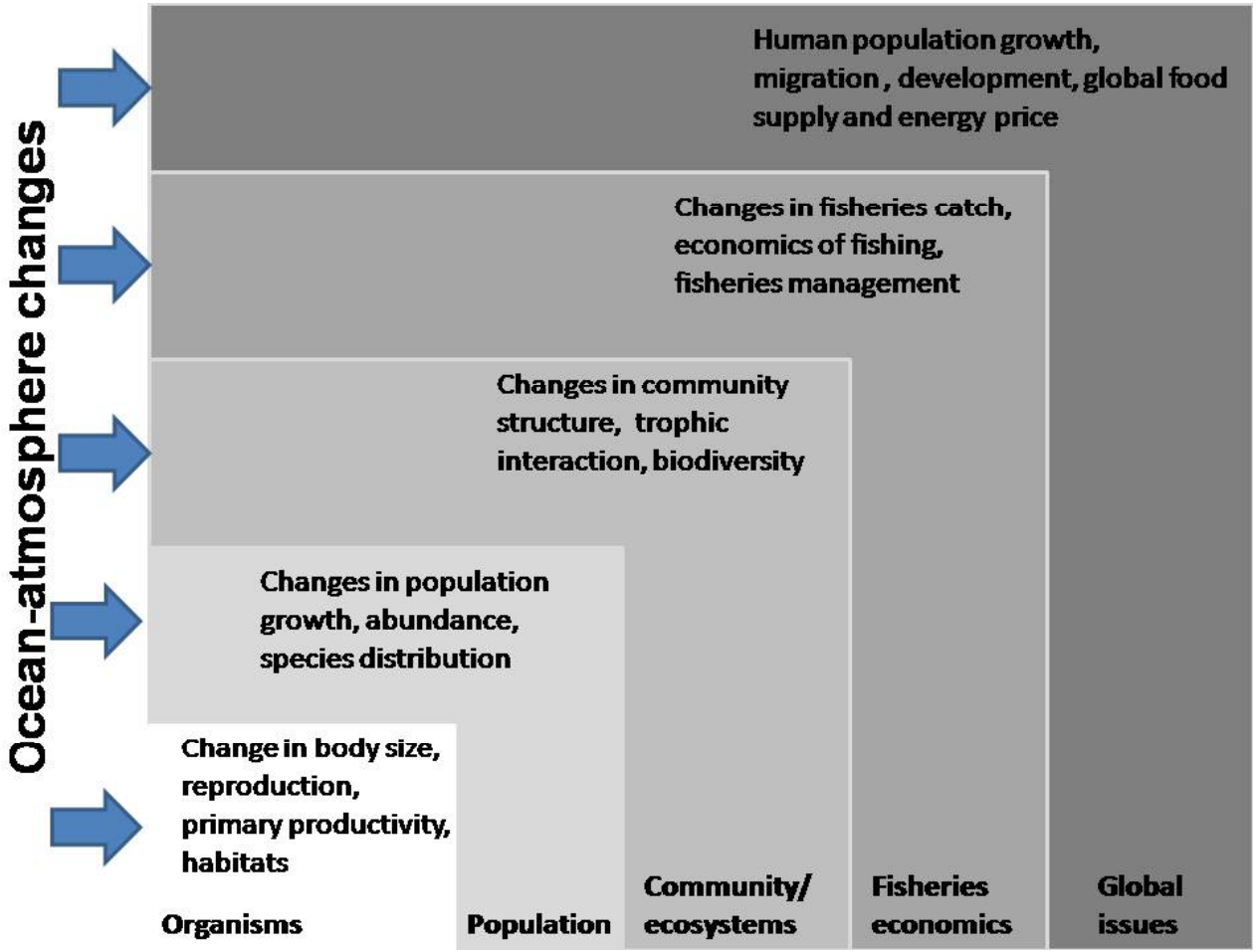
Elements of sustainability in fisheries

- Essential fish habitats need to be protected and preserved;
- Fishing and related activities are carried out to minimize the release of greenhouse gases;
- Education, education, education.

Elements of sustainability in fisheries

- Global governance:
  - eco-label, fish traceability, food mileage;
  - sustainability based on the ecosystem approach such as the use of marine protected area;
  - Subsidies disciplines;
  - Joint management of high seas fish stocks.

In conclusion: sustainability science




Thanks for your attention