St. Croix, USVI Trip Report

NOAA/NOS/NCCOS/CCMA Biogeography Branch

May 7-18, 2012

St. Croix Hard Bottom Fish and Benthic Community Characterization

A cooperative investigation between NOAA, National Park Service, Virgin Islands Department of Planning and Natural Resources, The Nature Conservancy, the University of the Virgin Islands, and the University of Miami













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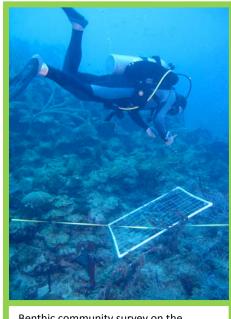
Mission Purpose and Background

A collaborative research effort between the NOAA's National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Monitoring and Assessment's (CCMA) Biogeography Branch (BB) and the National Park Service (NPS) has been inventorying and assessing reef fish populations in reef and reef-associated habitats in the northeast region of St. Croix from 2001-2011. The diver-based fish and benthic community survey methods have been developed to enable broader region-wide coverage at the scale of the USVI yet maintains high precision at smaller - Marine Protected Area (MPA) - spatial scales. Region-wide population metric estimates are required to effectively manage reef fisheries but are also imperative for spatial management and understanding ecosystem-level processes, such as measuring MPA efficacy. To date, very little information exists outside the northeast portion of St. Croix and this effort was designed to establish a baseline characterization for the whole island of St. Croix. This effort was also a logistical as well as statistical primer for the implementation of the National Coral Reef

Monitoring Program that will start in 2016. This program will implement a standardized fish and benthic community surveys across the USVI, Puerto Rico, Florida Keys and Flower Garden Banks National Marine Sanctuary and serve as a broad scale monitoring tool for the foreseeable future.

In May 2012, NOAA led a multiagency mission to conduct a comprehensive assessment of fish and benthic communities at depths between 1-100 feet (0.5-30 m) around the island of St. Croix. The mission included over 35 participants from NOAA-NCCOS, NOAA's Southeast Fisheries Science Center (SEFSC), the National Park Service (NPS, South Florida/Caribbean Network - Miami, St. John, and St. Croix), Virgin Islands Department of Planning and Natural Resources, The Nature Conservancy, the University of the Virgin Islands (St. Thomas campus and St. Croix campus), and the University of Miami.

The survey design implements a stratified random approach built around metrics from pre-existing data from the northeast region and extrapolated to the whole island. The survey stratification comprises hardbottom benthic habitats, two depth zones (less than and greater than 9.1m (30ft), and



Benthic community survey on the northshore of St. Croix.

region. There are 7 regional strata including 3 marine protected areas (MPAs)-Buck Island Reef National Monument managed by the National Park Service; East End Marine Park managed by the USVI

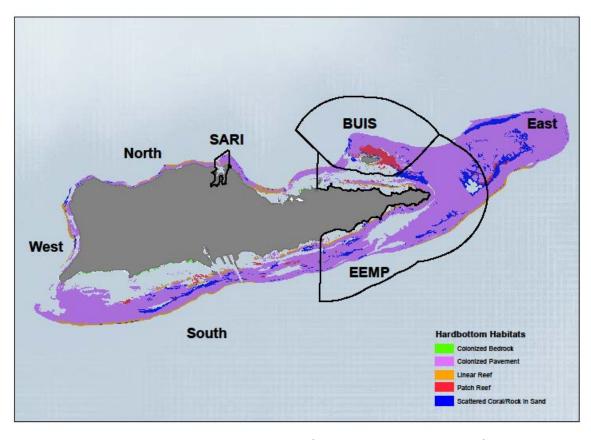


Figure 1. Hardbottom benthic habitats and regional strata for St. Croix. BUIS=Buck Island Reef National Monument; EEMP=East End Marine Park; and, SARI=Salt River Bay National Historic Park and Ecological Preserve.

Department of Planning and Natural Resources; and, the Salt River Bay National Historic Park and Ecological Preserve co-managed by NPS and USVI DNR (Figure 1). NOAA developed benthic habitat maps in 2001 where soft and hard bottom habitats were delineated from nearshore to depths near 30m (~100 ft) (http://ccma.nos.noaa.gov/ecosystems/coralreef/usvi pr mapping. aspx).

Previous fish and benthic community surveys in northeast St. Croix were conducted on all habitat types, this mission focused on hard bottom habitats including linear reef, patch reef, colonized pavement, scattered coral and rock in sand, and bedrock (Figure 1).



Overall 250 sites, with an additional 100 alternates, were originally allocated for the island wide survey. The goal was to survey all 250 sites and to include additional sites if time and weather permitted.

Survey Methods

All fish were identified to species, counted and measured in 5 cm size bins along a 100 m² (25x4m) belt transect (http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html).

Benthic surveys were collected along the same transect as the fish survey. The complete protocol can be found here: Percent cover of benthic organisms were estimated at 5 random locations along the transect using a 1 m² qaudrat. Percent cover of scleractinian corals were estimated by species, while other taxa were estimated in broader groups: filamentous algae, macroalgae, turf algae, crustose coralline algae, upright sponges, encrusting sponges, upright gorgonians, encrusting gorgonians, hydrocorals, tunicates, anemones, and zooanthids (http://ccma.nos.noaa.gov/ecosystems/coralreef/reef fish/protocols.html).

Other data collected included the counting of conch, lobster and diadema in each transect. Also the presence/absence of *Acropora cervicornis* and *A. palmata* on the transect or at the site level were recorded. Marine debris was also noted if observed on the transect.

Operational Accomplishments

- The team of 35 field participants using 7 boats completed 290 surveys in 10.5 days of operations around the island (Figure 2).
- Trained at least 12 divers either fish or habitat data collection methods
- Most boats averaged 6 dives per day.
- Very few boat breakdowns
- Used multiple dive shops around the island
- Dive reciprocity was granted between NPS and UVI, definitely helped staffing flexibility.
- Most boats were stationed at Christiansted, but one vessel
 was kept at Salt River, one small boat was trailered along
 the northeast and west shores, and one boat was moored
 on the west end for a few days.
- Zero accidents!



Three lionfish observed in the BUIS strata. Overall, 38 lionfish were seen on transects.

Logistics of Note

- Most out of town field participants stayed in the same housing area. This was very useful for planning and organization. It is highly recommended for future missions, this will be useful for keeping track of stations and keeping track of diver safety/health.
- Most boats were docked in Christiansted. We used one small whaler that could be trailered and used in protected areas. A few days it was launched in Fredericksted and worked the west side. Working the southside is still tricky. We tried to get access at Hovensa but it is a huge logistical nightmare. Will keep looking for other options. The best option was to use a mooring provided by N2theblue dive shop at Fredericksted and drive back and forth each day. This boat could work the southwest and west portions of the island. This was much better than boating from Christiansted. Boats departing from Christiansted and heading east could work the southeast portion of the island. Both options are sea-state dependent.

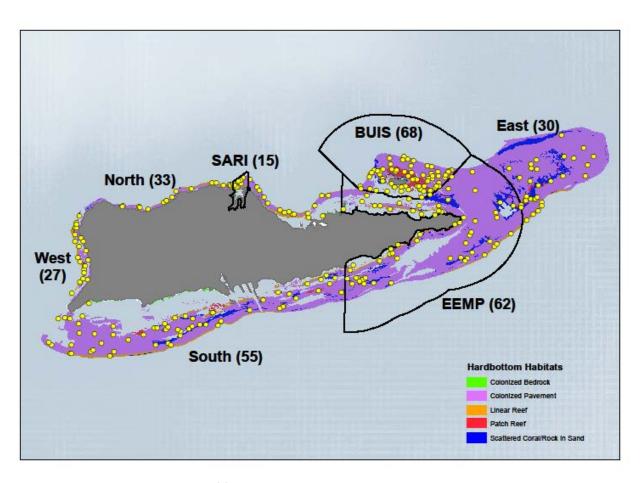


Figure 2. Spatial distribution of fish and benthic surveys.

Summary of survey results, by region

Fish and benthic habitat summary statistics for the East region (Deep strata only, no shallow strata in this region). *Shannon Diversity Index.

| гізіі | Number of | # indiv / | 100m ² | biomass (kg | g)/100m ² | # species / | / 100m² | *Diversity | /100m ² |
|-------------------------|-----------|-----------|-------------------|-------------|----------------------|-------------|-------------|------------|--------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | 5 | 217.2 | 37.8 | 11.7 | 4.4 | 28.6 | 1.7 | 2.5 | 0.1 |
| pavement | 16 | 285.6 | 20.1 | 8.3 | 1.1 | 22.1 | 0.8 | 2.1 | 0.1 |
| linear reef | 5 | 190.8 | 13.0 | 9.9 | 1.5 | 26.4 | 2.0 | 2.6 | 0.1 |
| scattered coral/rock | 4 | 148.8 | 38.9 | 5.6 | 2.7 | 17.5 | 4.5 | 2.1 | 0.2 |
| OVERALL | 30 | 267.4 | 15.3 | 8.0 | 0.9 | 21.7 | 0.7 | 2.1 | 0.1 |

| Benthic | Number | %Coral , | / 100m² | % Gorgo 100 | | % Spo 100 | · . | % Macr | · . | %Turf / | 100m ² |
|-------------------------|------------|----------|-------------|----------------|-------------|--------------|-------------|--------|-------------|---------|-------------------|
| | of surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | 5 | 7.7 | 2.5 | 2.0 | 0.7 | 0.8 | 0.3 | 20.3 | 7.0 | 37.2 | 8.1 |
| pavement | 16 | 3.4 | 1.1 | 1.6 | 0.5 | 2.7 | 0.6 | 6.1 | 0.8 | 67.1 | 2.8 |
| linear reef | 5 | 5.0 | 2.2 | 2.8 | 1.4 | 2.7 | 1.4 | 11.5 | 1.3 | 50.1 | 11.6 |
| scattered coral/rock | 4 | 1.8 | 1.8 | 1.1 | 0.9 | 1.8 | 1.6 | 13.4 | 9.5 | 28.1 | 14.0 |
| OVERALL | 30 | 3.3 | 0.9 | 1.6 | 0.3 | 2.6 | 0.5 | 7.2 | 0.7 | 61.8 | 2.3 |



Fish and benthic habitat summary statistics for the East End Marine Park (EEMP) region. *Shannon Diversity Index.

| Fish | Number of | # indiv | / 100m ² | bion (kg)/1 | nass 00m² | | cies /)m² | *Diversit | y/100m ² |
|-------------------------|--------------|---------|---------------------|----------------|--------------|------|---------------|-----------|---------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | 5 | 182.2 | 53.7 | 40.0 | 29.1 | 23.8 | 5.3 | 2.1 | 0.4 |
| pavement | 17 | 172.8 | 16.4 | 5.0 | 1.5 | 20.4 | 1.3 | 2.2 | 0.1 |
| linear reef | 4 | 189.0 | 35.8 | 19.6 | 6.3 | 27.5 | 3.9 | 2.6 | 0.2 |
| scattered coral/rock | 5 | 313.6 | 142.1 | 11.9 | 7.9 | 20.2 | 5.7 | 1.9 | 0.2 |
| Deep total | 31 | 186.3 | 14.3 | 6.1 | 1.3 | 20.4 | 1.1 | 2.2 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | 5 | 53.2 | 24.7 | 3.5 | 3.2 | 10.6 | 3.5 | 1.4 | 0.4 |
| patch reef | 5 | 132.8 | 28.4 | 5.7 | 1.6 | 20.4 | 4.2 | 2.3 | 0.2 |
| pavement | 12 | 168.9 | 28.3 | 6.2 | 2.3 | 19.1 | 1.8 | 2.3 | 0.1 |
| linear reef | 6 | 119.5 | 24.3 | 1.4 | 0.4 | 18.8 | 2.6 | 2.3 | 0.3 |
| scattered coral/rock | 3 | 53.7 | 9.2 | 0.5 | 0.2 | 11.0 | 3.1 | 1.8 | 0.3 |
| Shallow total | 31 | 145.4 | 12.9 | 4.7 | 1.0 | 18.3 | 0.9 | 2.2 | 0.0 |
| Overall | 62 | 178.7 | 9.9 | 5.8 | 0.9 | 20.0 | 0.8 | 2.2 | 0.0 |

| Benthic | Number of | %Coral , | / 100m² | % Gorg | | % Spo 100 | | % Macr 100 | | %Τι 100 | • |
|-------------------------|--------------|----------|-------------|--------|-------------|--------------|-------------|---------------|-------------|------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | 5 | 7.2 | 2.7 | 9.0 | 8.0 | 3.4 | 1.7 | 12.4 | 7.7 | 17.7 | 7.7 |
| pavement | 17 | 2.4 | 0.6 | 1.2 | 0.5 | 2.6 | 0.4 | 19.0 | 5.2 | 52.9 | 6.8 |
| linear reef | 4 | 10.1 | 1.7 | 4.5 | 2.2 | 4.0 | 0.6 | 14.8 | 2.5 | 54.0 | 8.8 |
| scattered coral/rock | 5 | 3.0 | 2.0 | 0.4 | 0.2 | 1.5 | 0.7 | 12.3 | 9.6 | 32.2 | 15.2 |
| Deep total | 31 | 2.6 | 0.5 | 1.2 | 0.4 | 2.5 | 0.3 | 18.3 | 4.2 | 50.7 | 5.5 |
| Shallow | | | | | | | | | | | |
| bedrock | 5 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 1.7 | 7.4 | 5.7 |
| patch reef | 5 | 0.7 | 0.3 | 0.4 | 0.3 | 0.4 | 0.2 | 27.9 | 12.9 | 9.8 | 4.2 |
| pavement | 12 | 1.8 | 0.5 | 0.6 | 0.3 | 1.1 | 0.4 | 21.3 | 5.7 | 47.6 | 7.8 |
| linear reef | 6 | 1.0 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 13.5 | 6.1 | 32.6 | 9.1 |
| scattered coral/rock | 3 | 3.3 | 3.3 | 0.2 | 0.2 | 0.2 | 0.2 | 5.8 | 4.2 | 23.7 | 23.7 |
| Shallow total | 31 | 1.6 | 0.2 | 0.5 | 0.1 | 0.7 | 0.2 | 18.4 | 2.6 | 39.7 | 3.7 |
| Overall | 62 | 2.4 | 0.3 | 1.1 | 0.3 | 2.2 | 0.2 | 18.3 | 2.9 | 48.6 | 3.8 |

Fish and benthic habitat summary statistics for the South region. *Shannon Diversity Index.

| Fish | Number of | # ind 100 | div /)m² | bion (kg)/1 | nass 00m² | # spe 100 | | *Diversit | y/100m ² |
|-------------------------|--------------|--------------|--------------|----------------|--------------|--------------|-------------|-----------|---------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | 3 | 144.3 | 9.8 | 5.9 | 3.8 | 18.0 | 2.9 | 2.0 | 0.2 |
| pavement | 16 | 185.4 | 23.9 | 11.6 | 4.5 | 18.9 | 1.2 | 2.1 | 0.1 |
| linear reef | 4 | 411.0 | 61.5 | 17.6 | 3.0 | 29.5 | 4.6 | 2.3 | 0.1 |
| scattered coral/rock | 4 | 118.0 | 41.2 | 6.8 | 5.1 | 11.5 | 4.0 | 1.5 | 0.5 |
| Deep total | 27 | 193.6 | 18.0 | 11.6 | 3.3 | 18.9 | 1.0 | 2.0 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | 1 | 105.0 | | 1.1 | | 16.0 | | 1.9 | |
| patch reef | 3 | 165.7 | 20.9 | 14.3 | 9.1 | 25.0 | 4.0 | 2.5 | 0.1 |
| pavement | 19 | 141.9 | 24.3 | 17.5 | 12.9 | 18.9 | 2.1 | 2.1 | 0.1 |
| linear reef | 2 | 112.5 | 12.5 | 2.7 | 0.9 | 18.0 | 2.0 | 2.3 | 0.1 |
| scattered coral/rock | 3 | 67.0 | 23.7 | 21.0 | 19.4 | 13.7 | 4.4 | 1.8 | 0.6 |
| Shallow total | 28 | 136.3 | 14.2 | 15.4 | 7.5 | 18.9 | 1.2 | 2.1 | 0.1 |
| Overall | 55 | 170.3 | 8.7 | 13.1 | 2.4 | 18.9 | 0.5 | 2.1 | 0.0 |

| Douthio | Number | 0/6 | / 400 ··· ² | % Gorgo | | % Spo | | % Macr | | %Tu | |
|-------------------------|---------|----------|------------------------|---------|-------------|-------|-------------|--------|-------------|------|-------------|
| Benthic | of | %Coral / | / 100m | 100 |)m | 100 |)m | 100 | ım | 100 |)m |
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | 3 | 0.4 | 0.0 | 0.5 | 0.3 | 2.4 | 0.4 | 20.5 | 14.8 | 40.9 | 26.6 |
| pavement | 16 | 1.2 | 0.3 | 0.6 | 0.3 | 3.2 | 0.9 | 17.3 | 5.5 | 40.0 | 8.7 |
| linear reef | 4 | 3.9 | 1.3 | 0.6 | 0.3 | 7.4 | 1.7 | 29.3 | 15.7 | 20.5 | 7.6 |
| scattered coral/rock | 4 | 0.5 | 0.3 | 0.0 | 0.0 | 0.4 | 0.2 | 3.2 | 1.6 | 16.9 | 12.6 |
| Deep total | 27 | 1.3 | 0.2 | 0.5 | 0.2 | 3.2 | 0.6 | 17.0 | 4.1 | 37.1 | 6.5 |
| Shallow | | | | | | | | | | | |
| bedrock | 1 | 0.2 | | 0.0 | | 0.2 | | 22.3 | | 72.4 | |
| patch reef | 3 | 0.3 | 0.1 | 1.1 | 1.1 | 1.5 | 1.3 | 14.2 | 2.6 | 23.5 | 20.2 |
| pavement | 19 | 1.5 | 0.4 | 0.4 | 0.2 | 1.1 | 0.3 | 27.0 | 5.5 | 32.8 | 7.2 |
| linear reef | 2 | 4.3 | 0.4 | 1.7 | 1.7 | 0.3 | 0.3 | 41.3 | 19.5 | 49.2 | 17.3 |
| scattered coral/rock | 3 | 2.7 | 2.1 | 0.0 | 0.0 | 1.5 | 0.7 | 12.0 | 10.5 | 21.0 | 10.0 |
| Shallow total | 28 | 1.6 | 0.2 | 0.6 | 0.1 | 1.0 | 0.2 | 26.7 | 3.4 | 34.9 | 4.3 |
| Overall | 55 | 1.4 | 0.1 | 0.5 | 0.1 | 2.3 | 0.3 | 20.9 | 2.0 | 36.2 | 3.0 |

Fish and benthic habitat summary statistics for the West region of St. Croix. *Shannon Diversity Index.

| Fish | Number of | # ind | div /)m² | bion (kg)/1 | nass 00m² | | cies /)m² | *Diversit | y/100m ² |
|-------------------------|--------------|-------|--------------|----------------|--------------|------|---------------|-----------|---------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | n/a | | | | | | | | |
| pavement | 3 | 142.3 | 18.7 | 11.7 | 4.1 | 22.3 | 2.2 | 2.4 | 0.1 |
| linear reef | 5 | 541.8 | 279.4 | 7.0 | 2.4 | 27.0 | 3.0 | 2.1 | 0.1 |
| scattered coral/rock | n/a | | | | | | | | |
| Deep total | 8 | 286.1 | 44.4 | 9.8 | 1.9 | 23.7 | 1.2 | 2.3 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | 3 | 45.3 | 8.8 | 0.3 | 0.2 | 8.0 | 0.0 | 1.6 | 0.0 |
| patch reef | n/a | | | | | | | | |
| pavement | 6 | 140.0 | 45.0 | 3.0 | 1.7 | 17.2 | 4.7 | 1.9 | 0.2 |
| linear reef | 5 | 326.8 | 51.1 | 10.9 | 2.3 | 29.4 | 1.9 | 2.5 | 0.1 |
| scattered coral/rock | 5 | 237.8 | 68.1 | 2.8 | 0.9 | 14.4 | 5.6 | 1.2 | 0.5 |
| Shallow total | 19 | 177.7 | 23.9 | 4.2 | 0.9 | 18.5 | 2.4 | 1.9 | 0.1 |
| Overall | 27 | 199.1 | 17.2 | 5.3 | 0.6 | 19.5 | 1.6 | 2.0 | 0.1 |

| Benthic | Number of | %Coral , | / 100m² | % Gorgo 100 | | % Spo 100 | | % Macr 100 | | %Τι 100 | |
|-------------------------|--------------|----------|-------------|----------------|-------------|--------------|-------------|---------------|-------------|------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | n/a | | | | | | | | | | |
| pavement | 3 | 3.4 | 2.8 | 0.1 | 0.1 | 4.9 | 2.6 | 0.3 | 0.2 | 18.6 | 18.6 |
| linear reef | 5 | 9.5 | 1.2 | 0.1 | 0.1 | 10.3 | 3.8 | 25.0 | 6.0 | 25.6 | 8.8 |
| scattered coral/rock | n/a | | | | | | | | | | |
| Deep total | 8 | 5.6 | 1.2 | 0.1 | 0.1 | 6.8 | 1.5 | 9.3 | 0.9 | 20.9 | 8.3 |
| Shallow | | | | | | | | | | | |
| bedrock | 3 | 2.6 | 1.6 | 0.3 | 0.3 | 0.9 | 0.7 | 1.0 | 0.9 | 25.2 | 19.6 |
| patch reef | n/a | | | | | | | | | | |
| pavement | 6 | 1.7 | 0.8 | 0.0 | 0.0 | 2.0 | 0.8 | 4.8 | 2.2 | 22.8 | 14.5 |
| linear reef | 5 | 8.9 | 2.8 | 0.5 | 0.4 | 7.4 | 0.9 | 14.5 | 11.9 | 14.6 | 8.0 |
| scattered coral/rock | 5 | 4.7 | 2.9 | 0.2 | 0.2 | 3.4 | 2.1 | 12.7 | 9.3 | 6.8 | 4.2 |
| Shallow total | 19 | 3.2 | 0.5 | 0.1 | 0.0 | 3.0 | 0.4 | 7.1 | 1.5 | 19.7 | 7.3 |
| Overall | 27 | 3.7 | 0.4 | 0.1 | 0.0 | 3.8 | 0.3 | 7.5 | 1.0 | 20.0 | 5.0 |

Fish and benthic habitat summary for the North region of St. Croix. *Shannon Diversity Index.

| Fish | Number of | # ind | div /)m² | bion (kg)/1 | nass 00m² | # spe 100 | cies /)m² | *Diversit | y/100m ² |
|-------------------------|--------------|-------|--------------|----------------|--------------|--------------|---------------|-----------|---------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | n/a | | | | | | | | |
| pavement | 4 | 299.0 | 122.3 | 11.2 | 2.8 | 28.5 | 5.0 | 2.1 | 0.2 |
| linear reef | 12 | 529.1 | 74.2 | 8.7 | 1.2 | 28.5 | 1.7 | 2.0 | 0.1 |
| scattered coral/rock | n/a | | | | | | | | |
| Deep total | 16 | 328.1 | 94.5 | 10.9 | 2.1 | 28.5 | 3.8 | 2.1 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | 1 | 104.0 | | 4.9 | | 20.0 | | 2.1 | |
| patch reef | n/a | | | | | | | | |
| pavement | 5 | 165.6 | 27.0 | 5.7 | 2.8 | 16.0 | 2.9 | 1.6 | 0.3 |
| linear reef | 8 | 453.5 | 173.7 | 11.7 | 2.7 | 26.6 | 1.7 | 2.2 | 0.1 |
| scattered coral/rock | 3 | 149.3 | 73.6 | 6.8 | 3.5 | 16.7 | 8.1 | 1.5 | 0.7 |
| Shallow total | 17 | 240.2 | 24.2 | 7.3 | 1.4 | 19.2 | 1.3 | 1.8 | 0.1 |
| Overall | 33 | 242.1 | 23.2 | 7.4 | 1.3 | 19.4 | 1.3 | 1.8 | 0.1 |

| Benthic | Number of | %Coral , | / 100m² | % Gorgo 100 | | % Spo 100 | | % Macr 100 | oalgae/)m² | %Τι 100 | |
|-------------------------|--------------|----------|-------------|----------------|-------------|--------------|-------------|---------------|----------------|------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | n/a | | | | | | | | | | |
| pavement | 4 | 12.7 | 1.5 | 0.8 | 0.5 | 2.8 | 0.6 | 48.4 | 12.4 | 25.7 | 8.5 |
| linear reef | 12 | 8.7 | 1.2 | 0.5 | 0.2 | 3.4 | 0.7 | 45.2 | 5.6 | 17.0 | 3.4 |
| scattered coral/rock | n/a | | | | | | | | | | |
| Deep total | 16 | 12.2 | 9.8 | 0.7 | 0.6 | 2.9 | 2.2 | 48.0 | 37.7 | 24.6 | 19.9 |
| Shallow | | | | | | | | | | | |
| bedrock | 1 | 0.9 | | 0.7 | | 1.2 | | 15.1 | | 2.0 | |
| patch reef | n/a | | | | | | | | | | |
| pavement | 5 | 4.5 | 0.8 | 0.6 | 0.2 | 2.1 | 0.8 | 17.5 | 11.8 | 41.8 | 18.0 |
| linear reef | 8 | 9.5 | 1.8 | 0.9 | 0.3 | 3.0 | 1.0 | 26.9 | 9.4 | 36.4 | 9.8 |
| scattered coral/rock | 3 | 6.4 | 3.2 | 1.0 | 0.8 | 3.8 | 2.6 | 10.4 | 8.0 | 24.0 | 14.9 |
| Shallow total | 17 | 5.7 | 0.5 | 0.7 | 0.1 | 2.3 | 0.4 | 19.8 | 5.6 | 37.5 | 8.2 |
| Overall | 33 | 5.8 | 0.4 | 0.7 | 0.1 | 2.4 | 0.4 | 20.4 | 5.4 | 37.2 | 7.8 |

Fish and benthic habitat summary statistics for the Salt River (SARI) region of St. Croix. *Shannon Diversity Index.

| Fish | Number of | # ind | div /)m² | bion (kg)/1 | nass 00m² | | cies /)m² | *Diversit | y/100m ² |
|-------------------------|--------------|-------|--------------|----------------|--------------|------|---------------|-----------|---------------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | n/a | | | | | | | | |
| pavement | 3 | 222.3 | 22.6 | 24.4 | 20.6 | 17.0 | 2.1 | 2.0 | 0.1 |
| linear reef | 4 | 463.5 | 187.2 | 10.5 | 2.4 | 26.3 | 3.0 | 2.1 | 0.2 |
| scattered coral/rock | 2 | 230.0 | 6.0 | 6.7 | 1.9 | 21.0 | 2.0 | 2.0 | 0.1 |
| Deep total | 9 | 266.9 | 24.3 | 17.2 | 7.0 | 17.7 | 1.0 | 1.8 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | n/a | | | | | | | | |
| patch reef | n/a | | | | | | | | |
| pavement | 3 | 328.0 | 168.3 | 7.8 | 3.5 | 17.0 | 2.1 | 1.7 | 0.3 |
| linear reef | 2 | 154.0 | 3.0 | 2.4 | 0.7 | 16.5 | 0.5 | 1.6 | 0.5 |
| scattered coral/rock | 1 | 515.0 | | 7.9 | | 20.0 | | 1.9 | |
| Shallow total | 6 | 276.7 | 91.7 | 6.3 | 1.9 | 15.9 | 1.2 | 1.6 | 0.2 |
| Overall | 15 | 278.3 | 77.4 | 7.3 | 1.7 | 16.2 | 1.0 | 1.6 | 0.2 |

| Benthic | Number of | %Coral / | / 100m² | % Gorgo 100 | | % Spo 100 | | % Macr 100 | | %Τυ 100 | |
|-------------------------|--------------|----------|-------------|----------------|-------------|--------------|-------------|---------------|-------------|------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | n/a | | | | | | | | | | |
| pavement | 3 | 3.9 | 1.8 | 1.4 | 0.9 | 3.5 | 0.4 | 12.6 | 10.4 | 33.3 | 18.3 |
| linear reef | 4 | 12.3 | 4.5 | 1.0 | 0.3 | 4.1 | 1.6 | 32.9 | 4.0 | 20.3 | 9.3 |
| scattered coral/rock | 2 | 1.9 | 1.6 | 1.2 | 1.0 | 1.5 | 0.5 | 1.6 | 1.4 | 30.5 | 9.5 |
| Deep total | 9 | 5.9 | 1.0 | 1.1 | 0.3 | 3.2 | 0.3 | 17.1 | 3.8 | 25.2 | 6.9 |
| Shallow | | | | | | | | | | | |
| bedrock | n/a | | | | | | | | | | |
| patch reef | n/a | | | | | | | | | | |
| pavement | 3 | 3.4 | 2.5 | 1.8 | 0.8 | 1.5 | 0.8 | 5.9 | 0.6 | 69.1 | 21.5 |
| linear reef | 2 | 1.7 | 0.1 | 0.9 | 0.7 | 0.0 | 0.0 | 13.2 | 10.4 | 64.0 | 27.4 |
| scattered coral/rock | 1 | 2.0 | | 3.4 | | 1.9 | | 4.8 | | 78.8 | |
| Shallow total | 6 | 2.8 | 1.3 | 1.5 | 0.5 | 1.1 | 0.5 | 6.9 | 0.7 | 63.9 | 12.7 |
| Overall | 15 | 3.1 | 1.1 | 1.5 | 0.4 | 1.3 | 0.4 | 7.8 | 0.6 | 61.0 | 10.7 |

Fish and benthic summary statistics for the Buck Island (BUIS) region of St. Croix. *Shannon Diversity Index.

| Fish | Number of | # indiv / 100m ² | | biomass (kg)/100m ² | | # species / 100m ² | | *Diversity/100m ² | |
|----------------------|--------------|--------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|------------------------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | |
| patch reef | 8 | 143.5 | 46.4 | 5.7 | 2.4 | 21.0 | 2.6 | 2.4 | 0.2 |
| pavement | 16 | 135.8 | 11.9 | 8.7 | 3.1 | 16.9 | 1.5 | 1.9 | 0.1 |
| linear reef | 4 | 179.3 | 27.8 | 8.3 | 1.9 | 23.5 | 3.1 | 2.5 | 0.2 |
| scattered coral/rock | 4 | 149.3 | 75.8 | 3.5 | 1.8 | 16.5 | 5.3 | 2.0 | 0.3 |
| Deep total | 32 | 140.7 | 7.9 | 7.6 | 1.4 | 18.1 | 0.8 | 2.1 | 0.1 |
| Shallow | | | | | | | | | |
| bedrock | 1 | 19.0 | | 0.1 | | 4.0 | | 0.6 | |
| patch reef | 11 | 214.5 | 54.0 | 13.5 | 5.3 | 21.6 | 1.1 | 2.4 | 0.1 |
| pavement | 20 | 184.2 | 20.5 | 6.2 | 1.8 | 18.7 | 1.2 | 2.0 | 0.1 |
| linear reef | 1 | 122.0 | | 4.4 | | 25.0 | | 2.9 | |
| scattered coral/rock | 3 | 175.3 | 37.2 | 3.0 | 1.7 | 21.0 | 1.2 | 2.1 | 0.0 |
| Shallow total | 36 | 187.8 | 11.7 | 7.6 | 0.7 | 19.8 | 0.5 | 2.2 | 0.0 |
| Overall | 68 | 170.4 | 5.7 | 7.6 | 0.6 | 19.2 | 0.3 | 2.1 | 0.0 |

| Benthic | Number of | %Coral / 100m ² | | % Gorgonians/ 100m ² | | % Sponges/ 100m ² | | % Macroalgae/ 100m² | | %Turf / 100m² | |
|-------------------------|--------------|----------------------------|-------------|------------------------------------|-------------|---------------------------------|-------------|------------------------|-------------|------------------|-------------|
| | surveys | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE | Mean | <u>+</u> SE |
| Deep | | | | | | | | | | | |
| patch reef | 8 | 7.7 | 2.5 | 2.0 | 0.7 | 0.8 | 0.3 | 4.9 | 1.6 | 27.9 | 6.8 |
| pavement | 16 | 3.4 | 1.1 | 1.6 | 0.5 | 2.7 | 0.6 | 10.7 | 2.3 | 46.2 | 8.1 |
| linear reef | 4 | 5.0 | 2.2 | 2.8 | 1.4 | 2.7 | 1.4 | 4.7 | 2.3 | 48.5 | 11.6 |
| scattered coral/rock | 4 | 1.8 | 1.8 | 1.1 | 0.9 | 1.8 | 1.6 | 0.6 | 0.5 | 4.0 | 3.9 |
| Deep total | 32 | 4.4 | 0.6 | 1.7 | 0.2 | 2.2 | 0.3 | 8.3 | 1.1 | 39.1 | 3.8 |
| Shallow | | | | | | | | | | | |
| bedrock | 1 | 0.0 | | 0.0 | | 0.0 | | 29.6 | | 23.2 | |
| patch reef | 11 | 3.8 | 8.0 | 2.4 | 0.6 | 0.5 | 0.2 | 17.3 | 4.4 | 38.8 | 7.3 |
| pavement | 20 | 4.0 | 0.6 | 1.6 | 0.5 | 1.7 | 0.4 | 5.2 | 1.2 | 59.4 | 6.2 |
| linear reef | 1 | 6.4 | | 2.8 | | 0.0 | | 7.2 | | 66.3 | |
| scattered coral/rock | 3 | 1.4 | 0.7 | 1.3 | 1.1 | 0.0 | 0.0 | 16.8 | 14.7 | 13.9 | 13.4 |
| Shallow total | 36 | 3.9 | 0.3 | 1.8 | 0.2 | 1.2 | 0.2 | 9.1 | 0.6 | 51.3 | 2.6 |
| Overall | 68 | 4.0 | 0.2 | 1.8 | 0.1 | 1.6 | 0.1 | 8.8 | 0.5 | 46.8 | 1.7 |

Species specific sightings

Acropora palmata and A. cervicornis

Acropora palmata was observed at 33 sites (11% of total surveys) and A. cervicornis was sighted on 12 sites (4% of total surveys). Two sites had both species present. Most observations were recorded on shallow habitats on the northshore, specifically within Buck Island Reef National Monument (Figure 3). Nearly 60% of these sightings were located in marine protected areas.

North Acropora species presence both A. cervicornis A. palmata Buls East Hardbottom Habitats Cointeed Bedrock Cointeed Pavement Linear Reef Path Reef Ocalteed Coral/Rock in Sand

Figure 3. Presence of *Acropora palmata* or *A. cervicronis* during fish and benthic surveys.

Red Lionfish Pterois volitans

The invasive Red lionfish was observed at 8% of the survey sites (n=23). Overall there were 38 individuals observed on transects ranging in size from 7-33 mm (FL). Most lionfish observations occurred at sites greater than 10 m (Figure 4). Lionfish sightings occurred in all regions around the island with no apparent spatial patterns. About half of the sightings occurred within MPAs.

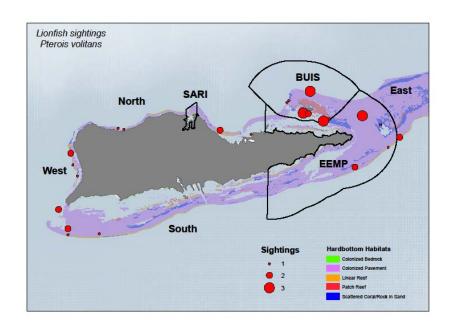


Figure 4. Spatial distribution of liontish, Pterois volitans,

Long spined sea urchin Diadema antillarum

Diadema sea urchins were observed at in all regions (21 sites) except for the East region. Densities ranged from 1 to 130 individuals/100 m². Figure 5 displays the spatial distribution of sightings; most were recorded in the southwest and west regions.

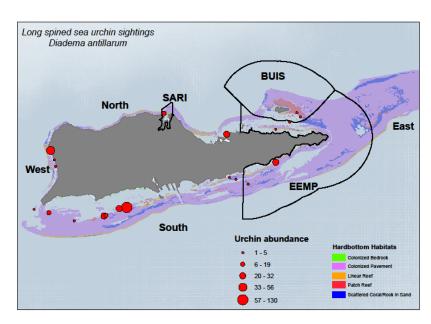


Figure 5. Spatial distribution of long spined sea urchin, *Diadema antillarum*, sightings.

Marine debris

Only four sites had marine debris observations (Figure 6). The items included fishing monofilament, old rope, a bottle, a cover to a cooler and a derelict fish trap with line attached.

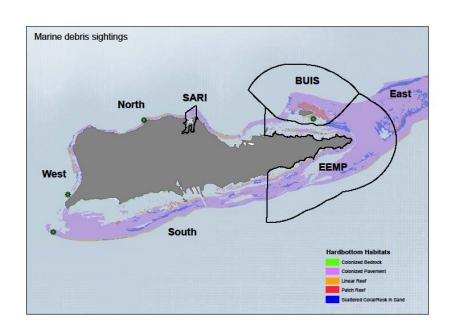


Figure 6. Spatial distribution of marine debris sightings.

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Patch reef on the western side of St. Croix



Northshore shelf edge, St. Croix.



Linear reef on the south of St. Croix.