Inspire
ocean & climate

Rashid Sumaila

University of British Columbia

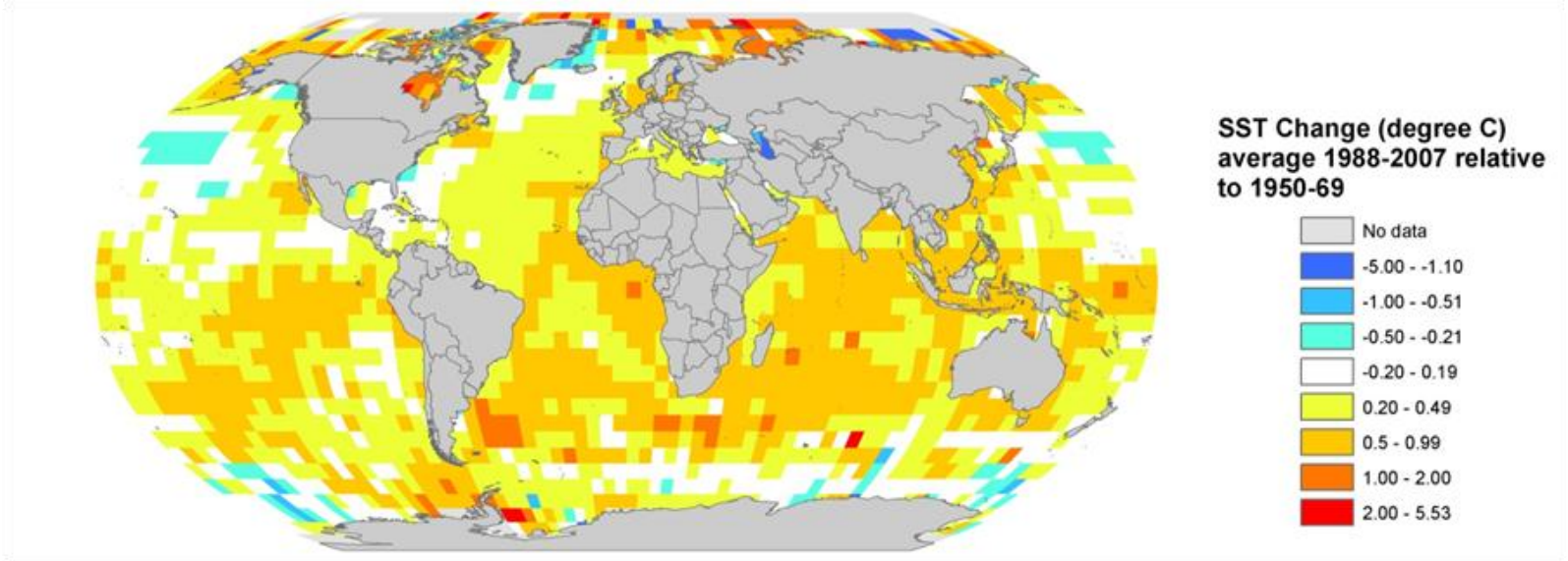
Fisheries as both victims and drivers of climate change

U. Rashid Sumaila
Fisheries Economics Research Unit
Institute for the Ocean and Fisheries
School of Public Policy and Global Affairs
The University of British Columbia
Vancouver, Canada
r.sumaila@oceans.ubc.ca

UNOC# Side Event on Climate and Oceans
Nice, France, June 11, 2025

Human-Ocean interaction
The need for management and marine protection

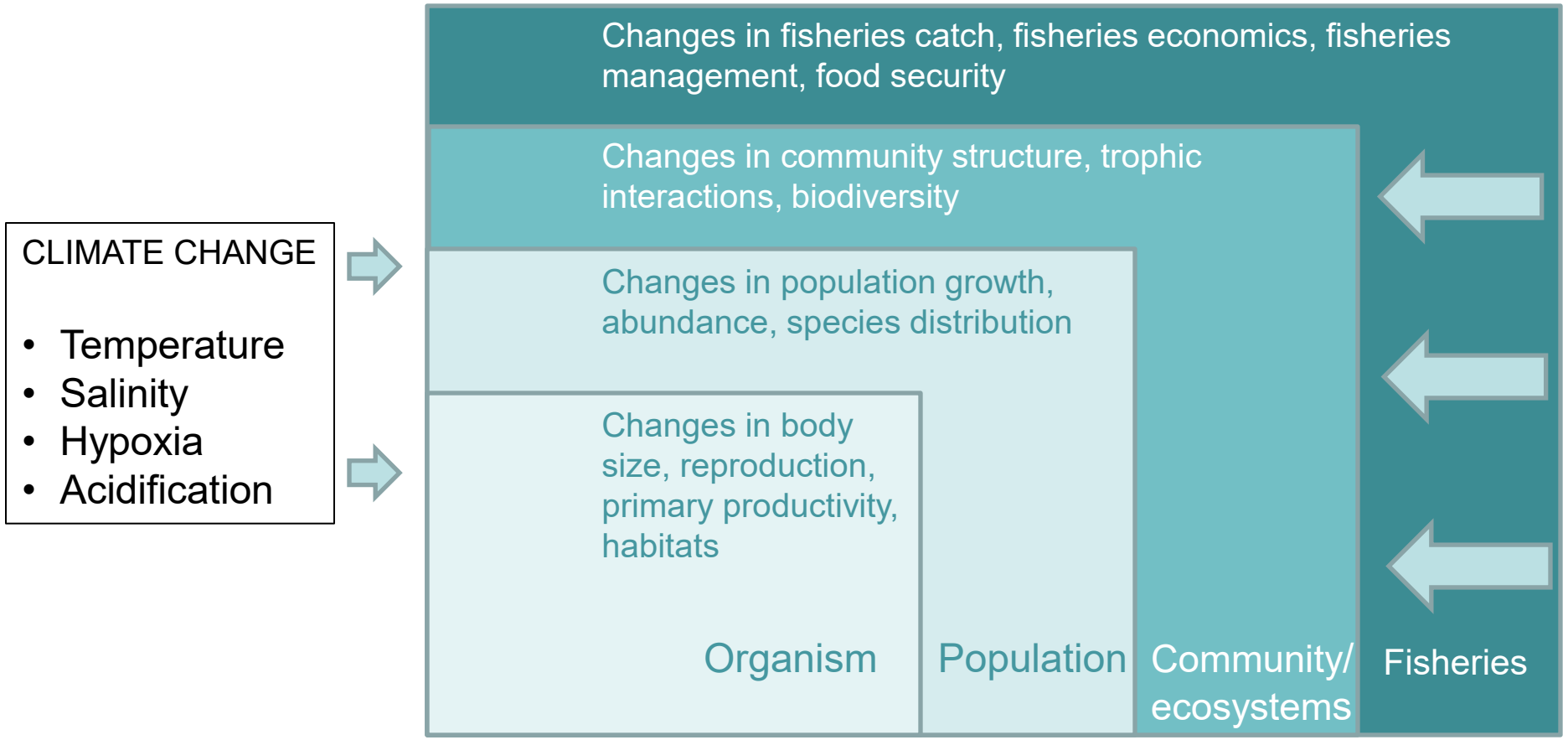
Ocean warming, acidification and deoxygenation



The ocean has become:

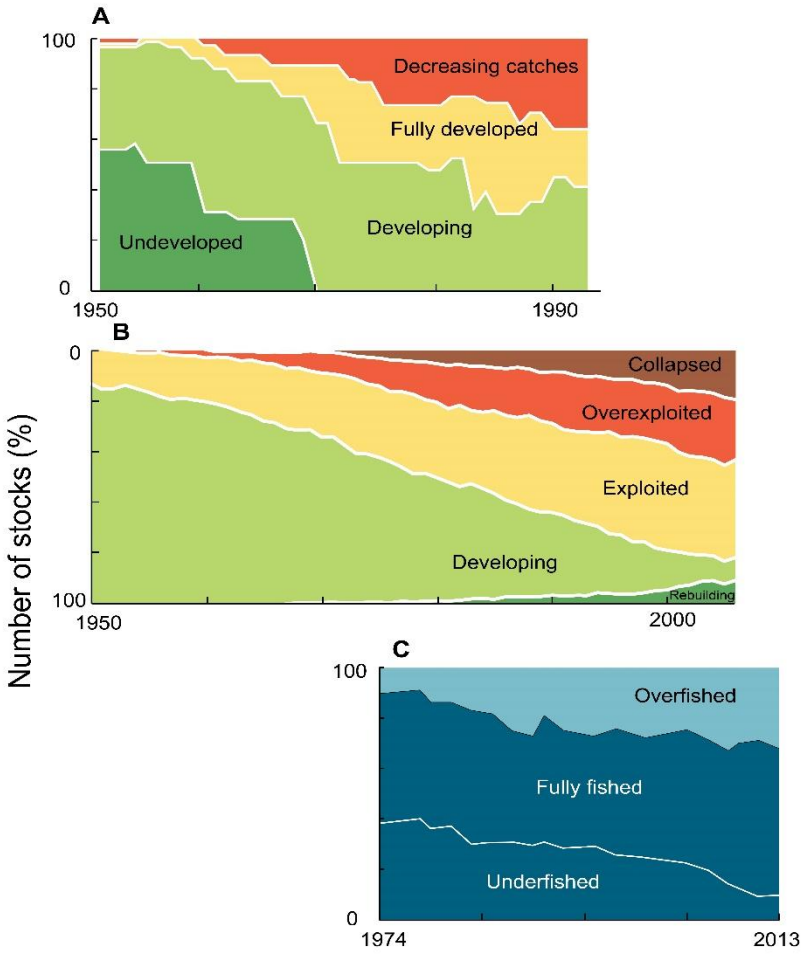
- **warmer** (with the world struggling to limit the increase in average temperature to 2°C into the future);
- with **less sea-ice** (summer Arctic sea ice extent is decreasing at 7.4% per decade);
- **more acidic** (acidity projected to triple in the future);
- **less oxygenated** in some area, **higher sea level**.

Climate change, the ocean, fish & fisheries



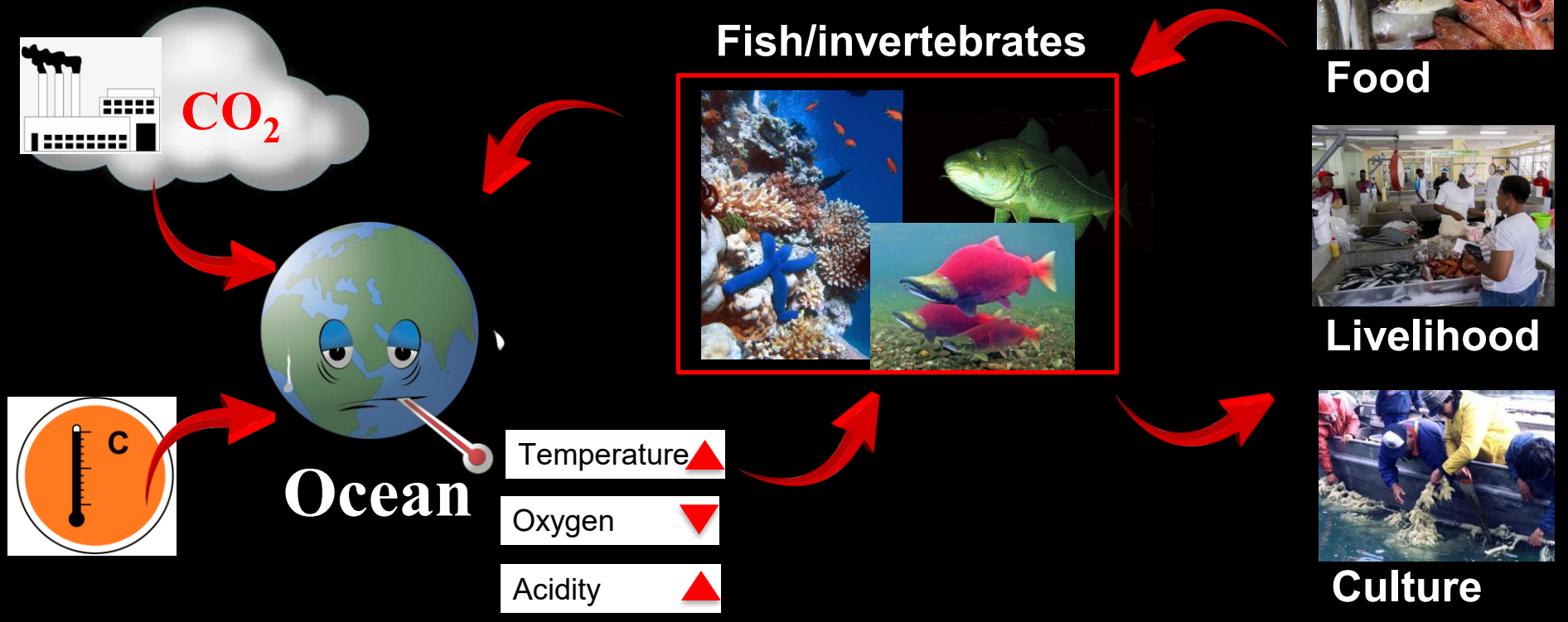
Adopted from Sumaila *et al.* (2011): *Nature Climate Change*

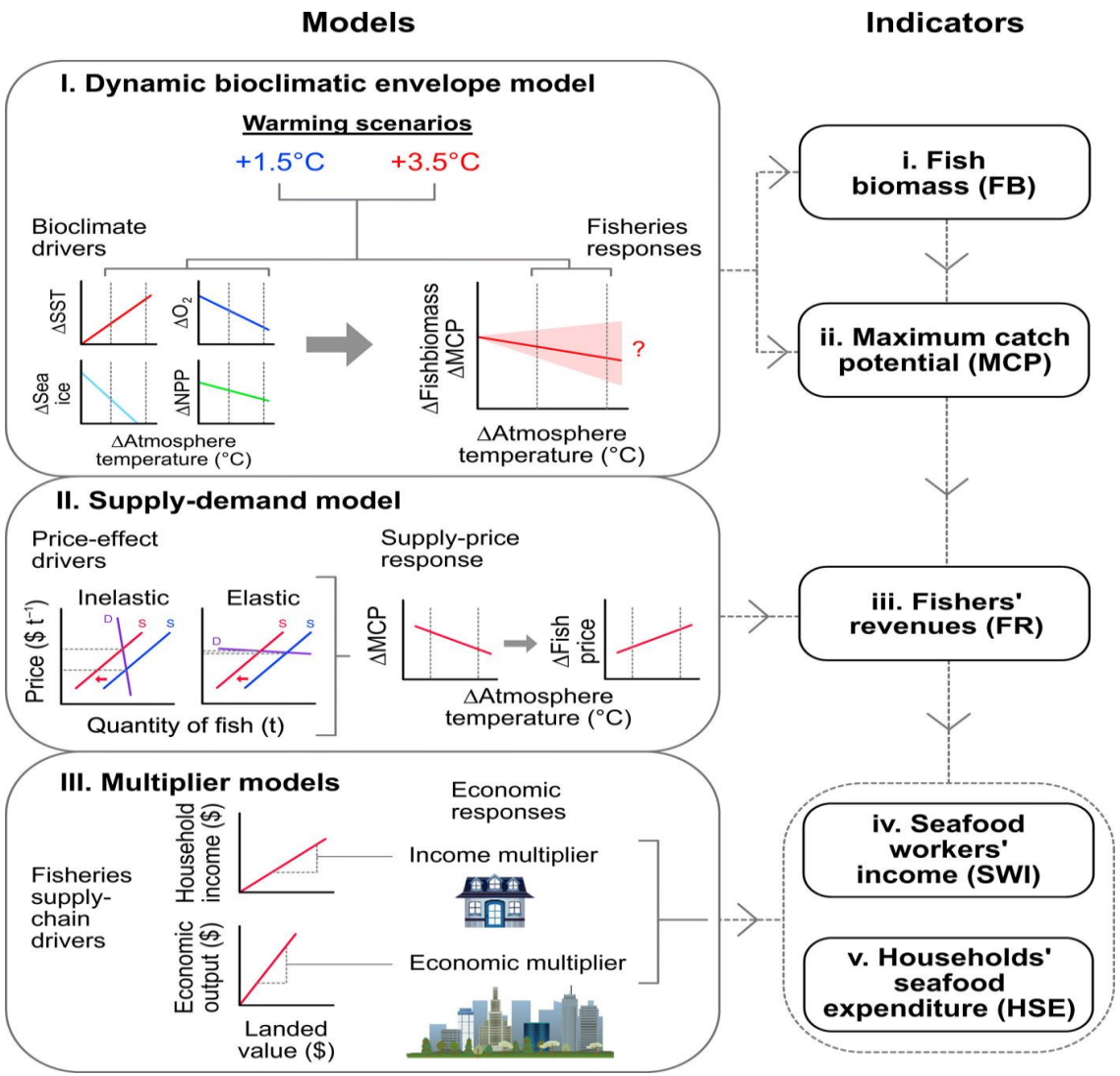
Declining oceans have serious human consequences



The Ocean as a victim of climate change

Climate change, fish stocks, fisheries and dependent human communities

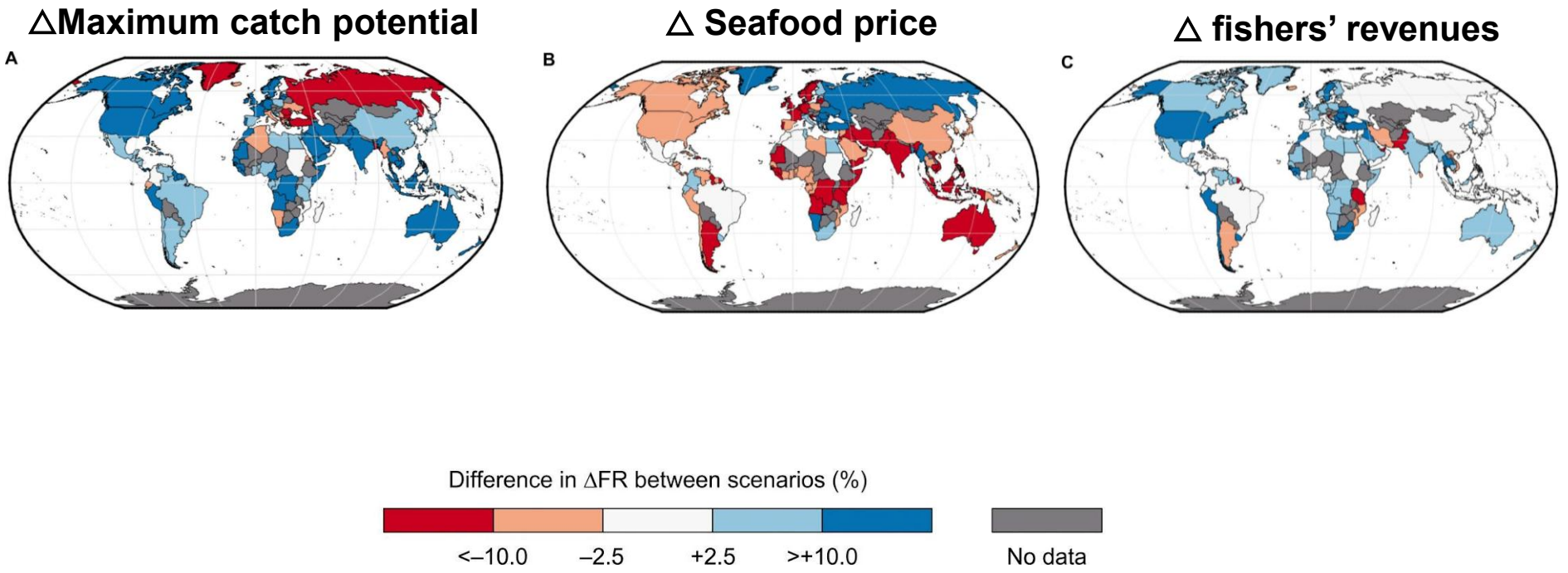




Projecting catches, revenues, workers' income and households' seafood expenditure

Source: Sumaila et al. (2019)

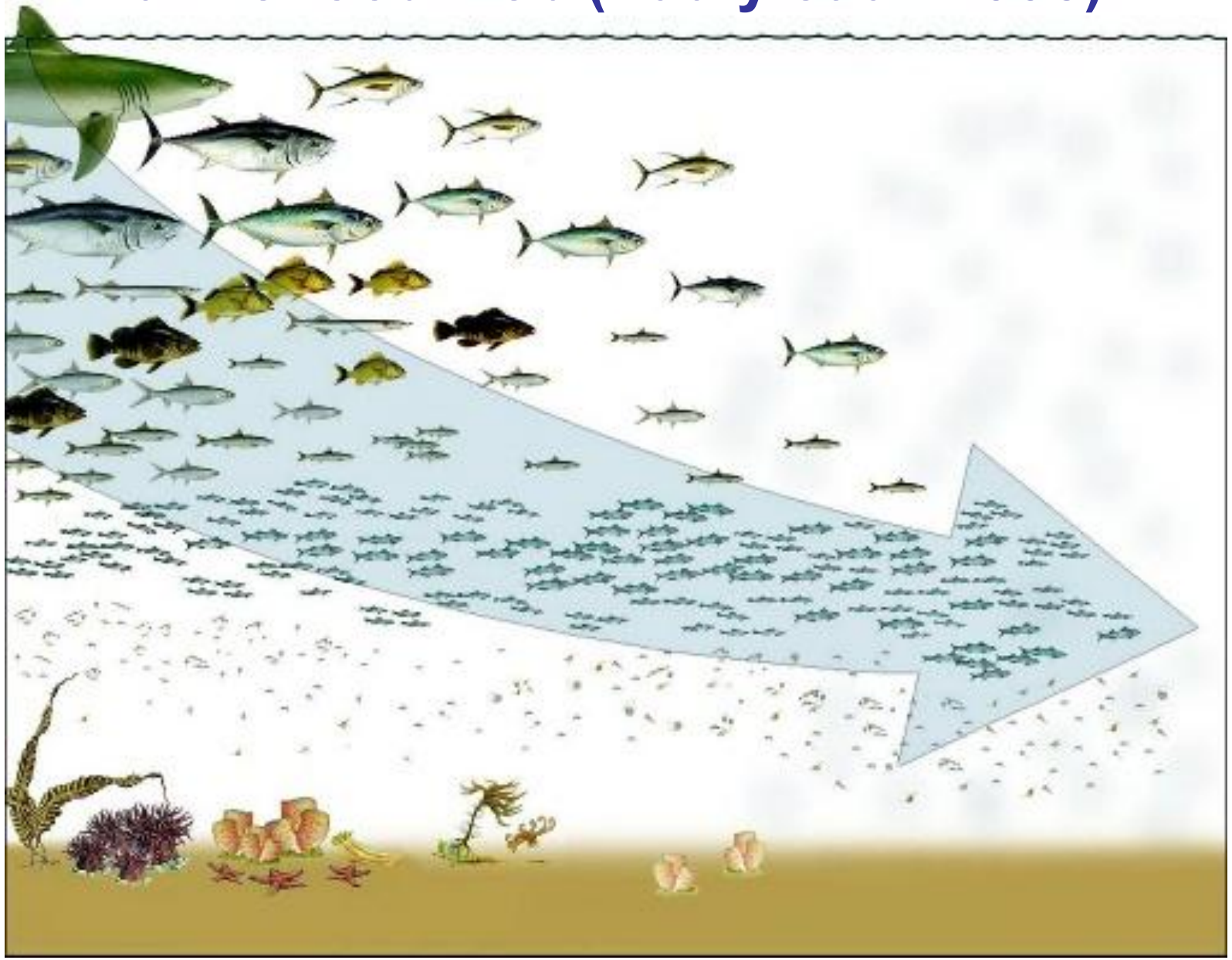
Projected differences in maximum catch potential, seafood price and fisher's revenues



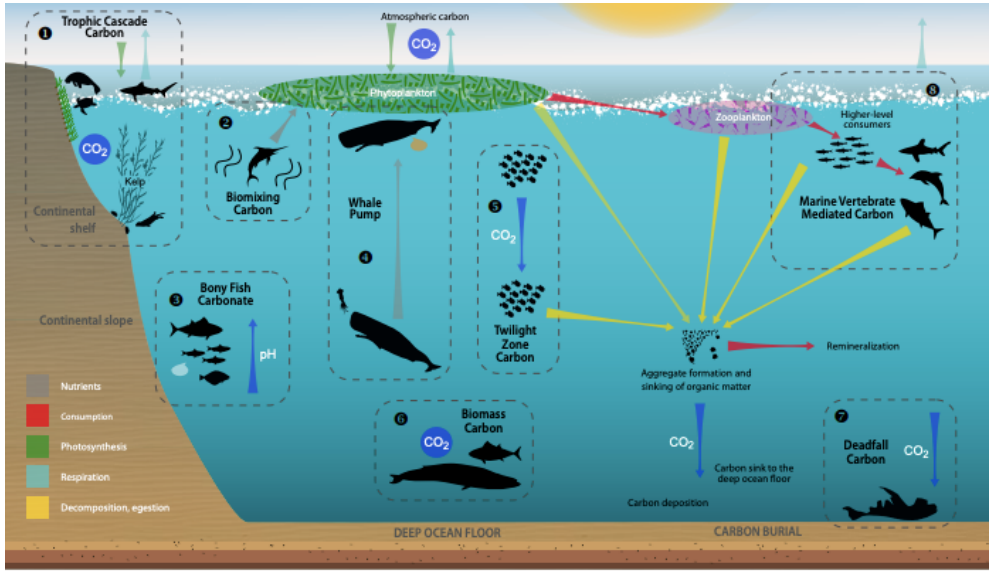
Source: Sumaila et al. (2019)

The Ocean as a drive of climate change

Overfishing as captured by fishing down marine food web (Pauly et al. 1998)

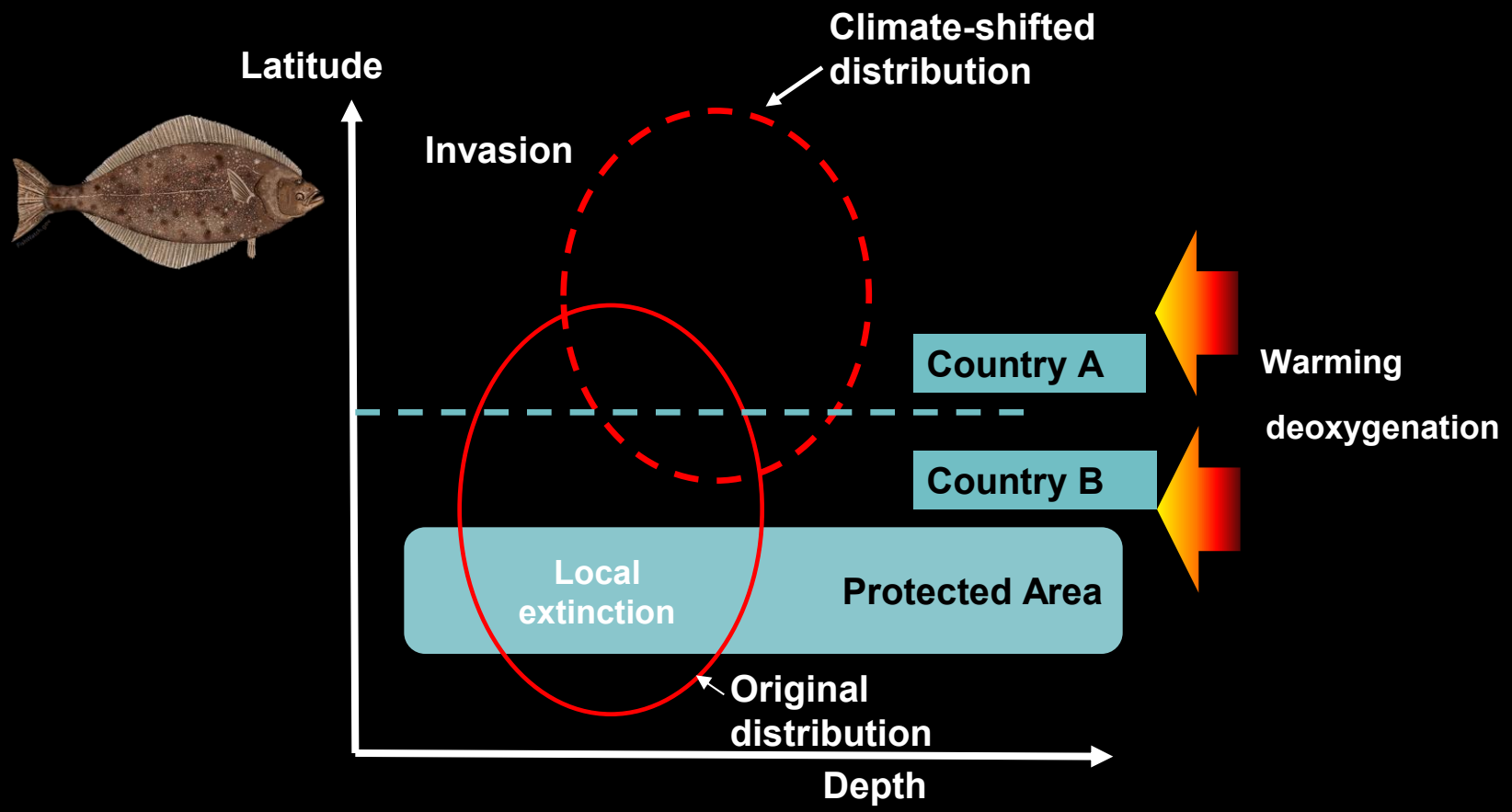


How an ocean full of life is also climate action



1	Trophic Cascade Carbon	Food web dynamics help maintain the carbon storage and sequestration function of coastal marine ecosystems (e.g. the health of primary producers such as seagrass meadows and kelp forests is maintained by herbivory and predation).
2	Biomixing Carbon	Turbulence and drag, associated with the movement of marine vertebrates, causes enhanced mixing of nutrient rich water from deeper in the water column towards the surface, where it enhances primary production by phytoplankton and thus the uptake of dissolved CO_2 .
3	Bony Fish Carbonate	Bony fish excrete metabolised carbon as calcium carbonate ($CaCO_3$) enhancing oceanic alkalinity and providing a buffer against ocean acidification.
4	Whale Pump	Nutrients from the faecal material of whales stimulate enhanced primary production by phytoplankton, and thus uptake of dissolved CO_2.
5	Twilight Zone Carbon	Mesopelagic fish feed in the upper ocean layers during the night and transport consumed organic carbon to deeper waters during daylight hours.
6	Biomass Carbon	Marine vertebrates store carbon in the ocean as biomass throughout their natural lifetimes, with larger individuals storing proportionally greater amounts over prolonged timescales.
7	Deadfall Carbon	The carcasses of large pelagic marine vertebrates sink through the water column, exporting carbon to the ocean floor where it becomes incorporated into the benthic food web and is sometimes buried in sediments (a net carbon sink).
8	Marine Vertebrate Mediated Carbon	Marine vertebrates consume and repackage organic carbon through marine food webs, which is transported to deep waters by rapidly sinking faecal material.

Management implications


Latitude
Climate-shifted distribution
Invasion
Country A
Country B
Warming
deoxygenation
Local extinction
Protected Area
Original distribution
Depth

Takeaway points

- Issues of overfishing and climate change must be addressed now.
- Continued inaction will jeopardize both wildlife and humans:
  - Biodiversity;
  - Food security;
  - Resources equity; and
  - Aggravate tensions and conflicts.

Thanks to ISC for organizing this session and for inviting me!

Thanks to you for your attention

OCEAN CANADA