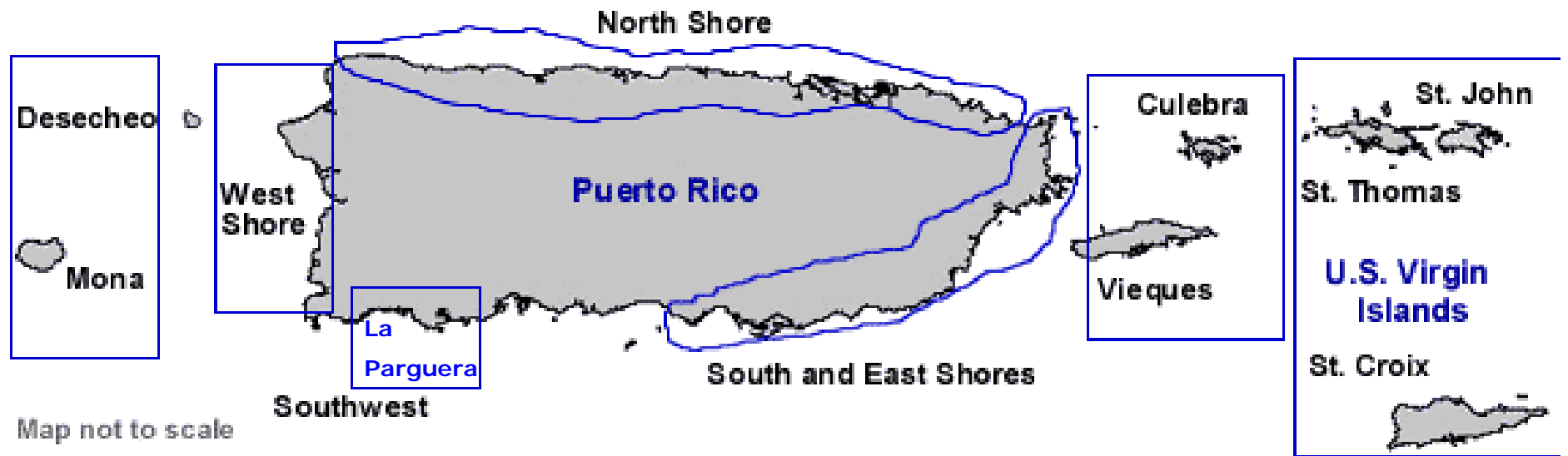


Making the connections with the human dimension of coral reef conservation in Puerto Rico: The CSCOR-Coral Reef Ecosystem Studies Program and the Caribbean Coral Reef Institute

Manuel Valdes Pizzini
Interdisciplinary Center for Coastal Studies
University of Puerto Rico at Mayaguez



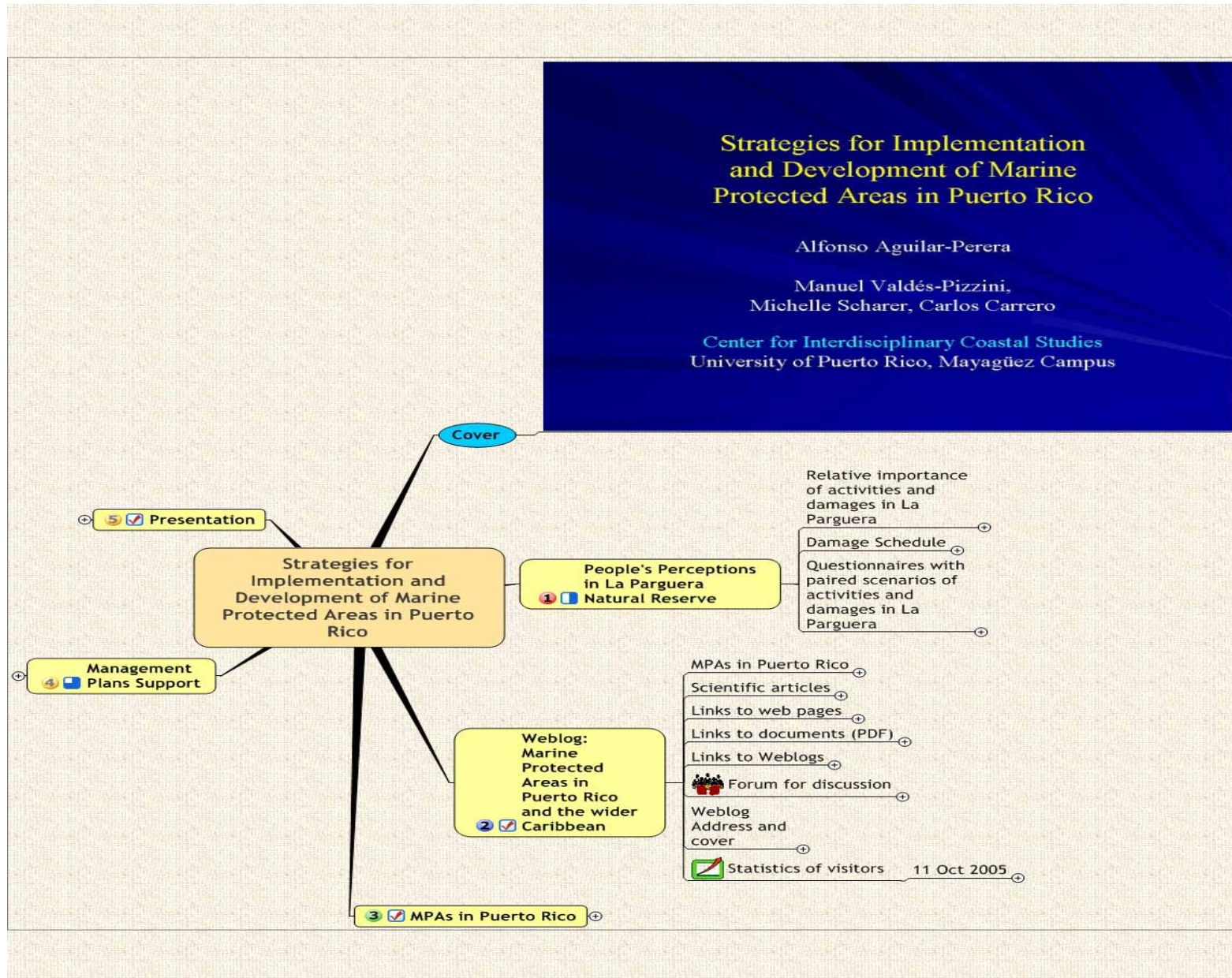


CRES La Parguera



- **Ecosystem based approach**
- **Models for conservation**
- **Socioeconomic component**
 1. **Human uses**
 2. **Connectivity**
 3. **MPA and social models**

Caribbean Coral Reef Institute CCRI UPR-M

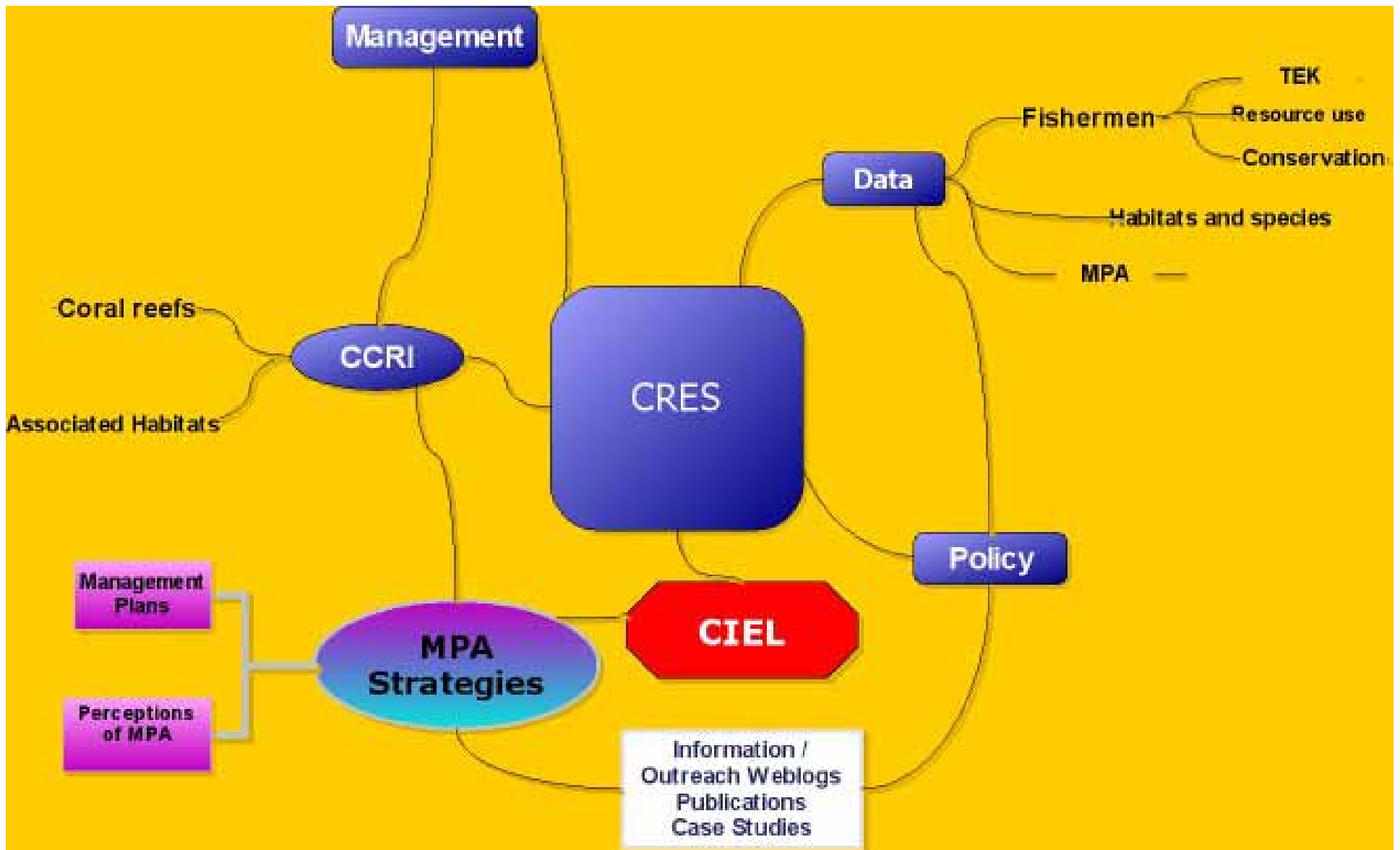


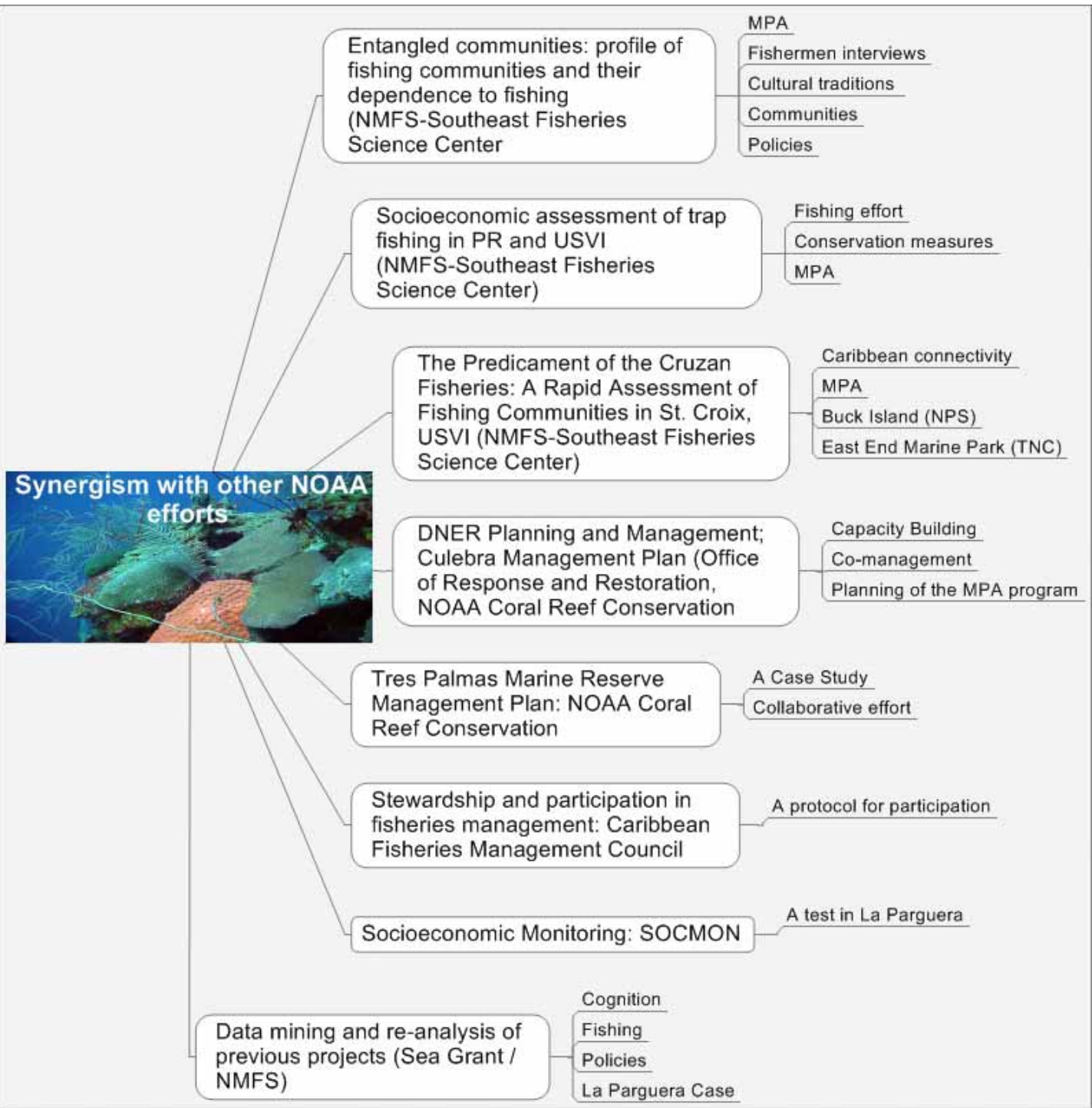
MPA of Puerto Rico



Legend

Reserva Isla Descabezo	Ext. Marina Reserva Natural Punta Petrona	Reserva Natural Caño Martín Peña
EE de Aguirre	Ext. Marina Reserva Natural Punta Yeguas	Reserva Natural Caño Tiburones
EE de Ceiba	Mona	Reserva Natural Cueva del Indio
EE de Piñones	Reserva Marina Tres Palmas	Reserva Natural Espíritu Santo
CFMC_NIZ Seasonal	Reserva Nacional Estuarina Bahía de Jobos	Reserva Natural La Parguera
Ext. Marina E.N. Bahía Ecológico de Vieques	Reserva Natural Arrecifes La Cordillera	Reserva Natural Pantano de Cibao
Ext. Marina Reserva Natural Boqueron	Reserva Natural Arrecifes Toumaline	Reserva Natural Punta Petrona
Ext. Marina Reserva Natural Cabezas de San Juan	Reserva Natural Arrecifes de Chayama	Reserva Natural Punta Tuna
Ext. Marina Reserva Natural Cueva del Indio	Reserva Natural Bahías Ecológicas de Vieques	Reserva Natural Punta Yeguas
Ext. Marina Reserva Natural Espíritu Santo	Reserva Natural C.L. Peña	Reserva Natural del Bosque Estatal de Boqueron
Ext. Marina Reserva Natural Hacienda La Esperanza	Reserva Natural Caja de Muertos	Zona de No Pesca Mona
Ext. Marina Reserva Natural Isla Caja de Muertos	Reserva Natural Cayo Estones y Aguas Adyacentes	Zona de No Pesca Monito
Ext. Marina Reserva Natural Punta Guaniguala	Reserva Natural Caño Boquilla	Mona land





CRES Data Relevant to MPA Strategies

- Scientific, local and traditional ecological knowledge
- Perceptions and knowledge of fishes, marine organisms and ecosystems.
- Perceptions of management systems.
- Local knowledge of the health of coral reefs and associated organisms.
- Case studies of scientific, policy and management processes of MPA: Tres Palmas in Rincón, Canal Luis Peña in Culebra and the East End Marine Park in St. Croix.



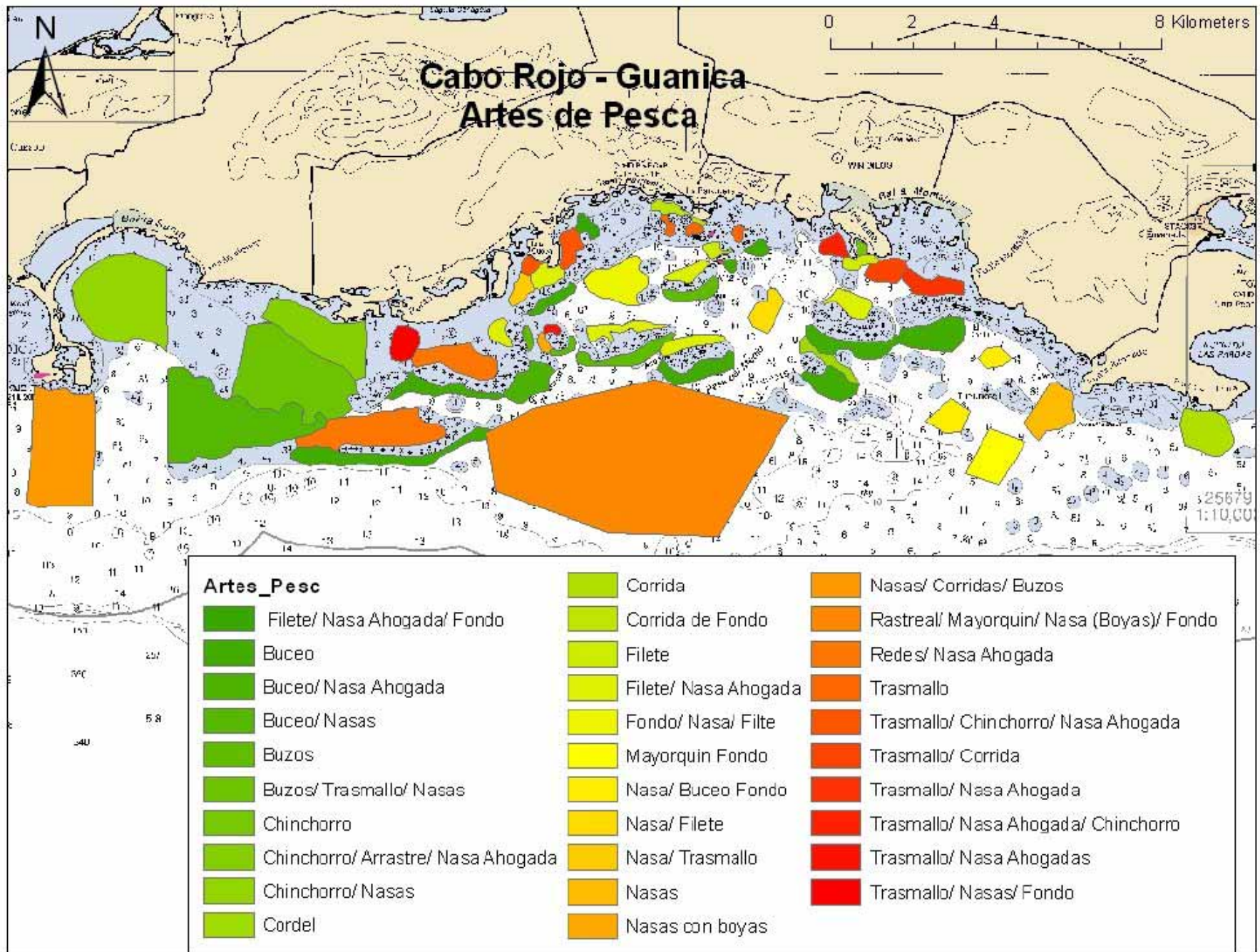
Data to support management decisions by Commonwealth, Federal agencies and NGOs:

- @ Maps of fishing activities and areas in La Parguera.**
- @ Maps of healthy reefs, and species of coral, based on the local knowledge of dive operators.**
- @ Revised maps of MPA in Puerto Rico.**
- @ Maps of activities, zoning and habitats for Culebra and Rincón.**
- @ Cognitive maps of habitats based on qualitative data (in preparation).**
- @ Network maps of trophic levels based on the Traditional Ecological Knowledge (TEK) of fishers**

Fishers views on one MPA

	Strongly Disagree*	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Maintains Spawning Aggregations	4.9	1.2	3.7	4.9	80.5	4.8
Improves quantity of fishes inside	6.1	1.2	2.4	7.3	75.6	7.3
Improves quantity of fishers in adjacent area	3.7	2.5	2.5	7.4	75.3	8.6
Protects species in vulnerable areas	6.1	2.4	2.4	6.1	79.3	3.6
Restores or maintains habitat quality	9.8	4.9	0	6.1	75.6	3.6
Creates problems for my family and myself	42.7	8.5	11.0	7.3	26.8	3.6
Creates problems for communities	17.1	7.3	14.6	7.3	47.6	5.1
Creates employment / investment opportunity	31.3	5.0	11.3	3.8	25.0	23.9

Mapping Fishing Areas



Incorporating Fishermen's Traditional Knowledge into Geographical Information Systems

Manuel Valdes-Pizzini¹, Idelfonso Ruiz-Valentin¹, Michelle T. Schärer¹, William Hernández²
 1- Interdisciplinary Center for Coastal Studies, University of Puerto Rico, Mayagüez Campus.
 2- U.S. Fish & Wildlife Service, Caribbean Islands NMR, Cabo Rojo, Puerto Rico.



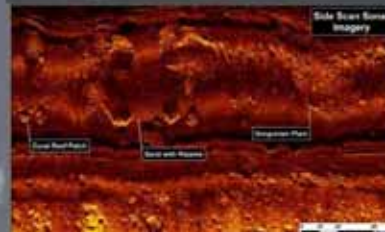
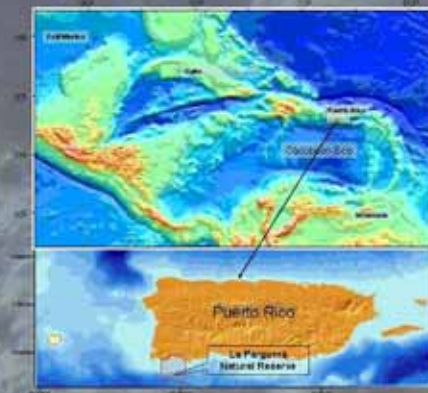
Spatial display of Fishermen's Ecological Knowledge

Environmental social scientists are increasingly realizing the critical importance of geographical information systems (GIS) in studying the diverse spatio-temporal dimension of human-environmental relationships (Aldenderfer and Mascher, 1996; Conant, 1994) and in employing such knowledge to design and implement resource management strategies (Bowman et al. 2004).

This poster presents the results of an interdisciplinary effort (social sciences and oceanography) in mapping fishing activities. Here we incorporate a GIS database and socio-spatial information, such as local fisherman's Traditional Ecological Knowledge (TEK) and artisanal fishing data (based on field observations of fishing effort) to determine the distribution of fishing effort within the MPA.

Fishers identified a number of fishing grounds and demarcated sites on the map. Fishing grounds are composed of areas (polygons) or floating spots (point) that are represented in the center figure.

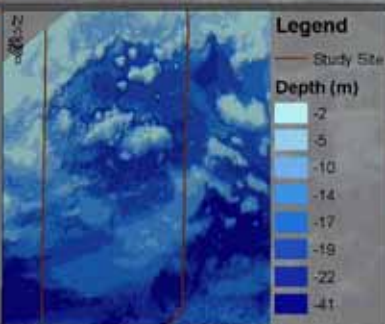
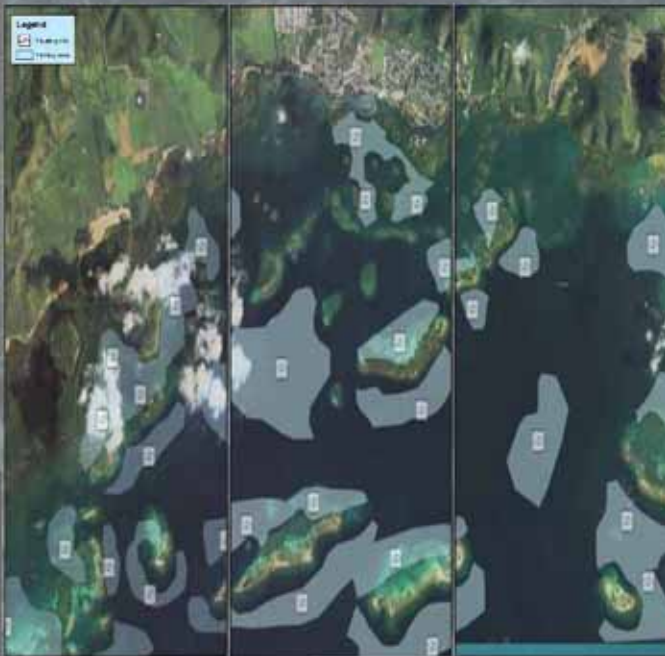
Study site



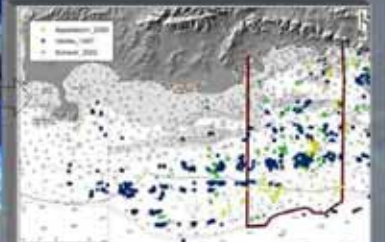
A detailed benthic habitat map was generated over a 99 km² area of La Parguera Natural Reserve. A 500 kHz side scan sonar was used to collect 8.15 m resolution imagery that was digitized with the NOAA habitat digitizer extension in Arc View (version 3.2). Twenty one benthic habitats were classified based on visual interpretation at a 4 m² maximum mapping unit.

National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science Biogeography Program, 2001. Benthic Habitats of Puerto Rico and the U.S. Virgin Islands. CD-ROM. Silver Spring, MD: NOAA.

Prada, Martha C. 2001. Mapping Benthic habitats of southwestern Puerto Rico as determined by side scan sonar. PhD Dissertation, University of Puerto Rico, Mayagüez Campus.



Using the 3D Analyst extension, a TIN was created from 48 m of resolution bathymetry transfer to shapefile (points) of La Parguera. This TIN was used to provide a visualization of the bottom contour to obtain the slope of the study area.



The position of each fish trap was collected in the field with handheld GPS. The coordinates for each trap were plotted in Arc View (version 3.1) through time. Data for this layer are from the following source:

Appeldoorn R.S., M. Nemeth, J. Vazquez, and M. Schärer, 2005. The Effect of Fish Traps on Benthic Habitats Off La Parguera, Puerto Rico. Report to the Caribbean Fishery Management Council, Hato Rey, Puerto Rico.

Schärer, M. T., M. C. Prada, R. S. Appeldoorn, R. Hill, P. Skelton and M. Valdes-Pizzini. 2002. The use of fish traps in Puerto Rico: current practice, long-term changes, and fishery perceptions. Proceedings of the 35th annual Gulf and Caribbean Fisheries Institute, pages 744-754.

Valdes-P. 2006. M., J. M. Pineda, K. Drove and M. Rosado. 197. Mapping Fishing Grounds Using Global Positioning System (GPS) Tackle tags. Proceedings of the Gulf of Caribbean Fisheries Institute 49:123-130.



Benthic Habitat and Zone Maps of Puerto Rico, was prepared by National Oceanic and Atmospheric Administration in 1993. This layer are applied for the descriptions of where they are fishing inside of the reserve and how this used zones change between months.



Acknowledgements

Thanks to the fishermen of La Parguera, for providing the data used in this study. Research for this study was supported by the University of Puerto Rico Sea Grant Program, and the analysis by the Puerto Rico Coral Reef Ecosystems Studies program (NOAA).

Local Ecological Knowledge: Diving Operators and the Health of Coral REeefs

Coral species reduced in coverage and their location

Species	Common name	Location
<i>Diplora strigosa</i>	Brain coral (7)*	Cayo Ratones, Escollo El Negro, El Natural, La Parguera
<i>Acropora palmata</i>	Elkhorn coral (5)	Turrumote, Escollo El Negro, Desecheo Island, La Parguera
<i>Gorgonia</i> sp.	Sea fans (3)	El Natural and Desecheo Island
<i>Acropora cervicornis</i>	Staghorn coral (3)	La Parguera, Mona Island, Desecheo Island and Escollo El Negro
<i>Porites porites</i>	Finger coral (2)	Las Cuevas and Fajardo
<i>Acropora</i> spp. (Species not specified)	Staghorn and Elkhorn coral	Cayo Ratones and Escollo El Negro
<i>Antipathes</i> spp.	Black coral	Guánica to La Parguera
<i>Porites astreoides</i>	Mustard hill coral	La Parguera
<i>Montastrea cavernosa</i>	Great star coral	La Parguera
<i>Millepora complanata</i>	Fire coral	Las Cuevas and Crashboat

Reefs visited the most by SCUBA Diving Operators and Instructors

Reef site	%
Escollo El Negro	11
El Tourmaline	8
Desecheo Island	8
El Ron	5
Fallen Rock	5
Turumote I	5
Mona Island	5
El Natural (Crashboat)	5
Cayo Enrique	5
Playa Bajuras	3
Playuela	3
Monito	3
North of Punta Ensenada (Rincón)	3
Caracoles	3
Media Luna	3
Bajo Gallardo	3
El Faro (Cabo Rojo)	3
Manchas Negras	3
Sector Las Cuevas	3
Quebrada de los Cedros	3
The Black Wall	3
The Hatchery	3
Los Pozos	3
Pablo	3

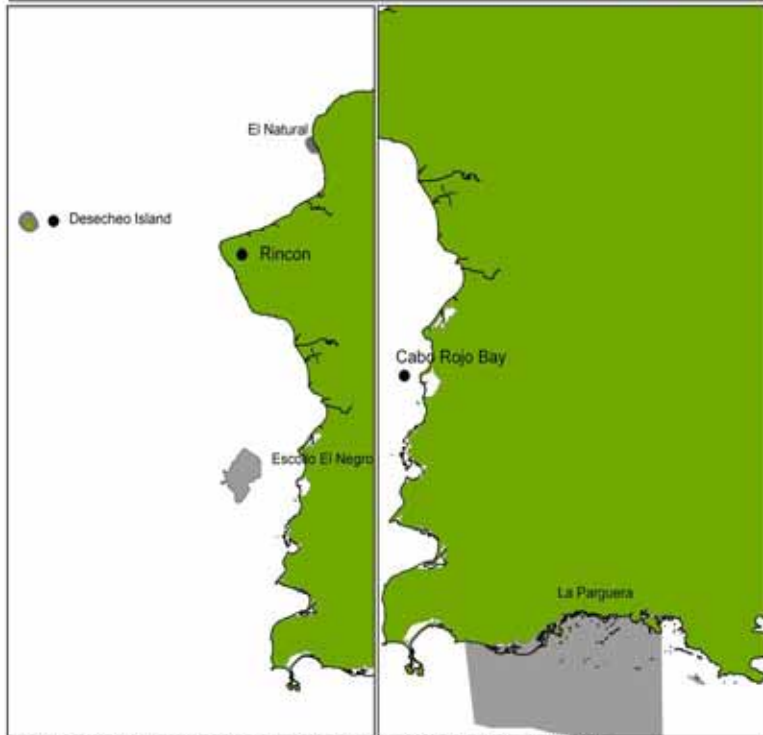


Figura 7. *Acropora palmata* species reduced in terms of coverage and the location.

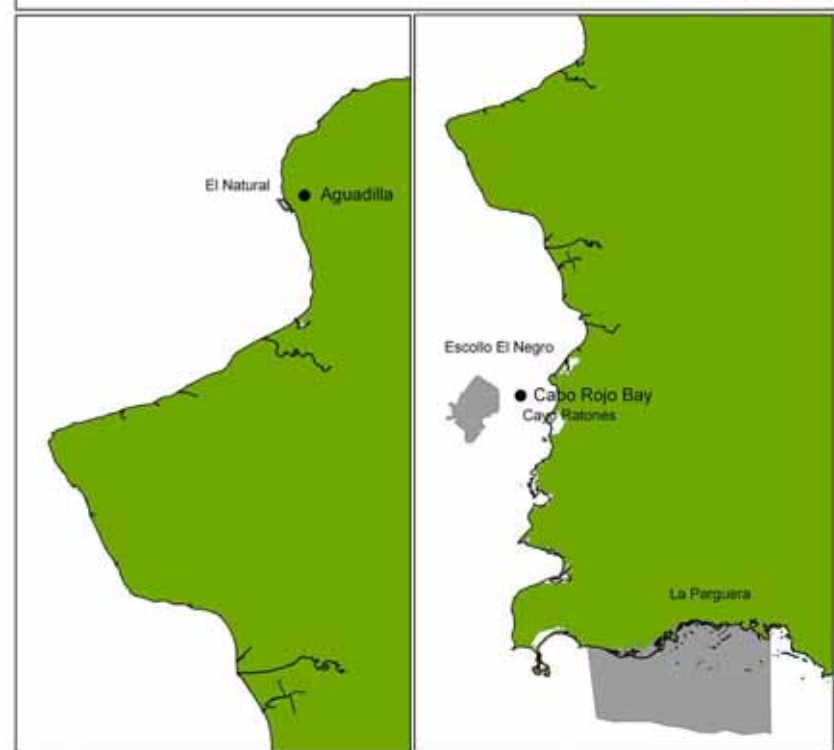
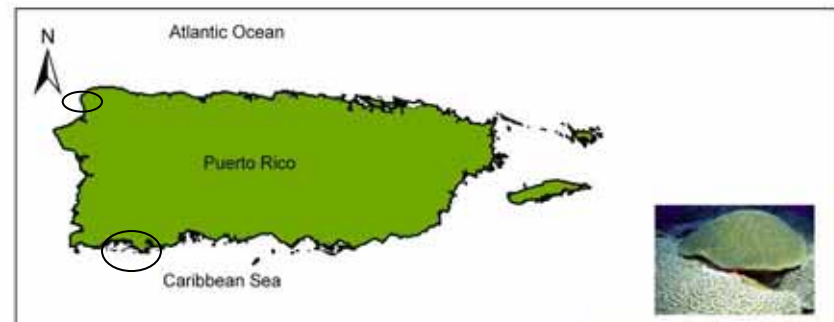
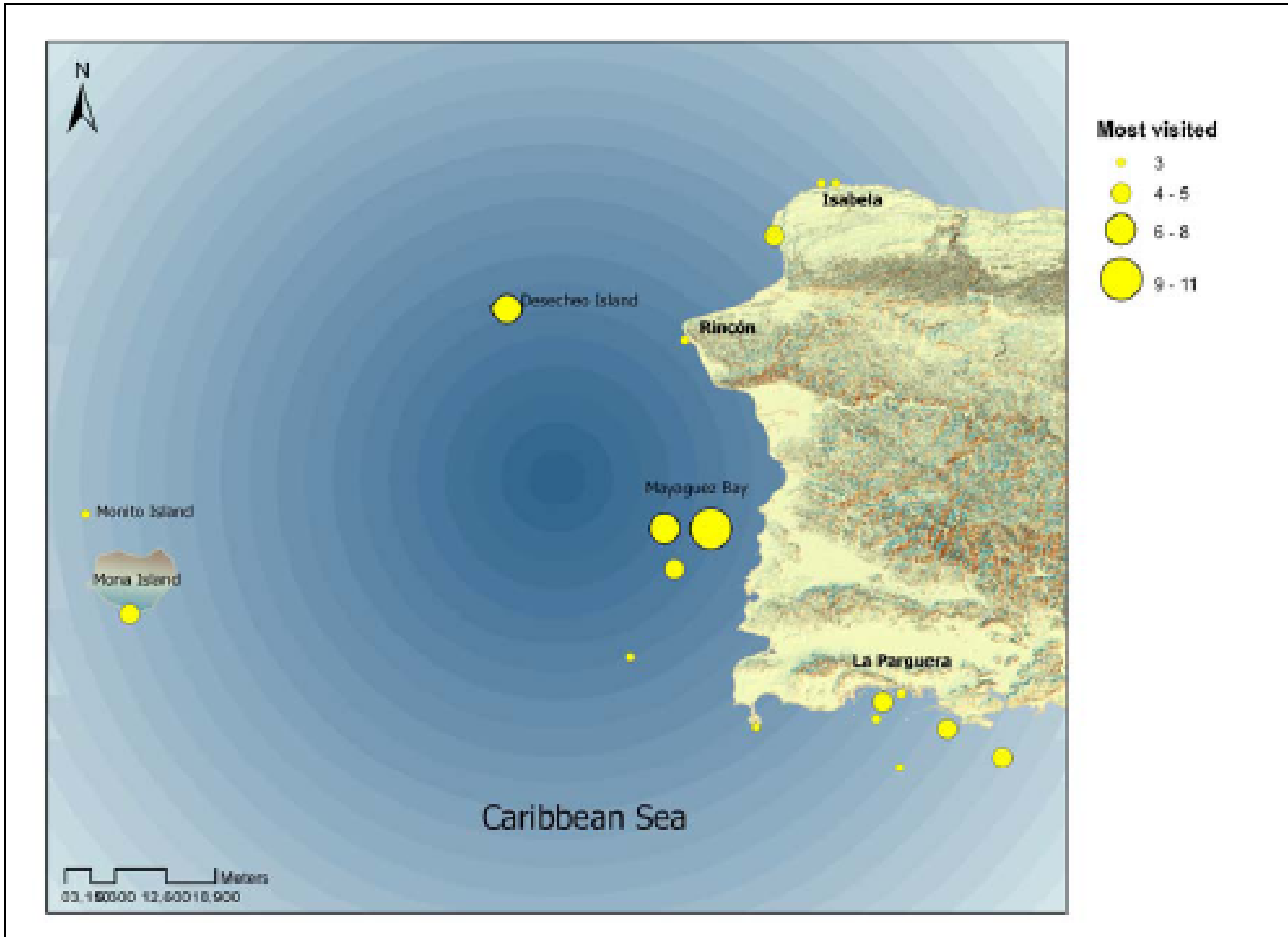


Figura 7. *Diploria strigosa* species reduced in terms of coverage and the location.



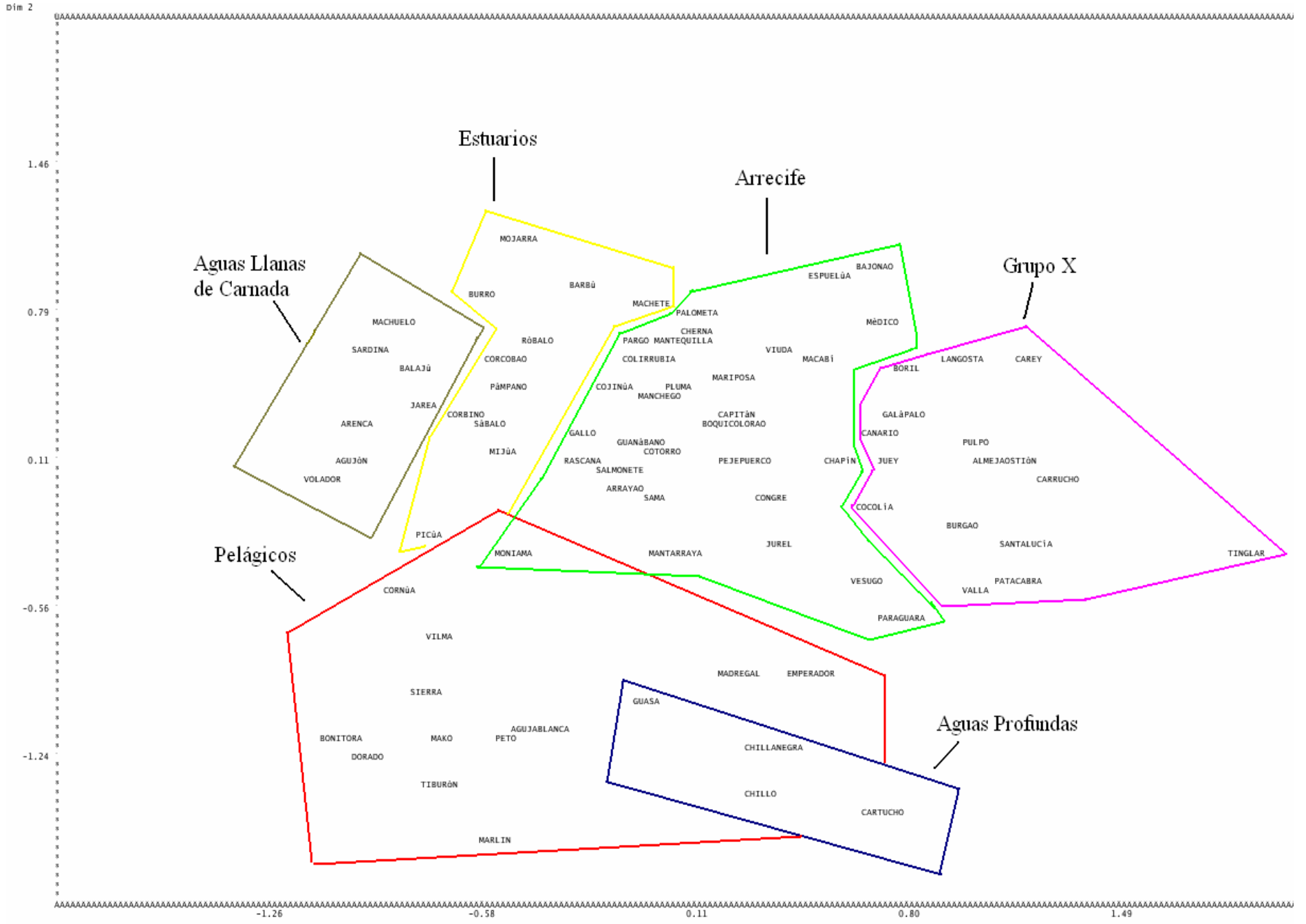
Traditional Ecological Knowledge: Fishers' Cognition of Species

TEK

- Species and behavior
- Association of species and habitats
- Ontogeny
- Historical perspectives on habitats, species abundance and variability
- Assessment of the stocks
- Role of MPA
- Alternatives to MPA



Figure 6.2. The Spotted goatfish (*Salmonete*, '*salmonete colora'o*'). *Pseudupeneus maculatus*, Mullidae (Photo from Humann 1994).



Stress in 2 dimensions is 0.215

Social models on the human dimension

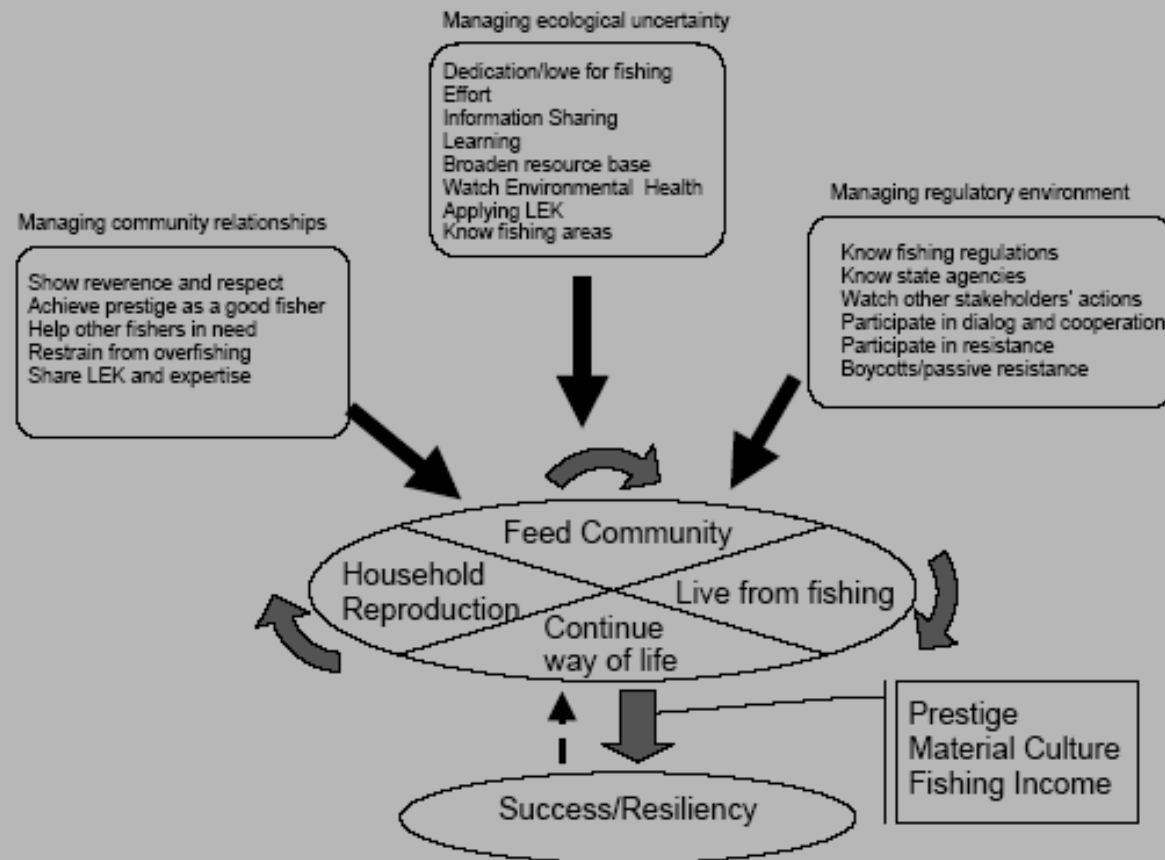
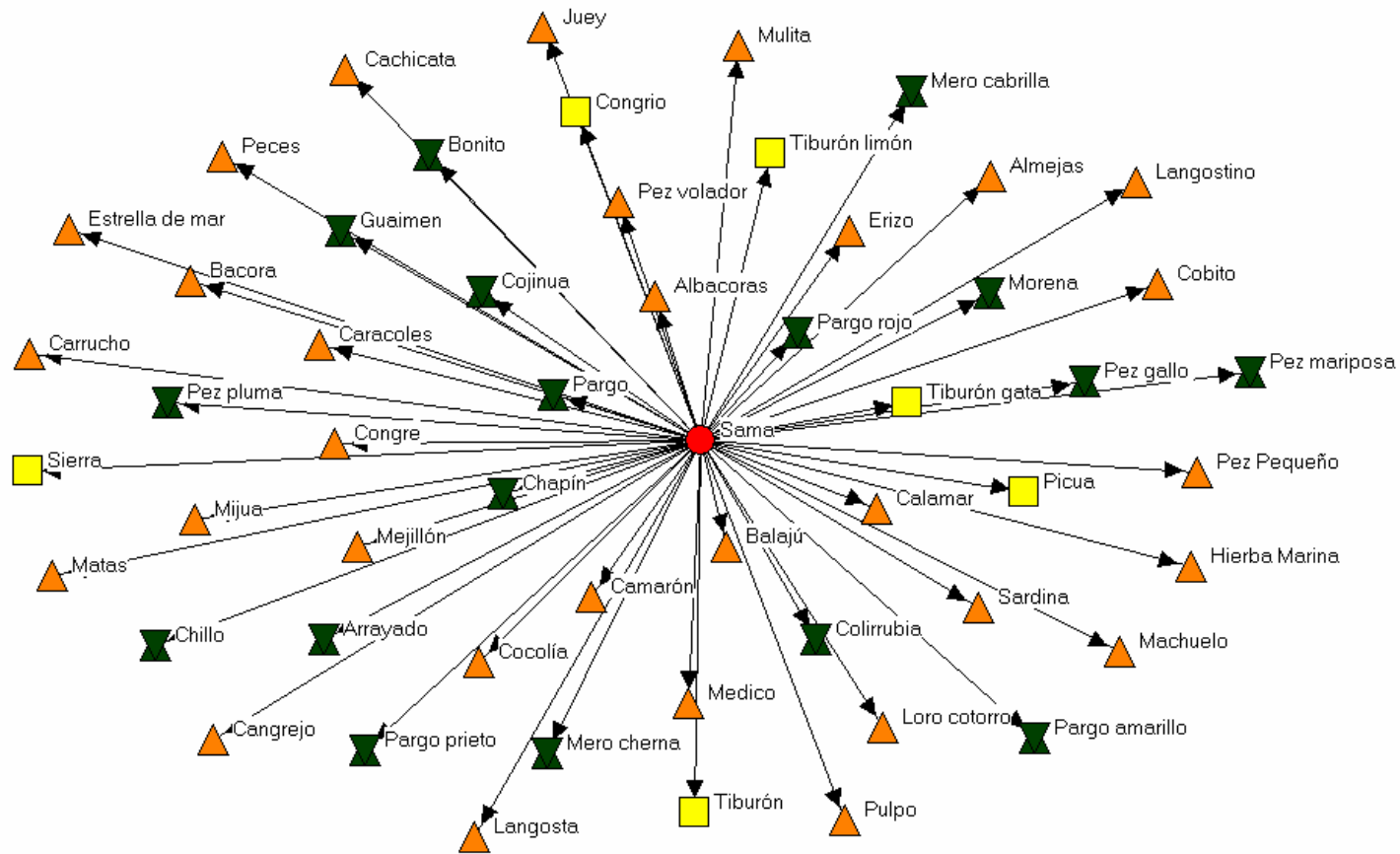
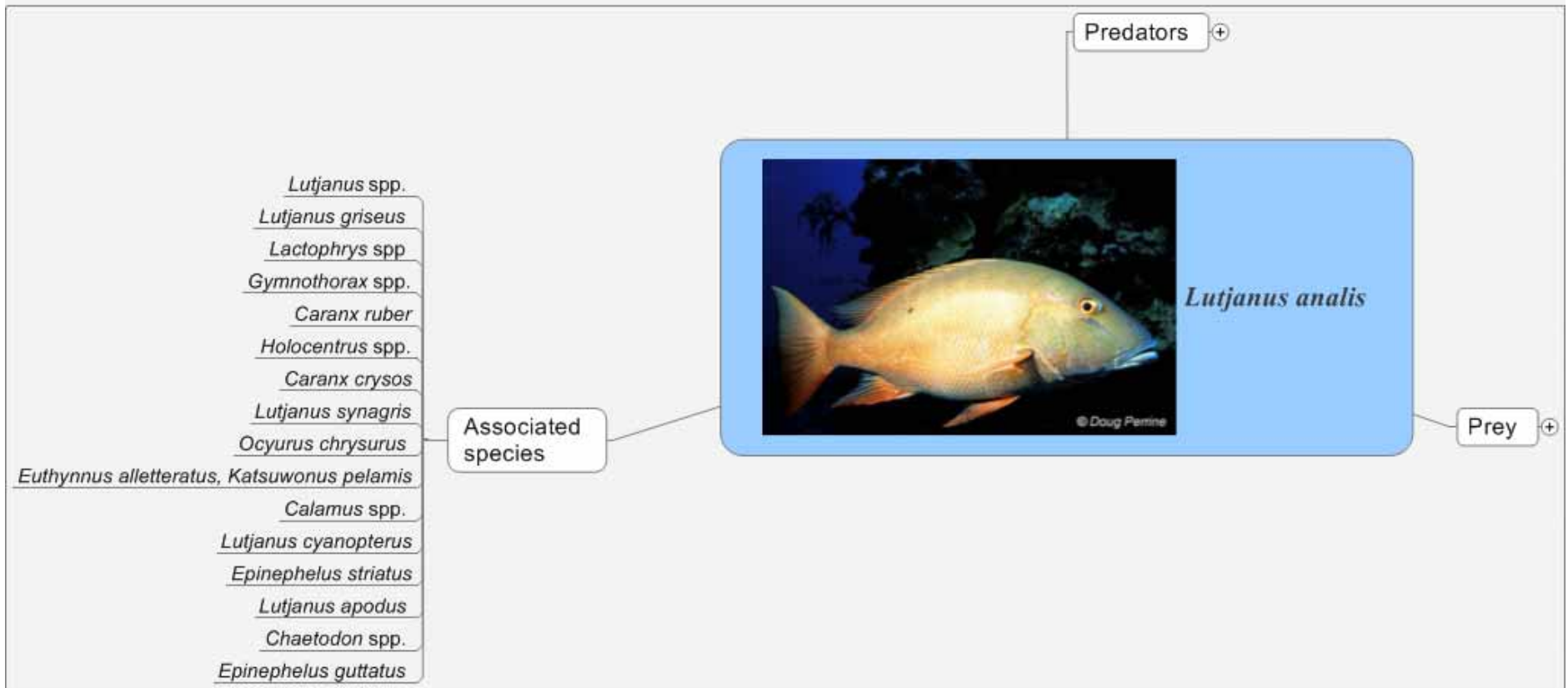


Figure 4.10. Schematic representation of the cultural model of success in fishing described by this research. By simultaneously managing ecological uncertainty, community relationships, and relationships with the regulatory environment, fishers increase their chances of accomplishing their goals, which are to make a living from fishing, to raise a family from fishing, to continue their way of life as commercial fishers, and to help feed their communities. Success is the product of the degree to which fishers achieve these goals. Resiliency is the degree to which fishers can continue to meet their goals over time in a changing environment. There are no clear-cut formulas for success, because the components of the cultural model are mutually-reinforcing. Success in managing one of the domains below will increase the capacity for success in the others.

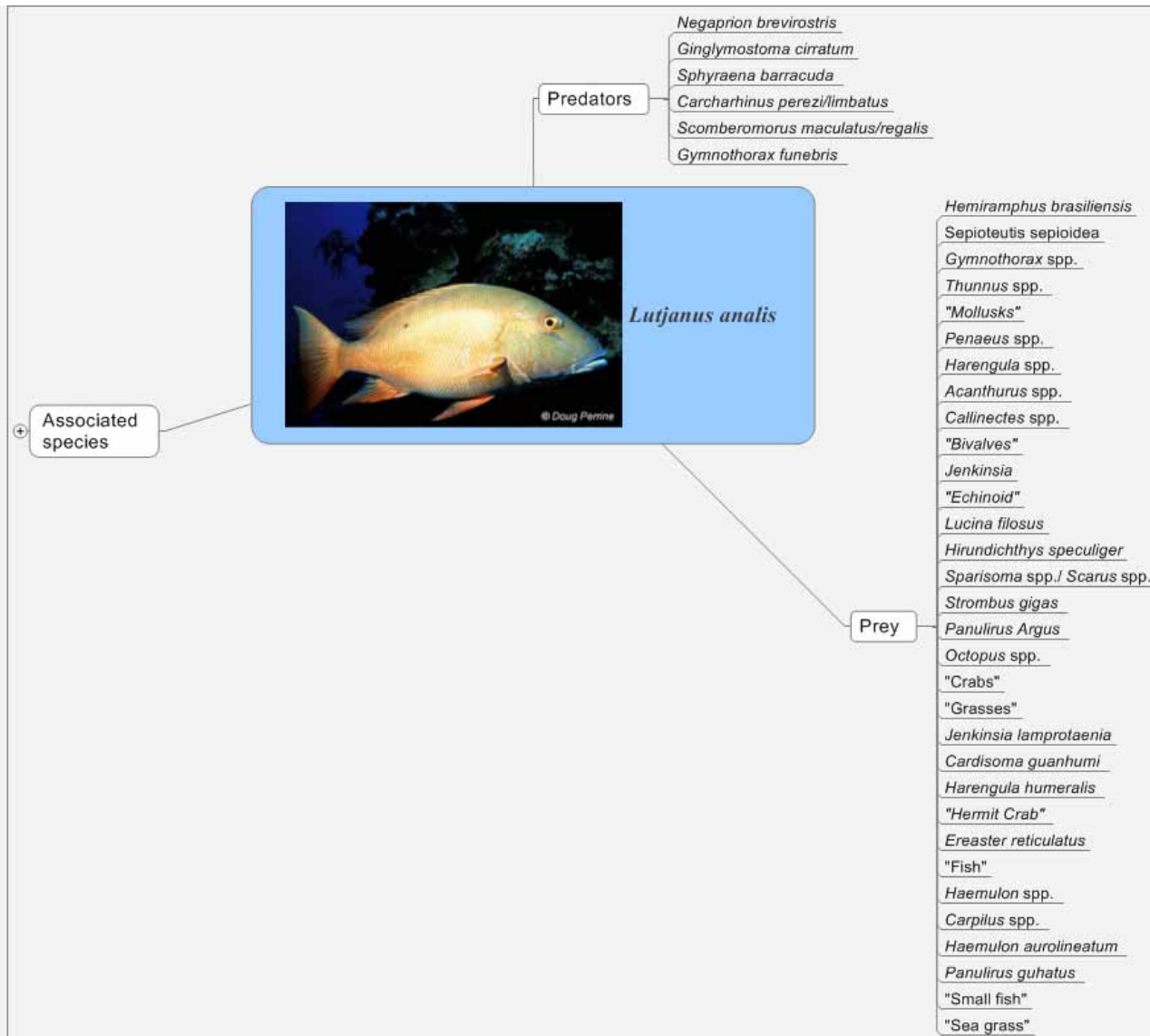
Lutjanus analis (Mutton Snapper, Sama)



Associated species



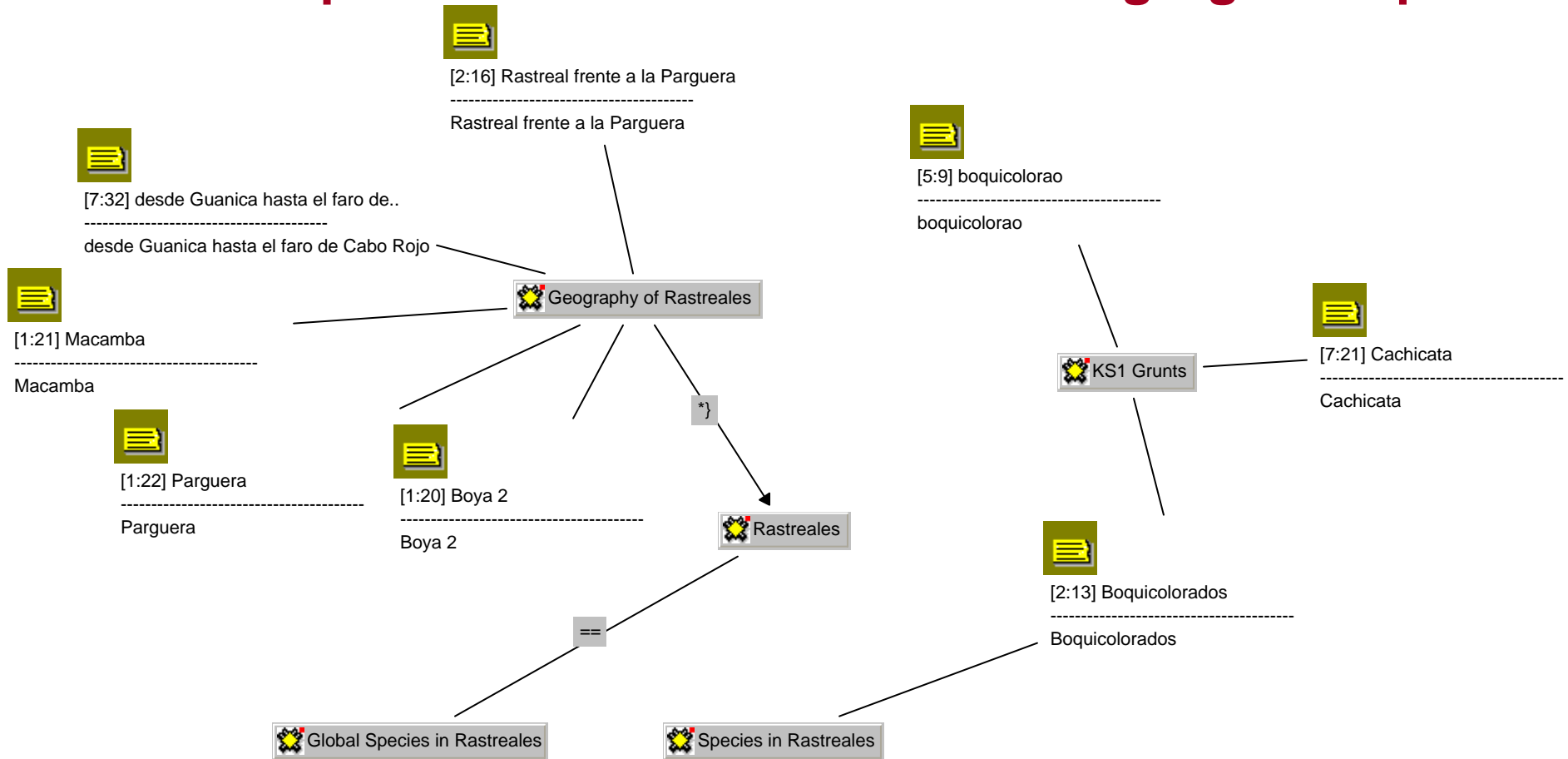
Predators and prey



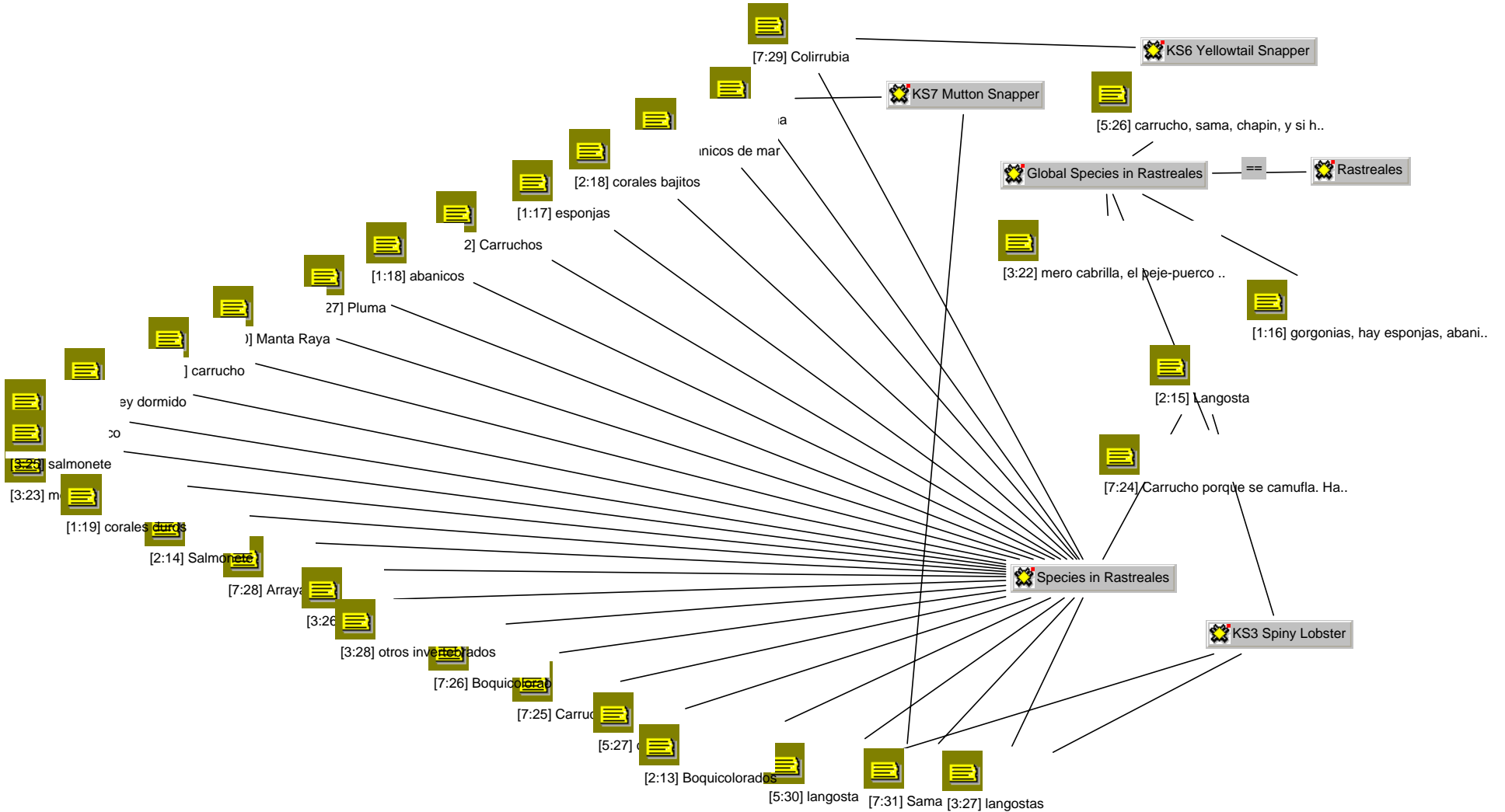
Traditional Ecological Knowledge: Fishers' Perceptions of Habitats

Rastreales

Colonized pavement – sand channels and gorgonian plains



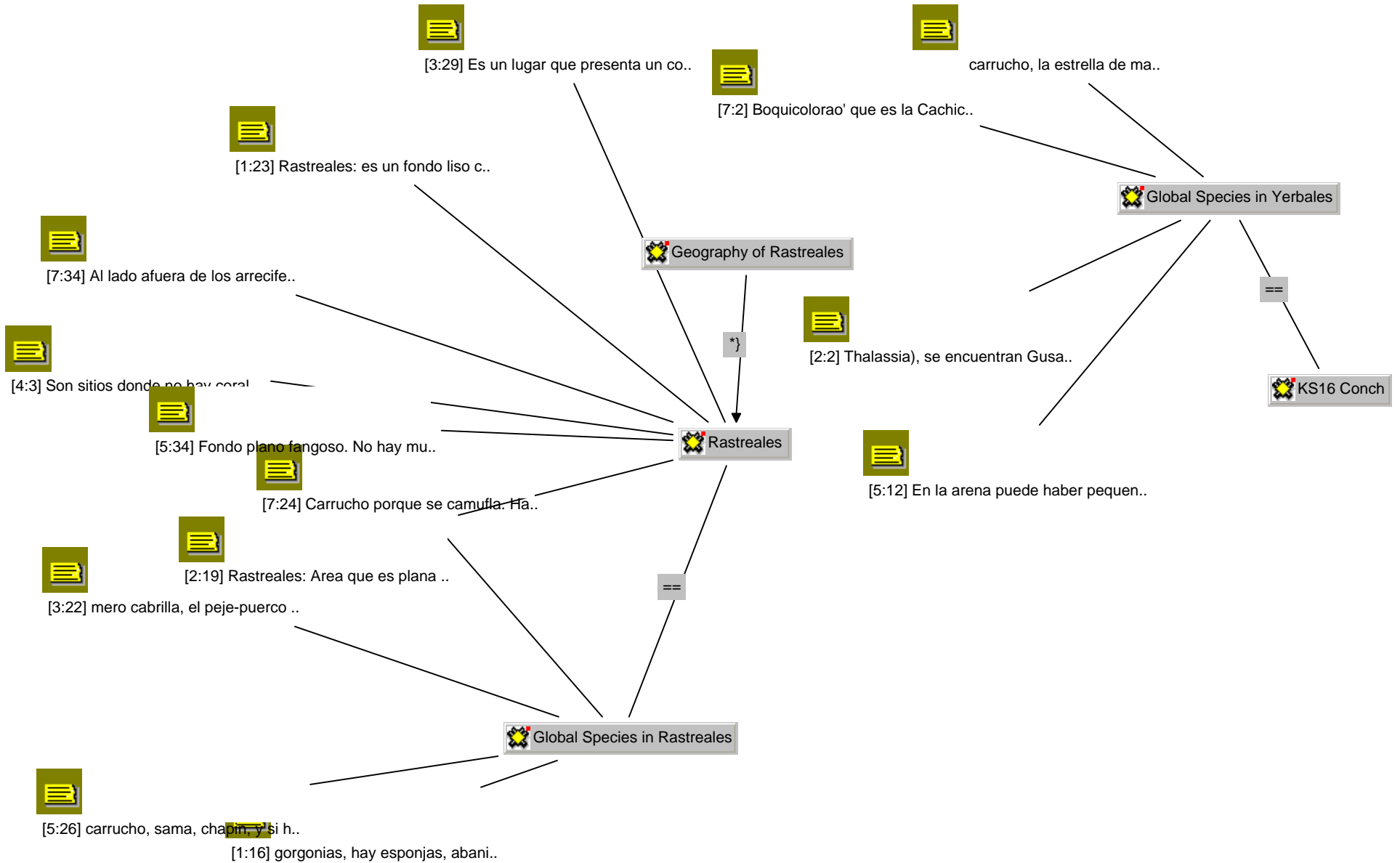
Species in Rastreales



Geography of yerbales

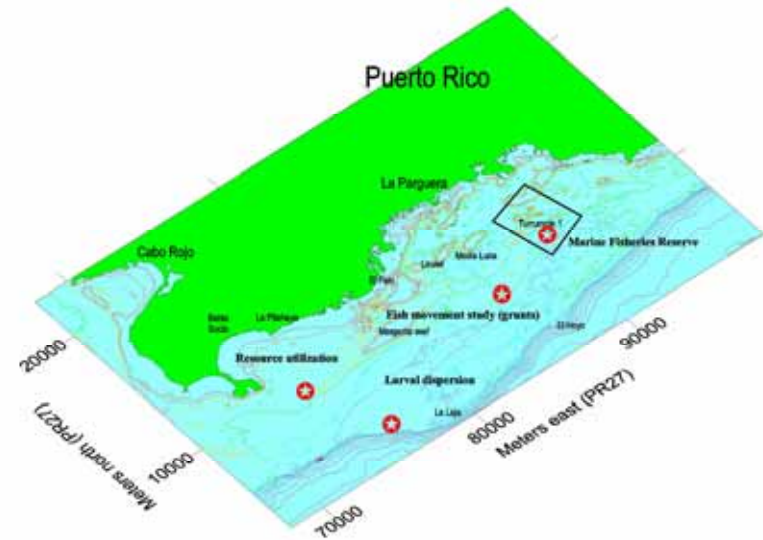
- 1:6 Pitahaya (22:22)
- 1:7 Boya 2 (22:22)
- 1:8 Punta Aguila (15:15)
- 1:9 el Bajo (15:15)
- 1:10 Bahia Salinas (14:14)
- 1:11 La Finca (18:19)
- 1:12 Los Tiburones (19:19)
- 1:13 Boya 8 (19:19)
- 1:14 Boya 6 (19:20)
- 2:3 Tres con Raya (16:16)
- 2:4 Maria Burdeo (16:16)
- 3:12 Las manchas (25:26)
- 3:13 El Negro (26:26)
- 3:14 Cayo Ron (26:26)
- 5:13 El yerbal que es de fideillo, .. (33:34)
- 5:17 Ventana (38:38)
- 5:18 Cayo El Rabon (38:39)
- 5:19 Playa Ballena (39:39)
- 5:20 Cana Gorda (39:39)
- 5:21 Punta de Brea (39:39)
- 5:22 El Encorcobado (39:40)
- 7:3 Bahia de Jobos (24:24)
- 7:4 Guayanilla (24:24)
- 7:5 Parguera esta llena de yerbale.. (24:24)
- 7:6 Combate (25:25)
- 7:7 Pitahaya (25:25)

Rastreales and yerbales



Case study: La Parguera

- ⊕ History of contentions and local claims
- ⊕ Process and lack of incorporation of stakeholders
- ⊕ Assumptions and questions on MPA
- ⊕ Patterns of resource use
- ⊕ Co-management ahead of time
- ⊕ Local politics
- ⊕ Environmental justice and coastal development



Case study: St. Croix

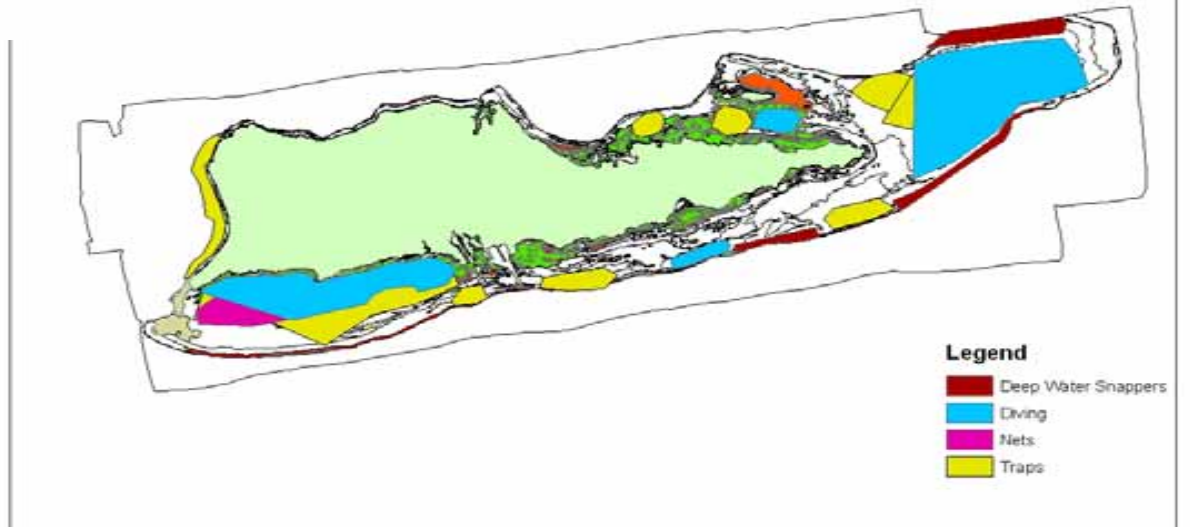
- ⊕ Array of management measures
- ⊕ Status of coral reefs and water quality
- ⊕ Increment in the number of MPA and fishers' displacement
- ⊕ Partial incorporation of stakeholders in the consulting process
- ⊕ Ethnicity, language and management
- ⊕ Territorial vs. Federal efforts
- ⊕ Role of Conservation NGO



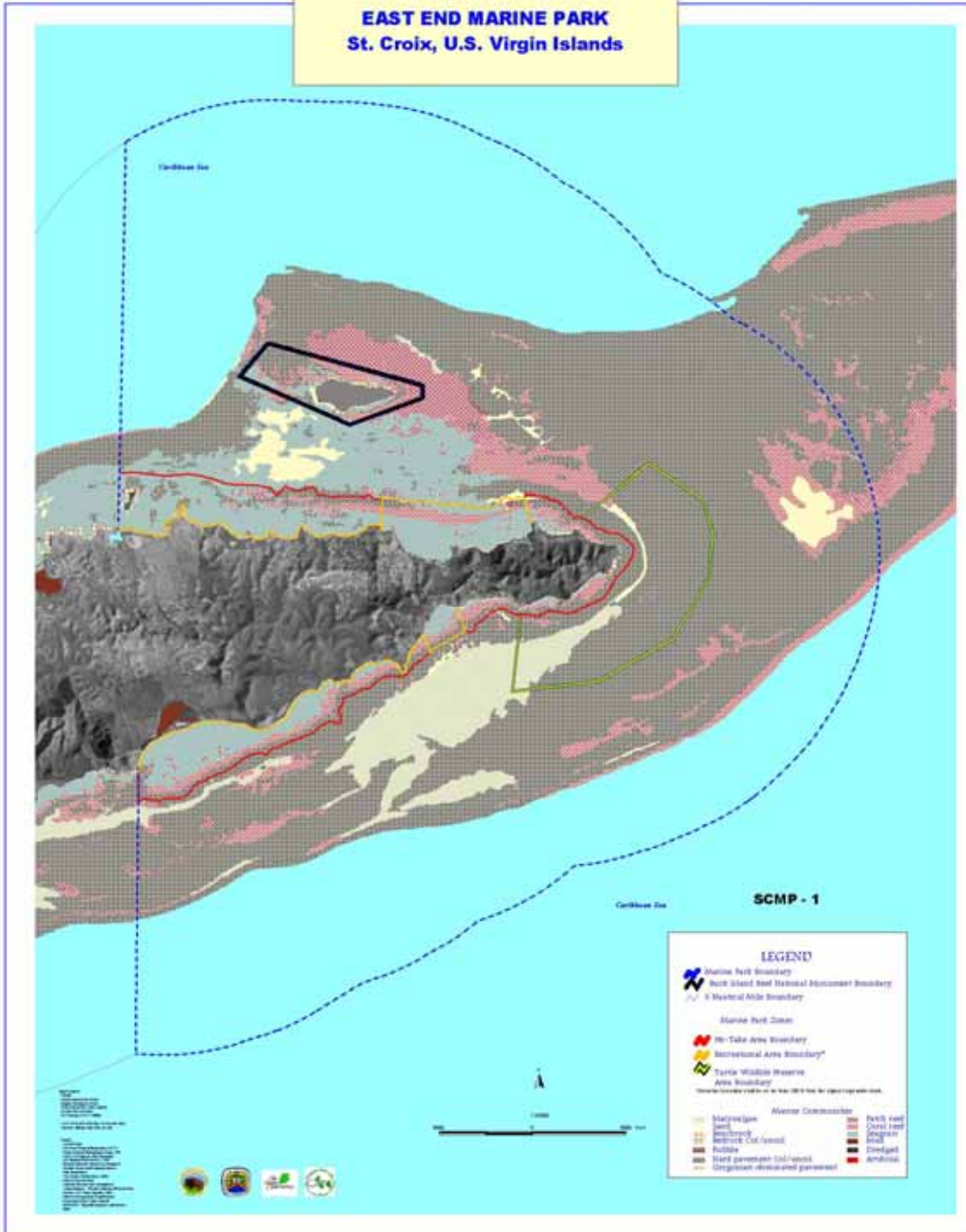
Map of St. Croix Marine Protected Areas



Fishing Areas by Gear



EAST END MARINE PARK
St. Croix, U.S. Virgin Islands



SCMP - 1

LEGEND

- Marine Park Boundary
- North Island Reef National Monument Boundary
- National Atoll Boundary

Marine Park Zones

- No-Take Area Boundary
- Recreational Area Boundary
- Turtle Wildlife Reserve Area Boundary

Marine Park Zones are shown in the map for informational purposes only.

Marine Communities

Mangrove	Patch reef
Sand	Coral reef
Sponges	Seagrass
Mollusk, Oct./Insect	Hard bottom
Rubble	Deepgas
Hard pavement (oil/wood)	Artificial
Organic pavement	

Map prepared by the U.S. Virgin Islands Department of Environmental Protection, 2010. All rights reserved. This map is for informational purposes only. It is not to be used for navigation or other purposes. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any errors or omissions in this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any damages or losses resulting from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any claims or liabilities arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any legal actions or proceedings arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any consequences or results arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any actions or inactions arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any decisions or judgments arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any outcomes or results arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any effects or impacts arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any changes or modifications arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any updates or revisions arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any deletions or removals arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any additions or insertions arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any alterations or changes arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any corrections or amendments arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any supplements or addendums arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any annexes or attachments arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any enclosures or inclusions arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any references or citations arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any footnotes or endnotes arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any appendices or supplements arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any glossaries or indexes arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any tables or figures arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any charts or diagrams arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any forms or tables arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any lists or tables arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any indexes or tables arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any tables or figures arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any charts or diagrams arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any forms or tables arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any lists or tables arising from the use of this map. The U.S. Virgin Islands Department of Environmental Protection is not responsible for any indexes or tables arising from the use of this map.



**Policy and management
applications
of the data:**

Practical lessons learned about MPA development and implementation

- Case studies
- A well structured plan
- Capacity building for co-management
- History: consumption, labor, policies, regional processes
- Resource use and traditional ecological knowledge (TEK)
- Policy and institutional arrangements
- Language and concepts
- Identification of stakeholders, issues and problems
- Appropriate forms of engagement
- Engagement of the community through education
- Connectivity: human, ecosystems and management

First Draft of the Management Plan for the Luis Peña Marine Reserve (a no-take reserve) in Culebra. In collaboration with Sea Grant, DNER, the municipality and the local NGOs.

Plan de Manejo de la Reserva Natural Canal Luís Peña, Culebra

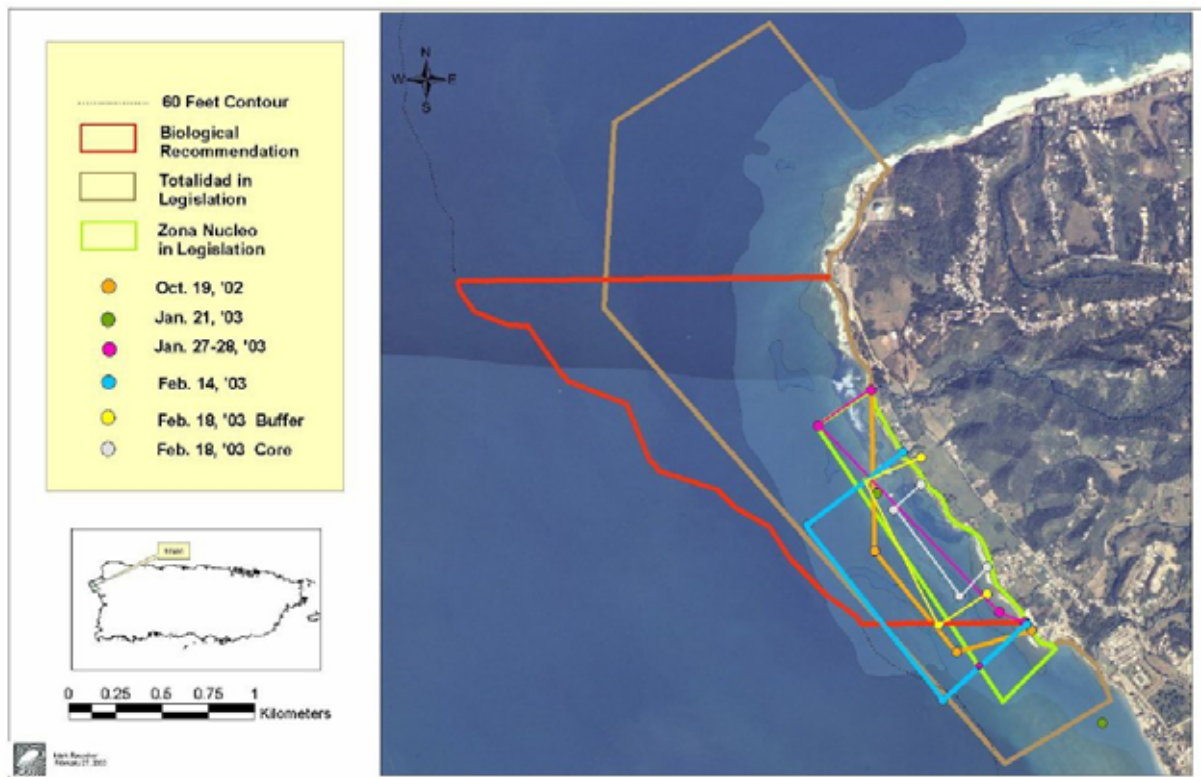


Documento base para el plan de manejo
Primer Borrador

Culebra, Puerto Rico
Octubre 28 de 2005



A Participatory Process for the Development of the Management Plan for Tres Palmas Marine Reserve in Rincón (version 3 of the plan is on its way). In collaboration with Surfrider Foundation, Sea Grant, DNER, the municipality and the local NGOs.



Reserva Marina Tres Palmas - Rincón, Puerto Rico



A bilingual (Spanish and English) web log on MPA in Puerto Rico and the conservation of coral reefs and the local fisheries: <http://www.amp-pr.org/blog> (supported by CCRI and the College of Arts and Sciences, UPR-Mayagüez, data from CRES).

Áreas Marinas Protegidas en Puerto Rico y el Gran Caribe

Ventana hacia el arrecife coralino / Window into the coral reefs
February 14th, 2006



Publicado por Alfonso Aguilar-Perera

Si desea echar una Mirada al arrecife coralino en tiempo real y durante el día, puede visitar este [enlace](#); cortesía del [Instituto Perry para la Ciencia Marina](#), en Las Bahamas. Este Instituto , con sede en Florida y con una estación biológica en Las Bahamas, desde 1970, está hacienda y apoyando investigación científica y educación innovadora en pro de los arrecifes coralinos.

If you like to take a look at the coral reef in real time and during daylight, you may visit this [link](#); courtesy of the [Perry Institute for](#)

1 visitor online



now online
PUERTO RICO
February 2006

Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

<< Jan



**CENTRO INTERDISCIPLINARIO
DE ESTUDIOS DEL LITORAL**