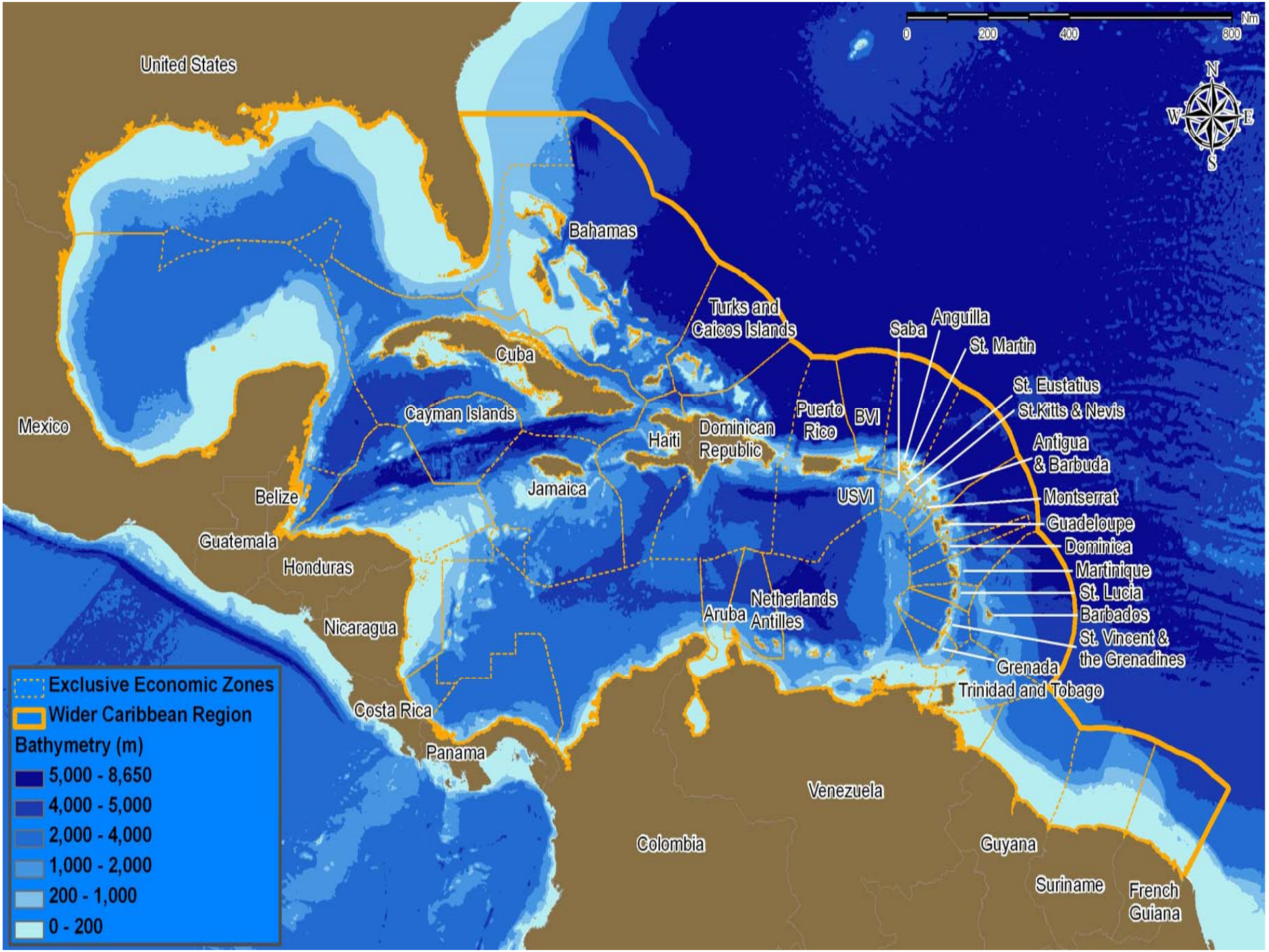
Science and Policy Considerations for Coastal and Marine Spatial Planning in the Wider Caribbean

John Ogden, University of South Florida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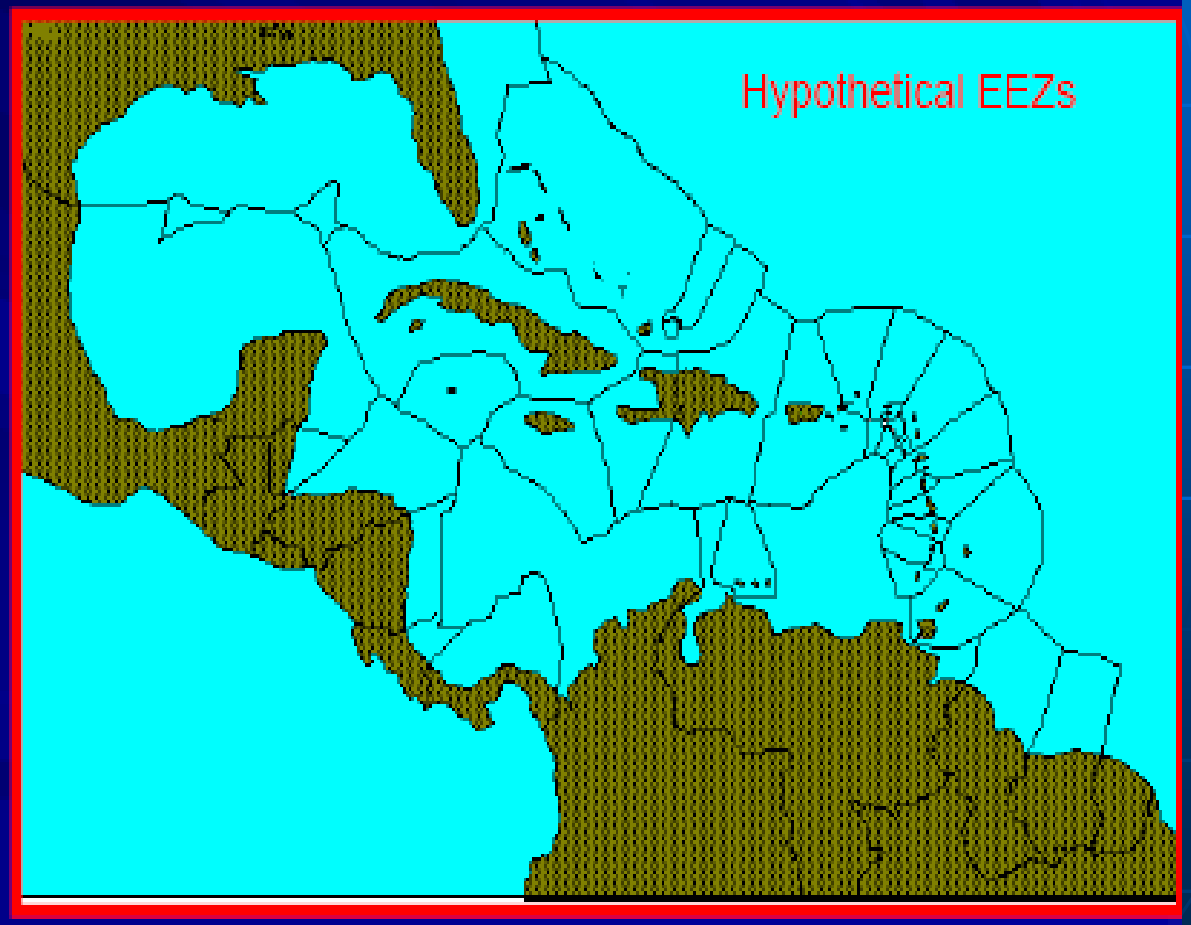
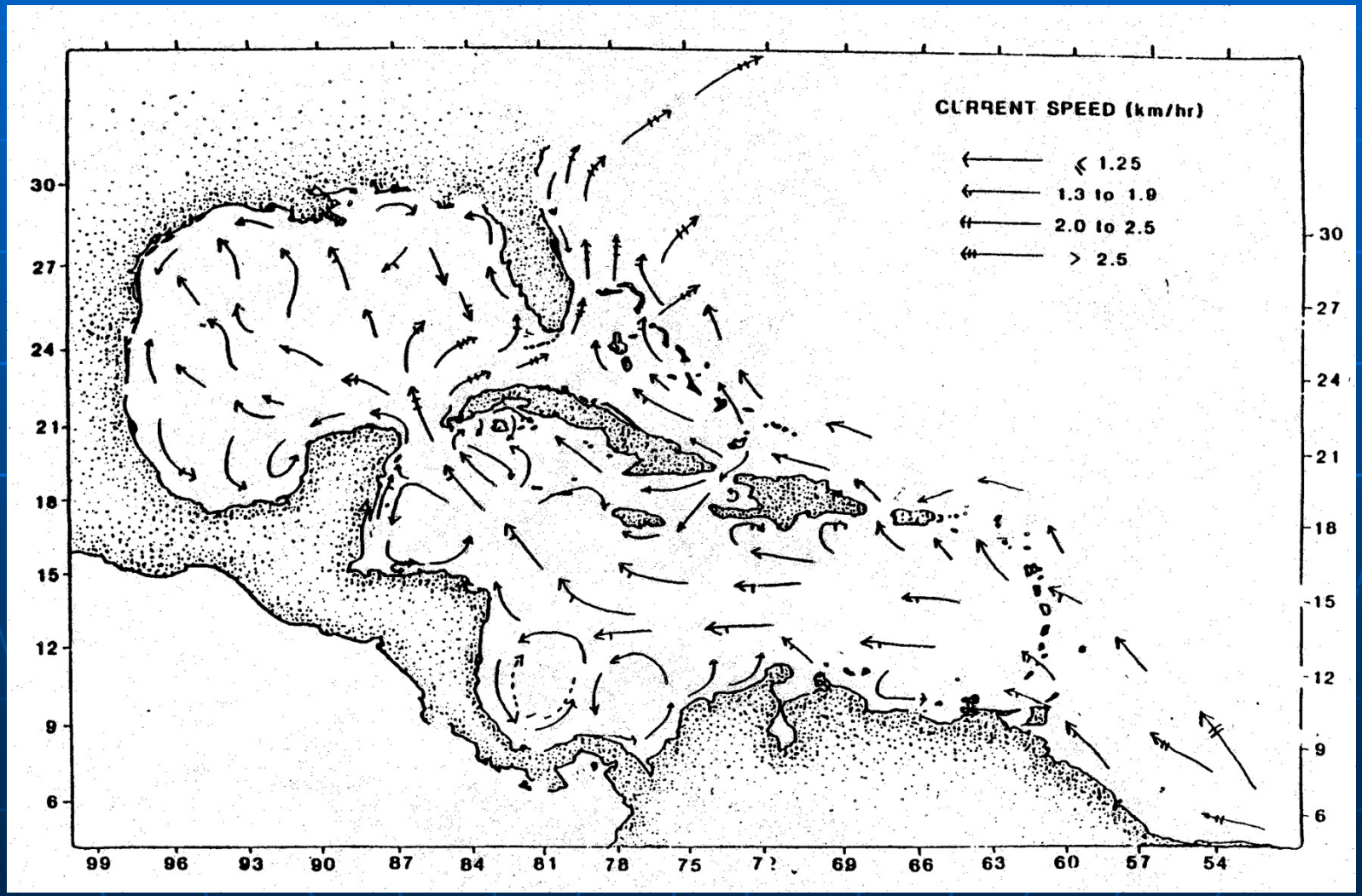
Haiti
Dominican Republic
Puerto Rico
BVI
USVI
Turks and Caicos Islands
Saba
Anguilla
St. Martin
St. Eustatius
St.Kitts & Nevis
Antigua & Barbuda
Montserrat
Guadeloupe
Dominica
Martinique
St. Lucia
Barbados
St. Vincent & the Grenadines
Grenada
Trinidad and Tobago
Aruba
Netherlands Antilles
Belize
Guatemala
Honduras
Nicaragua
Costa Rica
Panama
Venezuela
Colombia
Guyana
Suriname
French Guiana
Exclusive Economic Zones
Wider Caribbean Region
Bathymetry (m)
5,000 - 8,650
4,000 - 5,000
2,000 - 4,000
1,000 - 2,000
200 - 1,000
0 - 200

The Caribbean is Ecologically and Politically Complex

- **Geopolitical**
  - **– 33 states**
- **Cultural**
  - **– race, language**
- **Size**
  - **– smallest to largest**
- **Development**
  - **– poorest to most wealthy**



The Caribbean is a Large Marine Ecosystem (LME)

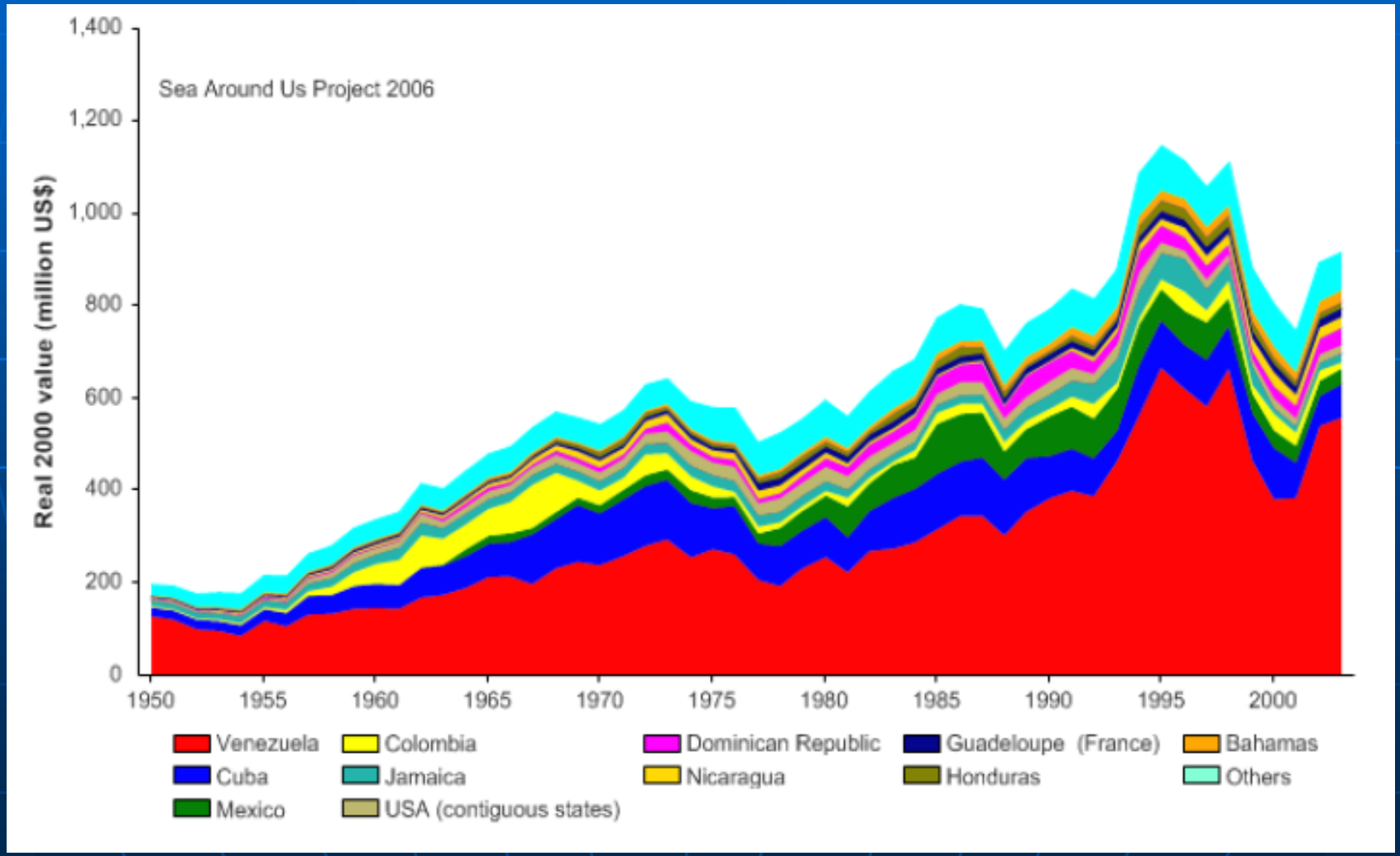


The living marine resources of the Caribbean Large Marine Ecosystem are the basis for much of the region's economy

Fisheries

Tourism

The Fish Catch in the Caribbean Sea is Worth about US$ 1 billion/ year



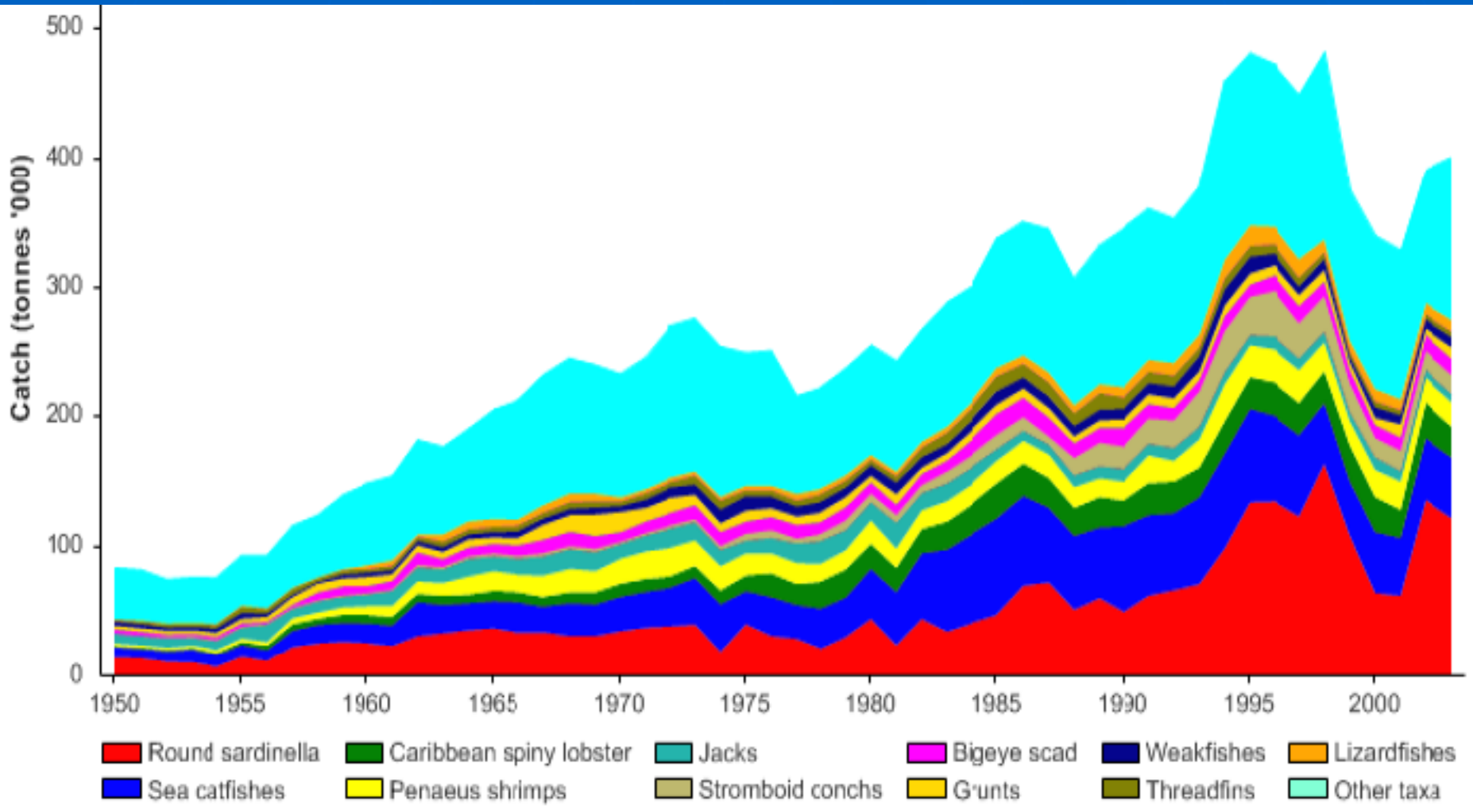
The Insular Caribbean is the most Tourism Dependent Region in the World Relative to its Size

- Direct impact:
- 567,870 jobs
- US$ 6.5 billion contribution to GDP
- Indirect impact:
- 1,857,000 jobs (12% of total employment)
- US 23.1 billion contribution to GDP (13% of total GDP **(#1 in the world relative to size)**

The Big Three

- Fishing: Local
- Land-Based Disturbances: Regional
- Ocean-Atmosphere Changes: Global

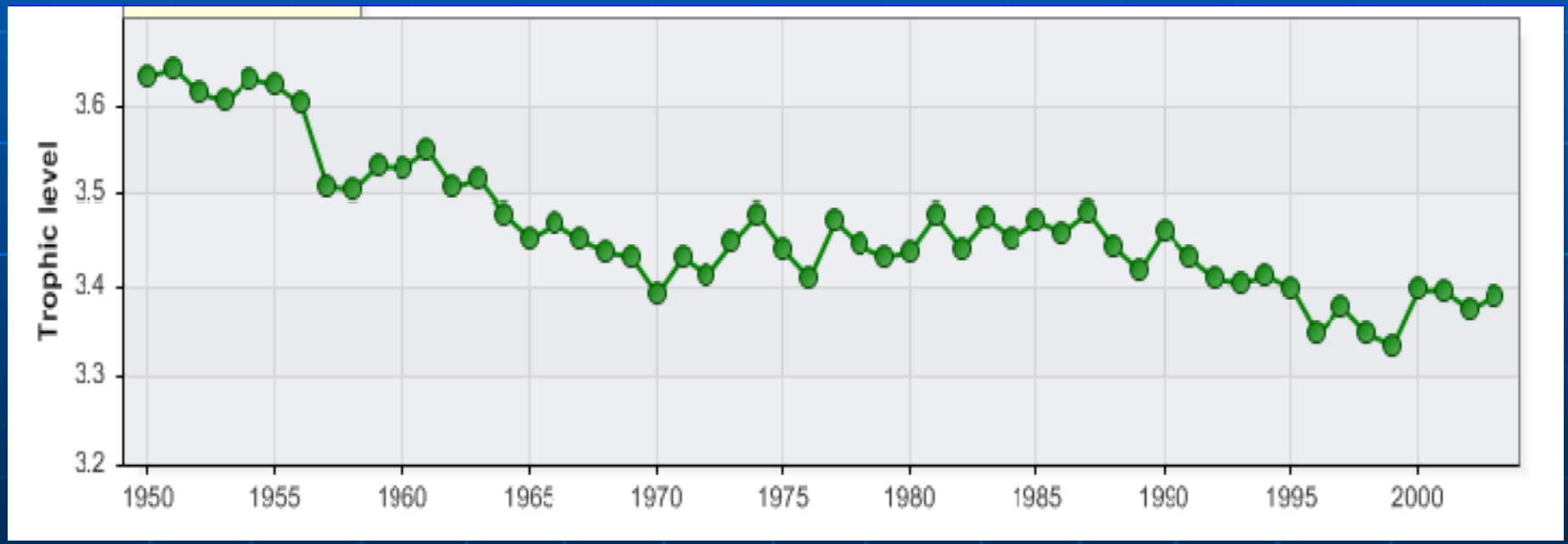
Fish Catches have been Declining since at least 1996



Source: The Sea Around Us Project

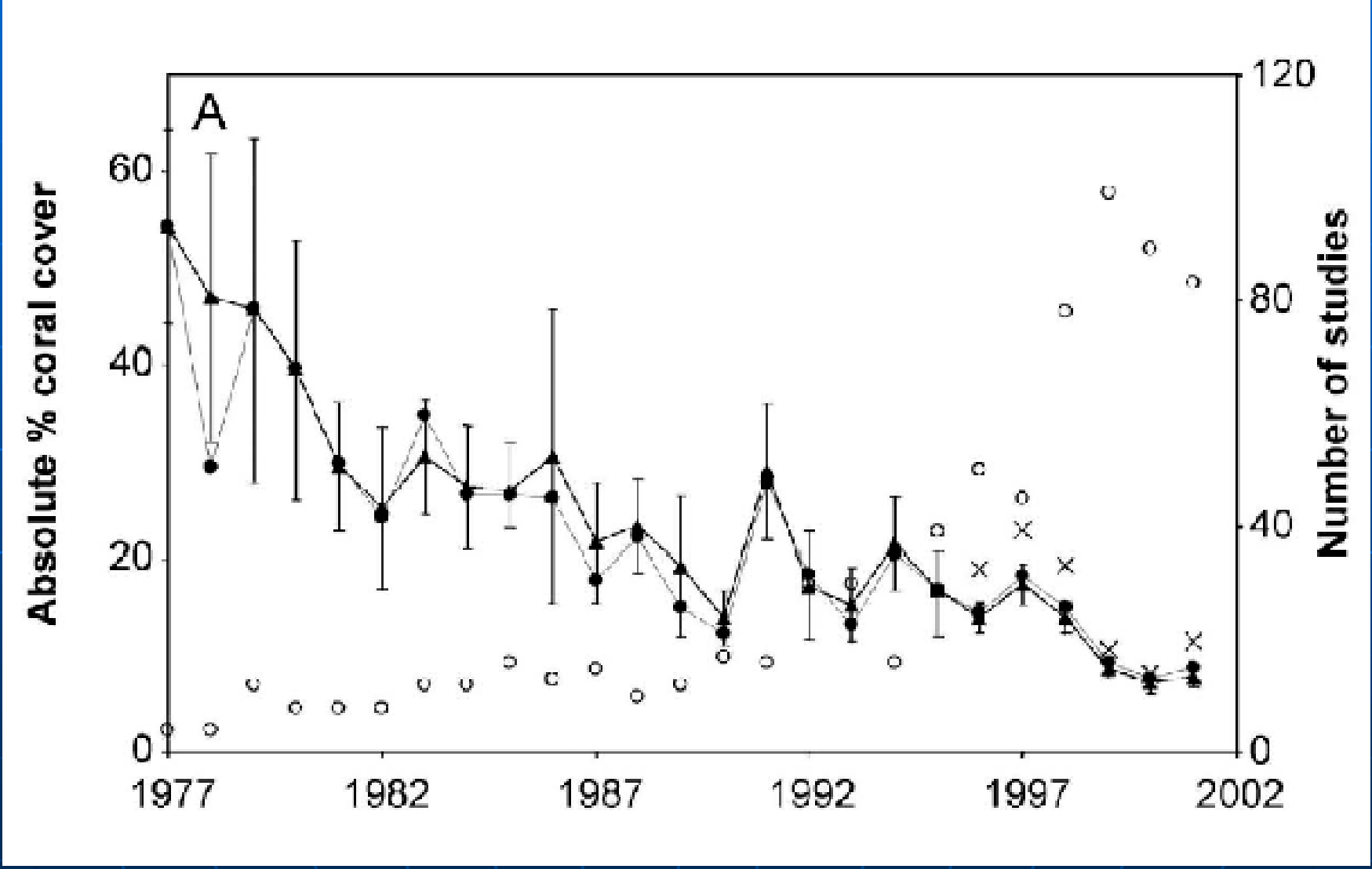
Fishing Down Food Chains:

The Mean Trophic Level of Caribbean Ecosystems has been Declining since at least 1956



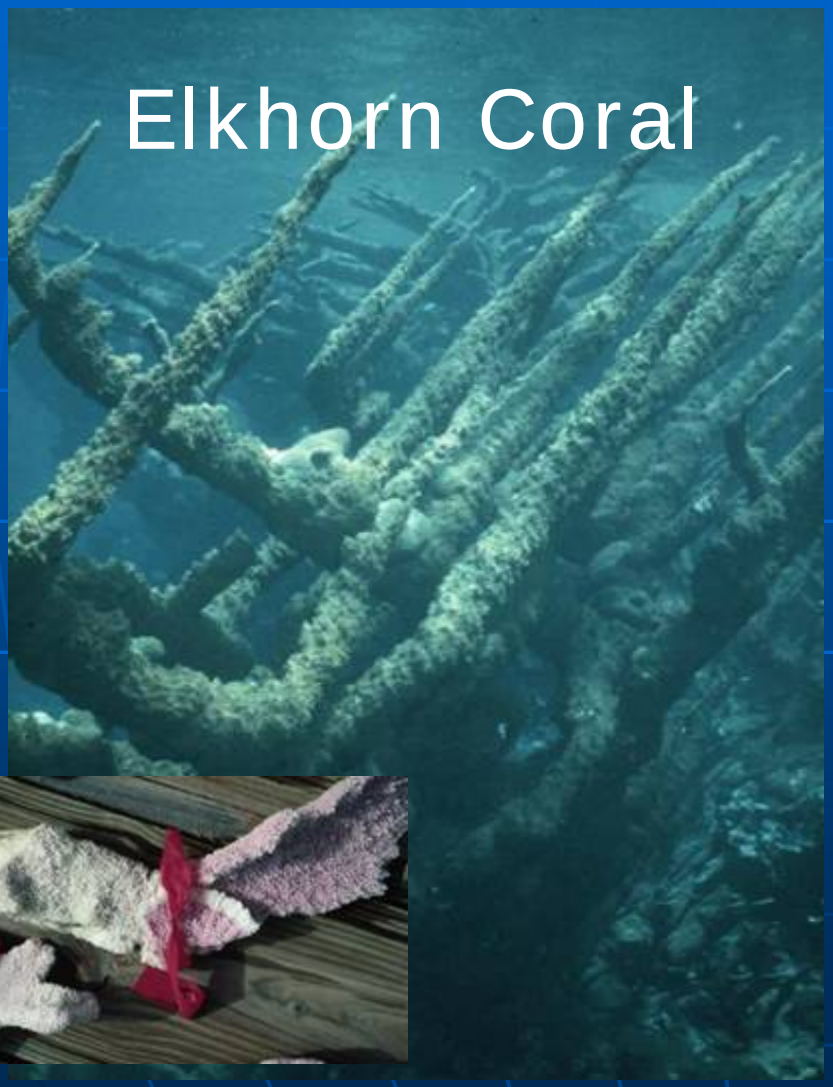
Source: Pauly, The Sea Around Us Project

Decline in Coral Cover

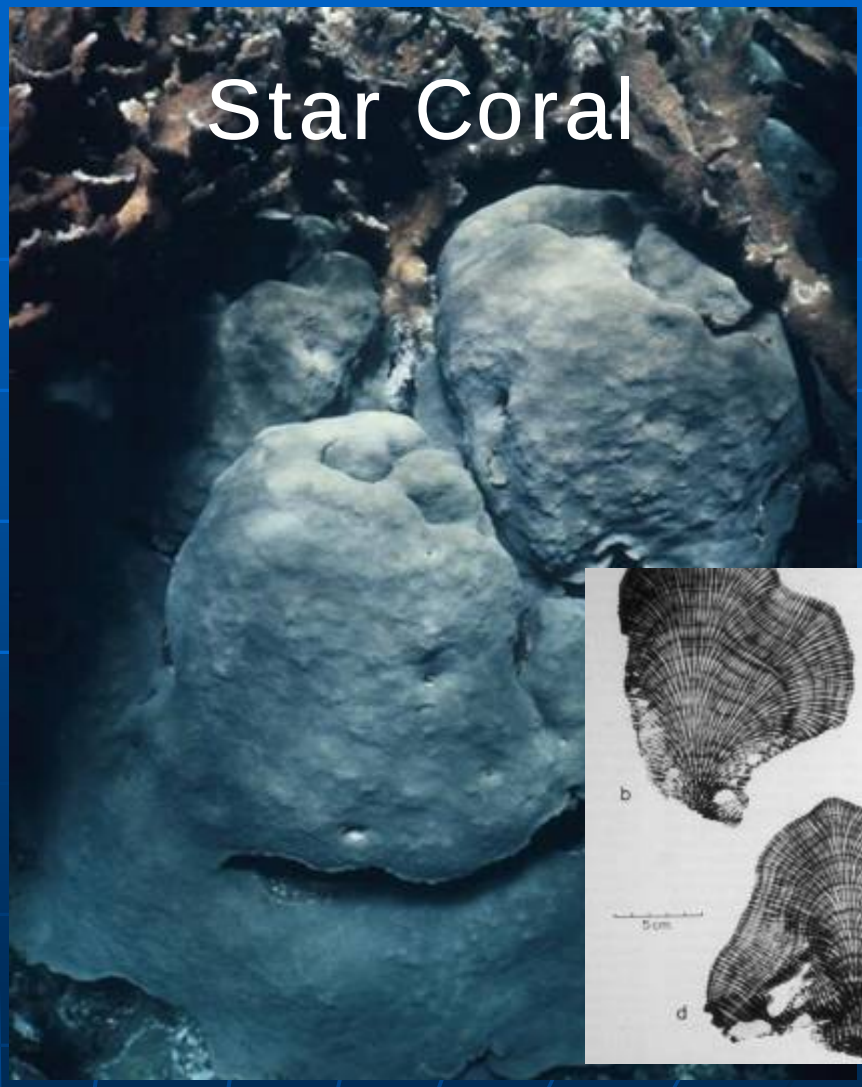


After Gardiner et al. 2003

Caribbean Reef-Building Corals



Acropora palmata

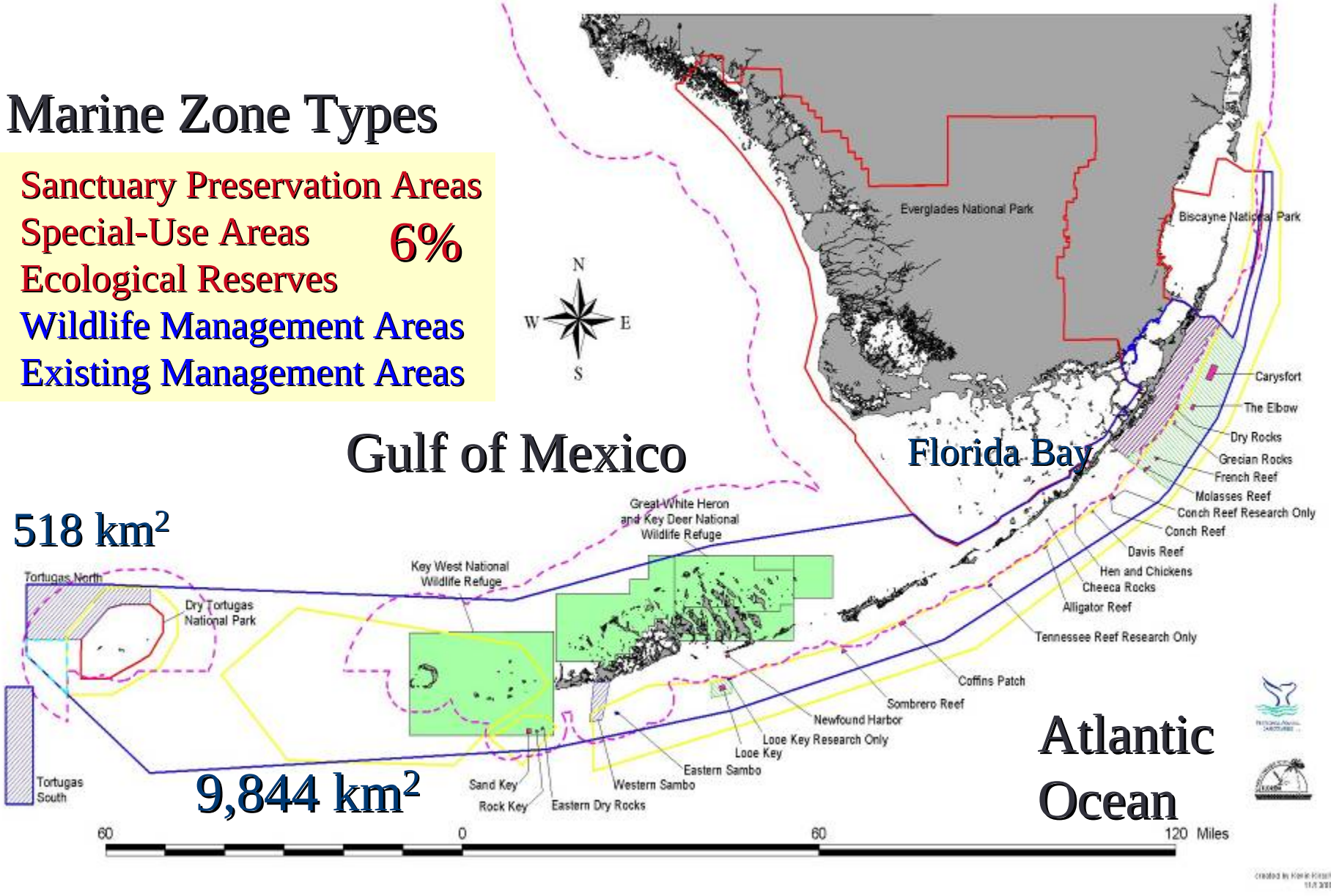


Montastrea annularis

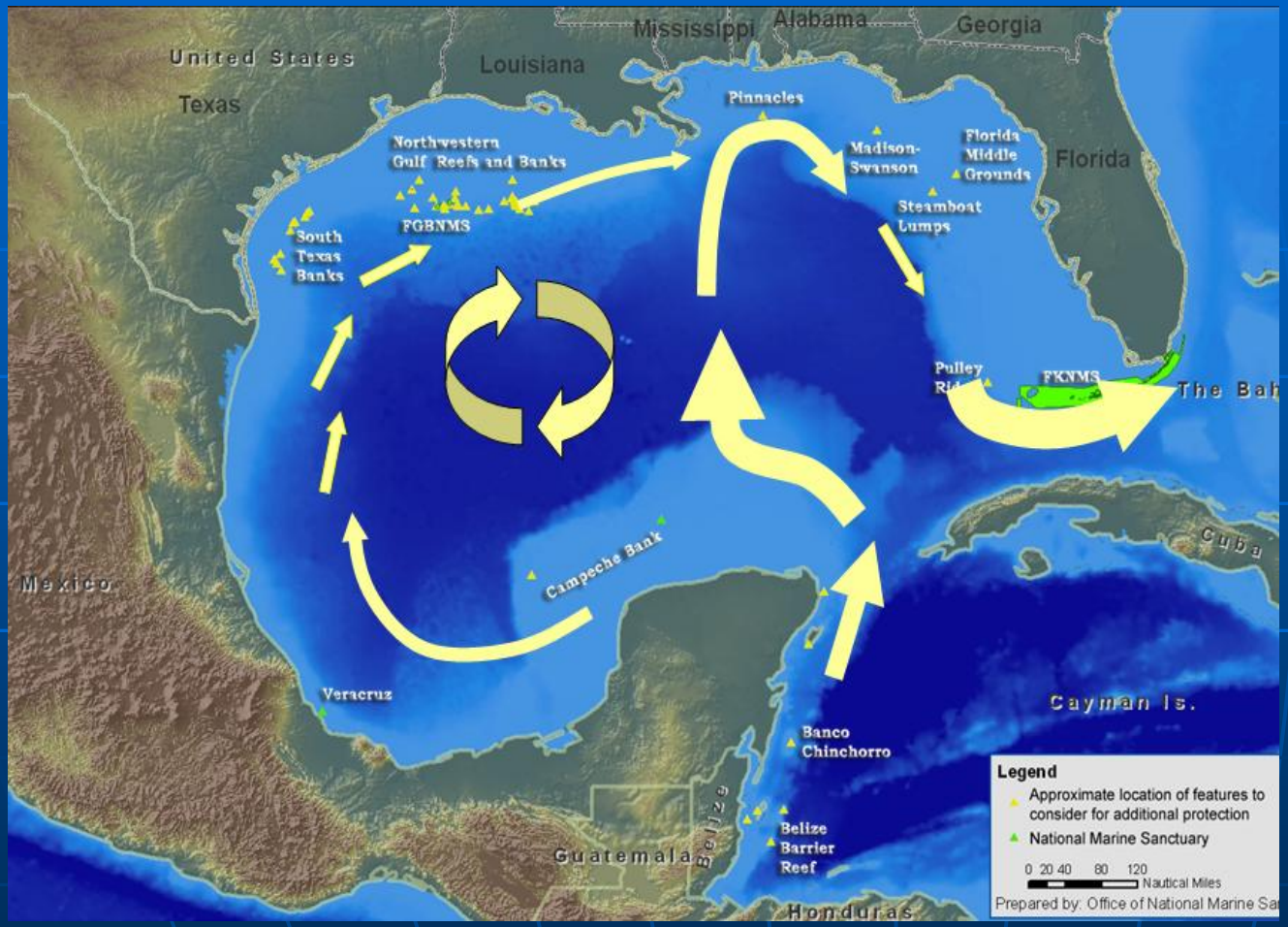
Florida Keys National Marine Sanctuary

Marine Zone Types

- Sanctuary Preservation Areas
- Special-Use Areas **6%**
- Ecological Reserves
- Wildlife Management Areas
- Existing Management Areas



“Islands in the Stream”



- **South Texas Banks**
- **Flower Gardens NMS**
- **NW Reefs / Banks**
- **Pinnacles**
- **Madison Swanson**
- **FL Middle Grounds**
- **Steamboat Lumps**
- **Pulley Ridge**
- **Florida Keys NMS**

A Network of Marine Protected Areas

We have monitored reef decline long enough.

There is sufficient science.

What we have failed to do is to apply it to comprehensive management and governance.

We can be accused of “fiddling while Rome burns…”

Existing Ocean Use Management

- **Fragmentation of management authority**
- **Spatial mismatches between scale of governance and ecological system.**
- **Temporal mismatches between governance and ecological processes.**

Need for More Comprehensive Ocean Use Management

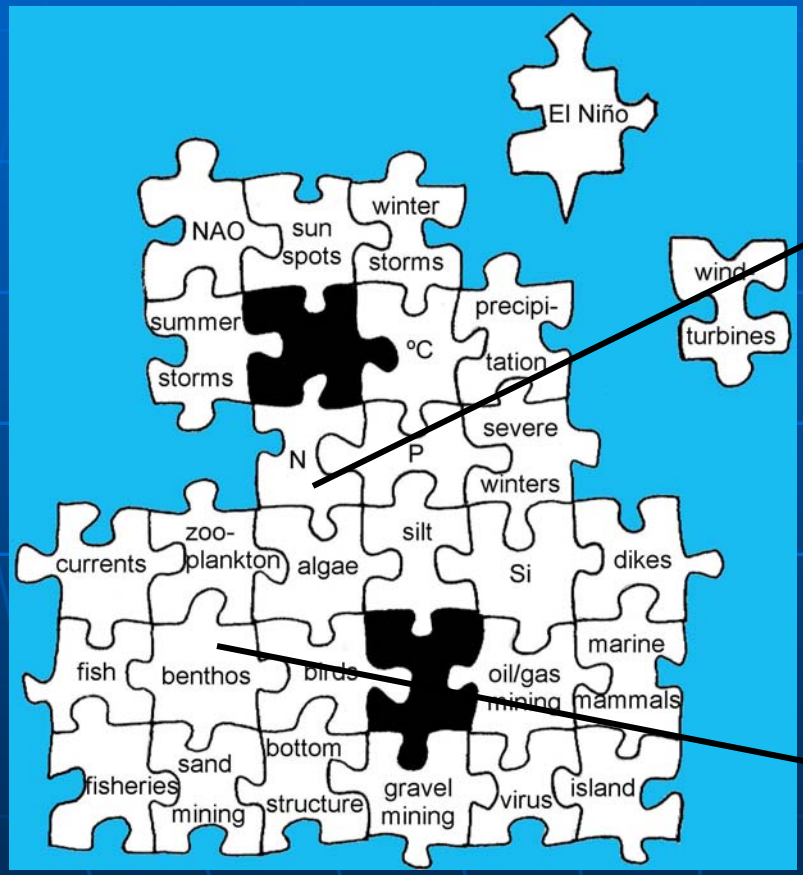
- Fishing and fisheries management
- Aquaculture
- Ports and harbors
- Channels, rights of way
- Pipelines and cables
- Wind power
- Tidal and wave power
- Offshore oil and gas
- Mining and dredging
- Ocean fertilization
- CO_2 sequestration
- Tourism
- Floating and submerged hotels
- Disposal
- Weapons testing
- Recreation
- Conservation
- Scientific research

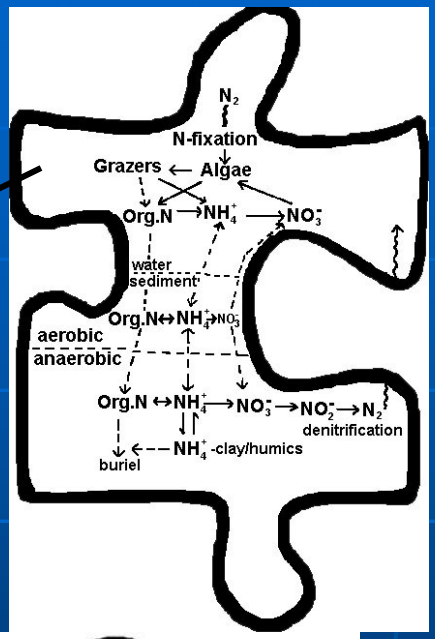
WHAT IS OCEAN USE MANAGEMENT?

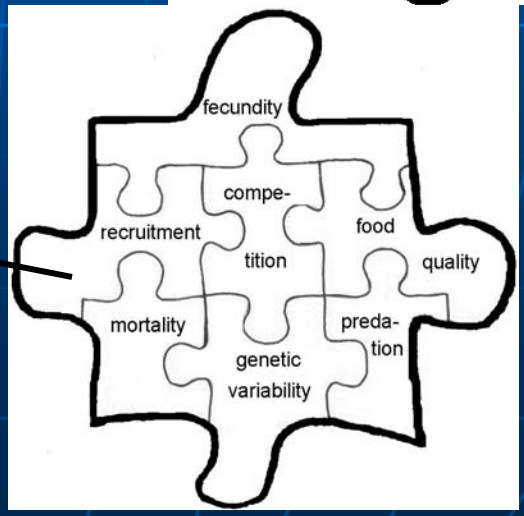
- Area-based (“ecosystem-based”)
- Protection of ecosystem structure and key processes
- Interconnectedness within and among systems
- Integration of ecological, social, economic, and institutional perspectives

Adapted from 2005 Consensus Statement (compassonline.org/?q=EBM)

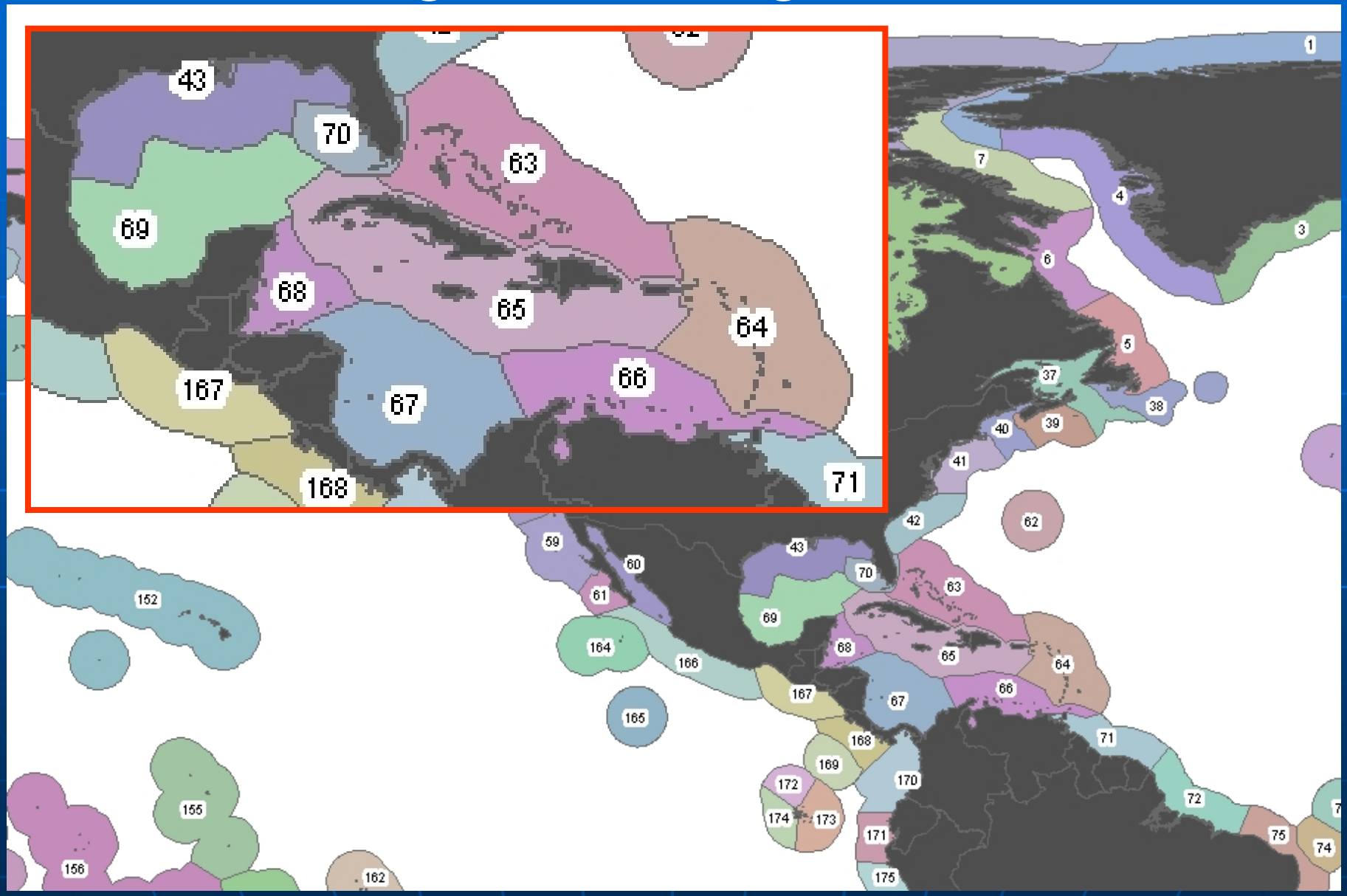
UNDERSTANDING THE MARINE ECOSYSTEM ?



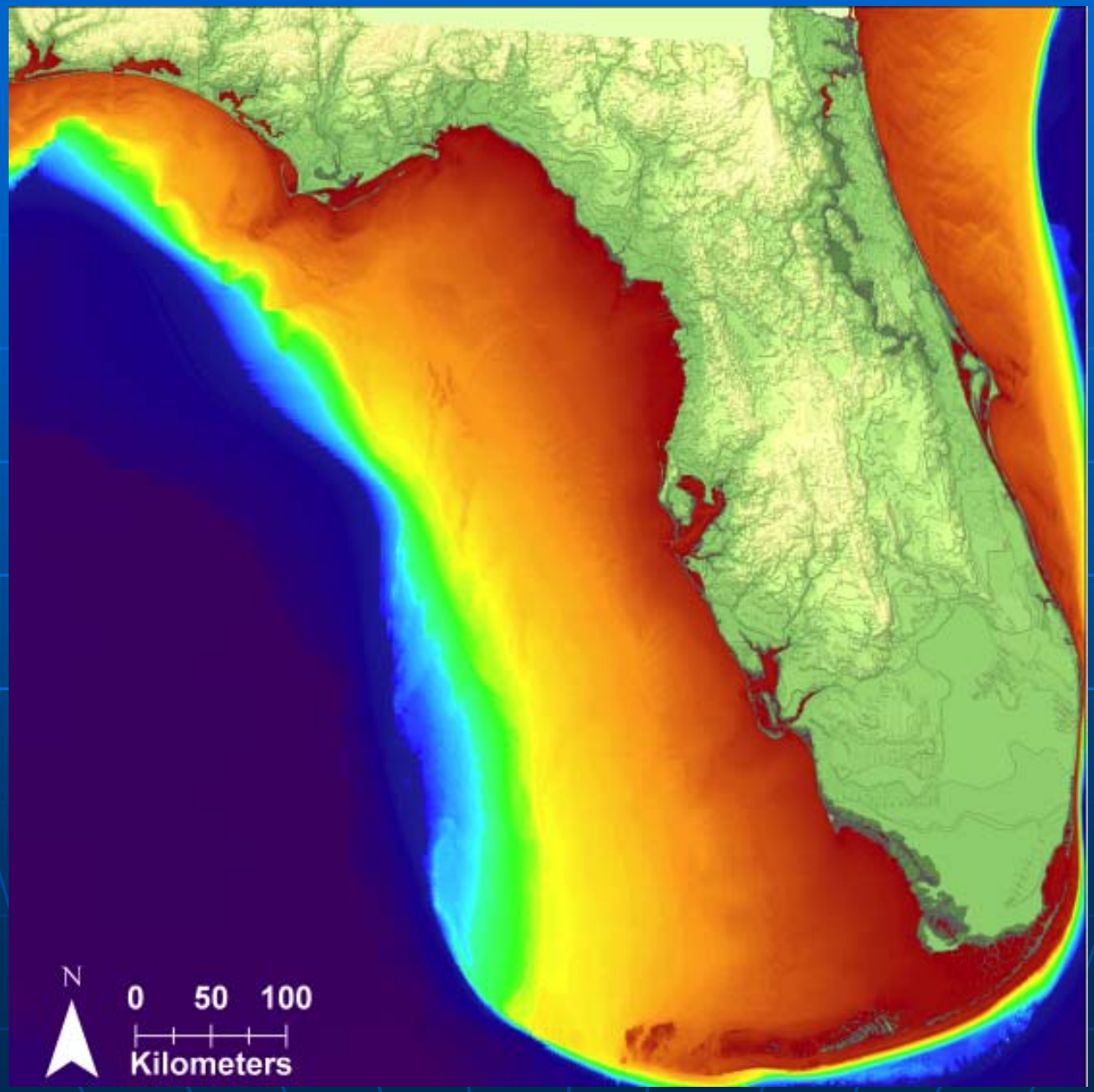




Defining the Management Unit



US and Caribbean Marine Ecoregions, Spalding et al. 2007. BioScience 57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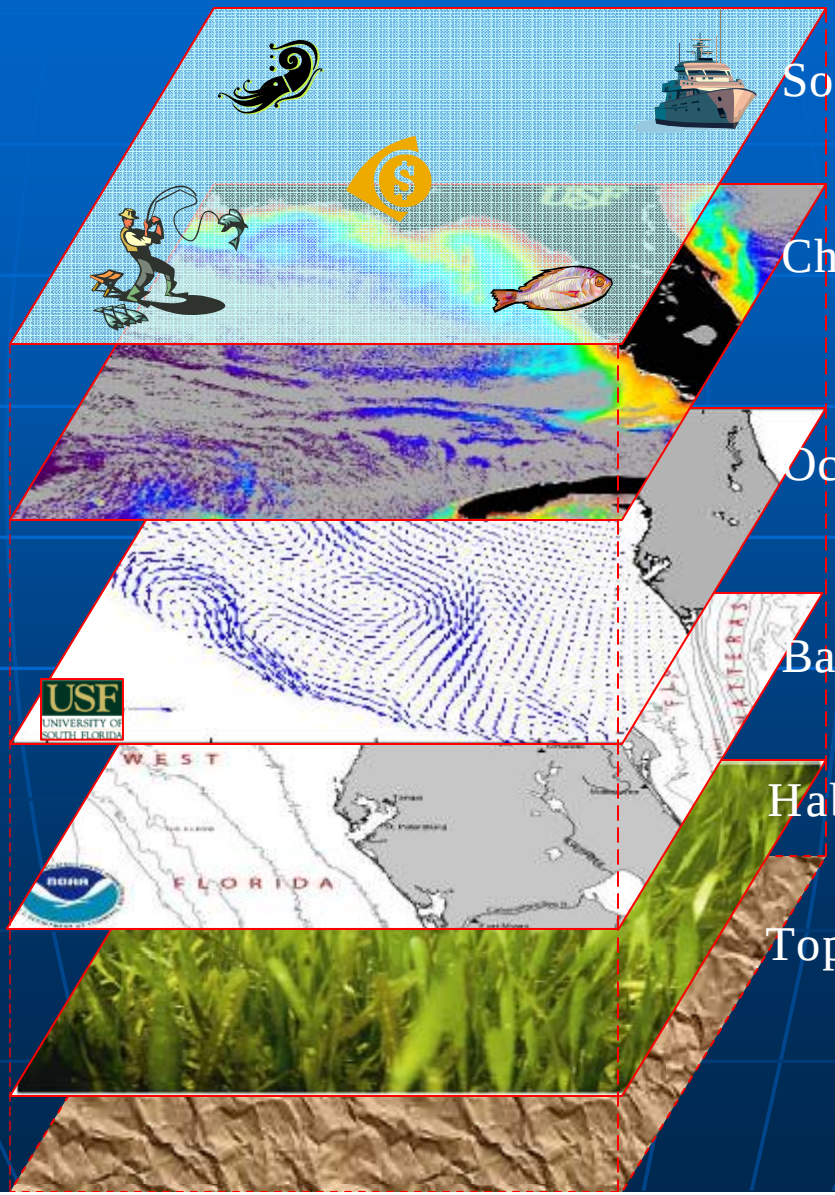
0 50 100
Kilometers

Geospatial Assessment – GIS Data Layers



Geospatial Assessment of Marine Ecosystems (GAME)

All Classes Combined

Bathymetry

Physical data

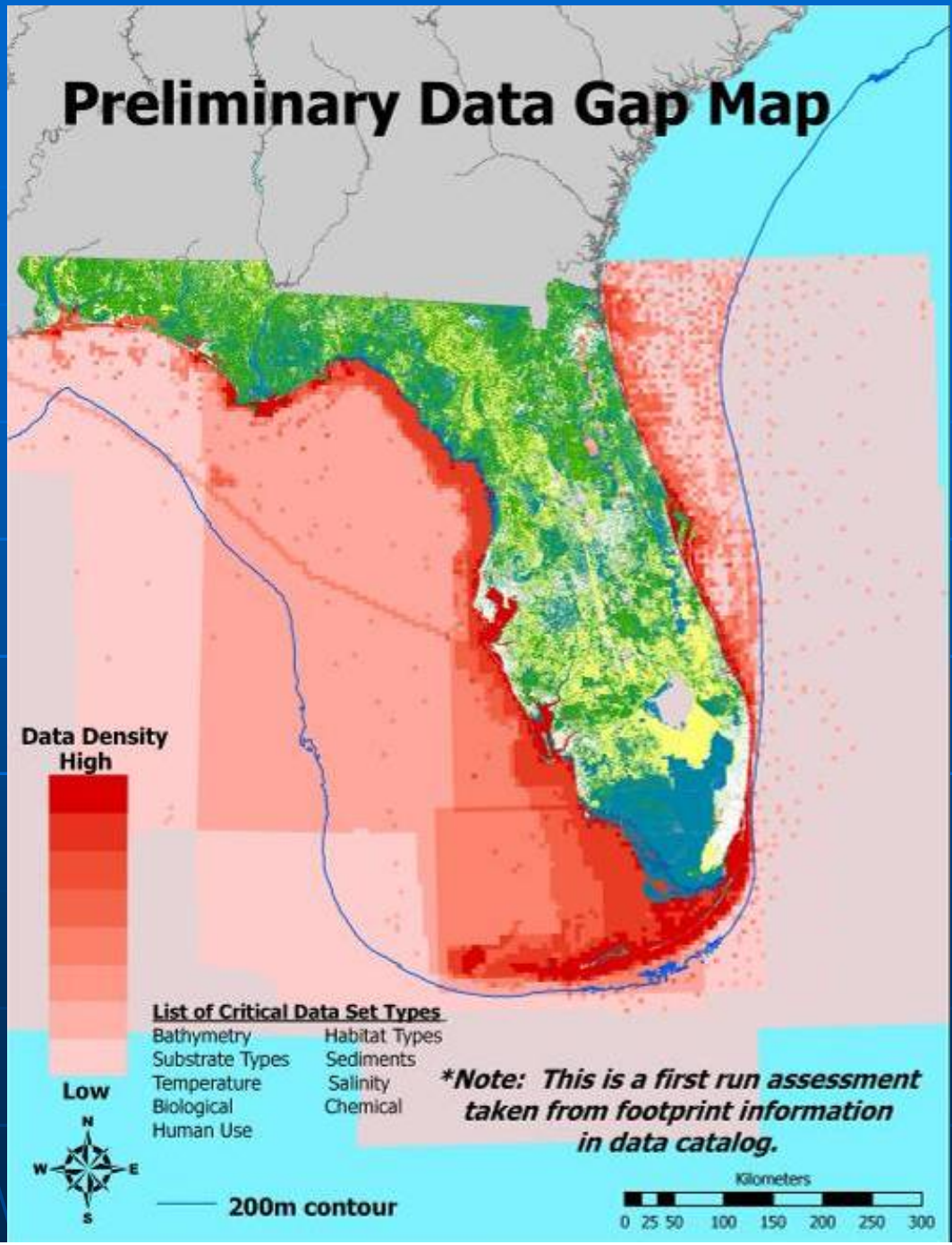
Chemical data

Substrate types

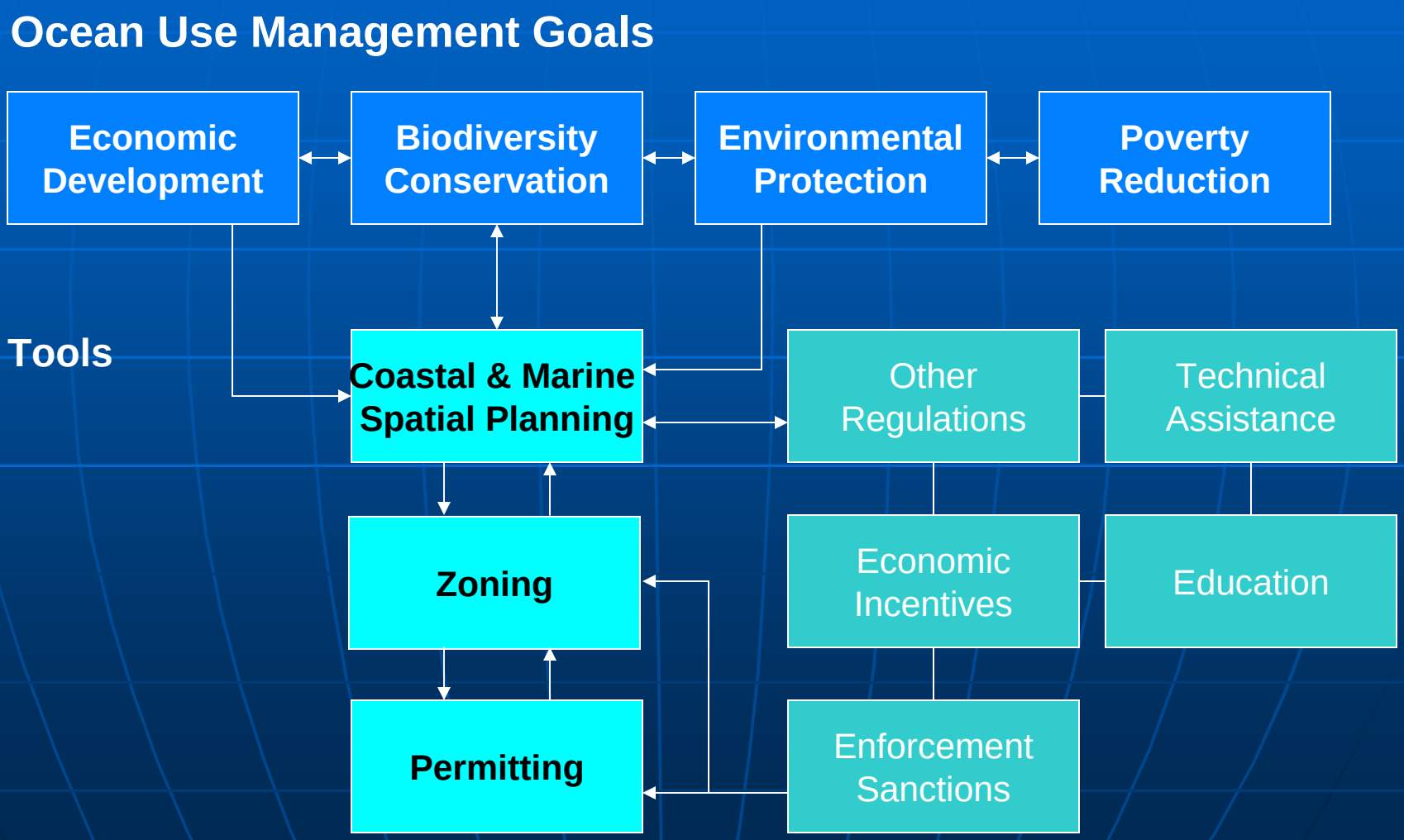
Habitat types

Biological data

Human uses



CREATING THE MANAGEMENT FRAMEWORK



THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY

Final Recommendations Of The Interagency Ocean Policy Task Force

July 19, 2010

National Priority Objectives

- Adopt ecosystem-based management
- Coastal and marine spatial planning
- Inform decisions and improve understanding
- Coordinate and support
- Resiliency and adaptation to change
- Ecosystem protection and restoration
- Water quality and land-use practices
- Environmental stewardship in the Arctic
- Ocean, coastal and Great Lakes observations, mapping and infrastructure

Puerto Rico-Virgin Islands Shelf

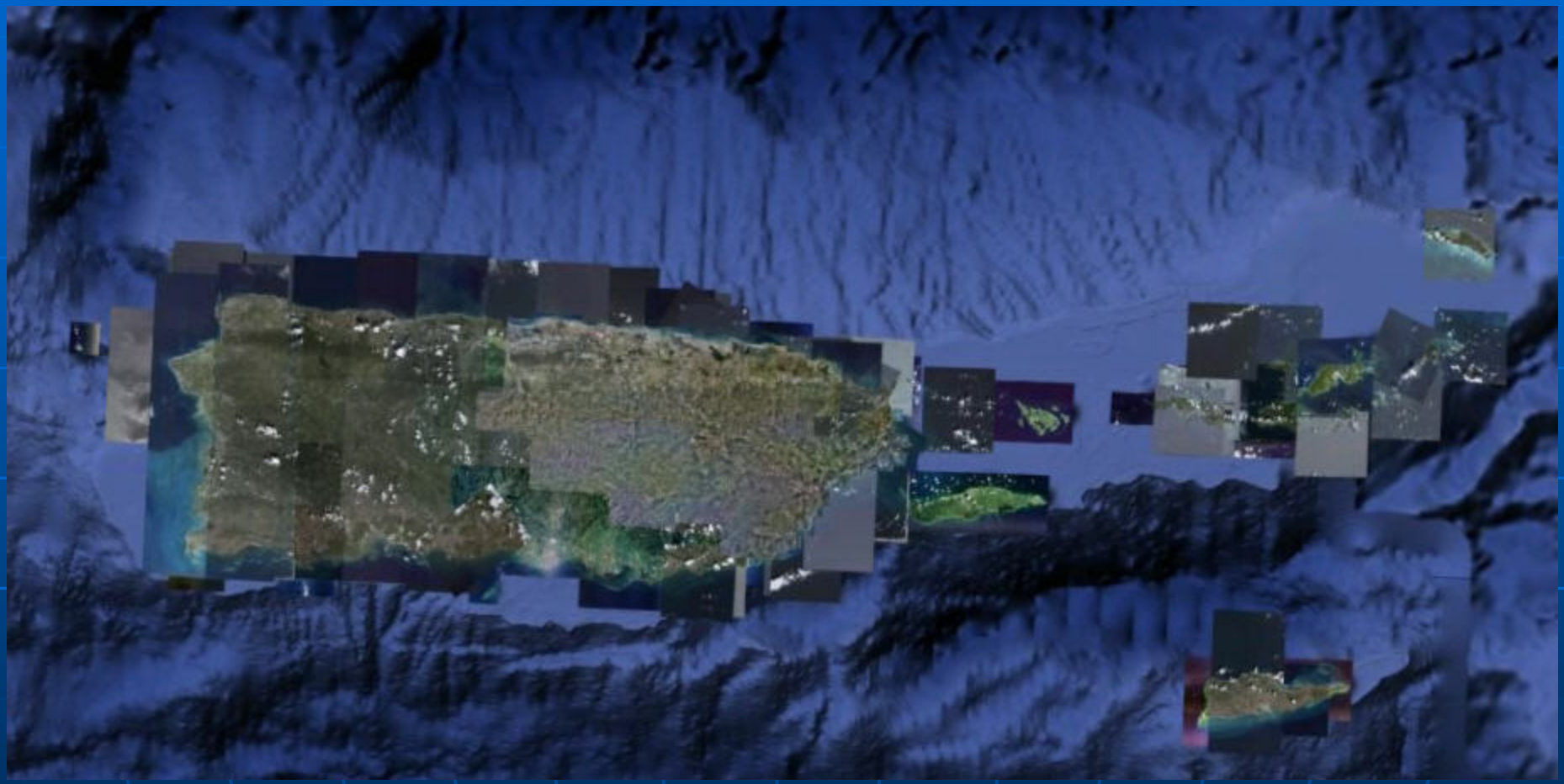
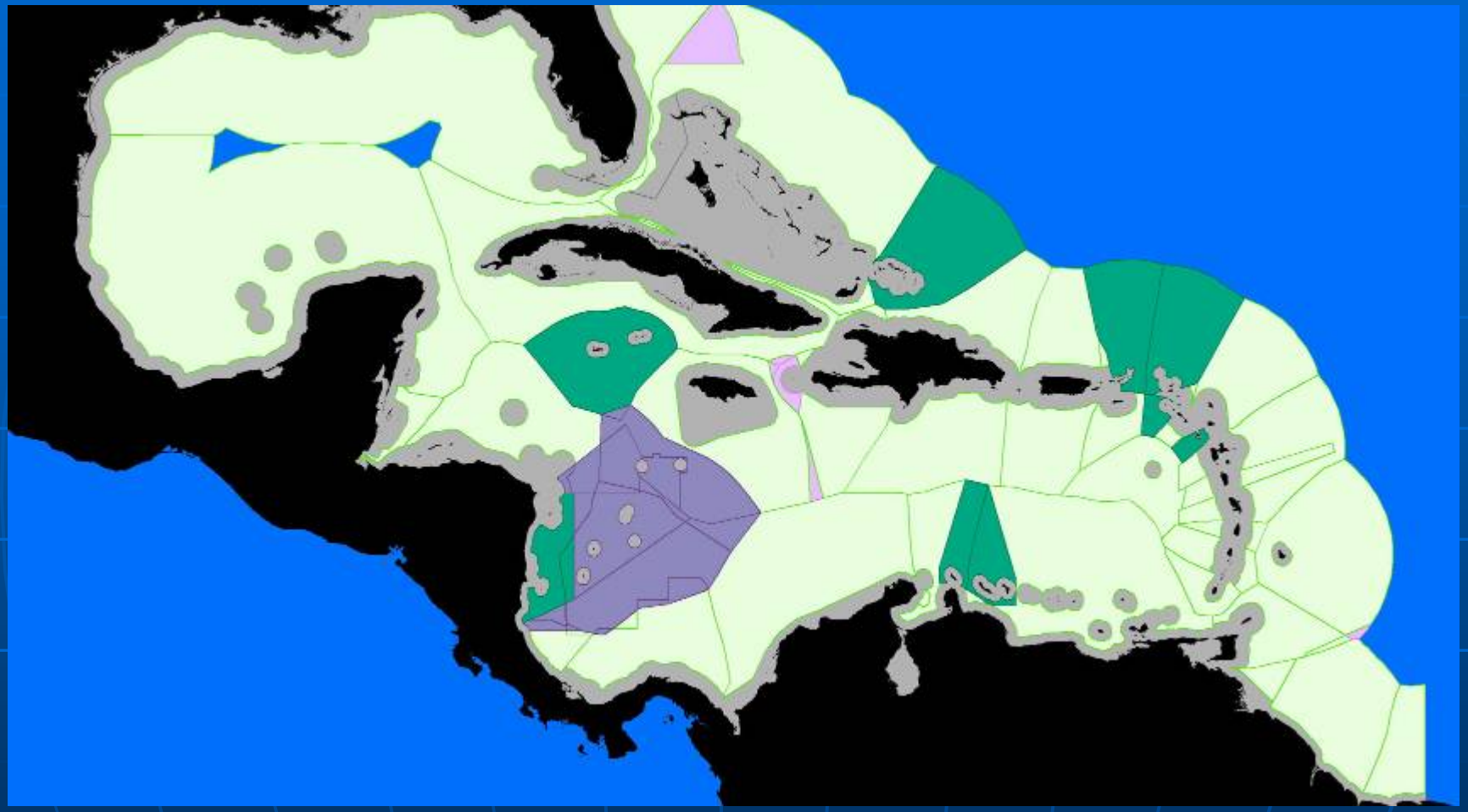


Image taken from Google Earth

The Real Caribbean



DISPUTED EEZ CLAIMS

ACCEPTED EEZ CLAIMS

ACCEPTED FZ CLAIMS

TERRITORIAL SEAS

CARIBBEAN REGION NATIONAL CLAIMS TO EXCLUSIVE ECONOMIC ZONES AND FISHERY ZONES

THANKS TO:

All the people (you know who you are!), going back to the founding Advisory Council of the Keys Sanctuary, who have patiently helped me to try to understand the role of science in ocean management.

NCEAS Study Group on Ocean Zoning: Satie Airame, Larry Crowder, Jon Day, Fanny Douvere, Bud Ehler, Julie Ekstrom, Ben Halpern, Karen McLeod, Elliott Norse, Gail Osherenko, Robbin Peach, Andy Rosenberg, Jim Wilson, and Oran Young

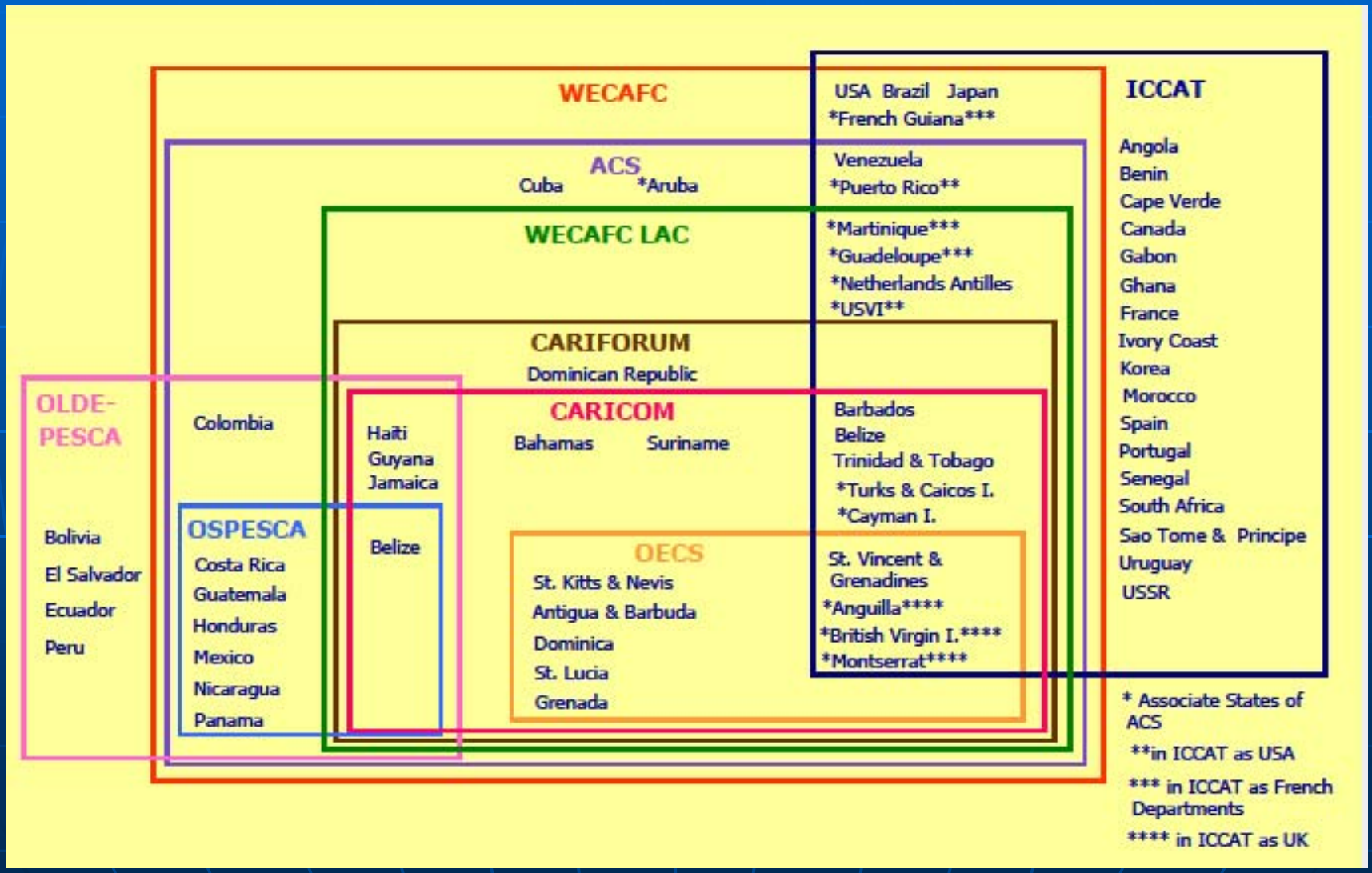
Prof. Robin Mahon, Dr. Cristina Carollo

Additional Resources:

GAME: http://research.myfwc.com/game

CLME: http://www.cavehill.uwi.edu/cermes/clme.html

Overlapping Fisheries Management



Summary: Status

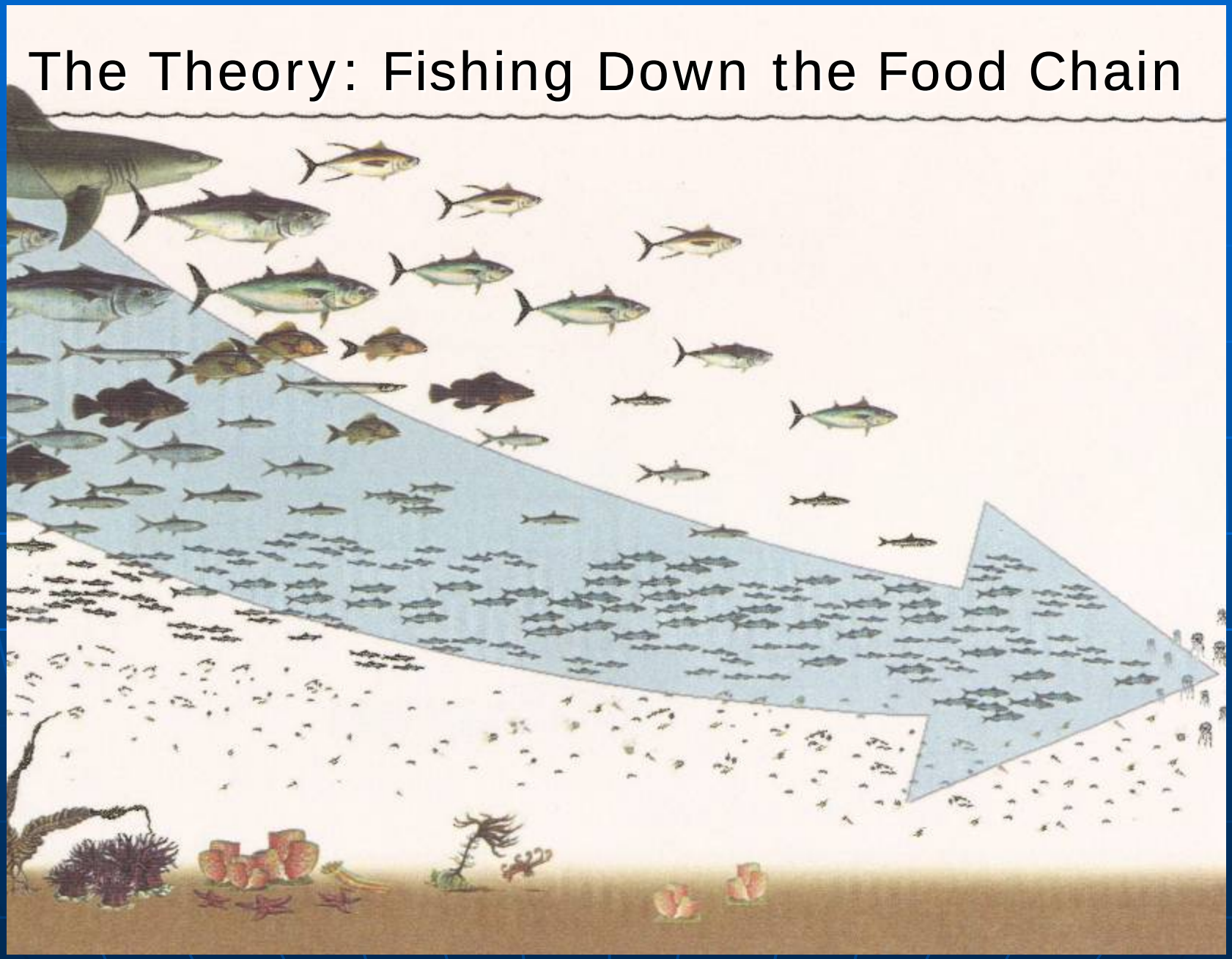
Habitats

- Reefs of the region are in decline
- Associated biodiversity in decline
- Coastal habitats in decline
- Current governance efforts and protected areas are inadequate

Resources

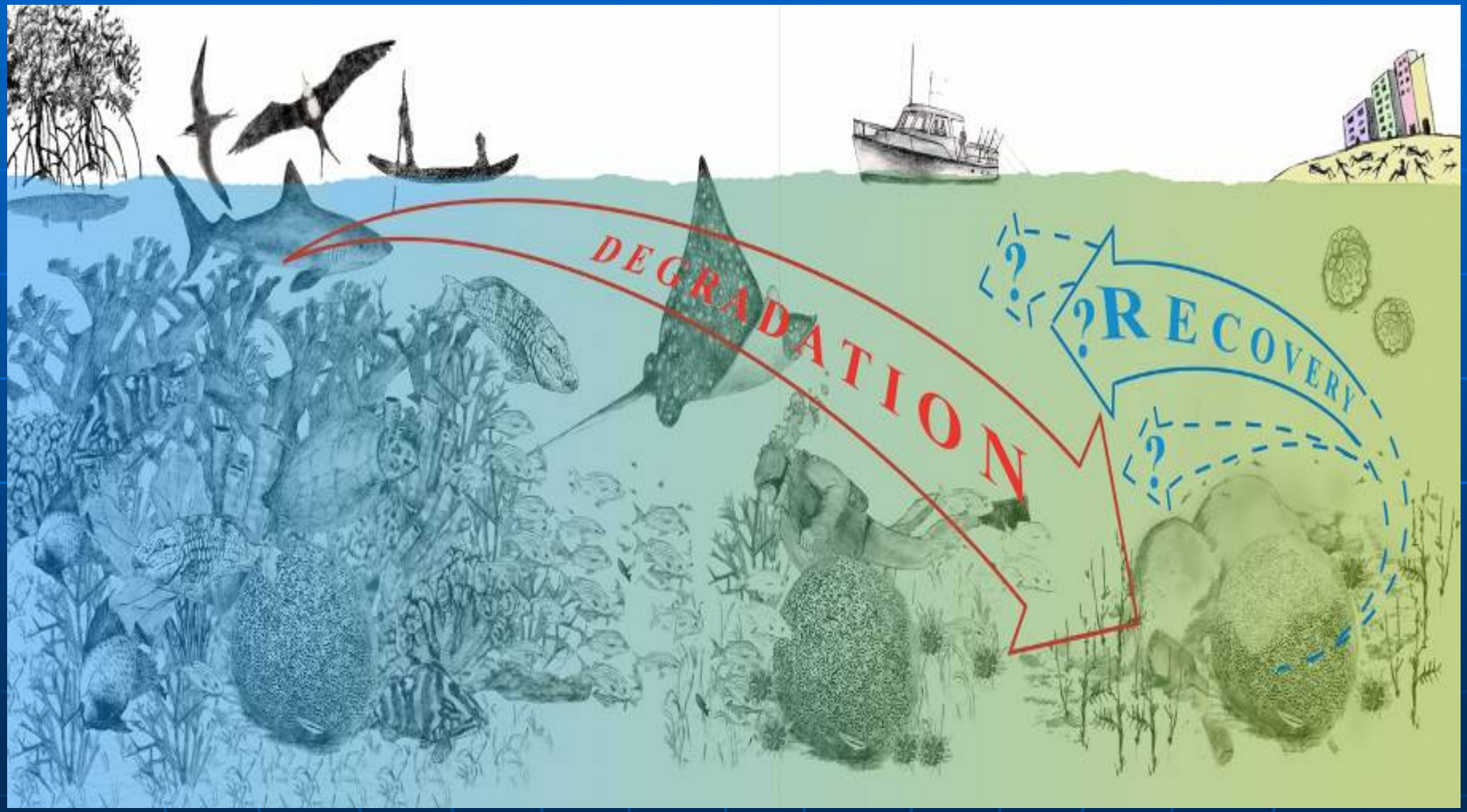
- Most resources fully- or over-exploited
- Most assessment effort in lobster, conch and shrimp
- Ocean-wide, large pelagic fishes assessed by ICCAT
- Status of regional pelagic fishes unknown

The Theory: Fishing Down the Food Chain



Source: Pauly 2003

The Slippery Slope to Slime

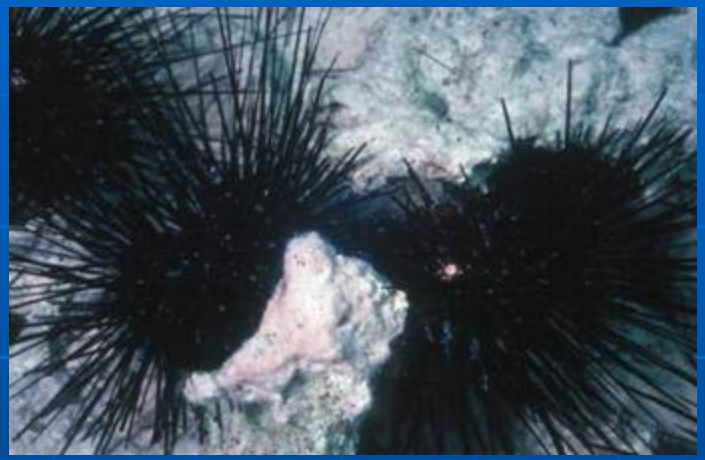


From Pandolfi et al. 2005

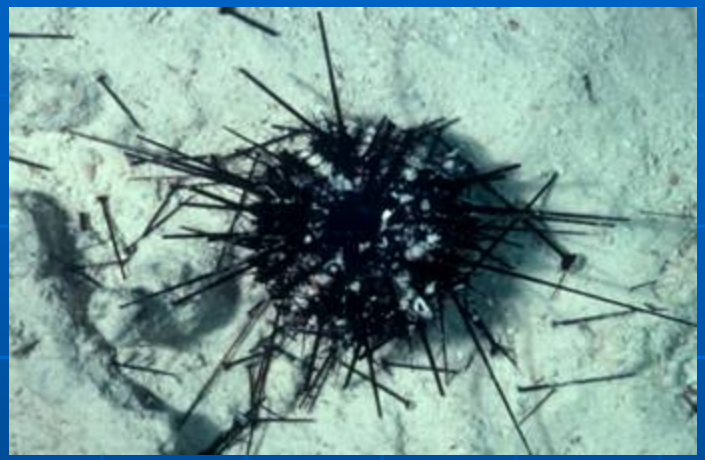
Coral Bleaching

Diadema Mass Mortality 1983-84

Pictures from St. Croix, USVI, February 1984



Sticky spines Day 1



Spines shed Day 4

Death and predation Day 6

Recovering Day 12

Spread of *Diadema* Mortality

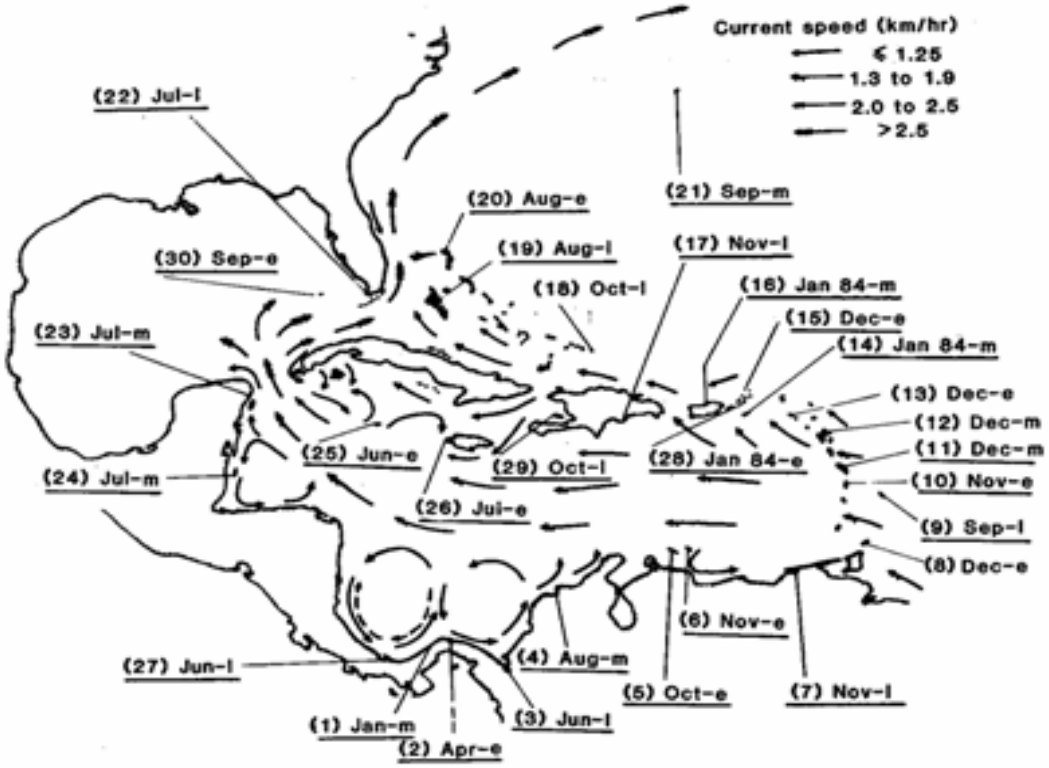


Fig. 2. Spread of *Diadema* mass mortality through the Caribbean and the western Atlantic. Underlined dates indicate the first time mortality was noted at each locality. Dates without underlining indicate the last time lack of mortality was verified in unaffected areas. e, m, and l indicate the early, middle, and late part of the month. Unless otherwise noted, dates refer to 1983. Current patterns were compiled from (*17, 18, 20, 21, 40, 61*). Numbers denote the following localities. 1: Galeta Point, Panama; 2: San Blas Archipelago; 3: Puerto Obaldia, Panama; 4: Santa Marta, Colombia; 5: Curaçao; 6: Bonaire; 7: Venezuela; 8: Tobago; 9: Barbados; 10: St. Lucia; 11: Martinique; 12: Guadeloupe; 13: St. Kitts; 14: St. Croix; 15: St. Thomas and St. John; 16: Puerto Rico; 17: Santo Domingo; 18: Grand Turk; 19: Andros and New Providence Islands; 20: Grand Bahama; 21: Bermuda; 22: Florida Keys; 23: Cancun, Mexico; 24: Belize; 25: Grand Cayman; 26: Jamaica; 27: Cahuita, Costa Rica; 28: Tortola, Virgin Gorda, and Salt Island; 29: Gulf of Gonave, Haiti; 30: Dry Tortugas.

336

- Began Panama, Jan. ‘83
- Spread followed gross circulation pattern
- Florida, July ‘83
- Bermuda, Sept. ‘83
- Pattern changed, Sept. ‘83
- Barbados, Sept. ‘83
- St. Croix, Jan. ’84

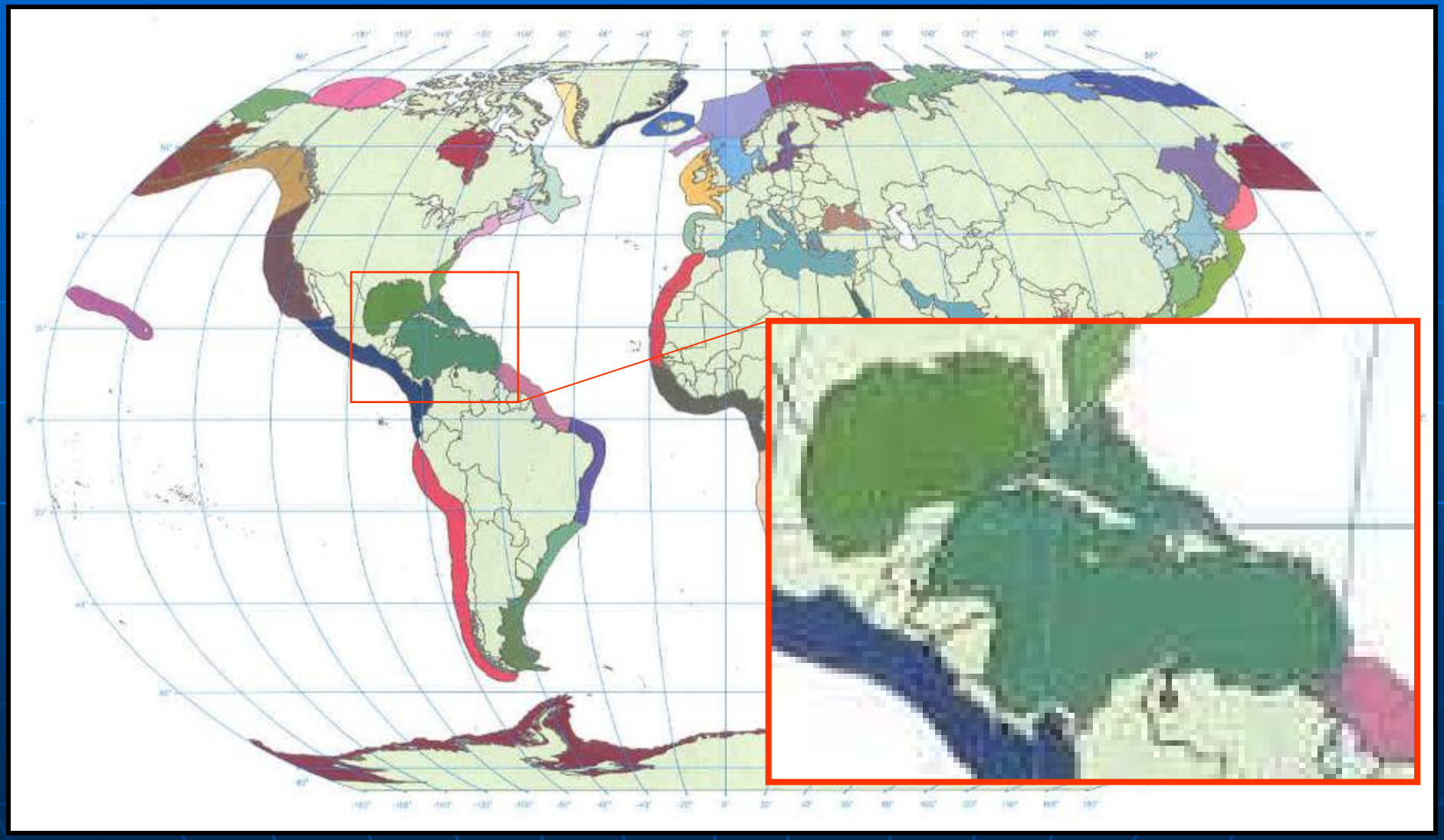
- Causative agent unknown
- No mortality in E. Atlantic
- Repeat mortality, Sept. ’85 St. Croix
- Earliest recovery St. Vincent and Grenadines

From Lessios, Robertson, and Cubit, 1984

Post-Mortality St. Croix

Ogden, Unpubl.

Large Marine Ecosystems



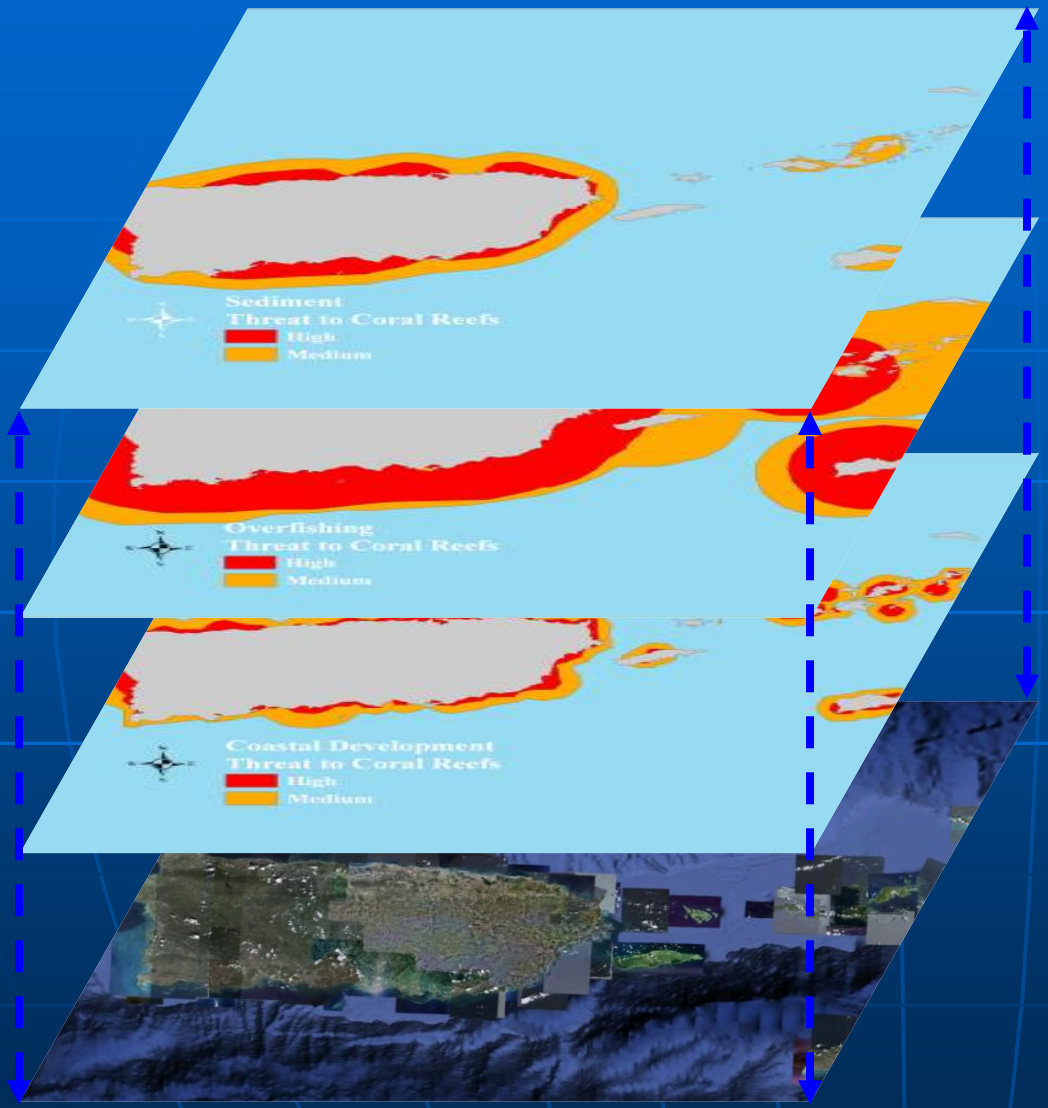
Designing MPAs and MPA Networks for Ecological Resilience

- Reduce non-climate stresses
- Protect the least exposed
- Protect the most resistant
- Protect the most valuable
- Protect resilient populations
- Make MPAs dynamic
- Maintain connectivity
- Spread the risk

Adaptively Managing Regional Ocean Governance

- Monitoring and evaluation
- Ecosystem characterization
- Predictive capabilities
- Agency coordination
- Education and public involvement
- Policy action thresholds
- Targeted research

GAME Application



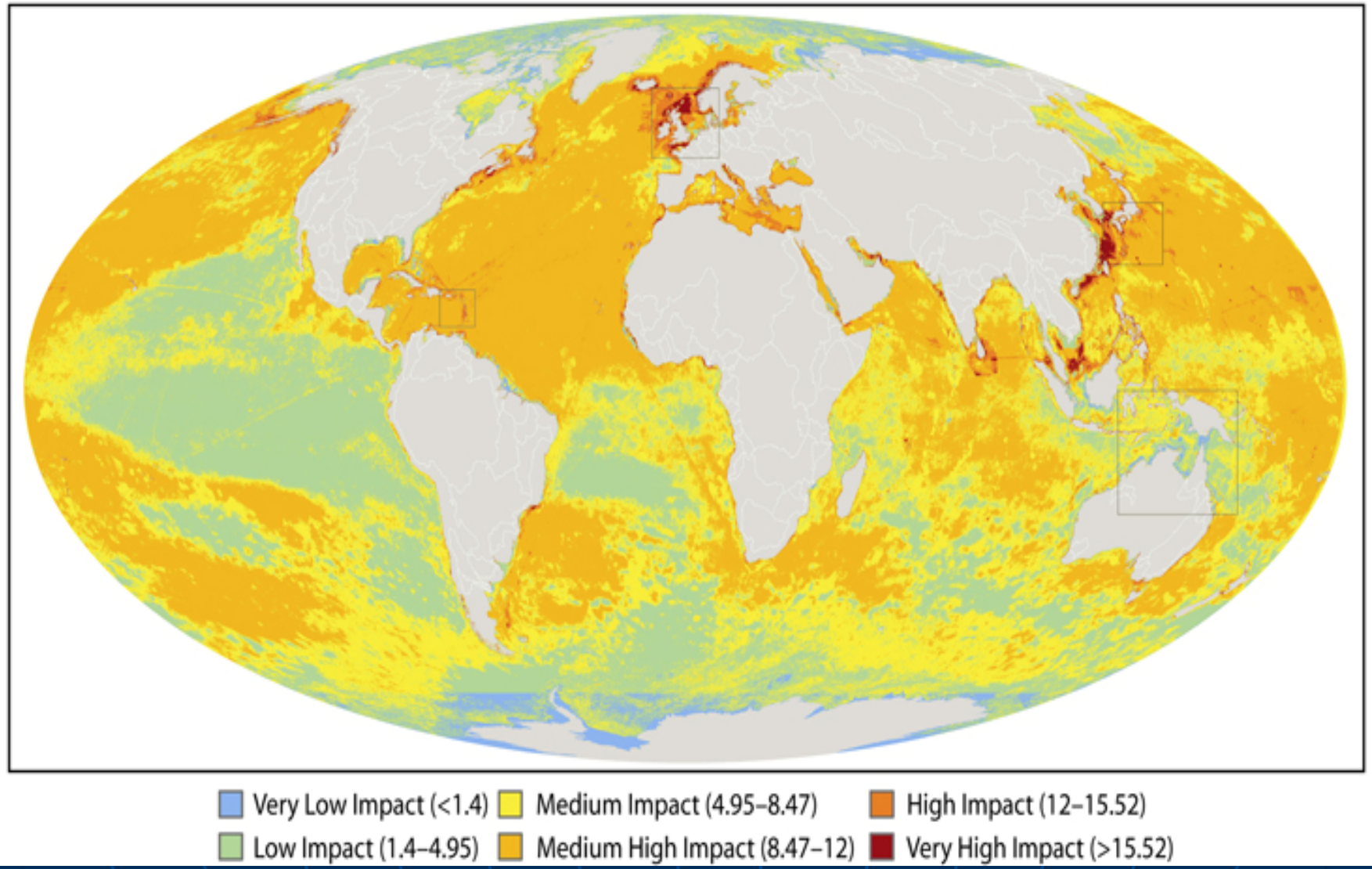
Sediment

Overfishing

Coastal Development

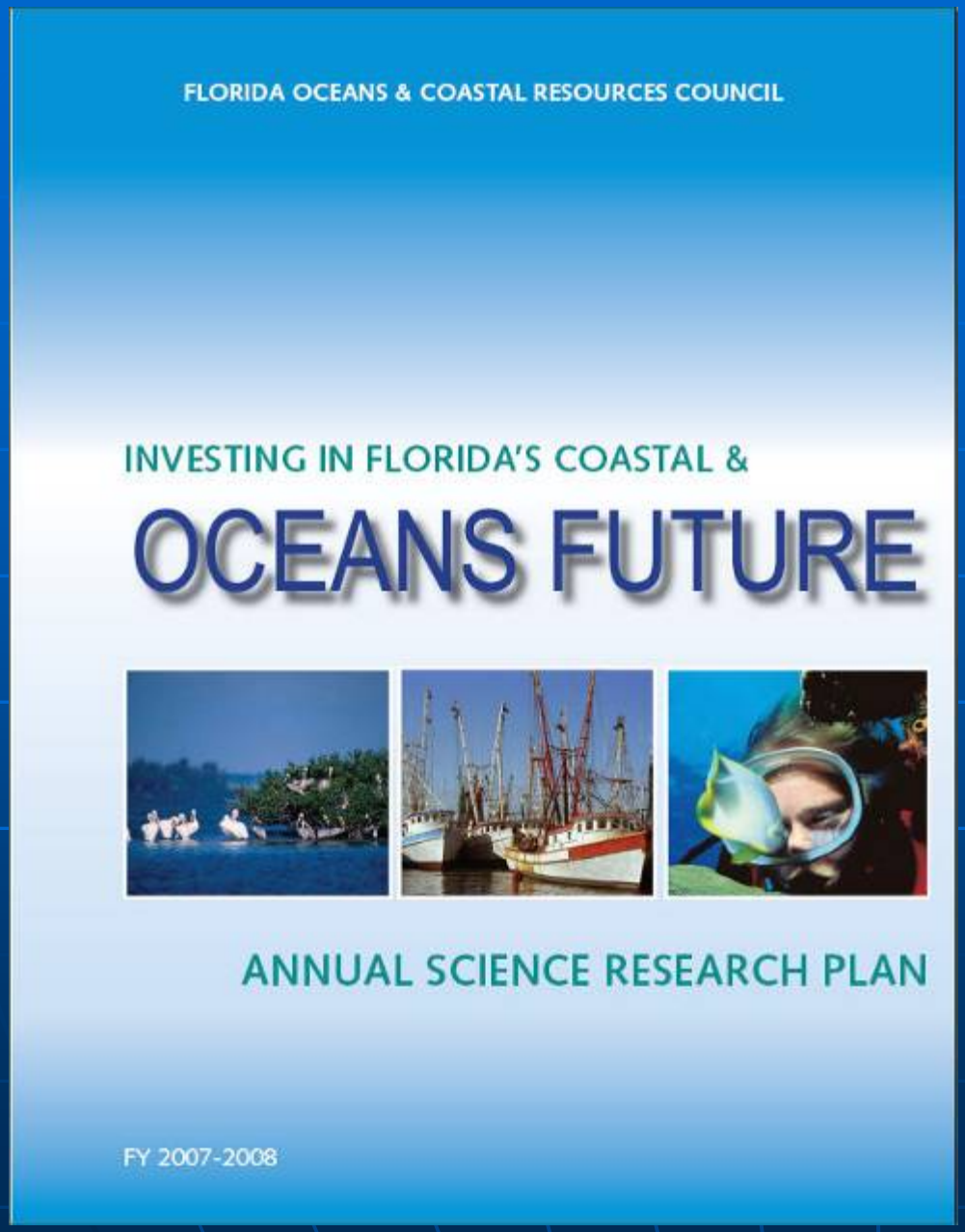
Satellite Imagery and Bathymetry

Global Map of Human Impact on Marine Ecosystems



Halpern et al. 2008. Science 319: 948-952.

Incompatibilities Among Human Uses

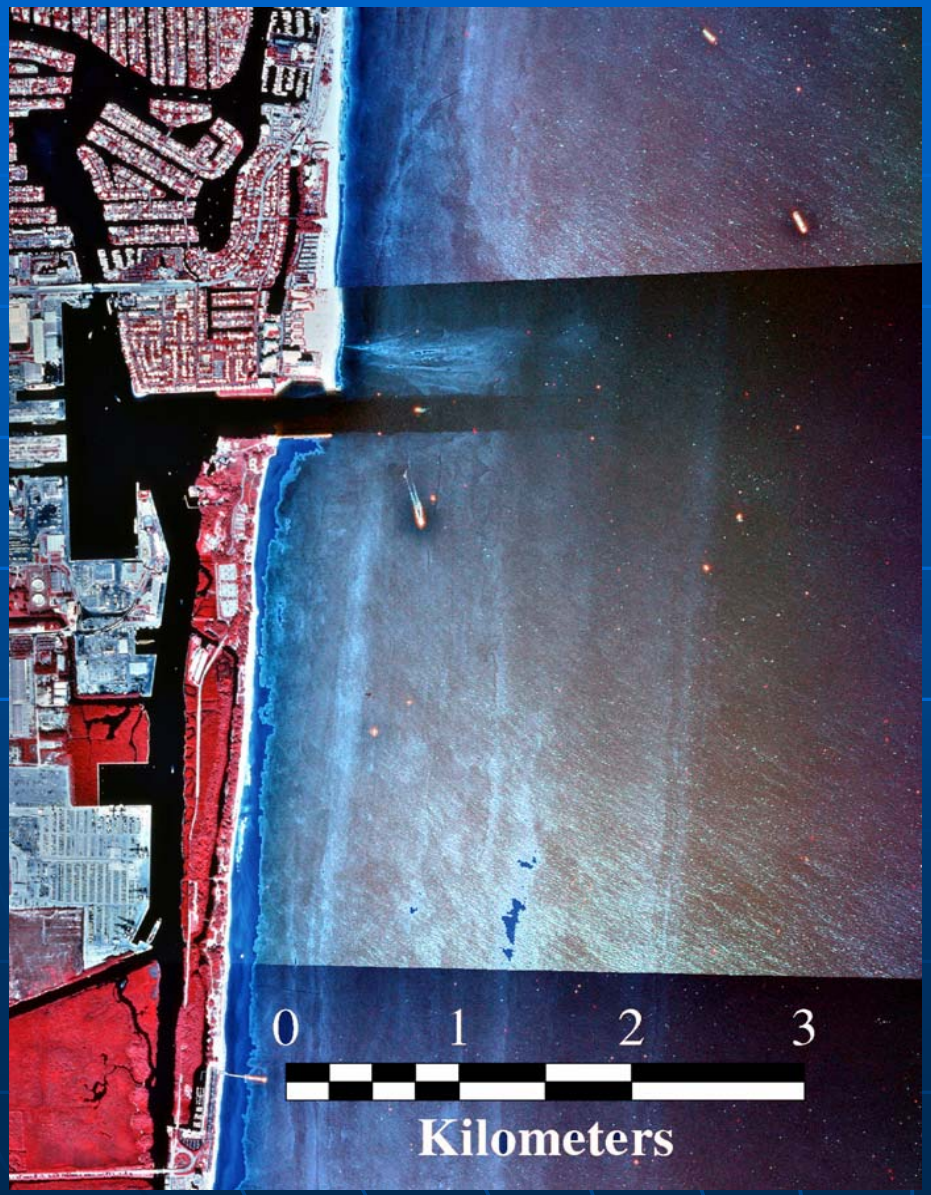


Charge to the Council:

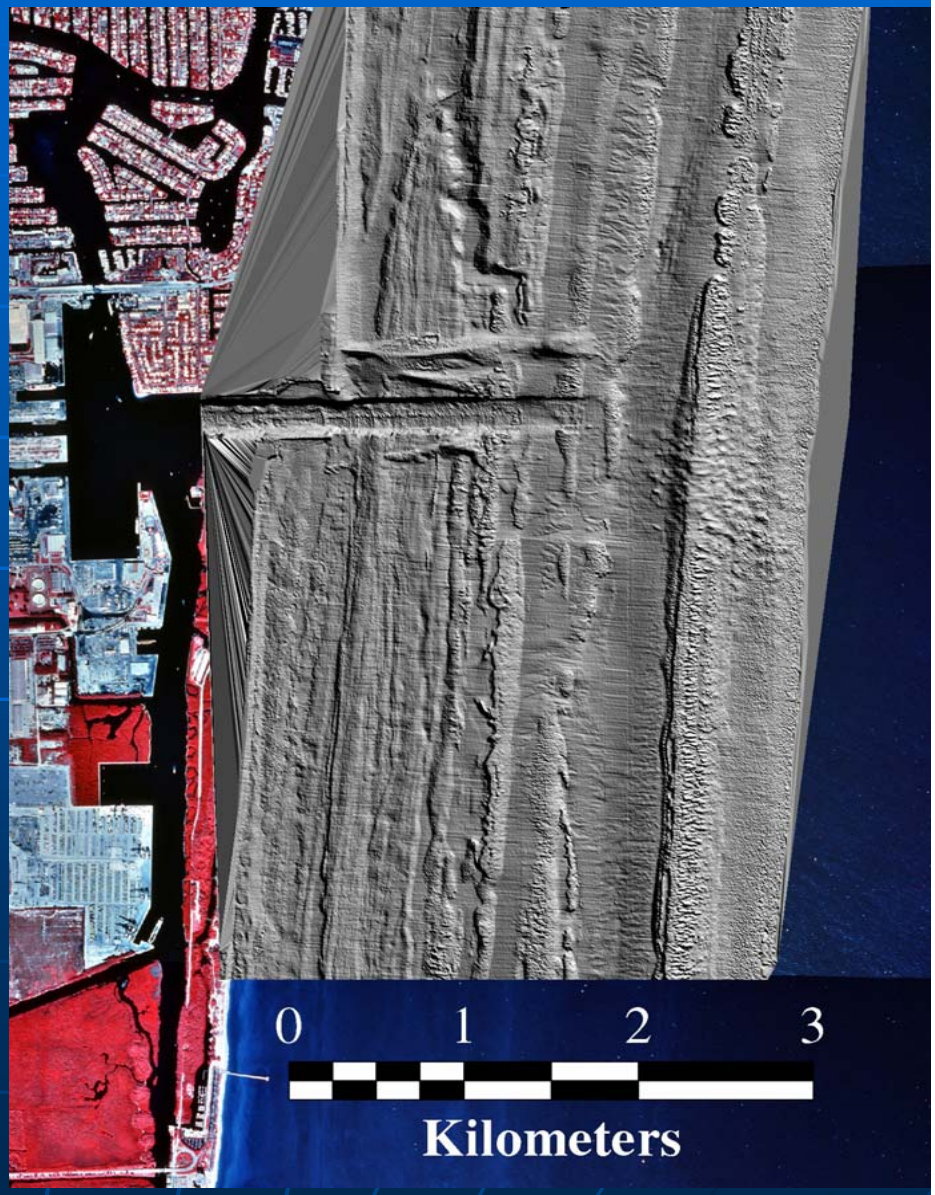
…assist the state in identifying new management strategies to achieve the goal of maximizing protection and conservation of ocean and coastal resources…

New Tools for Seafloor Mapping

Aerial Photograph Mosaic

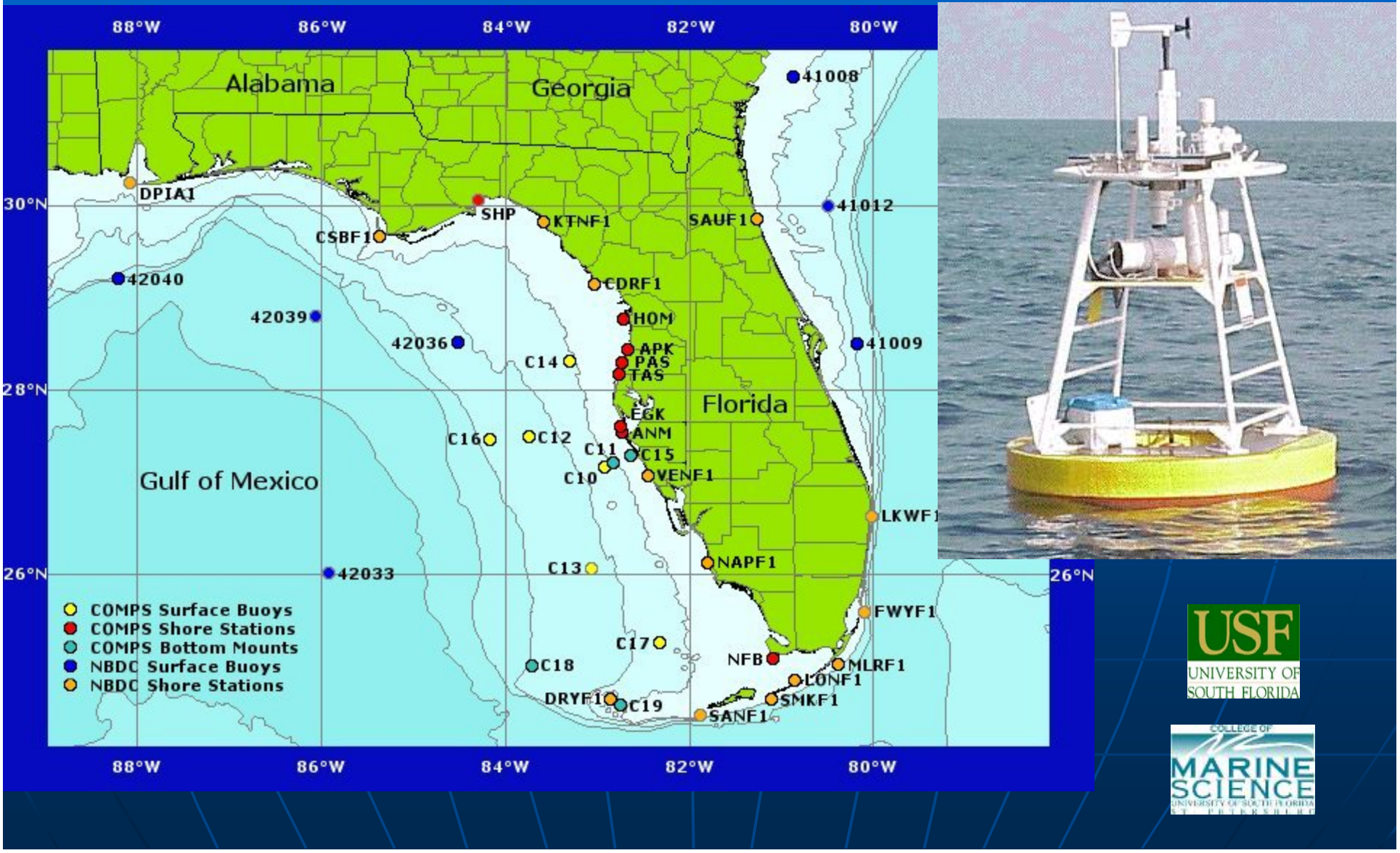


LADS Bathymetry Overlay



Coastal Ocean Observing System

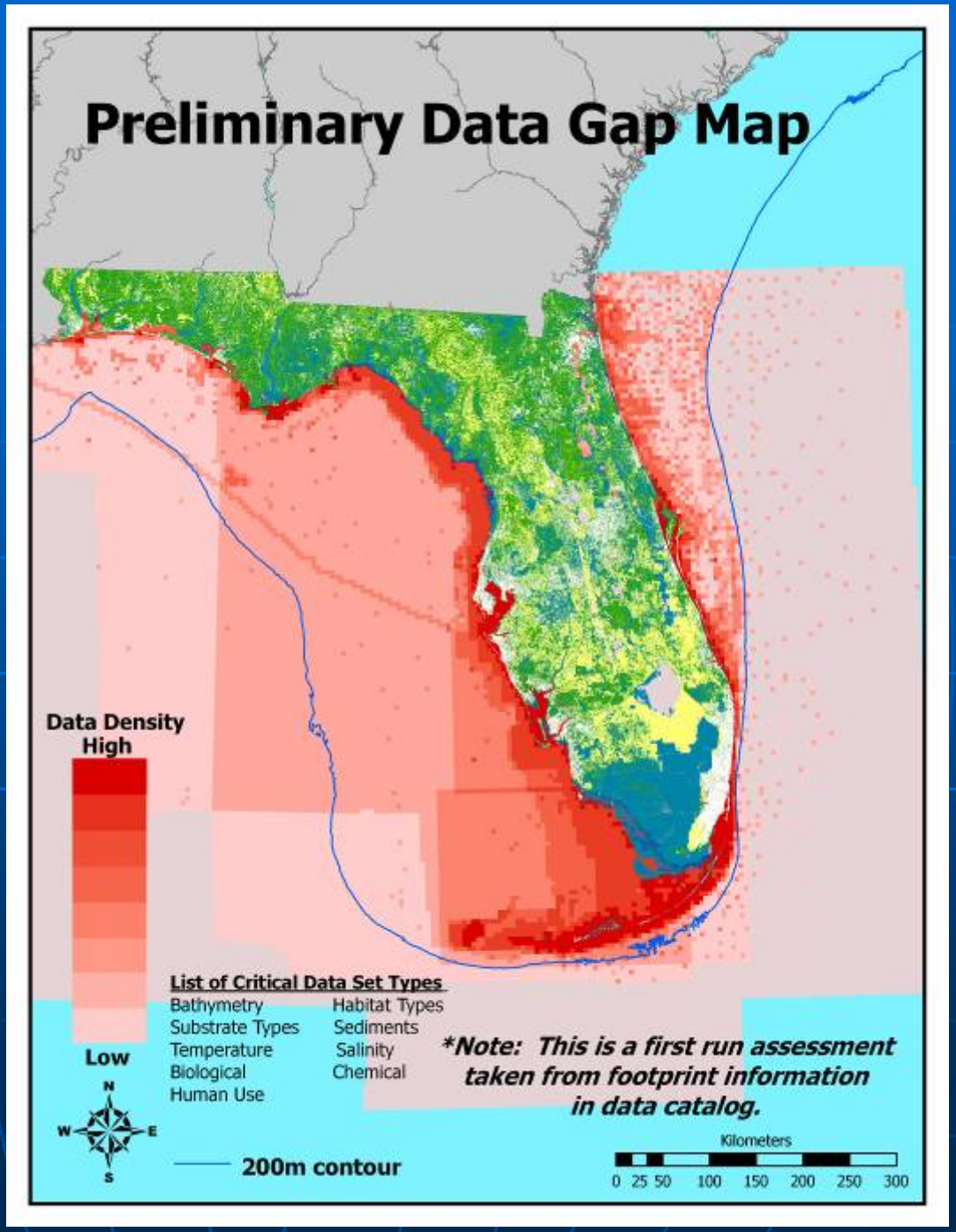
http://comps.marine.usf.edu http://ocg6.marine.usf.edu



USF UNIVERSITY OF SOUTH FLORIDA

COLLEGE OF MARINE SCIENCE UNIVERSITY OF SOUTH FLORIDA ST. PETERSBURG

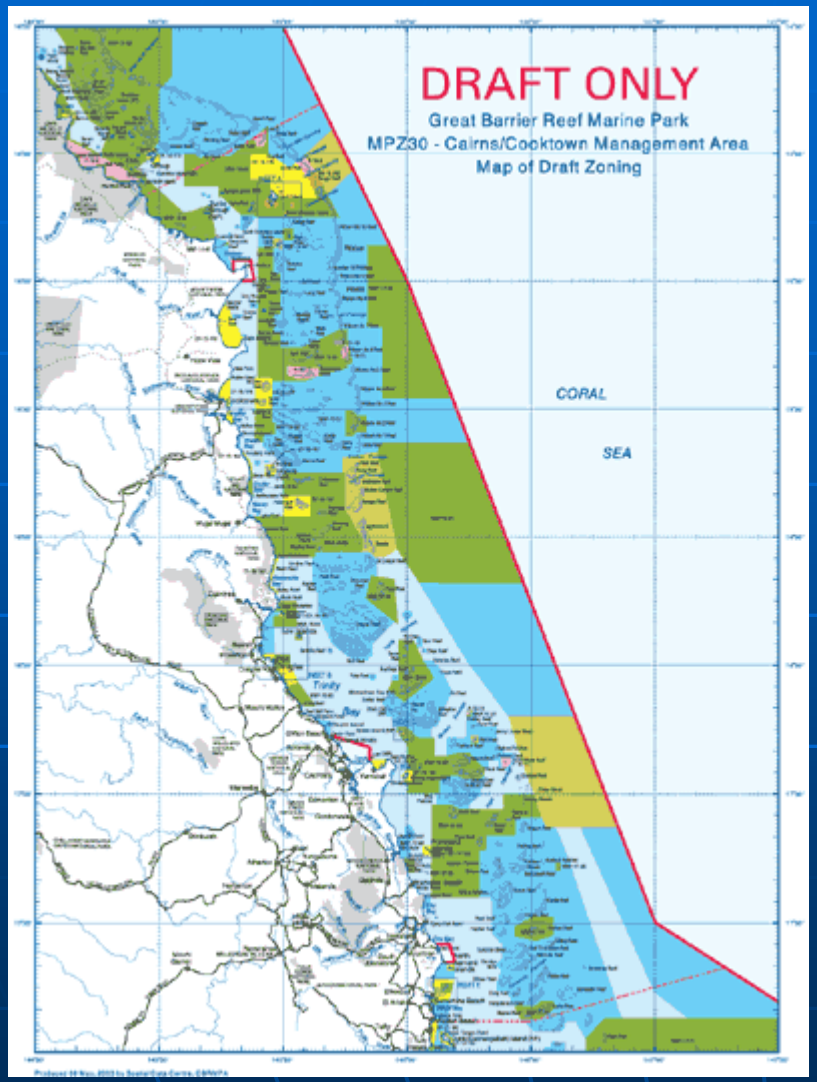
All Classes Combined



An Instructive Zoning Precedent: Great Barrier Reef Marine Park

- Huge area backed by strong national legislation, with strong public support
- Federal-state cooperation
- Conservation has precedence
- Zones based on sound science modified by public input
- Adaptive management: zones revised over time to incorporate new information

Zoning Scheme for the Cairns-Cooktown Section of the Great Barrier Reef Marine Park



MAJOR ZONES

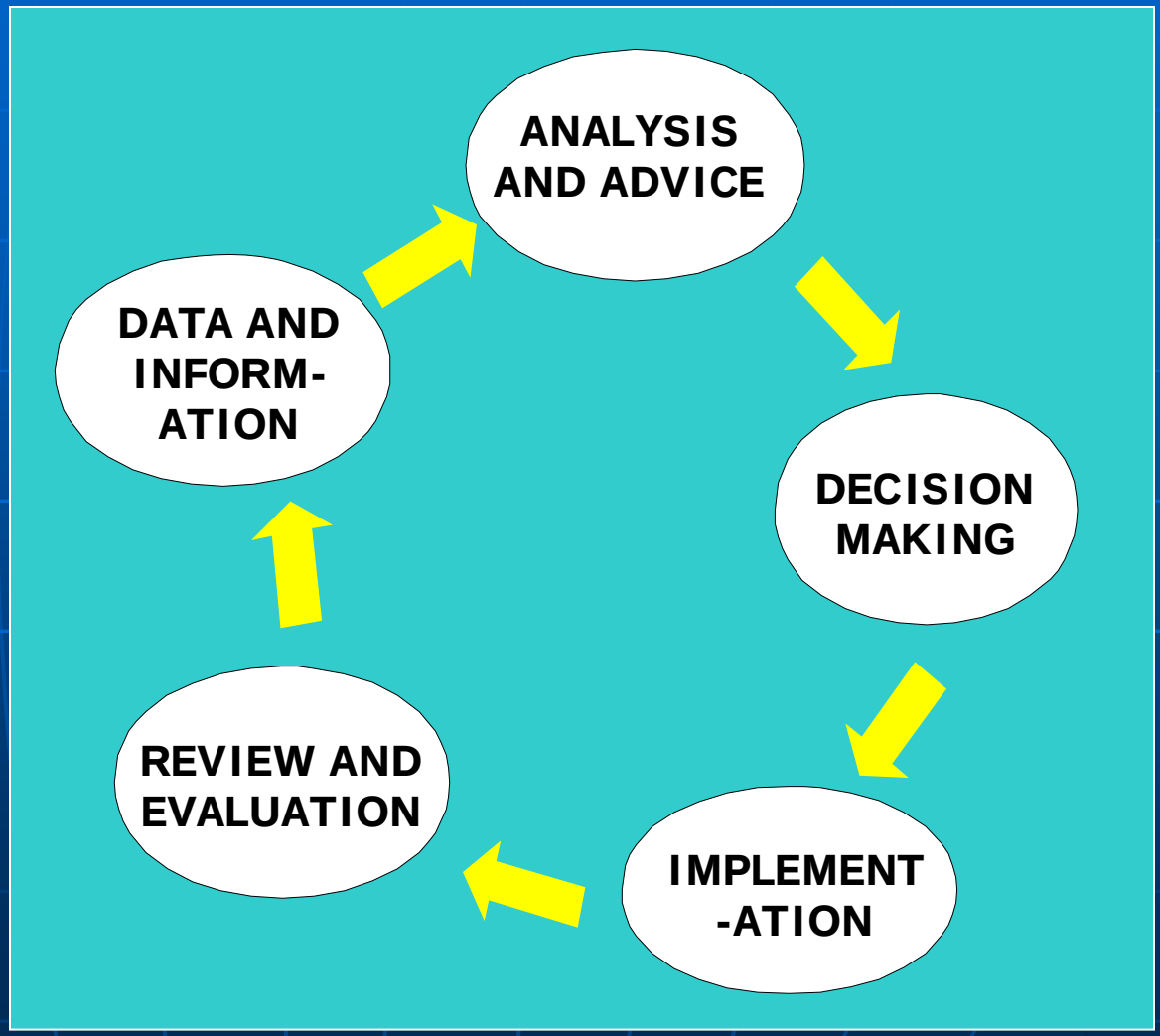
- Preservation Zone
- Marine National Park Zone
- Scientific Research Zone
- Buffer Zone
- Conservation Park Zone
- Habitat Protection Zone
- General Use Zone

Diagnosis of the Problem

- **Fragmentation of management authority**
- **Spatial mismatches between scale of governance and ecological system.**
- **Temporal mismatches between governance and ecological processes.**

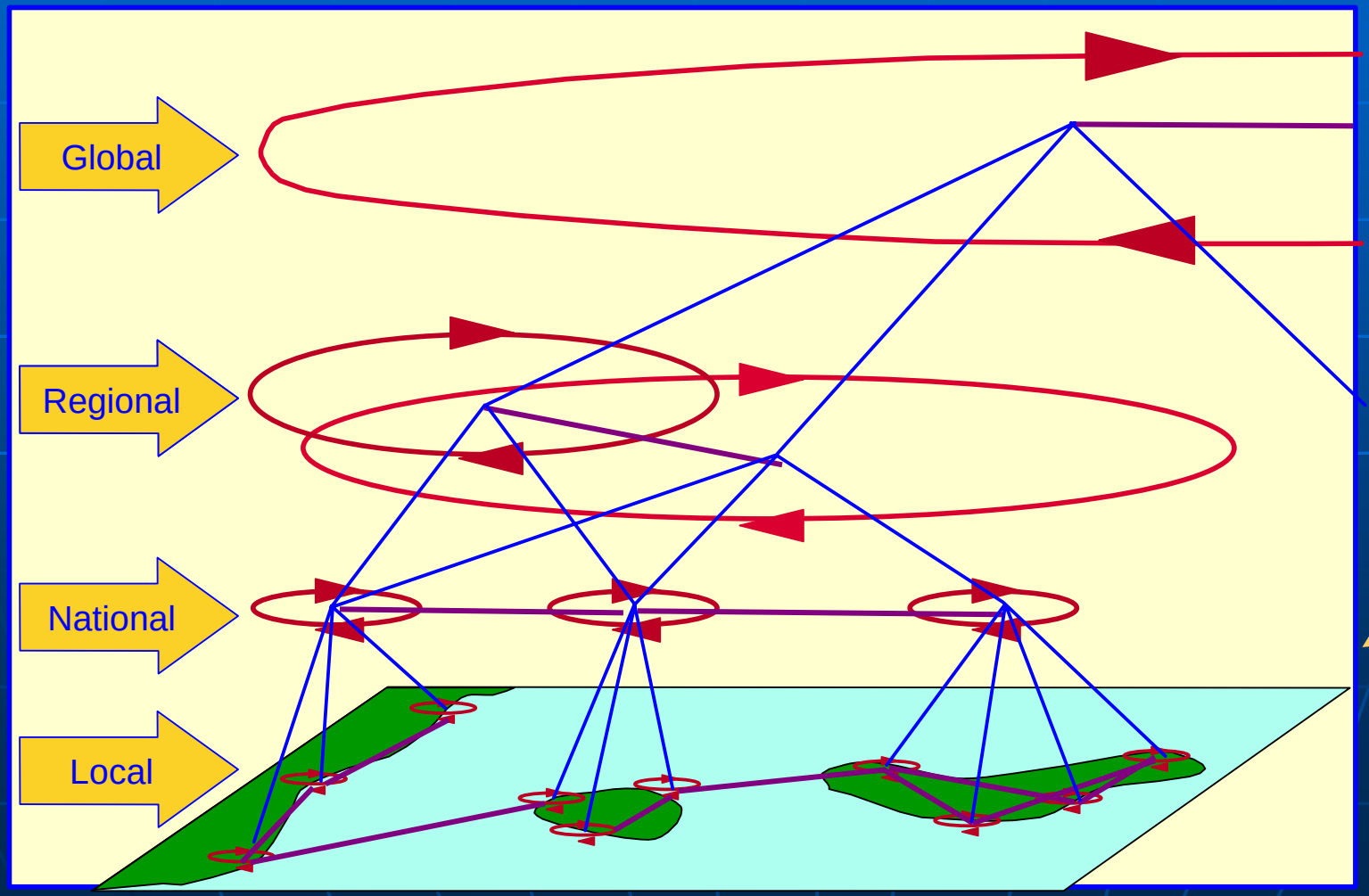
A networking approach that makes the best use of existing organisations?

We approached this through a governance framework based on the conventional policy cycle -- Like this one.



The LME Governance framework

Building a multi-scale policy-cycle based governance framework



Complete

Linked vertically

Linked laterally

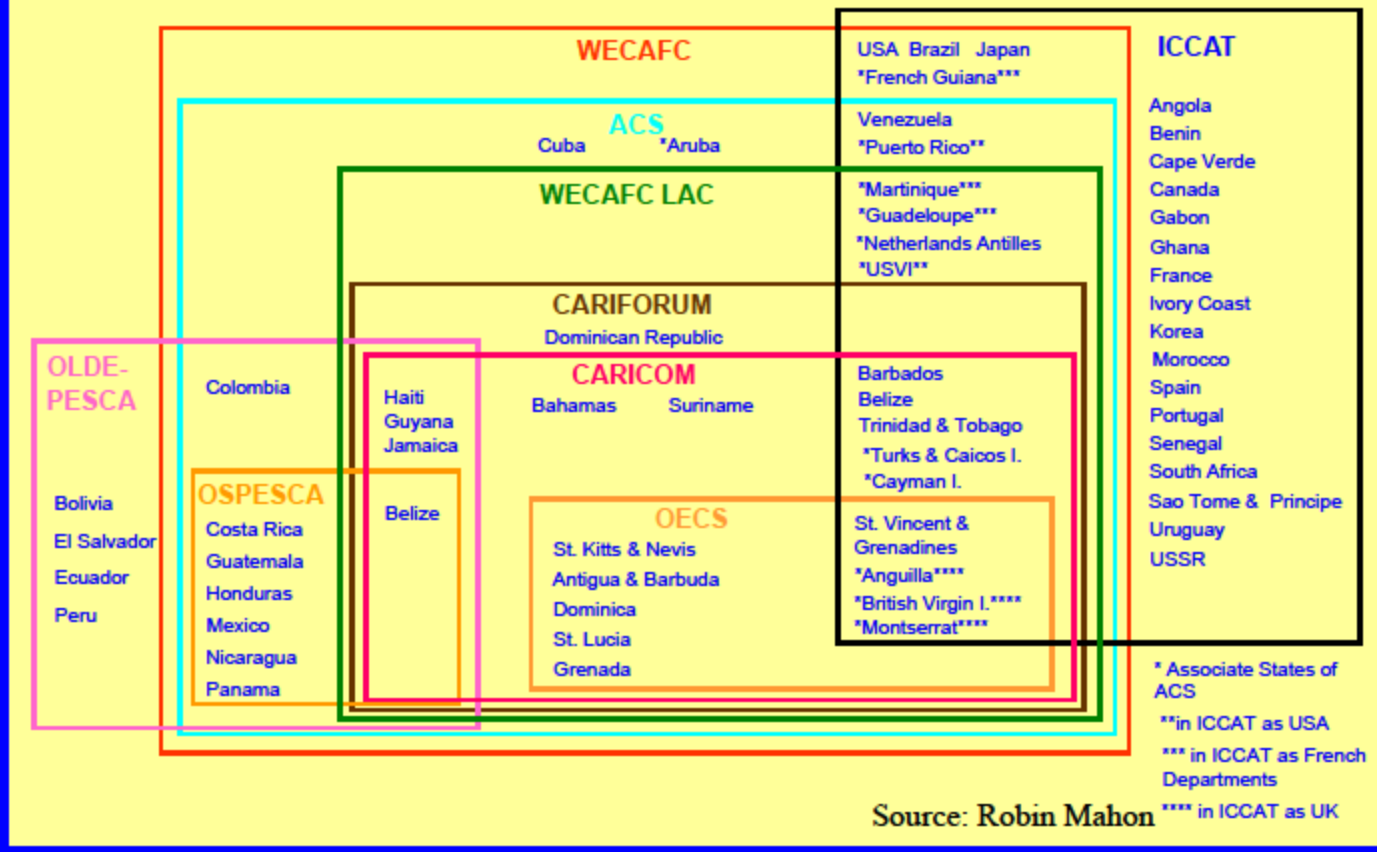
Iterative

Findings of fact 5:
Amenity Value, Tourism Jobs and Income

THE INSULAR CARIBBEAN IS THE MOST DEPENDENT REGION IN THE WORLD ON TOURISM RELATIVE TO ITS SIZE

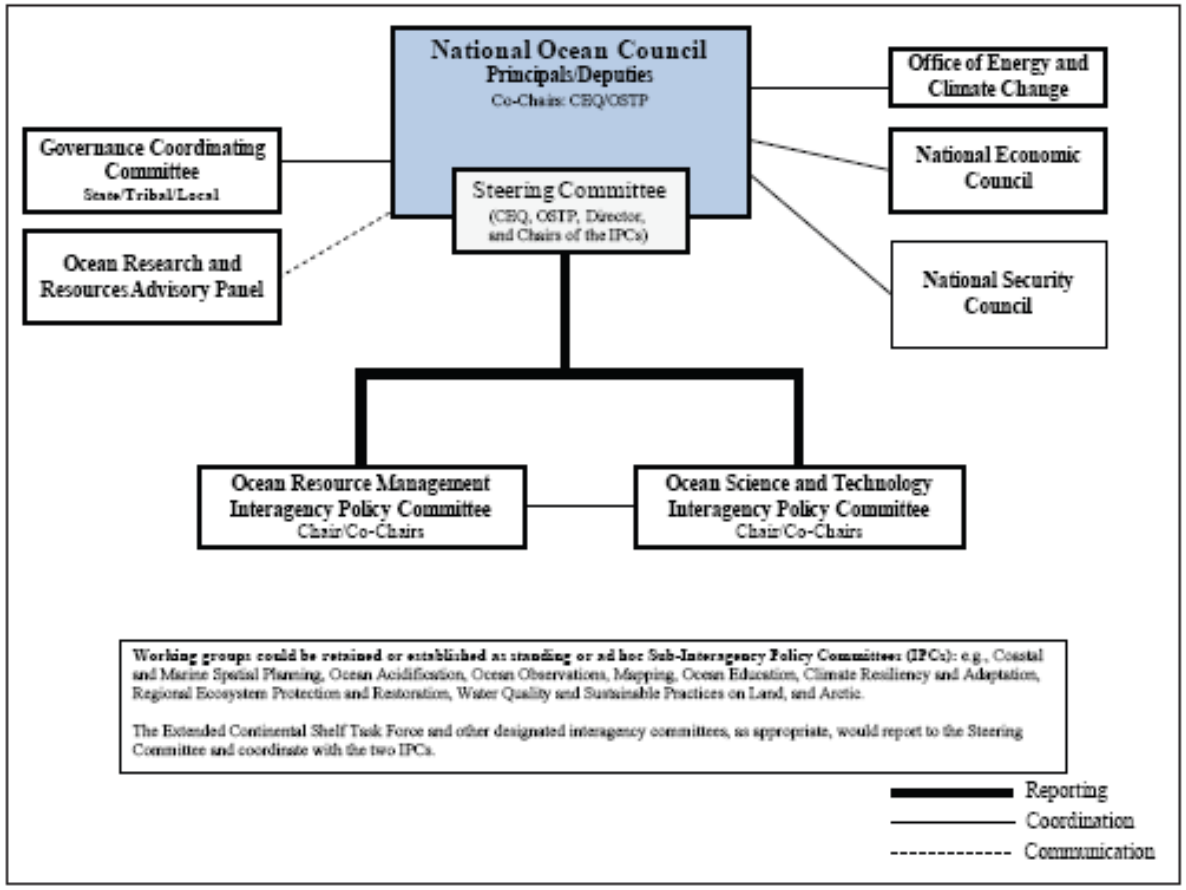
- Direct impact:
- 567,870 jobs
- US$ 6.5 billion contribution to GDP
- Indirect impact:
- 1,857,000 jobs (12% of total employment)
- US 23.1 billion contribution to GDP (13% of total GDP **(#1 in the world relative to size)**

For example look at the overlapping and nested fisheries related organisations in the Caribbean Sea



Source: Robin Mahon

Policy Coordination Framework



These recommendations establish high-level direction and policy guidance from a clearly designated and identifiable authority. They also call for more consistent and sustained senior-level participation and attention on ocean-related issues from all member agencies and departments essential to effective

plans. The Task Force recommends the following nine priority objectives:

National Priority Objectives

1. **Ecosystem-Based Management:** Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes.
2. **Coastal and Marine Spatial Planning:** Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States.
3. **Inform Decisions and Improve Understanding:** Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to change and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.
4. **Coordinate and Support:** Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government, and as appropriate, engage with the international community.
5. **Resiliency and Adaptation to Climate Change and Ocean Acidification:** Strengthen resiliency of coastal communities and marine and Great Lakes environments and their abilities to adapt to climate change impacts and ocean acidification.
6. **Regional Ecosystem Protection and Restoration:** Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, State, tribal, local, and regional levels.
7. **Water Quality and Sustainable Practices on Land:** Enhance water quality in the ocean, along our coasts, and in the Great Lakes by promoting and implementing sustainable practices on land.
8. **Changing Conditions in the Arctic:** Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes.
9. **Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure:** Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts.

The NOC would develop strategic action plans for each of the priority objectives, focusing on key areas identified by the Task Force. Each strategic action plan would identify specific and measurable near-term, mid-term, and long-term actions, with appropriate milestones, performance measures, and outcomes to meet each objective. In addition, each plan would explicitly identify key lead and participating agencies; gaps and needs in science and technology; potential resource requirements and efficiencies; and steps for integrating or coordinating current and out-year budgets. This strategy would allow adequate time to fully consider the necessary details for implementation, and, as appropriate, to coordinate and collaborate with States, tribal, and local authorities, regional governance structures, academic institutions, non-governmental organizations, recreational users, and private enterprise.

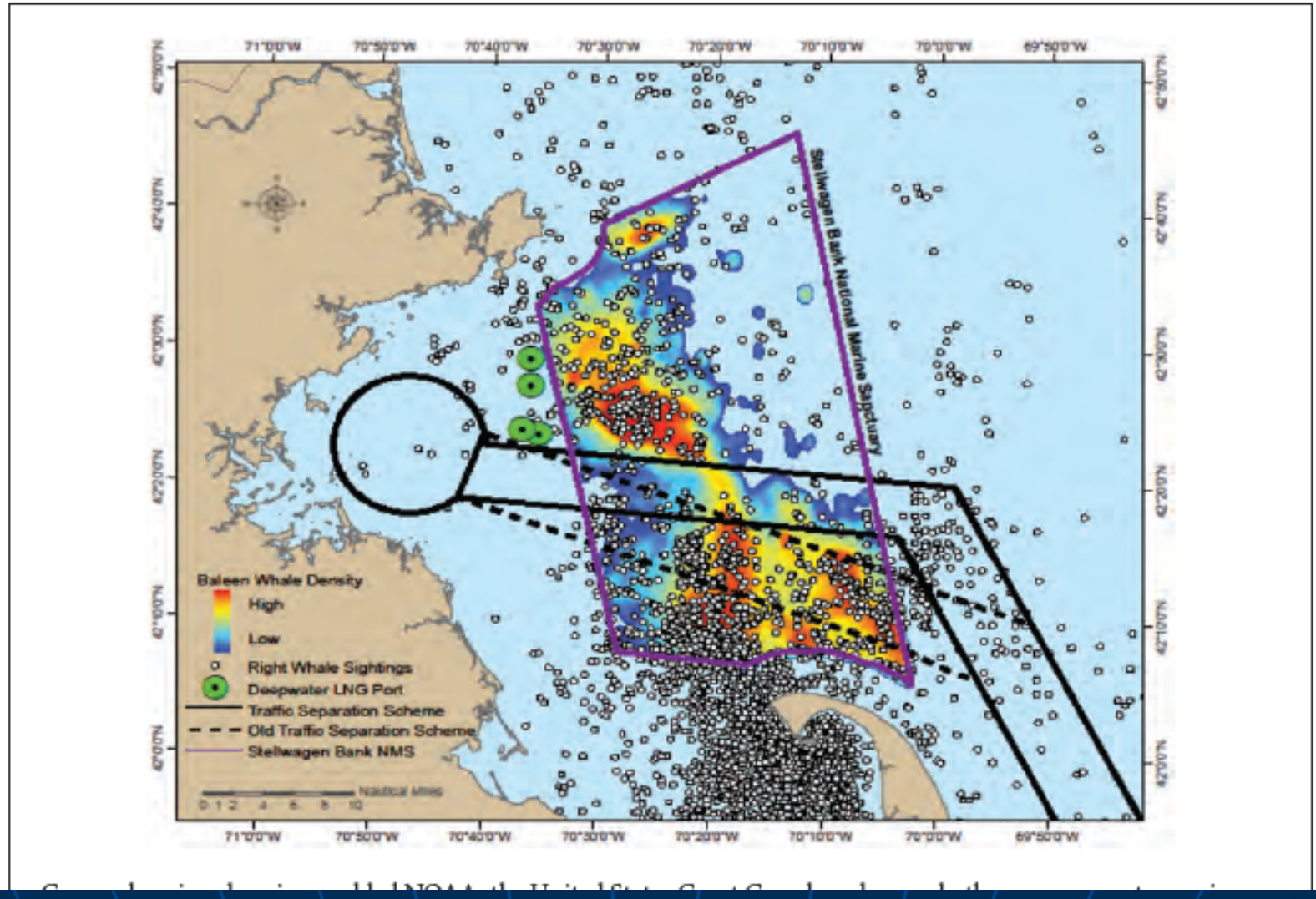
Framework for Effective Coastal and Marine Spatial Planning

As called for in President Obama's June 12, 2009 memorandum, the Task Force recommendations provide a framework for CMSP that offers a new, comprehensive, integrated, regionally-based approach to planning and managing uses and activities. The recommended framework places sound science and the best available information at the heart of decision-making and would bring Federal, State, and tribal partners together in an unprecedented manner to cooperatively develop coastal and marine spatial plans (CMS Plans). This process is designed to decrease user conflict, improve planning and regulatory efficiencies, decrease associated costs and delays, engage affected communities and stakeholders, and preserve critical ecosystem functions and services. The recommendations emphasize

The National Goals of Coastal and Marine Spatial Planning

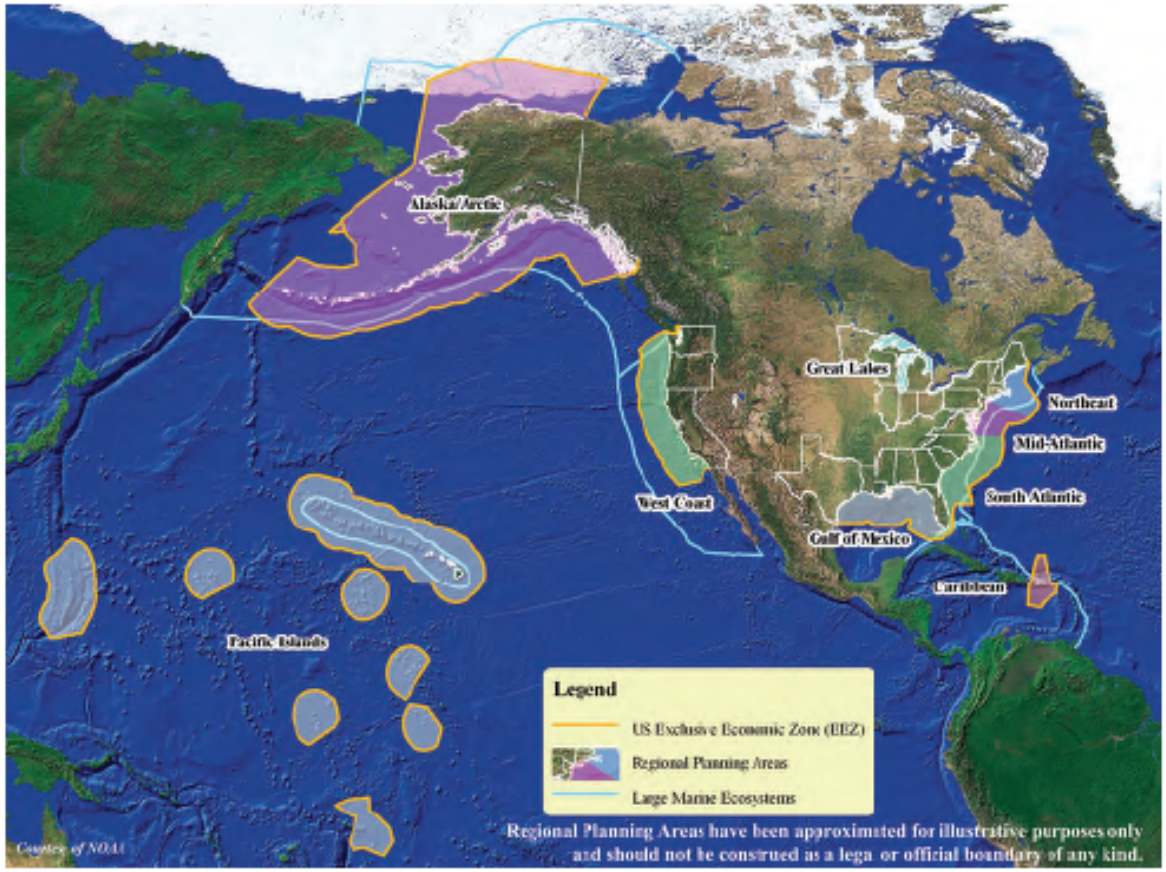
1. Support sustainable, safe, secure, efficient, and productive uses of the ocean, our coasts, and the Great Lakes, including those that contribute to the economy, commerce, recreation, conservation, homeland and national security, human health, safety, and welfare;
2. Protect, maintain, and restore the Nation's ocean, coastal, and Great Lakes resources and ensure resilient ecosystems and their ability to provide sustained delivery of ecosystem services;
3. Provide for and maintain public access to the ocean, coasts, and Great Lakes;
4. Promote compatibility among uses and reduce user conflicts and environmental impacts;
5. Improve the rigor, coherence, and consistency of decision-making and regulatory processes;
6. Increase certainty and predictability in planning for and implementing new investments for ocean, coastal, and Great Lakes uses; and
7. Enhance interagency, intergovernmental, and international communication and collaboration.

Example of the Potential Benefits of CMSP: Stellwagen Bank National Marine Sanctuary

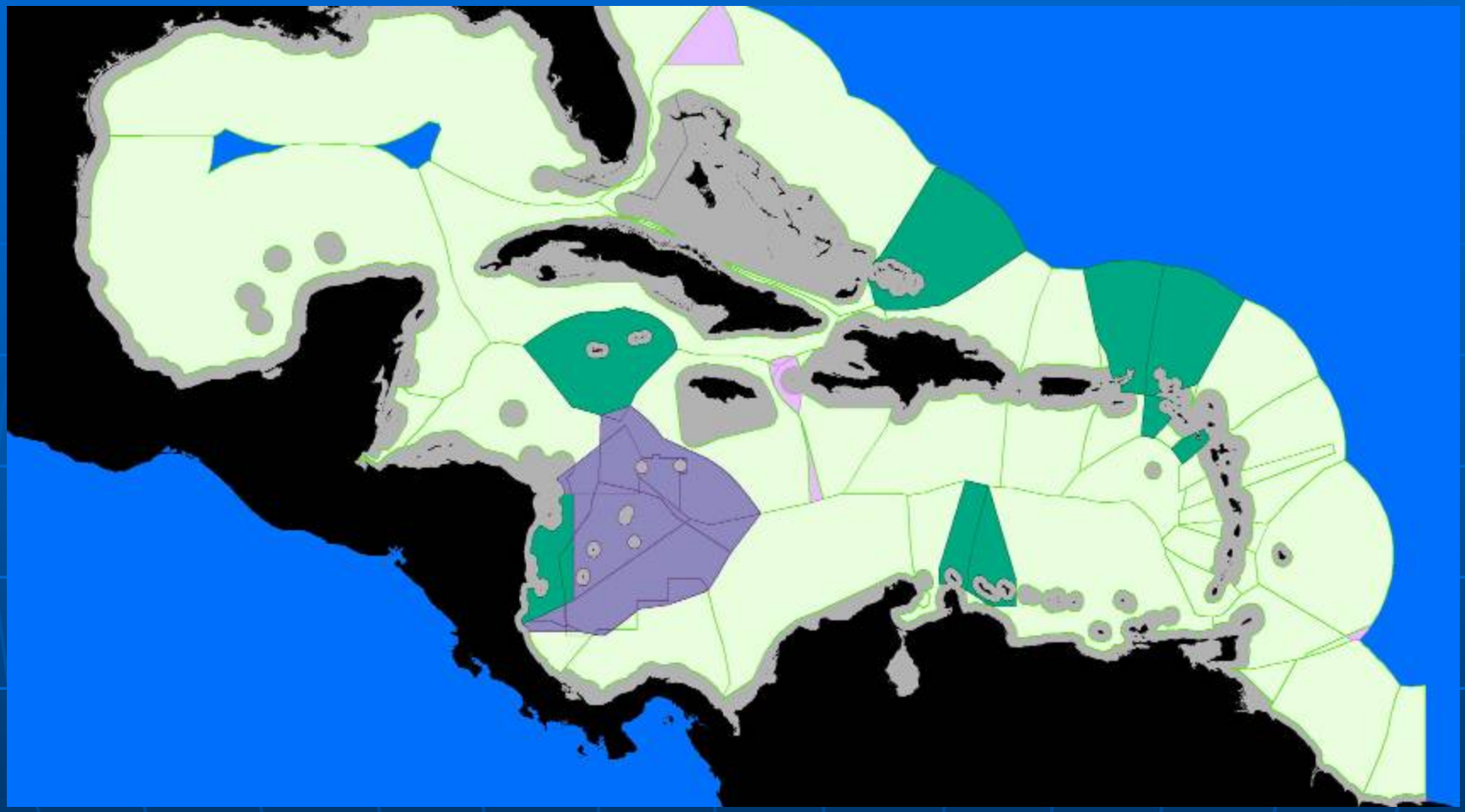


Final Recommendations Of The Interagency Ocean Policy Task Force

Large Marine Ecosystems and Regional Planning Areas



Regional Planning Body



DISPUTED EEZ CLAIMS

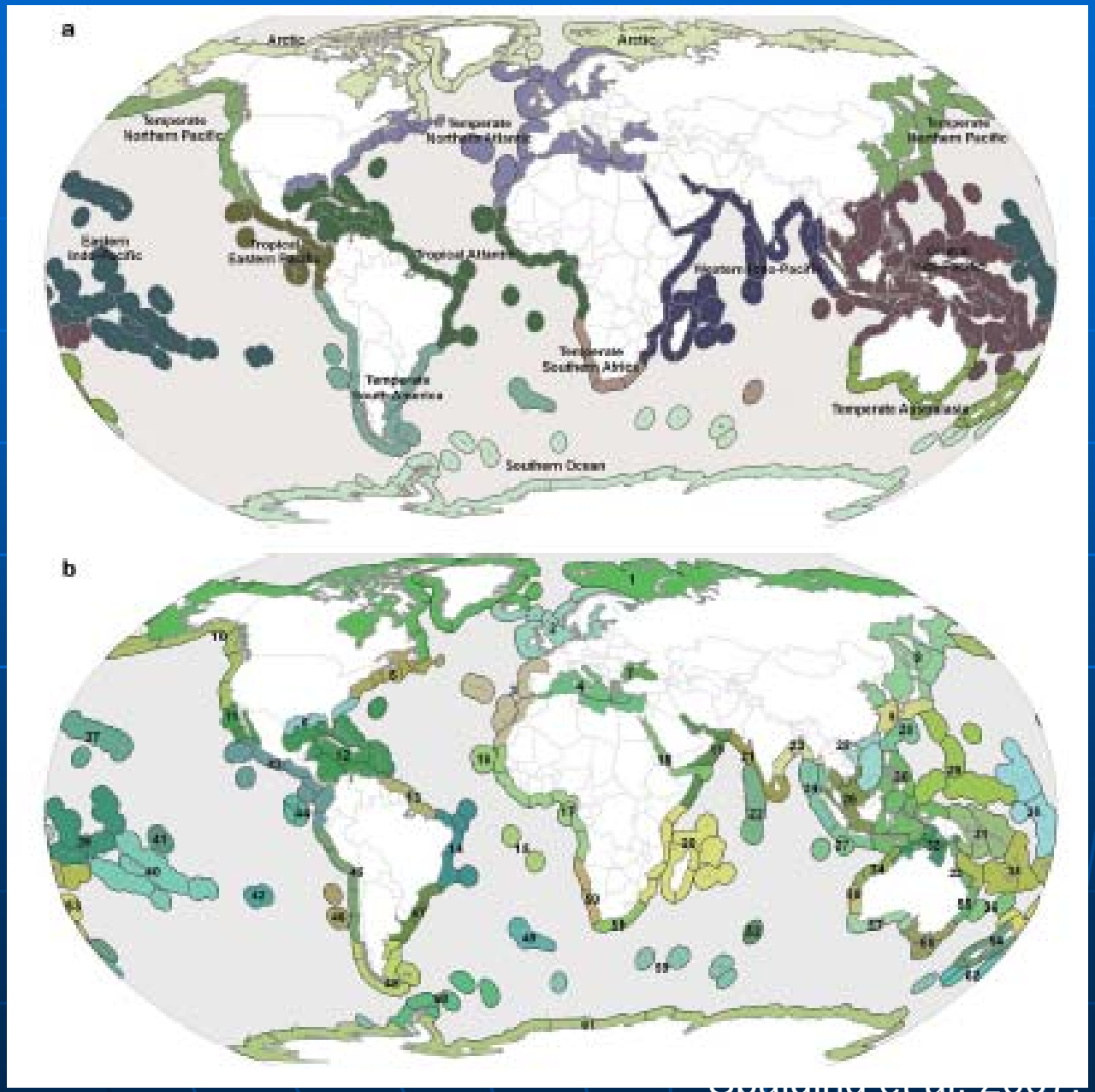
ACCEPTED EEZ CLAIMS

ACCEPTED FZ CLAIMS

TERRITORIAL SEAS

CARIBBEAN REGION NATIONAL CLAIMS TO EXCLUSIVE ECONOMIC ZONES AND FISHERY ZONES

Global Biogeographic Framework



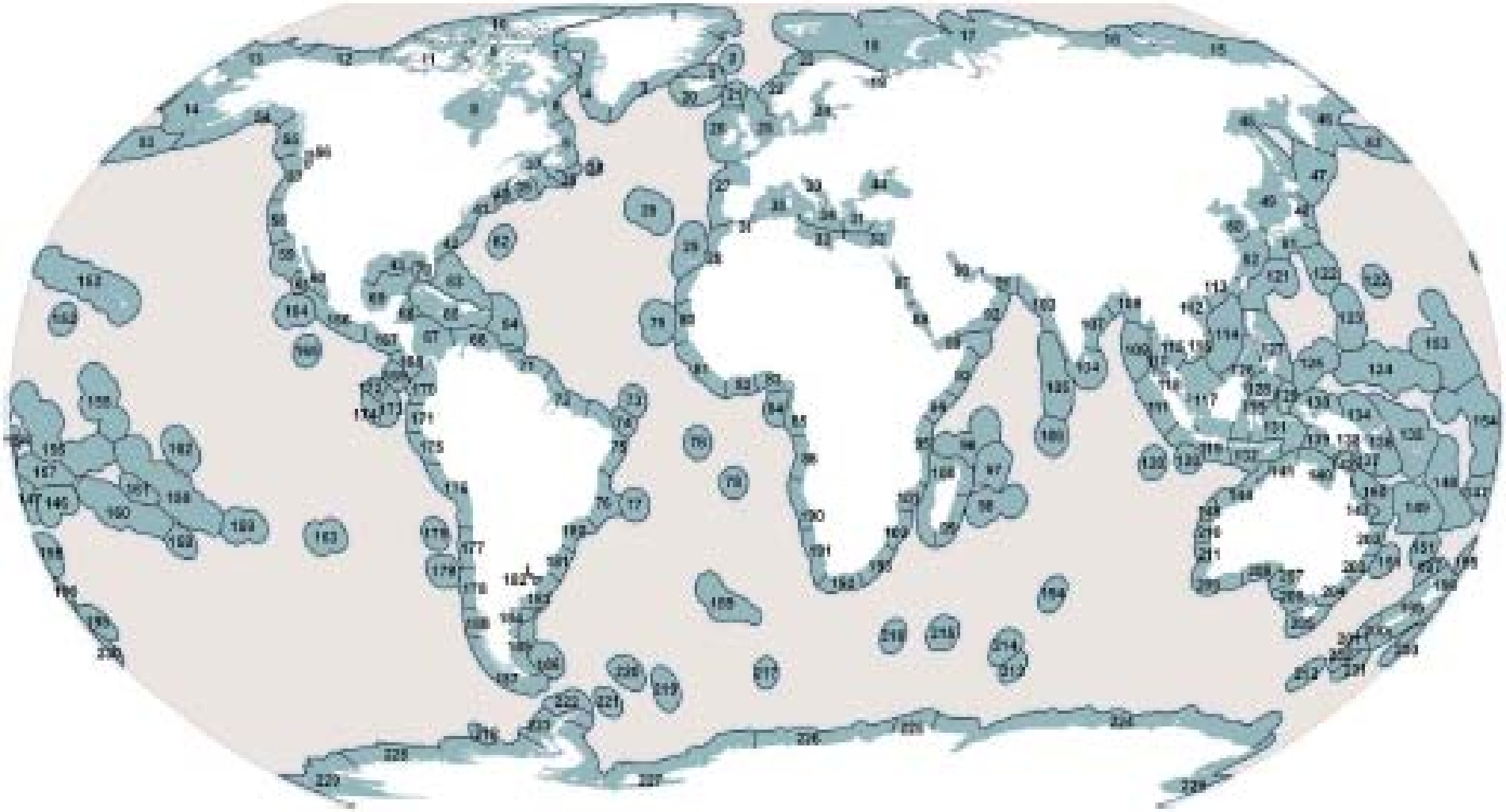
Biogeographic Realms (12)

Biogeographic Provinces (62)

Spalding et al. 2007. BioScience 57: 573-583

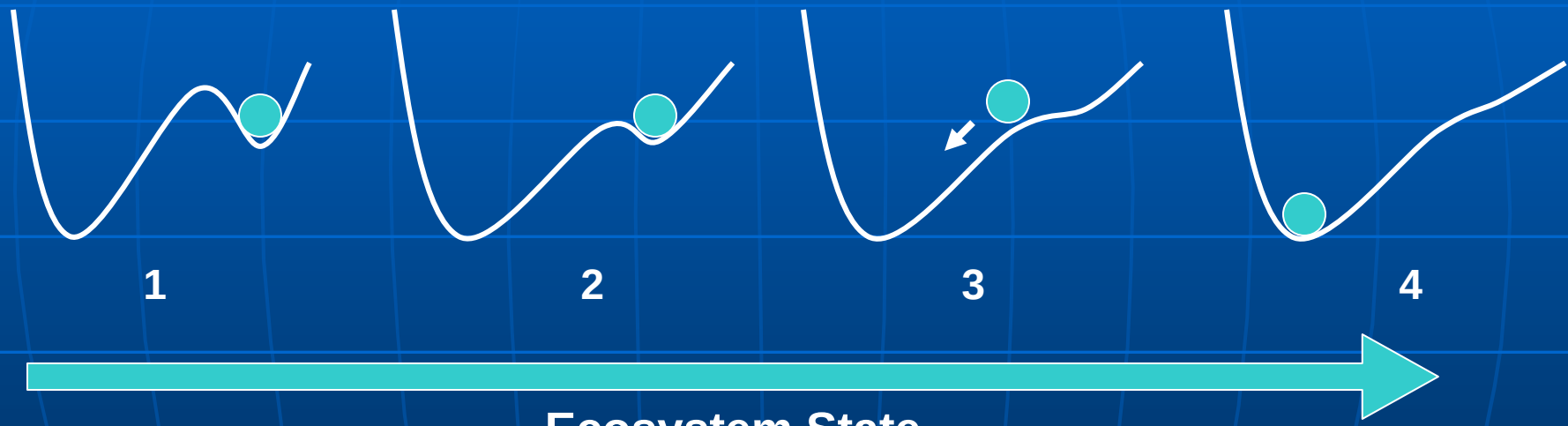
Global Biogeographic Framework

Showing 232 Ecoregions



Spalding et al. 2007. BioScience 57: 573-583

Resilience & Alternate States



Coral Dominance

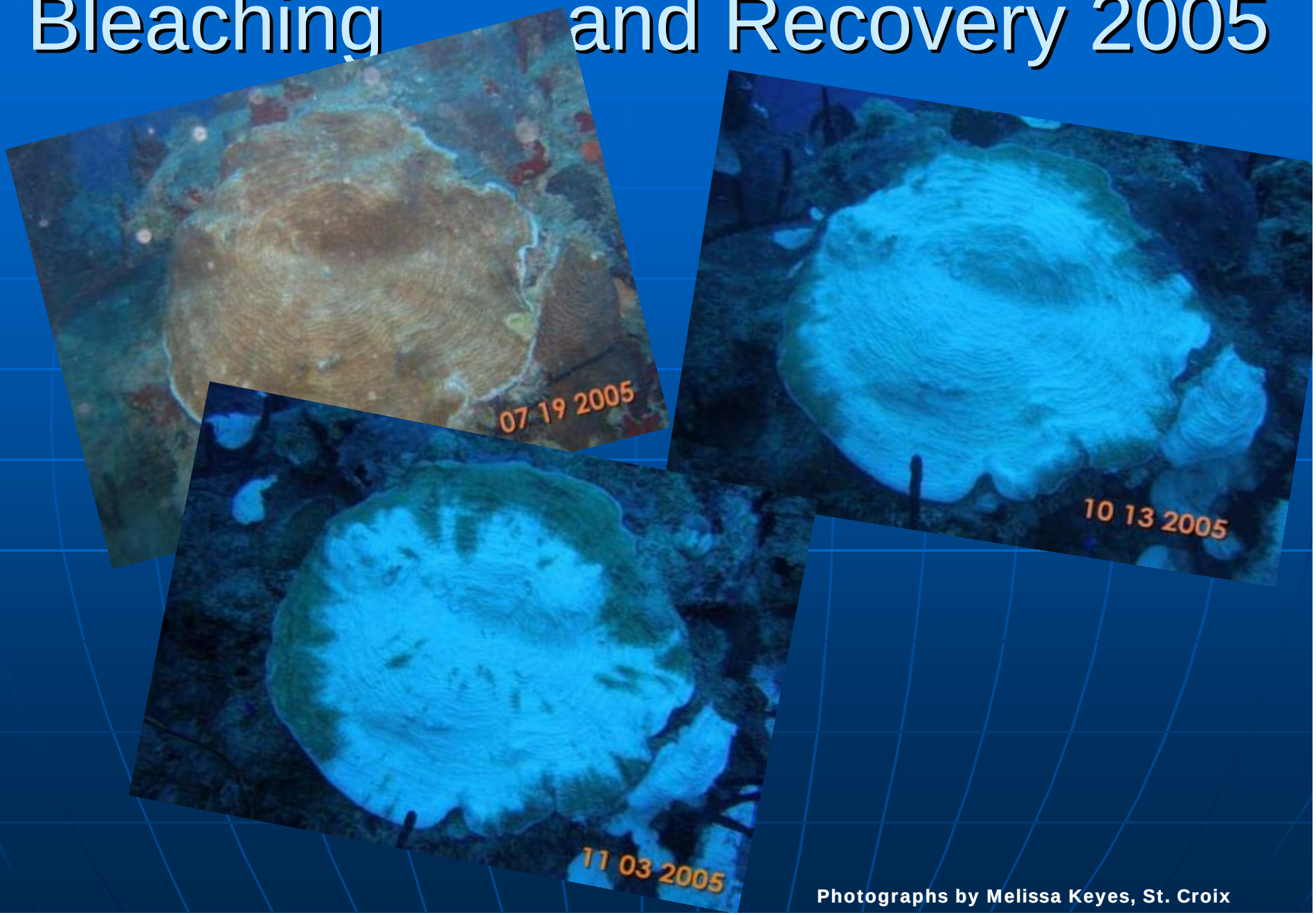
Overfishing, *Diadema* dominance

***Diadema* Mass-Mortality**

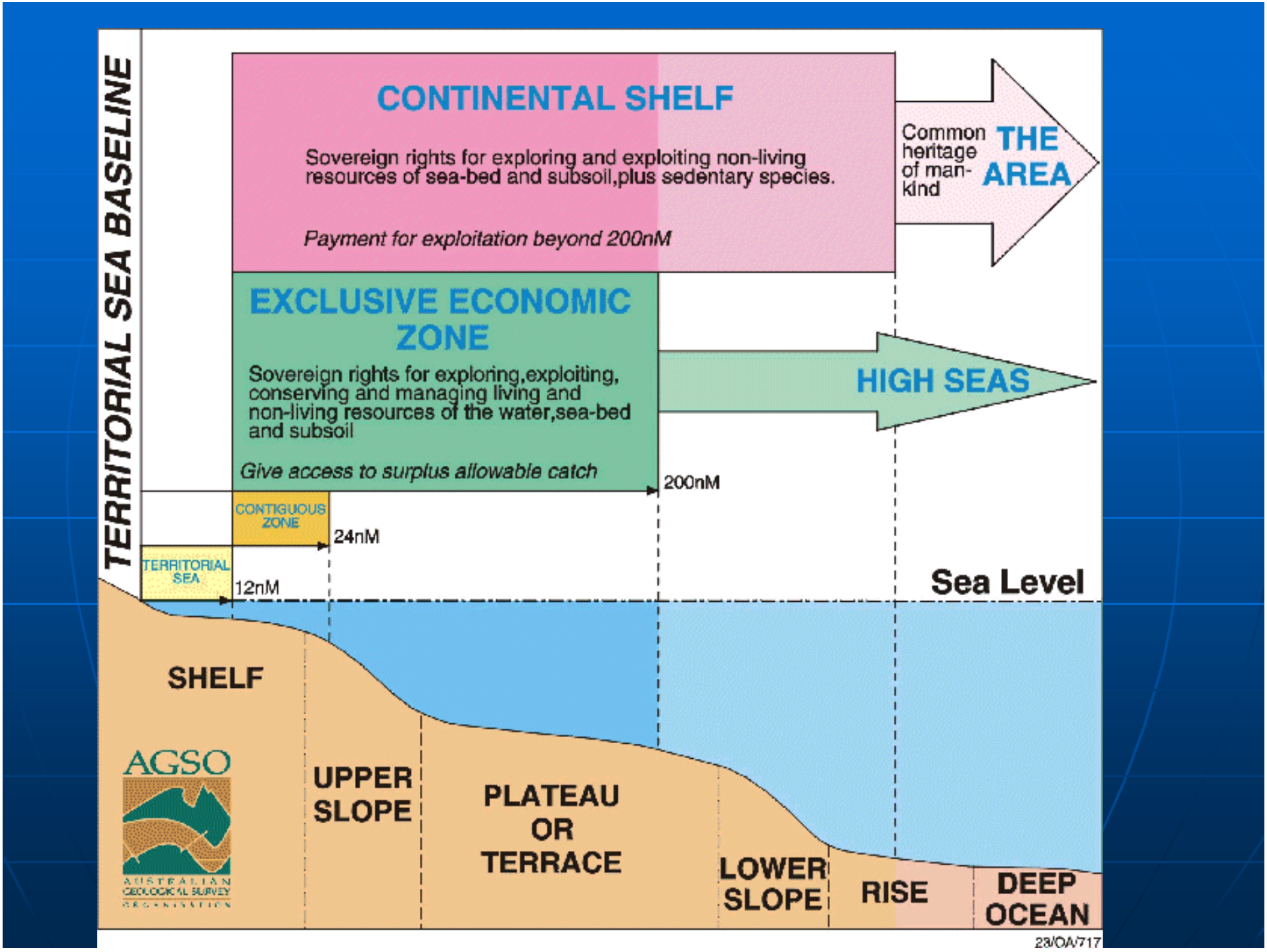
Algal Dominance

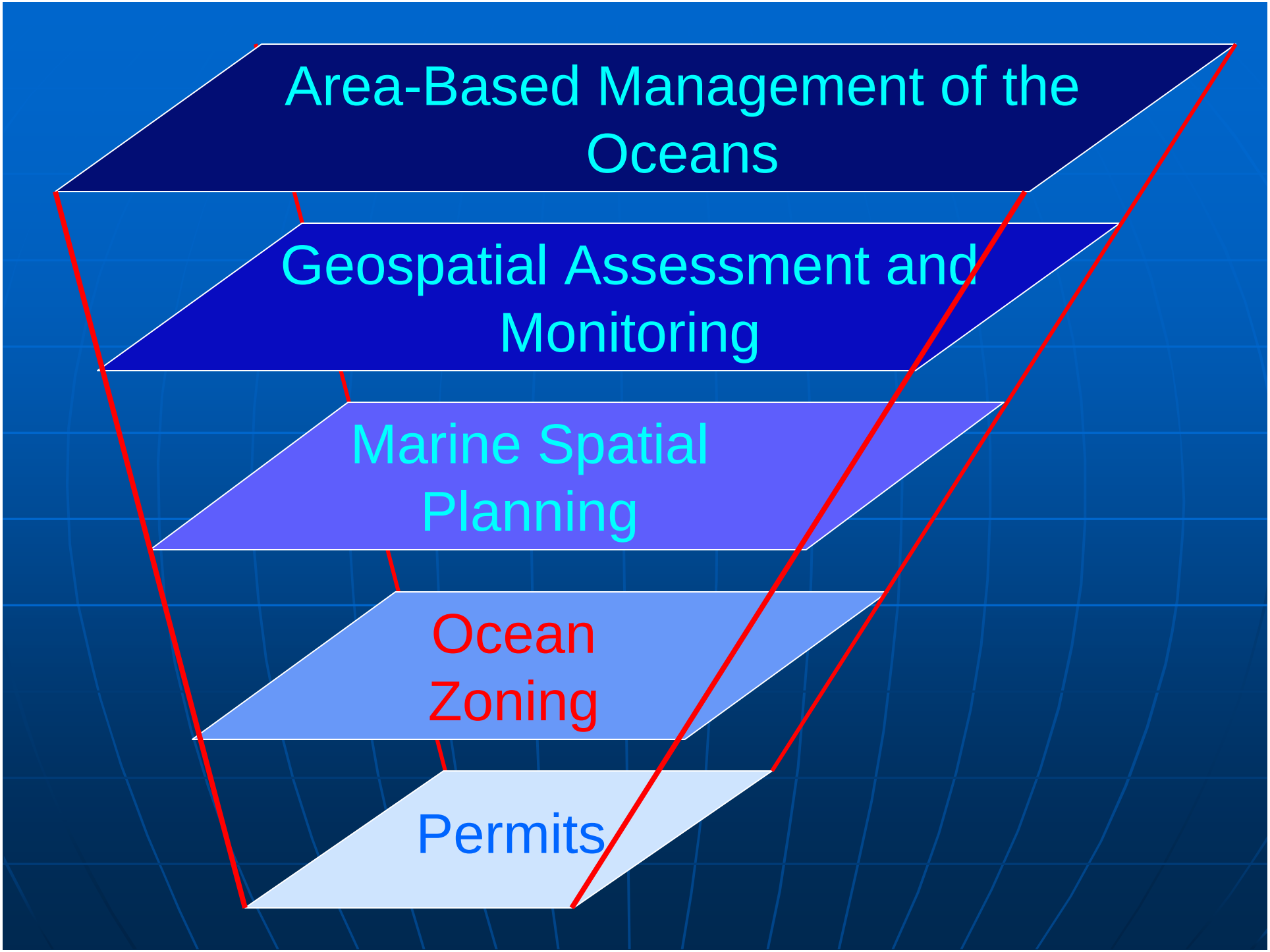
After Deutsch et al. 2003

Bleaching and Recovery 2005



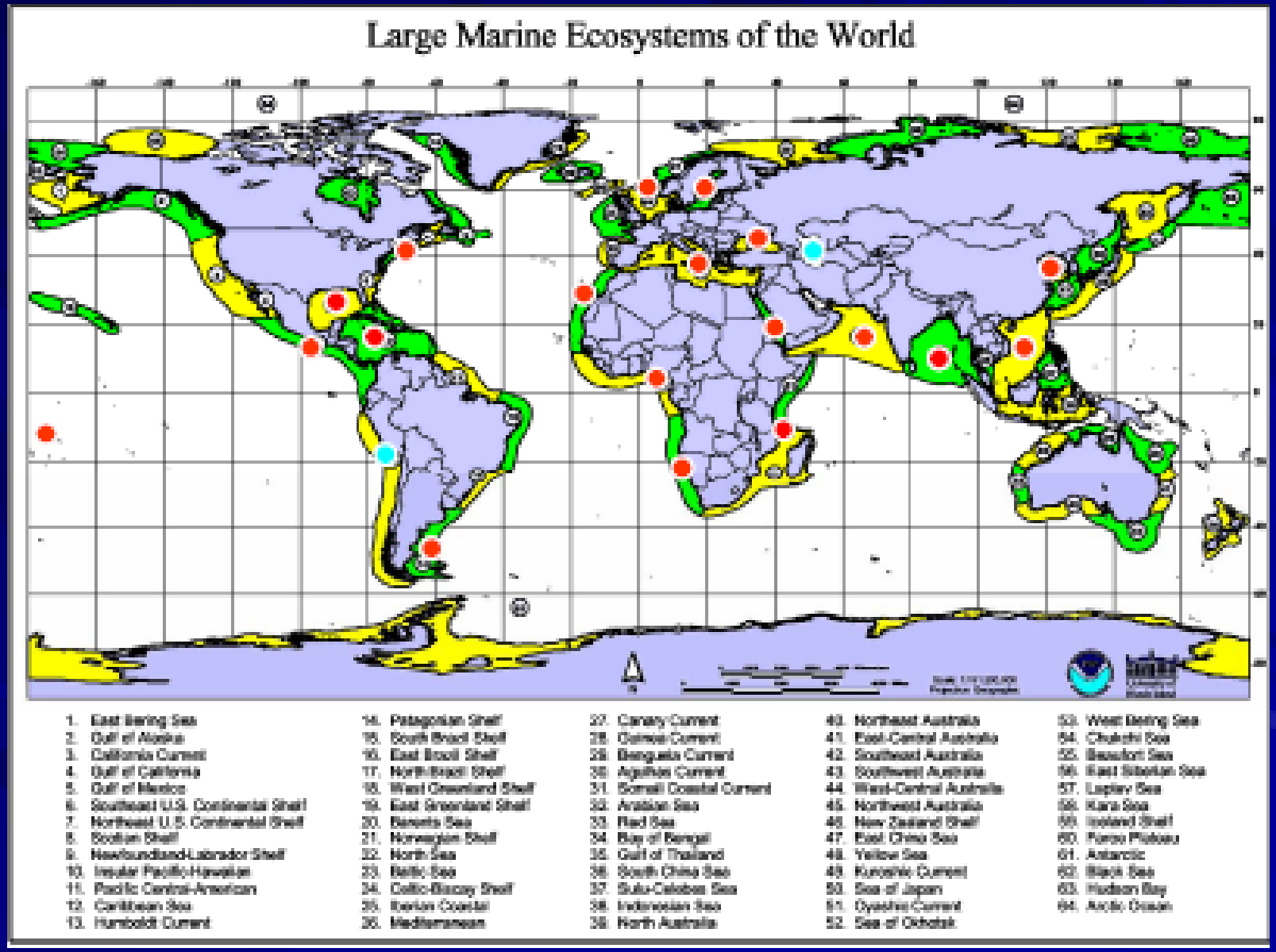
Photographs by Melissa Keyes, St. Croix


TERRITORIAL SEA BASELINE
CONTINENTAL SHELF
Sovereign rights for exploring and exploiting non-living resources of sea-bed and subsoil,plus sedentary species.
Payment for exploitation beyond 200nM
Common heritage of man-kind
THE AREA
EXCLUSIVE ECONOMIC ZONE
Sovereign rights for exploring,exploiting, conserving and managing living and non-living resources of the water,sea-bed and subsoil
Give access to surplus allowable catch
HIGH SEAS
200nM
CONTIGUOUS ZONE
24nM
TERRITORIAL SEA
12nM
Sea Level
SHELF
UPPER SLOPE
PLATEAU OR TERRACE
LOWER SLOPE
RISE
DEEP OCEAN
AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION
23/OA/717


Area-Based Management of the Oceans
Geospatial Assessment and Monitoring
Marine Spatial Planning
Ocean Zoning
Permits

The LME Concept

Generated projects to pursue LME level management

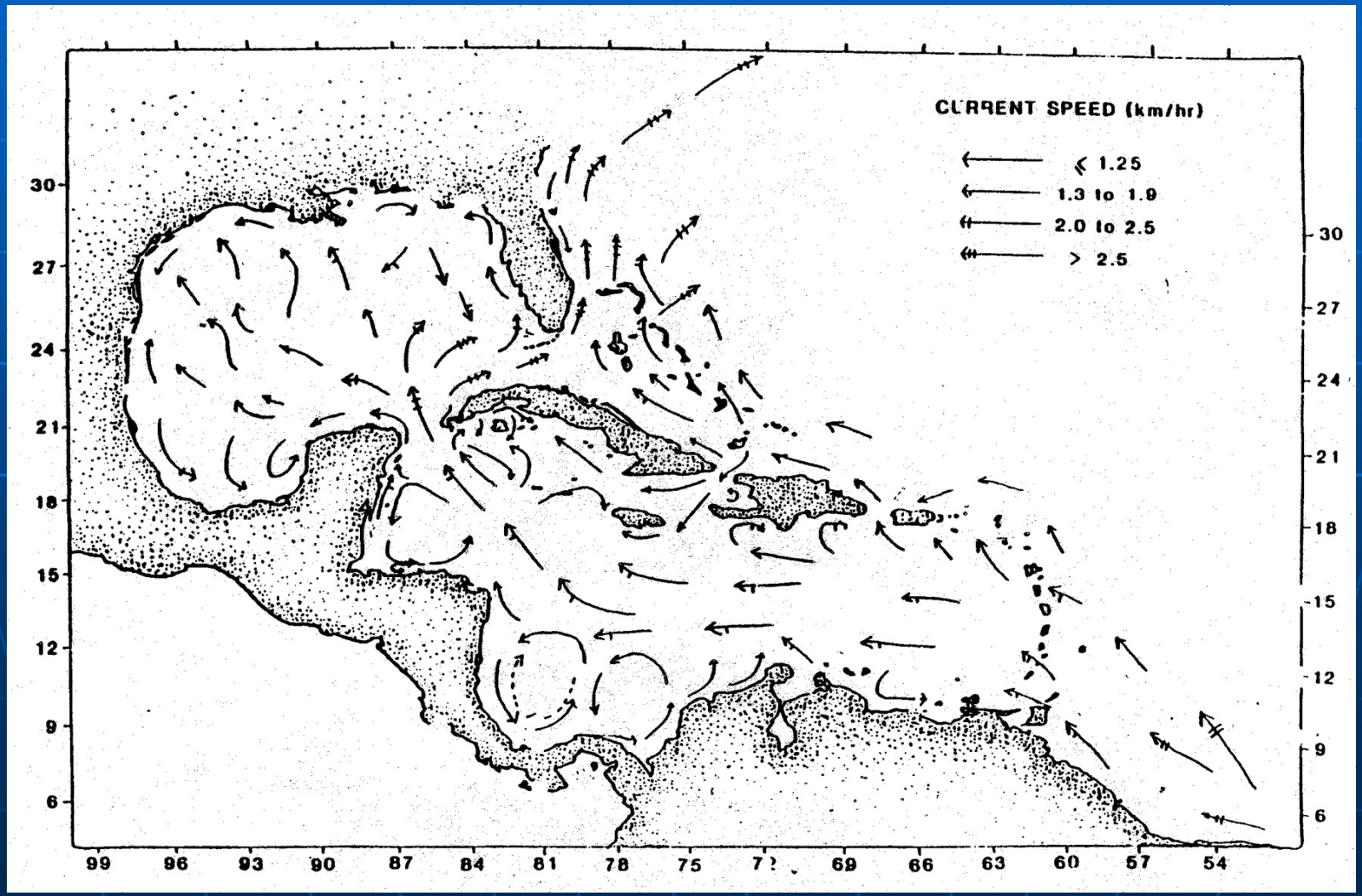



Discovery Bay, Jamaica 1985

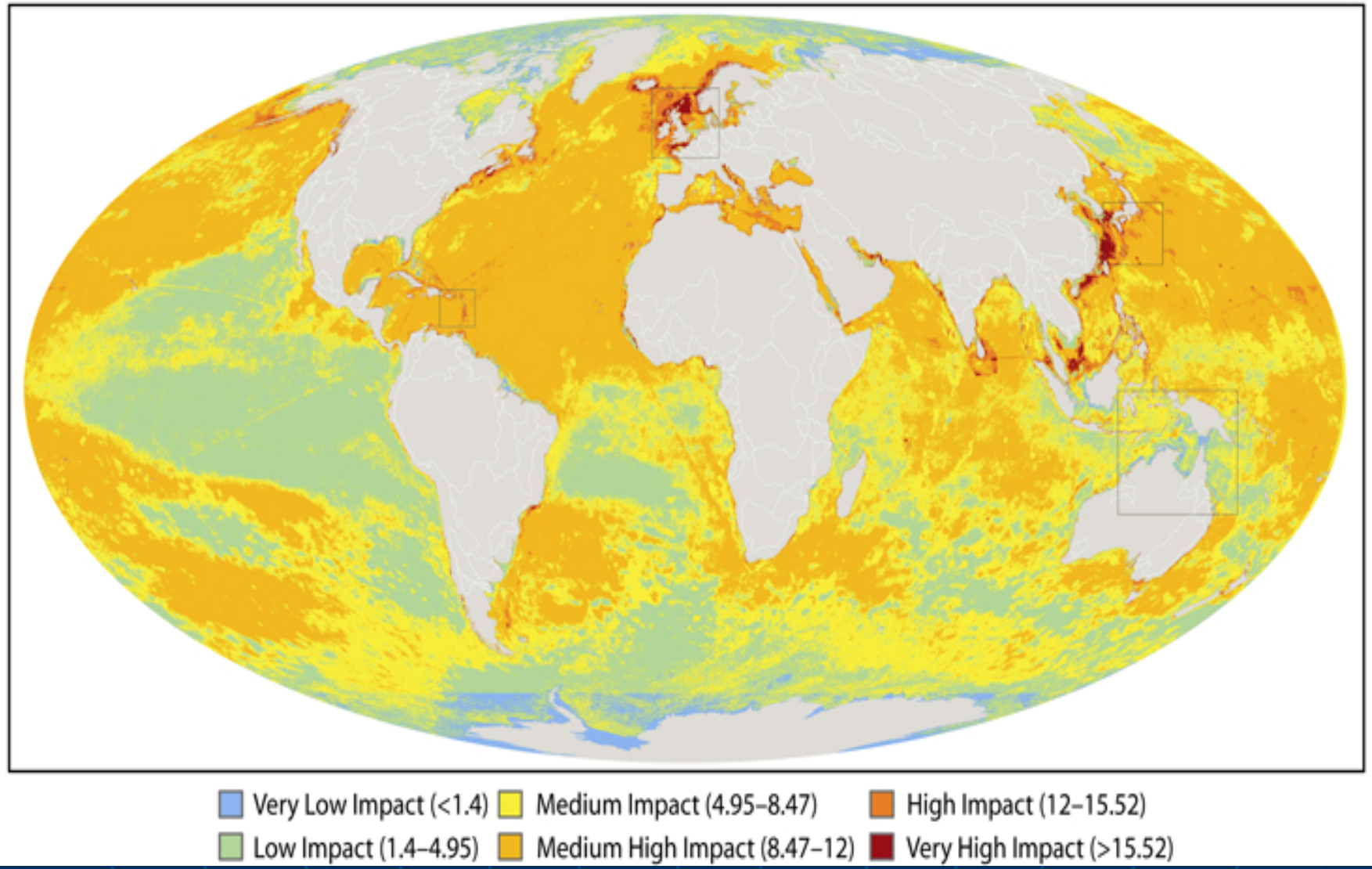
Ecosystem-Based Management in the Wider Caribbean Sea

John Ogden
University of South Florida

The Caribbean is a Large Marine Ecosystem (LME)



Global Map of Human Impact on Marine Ecosystems



Halpern et al. 2008. Science 319: 948-952.

Summary of Estimated Values of Selected Goods and Services from Coral Reefs in the Caribbean

Good/Service	Estimated Annual Value in 2000 US$	Estimated Future Annual Losses Due to Coral Reef Degradation
Fisheries	312 million	loss of annual net benefits valued at US$11-140 million
Tourism and Recreation	2.1 billion	region-wide loss of annual net benefits valued at an estimated US$100-300 million
Shoreline Protection	0.7 - 2.2 billion	The estimated value of lost annual net benefits is estimated at US$140-420 million
TOTAL	**3.1 - 4.6 billion**	**US$350-870 million**

World Resources Institute 2005