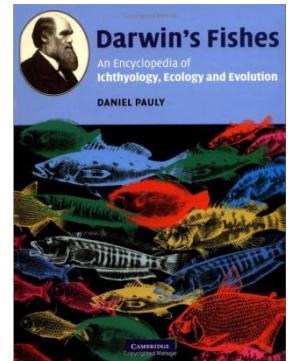
A large, dark blue whale tail is shown from a low angle, pointing towards the bottom right. The ocean is visible in the background.

Darwin's Fishes: Why should we care about Marine Biodiversity?



Mary Glackin
Deputy Undersecretary for Oceans and Atmosphere
National Oceanic and Atmospheric Administration | NOAA
Darwin Symposium | National Academy of Sciences
February 11, 2009



Overview

Importance of Marine Biodiversity to Society

Understanding Marine Biodiversity

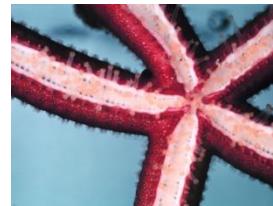
- The role of exploration, surveying and process-oriented research

Emerging Threats to Marine Biodiversity

- Climate change and ocean impacts, coastal change, marine sound, etc

Protecting Marine Biodiversity

- Managing use and protection of biodiversity domestically and internationally





Importance of Marine Biodiversity (MBD)

Food Source: World Annual Seafood production (wild & aquaculture): **141 million tons** (93 million tons wild - static; 48 million tons aquaculture, - increasing)

20% of the world's human population have fisheries as their major source of protein

Economics: Total USA Fish Catch Landings in 2007: **9.5 billion pounds, 1st Sale Value \$4.1b**

Total USA Recreational Fish Catch (2006): **257 million pounds**

Total USA Fisheries Sales: **\$185 billion; 2 million American jobs are fisheries-dependent**

Marine resources are iconic, culturally and recreationally important, and a potential new source of genetic diversity for uses such as food, pharmaceuticals and other product



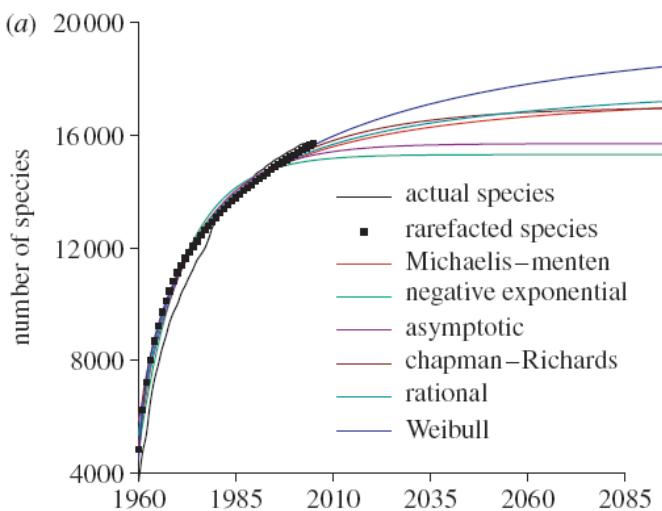
The Known, Unknown and Unknowable of Marine Biodiversity

Example, Marine Fishes: **One can not conserve what one does not know**

Currently there are 27,997 known fish species in the world (9,000 in CD's time):

- 51% of the known vertebrates (54,711) are fish
- about 12,000 are fresh water, 16,000 marine
- Projecting the total numbers of marine fishes from their rate of discovery: 20,000?

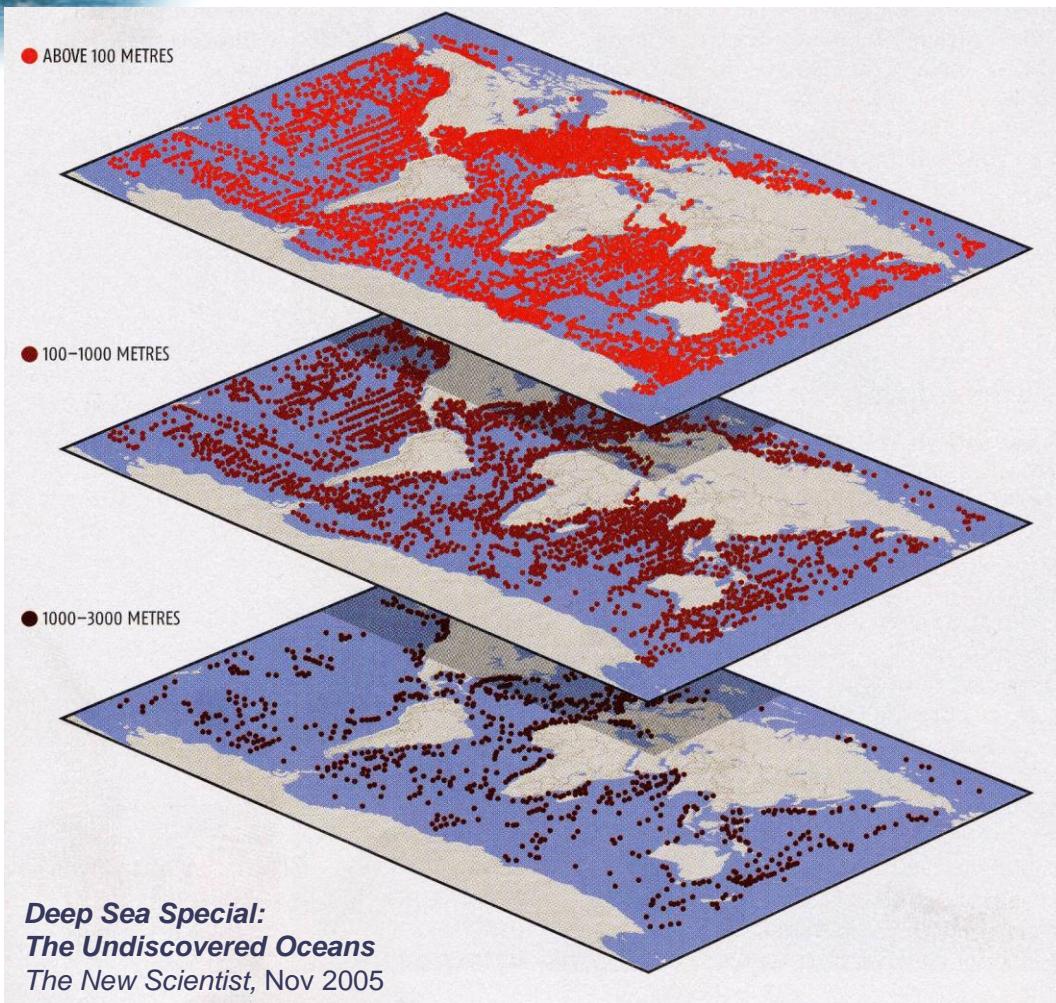
Most species yet to be discovered are in the deep parts of the oceans & on bottom



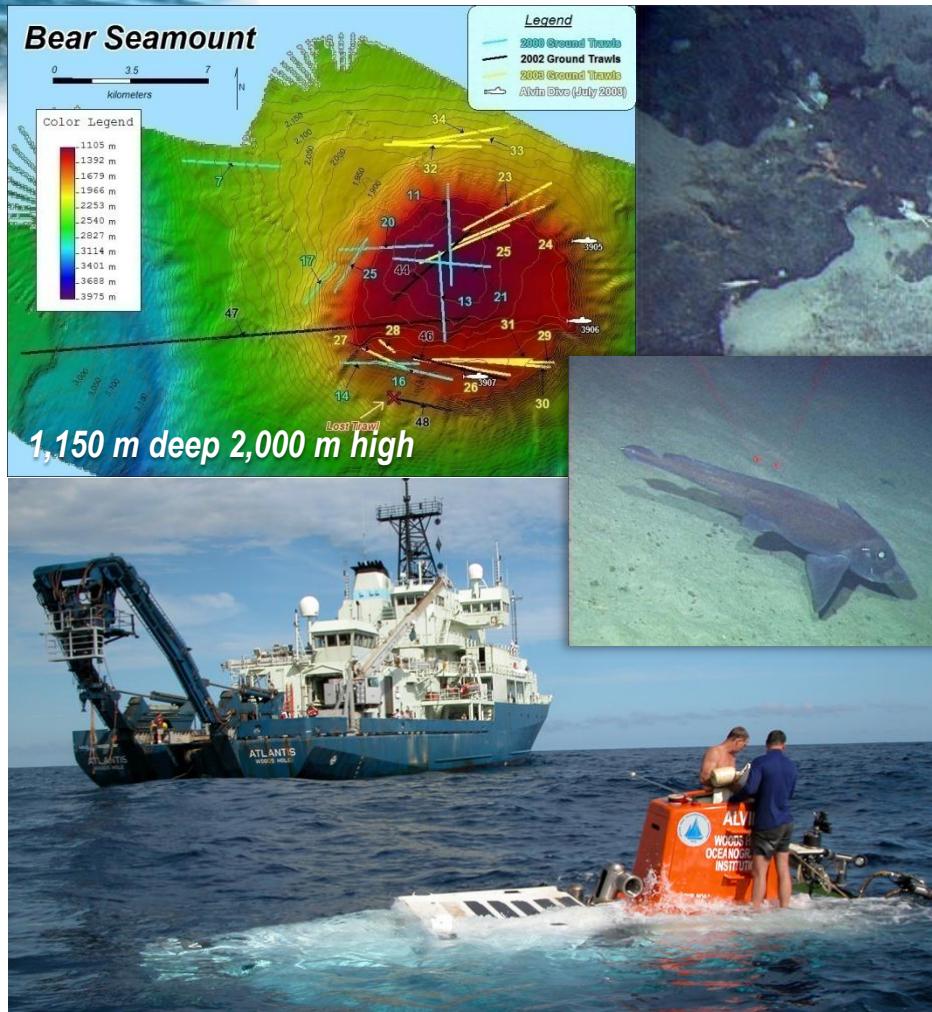
*Mora, Tittensor & Myers 2008
Proceedings of the Royal Society*

How Much of the Oceans Has Been Explored?

Mean Depth 4,000 m



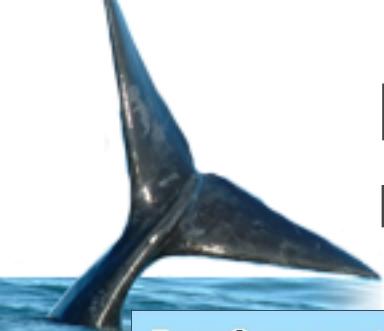
Documenting marine biodiversity requires an exploration capability



Bear Seamount off New England
NOAA Ocean Exploration



Michael Vecchione, Smithsonian & NOAA





Emerging Threats to Marine Biodiversity

Climate Change Impacts

- ocean acidification
- sea level rise
- changes in fresh water in coastal areas
- loss of sea ice (at both poles)
- ocean warming and changes in circulation



Bleached Coral



Harmful Algal Blooms



Pollution

Marine Sound & Vessel Traffic
(sonar, shipping, construction, oil and gas exploration)

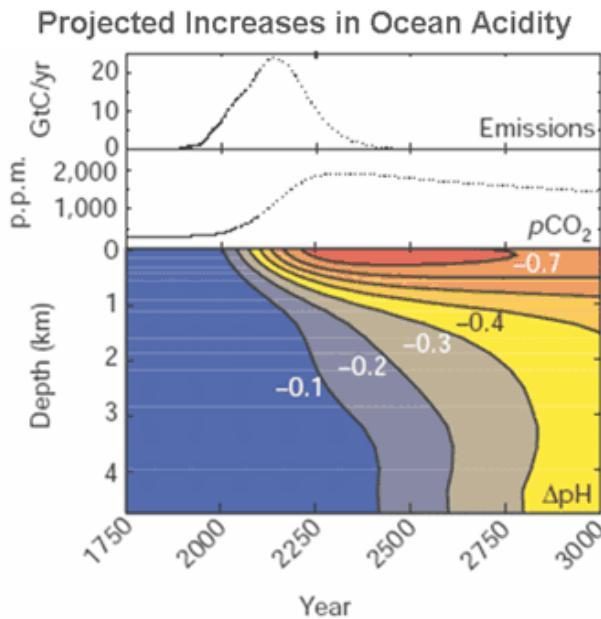
Pollution (plastics, endocrine disruptors , marine debris)

Coastal habitat loss and nutrient enrichment, HABs, Hypoxia, loss of sea grasses



Ocean Acidification:

A Consequence of Human Production of Greenhouse Gasses – Potentially Serious consequences for MBD



Ocean Acidification
That 'other' CO_2 problem

2005 Fishery Landings Value = \$3.933 Billion
(First Sale)



Value:

Bivalves: **\$732M ex-vessel commercial value**

Crustaceans: **\$1,265M ex-vessel commercial value**

Combined : **\$1,997M ex-vessel commercial value**
(51% of commercial catch by \$)

Potential impacts on shelled plankton, coral reefs (shallow and deep), bivalves and crustaceans, and marine food chains

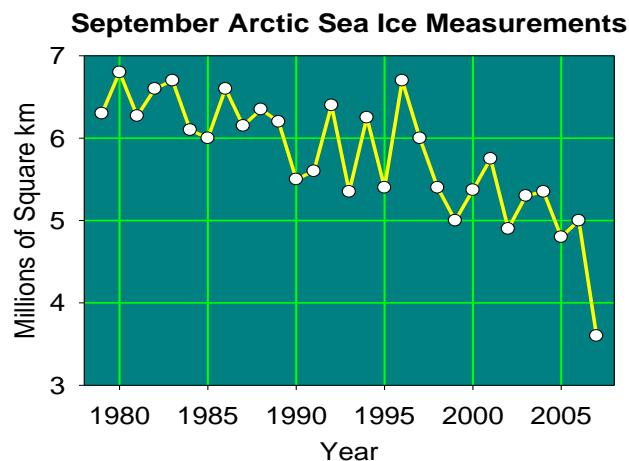
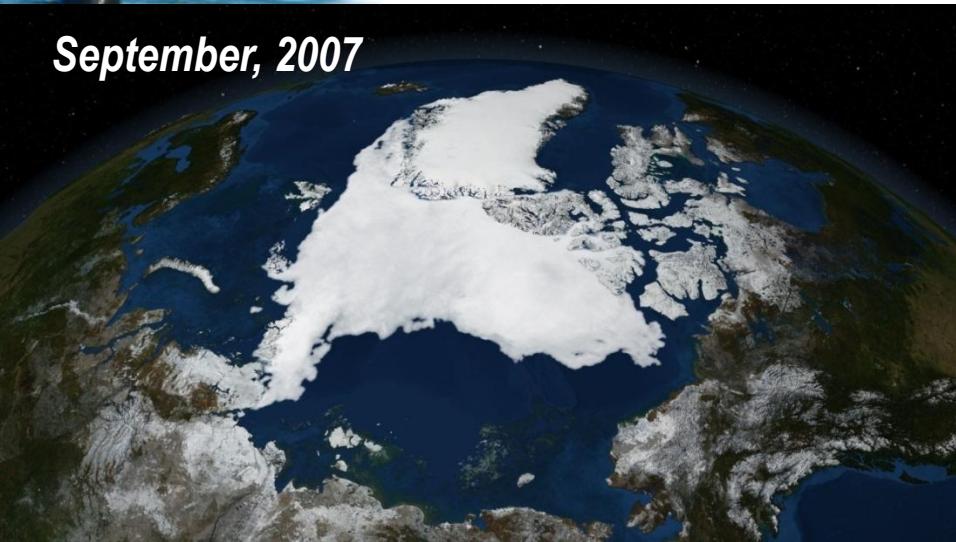
New National Research Council Ocean Studies Board Study on OA

Loss of Arctic Sea Ice

Ecological Implications



September, 2007



NOAA Trust Resources
MMPA + ESA

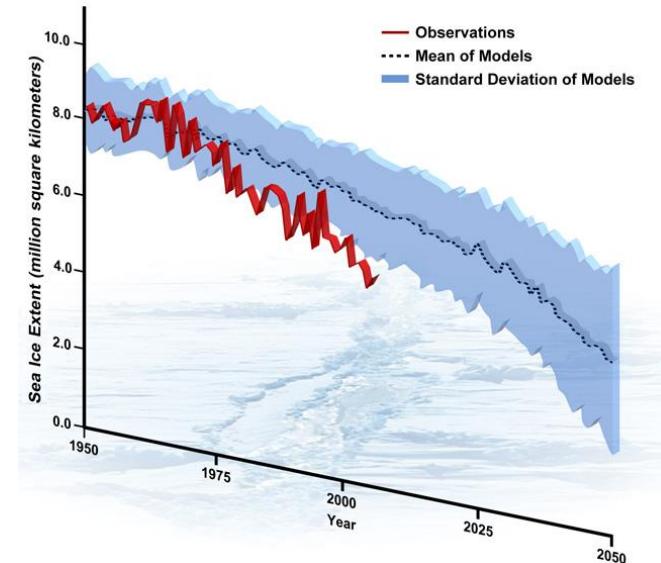


*Ringed, Ribbon,
Spotted , Bearded
Seals*



+Arctic FMP

Arctic September Sea Ice Extent:
Observations and Model Runs



Petitions To List





Conserving Marine Biodiversity

Enforceable Legal Instruments are a Key

Marine Fisheries –Magnuson Stevens Fishery Conservation and Management Act (MSRA) **dictates overfishing ended by 2010**; reduction of bycatch, protection of essential fish habitat and increasing ecosystem approaches to fisheries

- International Regional Fishery Management Organizations (RFMOs) coordinate multi-lateral interests with mixed success (e.g., ICCAT), IUU

Marine Mammals –Marine Mammal Protection Act (MMPA) generally successful in increasing marine mammals with some exceptions (Steller Sea Lion)

Other Endangered Species – All sea turtles, Anadromous salmonids, some invertebrates, most large whales managed under Endangered Species Act in the USA

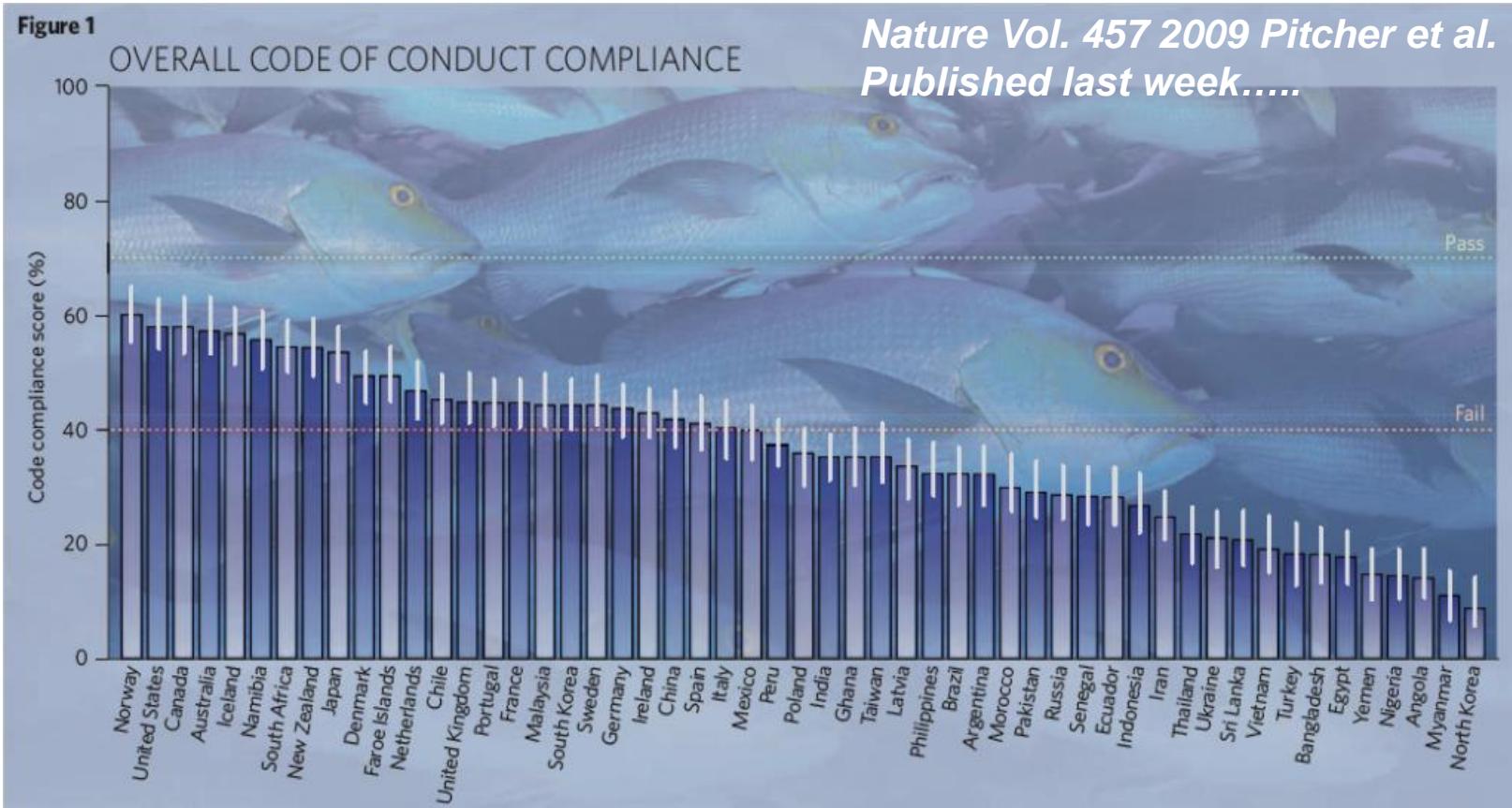
Corals and other Vulnerable Marine Ecosystems (VMEs) – Increasing domestic and international focus. USA - National Marine Sanctuaries Act, Coral Reef Conservation Act



Compliance with the Voluntary FAO* Code of Conduct for Responsible Fishing

Even countries such as Norway & the USA do not have perfect scores

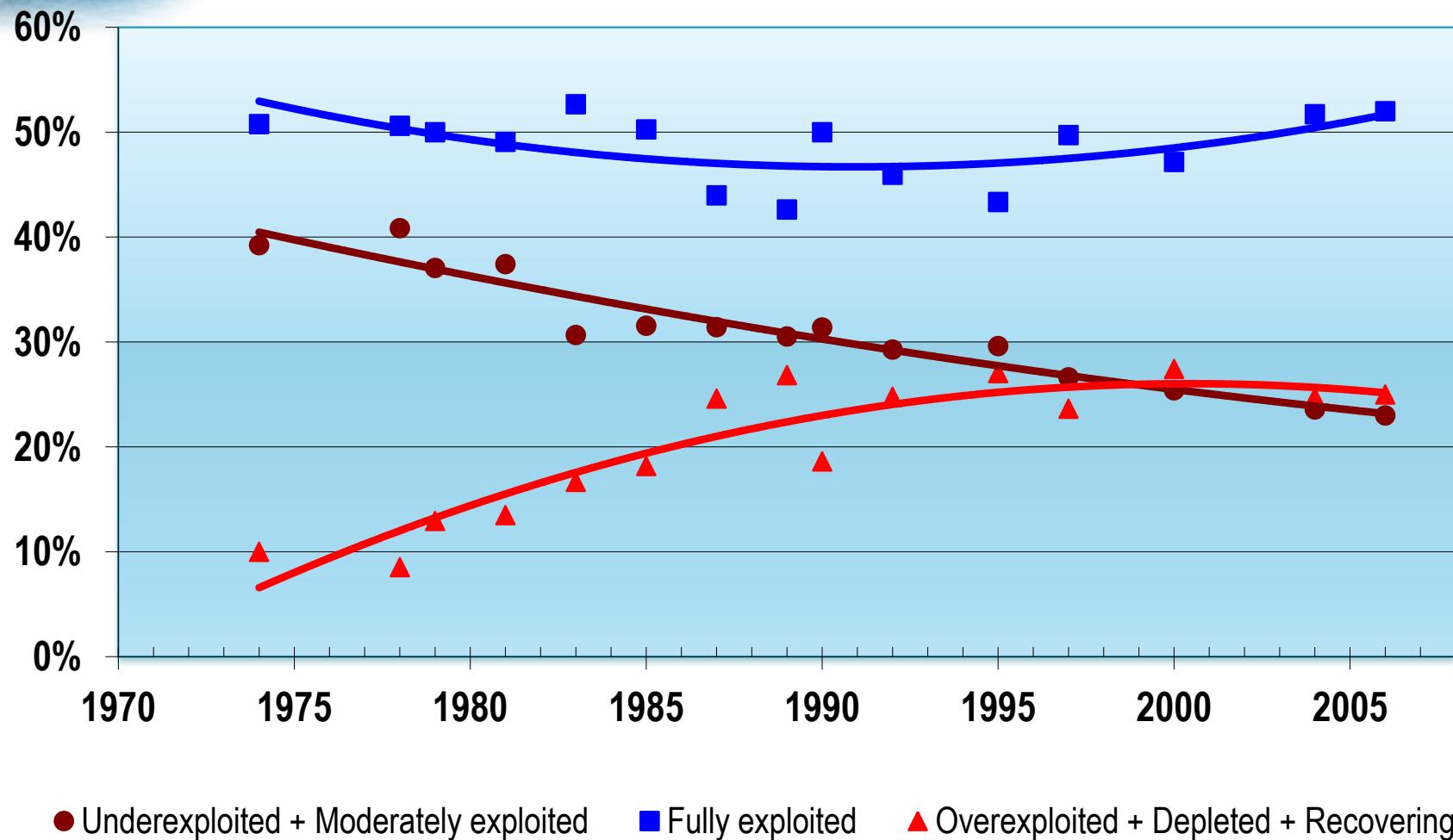
N.B.—Much to do in implementation despite strong laws



*FAO = Food and Agriculture Organization of the UN

Global Trends In The State Of World Marine Fish Stocks Since 1974

Ray Hilborn, *Ecosystems* 2007



● Underexploited + Moderately exploited

■ Fully exploited

▲ Overexploited + Depleted + Recovering

USA Stocks “Subject to Overfishing” (42) – as of 4th quarter 2008

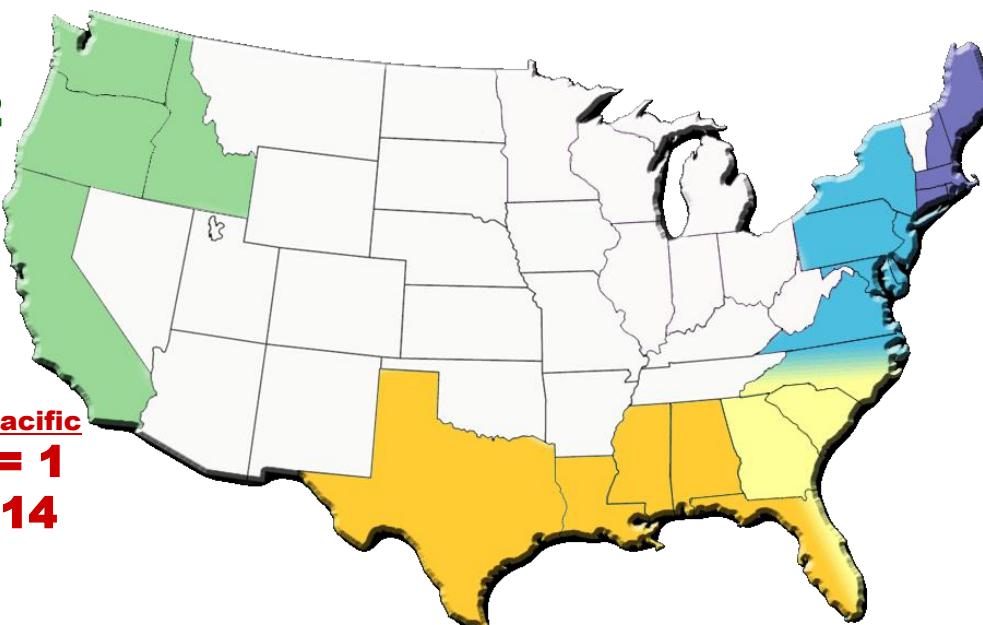
Overfishing = the harvest rate (% caught of the stock per year) exceeds maxima for sustainable fisheries



17% of USA Stocks Overfishing Occurring

56% of managed stocks currently assessed

Northwest & Alaska:
Overfishing = 2
Unknown = 14



Southwest and Western Pacific
Overfishing = 1
Unknown = 14

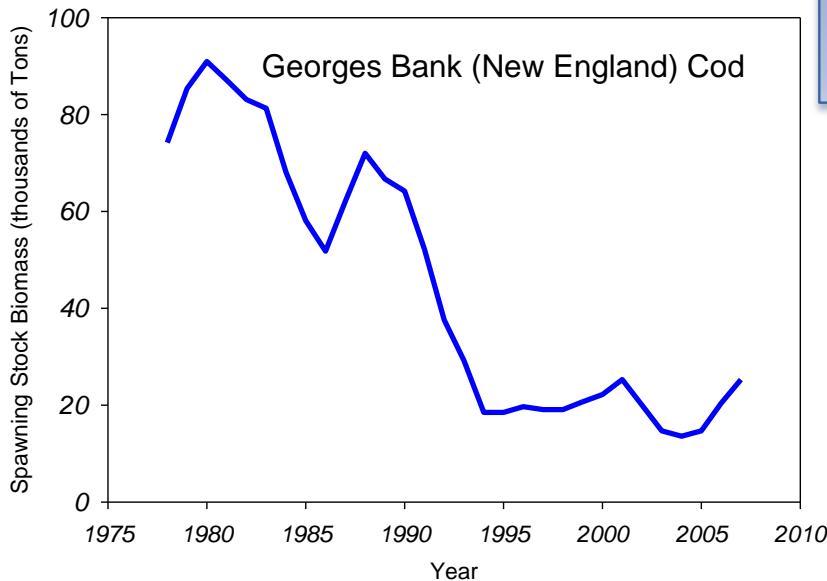
Northeast:
Overfishing = 10
Unknown = 4

Highly Migratory Species:
Overfishing = 9
Unknown = 2

Southeast:
Overfishing = 20
Unknown = 8

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Sustainable Fisheries

Fishing Can Be An Intense Source Of “Un-natural” Selection



Cod in the North Atlantic
Likely Evolutionary Shift to earlier onset of
Sexual Maturity
LIVE FAST, DIE YOUNG!



Average age of attainment of female sexual maturity has declined from 3.5 years to 2.1 y or from 2.9 kg average weight to 1.5 kg

1978-2007

Known Locations of Deep-Sea Corals USA EEZ

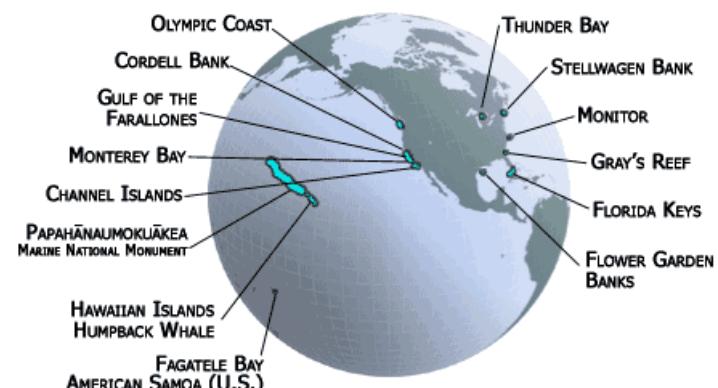
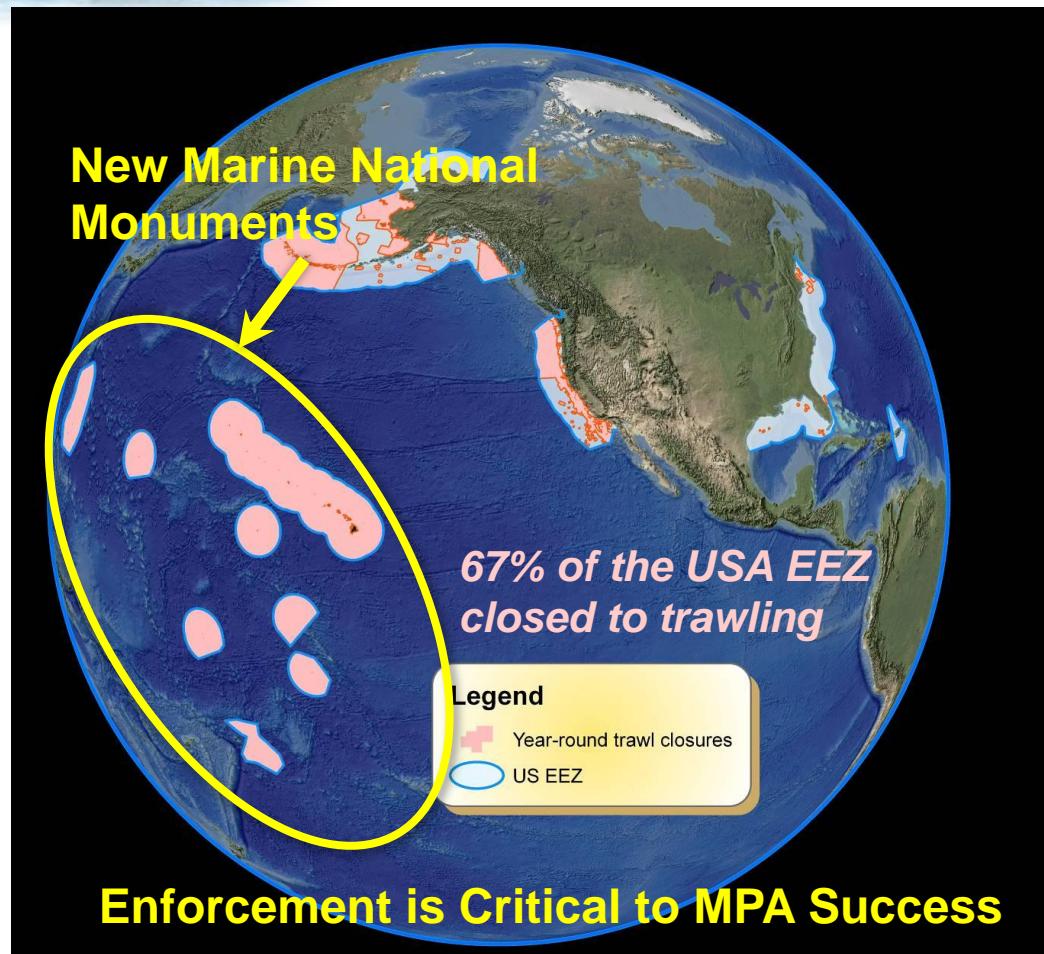
The major threat to deep coral is bottom fishing with trawls & dredges

- locations of documented deep-water coral presence
- U.S. EEZ

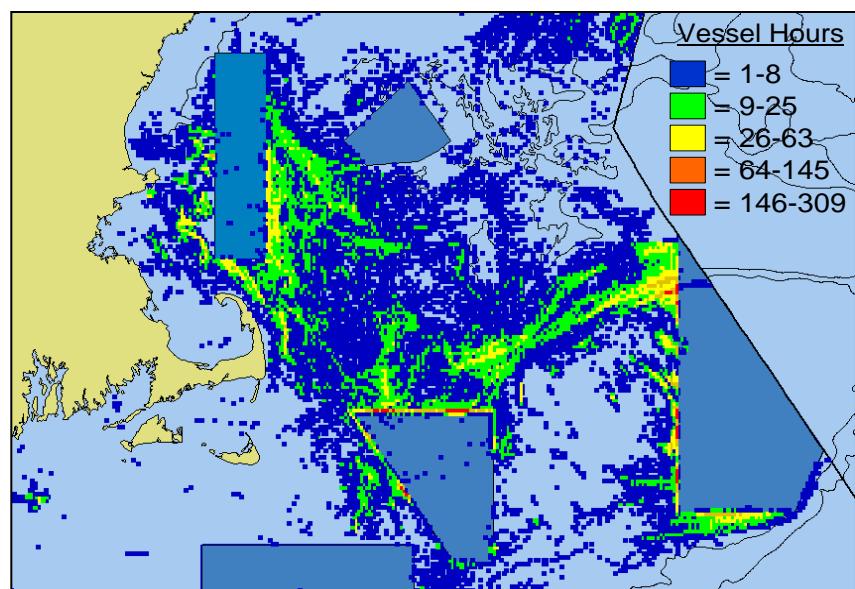


Marine Protected Areas (MPAs)

A Management Tool serving Multiple Purposes to Protect MBD



US National Marine Sanctuaries



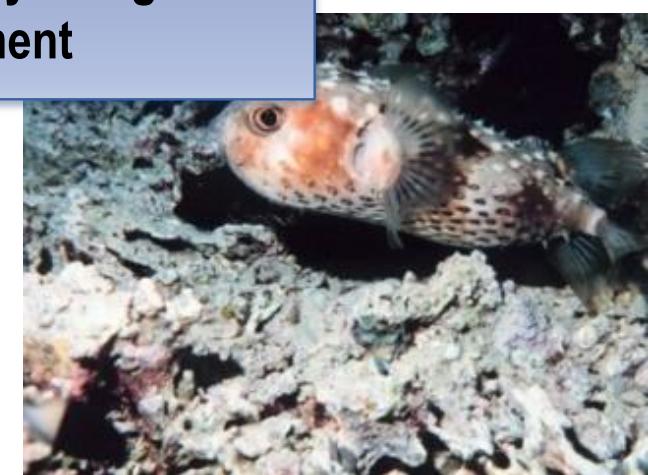


“Plants and animals remote in the scale of nature, are bound together by a web of complex relations”

Origin of the Species, Charles Darwin, 1872



Stewardship of living marine resources through science-based conservation is enabled by using an ecosystem approach to management





Summary

Significant Conservation Challenges worldwide – More Effective Public education required

Strengthen National and International Agreements (formal & Informal)

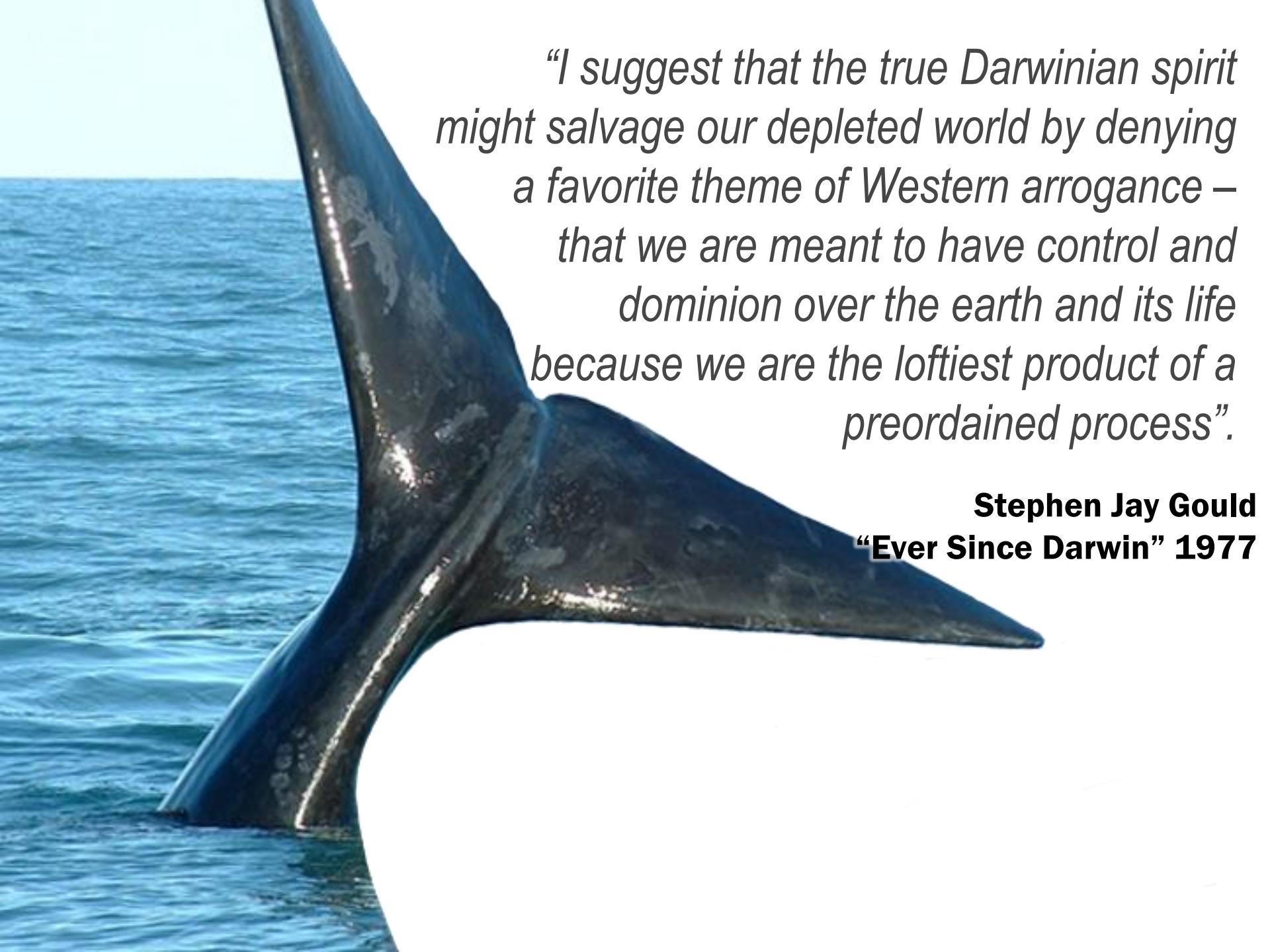
Greater focus on outcomes rather than just processes and agreements

Critical need for capacity building for MBD protection in developing countries

Climate impacts and adaptation strategies are increasingly critical issues facing MBD

Ecosystem approaches to management and economic instruments (ITQs) and MPAs increasingly used

We should beware of excessive commodification of the oceans because there is much we do not know about how they support all forms of life on earth, including our own



“I suggest that the true Darwinian spirit might salvage our depleted world by denying a favorite theme of Western arrogance – that we are meant to have control and dominion over the earth and its life because we are the loftiest product of a preordained process”.

Stephen Jay Gould
“Ever Since Darwin” 1977