Coral Reef Ecosystem Studies

Integrating Science & Management in the Caribbean

Institutional Partners

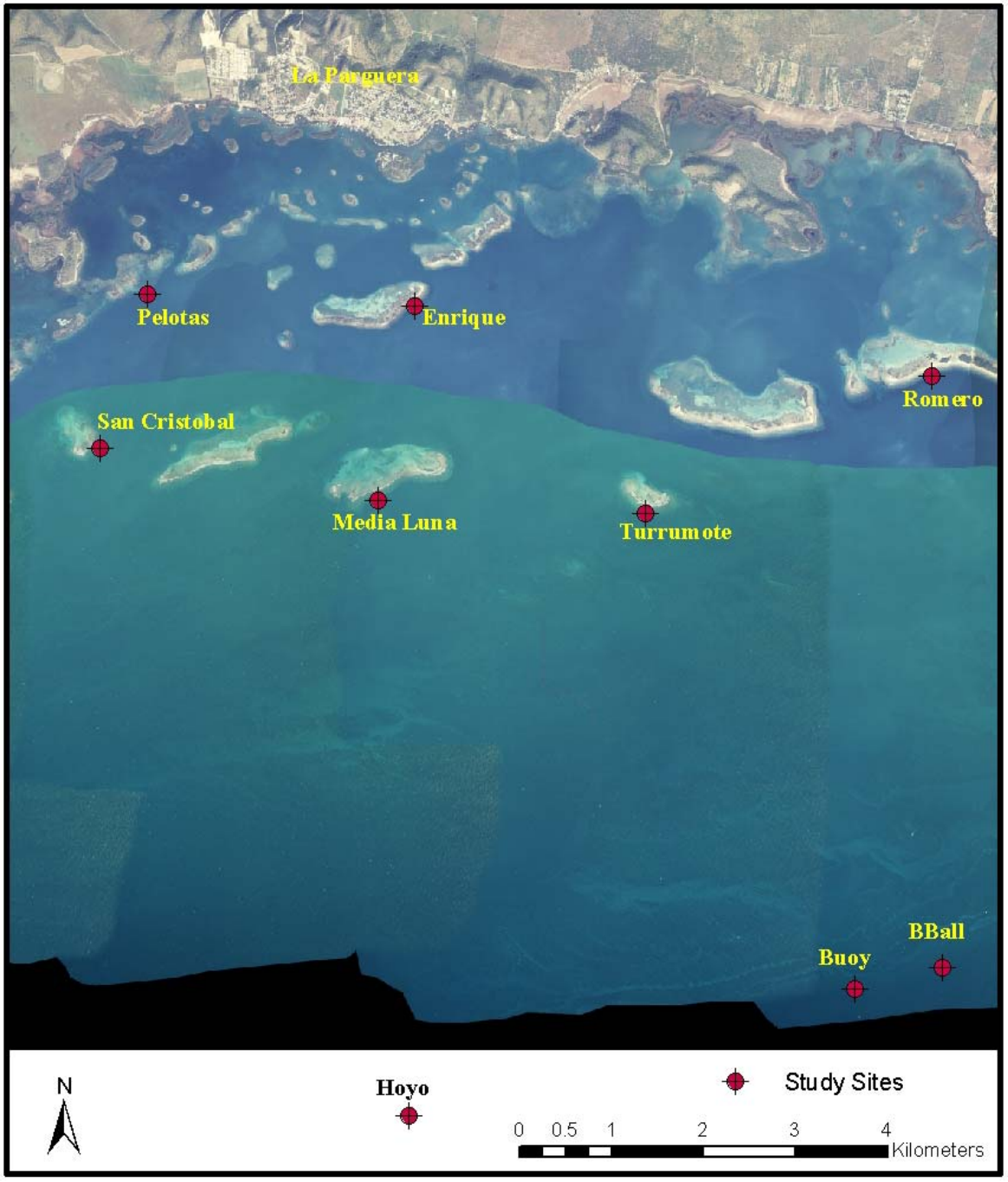
- University of Puerto Rico
- University of Miami
- Island Resources Foundation
- University of South Carolina
- University of Rhode Island
- CARICOMP

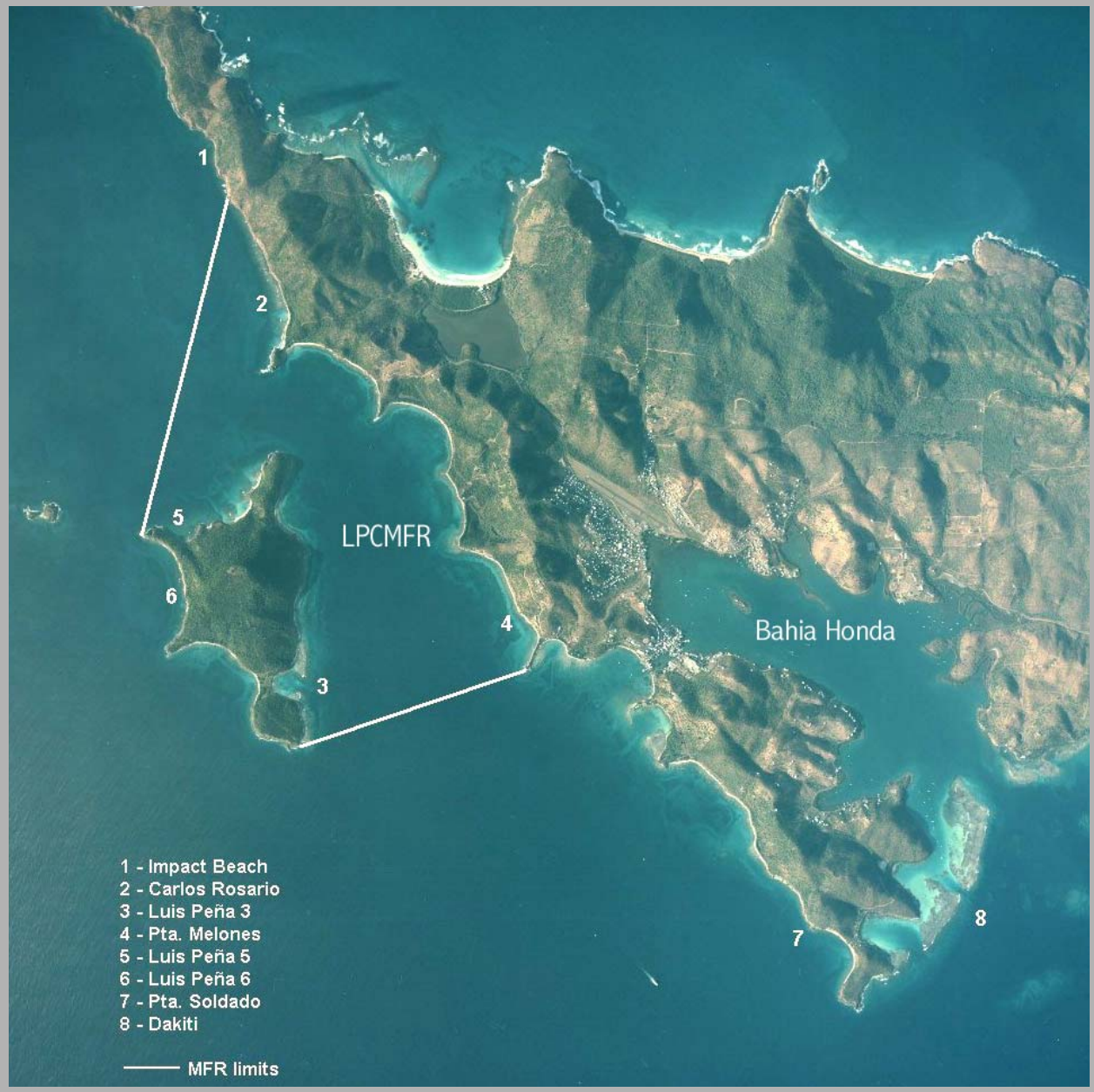
Federal Partners

- NOS – Centers for Coastal Monitoring and Assessment
- NMFS – Galveston Laboratory
- USGS – Biological Resources Division

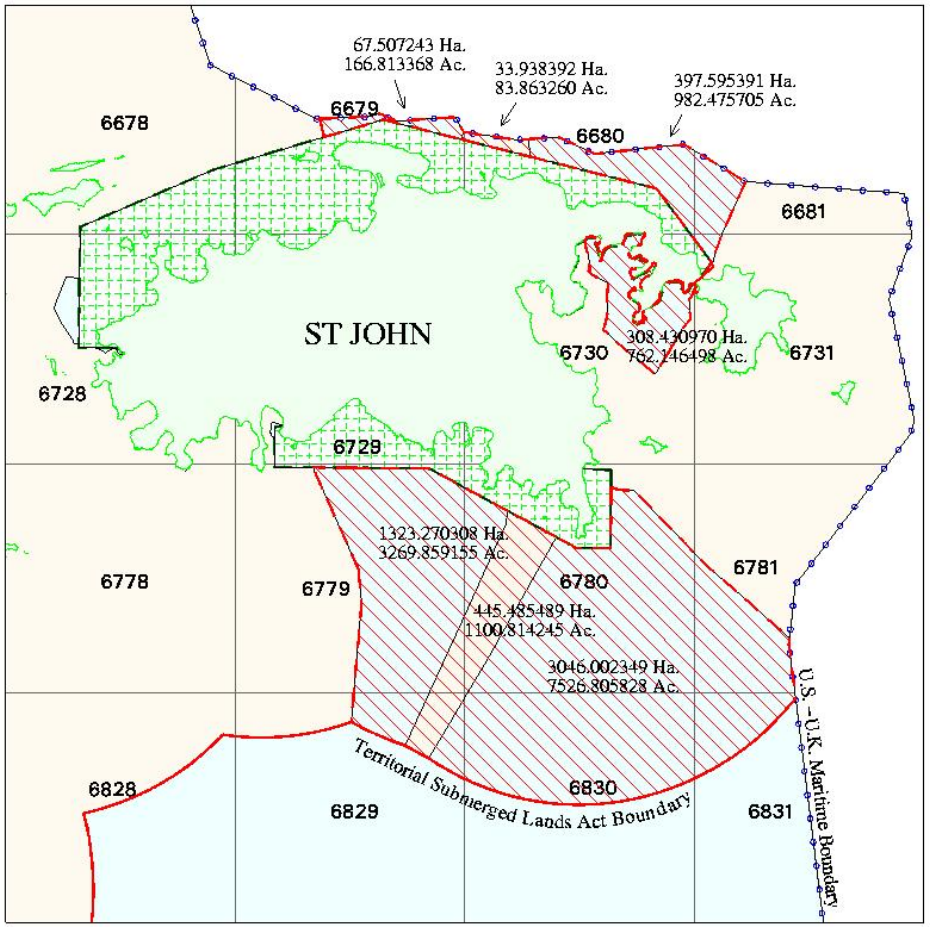
Field Locations

- La Parguera, PR
- Culebra Island, PR (LPCMR)
- St. John, USVI (National Park & Marine Monument)


La Parguera
Pelotas
Enrique
Romero
San Cristobal
Media Luna
Turrumote
BBall
Buoy
N
Hoyo
Study Sites
0 0.5 1 2 3 4
Kilometers


1
2
5
6
4
3
LPCMFR
Bahia Honda
7
8
1 - Impact Beach
2 - Carlos Rosario
3 - Luis Peña 3
4 - Pta. Melones
5 - Luis Peña 5
6 - Luis Peña 6
7 - Pta. Soldado
8 - Dakiti
MFR limits

Virgin Islands
Coral Reef National Monument

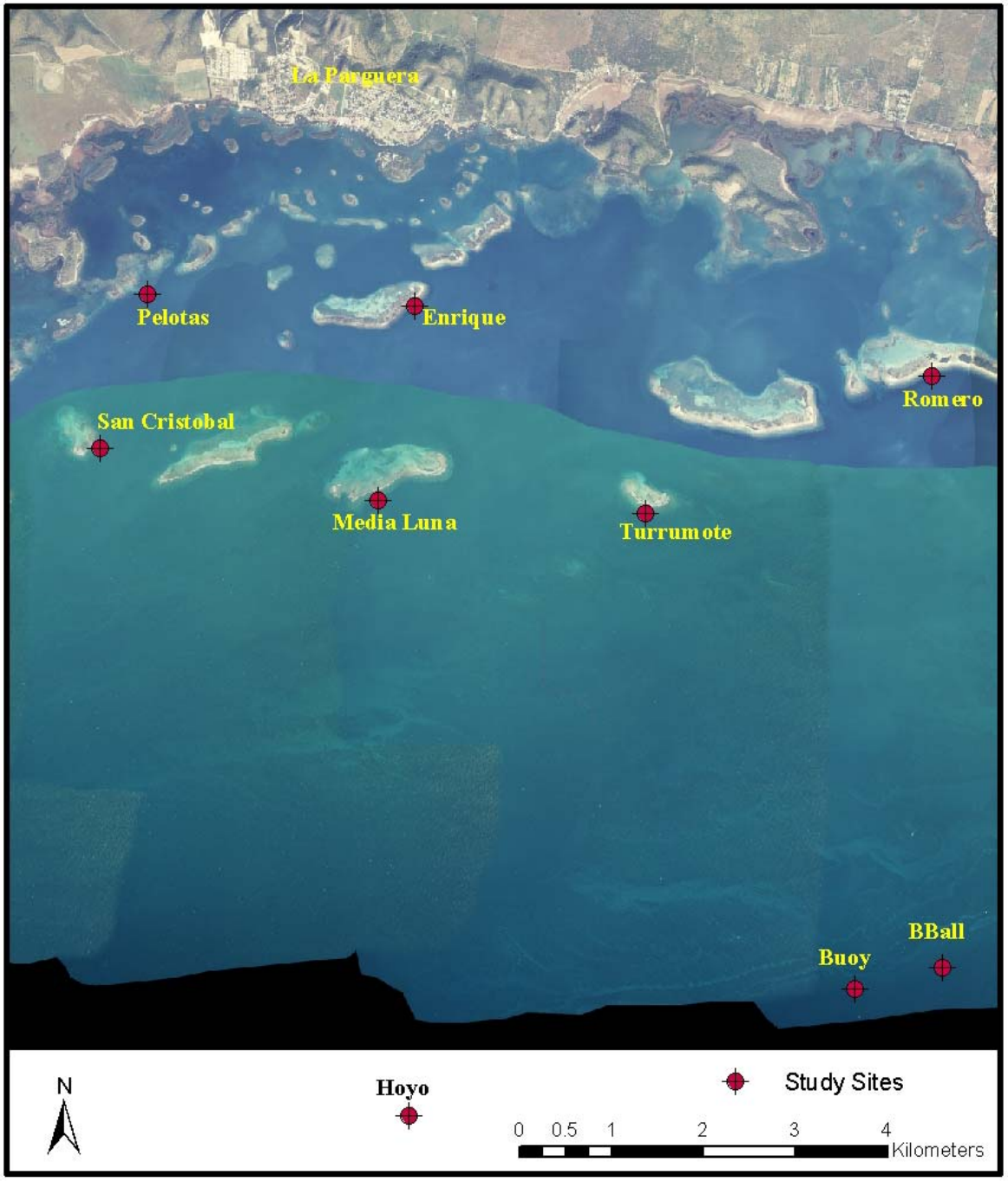


Purpose

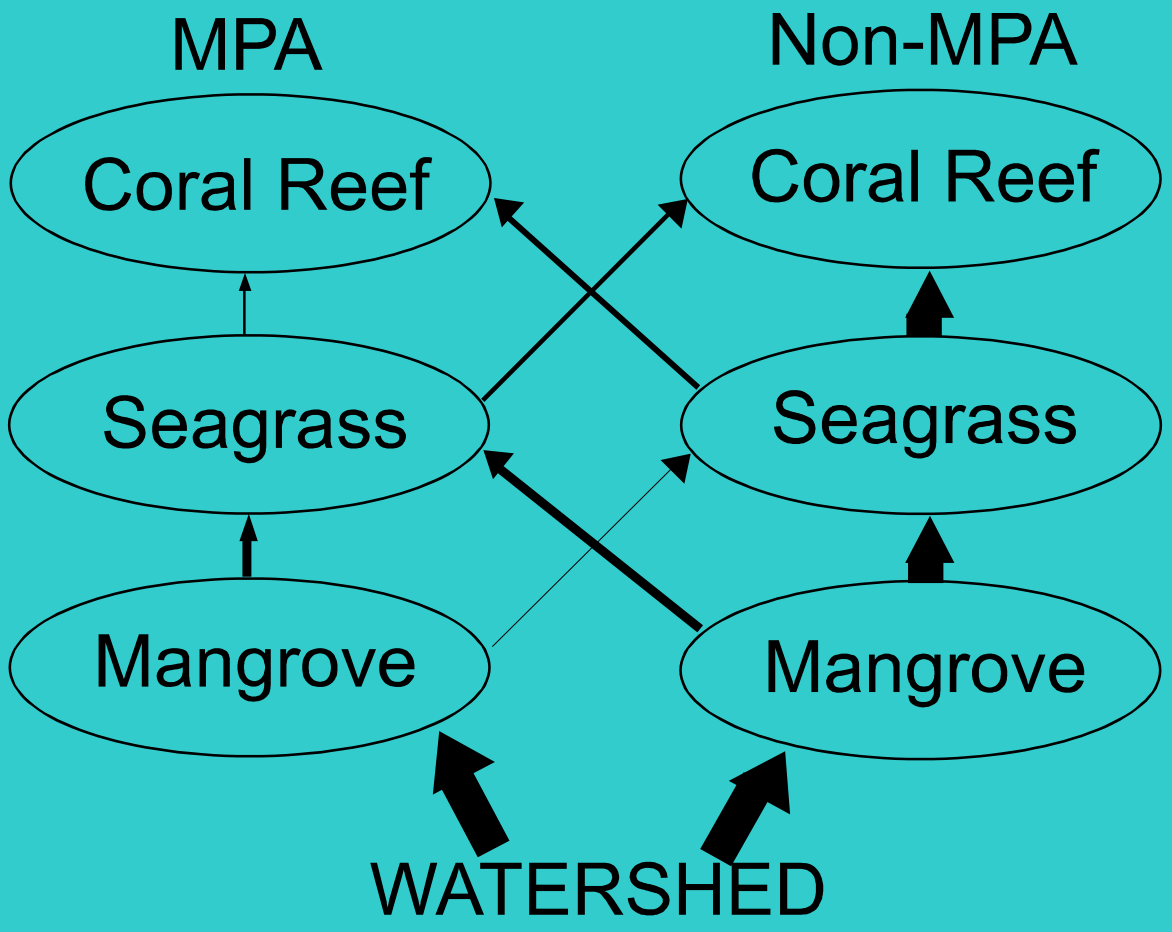
- Study processes responsible for decline in coral reefs
- Study feasibility of alternative management strategies
- Offer practical management advice and tools

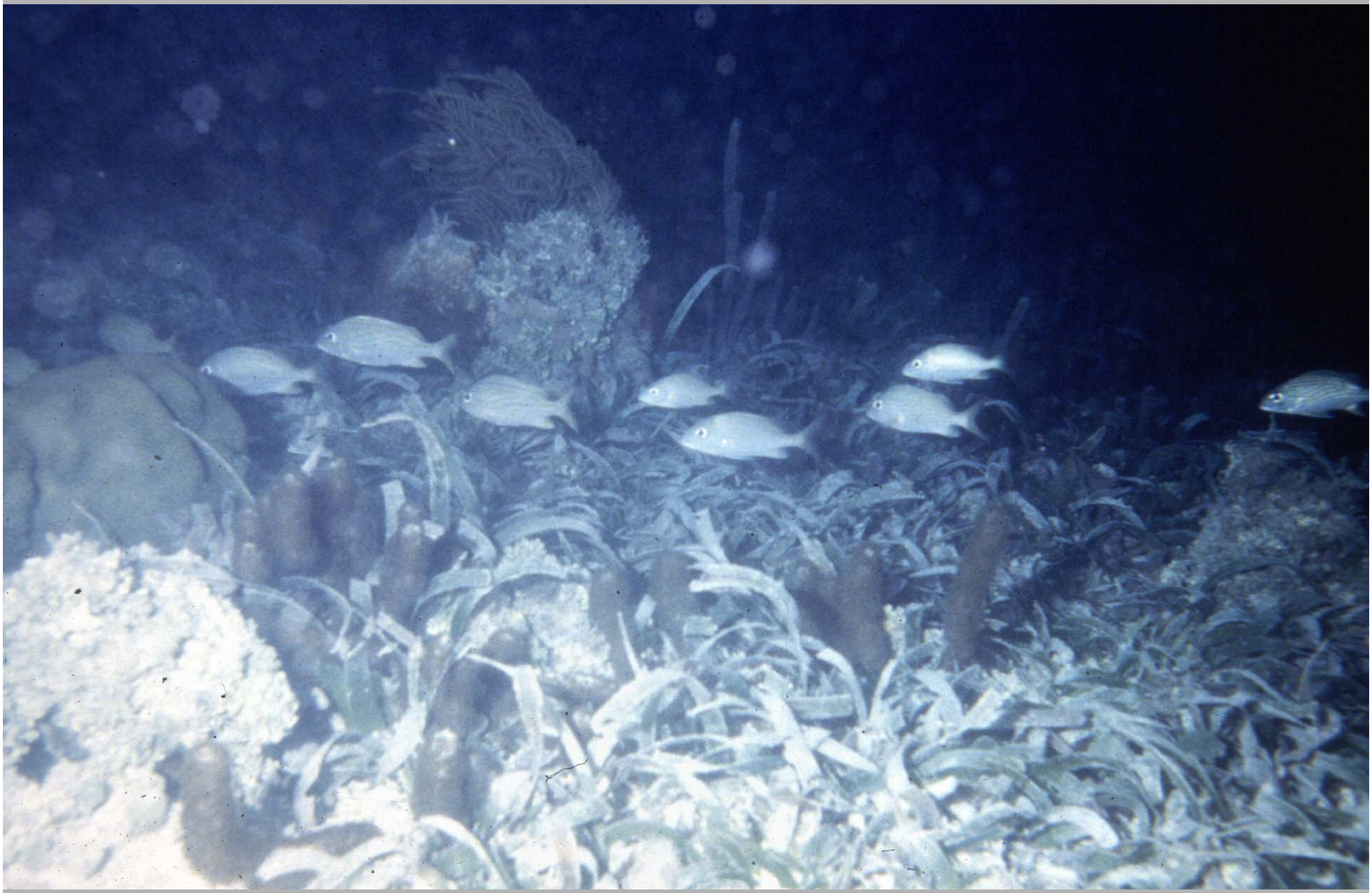
Basic Premises of Coral Reef Ecosystems

- The integrity of coral reef ecosystems depends upon low transports of watershed-based materials to the marine environment
- Cross-shelf movements of organisms play a vital role in the structure and function of coral reef systems
- Internal (in situ) processes play a major role in the structure and function of coral reef communities.

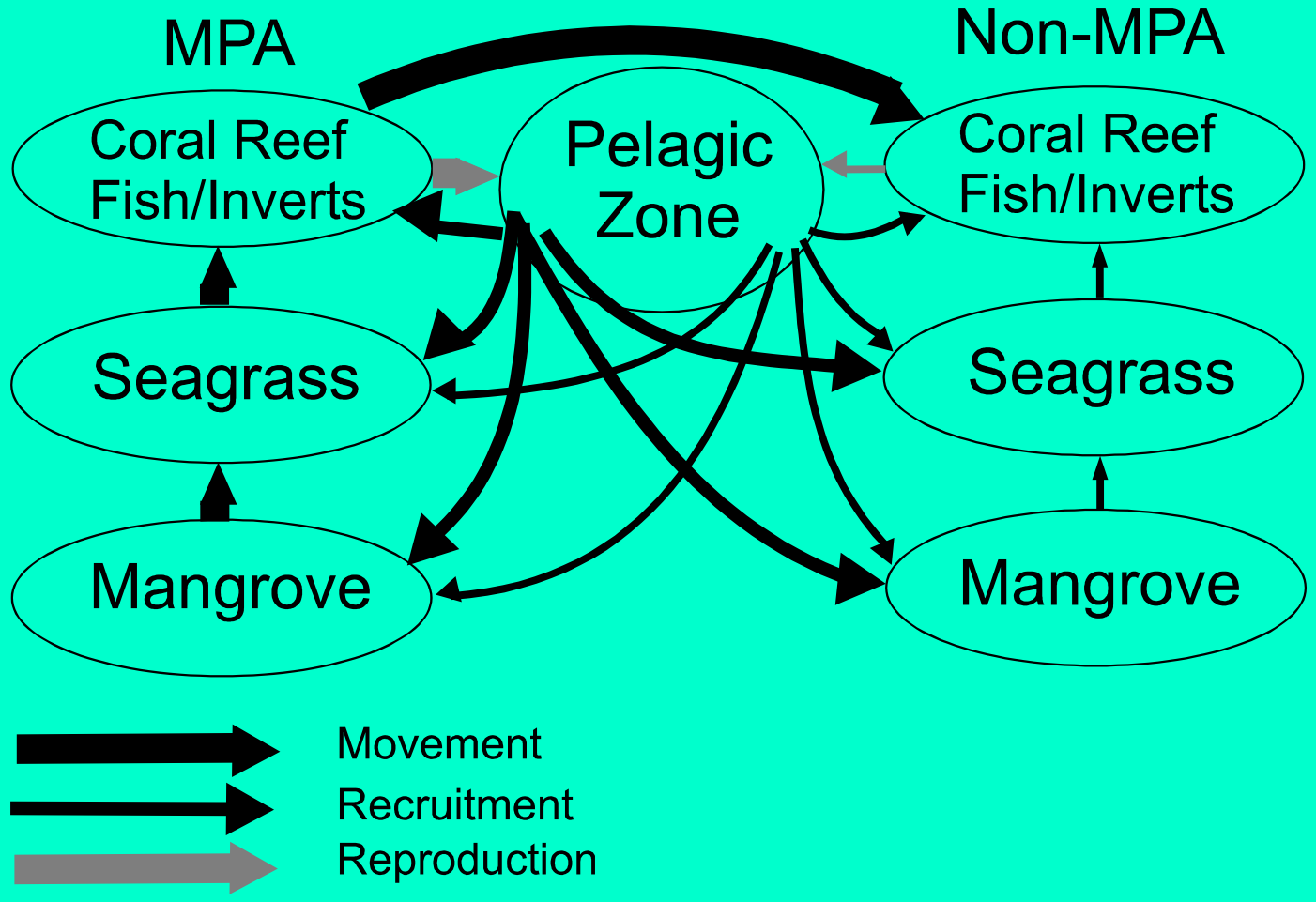

La Parguera
Pelotas
Enrique
Romero
San Cristobal
Media Luna
Turrumote
BBall
Buoy
N
Hoyo
Study Sites
0 0.5 1 2 3 4
Kilometers

Can MPAs have ameliorating effects on transports of watershed-based materials to coral reefs?

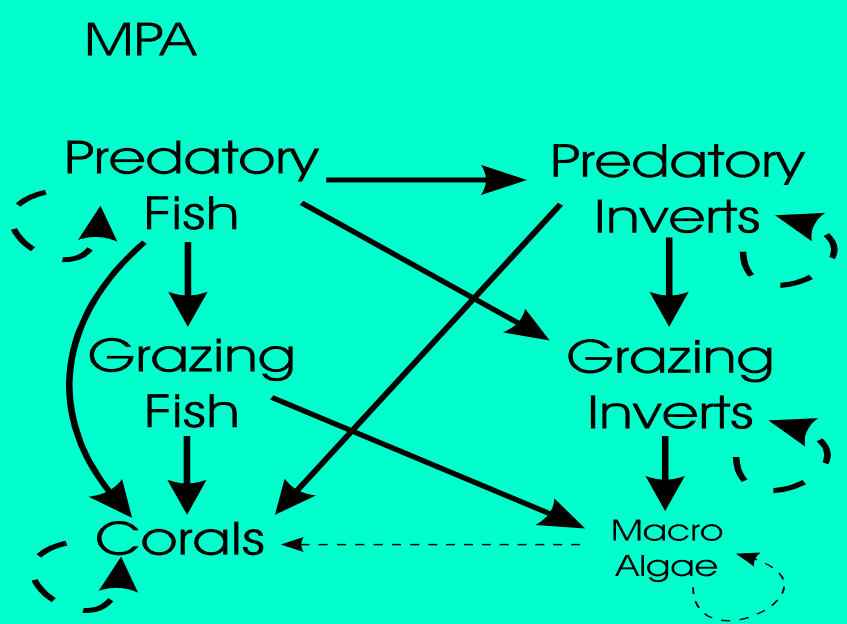


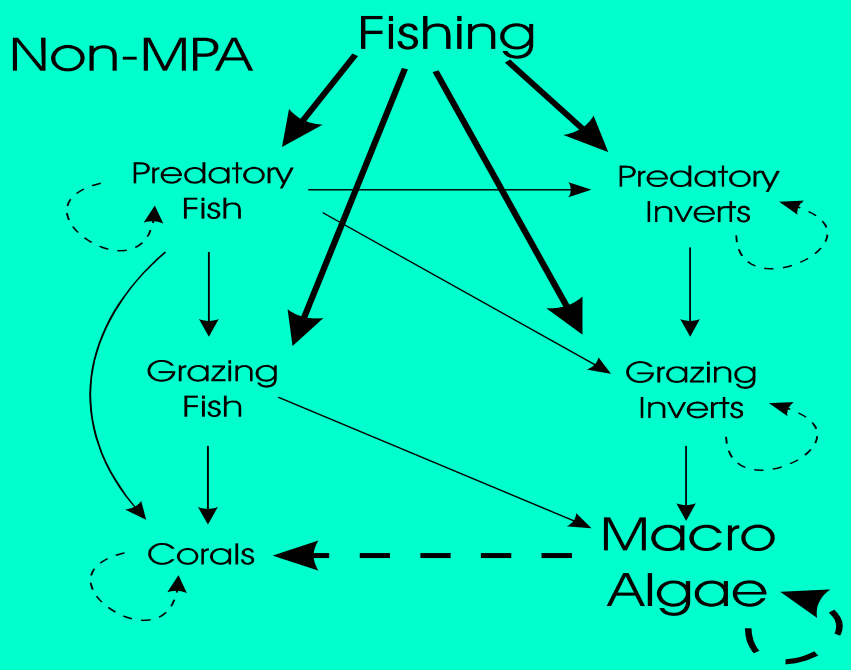


Do regional fisheries benefit from the cross-shelf movements of commercial fish and invertebrates between MPAs and nonMPAs?



Internal Processes Represent Critical Linkages





Relationships Between Watershed Activities & Coral Reef Ecosystems

- Sediment Loading and Associated Impacts
- Water Column Transport Processes
- Physical Oceanography
- Transport of watershed-based materials: Sediment studies

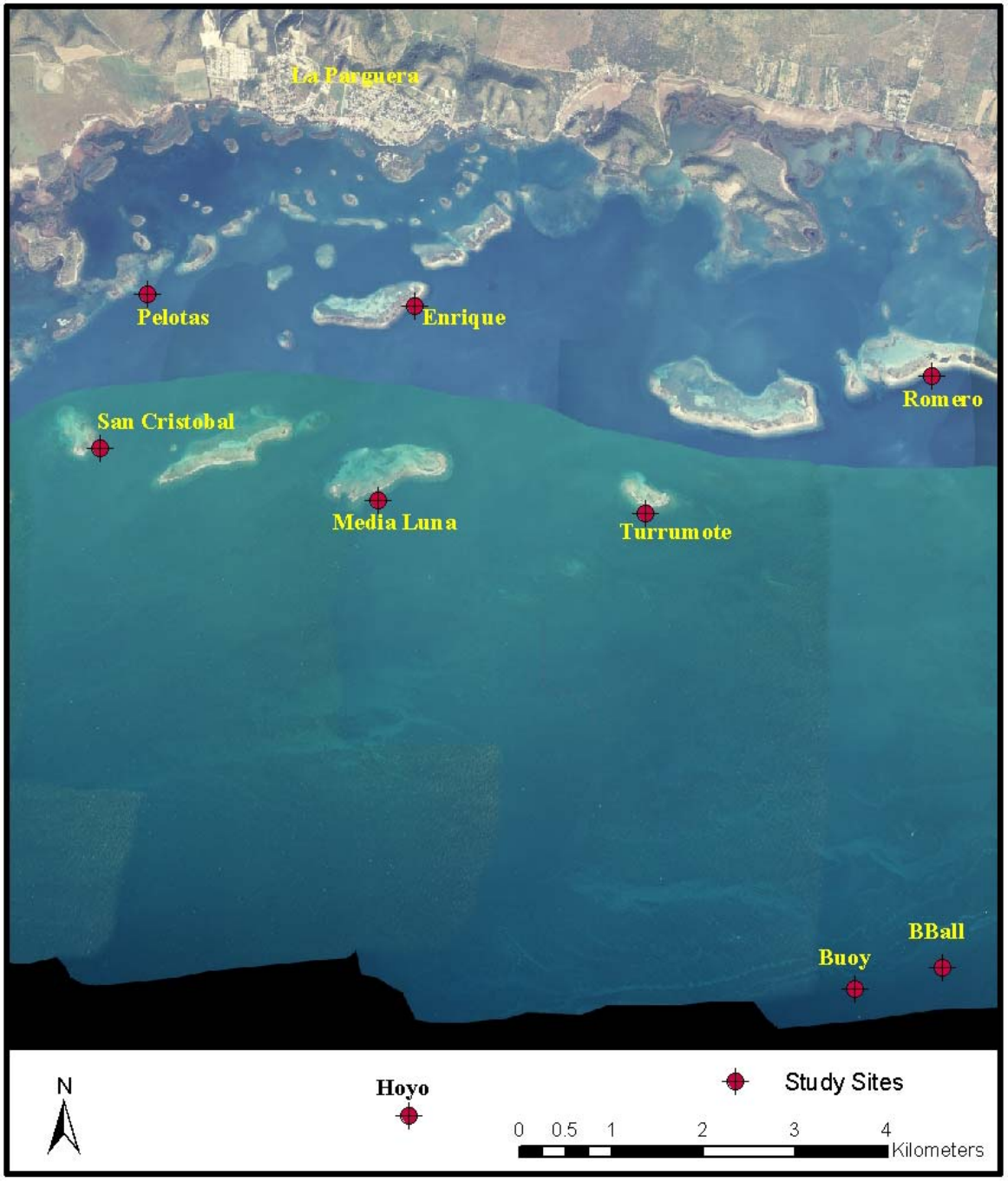
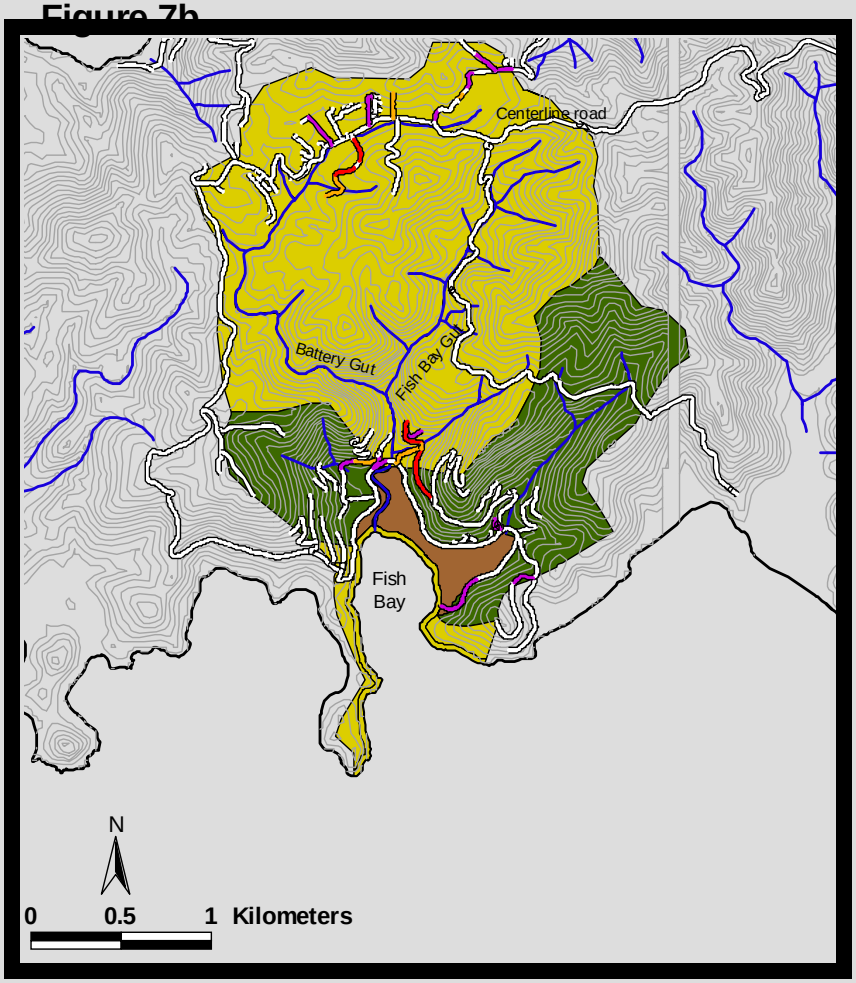

La Parguera
Pelotas
Enrique
Romero
San Cristobal
Media Luna
Turrumote
BBall
Buoy
N
Hoyo
Study Sites
0 0.5 1 2 3 4
Kilometers

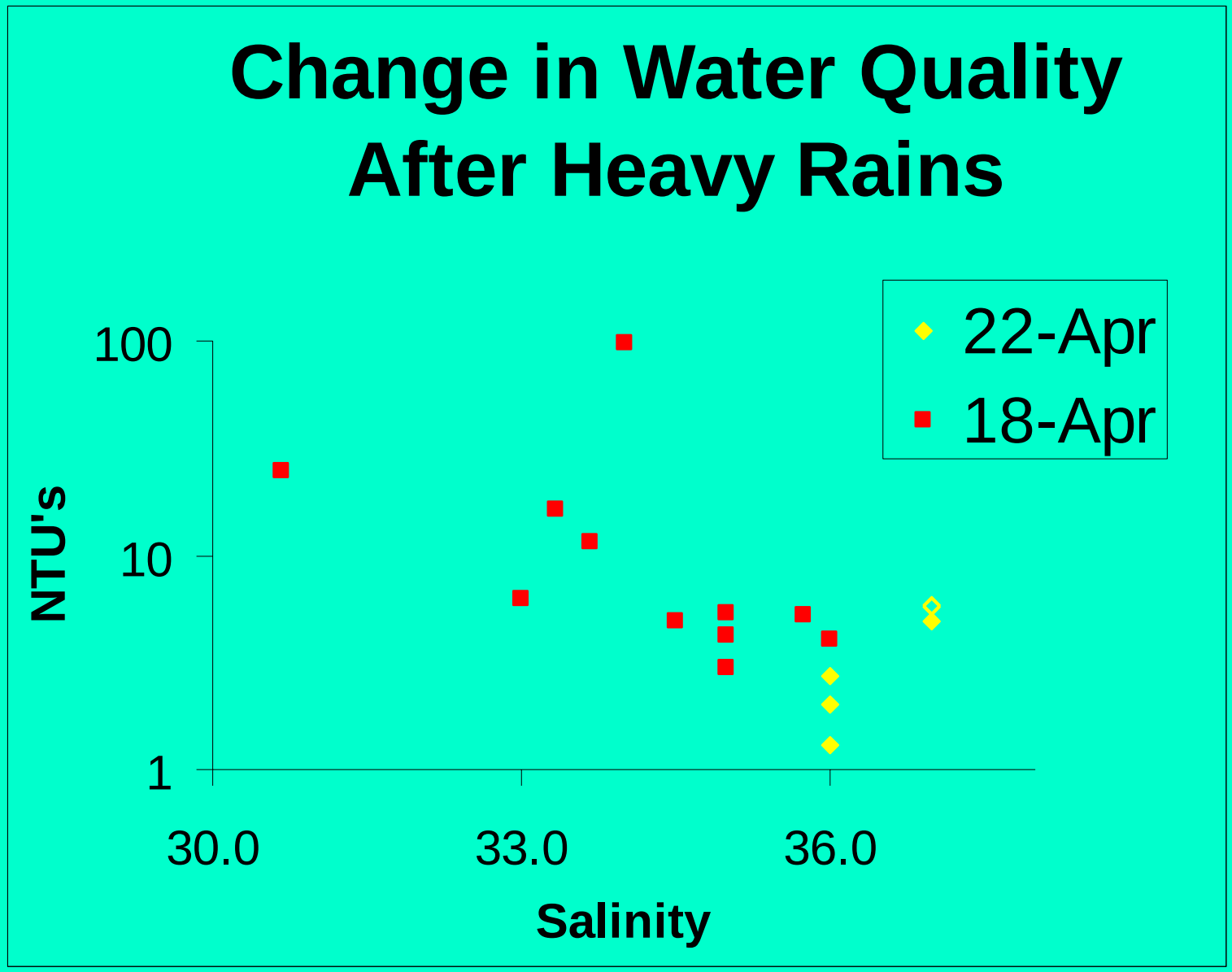
Figure 7b



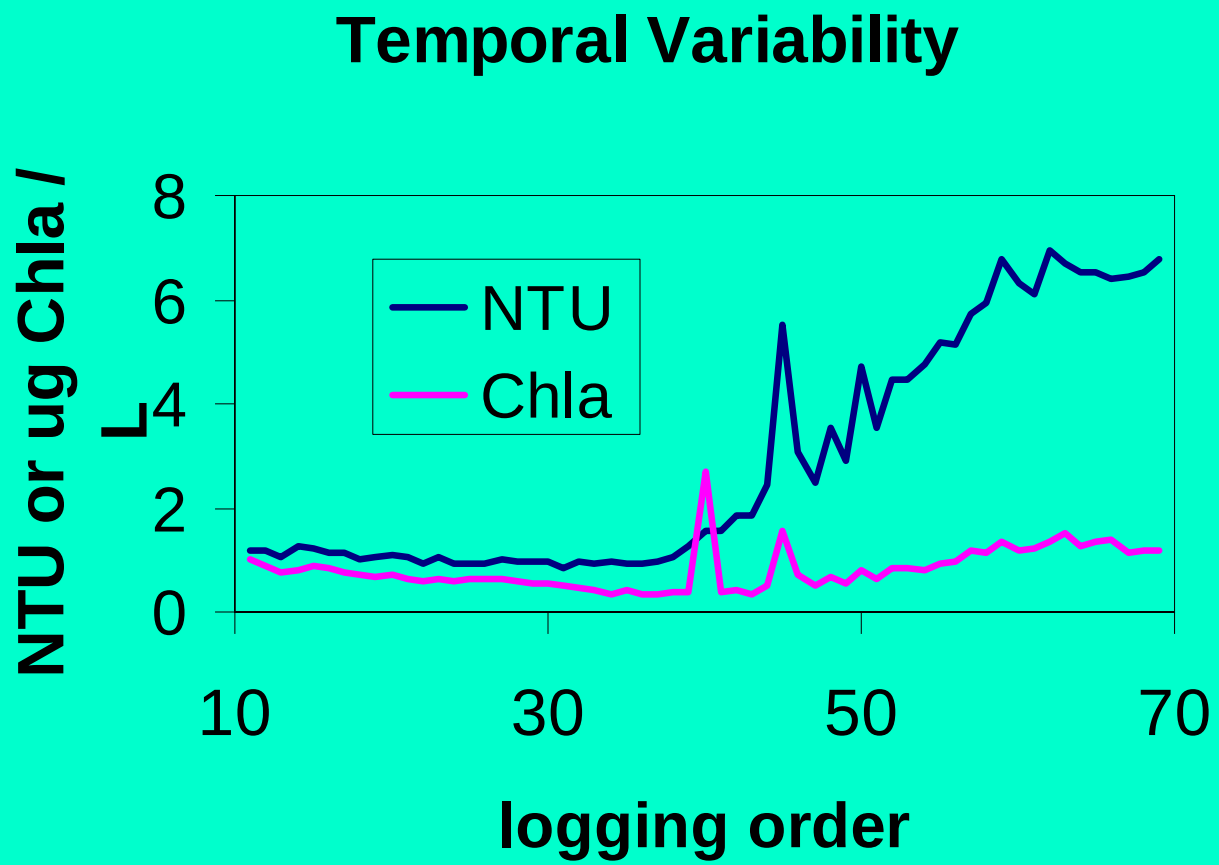
Road travelway sediment delivery
- 0 - 1 (tons/yr)
- 1 - 3 (tons/yr)
- 3 - 7 (tons/yr)
- 7 - 15 (tons/yr)
- Streams
- 40 ft contours

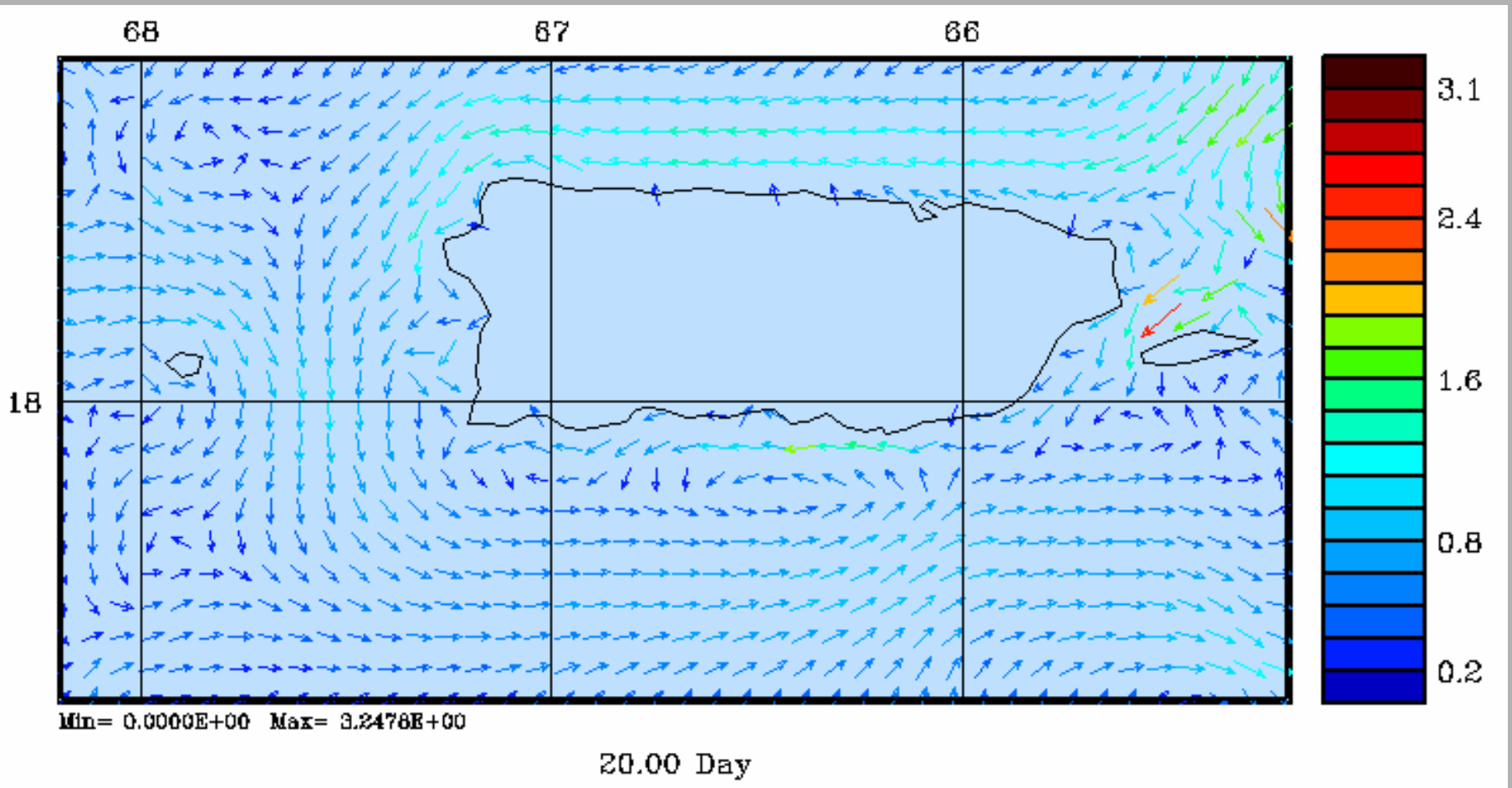
Delivery potential
- high
- moderate
- wetland
- Coastline

Change in Water Quality After Heavy Rains



Short-term Variability in Chl *a* and Turbidity

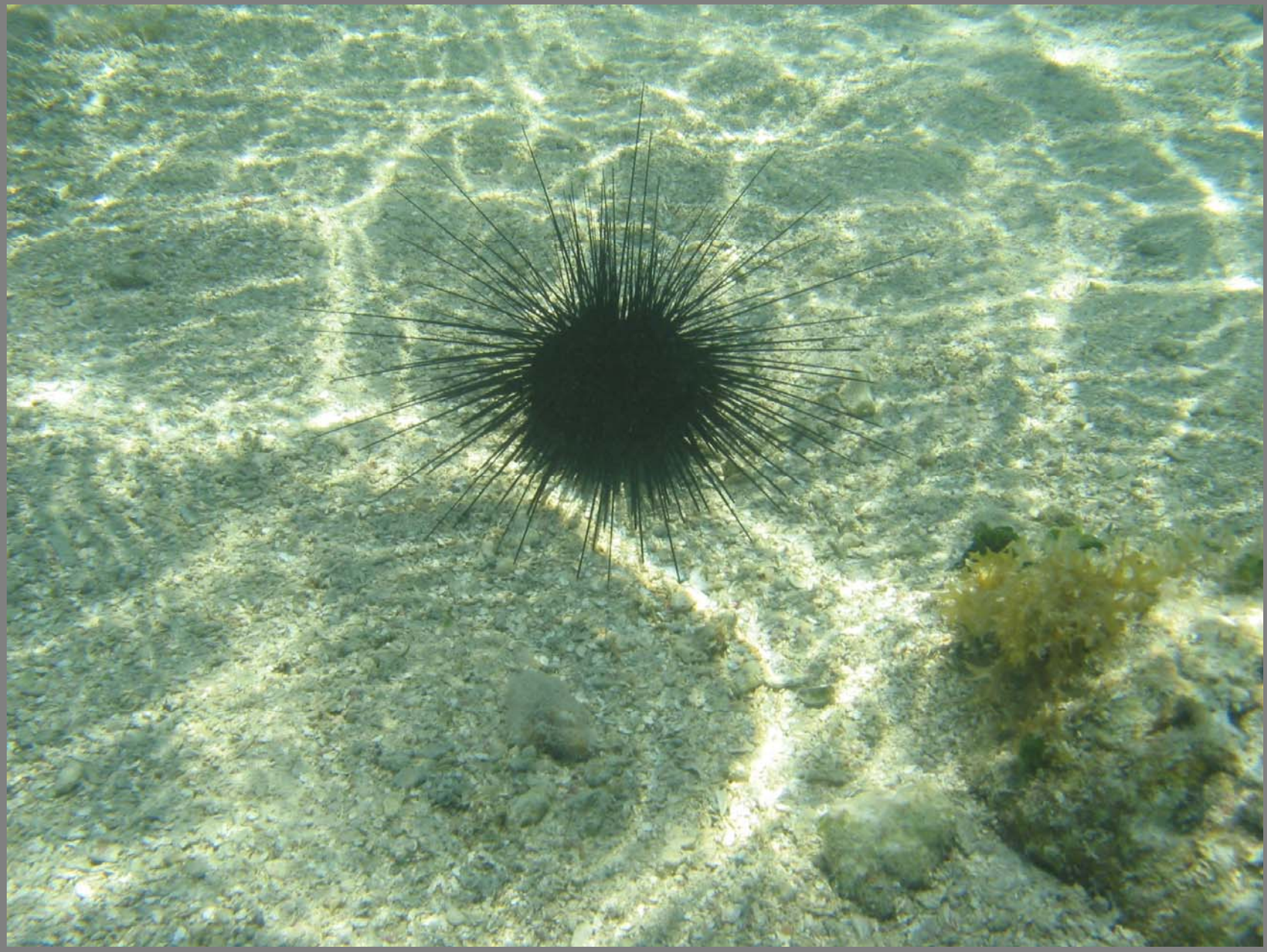


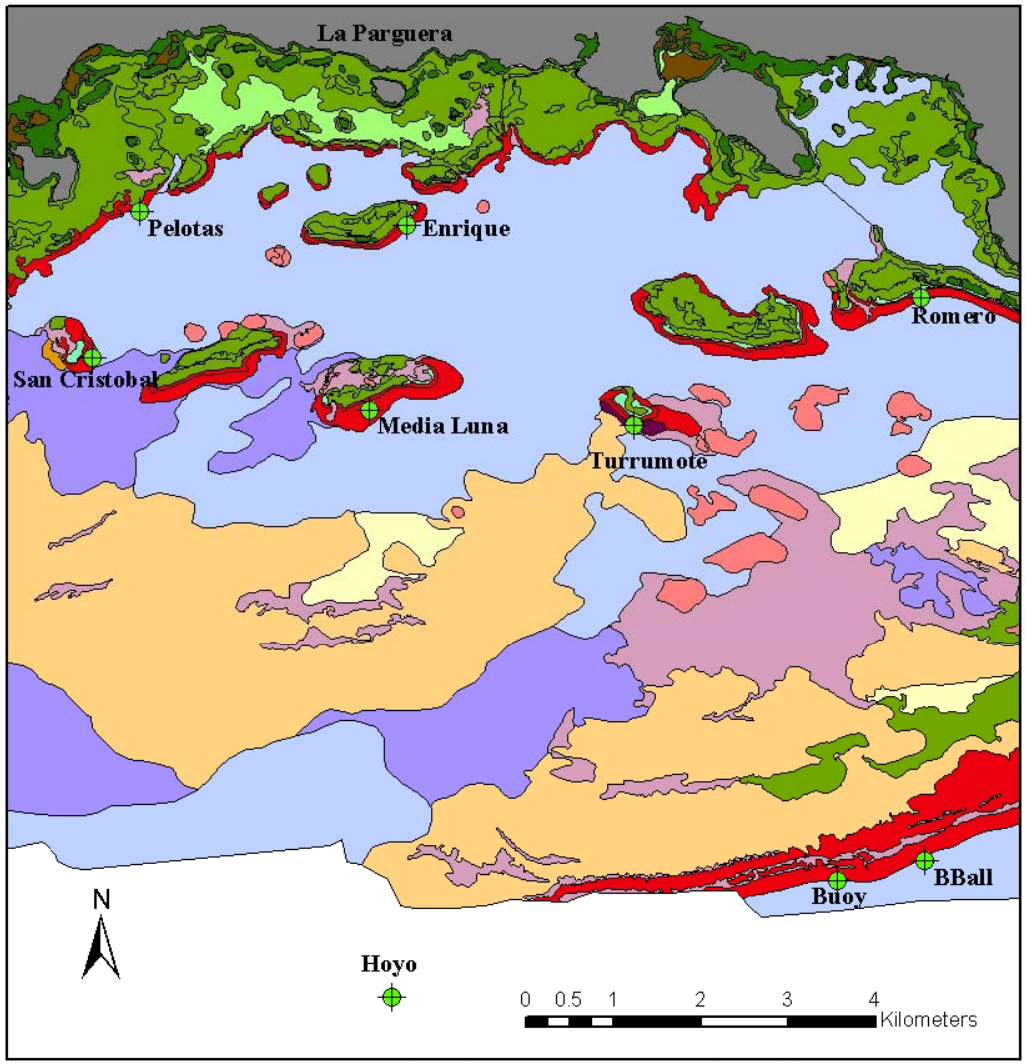

68
67
66
18
3.1
2.4
1.6
0.8
0.2
Min= 0.0000E+00 Max= 3.2478E+00
20.00 Day

Reef Processes

- Benthic Organism Tissue Nutrient Content
- Coral Diseases
- Demographic Studies: Coral Reef Communities
- Ecological Linkages: *Diadema* transplant experiment
- Coupling of Species and Habitats
- Coupling of MPAs: Large-scale Larval Dispersal

Demographic studies and environmental correlates
Epizoology and impacts
Verification, identification and pathogenesis
Diagnostic biomarkers and coral physiological health



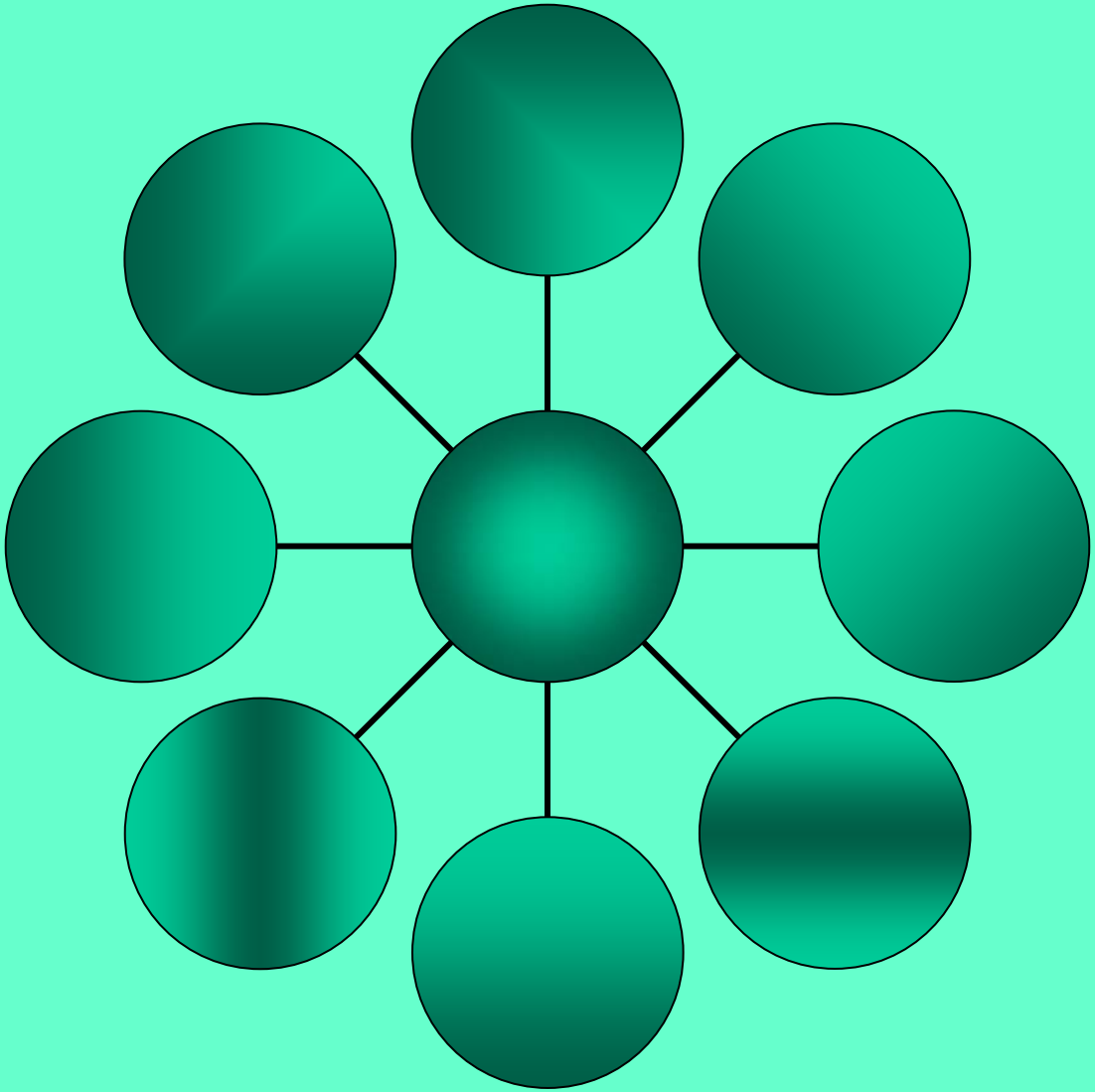


Study Sites	Macroalgae	Sand
Habitat Types	Mangrove	Scattered Coral/Rock
Colonized Pavement	Mud	Seagrass
Colonized Pavement/Channels	Patch Reef (Aggregated)	Spur and Groove Reef
Land	Patch Reef (Individual)	Uncolonized Bedrock
Linear Reef	Reef Rubble	Unknown

Socioeconomic Studies

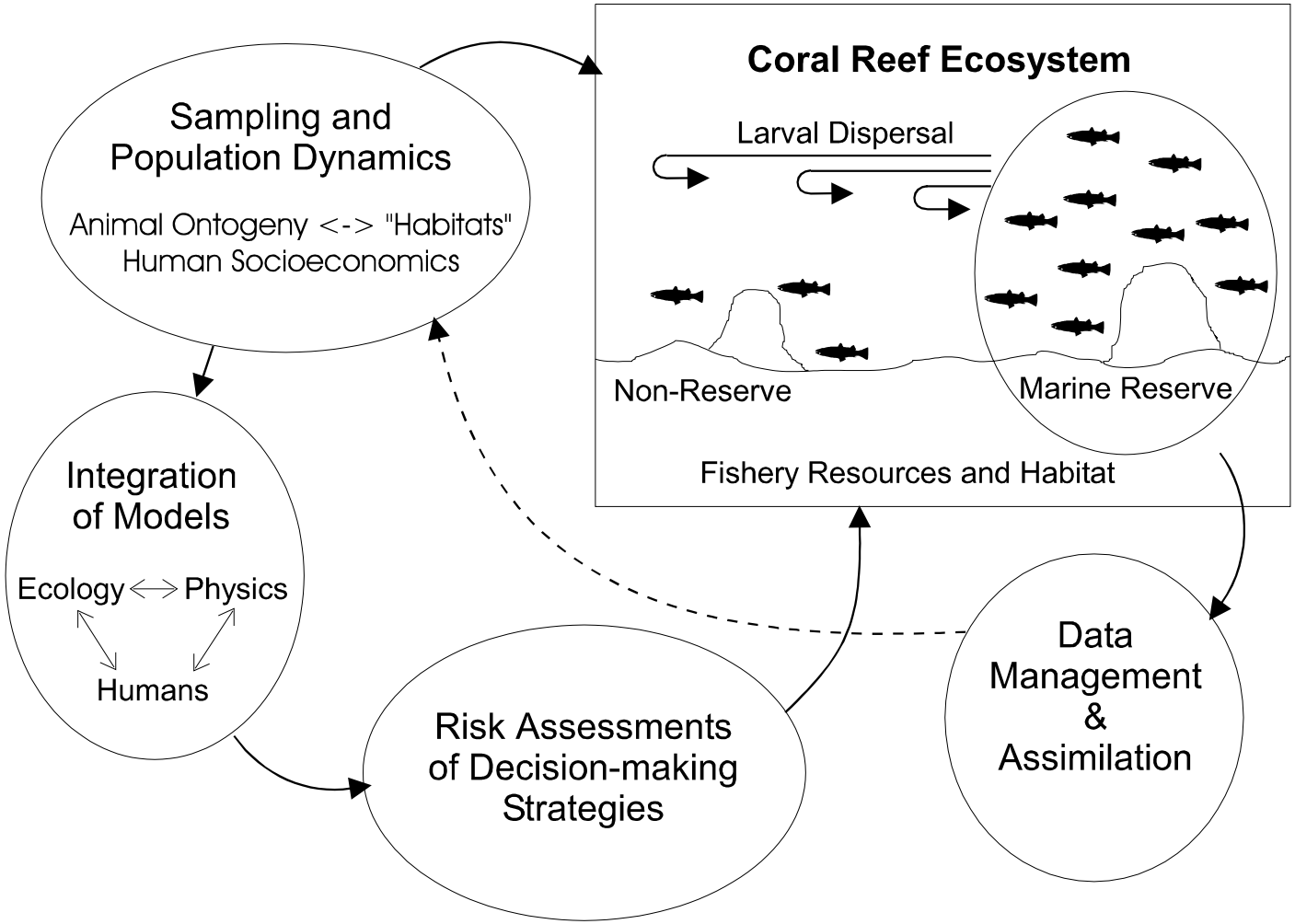
- Understanding fishers' knowledge & perceptions
- Identification of key stakeholders
- Ethnographic observations and data collection
- Analysis of the policy process
- Case studies - MPA development process

Expected (end)



Ecological and Socioeconomic Coupling

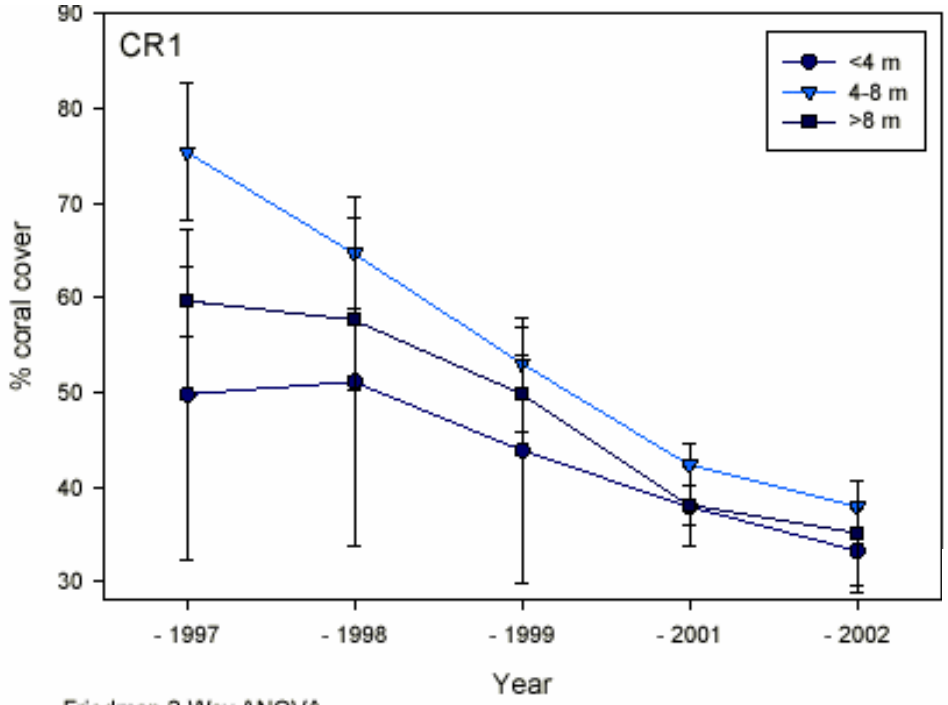
- Create a flexible decision support system
- risk assessment and information management framework
- Multi-layer object-oriented modeling


Coral Reef Ecosystem
Larval Dispersal
Non-Reserve
Marine Reserve
Fishery Resources and Habitat
Sampling and
Population Dynamics
Animal Ontogeny <-> "Habitats"
Human Socioeconomics
Integration
of Models
Ecology
Physics
Humans
Risk Assessments
of Decision-making
Strategies
Data
Management
&
Assimilation

Evaluation of MPAs

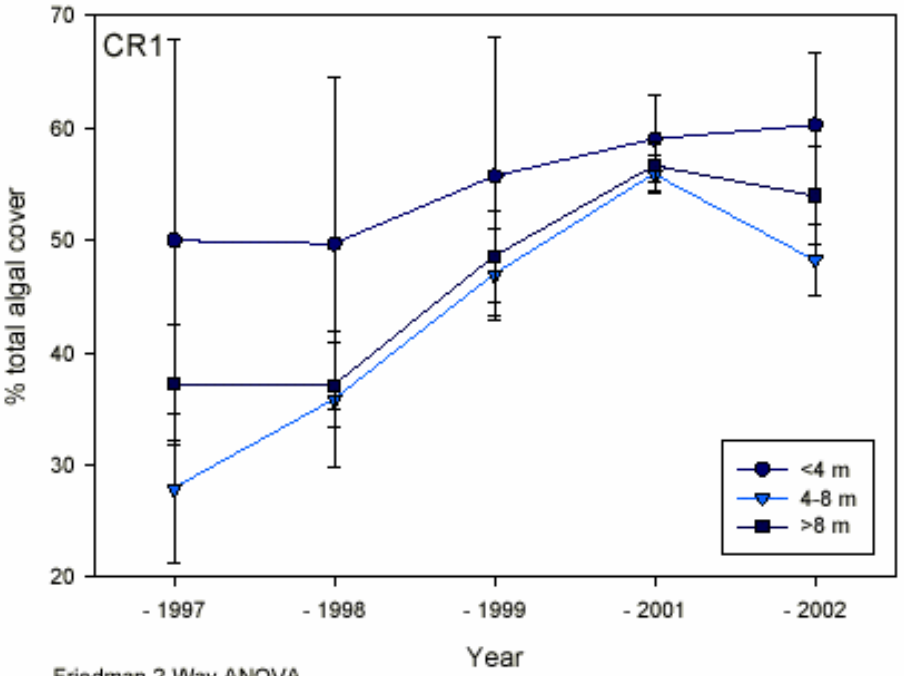
- Habitat Connectivity
- Larval Connectivity
- Measuring Impacts of Fishing
- Modeling Long-term Impacts of Fishing
- MPA development process

% Coral Cover



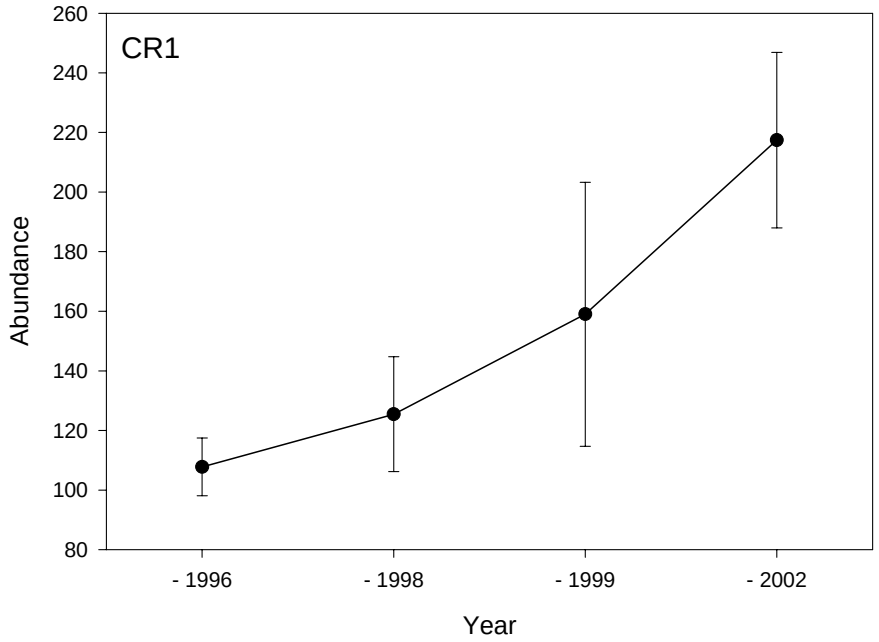
Friedman 2-Way ANOVA
Year: d.f.=4; Friedman Statistic= 11.47; *p*=0.0218
Depth: d.f.=2; Friedman Statistic= 10.00; *p*=0.0067

% Algal Cover



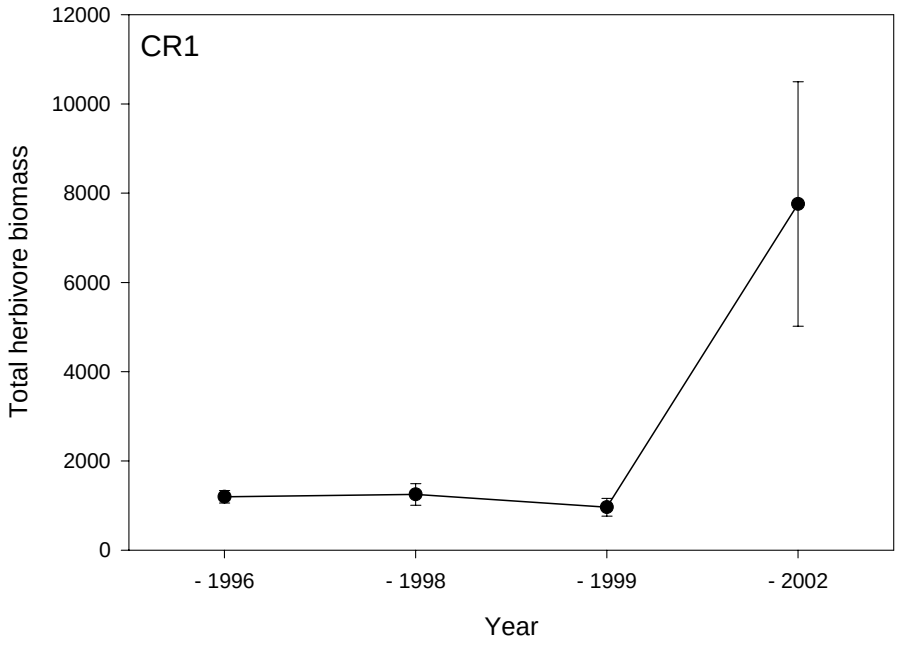
Friedman 2-Way ANOVA
Year: d.f.=4; Friedman Statistic= 10.93; *p*= 0.0273
Depth: d.f.=2; Friedman Statistic= 10.00; *p*= 0.0067

Abundance

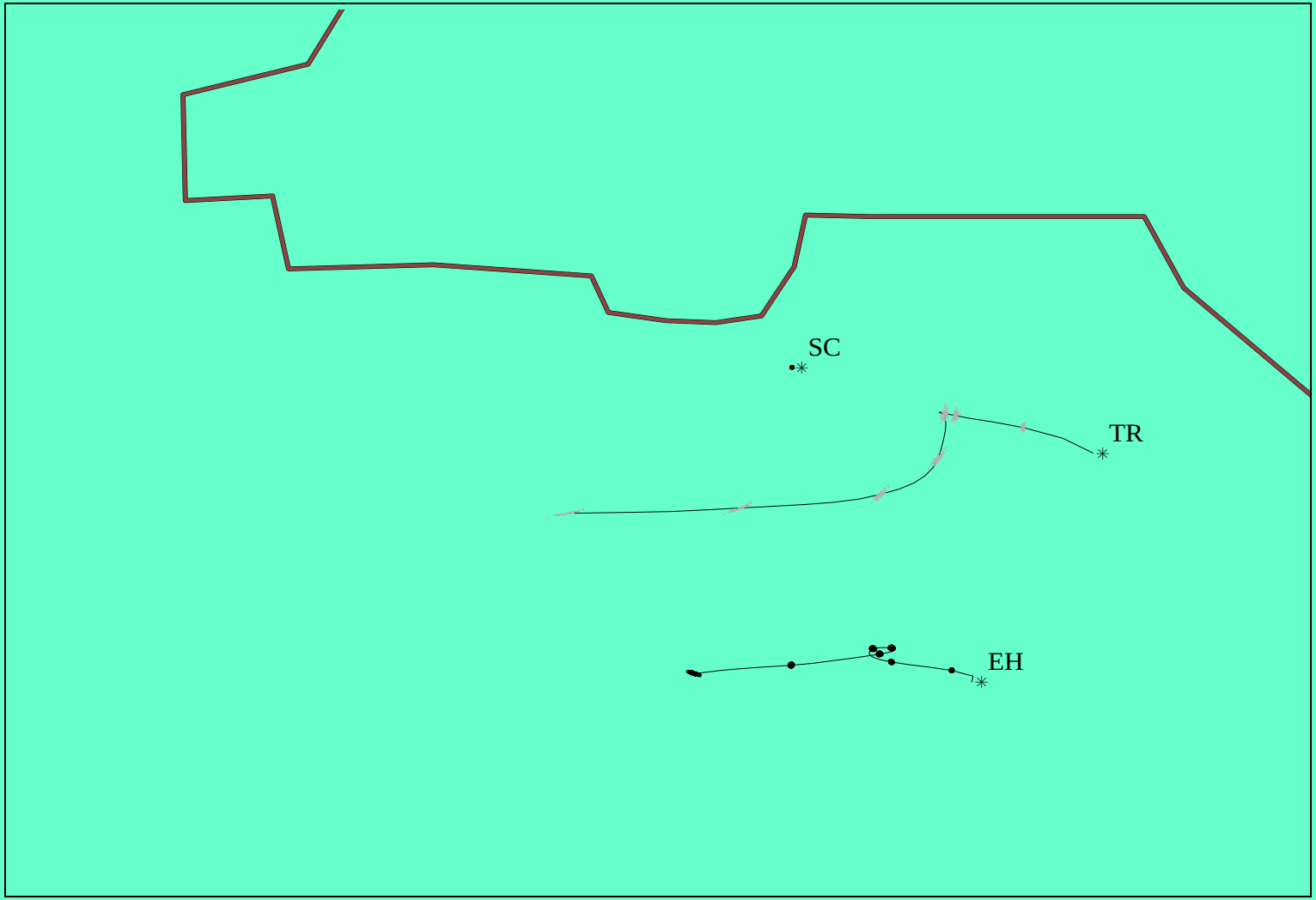


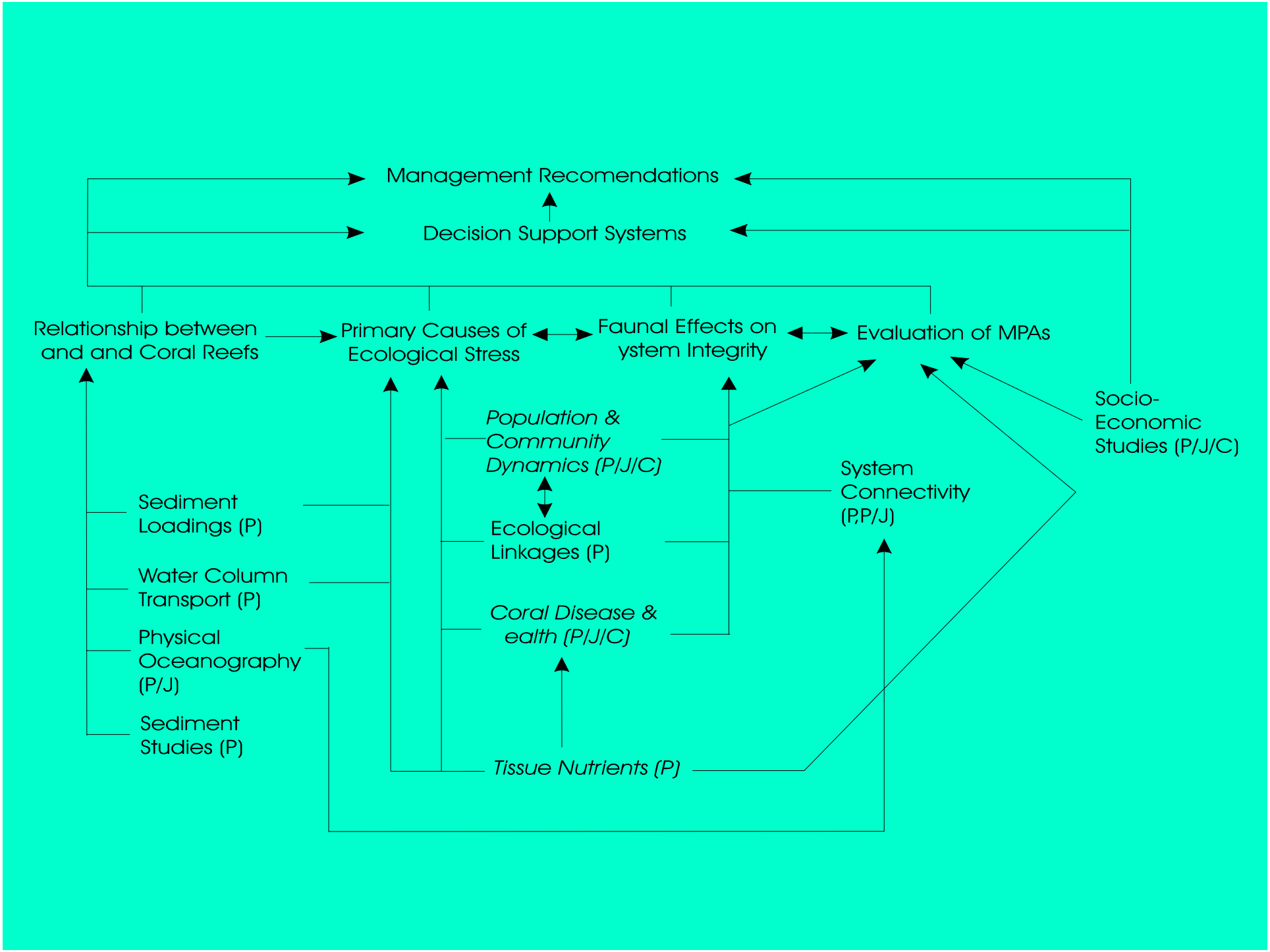
Kruskal-Wallis= 16.60; *p*=0.0009

Herbivore Biomass



Kruskal-Wallis= 38.97; *p*<0.0001


SC
TR
EH


Management Recomendations
Decision Support Systems
Relationship between and and Coral Reefs
Primary Causes of Ecological Stress
Faunal Effects on ystem Integrity
Evaluation of MPAs
Socio-Economic Studies (P/J/C)
Population & Community Dynamics (P/J/C)
System Connectivity (P,P/J)
Sediment Loadings (P)
Ecological Linkages (P)
Water Column Transport (P)
Coral Disease & ealth (P/J/C)
Physical Oceanography (P/J)
Sediment Studies (P)
Tissue Nutrients (P)

Scientific and Coastal Management Advisory Committee

- 7 Project PI's
- Director of the UPR Sea Grant College Program
- CARICOMP Representative
- PR Coastal Zone Management Program (DNER)
- USVI Coastal Zone Management Program (DPNR)
- National Parks Service (St. John)
- Caribbean Fisheries Management Council
- PR Conservation Trust

SCMAC - Goals

- Project develops the necessary knowledge
- Knowledge is in the necessary format, for immediate application to coral reef management
- Facilitate the rapid adoption of knowledge and assessment tools into management practices

Center for Integrated Coral Reef Studies (CICoRS)