Integrated Watershed Management:
LAND BASED SOURCES OF POLLUTION





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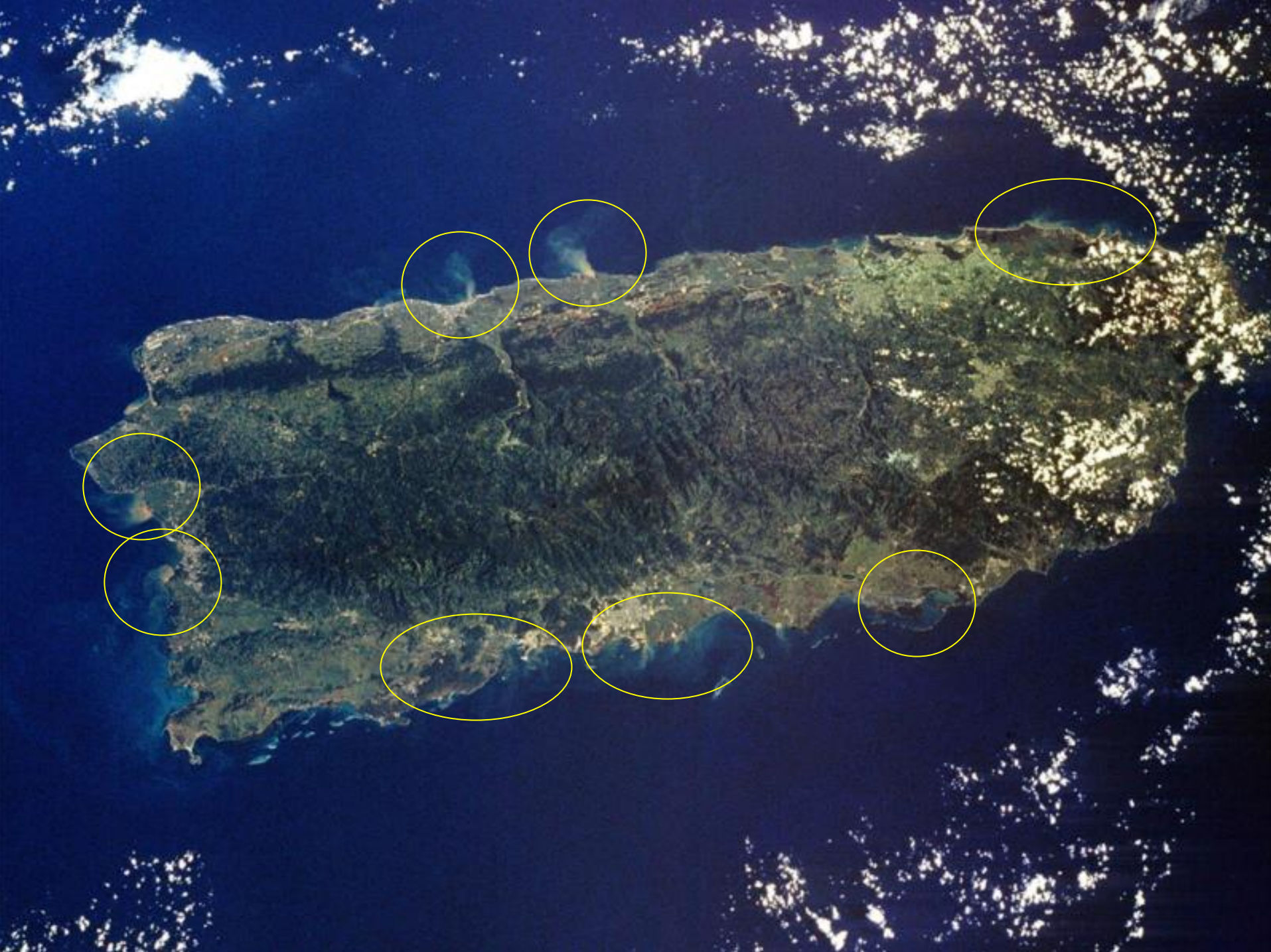
OBJECTIVE

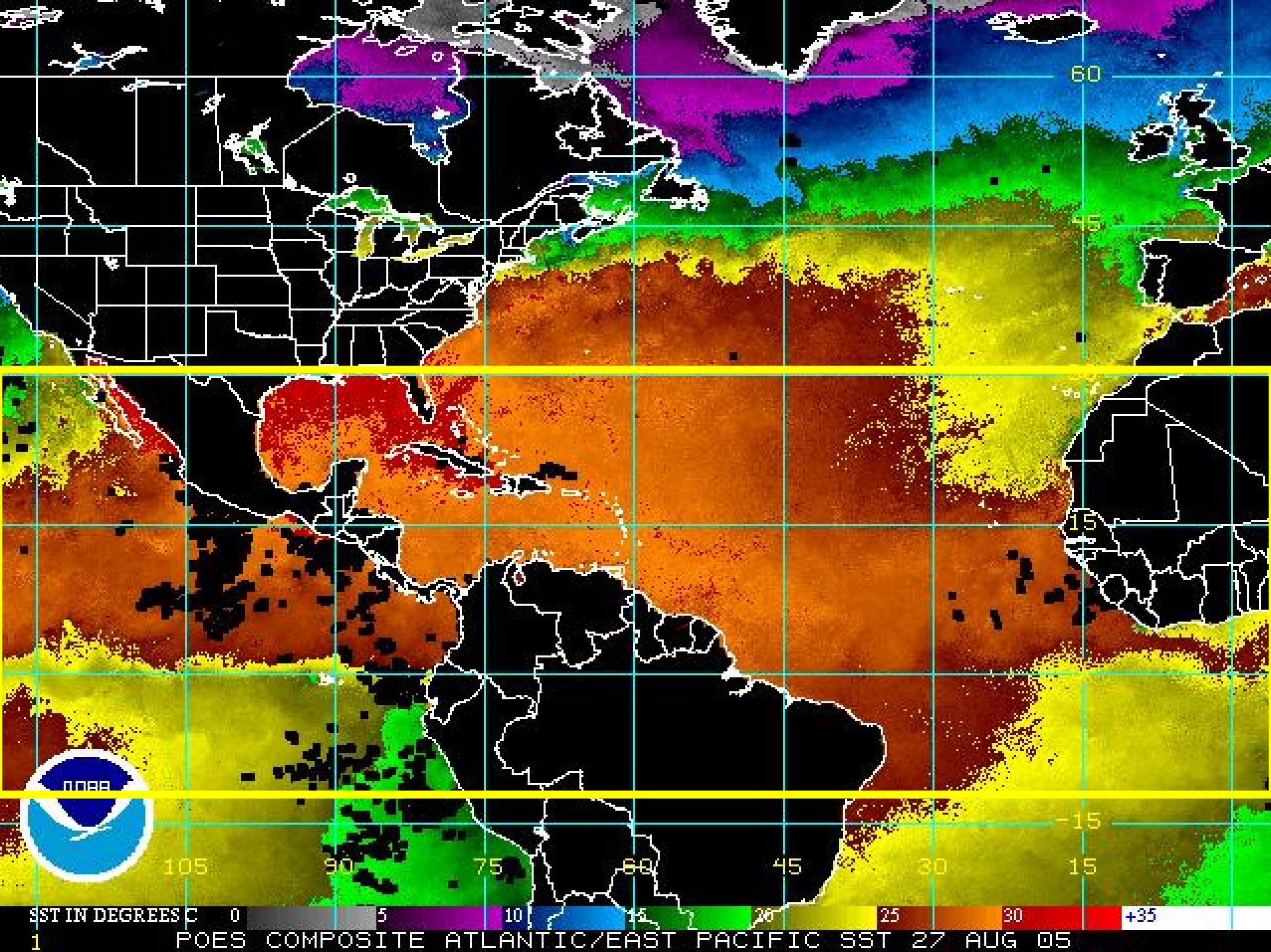
- Provide an example of the impacts of LBS on a unique habitat and resources (i.e. coral reefs)
- Discuss potential management gaps and tools in the control of land based sources of pollution, erosion and sedimentation in Puerto Rico through Integrated Watershed Management.

OVERVIEW

- Reefs of Puerto Rico
- Impacts of LBS of pollution (i.e. Sedimentation)
- Integrated Watershed Management
- Potential Gaps in Implementation
- Potential New Tools


Florida
Cuba
Hispaniola
Puerto Rico
USVI

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POES COMPOSITE ATLANTIC/EAST PACIFIC SST 27 AUG 05

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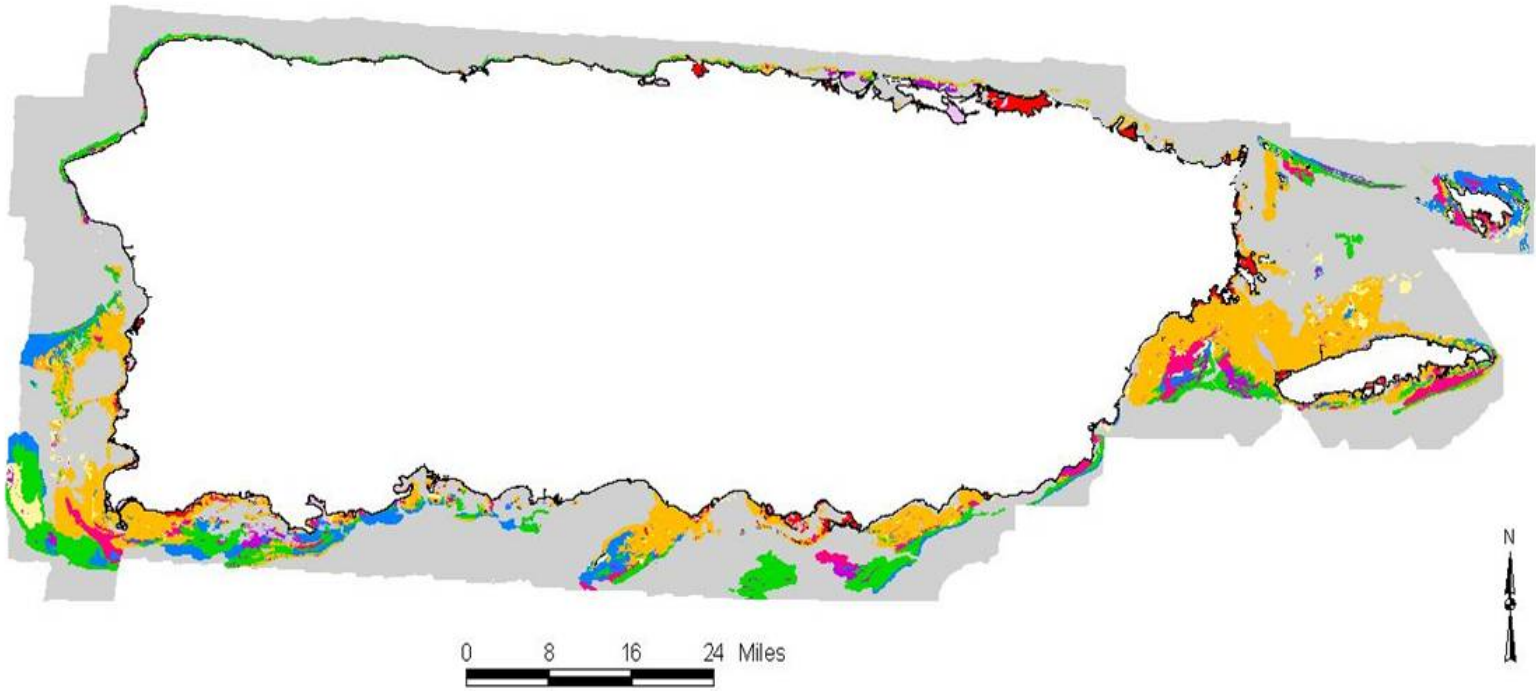


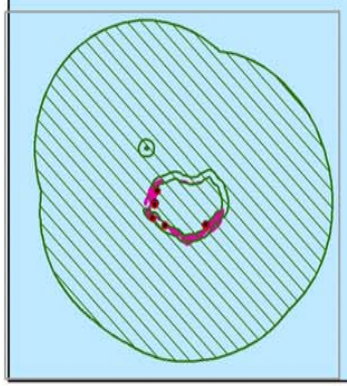
Distribución de Arrecifes de Coral(1)

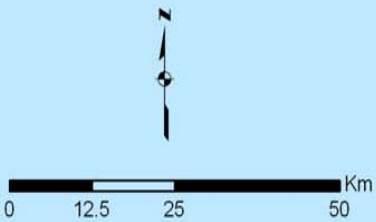
(1)Fuente: NOAA/NOS

Leyenda:

- Artificial
- Colonized Bedrock
- Colonized Pavement
- Colonized Pavement with Sand Channels
- Land
- Linear Reef
- Macroalgae
- Mangrove
- Mud
- Patch Reef (Aggregated)
- Patch Reef (Individual)
- Reef Rubble
- Sand
- Scattered Coral/Rock in Unconsolidated Sediment
- Seagrass
- Spur and Groove Reef
- Uncolonized Bedrock
- Unknown

Mapa síntesis: Datos para el desarrollo del Programa de Ordenación de Aguas Costeras y Terrenos Sumergidos





- Marinas
- Rampas
- Boyas
- Areas Naturales Protegidas -DRNA
- Arrecifes de coral y suelo colonizado
- Vegetación sumergida
- 9 millas naúticas

MPA STATISTICS

MPA / Aguas territoriales	22.87%
Reefs within MPA/ Total PR Reefs	51.49%
Sea Grasses within MPA/ Total PR Seagrasses	49.24%
Macroalgaes en AMP/ Total PR macroalgaes	22.53%
SAV within MPA/ Total PR SAV	22.28%

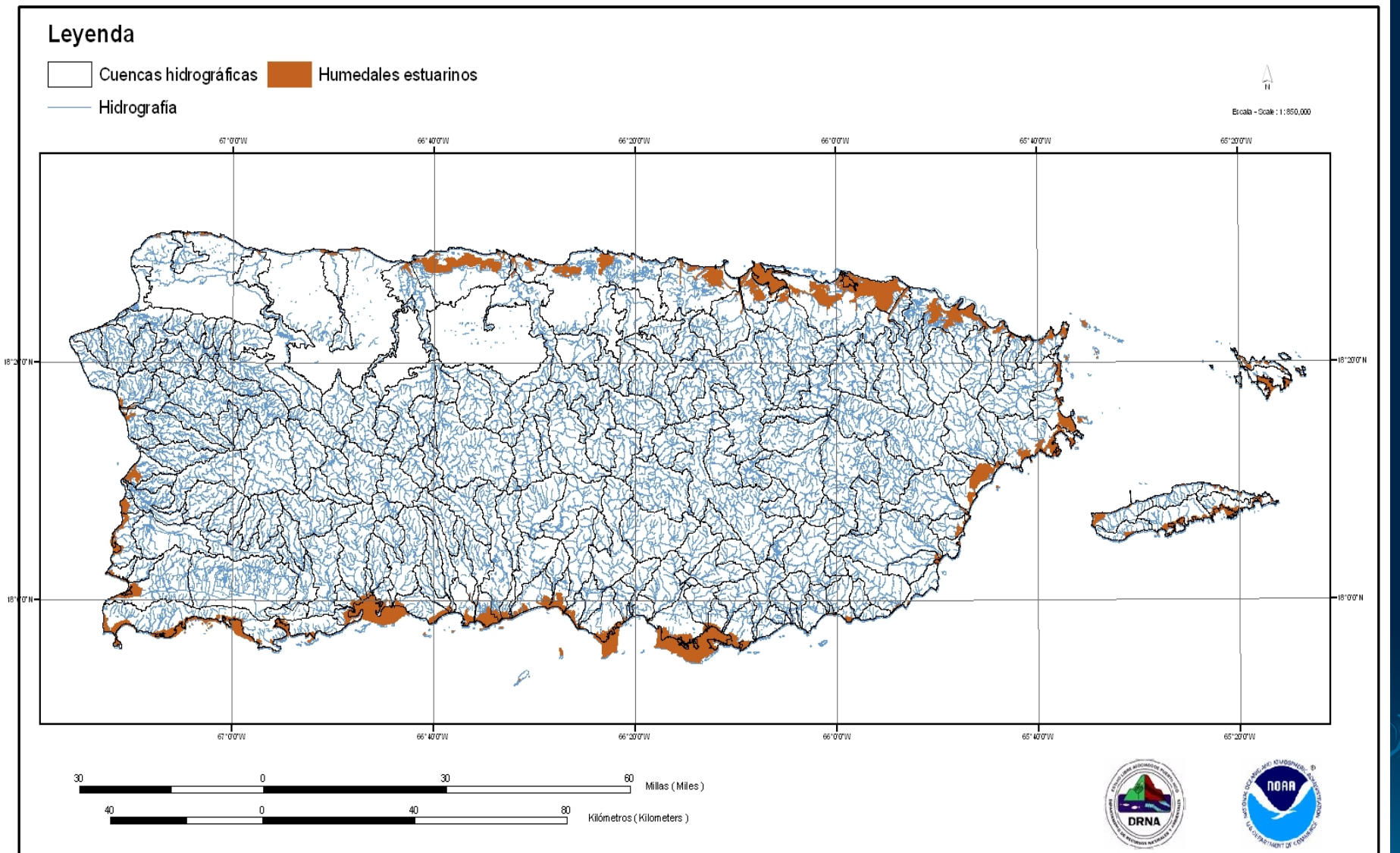
Source: Matthew S. Kendall[1], Curtis R. Kruer[2], Ken R. Buja[1], John D. Christensen[1], Ernesto Diaz[3], Robert A. Warner[4], and Mark E. Monaco[1]

PMZC 2005
(Alvarez N. y E. Diaz)

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)



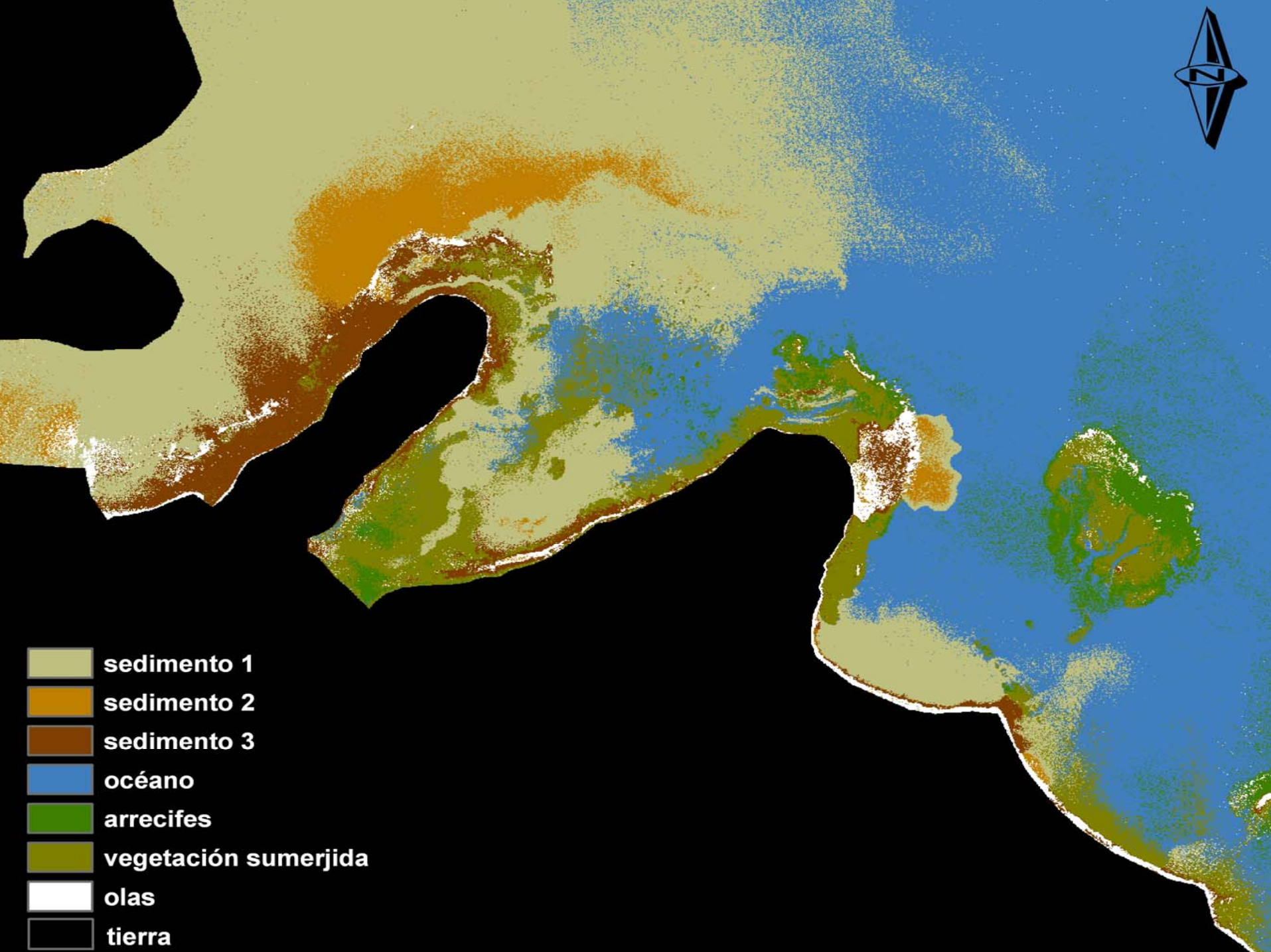
Cuencas hidrográficas e hidrografía de Puerto Rico

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

Fuente de información - Source:

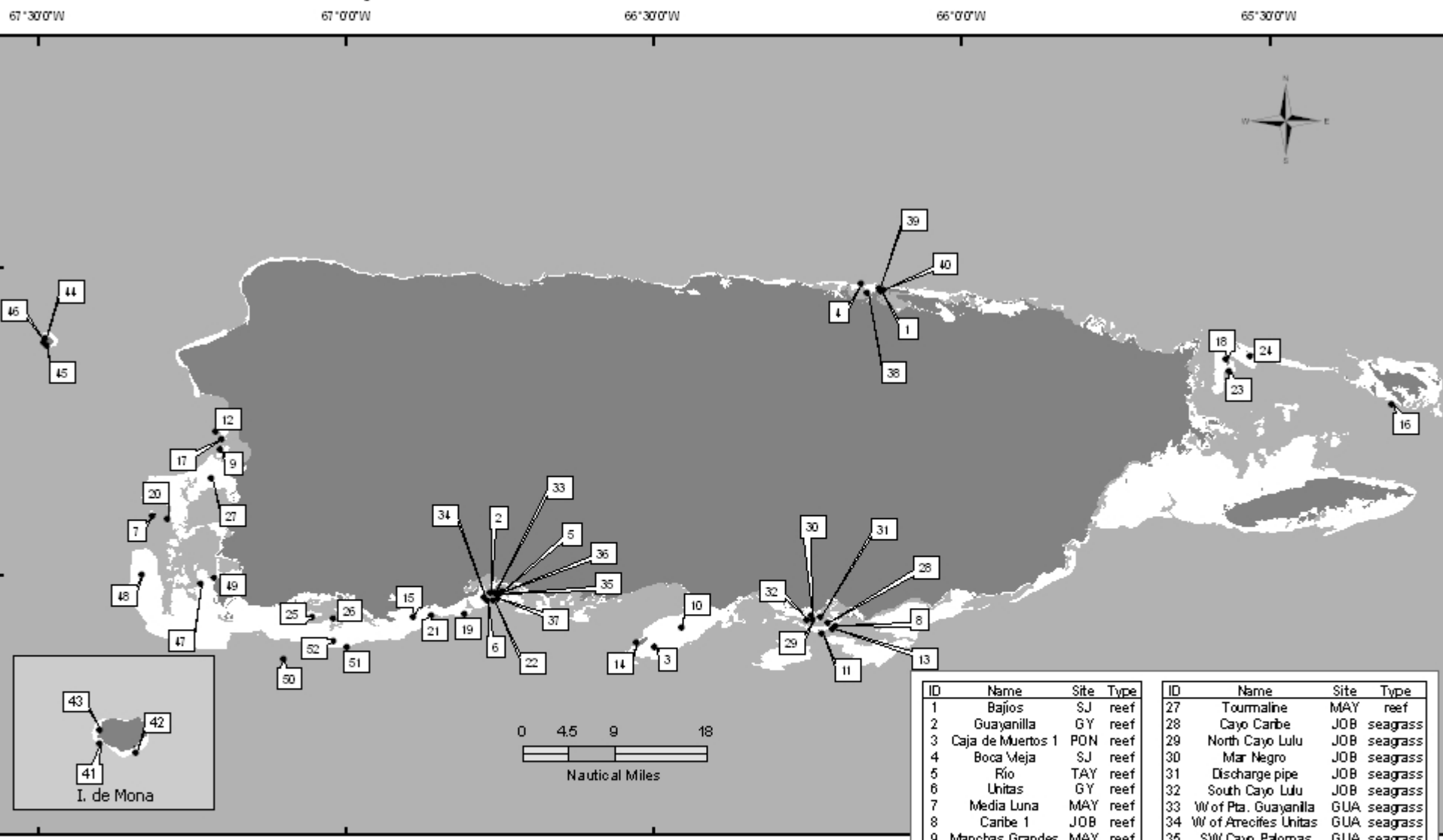
Departamento de Recursos Naturales y Ambientales

Puerto Rico
Coastal Zone Management Program


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

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.



ID	Name	Site	Type
1	Bajíos	SJ	reef
2	Guayanilla	GY	reef
3	Caja de Muertos 1	PON	reef
4	Boca Vieja	SJ	reef
5	Río	TAY	reef
6	Unitas	GY	reef
7	Media Luna	MAY	reef
8	Caribe 1	JOB	reef
9	Manchas Grandes	MAY	reef
10	Berbería	PON	reef
11	La Barca	JOB	reef
12	Manchas Ext 2	MAY	reef
13	Caribe 2	JOB	reef
14	Caja de Muertos 2	PON	reef
15	Cayo Coral	GUA	reef
16	Pta. Maguey	CUL	reef
17	Manchas Int 2	MAY	reef
18	Isla Palomino	FAJ	reef
19	Pta. Ventana 2	GY	reef
20	Las Coronas	MAY	reef
21	Pta. Ballena	GUA	reef
22	Fanduco	GY	reef
23	Isla Palominitos	FAJ	reef

ID	Name	Site	Type
27	Tourmaline	MAY	reef
28	Cayo Caribe	JOB	seagrass
29	North Cayo Lulu	JOB	seagrass
30	Mar Negro	JOB	seagrass
31	Discharge pipe	JOB	seagrass
32	South Cayo Lulu	JOB	seagrass
33	W of Pta. Guayanilla	GUA	seagrass
34	W of Arrecifes Unitas	GUA	seagrass
35	SW Cayo Palomas	GUA	seagrass
36	W of Cayo Palomas	GUA	seagrass
37	N of Maria Langa	GUA	seagrass
38	Ensenada Boca Vieja	SJ	seagrass
39	W Bajo Colnas	SJ	seagrass
40	Bajo Santa Elena	SJ	seagrass
41	Playa Mujeres	MON	reef
42	Playa Pajaros	MON	reef
43	Carmelitas	MON	reef
44	North Reef	DES	reef
45	Puerto Canoas	DES	reef
46	Puerto Botes	DES	reef
47	Resuellos	BOQ	reef
48	Gallardo	BOQ	reef
49	El Palo	BOQ	reef

I. Alvarez 2004

Estado Libre Asociado Puerto Rico
Departamento de Recursos Naturales y Ambientales

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.
  - Most reefs should have been able to endure episodic storm influx…

1) because waves and currents are strong during tropical disturbances,

2) because storms promote 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.

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” gentle slopes vs.
- SOUTH: Low 35” steeper slopes)

Impacts of Sedimentation

- Major impacts of river-derived sediment and nutrients:
  - Reduced live coral cover,
  - reduced coral abundance and diversity, and
  - increased algal and sponge density and diversity.

INTEGRATED WATERSHED MANAGEMENT

...an Interagency and Community based 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.
- USACE administers CWA 404 permits
- National Resources Conservation Service (NRCS) provides incentives and extension service.

THEMES OF PARTICULAR CONCERN

- Land based Sources of Pollution
- Storm water runoff management
- Storm water management within construction projects
- Inadequate selection of waste water disposal systems (i.e.septic tanks)
- Erosion and Sedimentation Control from AGRICULTURAL and URBAN sources
- Best management practices implementation (BMP)
- Self monitoring- Institutional Auditing system…a realistic option?

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

NRCS

PUERTO RICO EROSION AND SEDIMENT CONTROL HANDBOOK FOR DEVELOPING AREAS

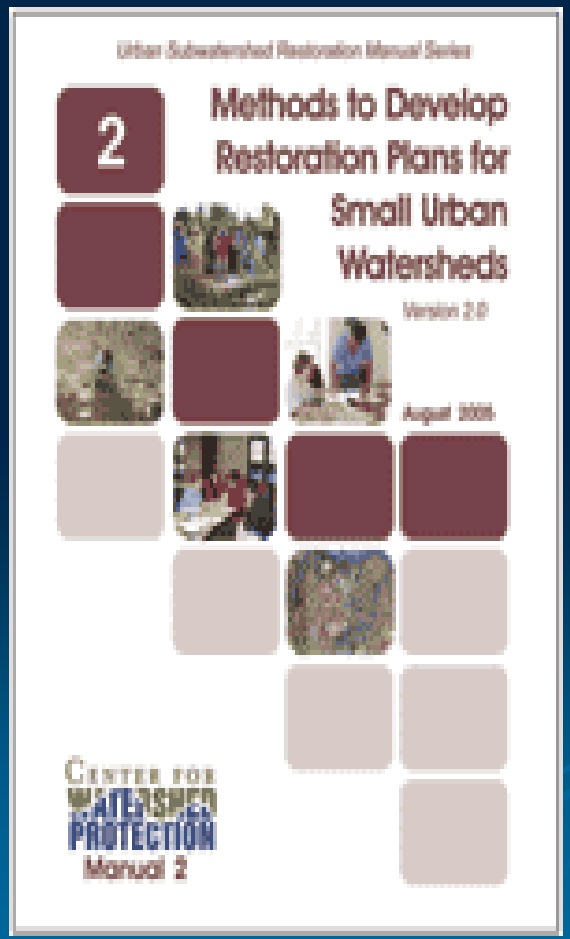
Puerto Rico Environmental Quality Board
and
USDA – Natural Resources Conservation Service

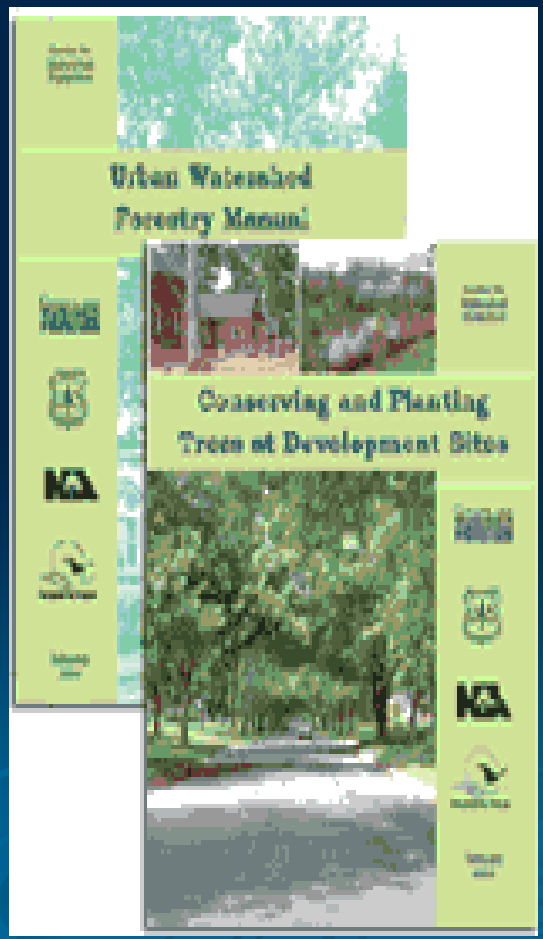
March 2005

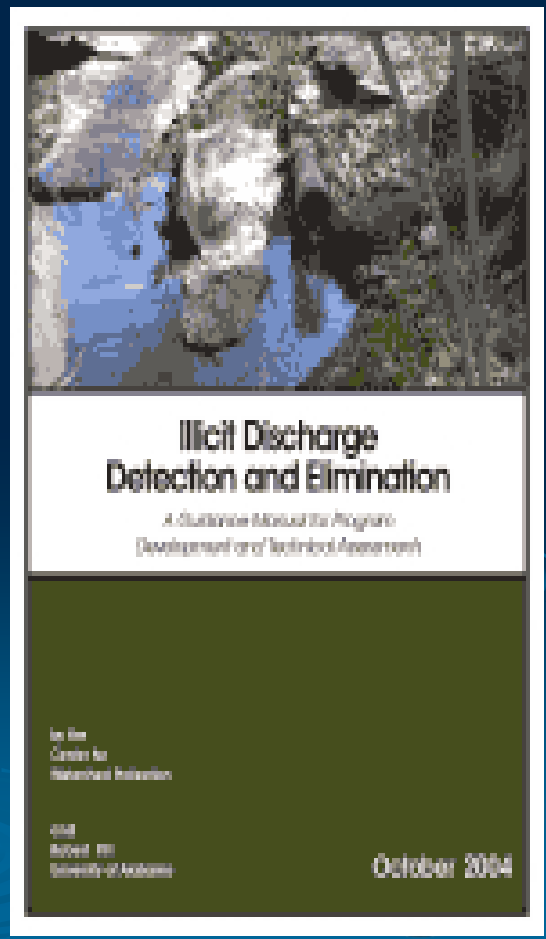
DRNA

What's Available

- Integrated Water Resources Management Plan (Plan de Aguas)
- Coastal Zone Management Plan: Coastal Nonpoint Plan
- CWA 319
- CZMA 6217
- SJBEP
- Coral Reef Intiative: Land Based Sources LAS
- Anasco-Mayaguez W'shed Program
- Jobos Bay SPA and RWA
- Summit to Sea intiative
- NRCS-DNER intiative
- Loiza River W'shed Management Plan
- TMDLs La Plata basin


Urban Subwatershed Restoration Manual Series
2
Methods to Develop Restoration Plans for Small Urban Watersheds
Version 2.0
August 2008
Center for Watershed Protection
Manual 2


Urban Watershed Forestry Manual
Conserving and Planting Trees at Development Sites


Illicit Discharge Detection and Elimination
October 2004

Puerto Rico LBS projects (Ongoing or completed)

- Training to marina operators
- Training to agronomists and farmers at various watersheds
- Training in septic tanks and waste water disposal techniques
- Guides: Coral Reefs Laws and Regulations
- Inventory of marina related sources of pollution
- GIS based Island-wide land use change analysis
- Watershed and coastal nonpoint pollution models and characterizations.
- Designation of coastal or marine natural reserves and MMA
- Training in storm water runoff and septic tanks maintanance and management (Center for Watershed Protection)
- Special Concern Areas and natural reserves management plans
- Hot spot and CNP critical areas identification, analysis, as well as signage development.
- Education and outreach workshops.

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 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
- Notice of termination (NOT): could be required with final report on plan implementation.

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

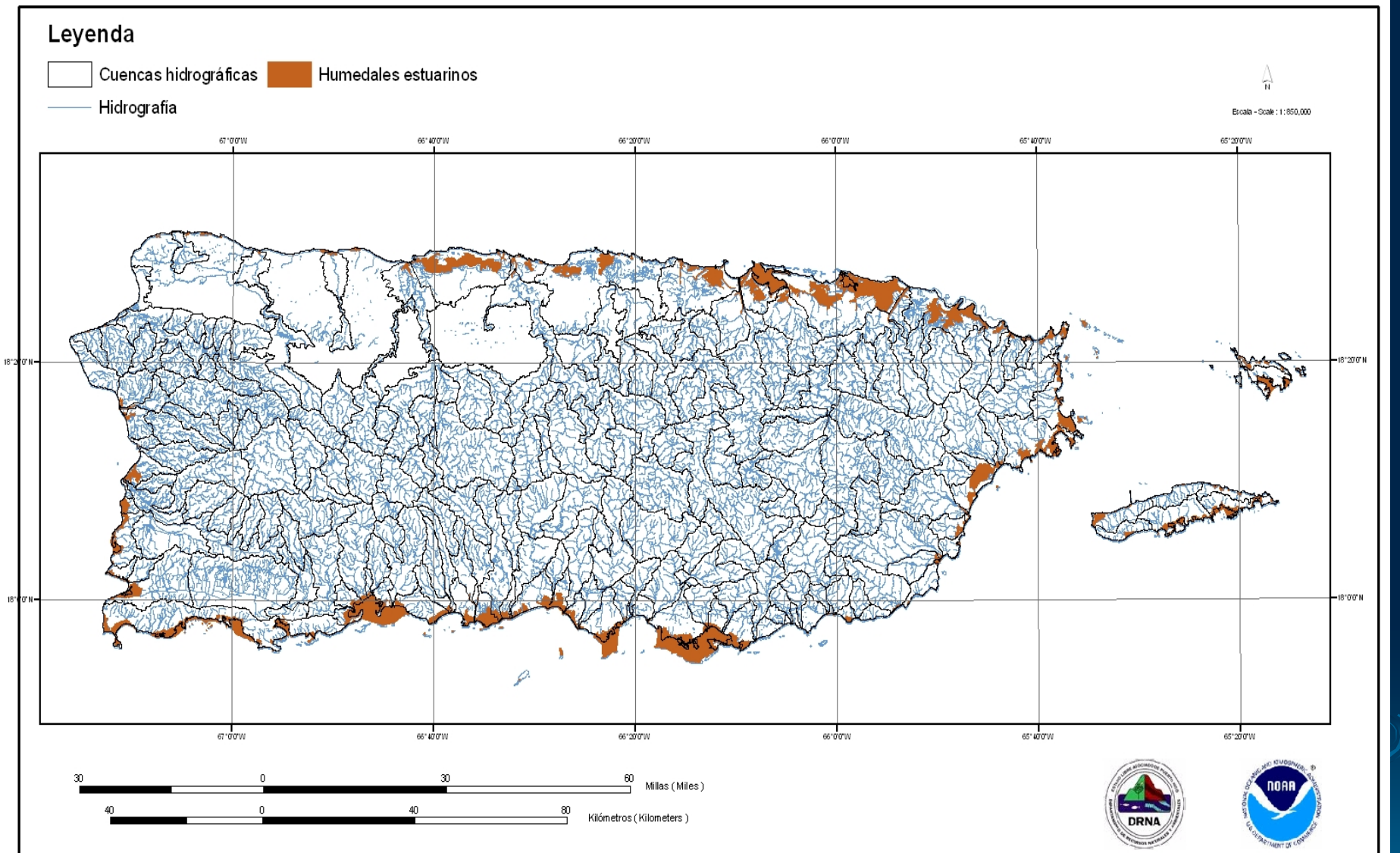
- Laws and regulations in Puerto Rico establish fines depending on the type of violation.
- Monitoring of the surface and receiving waterbodies clearly indicate that the fine system is not enough to reduce erosion and sedimentation.

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, coastal resource and MPA managers are natural partners,
  - and should work jointly with watershed managers and stakeholders to address erosion and sedimentation issues.
  - Suitable dredged material can be used beneficially in habitat restoration or creation.



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