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

John Ogden, University of South Florida
The Caribbean is Ecologically and Politically Complex

- **Geopolitical**
  - 33 states

- **Cultural**
  - race, language

- **Size**
  - smallest to largest

- **Development**
  - poorest to most wealthy

Hypothetical EEZs
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.
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

Elkhorn Coral

Star Coral

Acropora palmata

Montastrea annularis
Marine Zone Types

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

Florida Keys National Marine Sanctuary

Marine Zone Types

Gulf of Mexico

- Florida Bay
  - 6%

- Florida Keys National Marine Sanctuary

Atlantic Ocean

- 9,844 km²
- 518 km²
“Islands in the Stream”

A Network of Marine Protected Areas

- South Texas Banks
- Flower Gardens NMS
- NW Reefs / Banks
- Pinnacles
- Madison Swanson
- FL Middle Grounds
- Steamboat Lumps
- Pulley Ridge
- Florida Keys NMS
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
- CO₂ 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
Geospatial Assessment – GIS Data Layers

- Socioeconomic data
- Chlorophyll distribution
- Ocean Currents
- Bathymetry
- Habitat Type
- Topography
Geospatial Assessment of Marine Ecosystems (GAME)
CREATING THE MANAGEMENT FRAMEWORK

Ocean Use Management Goals

- Economic Development
- Biodiversity Conservation
- Environmental Protection
- Poverty Reduction

Tools

- Coastal & Marine Spatial Planning
- Zoning
- Permitting
- Other Regulations
- Economic Incentives
- Enforcement Sanctions
- Technical Assistance
- Education

Economic Incentives
Enforcement Sanctions
Technical Assistance
Education
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

CARIBBEAN REGION NATIONAL CLAIMS TO EXCLUSIVE ECONOMIC ZONES AND FISHERY ZONES

- DISPUTED EEZ CLAIMS
- ACCEPTED EEZ CLAIMS
- ACCEPTED FZ CLAIMS
- TERRITORIAL SEAS
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

- WECAFC
  - ACS
    - Cuba
    - Aruba
  - WECAFC LAC
    - Dominican Republic
      - Haiti
      - Guyana
      - Jamaica
    - Bahamas
    - Suriname
  - CARIFORUM
    - Barbados
    - Belize
    - Trinidad & Tobago
    - Turks & Caicos I.
    - Cayman I.
  - CARICOM
    - St. Kitts & Nevis
    - Antigua & Barbuda
    - Dominica
    - St. Lucia
    - Grenada
  - OEC
    - St. Vincent & Grenadines
    - Anguilla
    - British Virgin I.
    - Montserrat
- ICCAT
  - Angola
  - Benin
  - Cape Verde
  - Canada
  - Gabon
  - Ghana
  - France
  - Ivory Coast
  - Korea
  - Morocco
  - Spain
  - Portugal
  - Senegal
  - South Africa
  - Sao Tome & Principe
  - Uruguay
  - USSR

* Associate States of ACS
**in ICCAT as USA
*** in ICCAT as French Departments
**** in ICCAT as UK
Summary: Status

<table>
<thead>
<tr>
<th>Habitats</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reefs of the region are in decline</td>
<td>Most resources fully-or over-exploited</td>
</tr>
<tr>
<td>Associated biodiversity in decline</td>
<td>Most assessment effort in lobster, conch and shrimp</td>
</tr>
<tr>
<td>Coastal habitats in decline</td>
<td>Ocean-wide, large pelagic fishes assessed by ICCAT</td>
</tr>
<tr>
<td>Current governance efforts and protected areas are inadequate</td>
<td>Status of regional pelagic fishes unknown</td>
</tr>
</tbody>
</table>
The Theory: Fishing Down the Food Chain

Source: Pauly 2003
The Slippery Slope to Slime

From Pandolfi et al. 2005
Coral zoox are expelled with prolonged high seawater temperature; bleached corals may die.
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

- 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

Feb. 6, 1984
March 11, 1984
June 23, 1984
June 23, 1985

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
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

All Classes Combined

Preliminary Data Gap Map

List of Critical Data Set Types:
- Bathymetry
- Substrate Types
- Temperature
- Biological
- Human Use
- Habitat Types
- Sediments
- Salinity
- Chemical

*Note: This is a first run assessment taken from footprint information in data catalog.

200m contour

Kilometers
0 25 50 100 150 200 250 300
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
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
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- Indirect impact:
  - 1,857,000 jobs (12% of total employment)
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For example look at the overlapping and nested fisheries related organisations in the Caribbean Sea.

**OLDE-PESCA**
- Bolivia
- El Salvador
- Ecuador
- Peru

**OSPESCA**
- Costa Rica
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama

**WECAFC**
- USA
- Brazil
- Japan
- *French Guiana***

**WECAFC LAC**
- Venezuela
- *Puerto Rico**
- *Martinique***
- *Guadeloupe***
- *Netherlands Antilles
- *USVI***

**CARIFORUM**
- Dominican Republic
- Haiti
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- *Montserrat***

**ICCAT**
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- Benin
- Cape Verde
- Canada
- Gabon
- Ghana
- France
- Ivory Coast
- Korea
- Morocco
- Spain
- Portugal
- Senegal
- South Africa
- Sao Tome & Principe
- Uruguay
- USSR

* Associate States of ACS
**in ICCAT as USA
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Source: Robin Mahon
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
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.
**Final Recommendations of the Interagency Ocean Policy Task Force**

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

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**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

Legend
- US Exclusive Economic Zone (EEZ)
- Regional Planning Areas
- Large Marine Ecosystems

Regional Planning Areas have been approximated for illustrative purposes only and should not be construed as a legal or official boundary of any kind.
CARIBBEAN REGION NATIONAL CLAIMS TO EXCLUSIVE ECONOMIC ZONES AND FISHERY ZONES
Global Biogeographic Framework

Biogeographic Realms (12)

Biogeographic Provinces (62)

Global Biogeographic Framework
Showing 232 Ecoregions

Resilience & Alternate States

Ecosystem State

1. Coral Dominance
2. Overfishing, *Diadema* dominance
3. *Diadema* Mass-Mortality
4. Algal Dominance

After Deutsch et al. 2003
Bleaching and Recovery 2005

Photographs by Melissa Keyes, St. Croix
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

Large Marine Ecosystems of the World
Ecosystem-Based Management in the Wider Caribbean Sea

John Ogden
University of South Florida

Discovery Bay, Jamaica  1985
The Caribbean is a Large Marine Ecosystem (LME)
Summary of Estimated Values of Selected Goods and Services from Coral Reefs in the Caribbean

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