

Hot Science Cool Talks

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Brave New Ocean

Dr. Jeremy Jackson

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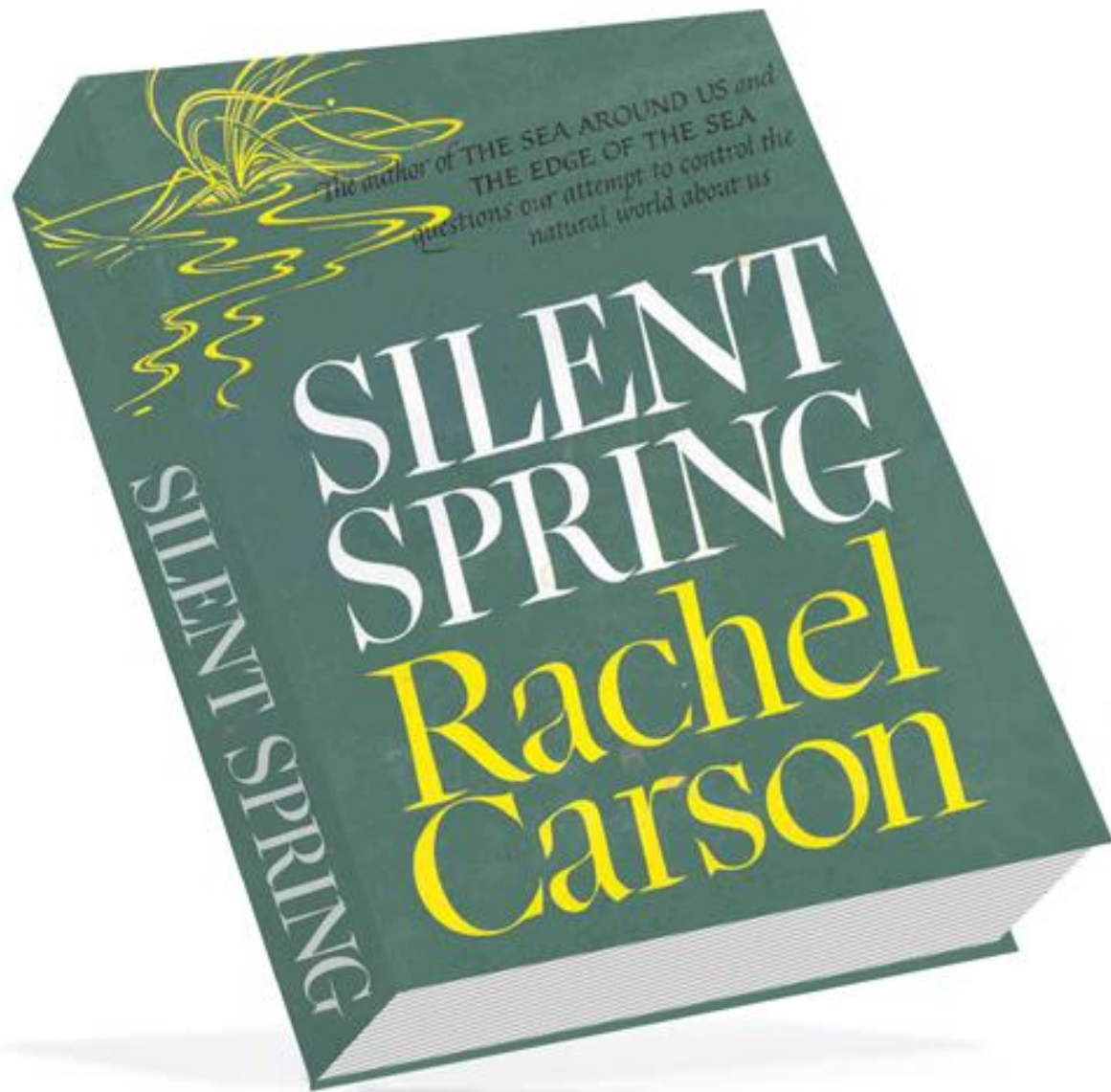
Brave New Ocean

Jeremy Jackson

**Scripps Institution of
Oceanography**

and

**Smithsonian Tropical
Research Institute**



The author of THE SEA AROUND US and
THE EDGE OF THE SEA
questions our attempt to control the
natural world about us

SILENT SPRING

SILENT
SPRING
Rachel
Carson

“A Fable for Tomorrow”

“There was once a town in the heart of America where all life seemed to live in harmony with its surroundings...”

“Then a strange blight crept over the area and everything began to change. Some evil spell had settled on the community: mysterious maladies swept the flocks of chickens. The cattle and the sheep sickened and died. Everywhere was a shadow of death.”

“This town does not actually exist... Yet every one of these disasters has actually happened somewhere... A grim specter has crept upon us almost unnoticed, and this imagined tragedy may easily become a stark reality we shall all know.”

A Story for Today

There was once an estuary where the water was sparkling clear. Great meadows of seagrass full of fishes and crabs lined the shores. Vast oyster reefs broke the surface at low tide. Fisheries were so abundant their bounty seemed infinite. Whales, dolphins, and sea turtles were abundant.

Then a strange blight came to the Bay. The water became cloudy and murky. The seagrass and oyster reefs disappeared. Fisheries collapsed. The whales, dolphins, and sea turtles were gone.

But nutrients, microbes, and jellyfish abound. Outbreaks of new species clog the shore. Toxic plankton kills the fish, the water is polluted, and the oxygen is almost gone.

This estuary **does** actually exist. It is the Chesapeake Bay, Pamlico Sound, and San Francisco Bay. It is almost every large estuary in the U.S.A.

It is the Baltic Sea, the Wadden Sea, and the northern Adriatic. It is almost every large estuary in Europe.

It is Moreton Bay, Jakarta Harbor, Tokyo Bay, and Hong Kong. It is almost every large estuary in the Western Pacific.

It is almost every large estuary around the world.

It is NOW.

More Stories for Today

We can tell similar stories about the world's

- **Coral Reefs**
- **Kelp Forests**
- **Continental Shelves and Slopes**
- **Seamounts**
- **Upwelling Fisheries**
- **Pelagic Fisheries**

But there is little public or general scientific awareness of the scale of the changes that have occurred or their implications for the future.

So what can we say about the future?

Given that as scientists we are not
supposed to speculate.....

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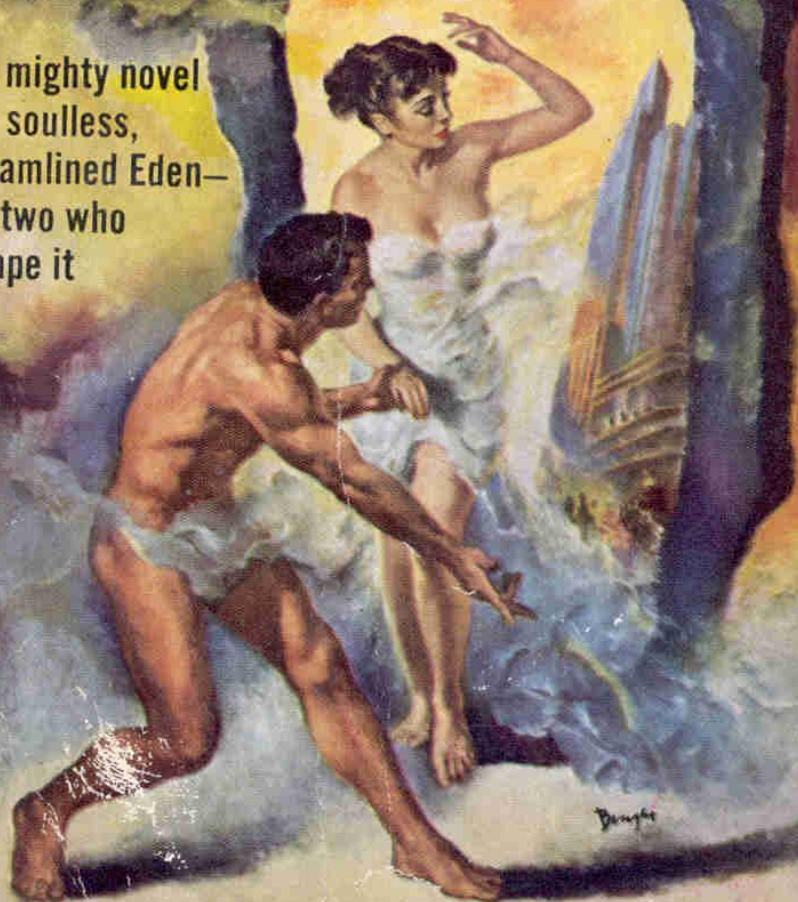


Every Book Complete

ALDOUS HUXLEY

Brave New World

The mighty novel of a soulless, streamlined Eden—and two who escape it



Dunlop

A BANTAM GIANT

This is the savage, witty and shocking story of a natural man in an unnatural world, Aldous Huxley's sardonic vision of a cellophane-wrapped tomorrow—a world where freedom is not just dead, but forgotten, a licentious world where morality as we know it is taboo. It is an open-eyed, unforgettable look at a tomorrow that is frighteningly possible.

"A book to be read again and again, and to ponder before oblivion comes."

—Los Angeles TIMES



35¢

BANTAM GIANTS —
Not one word cut

A1071



Every Book Complete

Brave New Ocean

Brave New Ocean

The mighty novel
of a soulless,
streamlined Eden—
and two who
escape it

A BANTAM GIANT



Brave New Ocean?

Rachel Carson did not make wild predictions about the future. She asked two simple questions:

- 1. What is happening now that is new and different that raises serious concern?**
- 2. What are some of the possible outcomes if these new developments persist?**

Major drivers of the Brave New Ocean

1. Over-exploitation of everything big

2. Destruction of benthic habitats

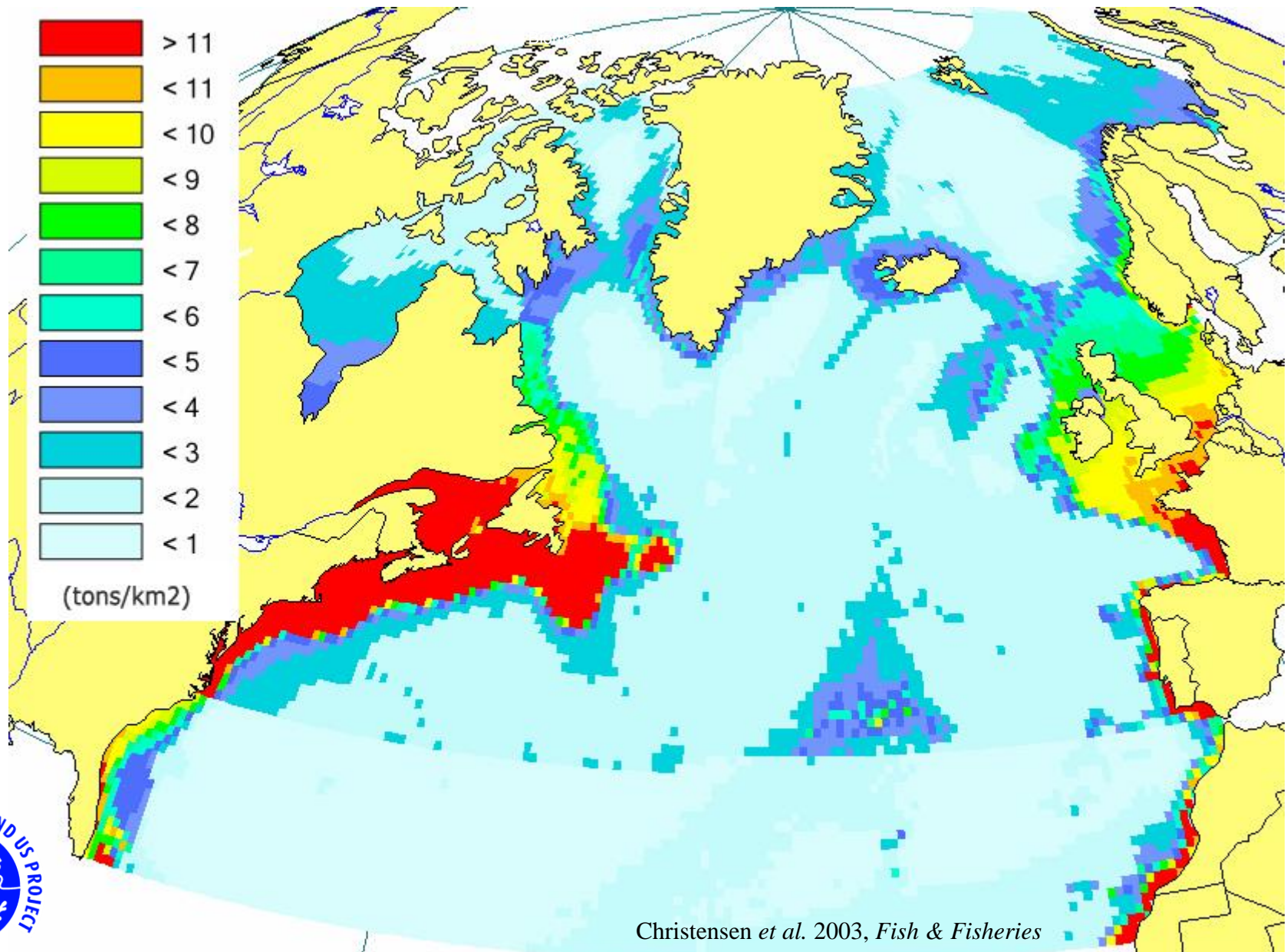
3. Globalization of species

4. Ocean warming

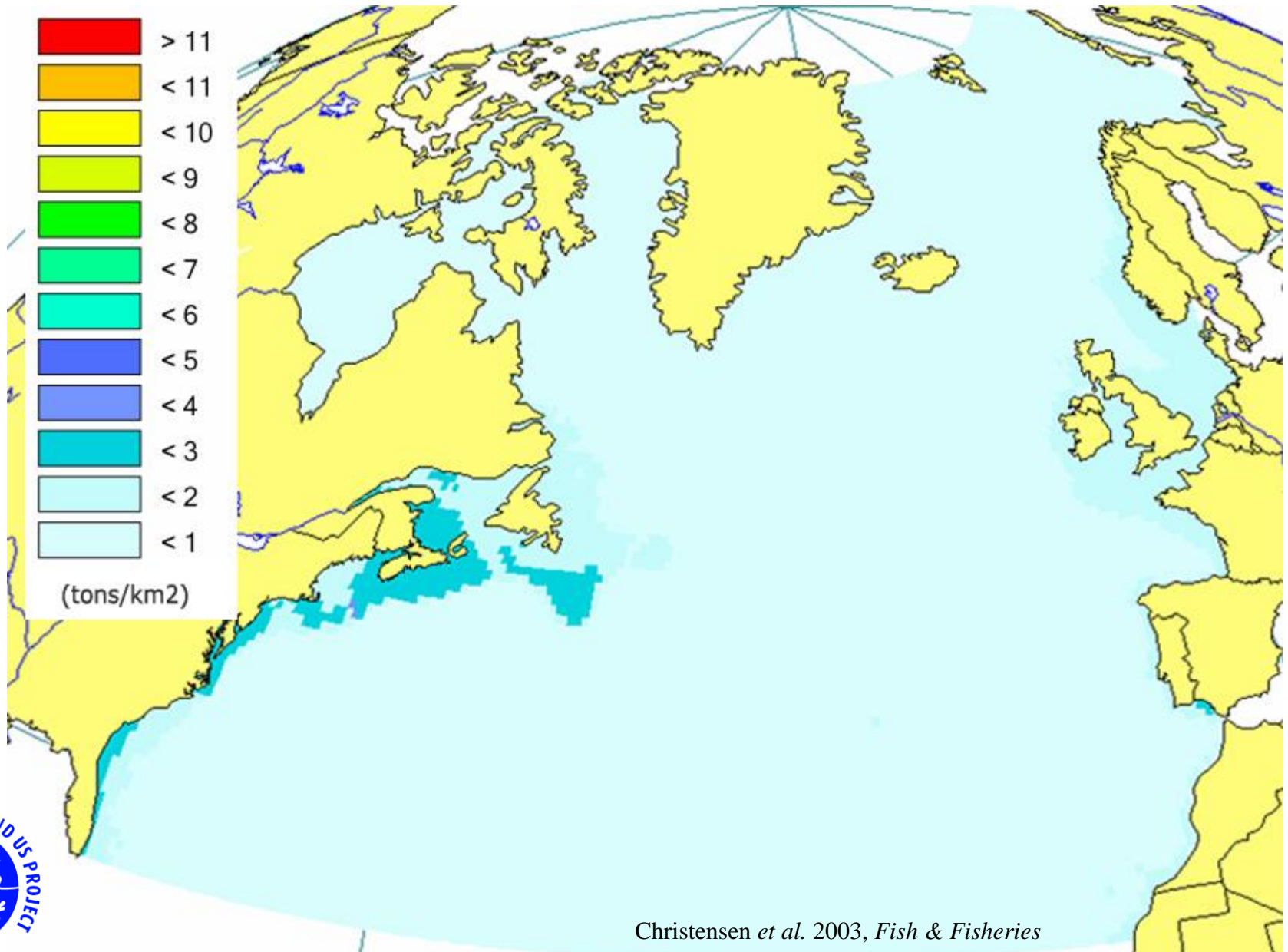
5. Poisoning of food webs

6. Rise of slime

Biomass of table fish in 1900



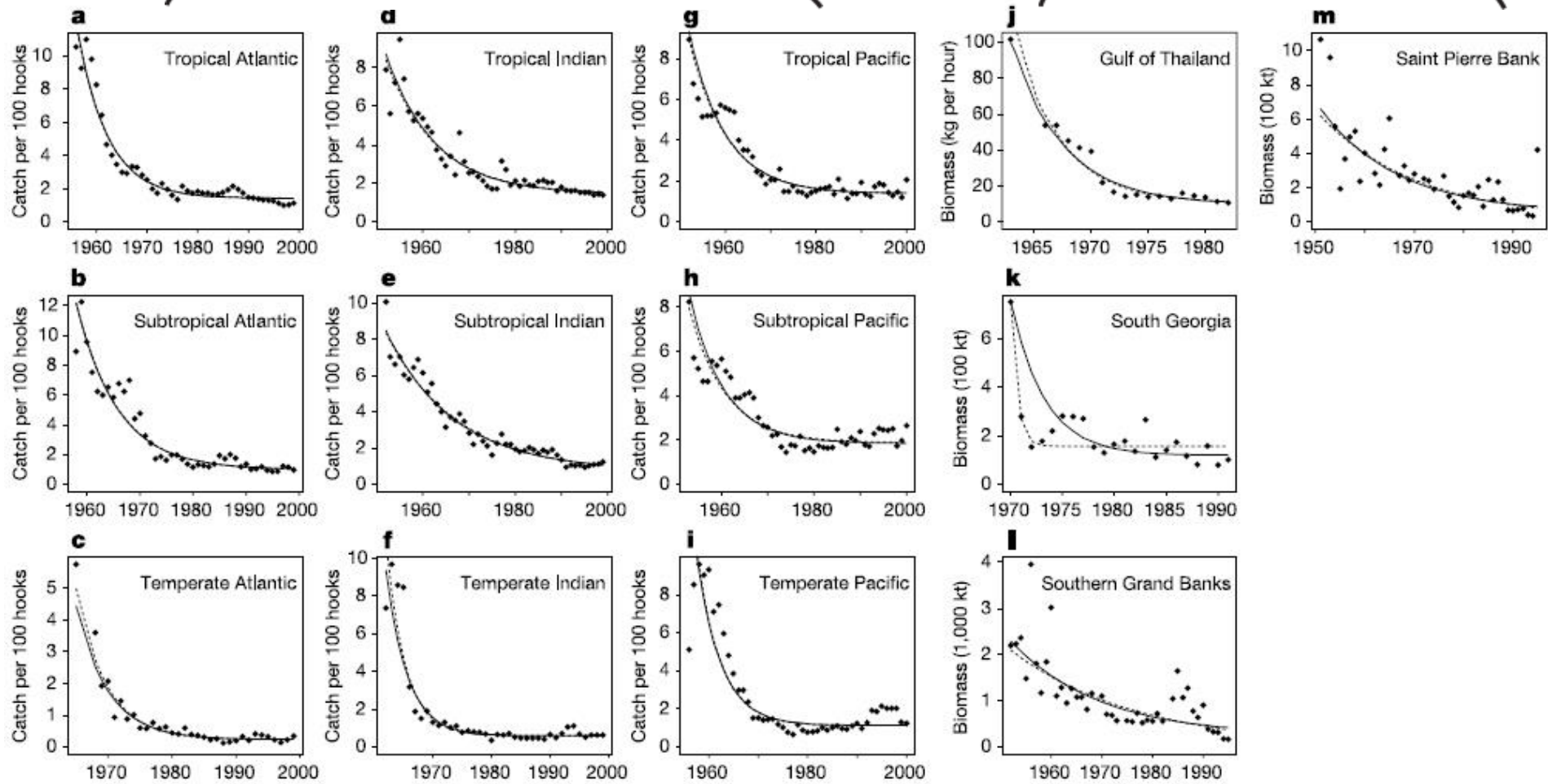
and in 2000...



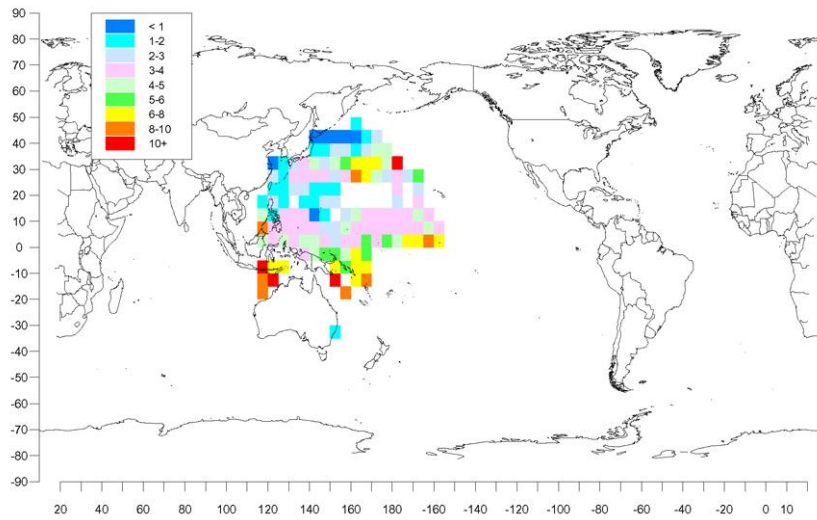
Biomass Time Trends

Oceanic

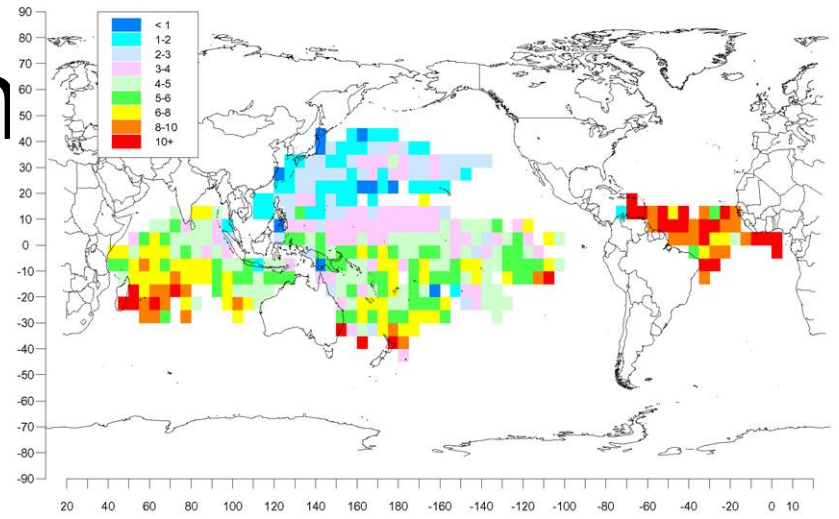
Shelf



Catch Per Hundred Hooks, Year = 1952

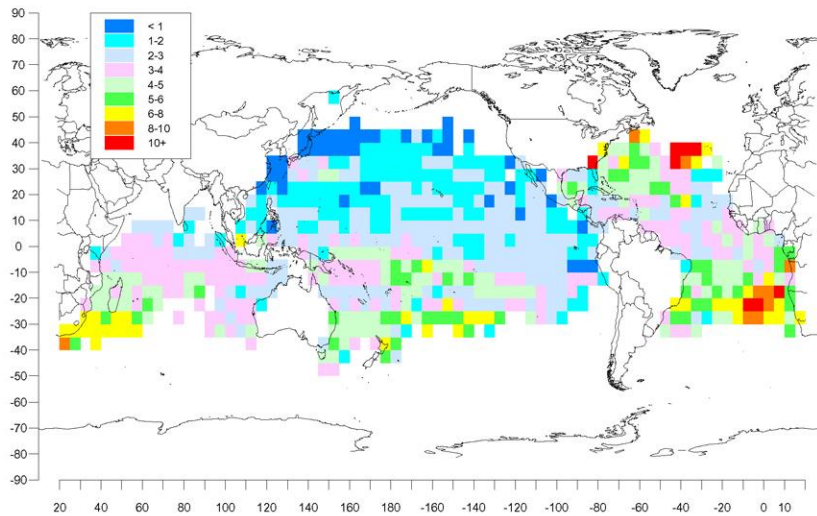


Catch Per Hundred Hooks, Year = 1958

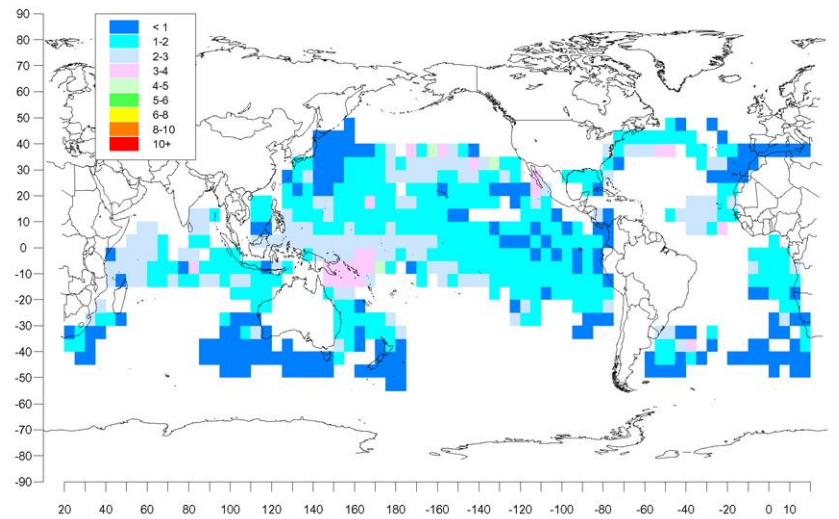


In

Catch Per Hundred Hooks, Year = 1964



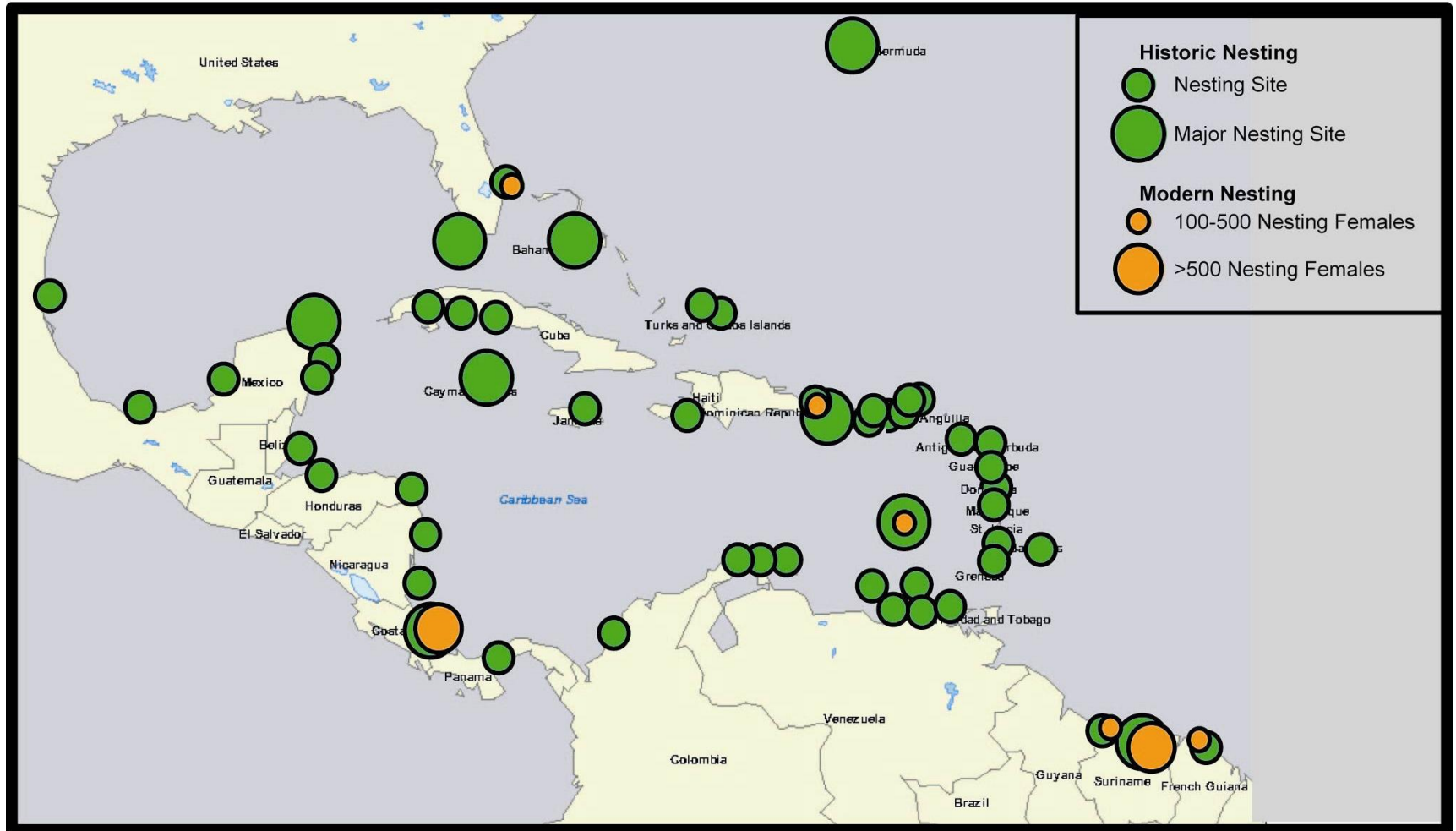
Catch Per Hundred Hooks, Year = 1980



Latitude

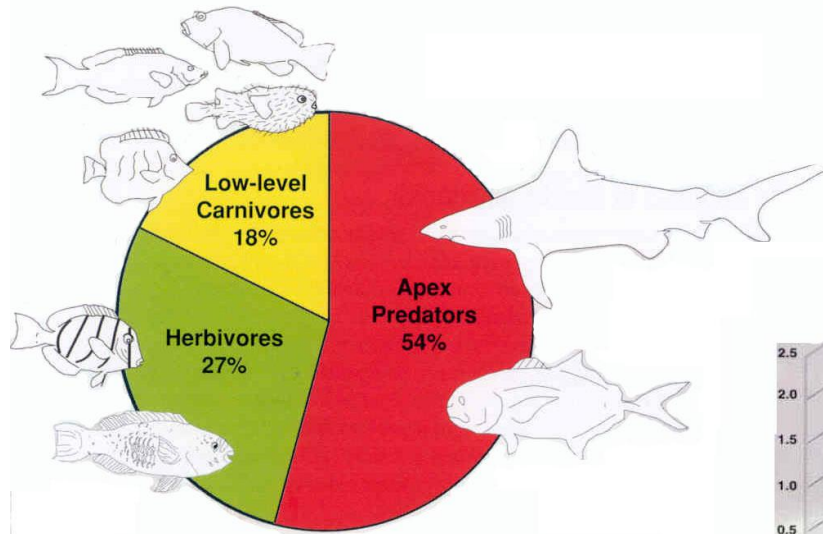
Longitude

Green Turtle Nesting Beaches

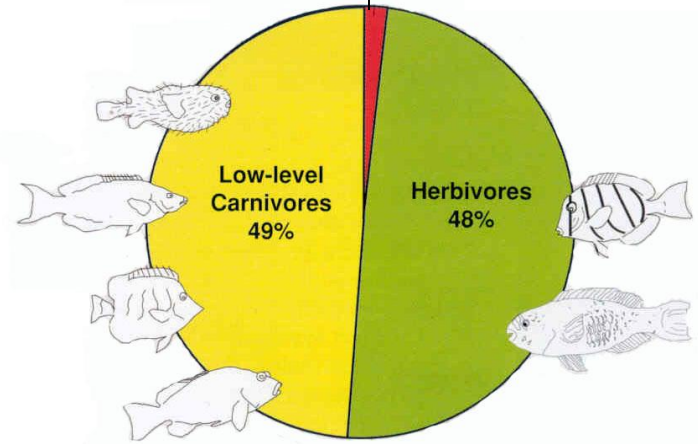


Hawaiian Fish Communities

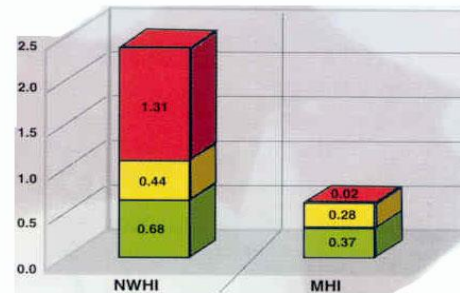
NW Hawaiian Islands



Apex Predators
3%



Main Hawaiian Islands



Comparative fish biomass
(megatons/hectare)

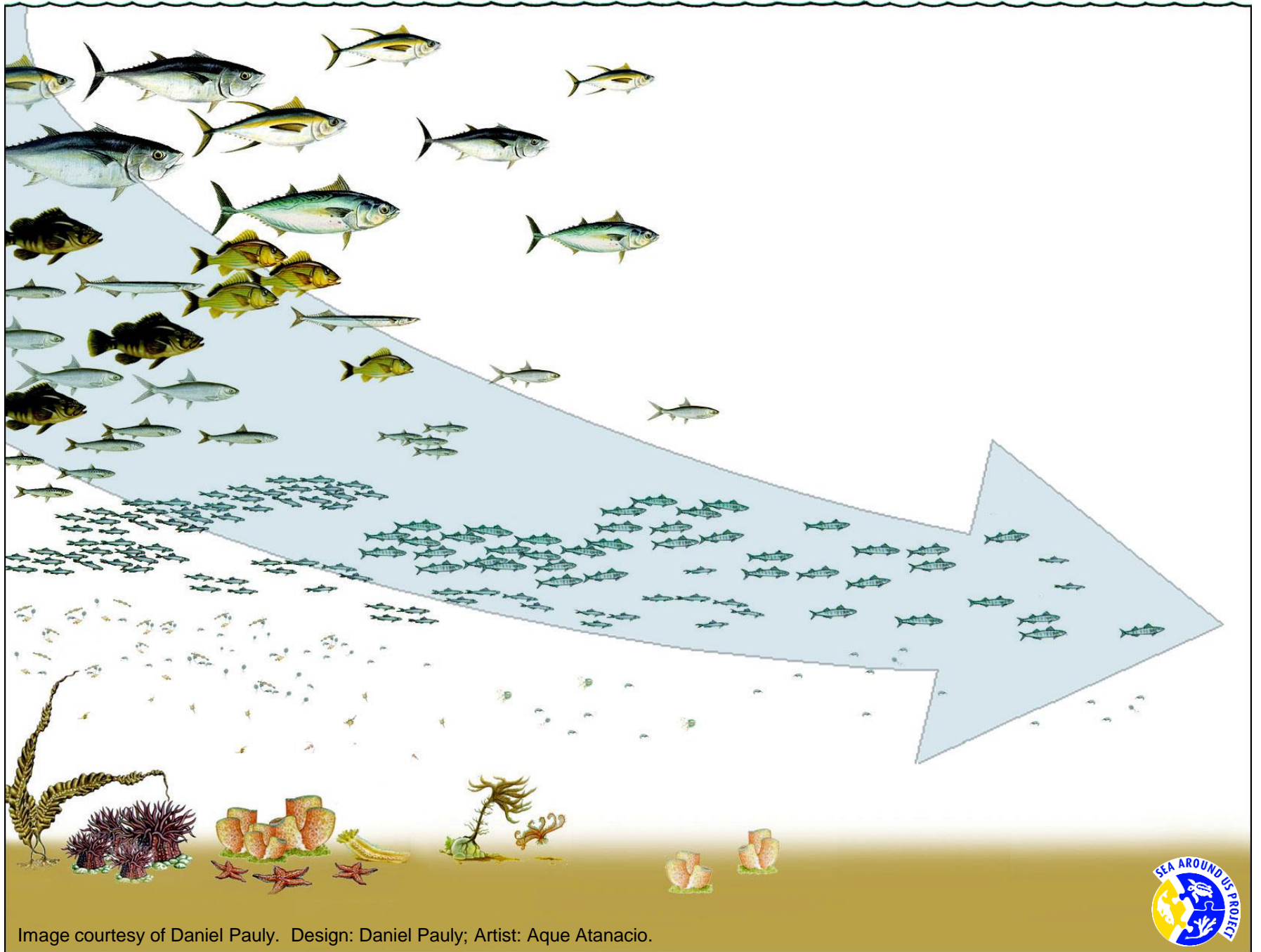
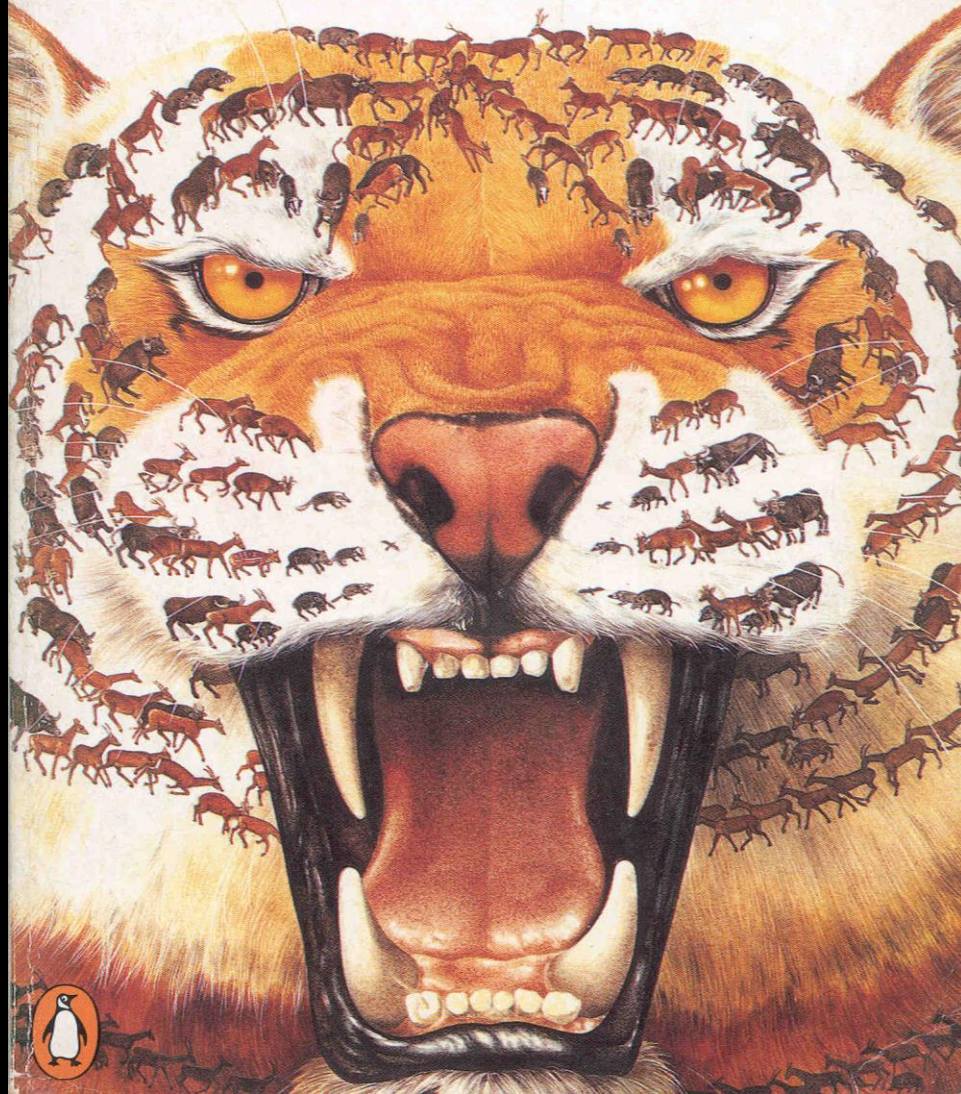


Image courtesy of Daniel Pauly. Design: Daniel Pauly; Artist: Aque Atanacio.



Why Big Fierce Animals Are Rare

Paul Colinvaux



Major drivers of the Brave New Ocean

1. Over-exploitation of everything big
- 2. Destruction of benthic habitats**
3. Globalization of species
4. Ocean warming
5. Poisoning of food webs
6. Rise of slime

Deep coral reefs before and after trawling



The area of sea floor scraped clean by trawling rivals that of all the forests ever cut down on land.

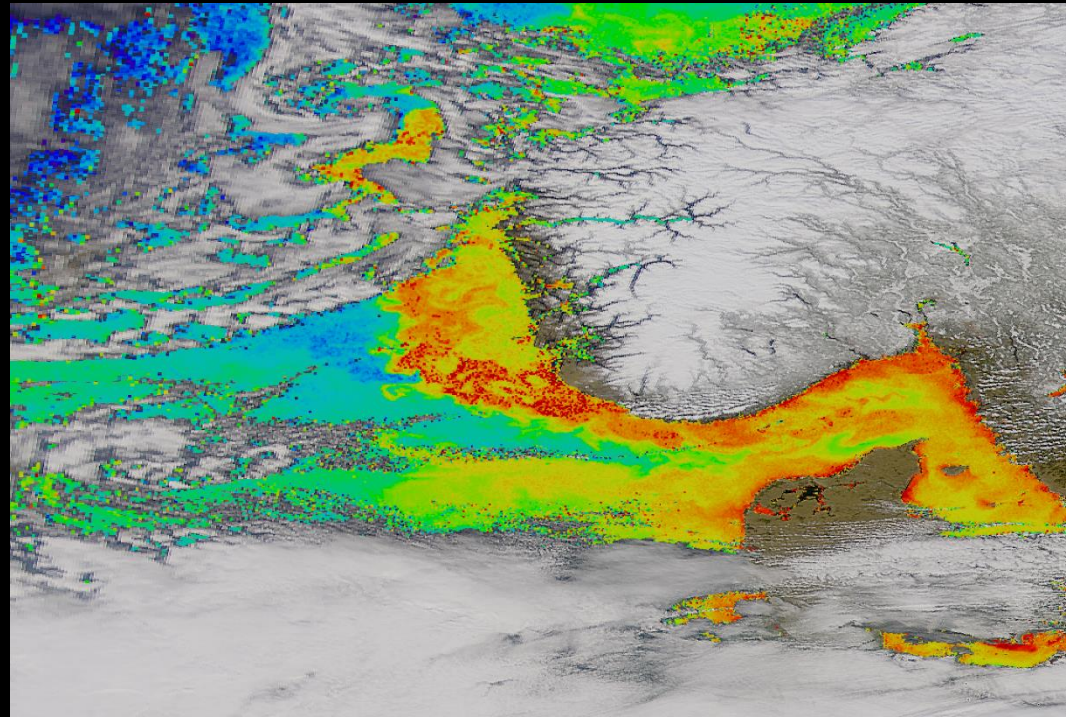


Image courtesy of Peter Auster.

Major drivers of the Brave New Ocean

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Introduced *Caulerpa taxifolia* is carpeting the Mediterranean and smothering communities of thousands of species.



**NASA Satellite Imagery Tracks Killer Toxic Algae
Off the Coast of Norway**

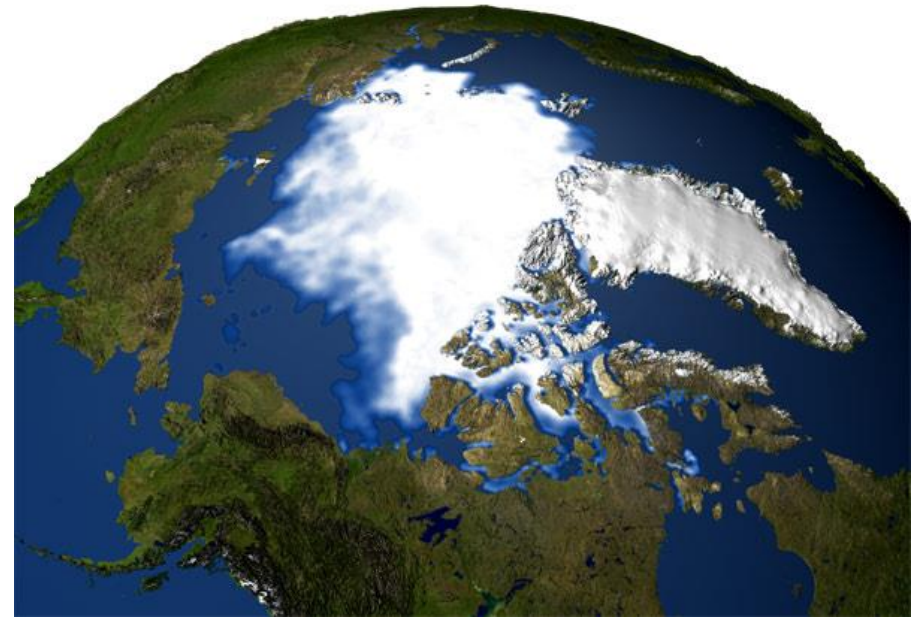
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Permanent Sea Ice Comparison



1979



2003

Ocean warming

1. Polar ice caps are rapidly melting and may disappear in the Arctic within a century
2. Entire ecosystems epitomized by polar bears and penguins are likely to disappear within our children's lifetimes
3. Species' ranges are shifting towards the poles from lower latitudes
4. Tropical reef corals are suffering mass mortality because of coral bleaching

Coral Bleaching



Image courtesy of David Kline.

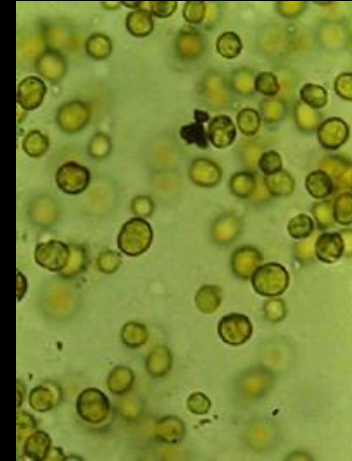
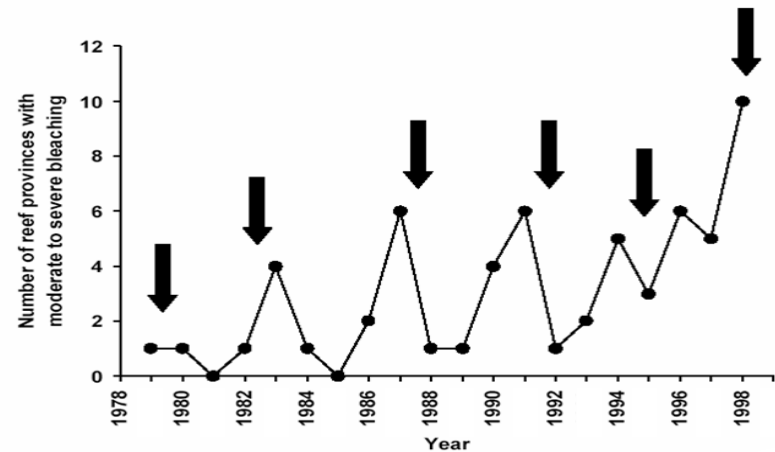
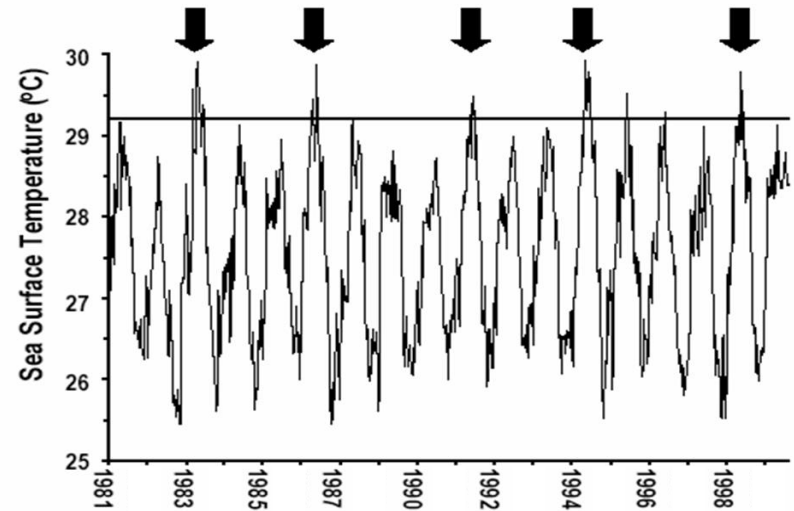


Image courtesy of Scott R. Santos,
Auburn University

- Breakdown in mutualism between coral and symbionts caused by high temperature
- Highly variable response depending on species, environment, and history

Bleaching events are increasing in geographic extent and severity



Major drivers of the Brave New Ocean

1. Over-exploitation of everything big
2. Destruction of benthic habitats
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Poisoned Webs

- Reproduction and survival of Arctic fish and marine mammals are reduced by accumulation of mercury, PCBs, and other toxins in their tissues.
- Inuit mothers' breast milk contains dangerously high concentrations of toxins from their sea food diet.
- Wild salmon dying after spawning contaminate upland streams, lakes, and terrestrial food webs with toxins in the Pacific northwest.
- Farmed salmon contain even higher concentrations of toxins from their wild caught fish meal.

Major drivers of the Brave New Ocean

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Why do swimming pools get dirty?

1. Broken filter?
2. Increased inputs of nutrients and filth?

In responding to eutrophication in coastal habitats, we typically pretend to treat the inputs while ignoring the broken filters (oysters, sponges, menhaden, etc).



This was an oyster reef and oysters filtered all the water in Chesapeake Bay every 3-5 days

Jellyfish and bacteria abound in more than 150 “dead zones” around the world



The dead zone in the northern Gulf of Mexico is larger than the state of New Jersey and is increasing in size almost every year.

Dead zones reverse the achievements of more than half a billion years of evolution to take us back to the Precambrian Era before the rise of animals.

Toxic algal bloom of *Karenia brevis*

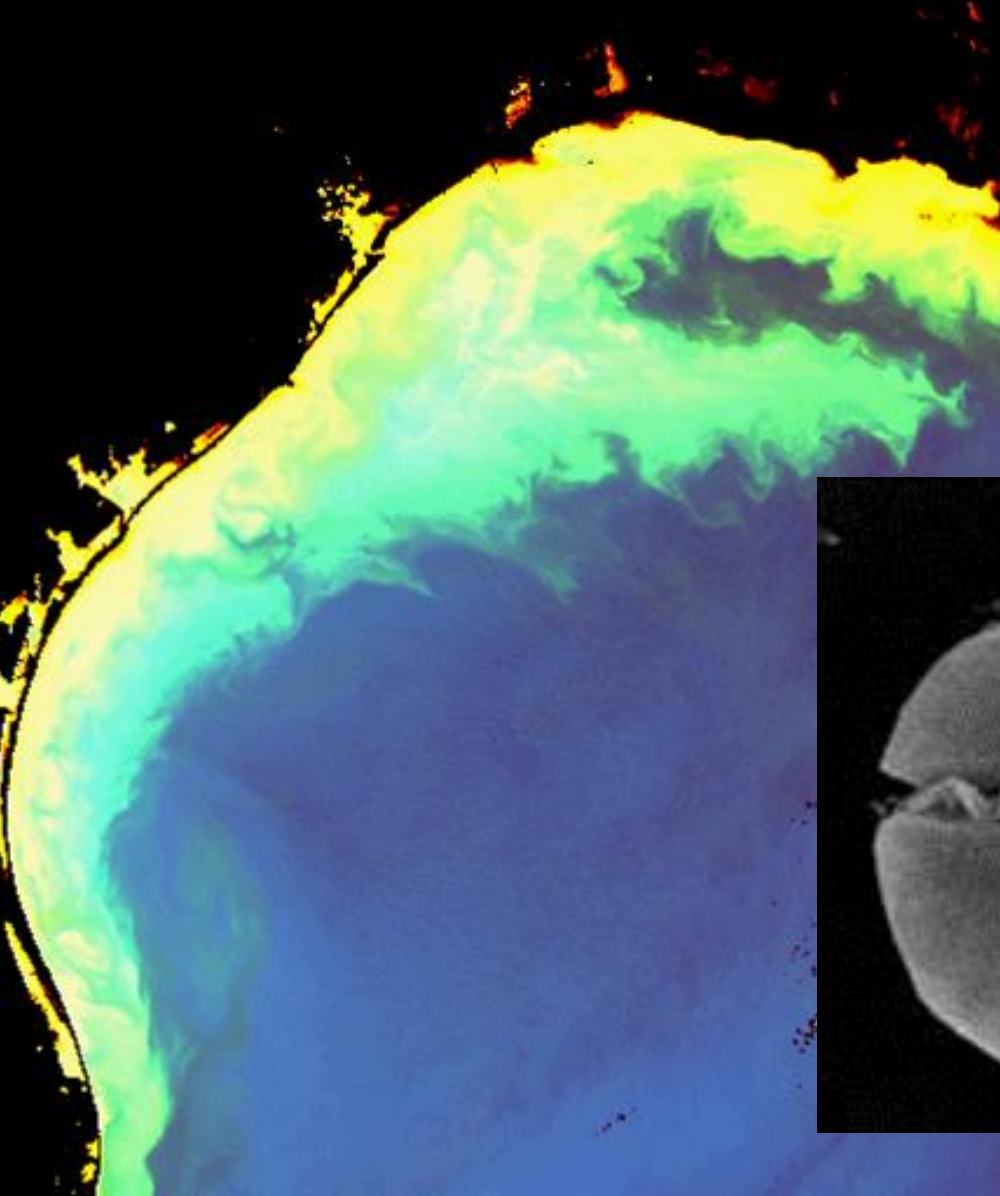


Image courtesy of Florida Fish and Wildlife Conservation Commission.



Image courtesy of Robert Myers/Mote Marine Laboratory.

Pfiesteria



Image courtesy of the Burkholder Laboratory.



Photo courtesy of Virginia Institute of Marine Science



Photo courtesy of Virginia Institute of Marine Science

Images courtesy of the Virginia Institute of Marine Science.

Epidemics of fatal bacterial diseases of reef corals are increasing in frequency



Image courtesy of Ursula Keuper-Bennett and Peter Bennett.

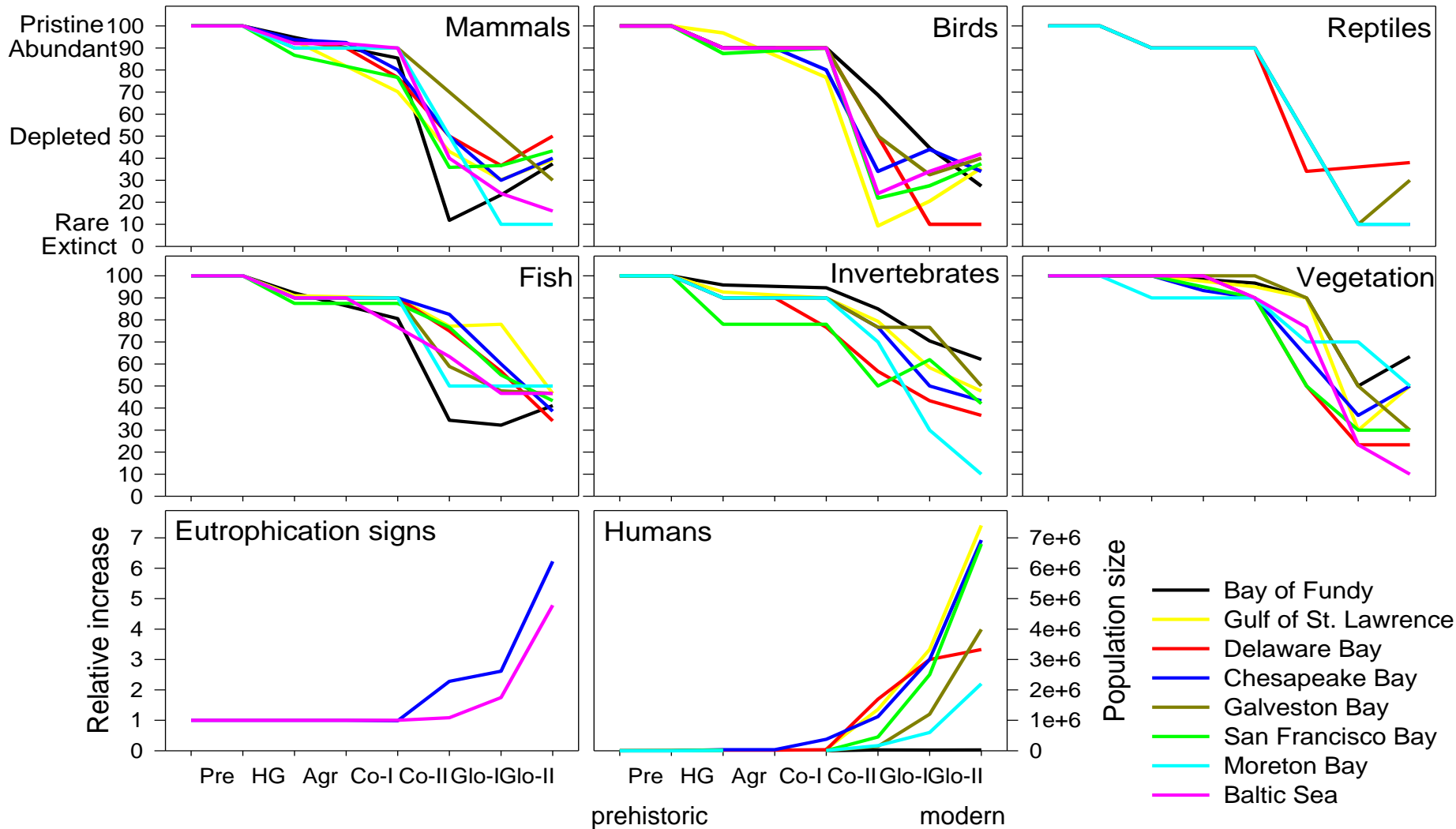
This was an Hawaiian coral reef

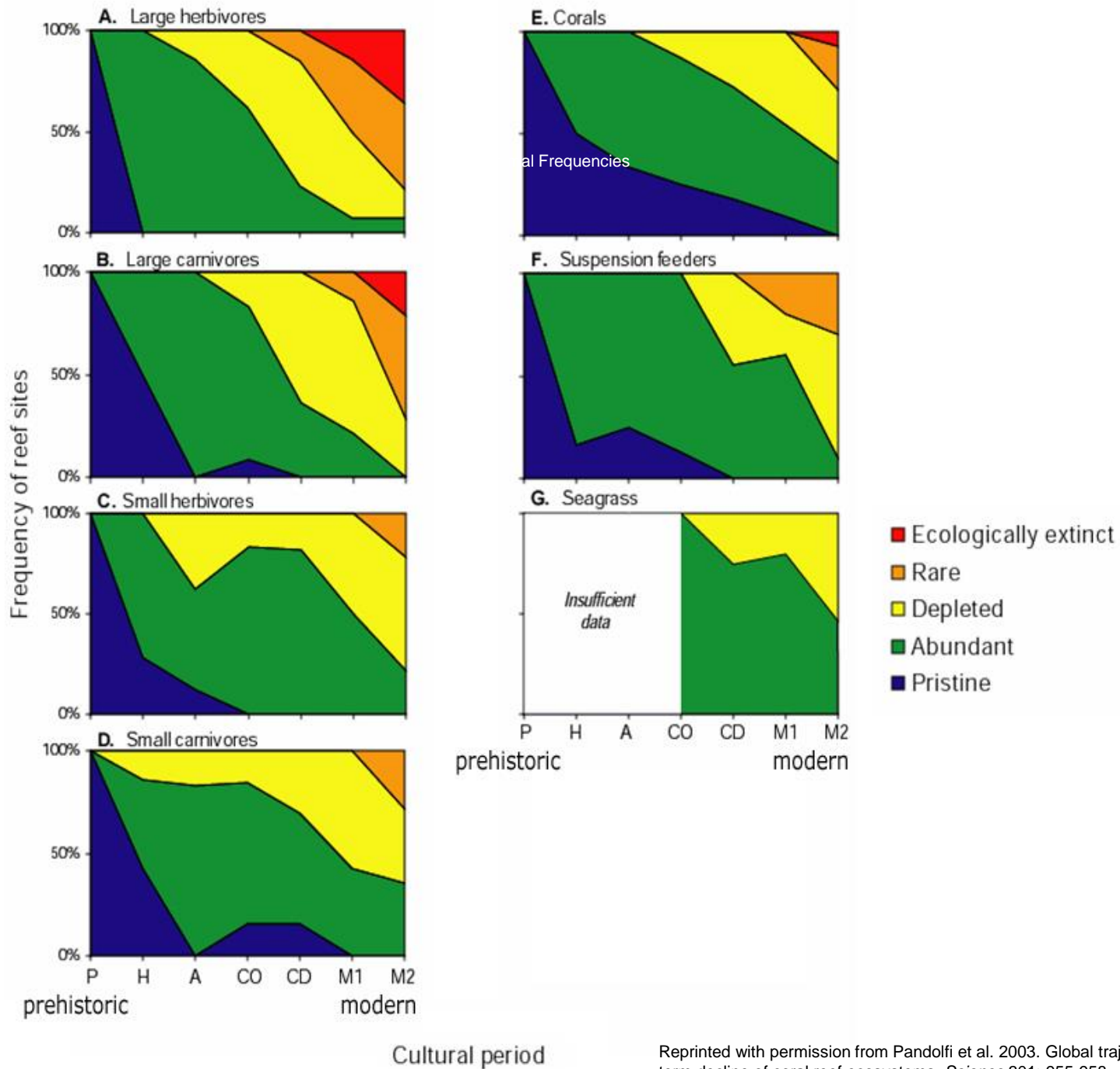


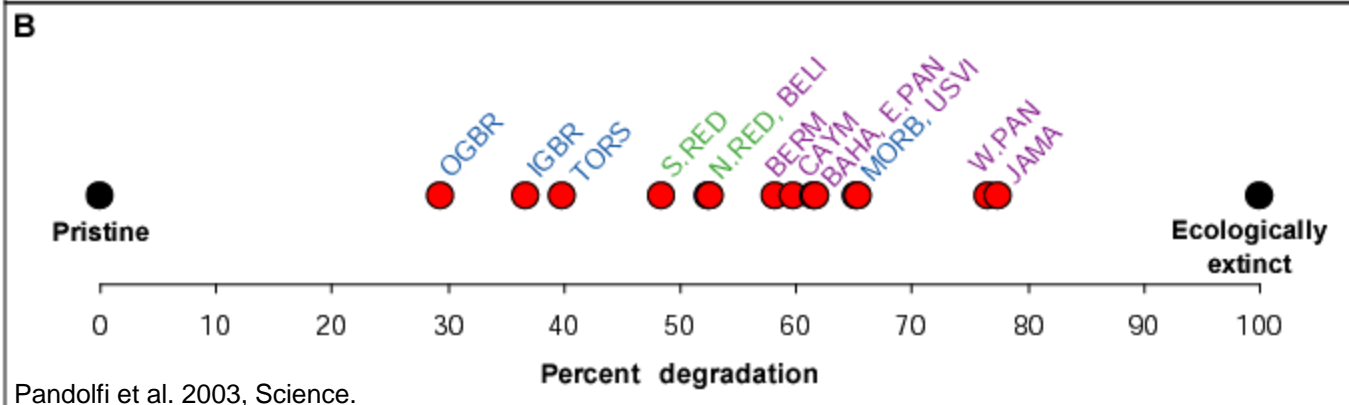
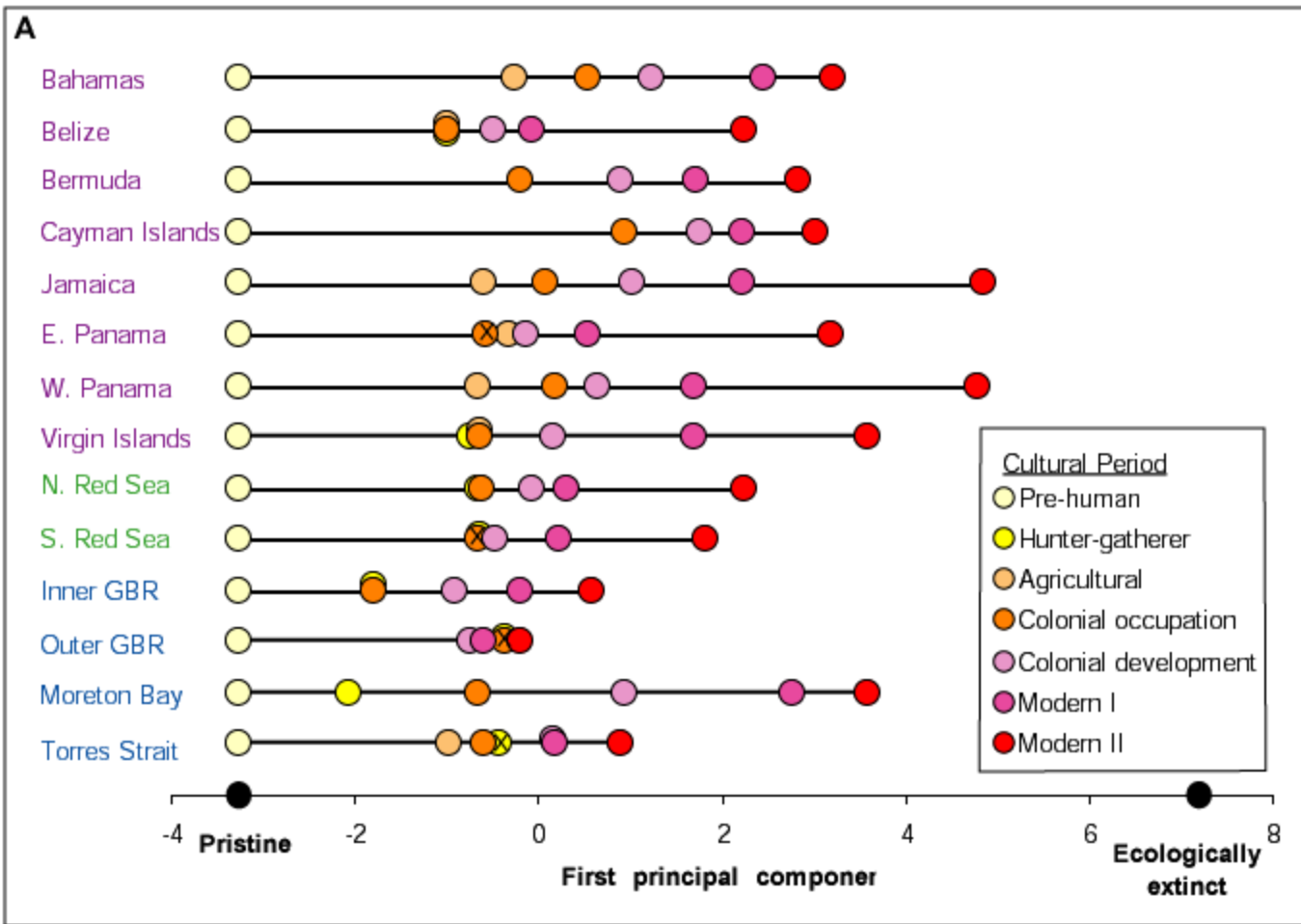
Global trajectories of ocean degradation

- 12 estuaries and coastal seas from Europe, North America and Australia
- 14 coral reefs from the Caribbean, Red Sea and western Pacific
- Scientists ranked ecosystem states over six stages of human cultural development

Common patterns in coastal seas worldwide



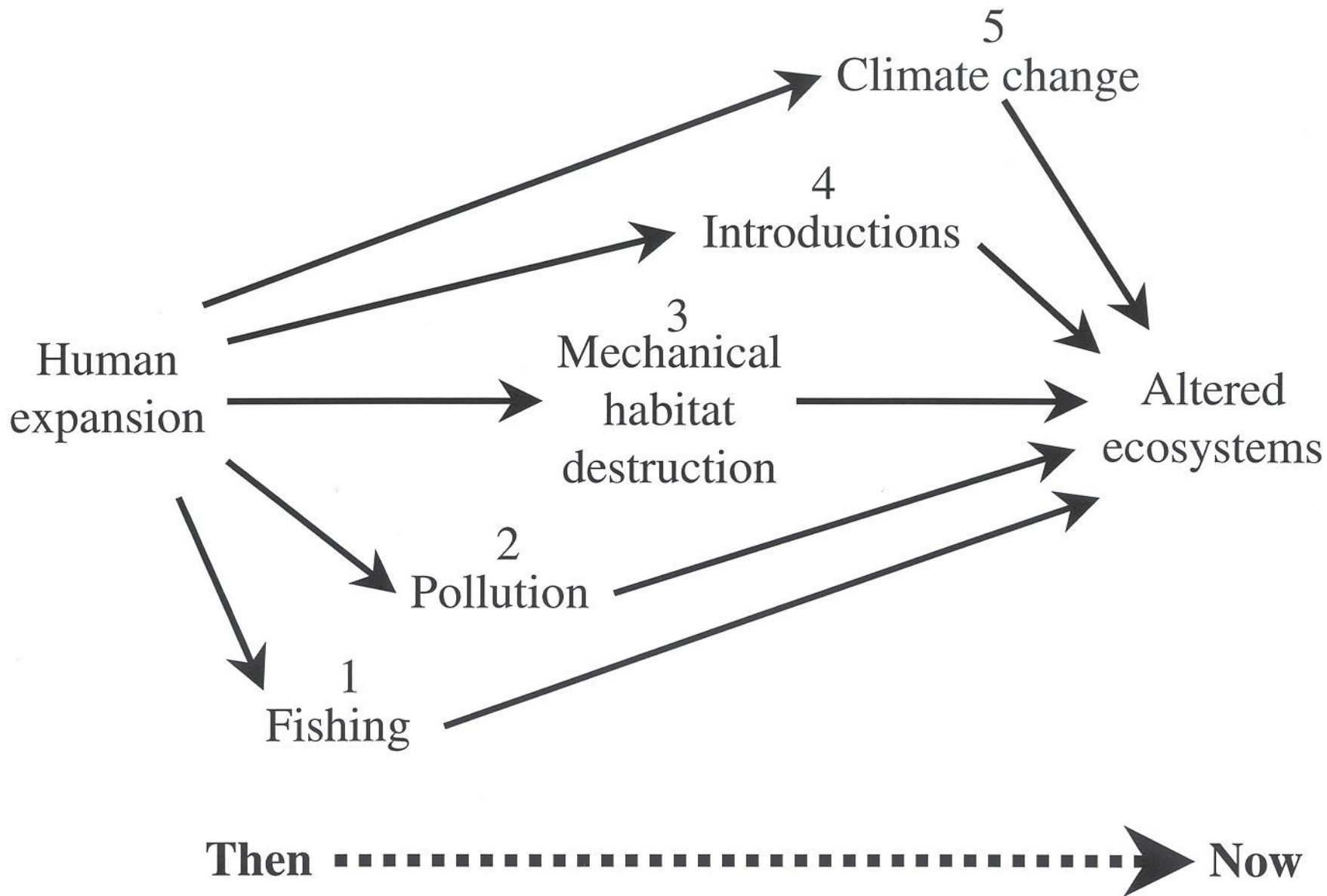




Trials and tribulations of reef corals

1. Overfishing → trophic cascades, algal overgrowth and coral death
2. Trawling and dynamiting → loss of corals and 3-dimensional structure
3. Introduced species → “killer algae” overgrowing corals
4. Warming → coral bleaching and death
5. Pollution → reduced coral growth and reproduction, coral death
6. Rise of slime → coral disease, explosions of seaweeds, coral death

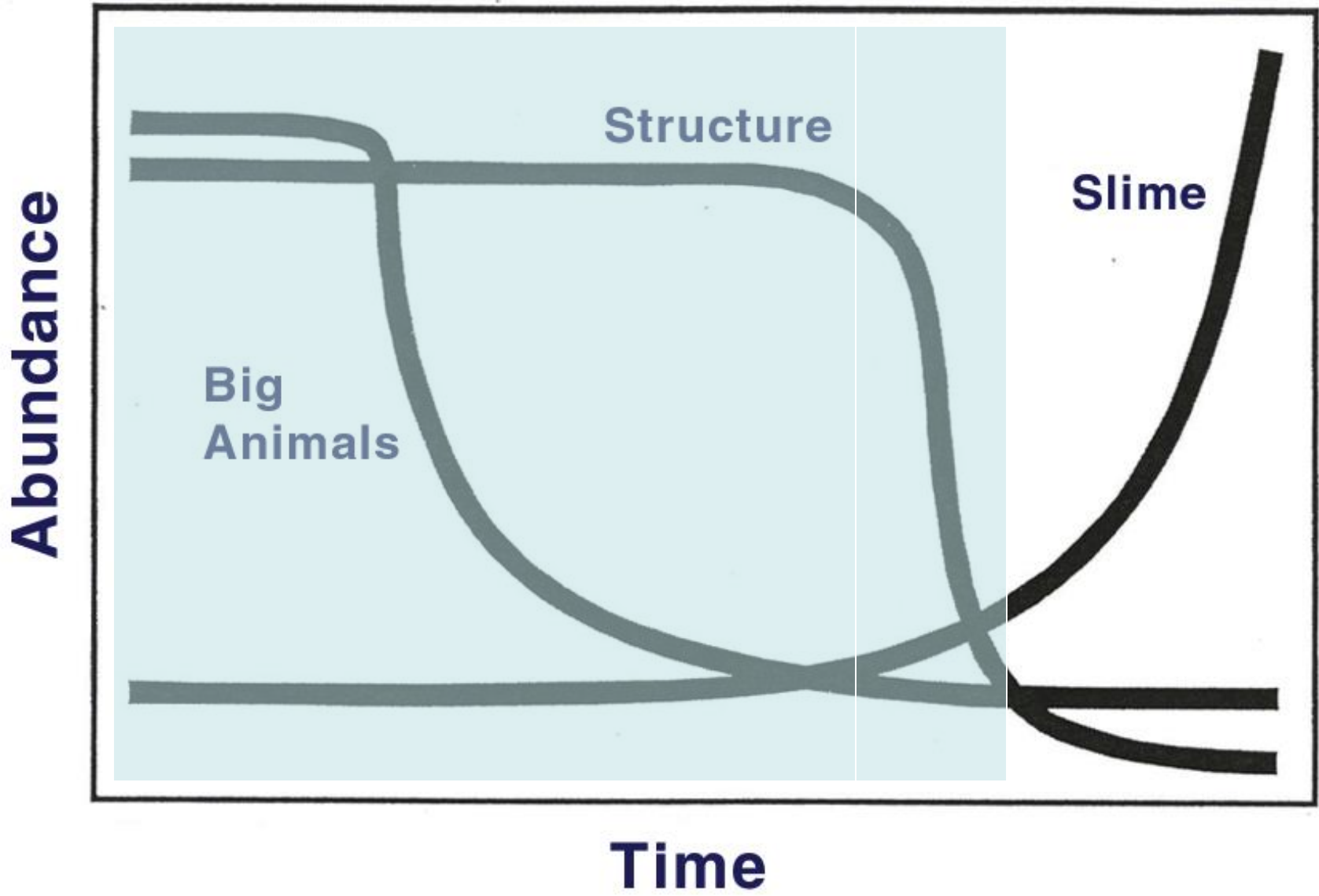
ALL of these are demonstrably significant threats to the future of corals and coral reefs. They cannot be successfully dealt with one by one.



Rachel Carson's 2nd Question

What are some of the possible outcomes if these new developments persist?

The past and future ocean



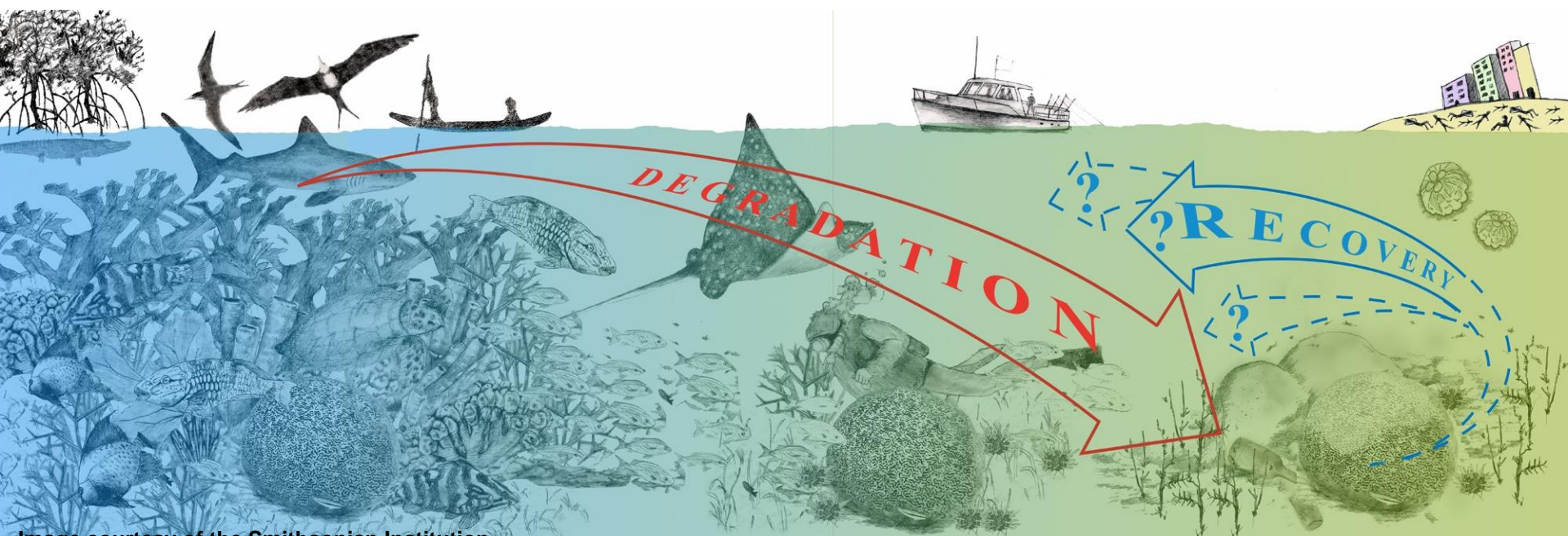


Image courtesy of the Smithsonian Institution.

Forecasting and managing the Brave New Ocean

1. Open our eyes to the magnitude of change
2. Focus attention on useful questions
3. Develop testable management and conservation strategies in the light of historical perspective
4. Test these strategies in specific, socially important contexts at ecologically realistic spatial and temporal scales

Opening our eyes to change

1. Nowhere in the oceans is wild or pristine and nowhere will ever be wild again
2. All the different drivers of change are likely to be important so they need to be addressed comprehensively
3. The potential for “recovery” is constrained by nonlinear dynamics and the evolutionary consequences of what has already occurred (We can't go home again...)

Asking useful questions

- 1. Questions should be answerable and testable**
 - We will never know how many species there are on earth (although it would be fun trying)
 - Even if we did know how many, it wouldn't help us to conserve them
- 2. Questions need to be placed in a context**
 - We can know how many species are lost along gradients of intensity of the human footprint and determine the shape of the relationship
 - We can observe and test the ecosystem consequences of their loss

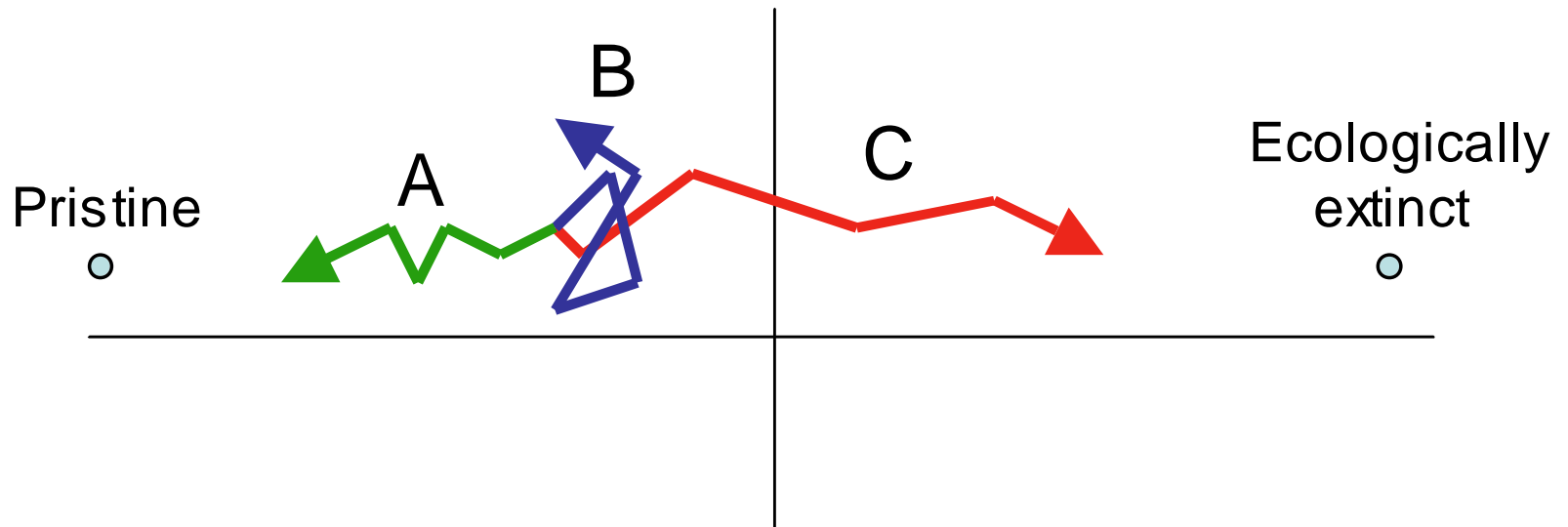
Developing useful strategies

1. Unveil the shifted baseline and the most likely drivers of ecosystem change
2. Describe the ecosystem consequences of historic losses in societal as well as scientific terms
3. Develop and implement strategies to address the drivers and to offer alternatives (less workshopping and more action)

Developing useful strategies, cont.

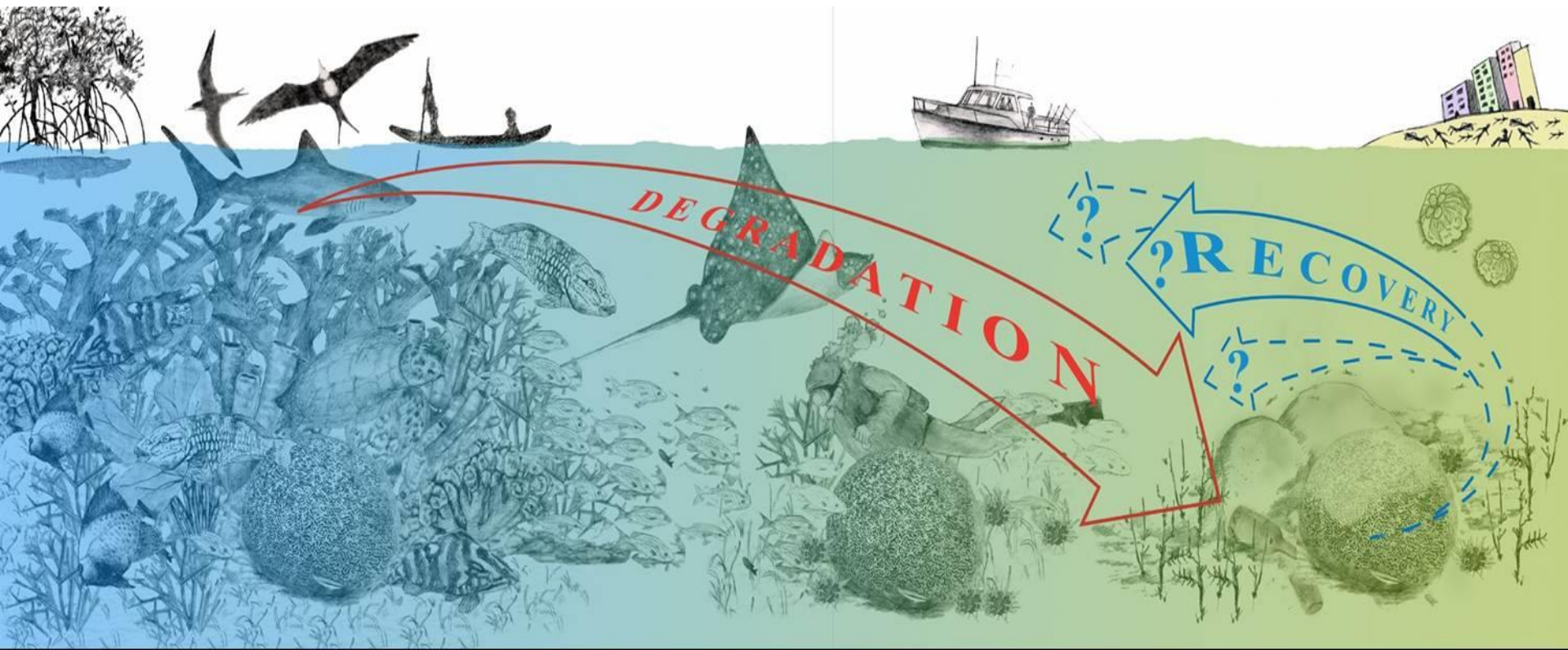
4. Focus efforts at the scale of specific, ecologically and socially important contexts and places
5. Treat management actions as experiments, take management risks, and have the courage to be wrong
6. Monitor the system to determine what actions do or do not work and be prepared to change in mid stream

Uncertainties of ecosystem restoration



So the challenge for sustainability in the oceans is to figure out how to move from the right to the left (in this picture).

This is not a conventional scientific question.



SHIFTING BASELINES common sense for the oceans

view
"PRISTINE?"

THE SB SLIDESHOW

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Shifting Baselines in the Surf



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Dr. Jeremy Jackson

**William E. and Mary B. Ritter Professor and
Director of the Geosciences Research
Division at Scripps Institution of
Oceanography**

Dr. Jeremy Jackson is one of the most prominent marine ecologists in the world and he has a message to get out about the world's oceans - sadly, it documents declines in coral reefs, decreasing numbers of large marine fish, and losses of coastal and marine ecosystems. More than just an academic researcher, Dr. Jackson has actively searched for innovative ways to reach the public, applying his skills as a communicator with his scientific knowledge to inspire action. Dr. Jackson desires to reach a broader audience and affect change into the future with tomorrow's generation on this topic of interest.

Dr. Jackson is the William E. and Mary B. Ritter Professor and Director of the Geosciences Research Division at Scripps Institution of Oceanography. In addition, he is a Senior Scientist at the Smithsonian Tropical Research Institute. Dr. Jackson was featured in a Scientists at Work article, "About the Oceans, He Says Firmly, Attention Must be Paid" in the April 26th edition of the New York Times.