

Impacts on Unique Habitat: Sediment and Coral Reefs

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OBJECTIVE

- Provide an example of the impacts of sediment on a unique habitat: coral reefs.
- Discuss potential management gaps and tools in the control of erosion and sedimentation in Puerto Rico.



OVERVIEW

- Reefs of Puerto Rico
- Impacts of Sedimentation
- Integrated Watershed Management
- Potential Gaps in Implementation
- Potential New Tools





Coral Reefs

Coral reefs are massive deposits of CaCO_3 produced primarily by corals (phylum Cnidaria, class Anthozoa, order Madreporaria/Scleractinia)

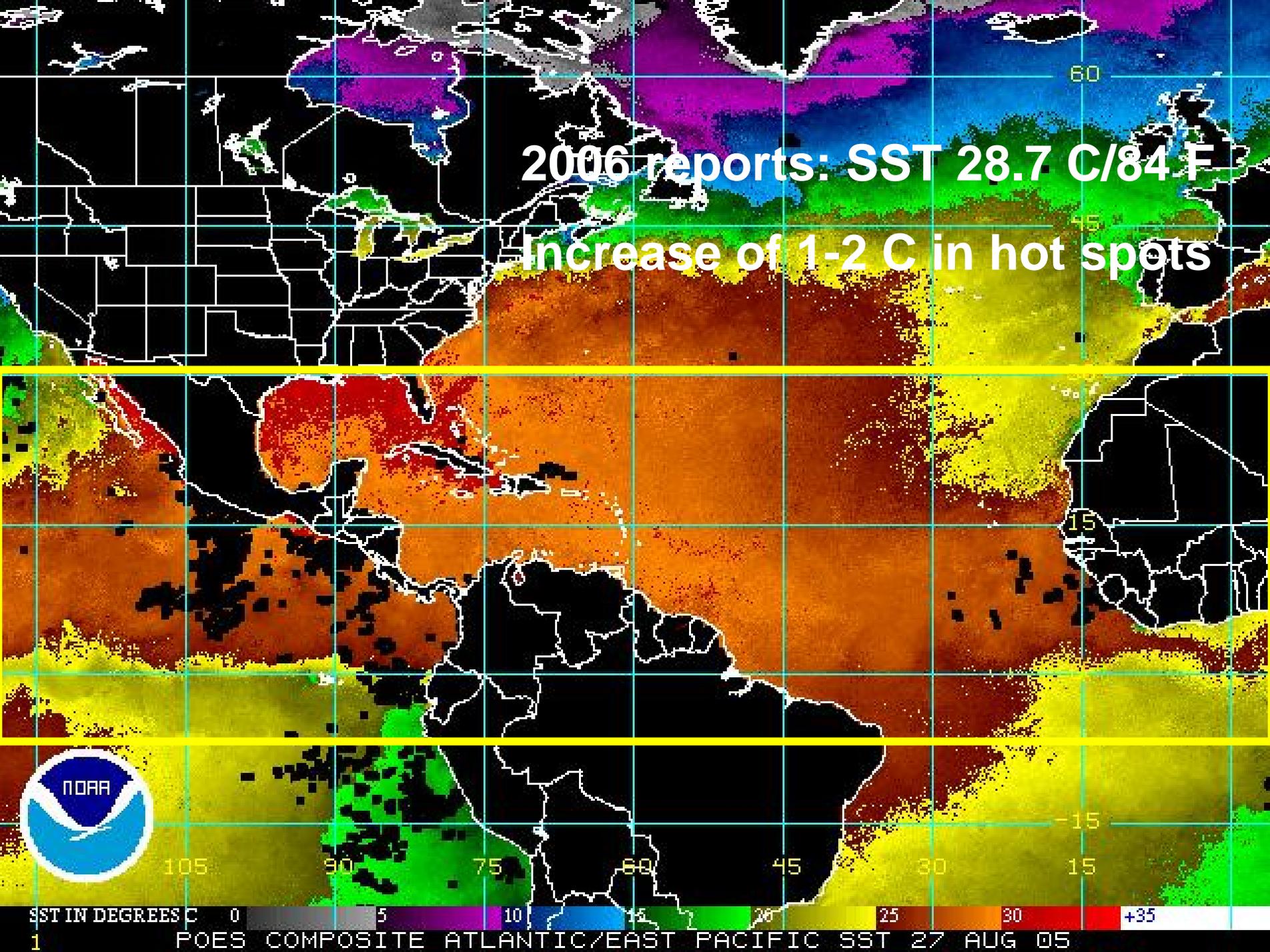
Reefs only develop in the tropics because of the presence of *hermatypic* corals.

Ahermatypic corals occur in all oceans including polar, temperate and tropical regions.

The main difference between the two types of corals is that most *hermatypic* corals have in their tissues small symbiotic plant cells called *Zooxanthellae*.

Optimal reef development occur in waters where mean annual temperatures are 23-25 C

2006 reports: SST 28.7 C/84 F
Increase of 1-2 C in hot spots



SST IN DEGREES C 0 5 10 15 20 25 30 +35

1 POES COMPOSITE ATLANTIC/EAST PACIFIC SST 27 AUG 05

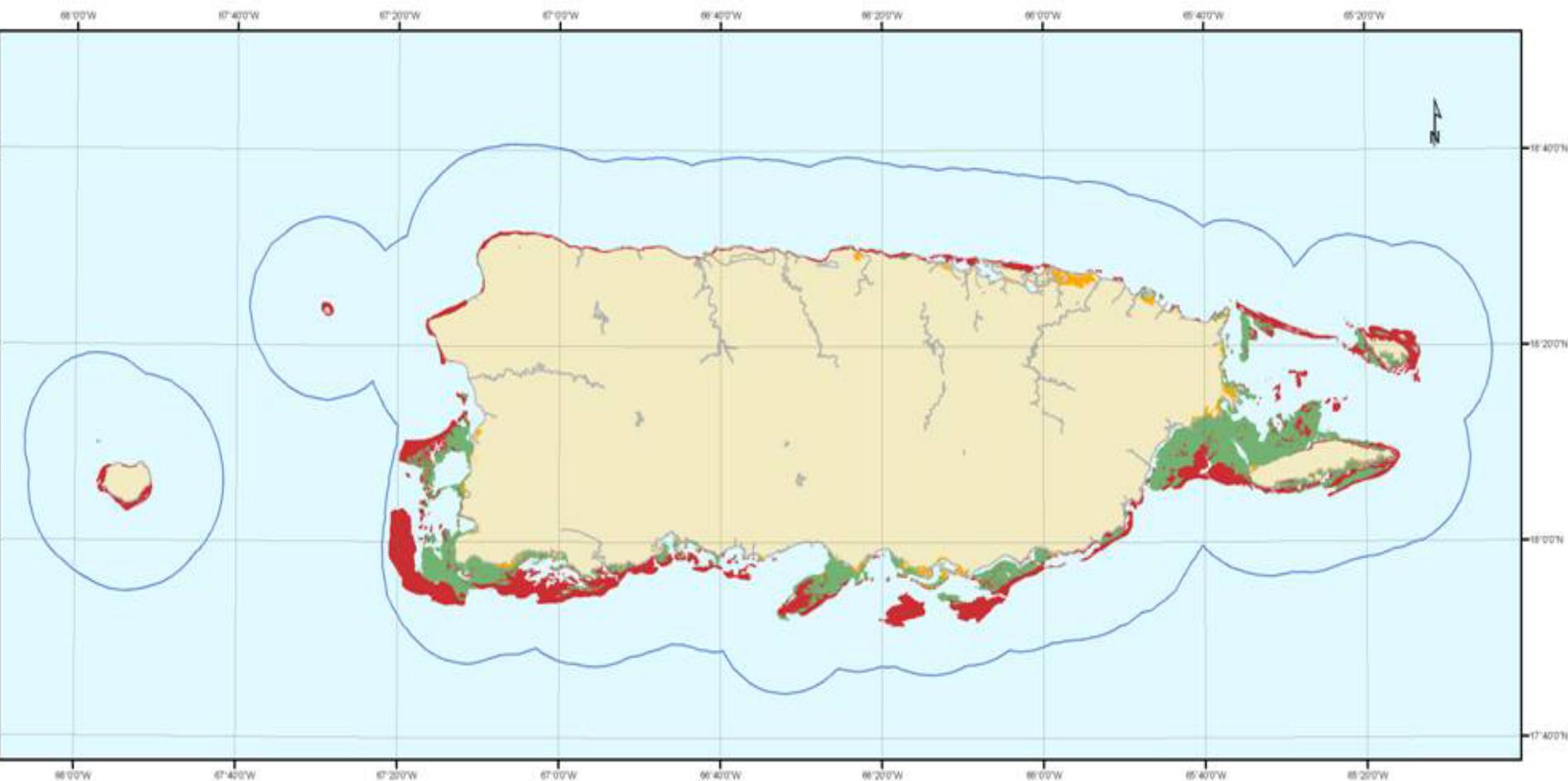
CR - Vegetación subacuática

B - Manglares

CR - Arrecifes de coral

Límite de la zona costanera marina (9 millas náuticas)

Zonificación Arrecifes de Coral - Trabajo en proceso



30 15 0 30
Miles

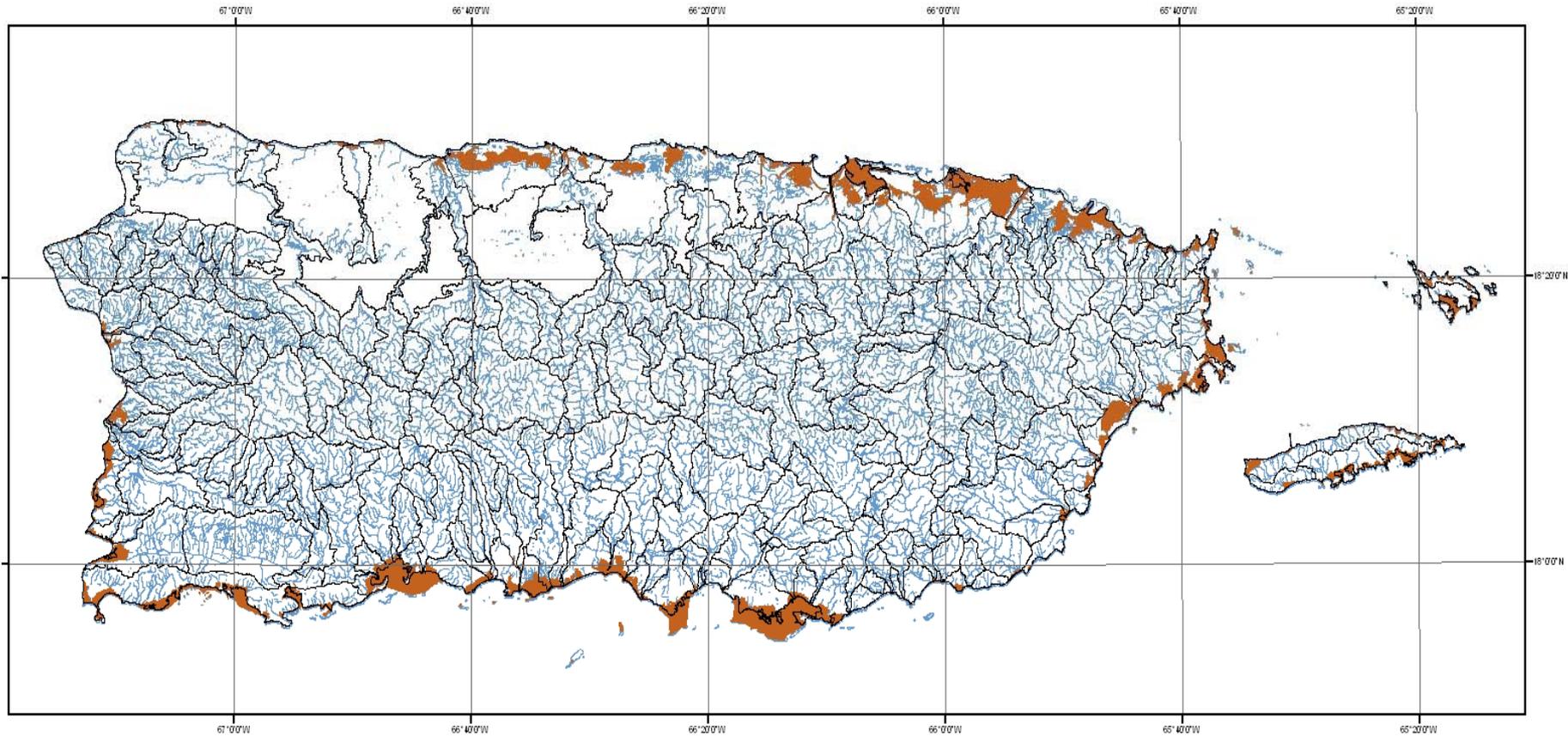
60 30 0 60
Kilómetros



Leyenda

-  Cuencas hidrográficas
-  Humedales estuarinos
-  Hidrografía

Brca - Scale : 1:850,000



Cuencas hidrográficas e hidrografía de Puerto Rico

Departamento de Recursos Naturales y Ambientales
Programa de Manejo de la Zona Costanera

Fuente de información - Source:

Departamento de Recursos Naturales y Ambientales

VALUE OF REEFS

- Critical part of the life cycle of many commercial fish and seafood species.
- Important indicator of climate change.
- Key element in maintaining tropical biodiversity.
- Key component in tourism industry.
- Effective barrier for storm-wave erosion of coastal areas.



SEDIMENTATION AND CORAL REEFS

“Although living coral reefs are present around Puerto Rico, (fringing) reefs are degraded, largely because of increased sediment and nutrient discharge resulting from anthropogenic modifications of the densely populated island.”

US Geological Survey (2005)









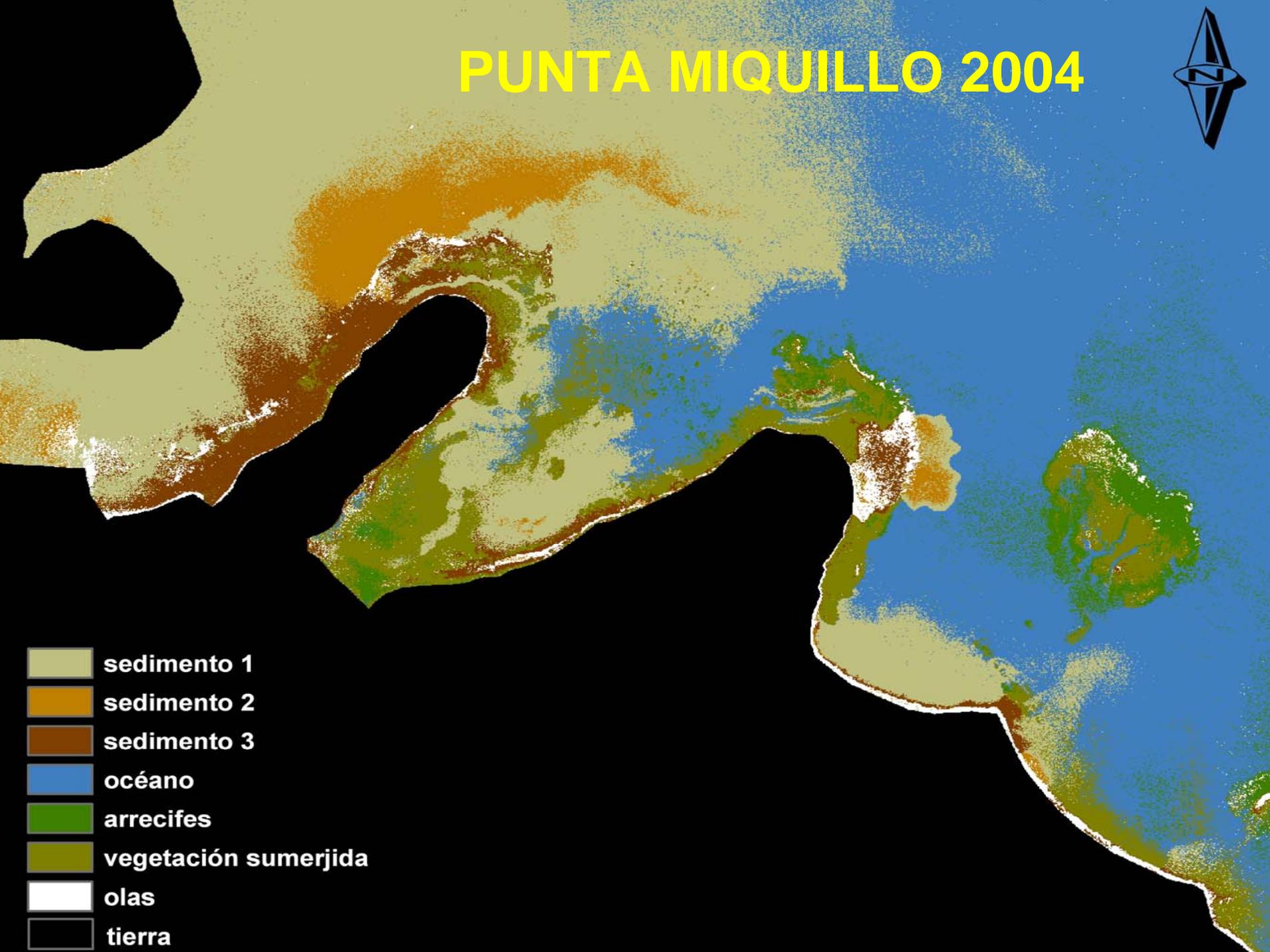








PUNTA MIQUILLO 2004



- sedimento 1
- sedimento 2
- sedimento 3
- océano
- arrecifes
- vegetación sumerjida
- olas
- tierra



WW2BW





SEDIMENTATION AND CORAL REEFS

“Coral reef degradation is widespread in waters surrounding the island, but generally greatest offshore of watersheds where population is high and terrestrial discharge of water and sediment are high.”

U.S. Geological Survey (2005)





DEPOSITO DE MATERIAL

LOS COROZOS LAGOON

ISLA VERDE

BARRIO GERERO

INTERNATIONAL AIRPORT

CANTERA PENINSULA

CARO MARTIN PERA DREDGING

SAN JOSE LAGOON

ALMACENAJE TEMPORERO DE EQUIPO Y MATERIALES (6.0 ACRES)

ALMACENAJE TEMPORERO DE EQUIPO Y MATERIALES (1.5 ACRES)

HATO REY

MUELLE TEMPORERO

ALMACENAJE TEMPORERO DE EQUIPO Y MATERIALES (6.2 ACRES)

RIO PIEDRAS

CAROLINA

DEPOSITO DE MATERIAL

Land-use Changes

- Before large-scale conversion to agriculture in 1800s:
 - sediment and nutrient discharges to coasts would have been negligible except during brief storms, and
 - marine waters would have been relatively transparent.



Land-use Changes

- Most reefs should have been able to endure episodic storm influx...
 - because waves and currents are strong during tropical disturbances,
 - because storms promotes transport of sediment to shelf edge and slope.



Land-use Changes

- Peak land-use conversion from forest to agriculture was from 1830s to 1950s.
- Currently, new construction is widespread.
 - As space in urban areas diminishes, development on steep slopes increases.
- These contribute to an increase in sediment erosion and transport to coasts.



Land-use Changes

- Land clearing for agriculture and urban development has increased watershed sediment and nutrient discharges to shelf, ...and,
- has likely contributed to widespread degradation of reefs around the island.



More Sediment Reaches PR Coast

- Watersheds are small and mountainous
- Stream lengths are short
- Channel gradients are high
- Stream valleys are steep and narrow
- Intense rainfall, and high runoff are common
- NORTH: High 200" gentler slopes vs.
- SOUTH: Low 35" steeper slopes



Impacts of Sedimentation

- Major impacts of river-derived sediment and nutrients:
 - Reduce coral abundance and diversity, and
 - increase algal and sponge density and diversity.





INTEGRATED WATERSHED MANAGEMENT

...an Interagency Approach

Why?

- Environmental Quality Board (EQB) issues Water Quality Certifications.
- DNER is responsible for the administration of the Water Resources Act and regulates tree cutting and reforestation.
- EQB regulates control of erosion and sedimentation.
- DNER and EQB implement nonpoint pollution control plan.



Why?

- US EPA regulates point source discharges and storm water discharges.
- Regulations and Permits Administration (RPA) issues construction permits.
- National Resources Conservation Service (NRCS) provides incentives and extension service.



What's Available

- Technical tools to address erosion and sediment control are available.
- Coastal Nonpoint Plan, Storm water, Erosion and sedimentation regulations; as well as ESC handbook are also in place.



***PUERTO RICO EROSION AND SEDIMENT CONTROL
HANDBOOK FOR DEVELOPING AREAS***

Puerto Rico Environmental Quality Board
and
USDA – Natural Resources Conservation Service

March 2005

What's Available

Regulations are in force requiring control of erosion & prevention of sedimentation:

- All activities that may cause or result in erosion require a permit.
- Permits require the development of plan to control erosion and prevent sedimentation.
- Inspectors must submit monthly progress reports on implementation of plan.



Potential Gaps

- Compliance
- Enforcement
- Training
- Plans effectiveness
- Plans, BMP, MM implementation



Potential Tools - Compliance

- Notice of termination (NOT): could be required with final report on plan implementation.
 - Percentage of NOT sites could be inspected.
 - NOT approval could be denied if terms of permit or regulations are not met.
 - Final use permit could be contingent upon approved NOT.



Potential Tools: Compliance

- Additional surveillance
 - Natural Resources Rangers Corps (DNER) could perform surveillance and inspections for sister agency Environmental Quality Board.
 - On-site signs could explain to workers and the public the purpose of erosion control measures and give Phone number or Email address to report problems.



Potential Gaps - Enforcement

- ❑ Laws and regulations in Puerto Rico establish fines depending on the type of violation.
- ❑ Monitoring of the surface and receiving water bodies clearly indicate that the fine system is not enough to reduce erosion and sedimentation.



Potential Tools: Enforcement

- Fines could be standardized and publicized.
- Cease and desist orders could be pursued for all violations.
- Final use permit could be contingent upon approved Notice of Termination.





DNER has also proposed an Integrated CES SELF-MONITORING PROGRAM based on:

1. Professional CES certification
2. Inspection by: EQB, DNER, PRPB, RPA & Federal agencies
3. Professional liability (Coordination with College Engineers & Surveyors and College of Architects)
4. Institutional Auditing processes by EQB-DNER; and
5. Rigorous and effective application of sanctions and fines.

STAKEHOLDERS: *Home Builders Association, Farmers Associations, Engineers, Architects, Contractors, Banks, Insurance cos.*

Potential Tools - Enforcement

- ❑ Performance bond could be required to pay for any work required to bring project into compliance.
- ❑ Penalties could be increased for fraudulent reports from inspectors (e.g., disbarment).

Potential Gaps: Training

Professionals are not receiving adequate and appropriate training



Potential Tools - Training

- Periodic training could be developed for inspectors, contractors, and developer staff:
 - erosion & sediment control requirements, techniques;
 - economic & environmental damage from sedimentation; and
 - new technologies.
- List of trained professional could be made publicly available.
- Periodic training to Agency staff and rangers is also required.



Making the Link to Dredging

- In addition to impacting coastal resources such as coral reefs, sediments from upland can fill in navigational channels.
 - Thus, dredging stakeholders and coastal resource managers are natural partners,
 - and should work jointly with watershed managers to address erosion and sedimentation issues.



Making the Link - Opportunities

Current dredging projects in PR include:

- San Juan Bay port channel
- Las Americas port at Ponce,
- River flood control projects, and
- Navigation channels for marinas

Suitable dredged material can be used beneficially in habitat restoration or creation in areas that have been dredged.

(i.e. Sand and fill material extraction for infrastructure construction in the past have created anoxic pits).



Special thanks to Dr. Elizabeth Kim (USEPA) and Secretary Javier Velez-Arocho (DNER) for their contribution and support to the development of new and innovative tools to protect coastal and marine environment.



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