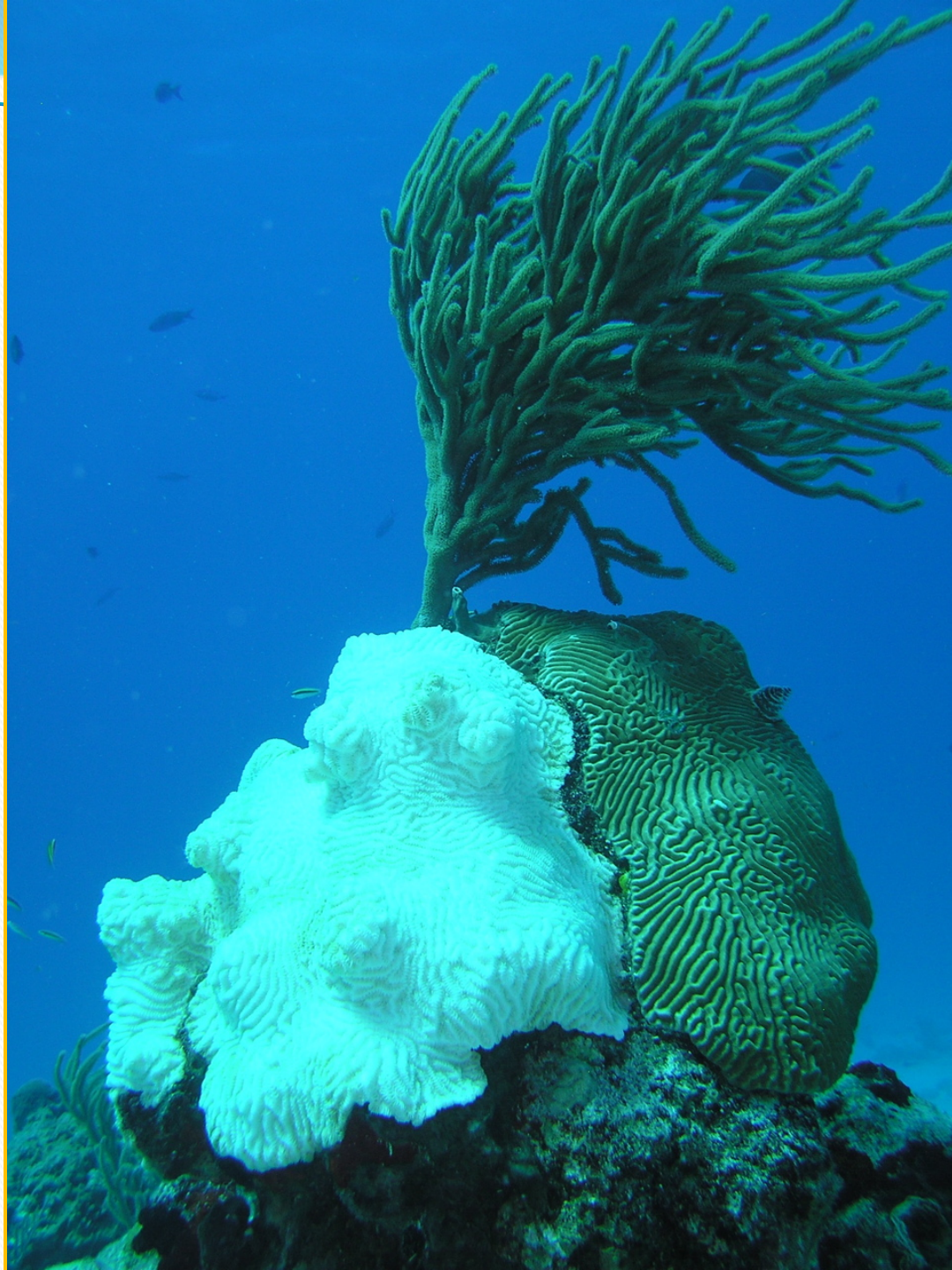


Coral Reefs

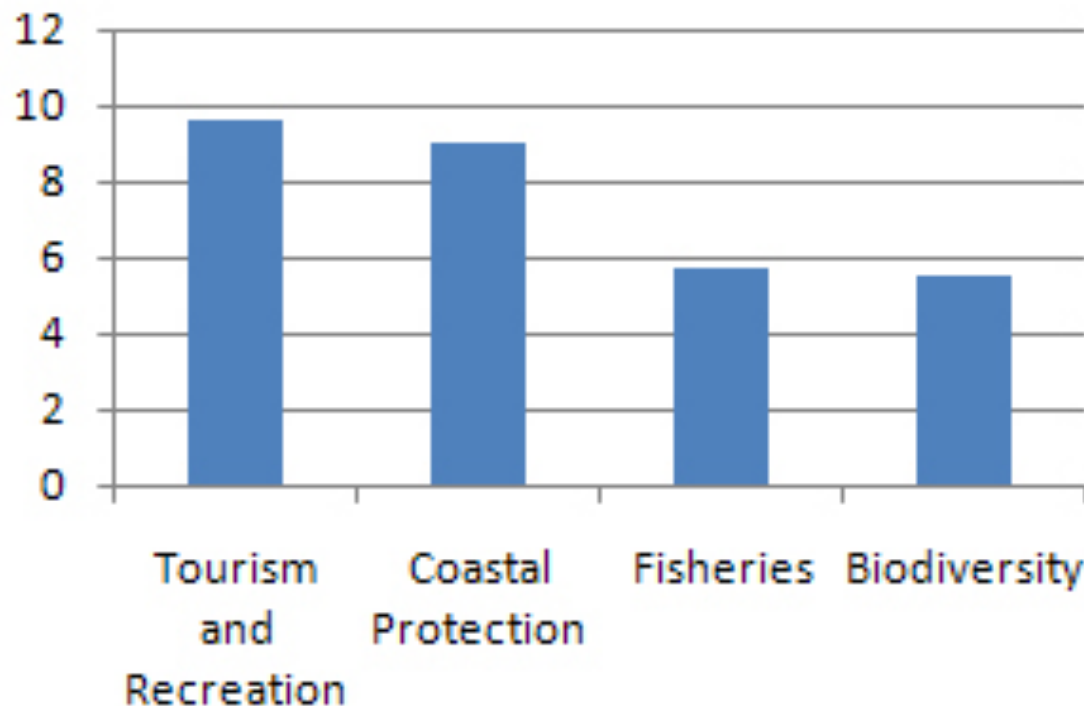
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USF UNIVERSITY OF
SOUTH FLORIDA.



Value of shallow tropical coral reefs

Economic Value of Reefs



- Jobs and income
- + Cultural importance
- >270 million people

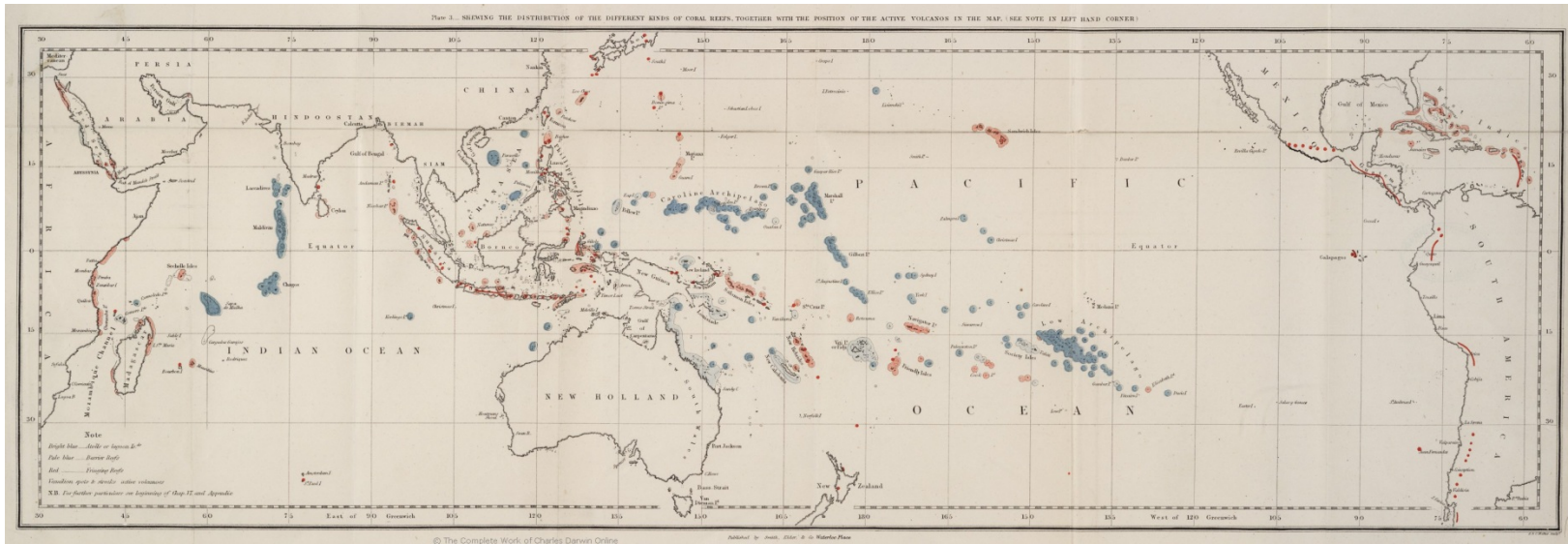
■ (\$ billion/yr)

- TOTAL:
- >\$30 billion/yr

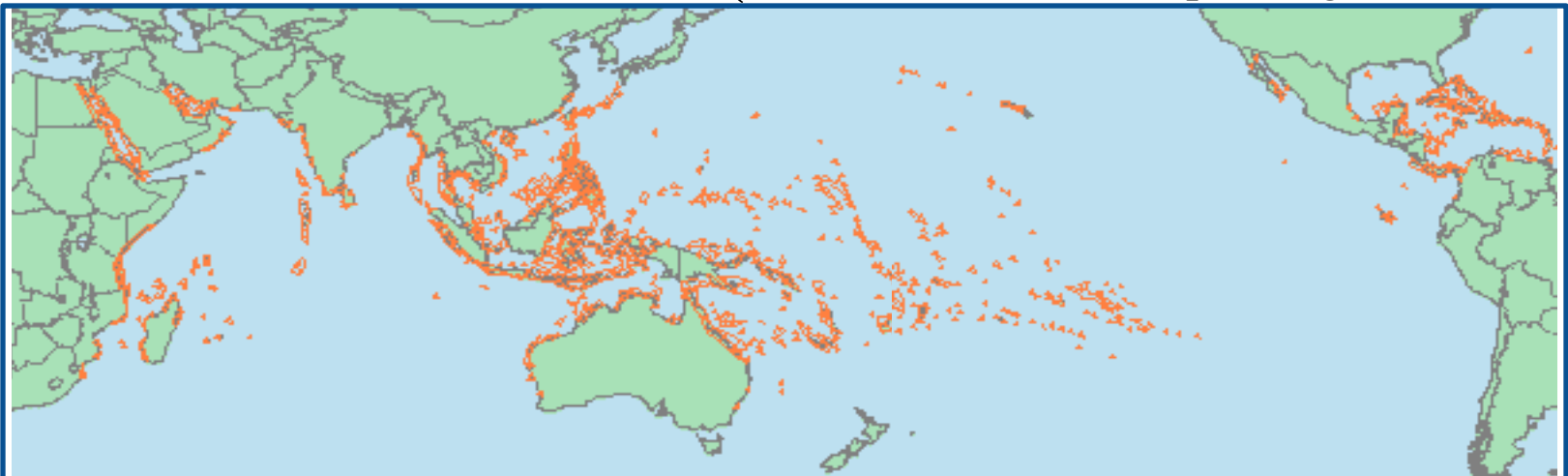
Credit: NOAA

Charles Darwin: 1846

(The structure and distribution of coral reefs)



UNEP-WCMC: Reefbase (2001 and 2012; <http://reefgis.reefbase.org/>)



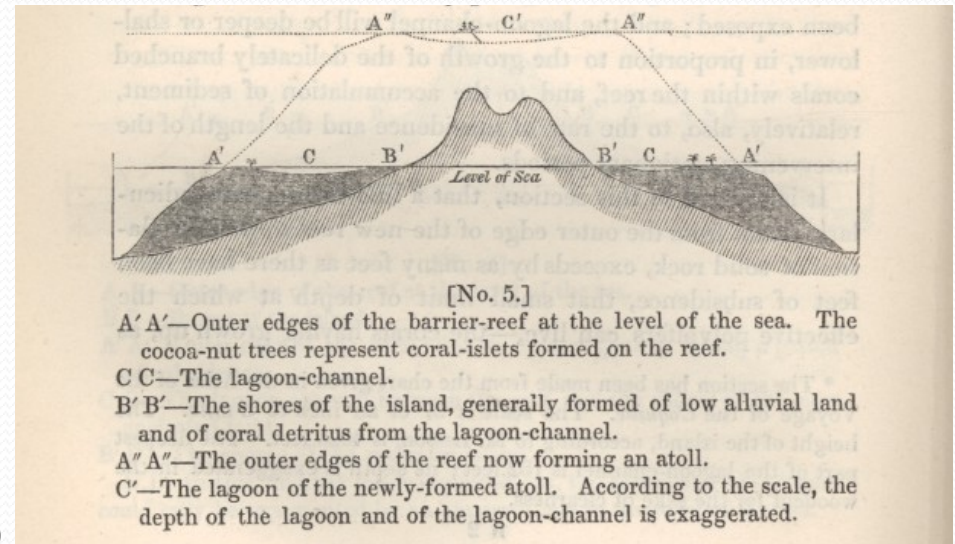
Status and trends for shallow tropical coral reefs

- 10,000 to ~3,000 y ago: Sea level rose ~120 m (~400 ft)
- Stable for past 2000 y +
- Last 100+ y sea level rising again (now 2-3 mm/y)
- Reefs we know have been stable for ~2000y+ of our history

The formation of an 'atoll'

Charles Darwin: 1846

(The structure and distribution of coral reefs)





1992/1993: Rio World Environmental Summit and Coral reef conference in Miami recognized that:

- we have poor information on global reef extent (area)
- status, trends in health

Led to:

- International Coral Reef Initiative (ICRI)
- Global Coral Reef Monitoring Network (GCRMN)
- Reef Check
- Local monitoring programs like CREMP (FL Keys)

Coral reef stressors: Environmental

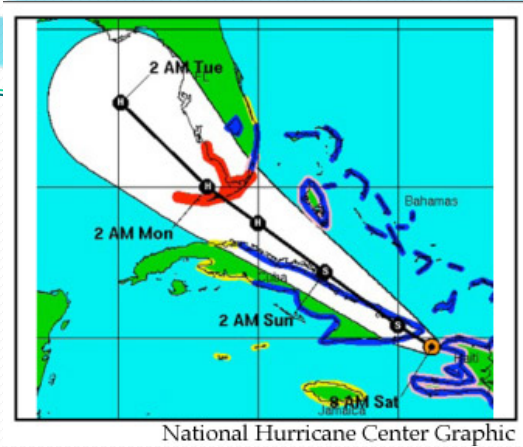
- Severe weather (cold, warm, storms/hurricanes)
- Long-term environment changes
 - Temperature
 - Excess atmospheric CO₂ dissolution in water
 - Sea level rise
 - Rainfall and fresh water discharge
 - Sediment input and sedimentation patterns
 - Biological/ecological (competition, predation)
- Volcanism, earthquakes

Coral reef stressors: Human

- Coastal development + tourism
- Extraction
 - Mining: sand, corals and other materials
 - Fishing/overfishing: fish, molluscs, sponges, etc.
 - Dredging
- Pollution (placing materials on reefs)
 - Chemicals, nets, plastics, sediment, people, boats/groundings

Impacts:


- Ecological imbalances
- Bleaching
- Disease (bacteria, viruses)
- Physical destruction
- Chemical dissolution



Hurricanes

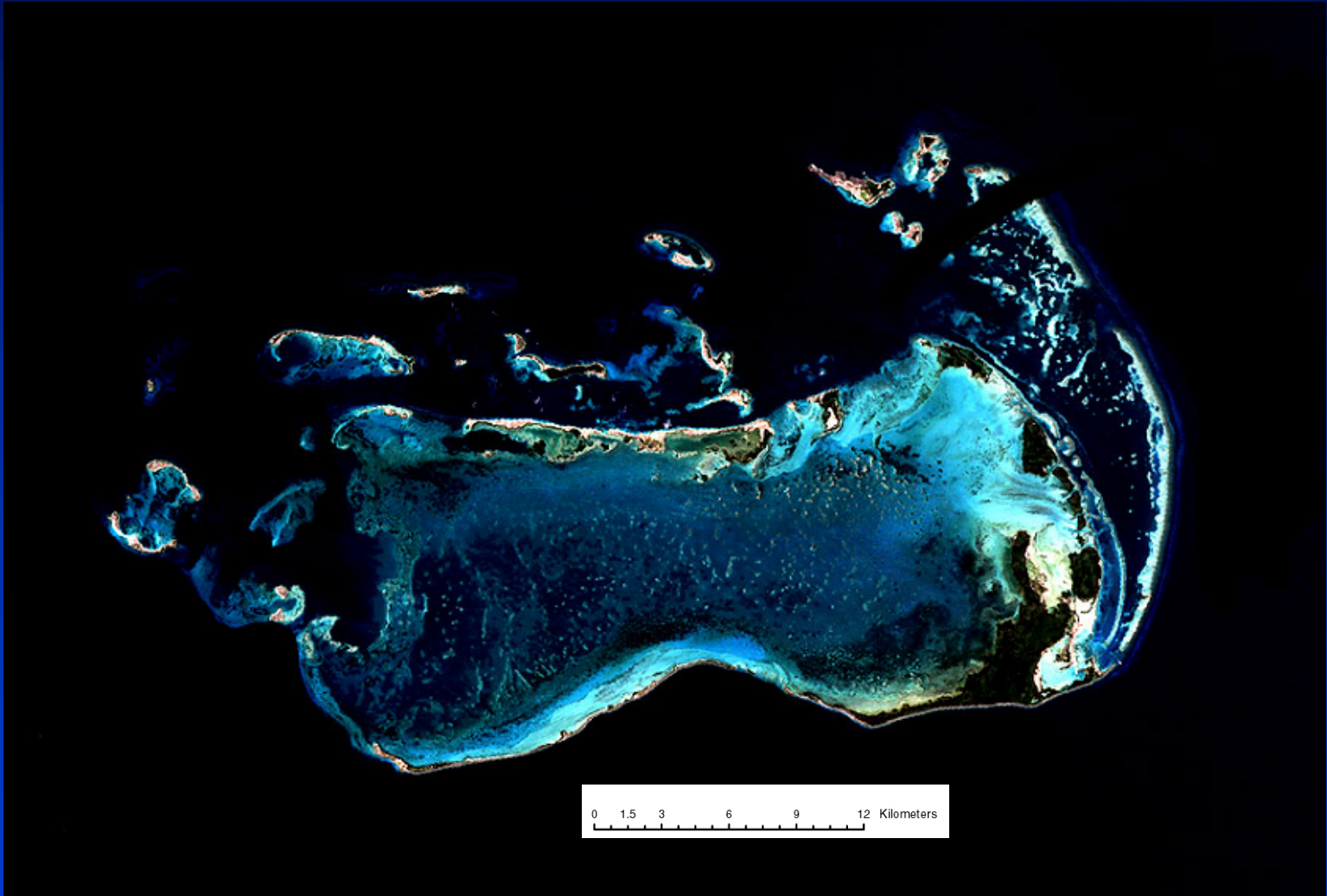


Ship and boat groundings
(2013: U.S. Navy mine countermeasure ship USS Guardian, which ran aground on the Tubbataha Reef in the Sulu Sea)



How do we evaluate
the scale of the
problem?

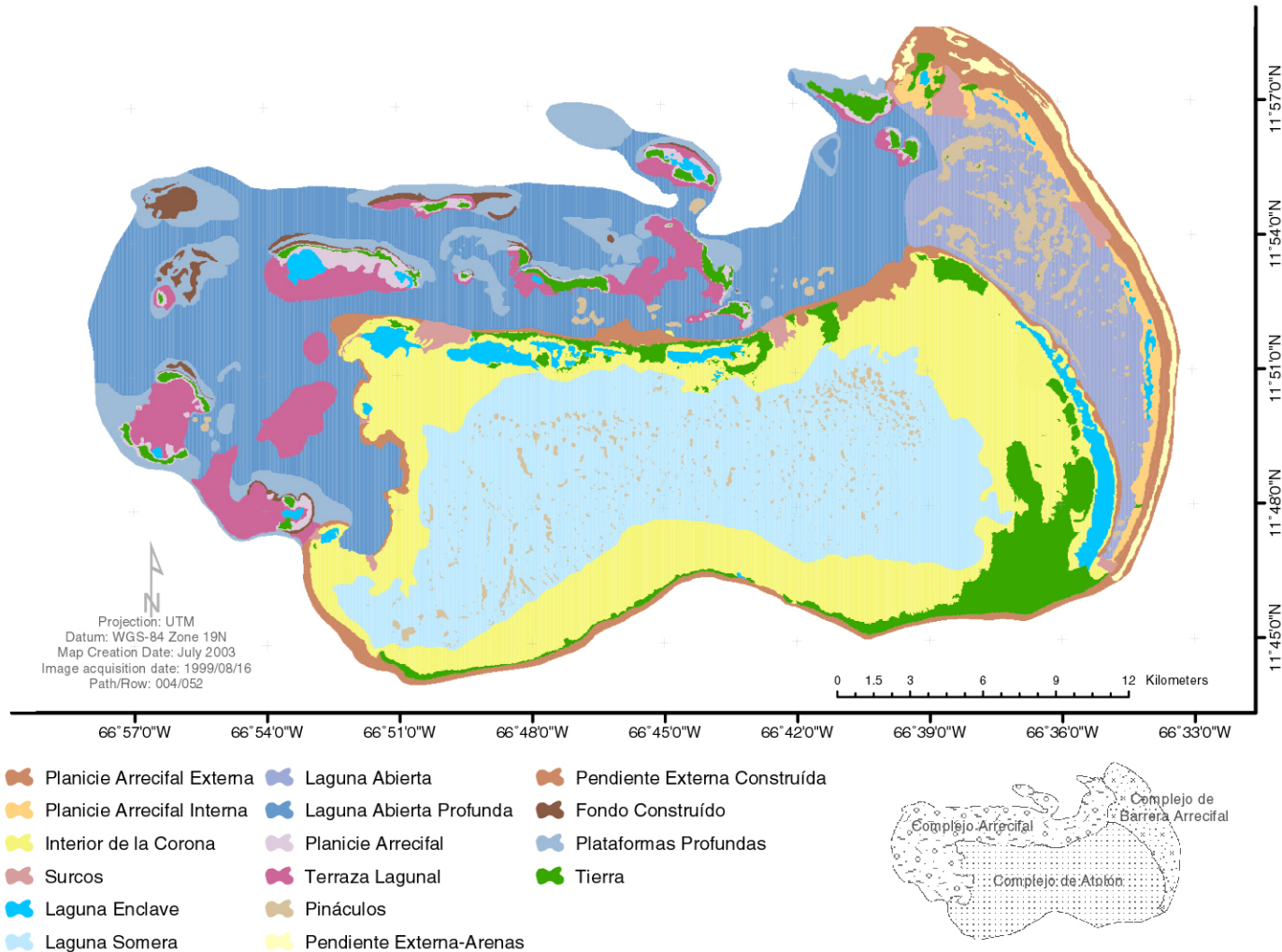
Mapping: divers, airplanes, and satellites



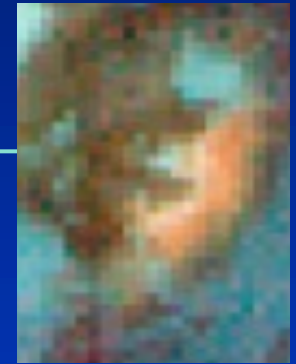
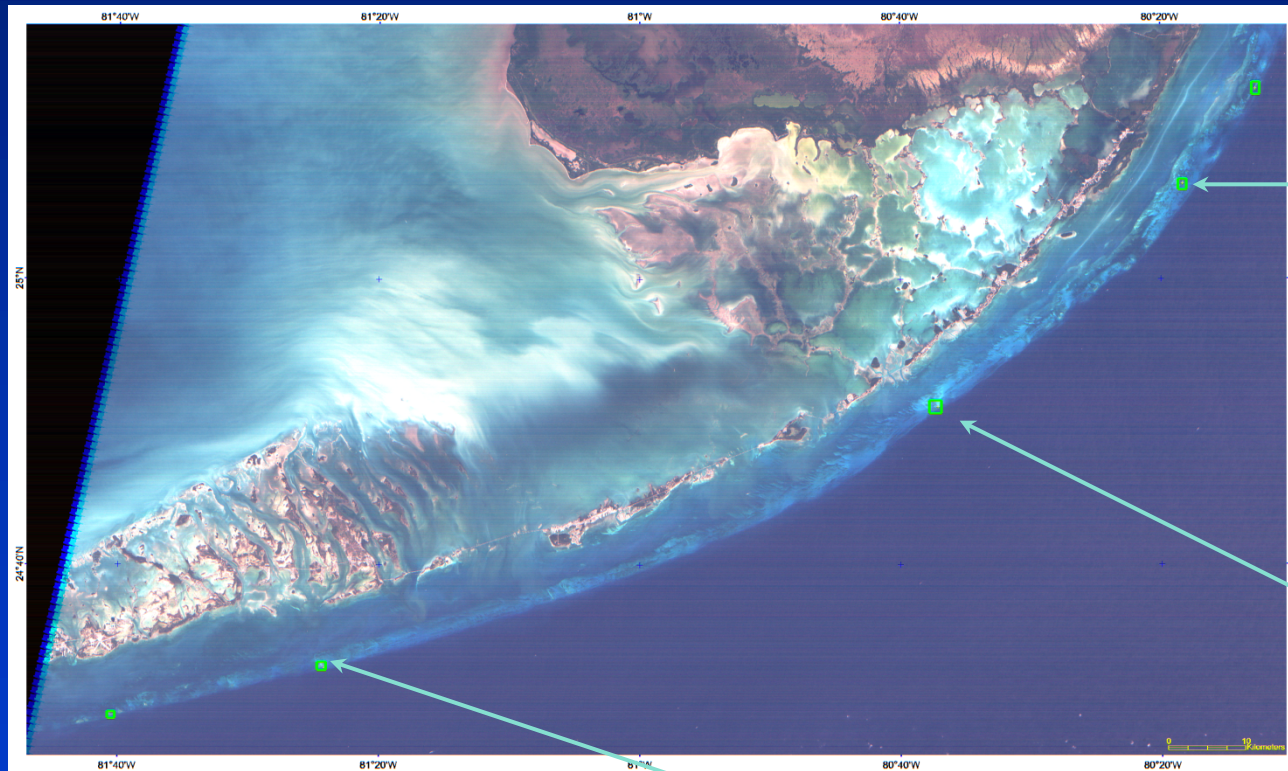
Los Roques, Venezuela

CARIBBEAN–Los Roques Archipelago, Venezuela Geomorphological map

Mapa Geomorfológico del Sistema Arrecifal Los Roques (Venezuela) Derivado de Imagen Landsat 7 ETM+



Landsat Satellite Data



Grecian Rocks



Alligator

Classification
based on benthic
spectral signal

Looe Key

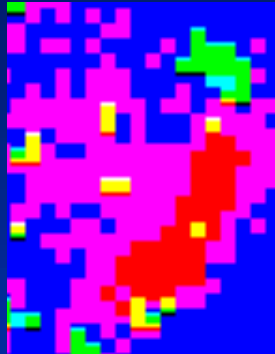


Coral Cover Change

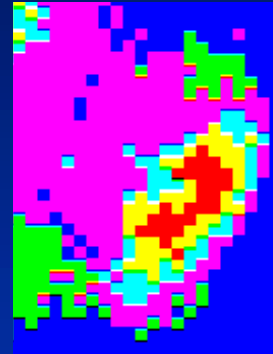
Grecian Rocks



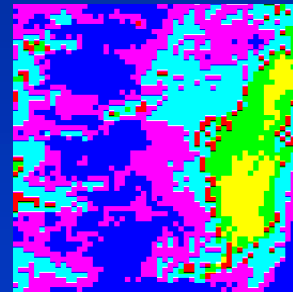
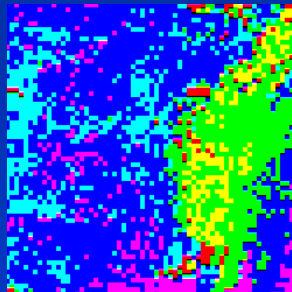
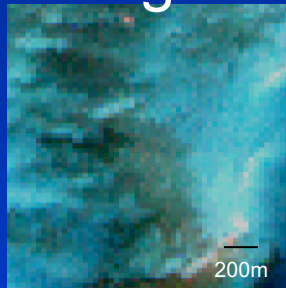
1996



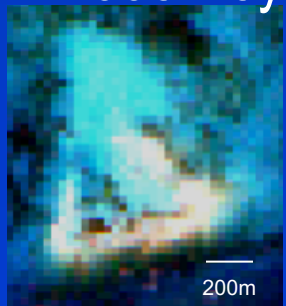
2000



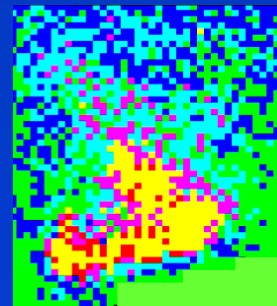
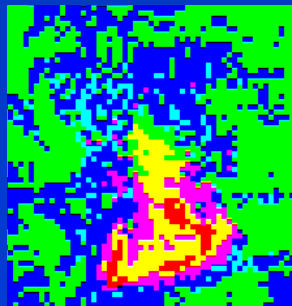
Alligator



Looe Key



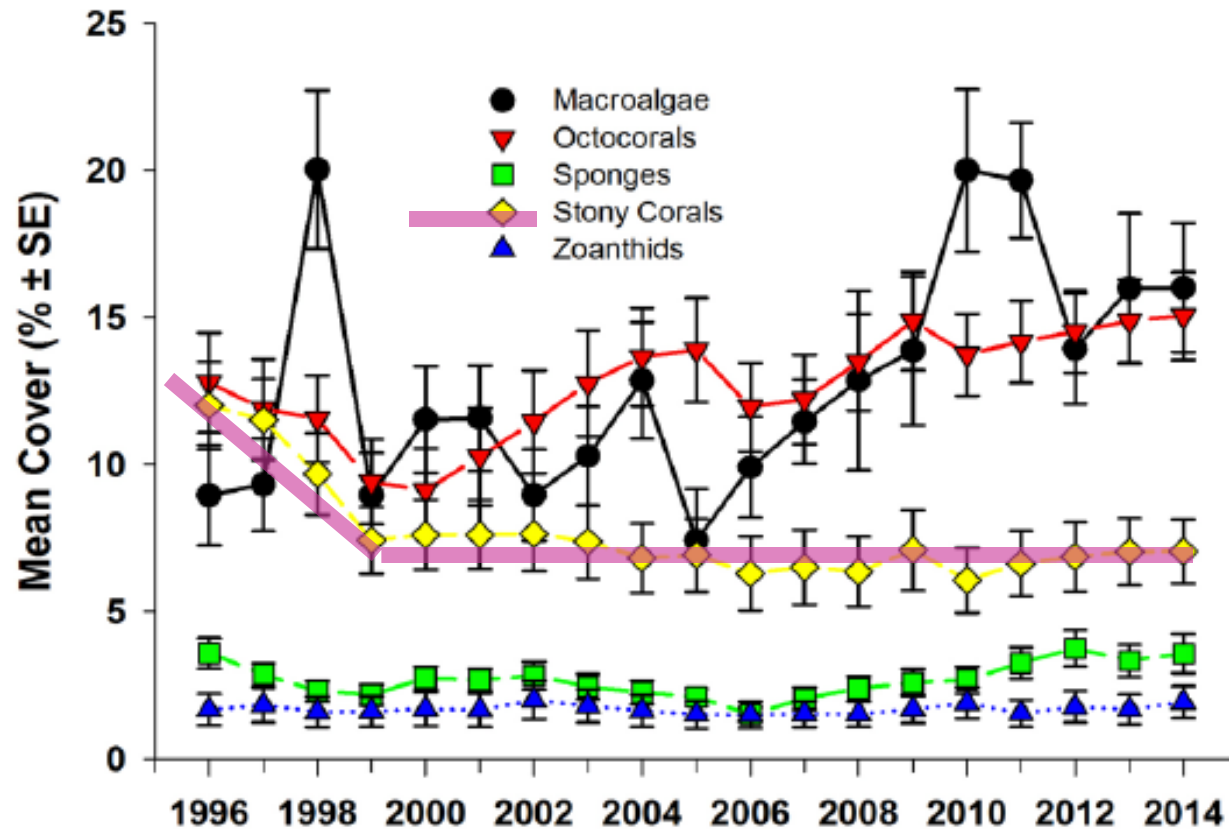
1998



LEGEND

-  Coral
-  Covered Substrate
-  Sand
-  Bare Substrate
-  Dense Seagrass
-  Sparse Seagrass

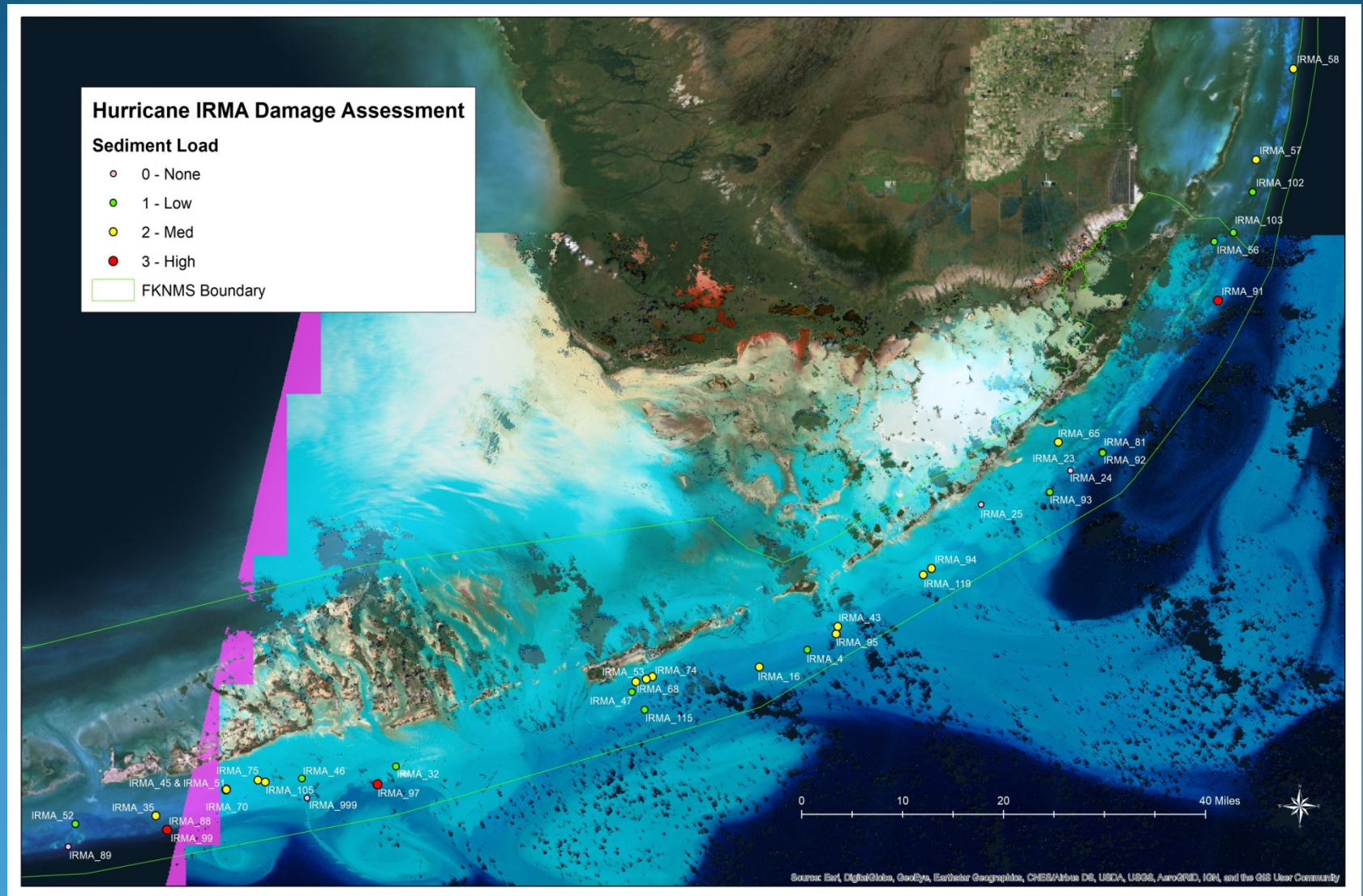
Diver surveys: Florida Keys



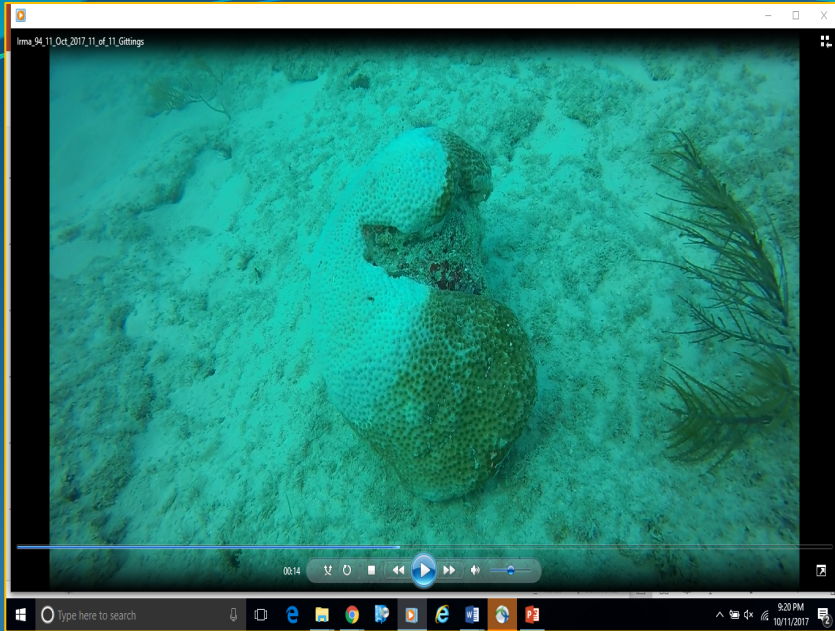
Mean percent cover (\pm SE) of five most spatially common taxa in the Florida Keys between 1996 and 2014.

Credit: Coral Reef Evaluation and Monitoring Project (CREMP)

Hurricane Irma: September 2017



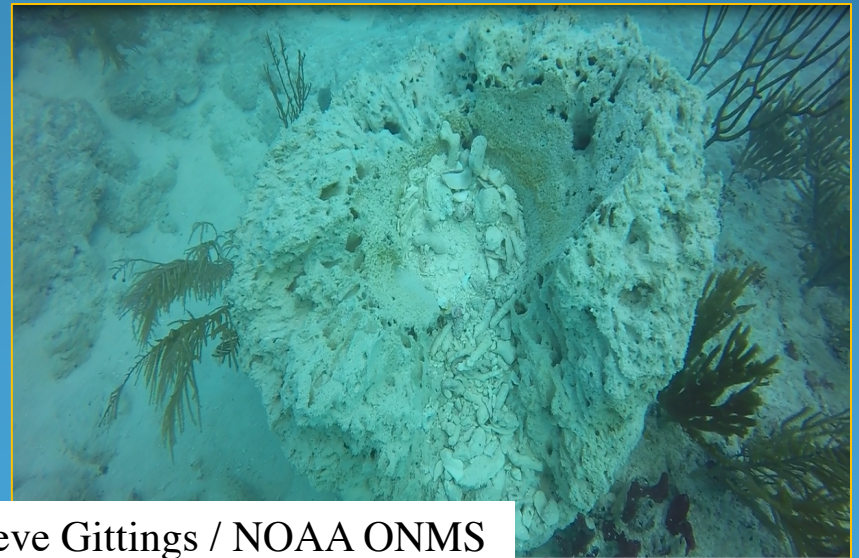
Corals flipped over



Corals covered by debris
Low light due to turbidity



Corals and sponges smothered or choked by sediment



Photos courtesy of Steve Gittings / NOAA ONMS

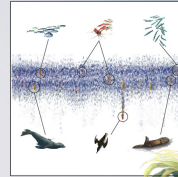
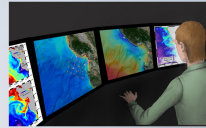
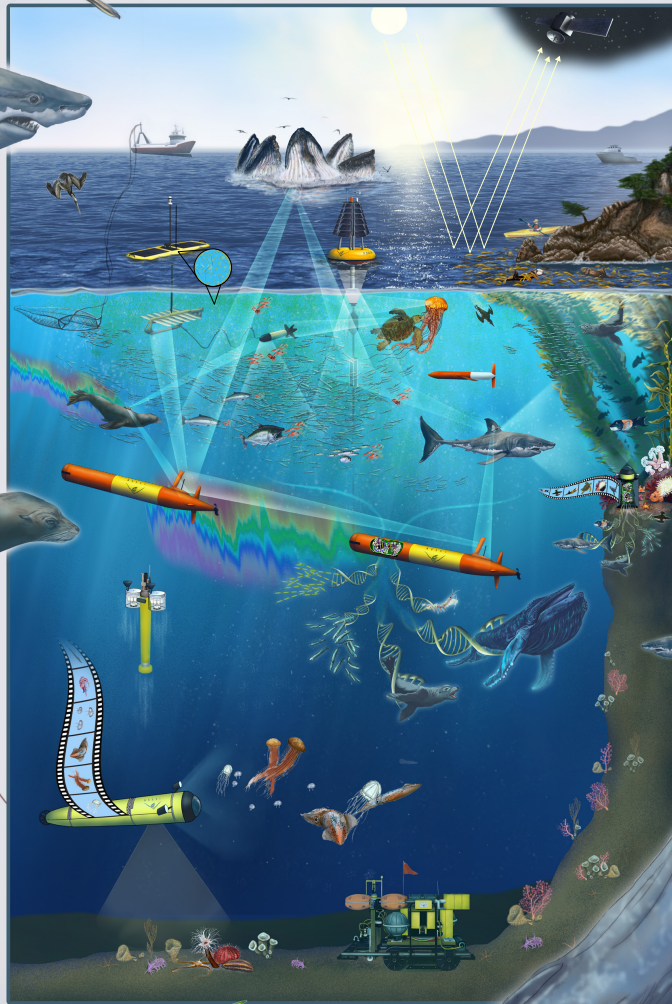
Important goals

- Observations:
 - Mapping
 - Monitoring and research of reef condition
- Valuation (value to society, ecosystem)
- Reduce adverse impacts of human activities
- Conservation

Relevant legal/policy framework (incomplete)

- International
 - Ramsar Convention
 - UN Agenda 2030 (Sustainable Development Goals)
 - United Nations Environment Programme (UNEP)
 - Convention on Biological Diversity (Aichi Targets)
 - UNEP Regional Seas Programme
 - World Heritage Convention
 - Global Coral Reef Monitoring Network (GCRMN)
 - The Convention on Migratory Species (CMS)
- USA:
 - Endangered Species Act
 - Clean Water Act
 - Coral Reef Conservation Act
 - National Marine Sanctuaries, Parks, Monuments, etc.

Observing Life in the Sea



GEO BON

MBON

Marine Biodiversity
Observation Network



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Image courtesy of Francisco Chavez / MBARI