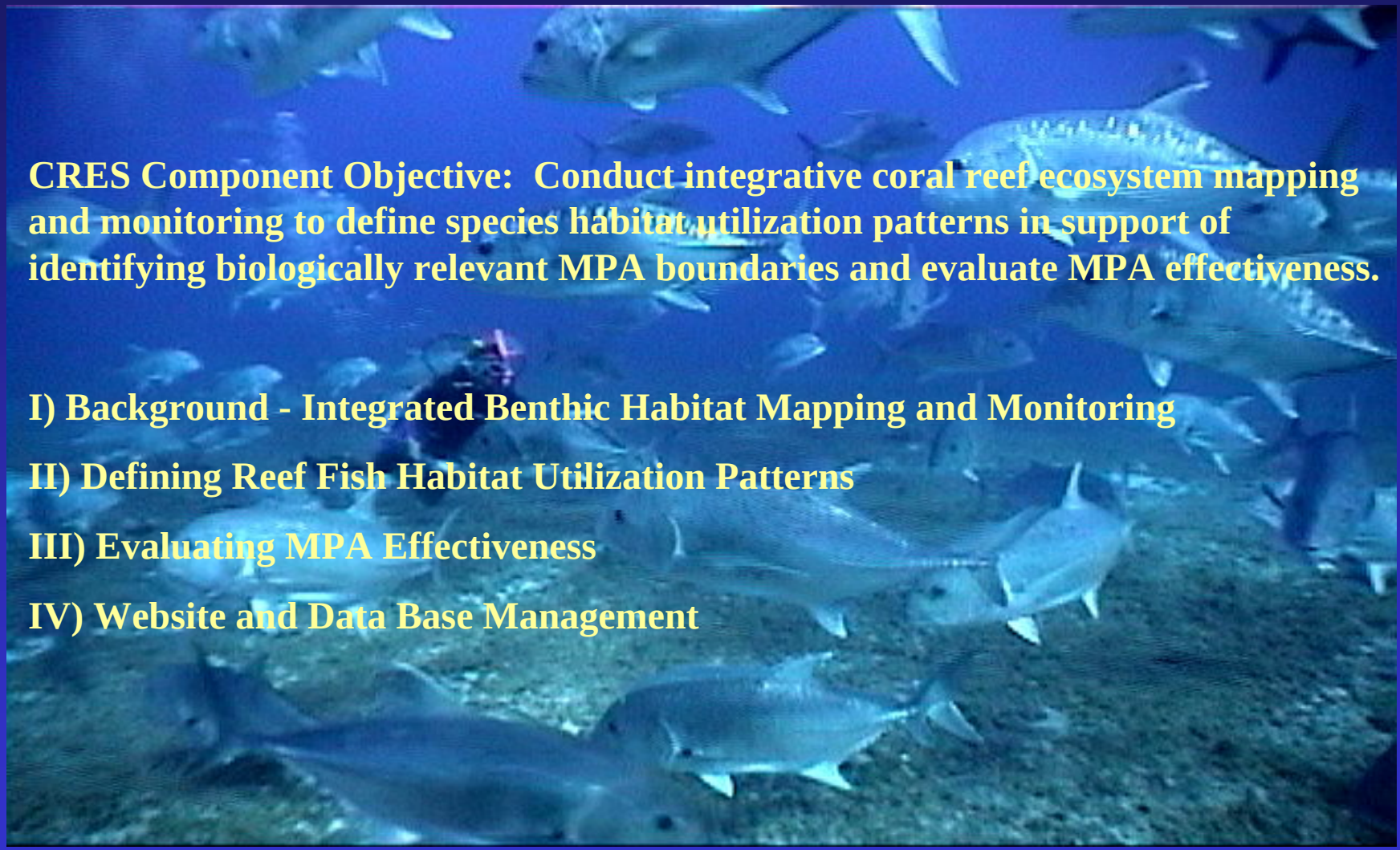
Coral Reef Ecosystem Studies (CRES): Quantifying Species Habitat Utilization Patterns

A Partnership Effort Led by NOAA's National Centers for Coastal Ocean Science

Study Team: Jim Beets, Chris Caldow, John Christensen, Alan Friedlander, Chris Jeffrey, Matt Kendall, Tom McGrath, Jeff Miller, Mark Monaco, Caroline Rogers, Rob Warra

NCCOS CRES Activities



CRES Component Objective: Conduct integrative coral reef ecosystem mapping and monitoring to define species habitat utilization patterns in support of identifying biologically relevant MPA boundaries and evaluate MPA effectiveness.

I) Background - Integrated Benthic Habitat Mapping and Monitoring

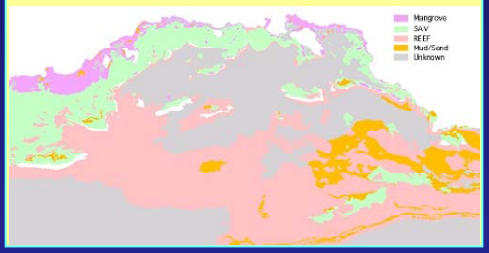
II) Defining Reef Fish Habitat Utilization Patterns

III) Evaluating MPA Effectiveness

IV) Website and Data Base Management

Coupling of Maps & Species Habitat Utilization Patterns

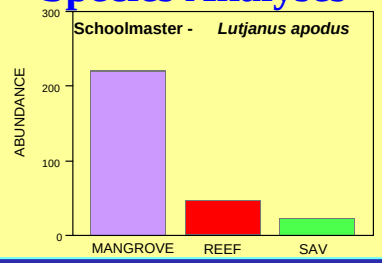
Benthic Habitat Map



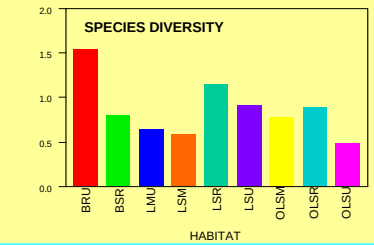
Random Stratified Sampling

Organism Census by Habitat Type

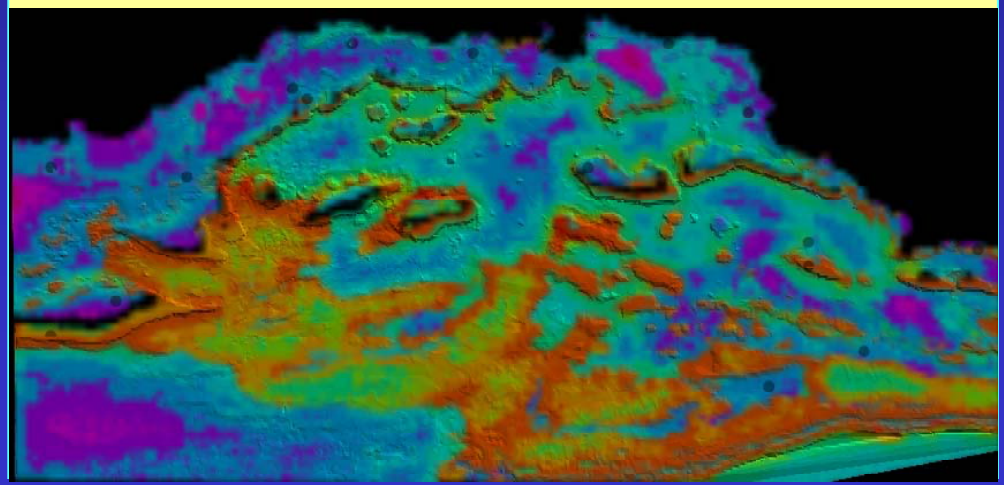
Species Analyses



Community Analyses



Biological Relevant Boundaries of MPA's & EFH

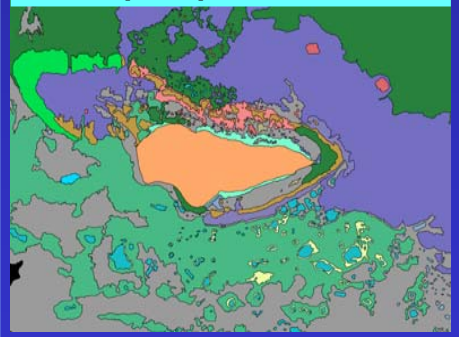


Integrative Mapping, Monitoring & Assessment

Mapping

Acquire Imagery

Develop Map



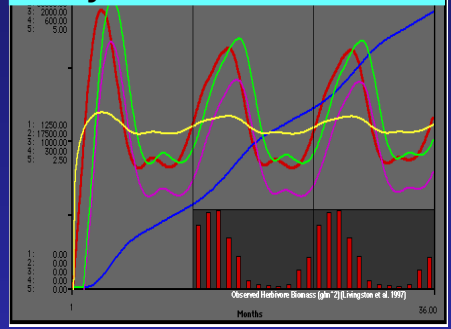
Monitoring

Design Sample Protocols

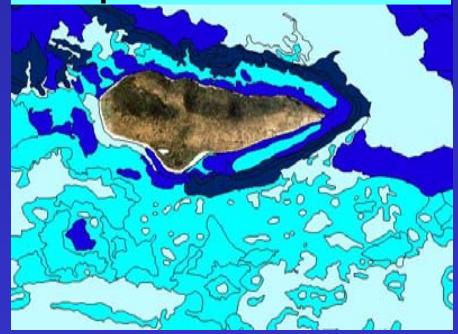
Implement Monitoring

Assessment

Analyze Data



Complete Assessment



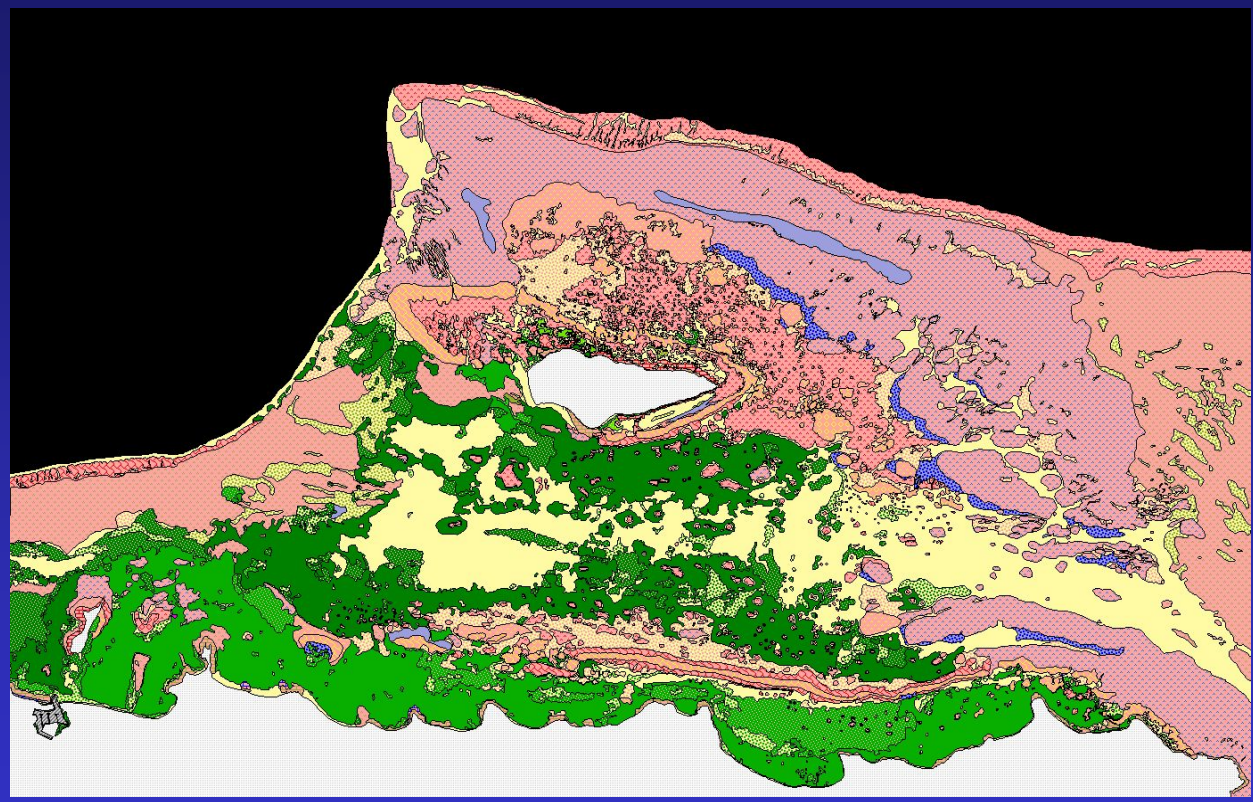
Multiple Remote Sensing Technologies

IKONOS – true-color; 4 m pixel

AERIAL PHOTOGRAPHY – true-color; 1.2 m pixel

HYPERSPECTRAL – 72 bands between 350 and 1000 nm; 3 m pixel

Example Benthic Habitat Map St. Croix, USVI



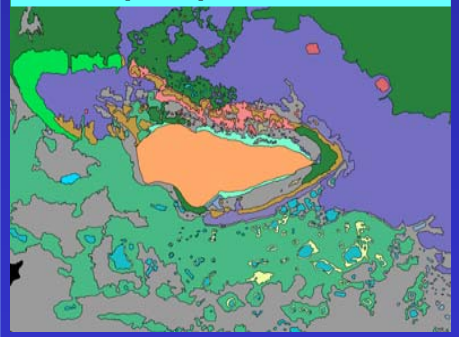
Habitat map of Eastern St. Croix and BIRNM

Integrative Mapping, Monitoring & Assessment

Mapping

Acquire Imagery

Develop Map



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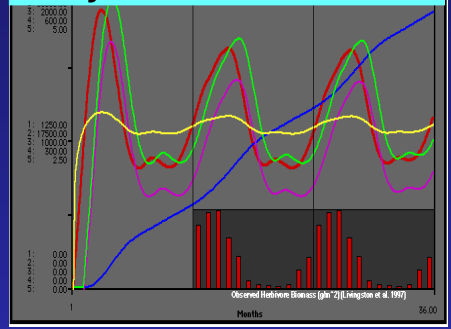
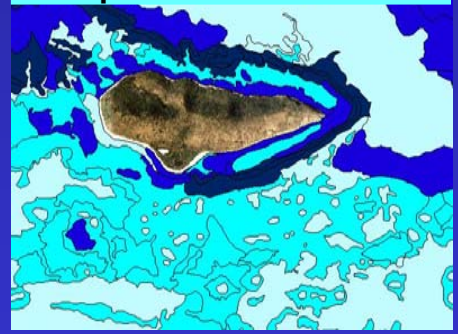


Complete Assessment



Coral Reef Ecosystem Study

Past Sampling Year (April 2003-April 2004)

La Parguera
- 255 visual fish surveys
- 1,275 benthic quadrat surveyed at randomly selected sites stratified by mangrove, SAV, hardbottom habitats

St. John
- 288 visual fish surveys
- 540 benthic quadrants on SAV and hardbottom habitats
- July 2004 144 stations

Buck Island - complementary site (NOAA Coral Funds)
- 200 visual fish surveys
- 1,000 benthic quadrants on SAV and hardbottom habitats

NOAA/NOS
National Centers for Coastal Ocean Science

NOAA NOS Biogeography Program Field Activities

To Date, a Total of 1500 Sites have been Surveyed (appx. 350 during FY02) to Develop a Comprehensive Baseline Characterization of Coral Reefs and Associated Biological Communities around St. John, St. Croix, and Southwestern Puerto Rico

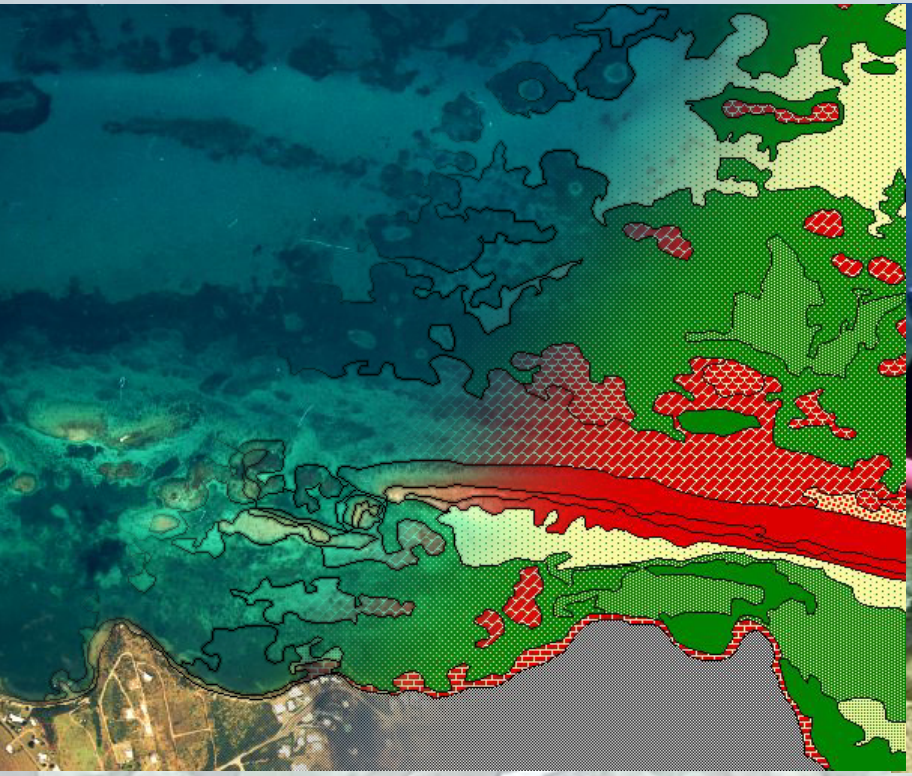
simultaneous collections

Fish Data Collected
- Abundance and Distribution
- Size Structure
- Trophic Dynamics (Gut Content Analysis)
- Habitat Utilization Patterns
- Community Structure (Diversity, Richness, etc.)

Fine-scale Habitat Characterization Data
- Coral Cover and Taxonomy
- Algal Cover and Taxonomy
- Seagrass Cover and Taxonomy
- Physiography
- Disease

Water Quality Data
- Temperature
- Salinity
- Turbidity
- Dissolved Oxygen
- Nitrates

Integration of Mapping, Monitoring & Assessments

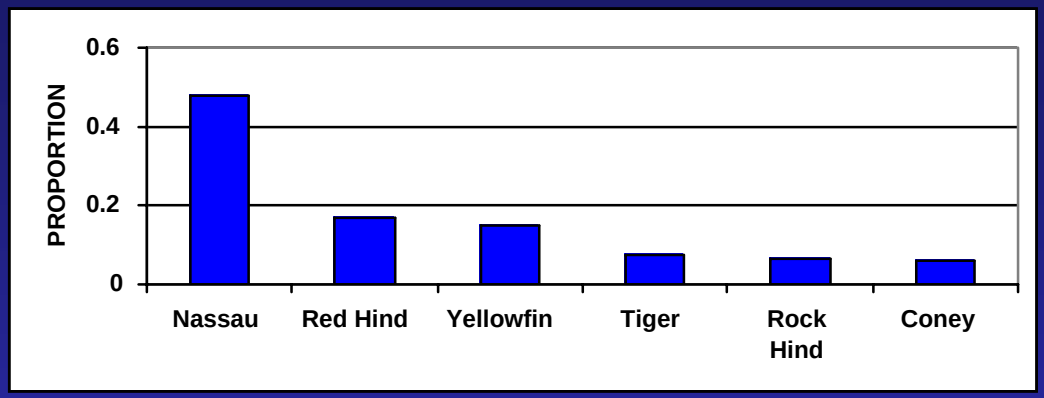


Habitat maps

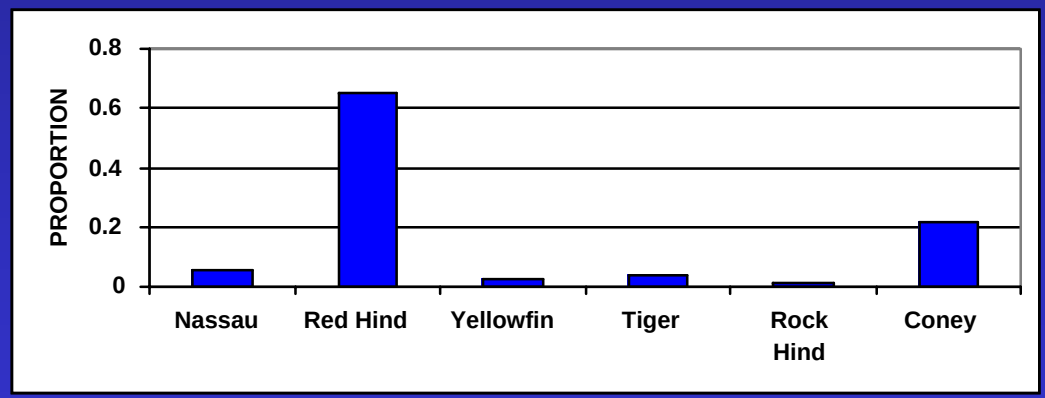
Divers collecting benthic habitat, fish size, and abundance data.

Historical Data Analyses

Abundance Comparisons



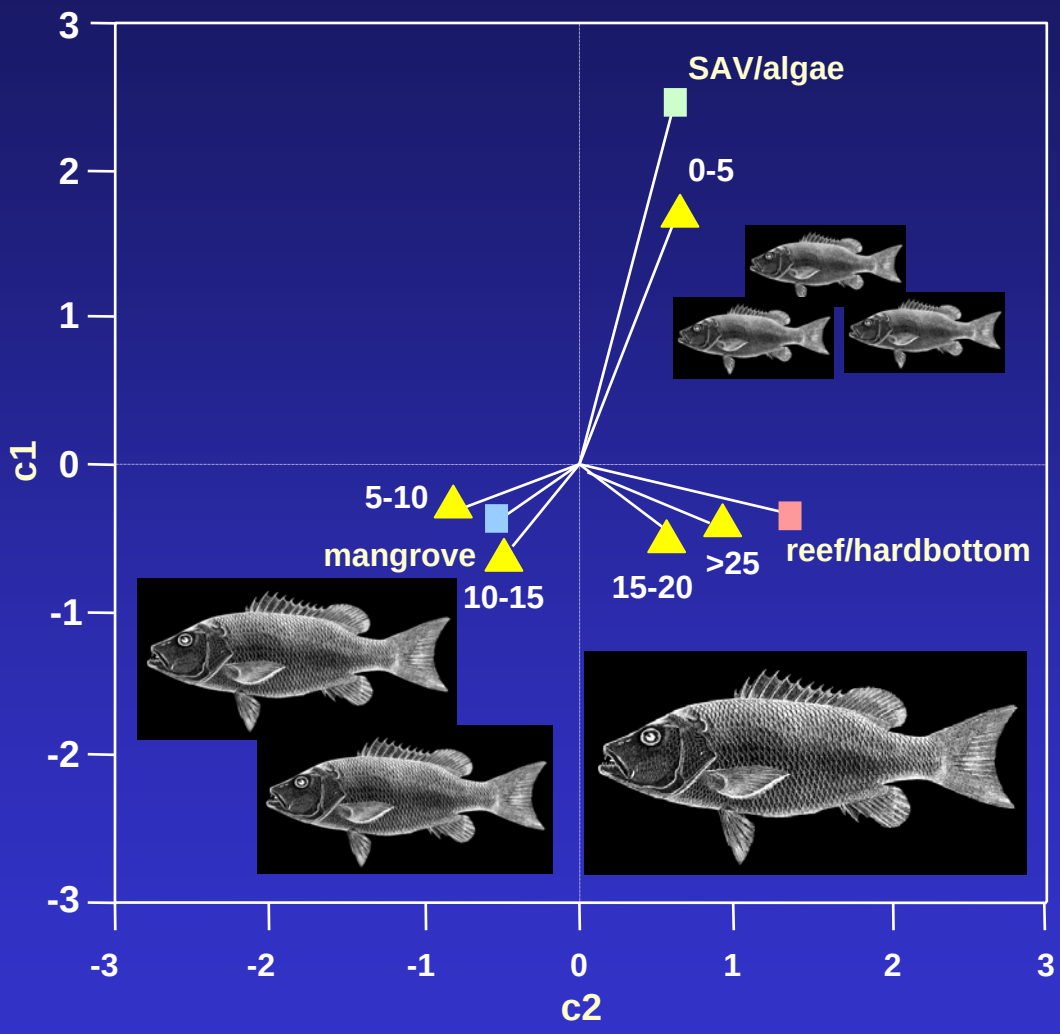
Comparison of the relative abundance of groupers collected by Randall, 1958-1961 around St. John, US Virgin Islands.



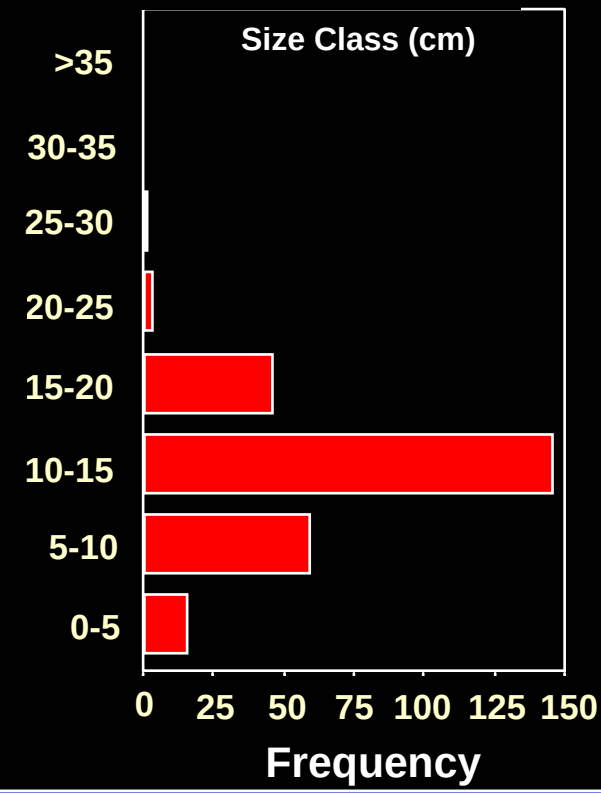
Comparison of the relative abundance of groupers observed by J. Beets, 1989-2000 around St. John, US Virgin Islands.

Example Assessment from Puerto Rico

Gray Snapper Habitat Utilization



In this example, smaller snappers (0-5cm size class) were observed to select for submerged vegetation, while intermediate sized fishes (5-15cm) selected for mangrove habitats, and the largest size classes (15+ cm) selected for reef structure.



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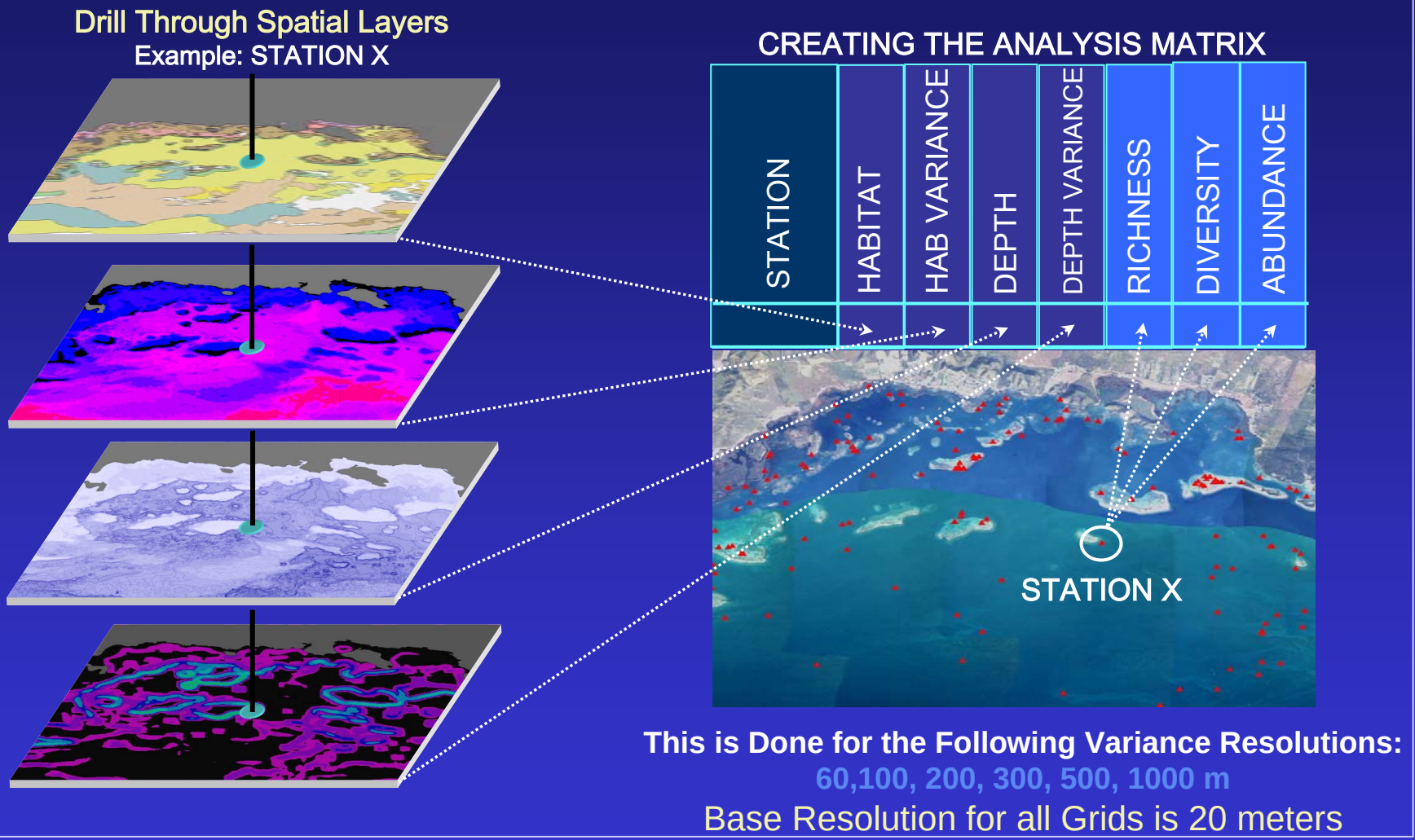
Example Assessment from Puerto Rico

Coupling Habitat & Biological Data



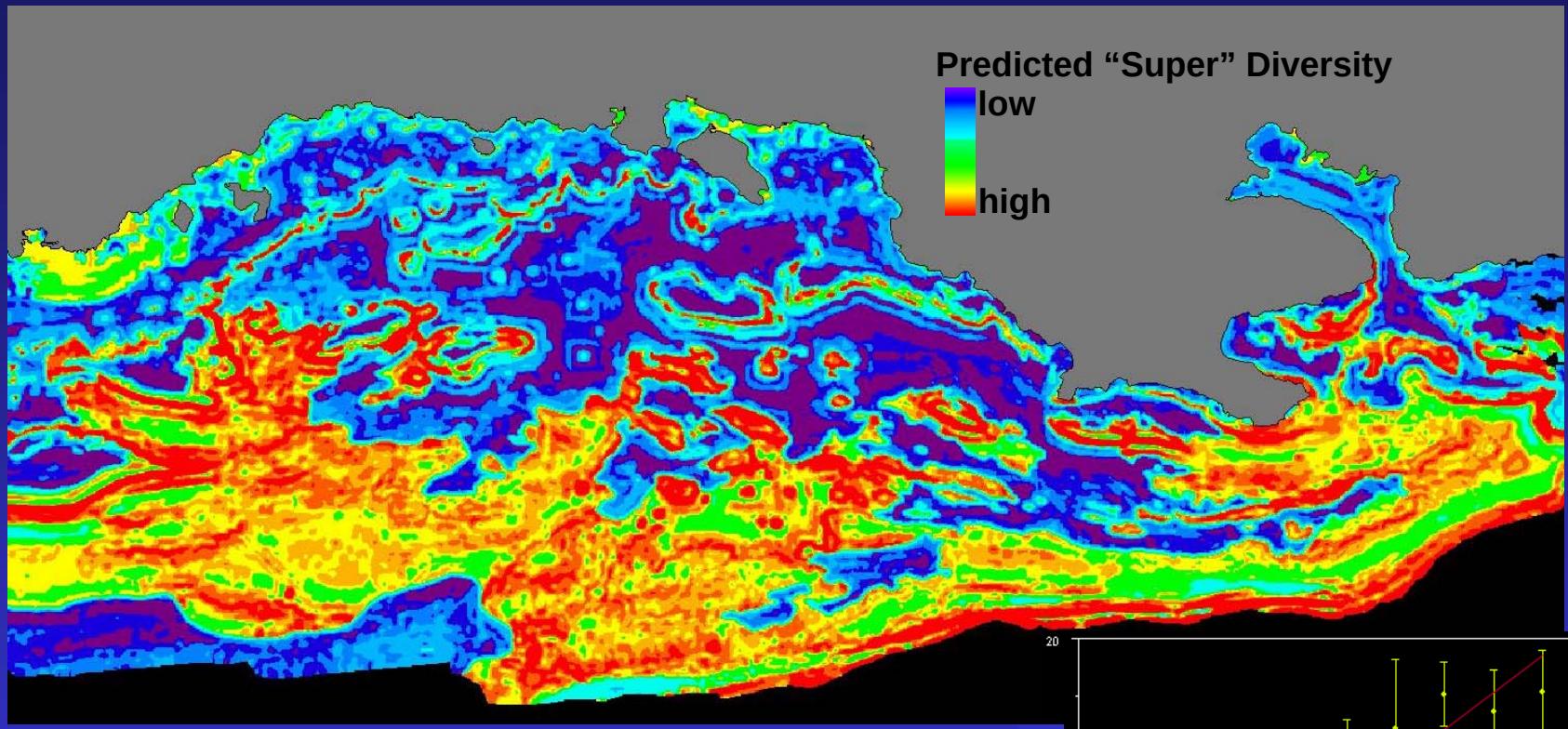
This is Done for the Following Variance Resolutions:

60,100, 200, 300, 500, 1000 m

Base Resolution for all Grids is 20 meters

Example Assessment from Puerto Rico

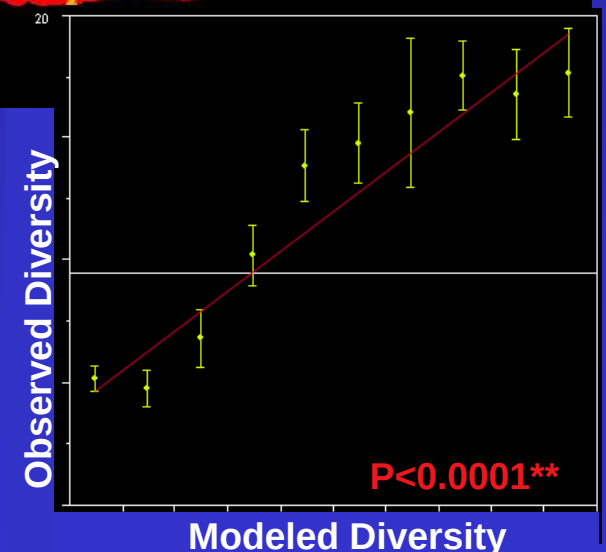
Modeling Fish Biodiversity



MAP ACCURACY

OVERALL

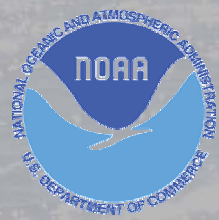
0.77



NOAA Ship Nancy Foster Deepwater Mapping and Biological Resource Assessment Cruise Debrief:

Seafloor Characterization and Biological Resource Inventory of the Buck Island Reef National Monument (BIRNM, St. Croix), and the US Virgin Islands National Coral Reef Monument (VINCRM, St. John/Thomas)

February 22 – March 3, 2004



A Collaboration Between
National Oceanic & Atmospheric Administration (NOAA)
US National Park Service (NPS)
Triton Elics International, Inc.
USVI Division of Fish & Wildlife

Mission Objectives

MAPPING

To explore the type and extent of habitats in selected portions of both National Monuments (BIRNM, VINCRM) using multi-beam sonar and towed video cameras.

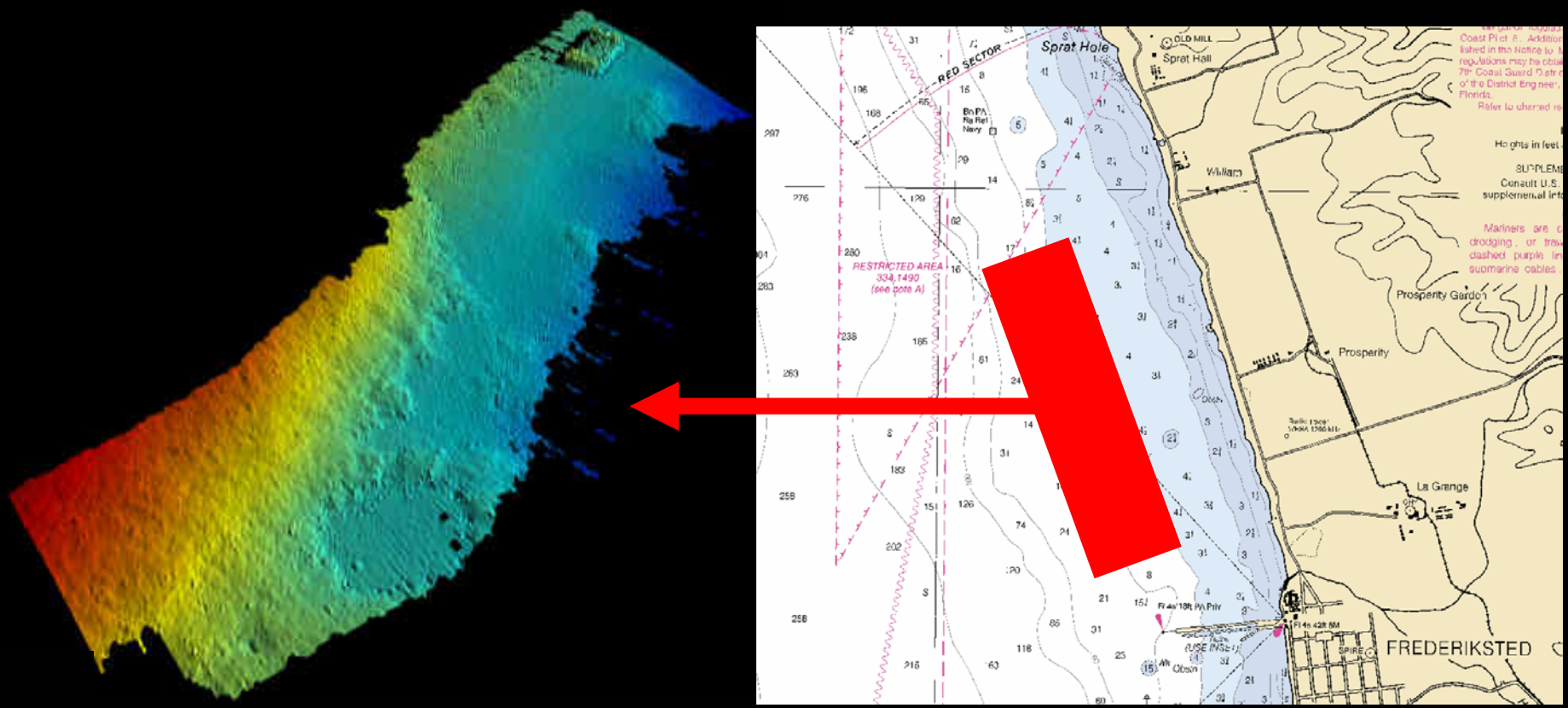
BIOLOGICAL RESOURCE INVENTORY

To conduct spatially-coincident fish trap surveys and visual censuses (e.g. visual observation by divers) of fish, conch, and lobsters to characterize the populations of these resources within and outside the National Monuments.

INTEGRATION

To produce maps of the seafloor topography, and spatially-explicit models of how fish species utilize habitats using data collected during the mission.

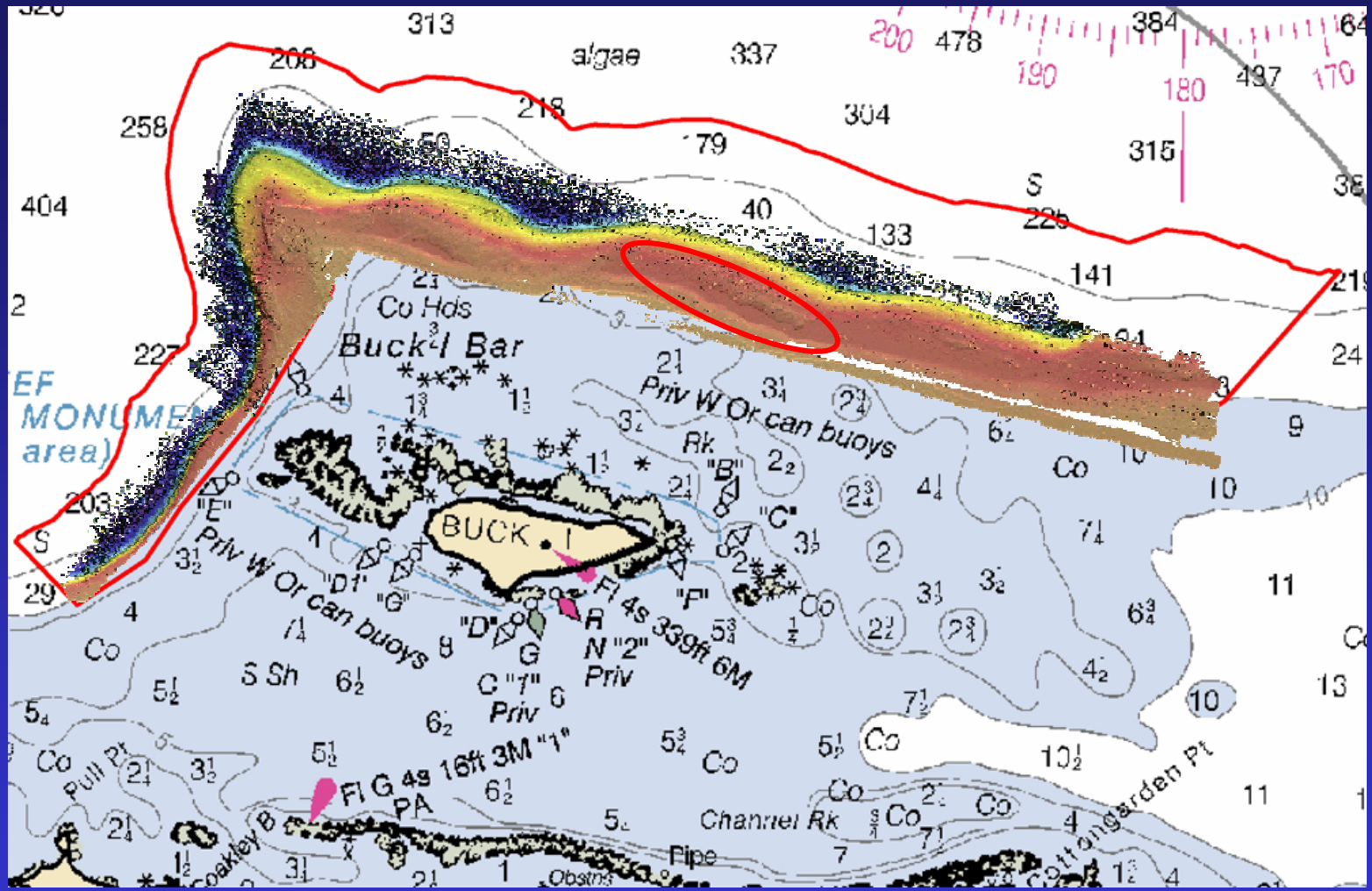
Mission Mapping Activities - Preliminary Results



US Virgin Islands Division of Fish & Wildlife "Target of Opportunity" (St. Croix, West)

- 3.0 square nautical miles mapped (bathymetry, backscatter, and pseudo-sidescan)

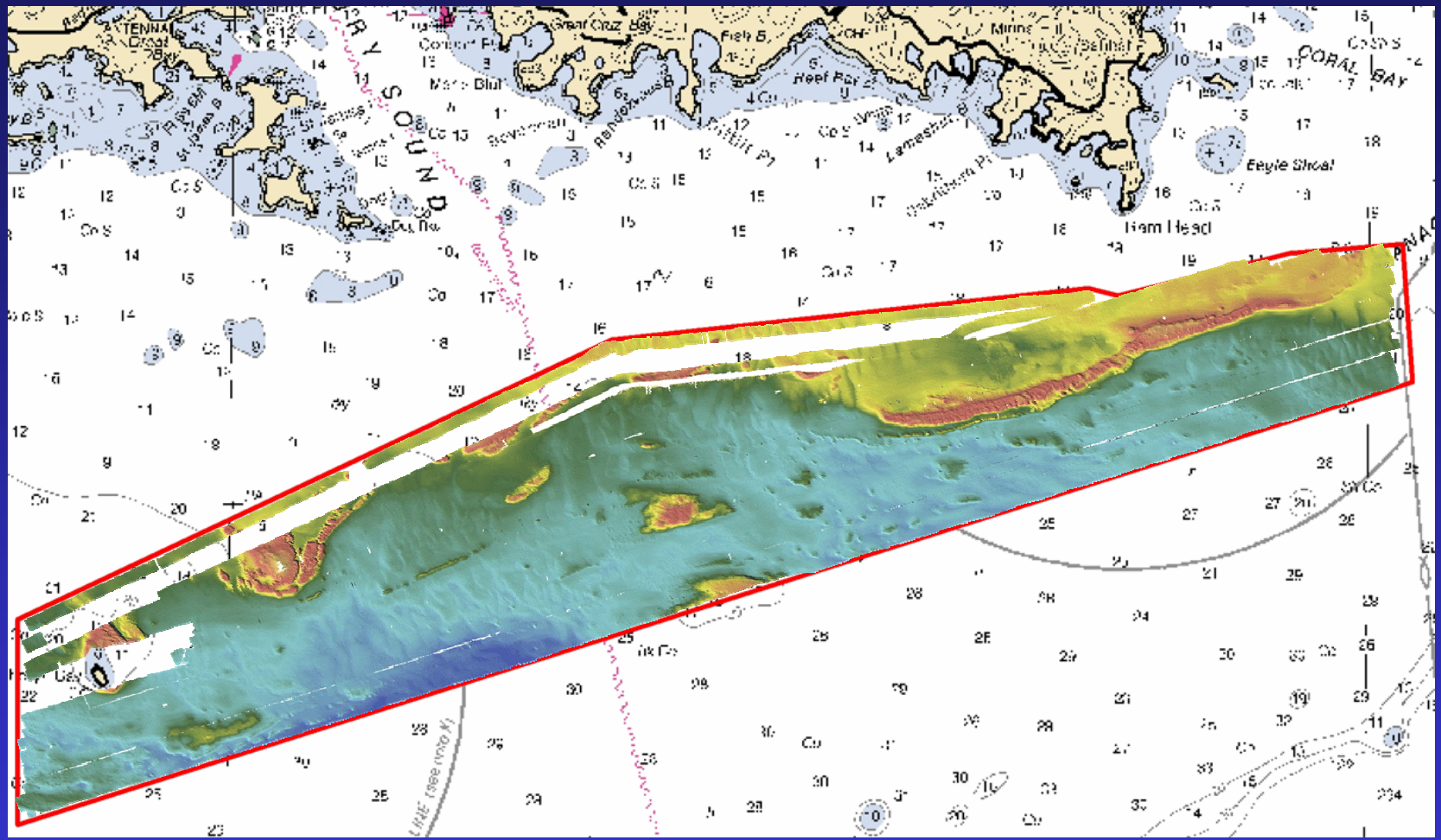
Mission Mapping Activities - Preliminary Results



Buck Island Reef National Monument (BIRNM)

- 3.0 square nautical miles mapped (bathymetry, backscatter, and pseudo-sidescan)

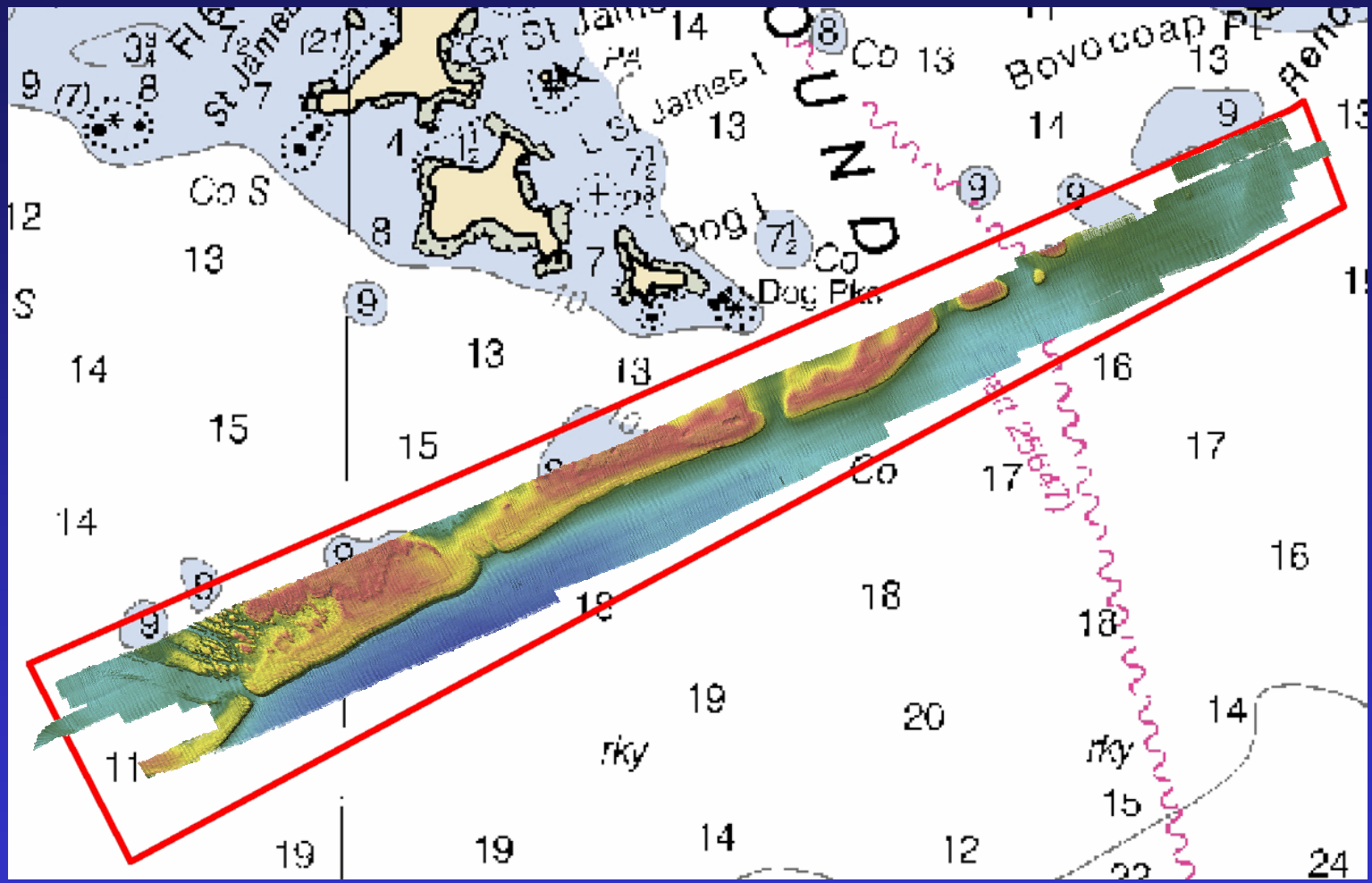
Mission Mapping Activities - Preliminary Results



US Virgin Islands National Coral Reef Monument (VINCRM; Mid Shelf Reef "East")

- 34 square nautical miles mapped (bathymetry, backscatter, and pseudo-sidescan)

Mission Mapping Activities - Preliminary Results



US Virgin Islands: "Mid Shelf Reef West" (Not Within National Monuments)

- 5.8 square nautical miles (bathymetry, backscatter, and pseudo-sidescan)

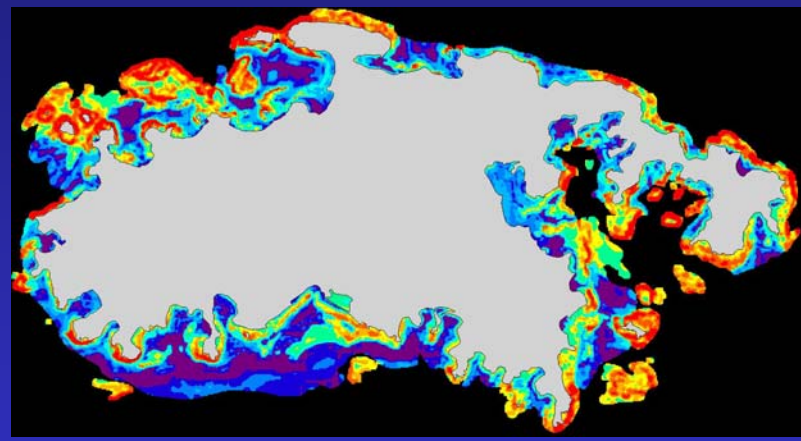
Deepwater Reef Biological Assessment Activities

Objectives

To conduct fish trap surveys and visual censuses (e.g. visual observation by divers) of fish, conch, and lobsters along deepwater reef sites that were being mapped to characterize the populations of these resources inside and outside of the US National Park Service Monuments.

Fish Trapping Activities

- Size
- Weight
- Community Structure
  - Species Richness
  - Diversity
  - Rarity



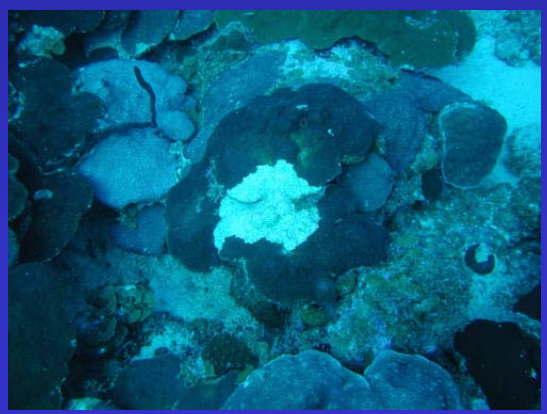
Example Integrated Model
Spatially-articulated Estimate of Biological Diversity (Christensen, 2003)

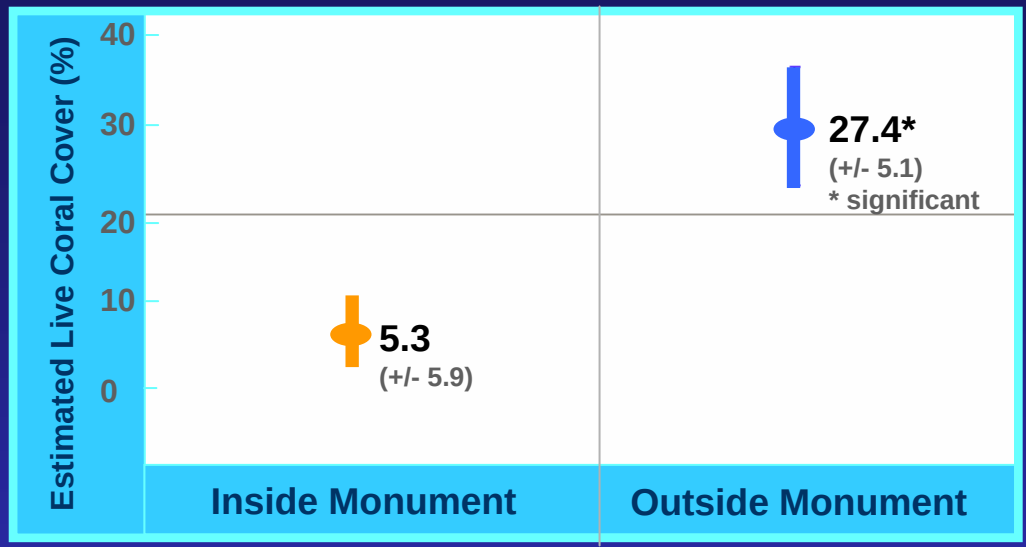
SCUBA Activities

- Transects (Number & Size of all Taxa)
- Point Counts (Number & Size of all Taxa)
- Habitat Assessment
  - Habitat Type
  - Depth
  - Complexity (Rugosity)
  - Abiotic Footprint
  - Biotic Footprint

Deepwater Biological Assessment Activities

Preliminary Results: Benthic Habitats



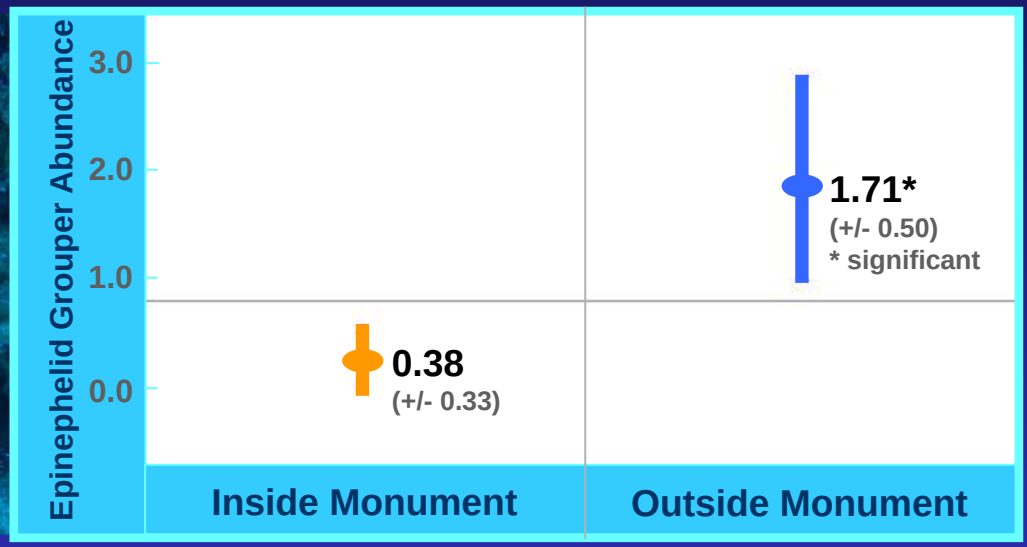


Further Habitat Data Analyses Indicating Significant Differences Among Sites Inside and Outside of the NPS Monument (Alpha = 0.05)

- Rugosity (Measure of Complexity): Higher Outside
- Percent Hardbottom: Higher Outside
- Percent Gorgonian Coverage: Higher Outside
- Percent Algal Turf Coverage: Higher Inside

Deepwater Biological Assessment Activities

Preliminary Results: Reef Fish Trapping Study



Summary Statistics for 24 Trap Sites in St. John

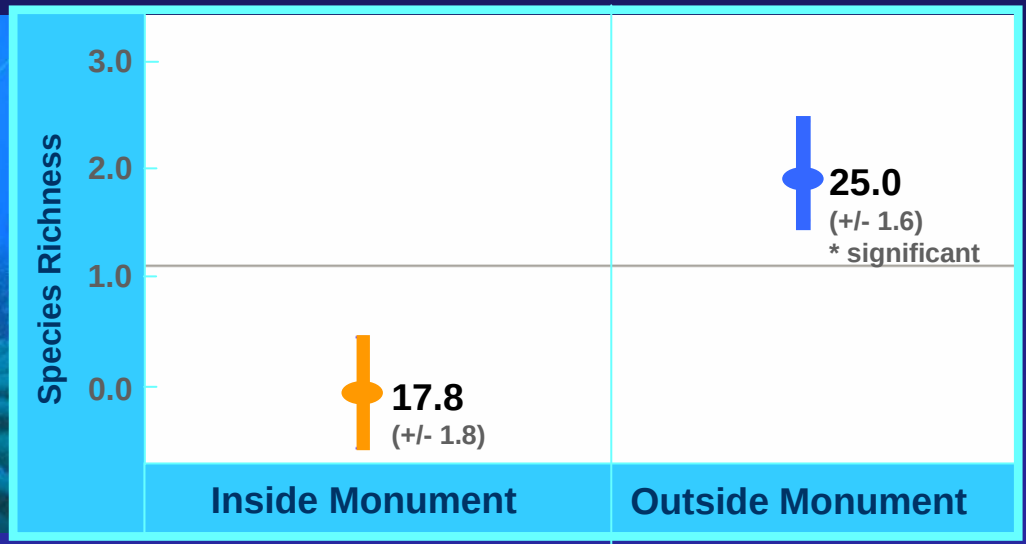
17 Species
43 Individuals
Size Class Distribution:
- <15 cm: 21.9%
- 15-25 cm: 70.8%
- 25-35 cm: 6.6%
- 35+ cm: 0.7%

Trap Data Analyses Indicating No Significant Difference Among Sites Inside and Outside of the NPS Monument

- Number of Fishes Caught
- Weight of Fishes
- Number of Snappers & Grunts
- Weight of Snappers & Grunts
- Size of Groupers
- Weight of Groupers

Deepwater Reef Biological Assessment Activities

Preliminary Results: Reef Fish Census



Summary Statistics for 28 Dive Sites in St. John

- 128 Species
- 8,274 Individuals
- Size Class Distribution:

<5 cm: 71.8%
05-10 cm: 11.1%
10-15 cm: 5.9%
15-20 cm: 6.4%
20-25 cm: 3.9%
25-30 cm: 0.6%
30-35 cm: 0.2%
35+ cm: 0.1%

Further Census Data Analyses Indicating Significant Differences Among Sites Inside and Outside of the NPS Monument (Alpha = 0.05)

- Total Number of Individuals: Higher Outside
- Snapper/Grunt/Grouper size Class Distribution: Larger Fish Outside

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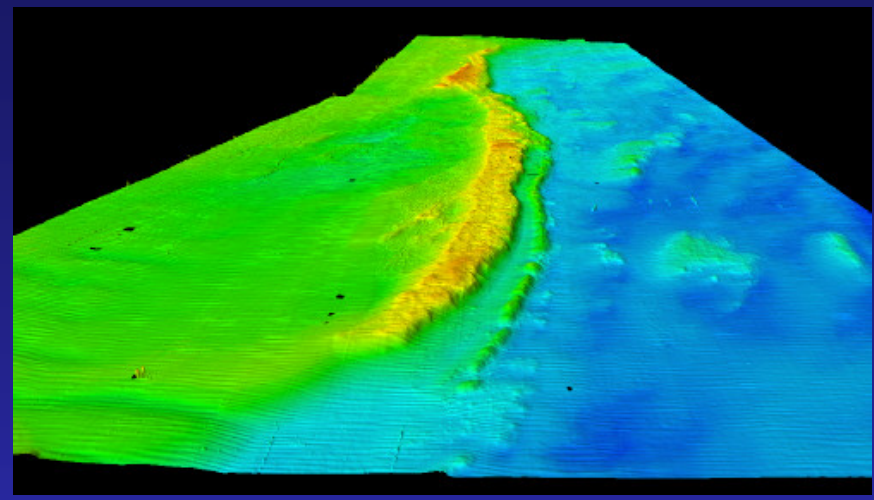
Deepwater Coral Mapping Activities

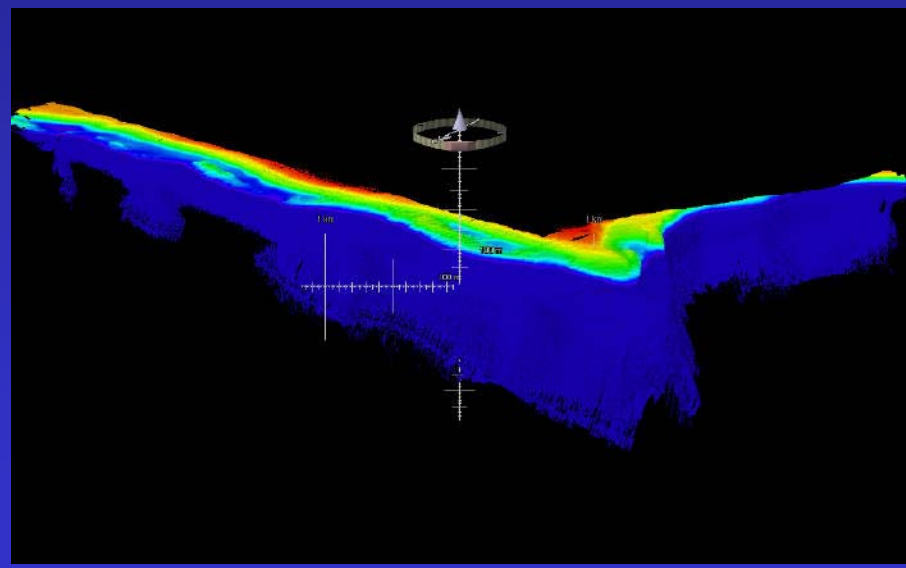
Next Steps

1) NCCOS will contract the post-process "cleaning" of the data. These will be provided to the Pacific Hydrographic Branch for QA/QC and smooth tide correction. PHB will return the data to NCCOS once the data have been certified to meet hydrographic standards. Estimated timeframe to completion: 2-3 months for each component.

2) NCCOS will continue to explore collaboration and partnerships so as characterize biologically-based seafloor habitats from the combination of bathymetry, backscatter, and pseudo-sidescan. Estimated timeframe to completion: 6-8 months for preliminary products.

3) Begin pre-mission planning for USVI surveying Year 2: Identify AOI's; pursue funding; pursue appropriate complement of personnel, platform, and survey systems; integrate results of Steps 1 and 2. Estimated timeframe to begin planning: 6-8 months for preliminary products.





Integrative Mapping, Monitoring & Assessment

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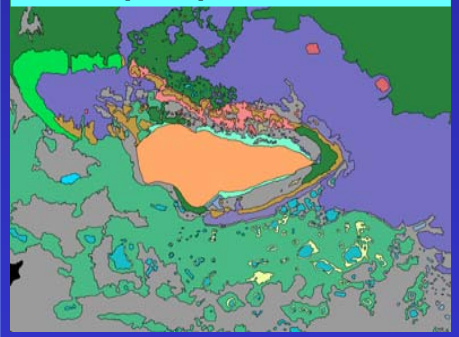
Acquire Imagery

Develop Map



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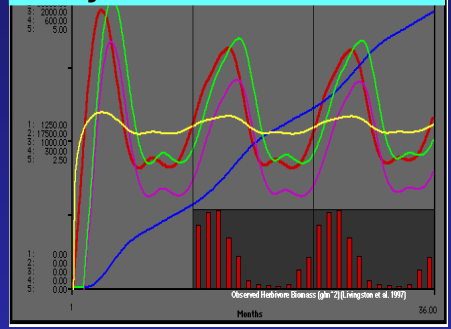

Complete Assessment