

Marine Biodiversity in the 21st Century: Making Ocean Life Count



Dr. Paul Snelgrove
Memorial University of Newfoundland
Canada Research Chair in
Boreal and Cold Ocean Systems

How can we do better as ocean scientists and managers?

The Good News

A Great Time to Study Ocean Life



- **New tools**
- **New discoveries**
- **New opportunities**

Changing oceans



Oceans
past

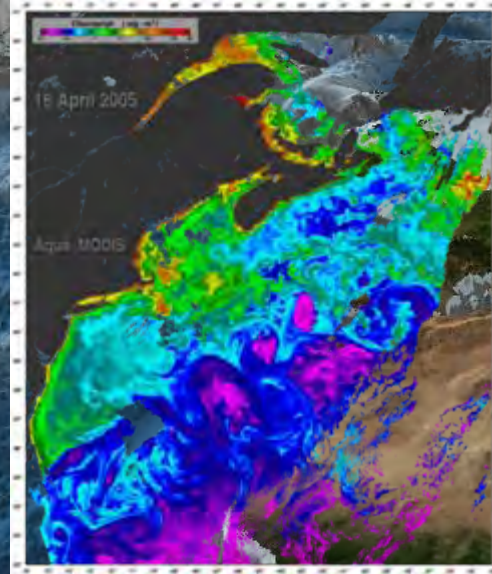
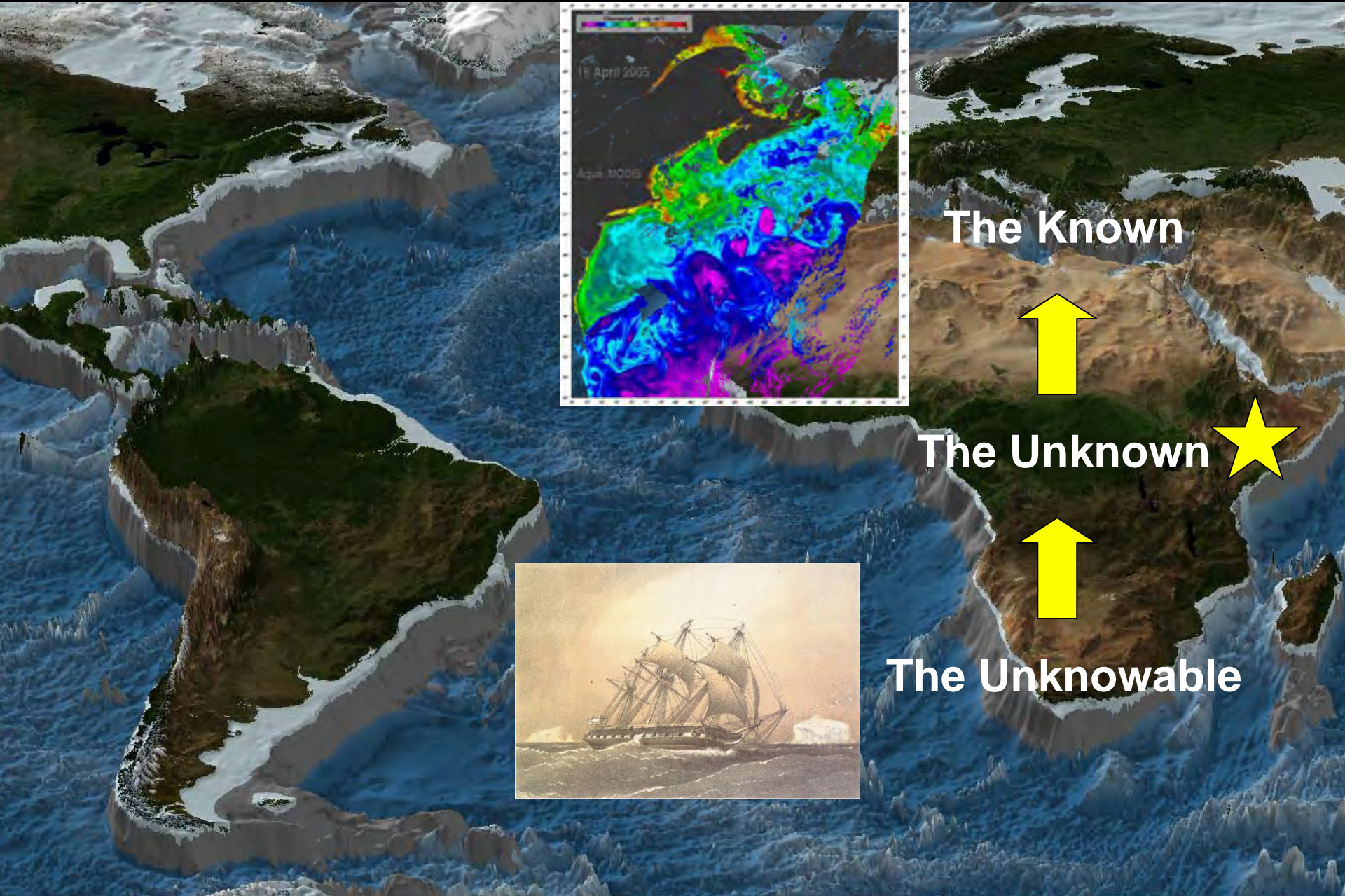


Oceans
present



Oceans
future

Changing technologies



The Known

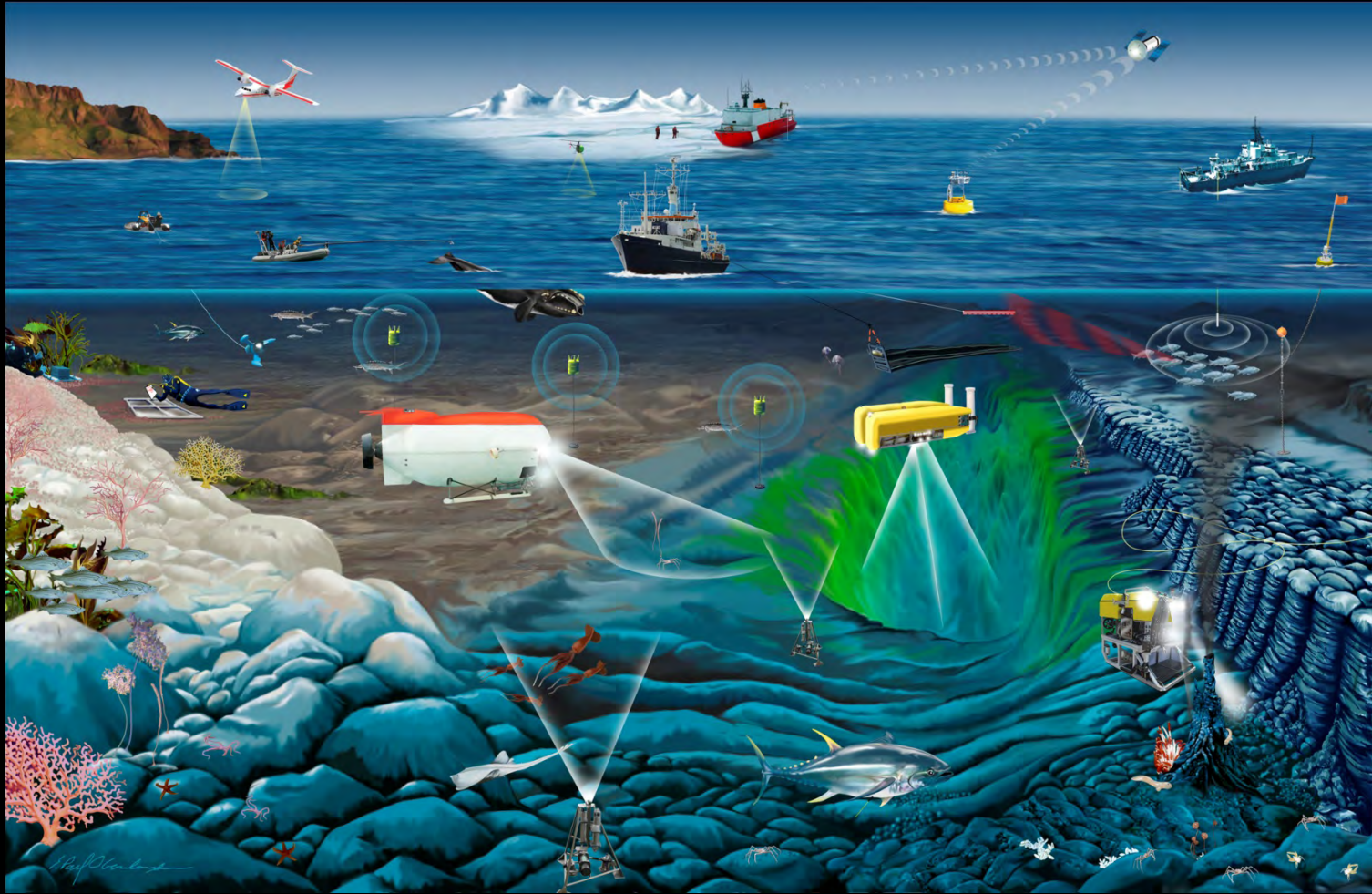
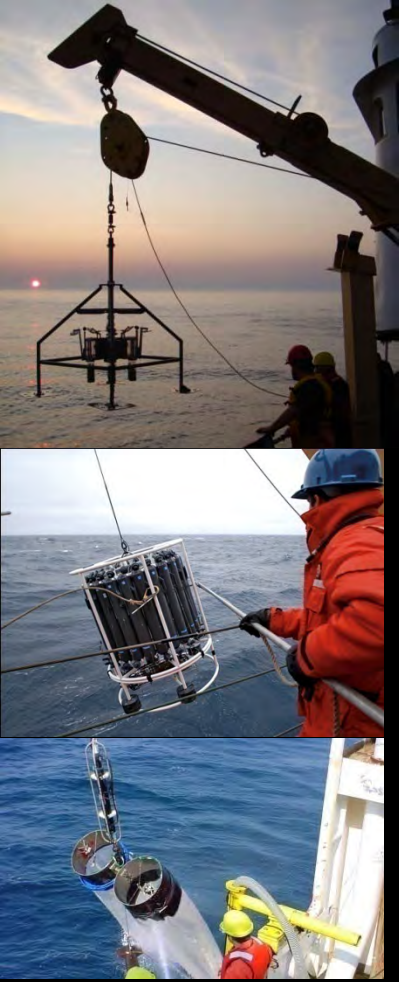


The Unknown ★



The Unknowable

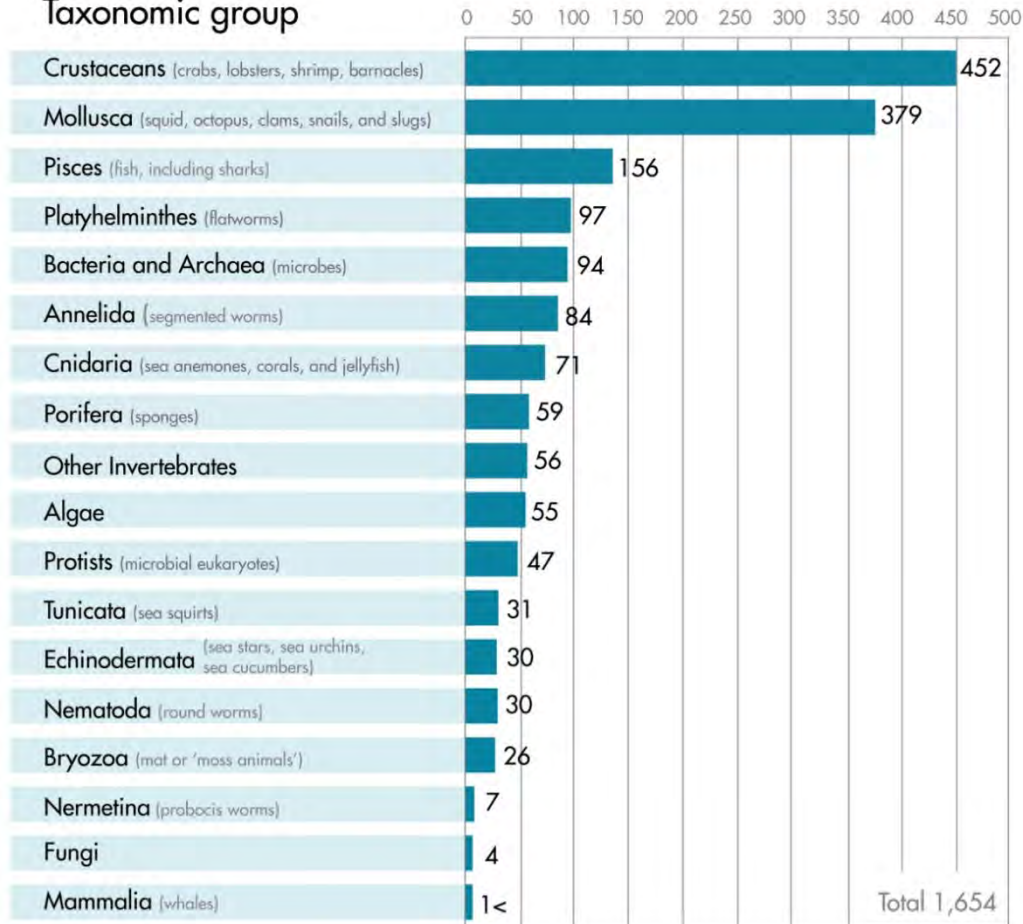
The once opaque ocean



A riot of species

~1654 new ones every year

Taxonomic group



A riot of species

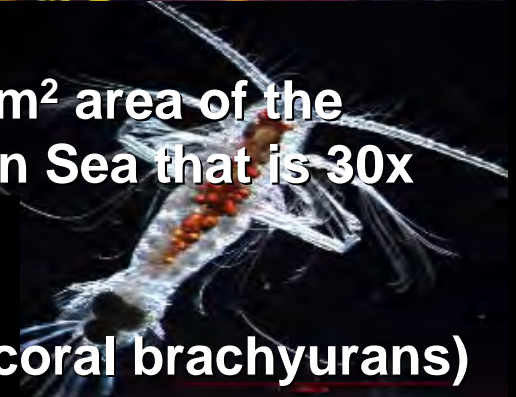
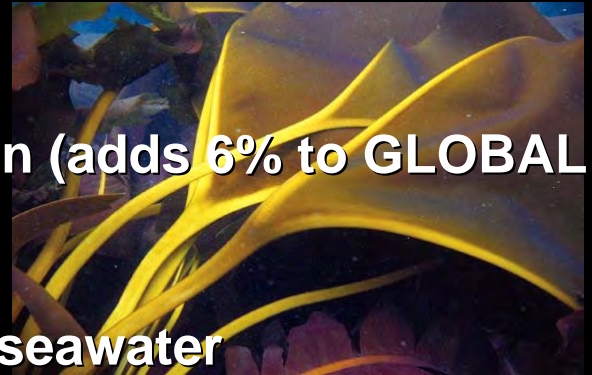
- 90% new isopods in the Southern Ocean (adds 6% to GLOBAL count)

- 160 microbial “species” in one drop of seawater

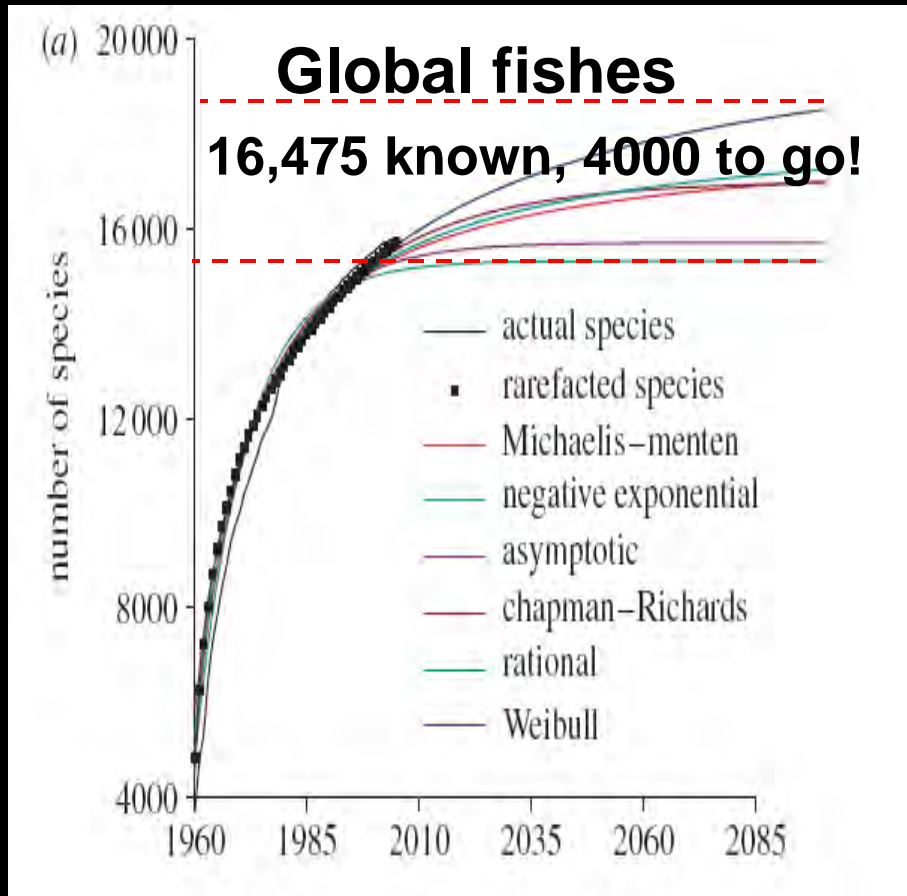
- More molluscs in samples from a 30,000 km² area of the tropical Pacific than all of the Mediterranean Sea that is 30x larger

- Rare is common, common is rare (44% of coral brachyurans)

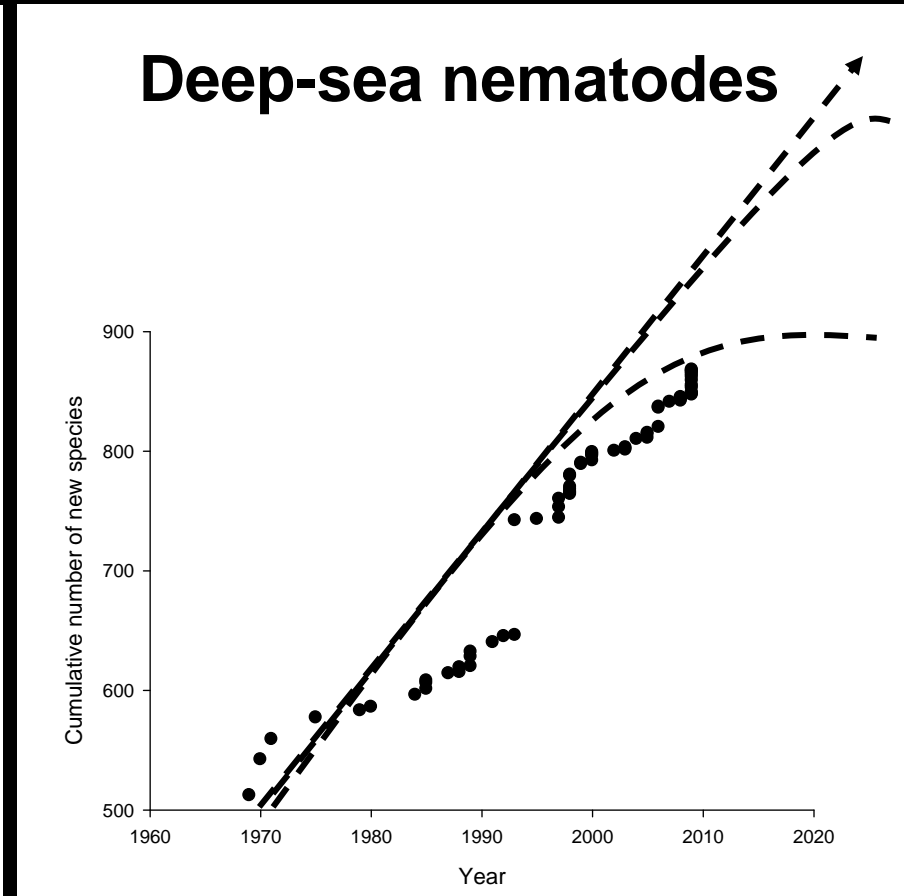
- 22 coral heads had 30% of all brachyurans in European seas.



How many fishes in the sea?



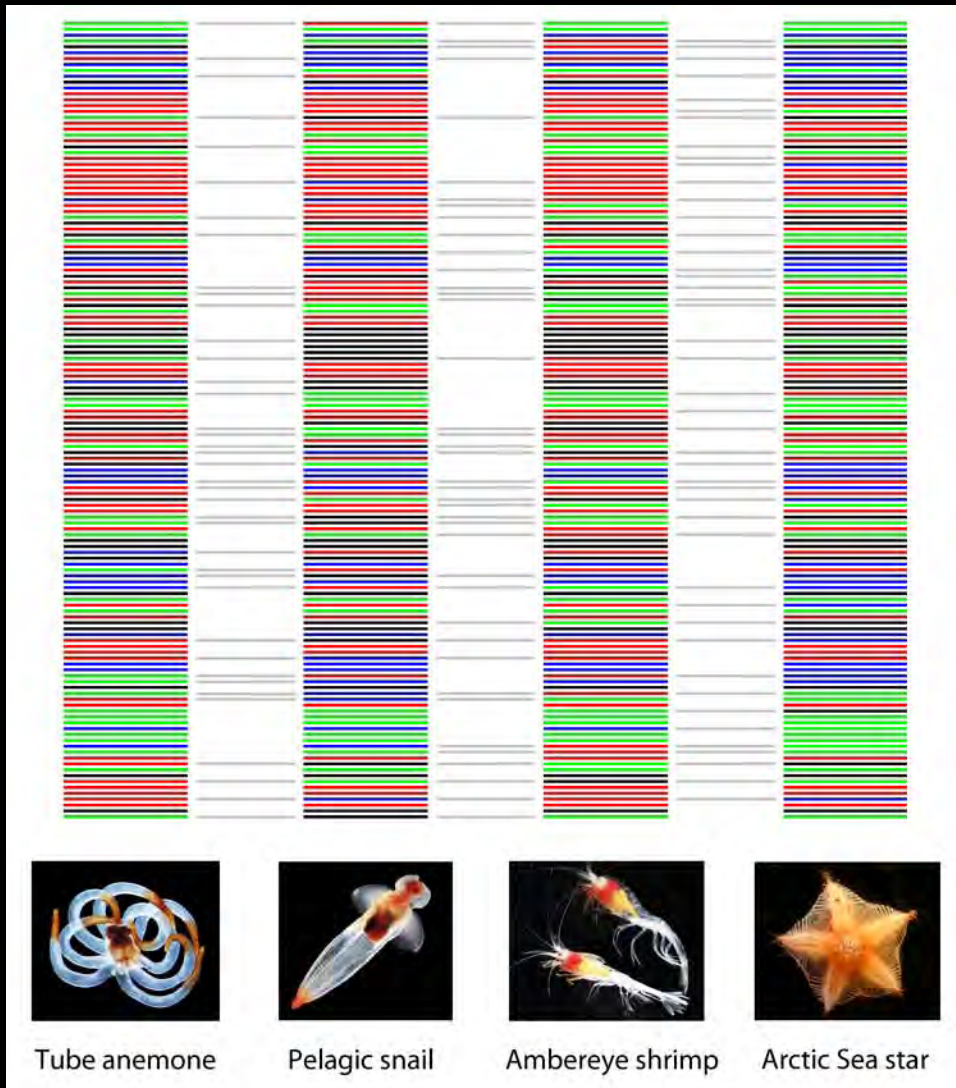
Mora et al. 2008



After Ramirez-Llodra et al. 2010

“People will be more excited about the last unknown, rare species of fish than the last 100,000 unknown species of nematodes.” – P. Bouchet

Barcode of Life



- Faster, unambiguous IDs
- Biogeography
- Sibling species resolved



Some fish sold in New York City are mislabeled as more expensive varieties

Sold as:
White (Albacore) Tuna
\$8.50/lb wholesale

DNA ID:
Mozambique Tilapia
\$1.70/lb wholesale



Photo FishBase M Bariche

Photo FishBase B Gratwicke

What do we know (e.g. Canadian waters?)



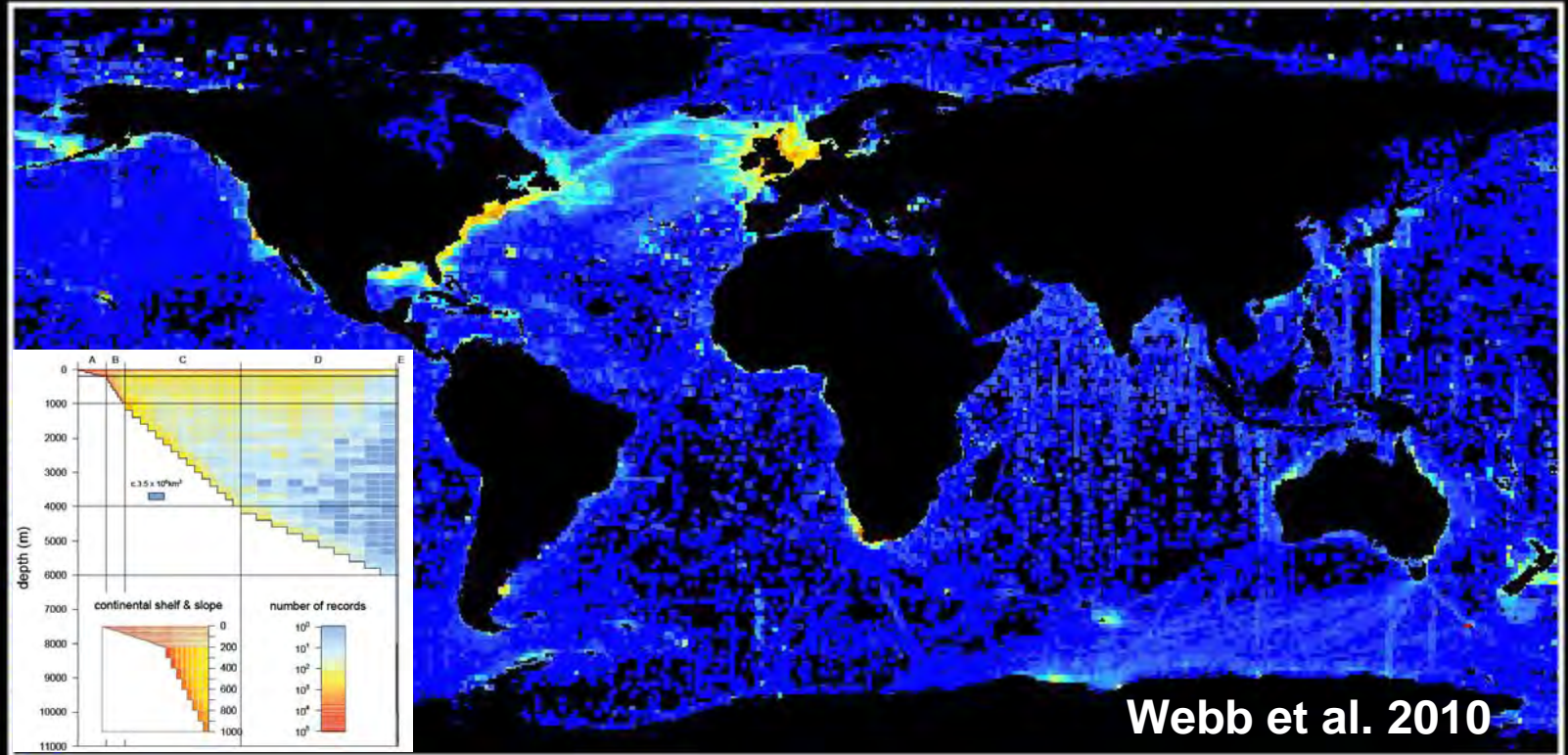
The Rise of WoRMS

- **Misnamed**
- **Double names**
- **Misspelled names**
- **Shared names**

200,000 species by October 2010

www.marinespecies.org

What do we know?



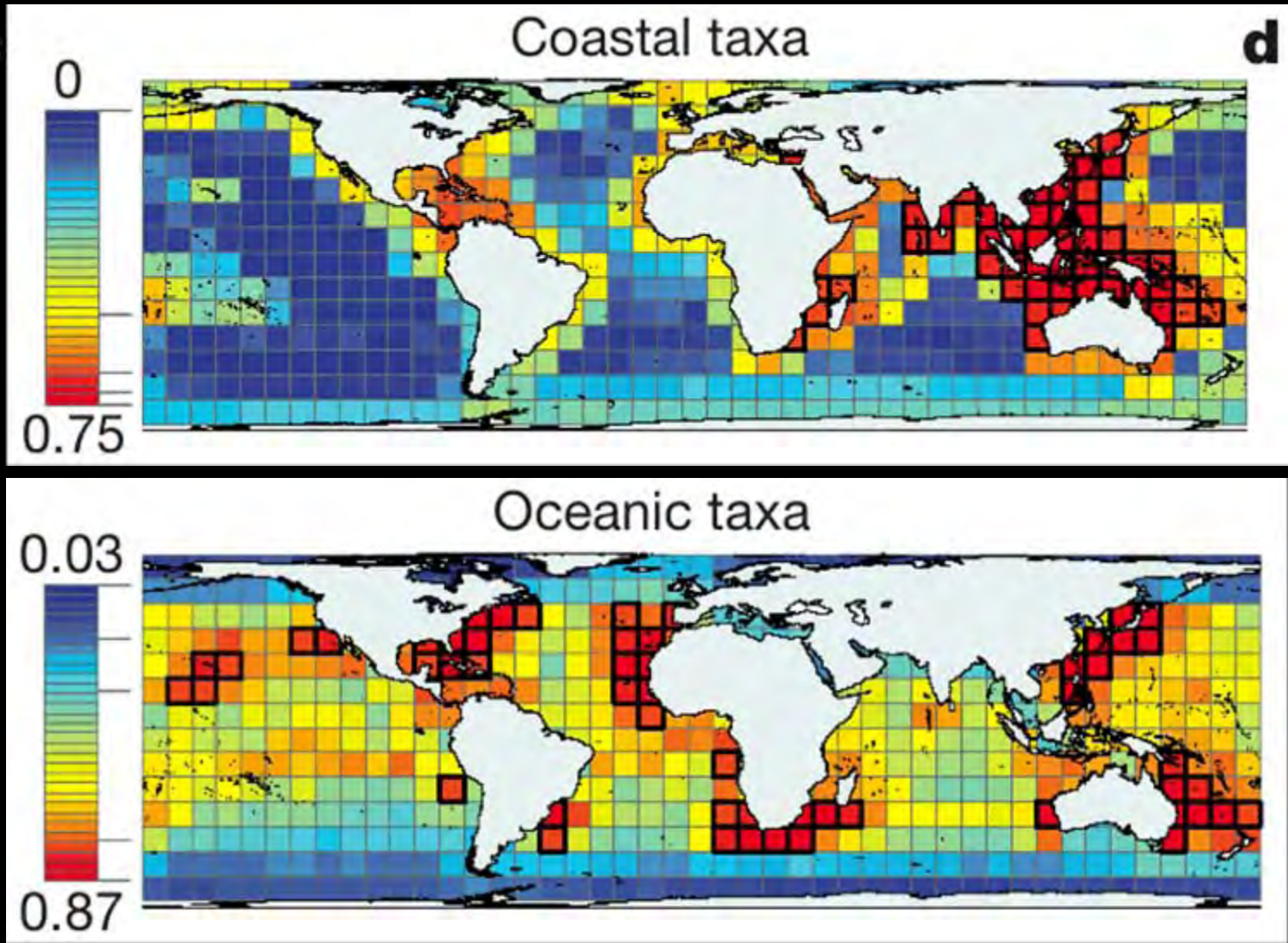
Ocean Biogeographic Information System 28+ million records



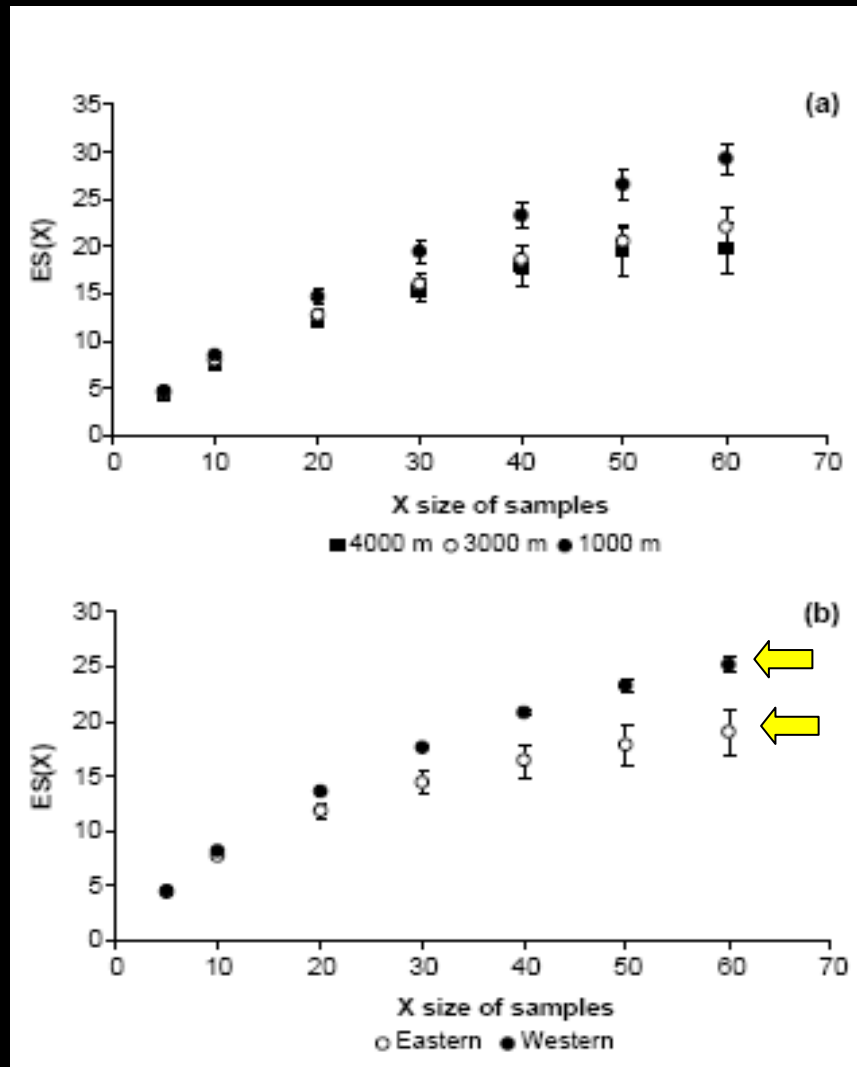
Few

Many

Diversity hotspots (coastal, oceanic)



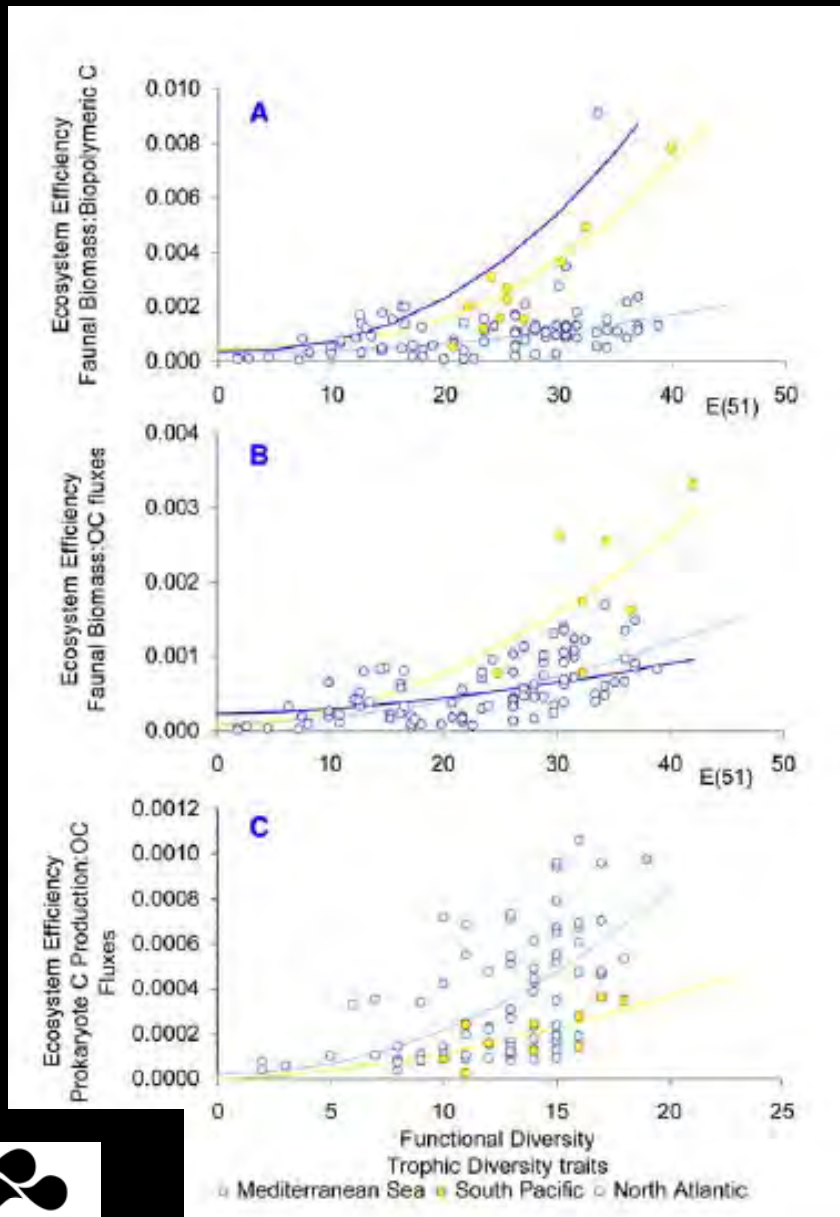
Regional diversity hotspots



**What managers
want to know!**

Danovaro et al. (2008)
Ecography

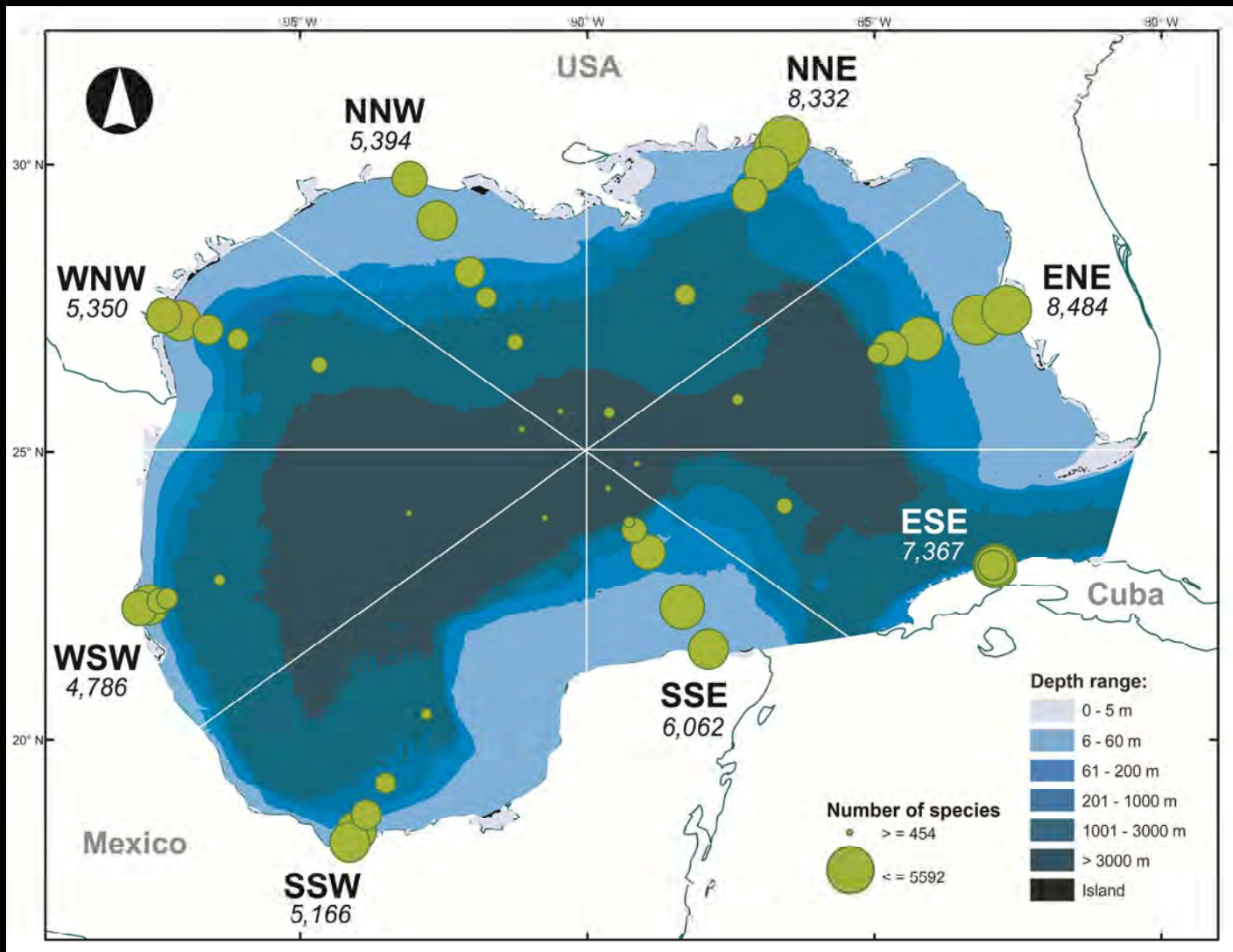
Biodiversity and ecosystem services



Danovaro et al.
(2008) MEPS

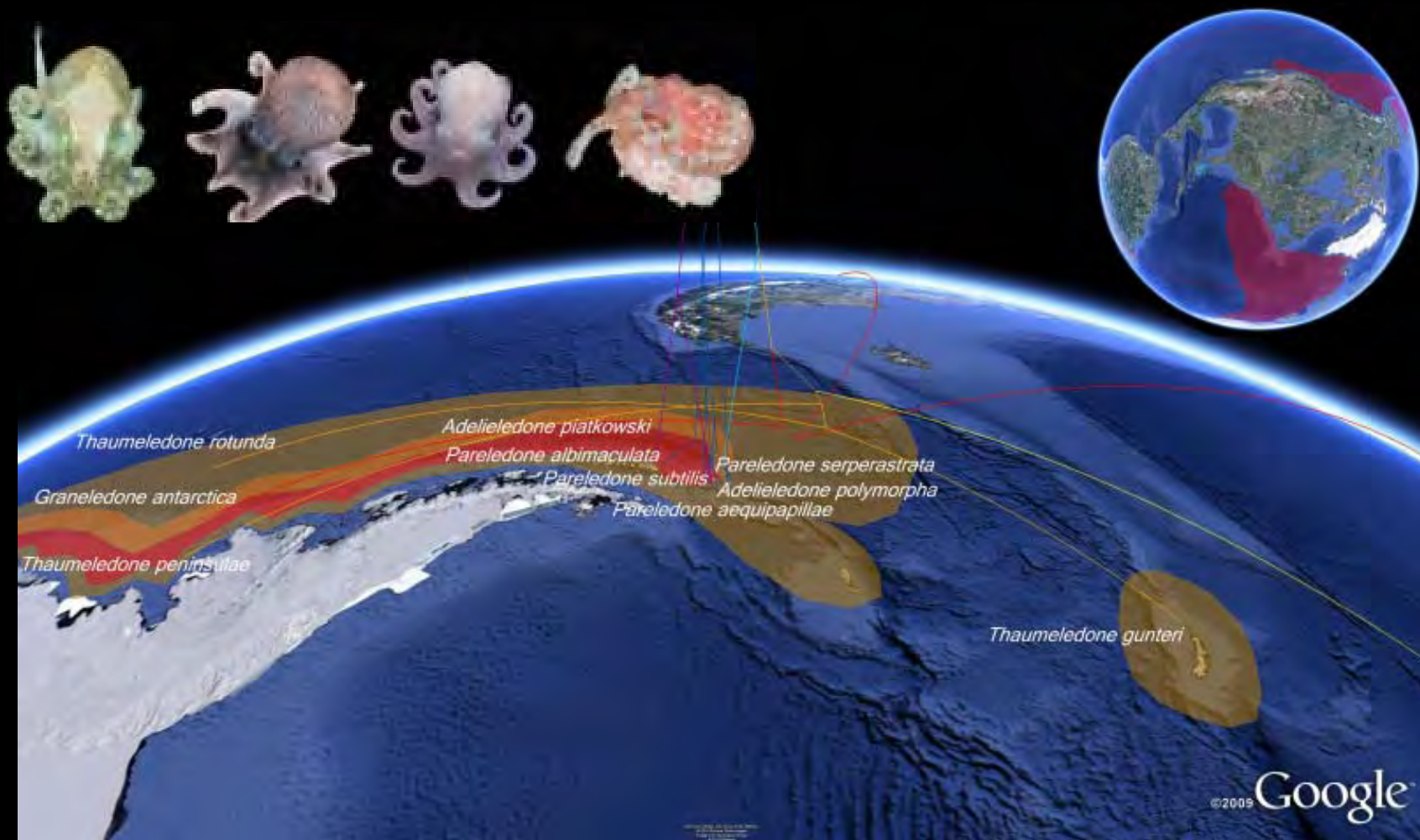
Baseline hotspots

53,000 barrels of oil for 120 days



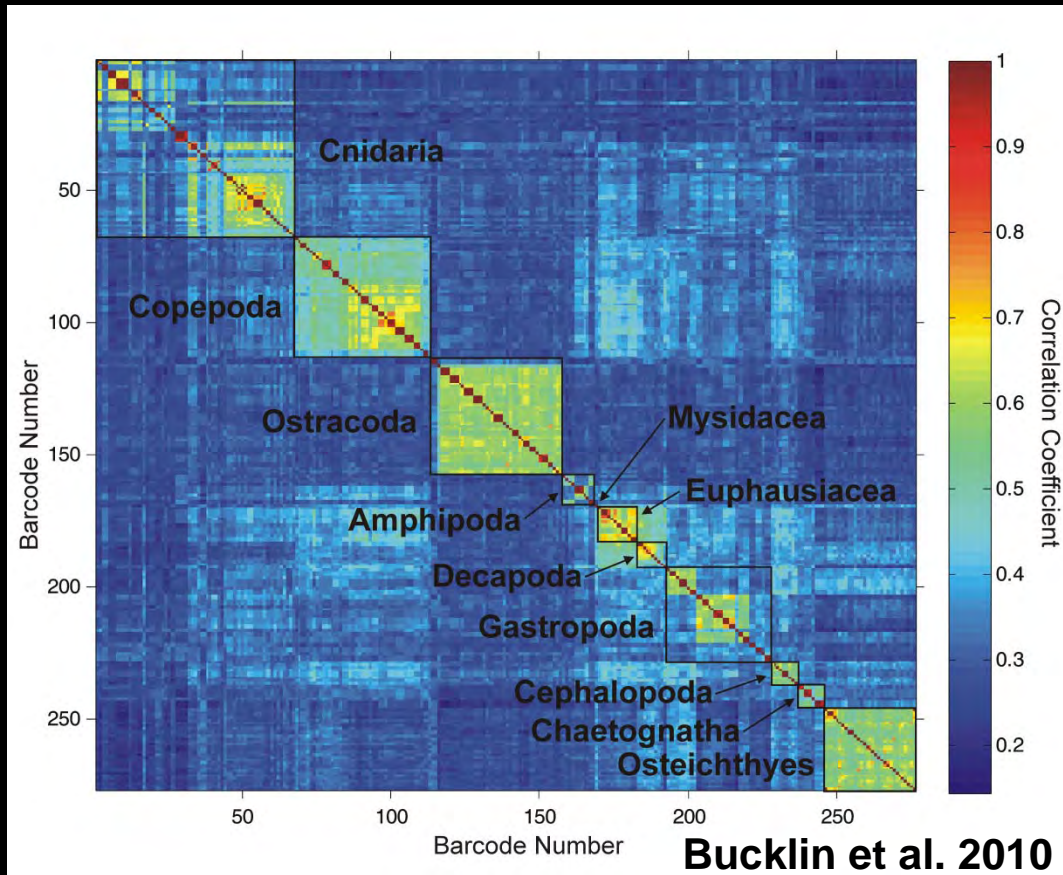
Evolutionary hotspots

The Southern Ocean Octopus' Garden



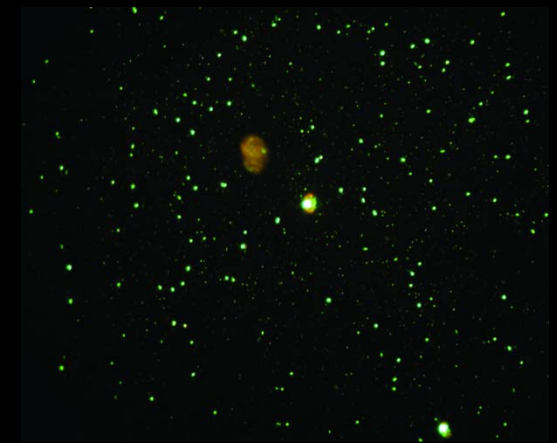
Visualization tools

Klee diagrams



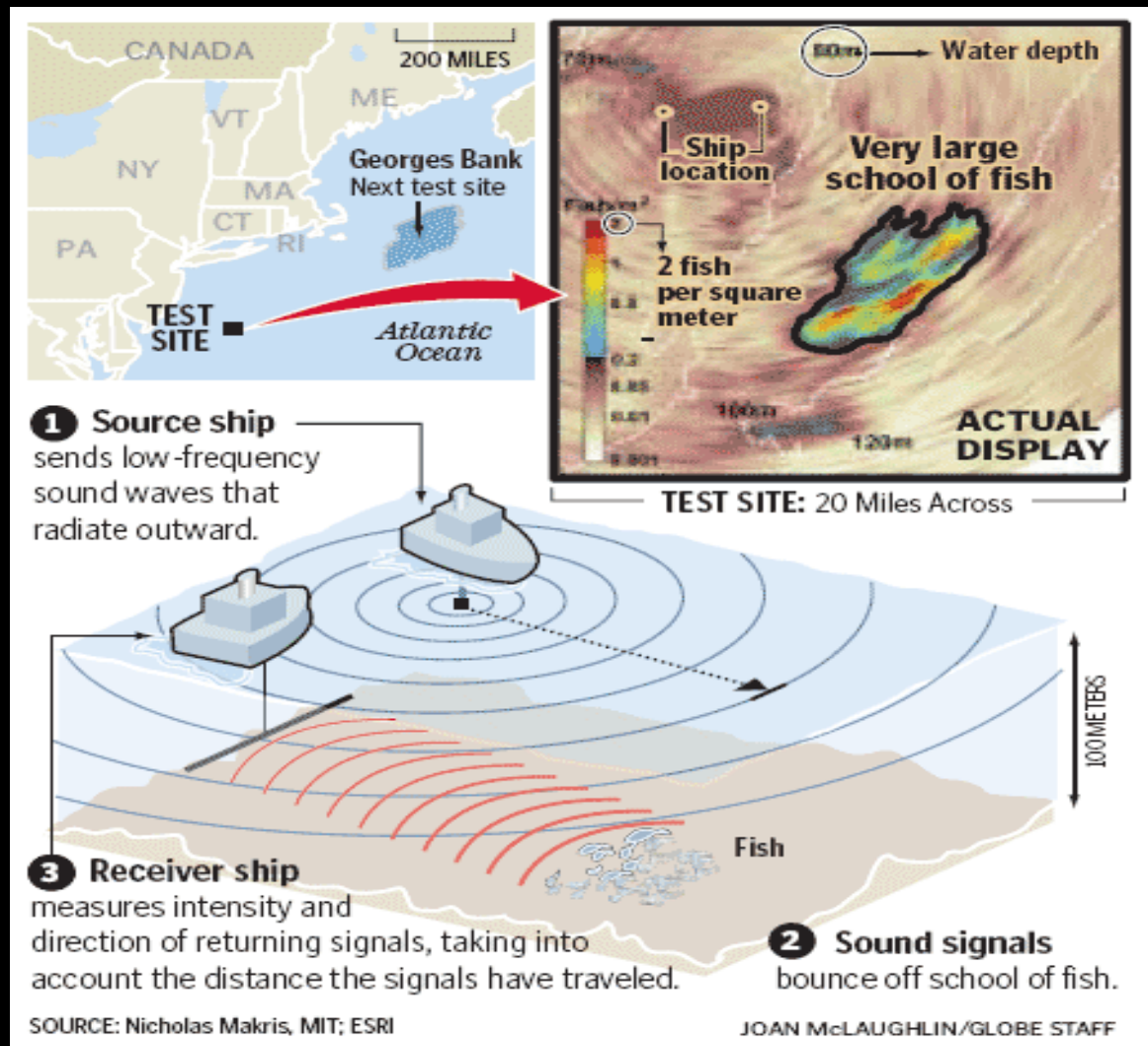
Genetic barcoding with COI gene, target of
38,000 species by October 2010 (Steinke et al.)

Compare evolution
within taxa, among
taxa, among regions

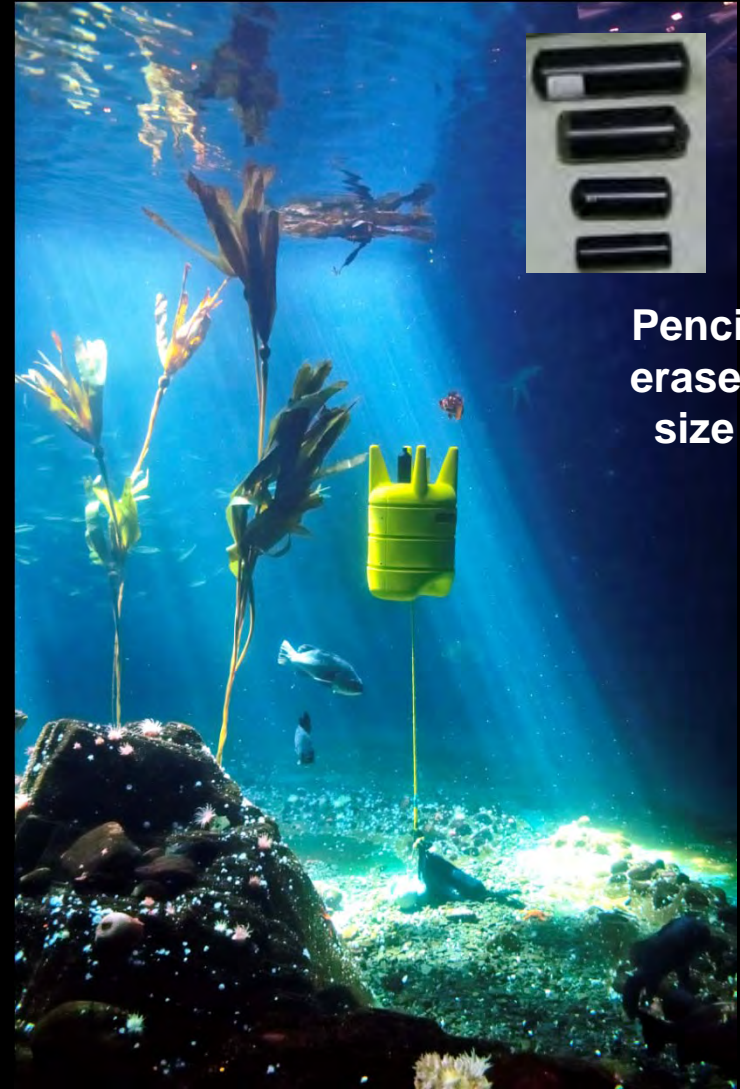
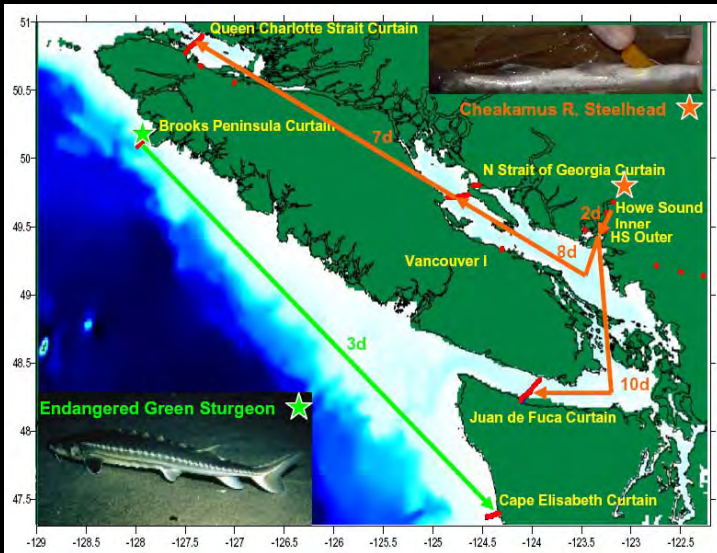


For microbes, 454
pyrosequencing

Counting fishes quickly and automatically

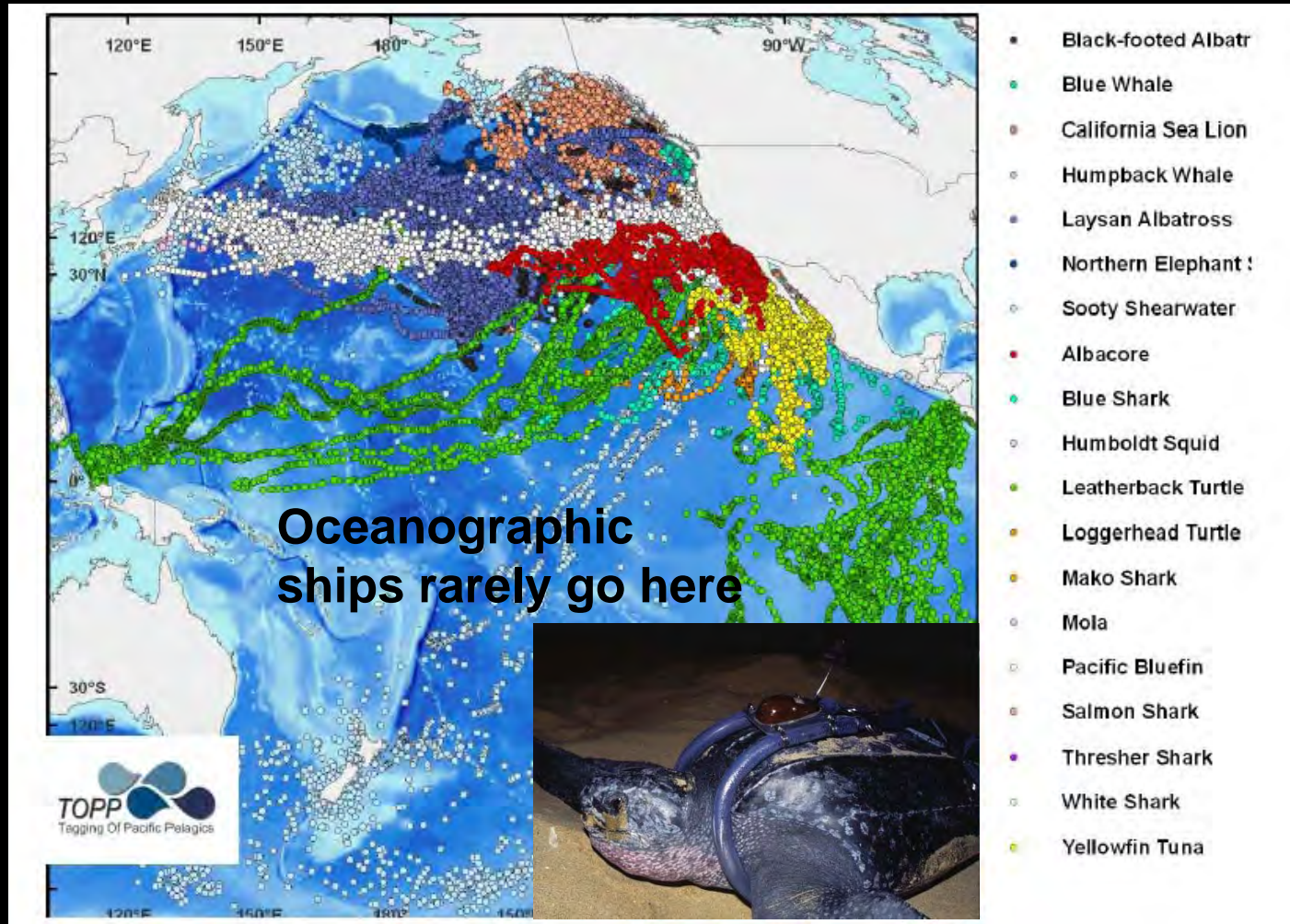


Tracking fishes



Pacific Ocean Shelf Tracking (POST)

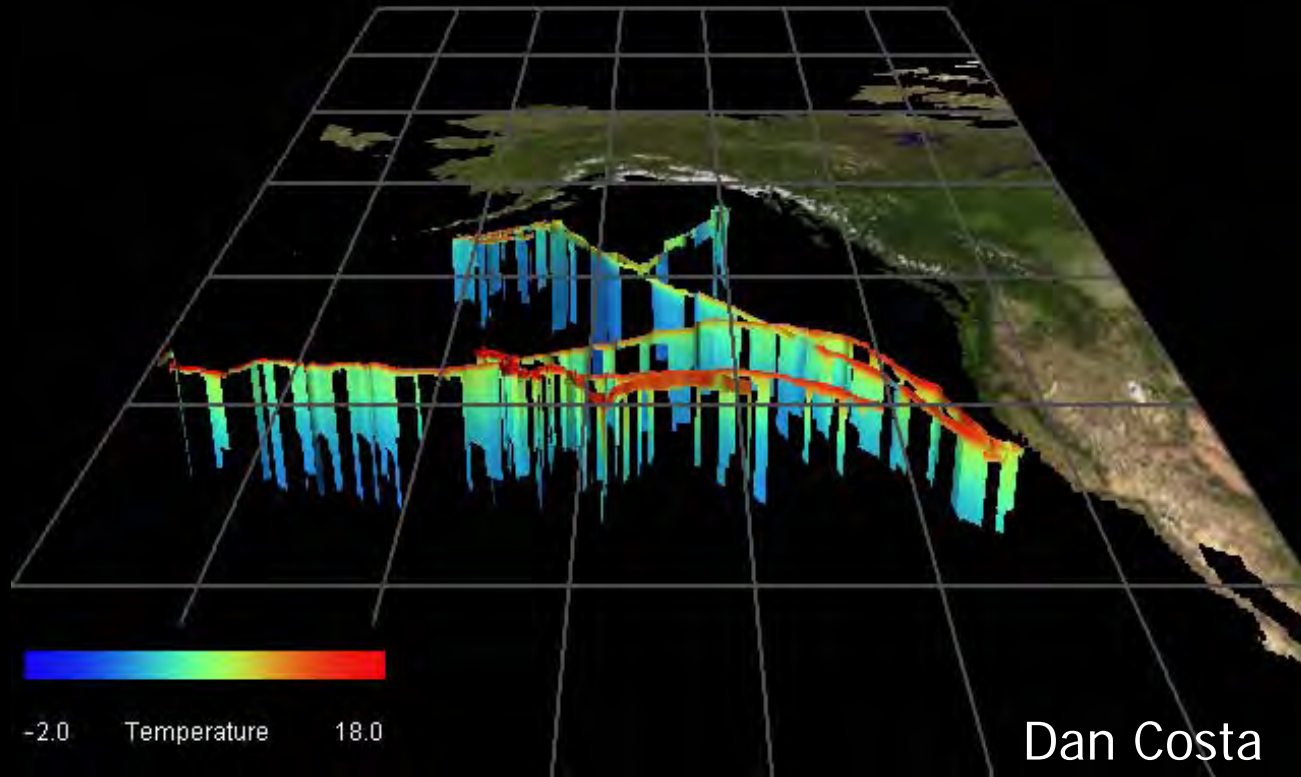
Blue highways, hotspots, coldspots and truckstops



Tagging of Pacific Predators uses GPS and daylight to track animals, satellite phones to call home

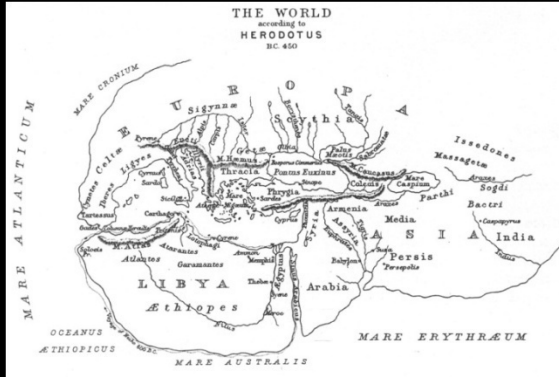
Animals as oceanographic “ships”

06-05 -> 01-23



Changing oceans and environmental history

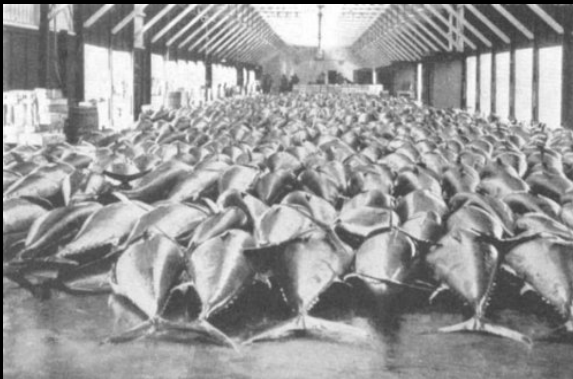
History of Marine Animal Populations



Early use



Early change



Early Depletion



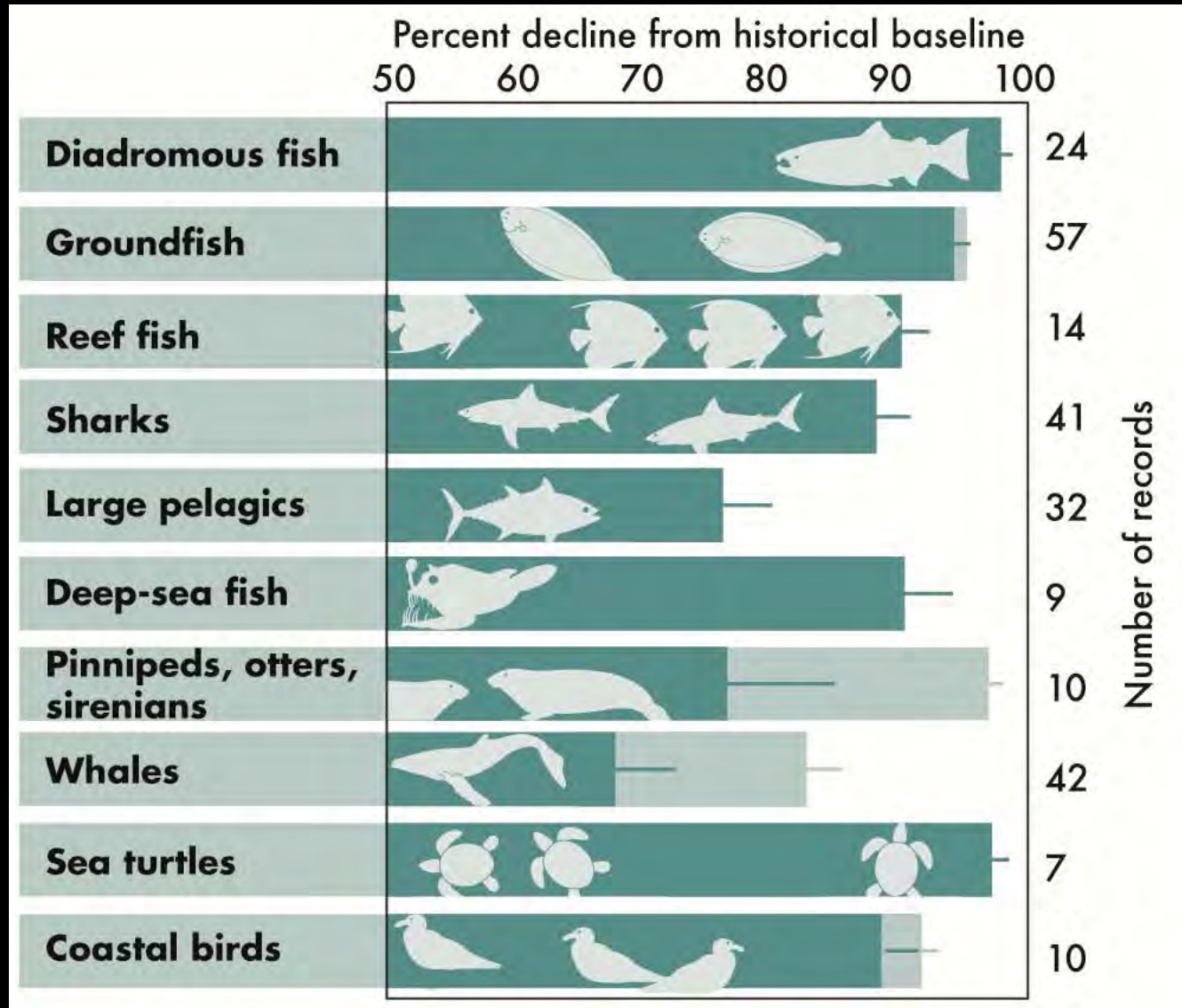
1950s

1980s

2007

Figure 1. Trophy fish caught on Key West charter boats: (a) 1957, (b) early 1980s, and (c) 2007.

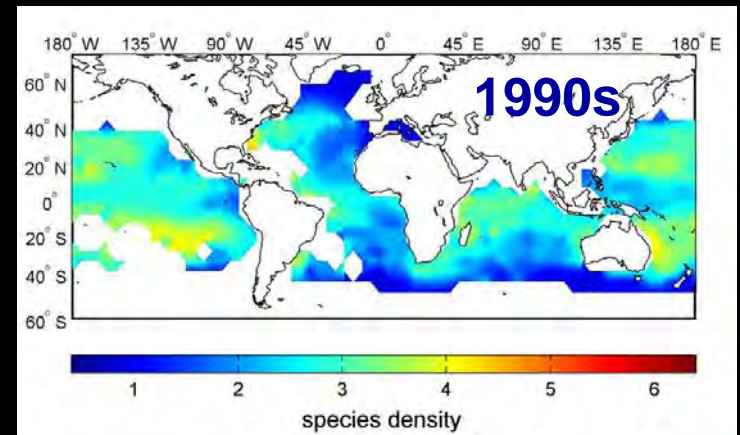
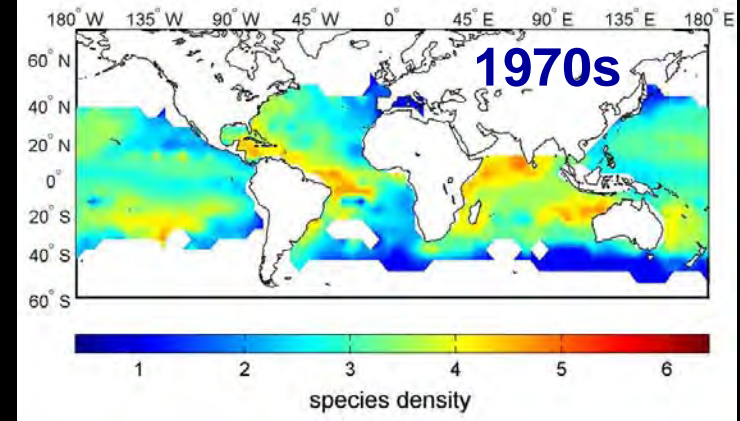
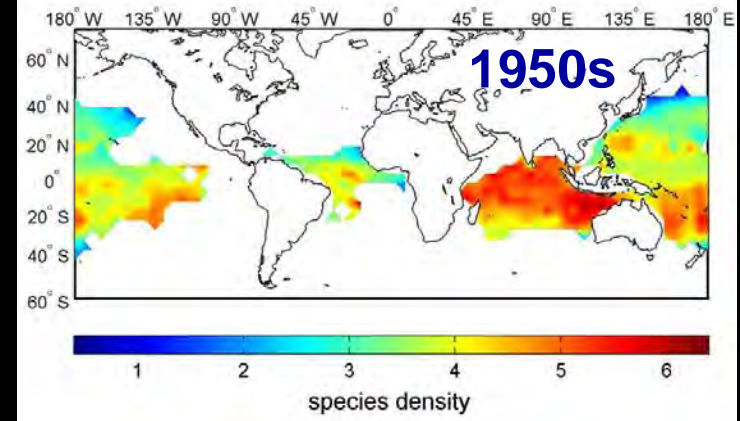
Changing ocean – distant past



Changing ocean – recent past

Tuna and billfish

- Fewer species caught
- Searching wider to find them



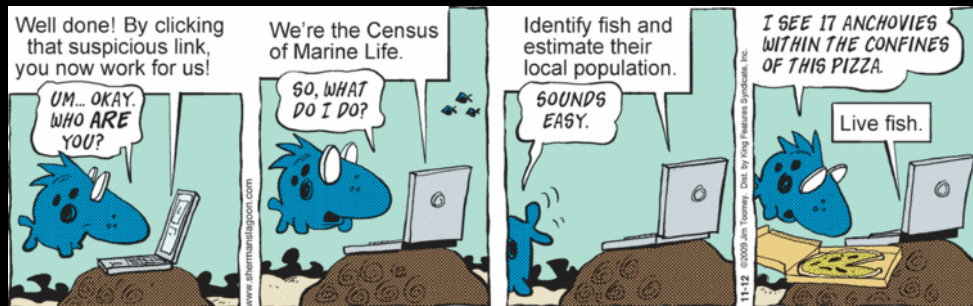
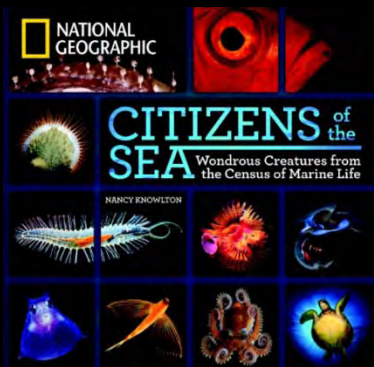
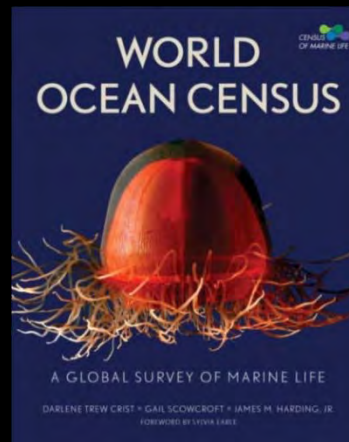
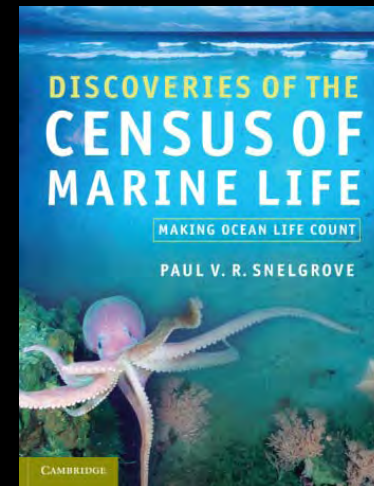
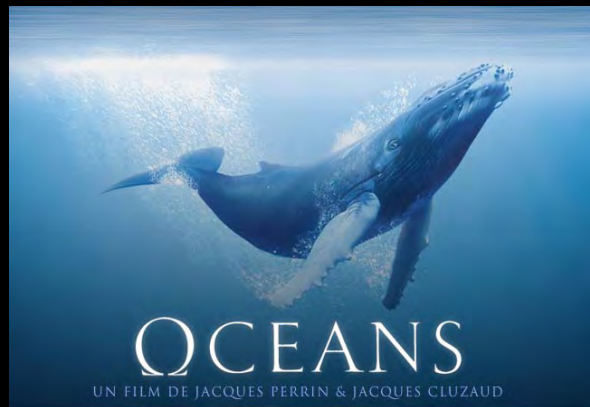
Worm et al. (2005) *Science*

The role of communication



"One thing I'll say for us, Meyer—we never stooped to popularizing science."

Published in *The New Yorker* 10/24/1977
by James Stevenson
James Stevenson <http://nytimes.com/>



Ocean future (2020 +)

More crowded

Energy extraction, Ocean transport, Population increase, Communication

More environmental changes

Coastal concerns, Global concerns

More biological changes

Rapid biological change (removal, bycatch, habitat loss)

More ocean conflicts

Unresolved boundaries, Fewer living resources

More information


More transparent, Better planning

Pressures on the ocean will worsen, not lessen

- establish a baseline of what's there
- figure out which species make the oceans function
- provide managers with rational criteria for spatial management



*Biodiversity Science
for Sustainability of
Canada's Three Oceans*



CHONE
CANADIAN HEALTHY OCEANS NETWORK

The Canadian Healthy Oceans Network is a collaboration of 15 universities and major federal government departments focused on developing scientific guidelines for sustainable ocean usage.


The Network is funded under the Natural Sciences and Engineering Research Council's Strategic Research Networks Program.

Other financial support comes from:

- Fisheries and Oceans Canada
- Province of Newfoundland and Labrador
- Memorial University
- Natural Resources Canada
- Atlantic Reference Centre of the Huntsman Marine Science Centre
- Canadian Museum of Nature

Universities participating in the Network are:

- Memorial University (the lead institution)
- Dalhousie University
- Cape Breton University
- University of Prince Edward Island
- Mount Allison University
- Université du Québec à Rimouski
- Université du Québec à Chicoutimi
- Université Laval
- McGill University
- Guelph University
- University of Waterloo
- University of Alberta
- Simon Fraser University
- University of British Columbia
- University of Victoria



NSERC
CRSNG

NSERC Canadian Healthy Oceans Network (CHONE)
Administrative Centre - Memorial University
St. John's, Newfoundland, A1C 5S7
Network Director Paul Snelgrove: psnelgro@mun.ca

Photo credits: NOAA/V. Tunnicliffe; ROPOS/E. Kenchington; ROPOS/P. Lawton; ROPOS/A. Metaxas; NOAA/K. Raskoff; NOAA/B. Bluhm & K. Iken

How can we do better as ocean scientists and managers?

Beyond 2010

- **Lots of ocean**
- **Few scientists**
- **Tight budgets**