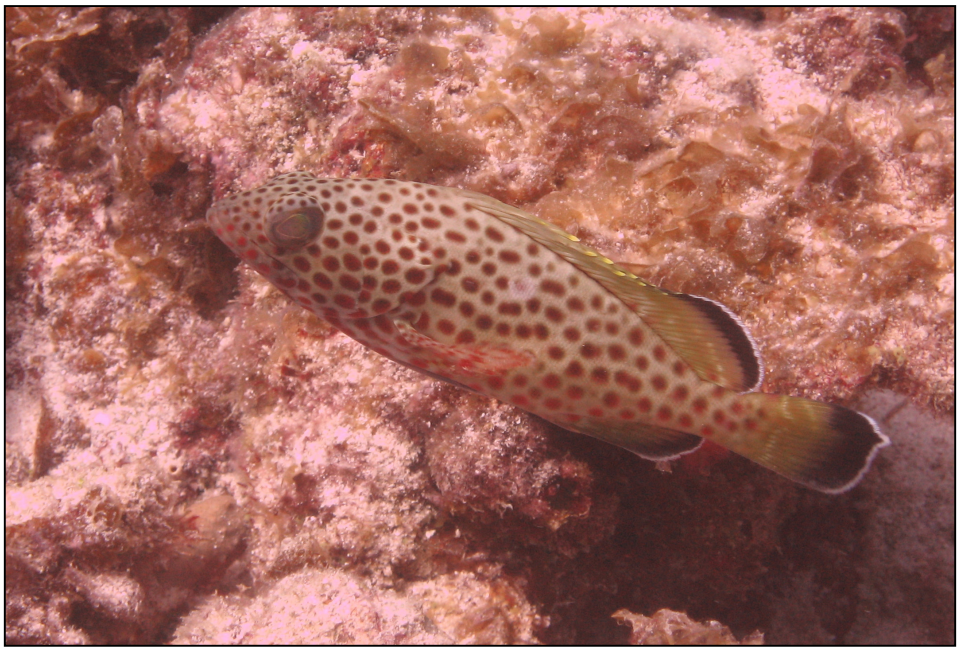
Grouper population assessment within bank hardbottom habitats of St. Croix, US Virgin Islands



Juvenile red hind grouper. Picture taken by Henry E. Tonnemacher

Prepared by
Philippe A. Mayor

The Ocean Conservancy
US Virgin Islands Regional Office
P.O. Box 667, Richmond
Christiansted, VI 00821-0667

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Summary

Groupers have been an important commercial fish species in the US Virgin Islands. However, within the past decades several of the grouper populations have crashed and consequently there has been a shift in the fish community composition. Using a fishery-independent method, this study assessed grouper occurrence and density within bank hardbottom habitats of St. Croix to depth of 30 m. Ten species within the genera *Cephalopholis*, *Epinephelus*, and *Mycteroperca* were the groupers of interest. The study area was divided into eight strata. Benthic cover and other data were also collected within the survey transects and are described in this report. Only one species, the coney, was found regularly within the surveys. Red hind and graysbys were found occasionally and at lower densities than coneys. In only one site yellowfin grouper juveniles were found. The remaining six species were absent in the surveys. Overall adult coney and graysby densities were higher than juvenile densities, whereas juvenile red hind density was higher than that of adults. Coney and graysby groupers are both non-migratory species that mature at approximately 15 cm total length. Red hind groupers mature at about 25 cm total length and migrate to spawning aggregations, where they are vulnerable to overfishing. No red hind adults greater than 35 cm total length were seen. Coney, graysby, and red hind groupers were present in all strata, with the exception of graysbys that were not seen within one stratum. Grouper densities appeared to differ among strata, however, the high variances and the low sample sizes within the strata, did not allow for detection of significant differences. If St. Croix's populations of large groupers are to recover, we believe that a moratorium should be placed on the catch of all grouper species within Territorial and Federal waters of St.

Croix, with the exception of coney and graysby groupers. We think it is important to set target densities above which a moratorium on a given species could be lifted. We also believe that all grouper spawning aggregation sites should be closed to fishing, even after a moratorium is lifted. It is critical that all management regulations be evaluated for effectiveness and compliance.

Introduction

Traditionally, groupers have been an important commercial fish species in the US Virgin Islands (USVI) (Fiedler and Jarvis 1932, IRF 2002). However, within the past decades several of the grouper populations, especially the ones reproducing in spawning aggregations, have crashed in the USVI (Olsen and LaPlace 1978, Appeldoorn et al. 1992, Beets and Friedlander 1992, Jeffrey et al. 2005), and consequently there has been a shift in the fish community composition (Beets and Friedlander 2003, Cummings et al. 1997, Garrison et al. 2004, Jeffrey et al. 2005). In response to the decline, laws were put in place prohibiting the harvest of goliath (*Epinephelus itajara*) and Nassau (*E. striatus*) groupers within all Federal waters of the USVI. It also has led to the establishment of seasonal and permanent no-take zones at spawning areas, such as the Marine Conservation District south of St. Thomas in 1990, and the Red Hind Closed Area at Lang Bank, St. Croix, in 1993.

Those management actions have led to red hind (*E. guttatus*) population increases around St. John and St. Thomas (Beets and Friedlander 1999, Nemeth 2005). Recently, also juvenile Nassau groupers have been sighted in several bays around St. Thomas and St. John (Nemeth, personal communication) and there are signs of a returning Nassau grouper spawning aggregation south of St. Thomas (Nemeth et al. In press). On St. Croix, on the other hand, red hind grouper populations have not responded in the same way as on St. Thomas. While the average size of red hind groupers caught on St. Thomas has been increasing since the mid 1990s, it has kept decreasing on St. Croix, and the estimated aggregation size on St. Croix in 2004 was about a 10^{th} of what was

estimated on St. Thomas in 2000 (Nemeth et al. 2006). Furthermore, sightings of other larger grouper species have remained rare on St. Croix (REEF 2006). During an assessment of the fish community of Buck Island Reef National Monument (BIRNM) in February 2001, the most common grouper species seen within 100 m^2 survey transects were coneys (*Cephalopholis fulvus*) (present within 19% of the surveys), followed by red hinds (13%), graysbys (*C. cruentatus*) (4%), and tiger (*Mycteroperca tigris*) (1%) (Kendall et al. 2004). No sightings were made of black (*M. bonaci*), goliath, Nassau, red (*E. morio*), rock hind (*E. adscensionis*), and yellowfin (*M. venenosa*) groupers, all of which were caught regularly within the USVI pot fishery in 1931 (Fiedler and Jarvis 1932).

The recovery of St. Croix's grouper populations may be more challenging than for St. Thomas and St. John, primarily due to the fact that St. Croix sits on its own island shelf and is isolated from other islands by deep water, thereby not allowing reef fish exchange with the exception of larval flow. The closest up-current shelf area is Saba Bank, located approximately 90 km to the southeast, which might be providing some recruitment to St. Croix. However, St. Croix may depend primarily on self-recruitment (Cowen et al. 2006).

For a primarily self-recruiting reef-fish community, the need to understand and protect juvenile life stages becomes especially important. Many species of coral reef fishes rely on seagrass and mangrove habitats as essential nursery grounds (Parish 1989). On St. Croix, the largest mangrove estuary system in the US Virgin Islands, Krause Lagoon,

was destroyed in the 1960's with the development of an industrial complex consisting of an oil refinery, an alumina plant, and a commercial port facility. Two of the remaining three mangrove estuaries on St. Croix, Salt River Bay and Altona Lagoon, were intensively surveyed between 1991 and 1995, but no groupers were found (Tobias et al. 1996). Seagrass beds and sand surveyed within the lagoon areas of the east end of St. Croix in 1999 and 2000 found no presence of juvenile groupers either (Adams and Ebersole 2002).

In August 2006, The Ocean Conservancy (TOC) conducted a pilot study to assess juvenile grouper occurrence and density in hardbottom habitats up to 20 m from shore all around the island of St. Croix (Lynford and Mayor 2006). Groupers were only found along the northwestern shore of St. Croix and at very low densities. The need was identified to expand the study area to other hardbottom habitats. This study assessed grouper occurrence and density within bank hardbottom habitats of St. Croix.

Materials and Methods

The study area was St. Croix's bank hardbottom (HB) habitats shallower than 30 m and was defined based on benthic maps of the US Virgin Islands (Kendall et al. 2001, NOAA 2001). The study area was divided somewhat subjectively into eight strata, based on combinations of management regime, availability of previously collected grouper data, general geographic heading from the island, and location in relation to the HOVENSA oil refinery (Figure 1). The East End Marine Park was divided into two strata, the northwestern part (EEMP NW) and the remaining area (EEMP). BIRNM and EEMP NW have recently been surveyed for reef fish by the NOAA Biogeography Program (Kendall et al. 2001, NOAA unpublished raw data, Mayor 2006). The Lang Bank area to the northeast of the EEMP is the only Federal area on St. Croix outside the 3 nm limit. The remaining areas to the north of St. Croix were placed into the stratum North Side, the ones to the west (in the lee of St. Croix) into the West End, and the ones to the south were divided into South Side East of HOVENSA and South Side West of HOVENSA. The areas of each stratum are given in Table 1.

Using GIS software (ESRI, Inc.), random points were selected within the strata for which no NOAA Biogeography Program data were available, and their coordinates were downloaded to a handheld Global Positioning System (GPS) unit. A motorboat was used to arrive at the survey sites. Once at a given census site, one diver visually surveyed a 25 by 4 m^2 (100 m^2) belt transect, recording estimated total length to the nearest 1 cm of ten grouper species from the three genera *Cephalopholis*, *Epinephelus*, and *Mycteroperca*. The transect direction was selected randomly prior to the dive.

Swimming speed was maintained such that the transect was completed in approximately 15 minutes regardless of substrate complexity. The second diver recorded benthic coverage within five 1 m^2 quadrats that were located on alternating sides of the transect line at randomly selected distances along the transect, but limiting one quadrat per 5 m. Additionally, long-spine sea urchins (*Diadema antillarum*), Caribbean spiny lobster (*Panulirus argus*), and queen conch (*Strombus gigas*) counts were made within the 25 by 4 m^2 belt transect. All surveys were conducted from 8:00 to 16:30 hours.

All data were entered into a relational database (MS Access). Habitat data within each site were averaged among the five quadrats and the mean and its 95% confidence limit, as well as all other site data, were exported into a GIS database. Analysis was done in MS Excel. NOAA Biogeography Program raw data from October 2002 to March 2005 were analyzed to compare to data collected in this study.

The size at which 50% of a grouper species are sexually mature (TL_m) were derived from Fishbase (www.fishbase.org) and rounded to the nearest 5 cm to be comparable to the NOAA Biogeography Program data. A brief summary of data found per grouper species follows:

- Coney, *C. fulvus*: max. size = 41 cm total length (TL), max. age = 11 y, TL_m = 16 cm TL, reef-associated, non-migratory, resilience = medium, min. population doubling time = 1.4 - 4.4 y, protogynous, mature females transform to males at a

length of about 20 cm, spawning occurs just before sunset over several days, and a male will spawn daily with each of the several females in his harem

- Graysby, *C. cruentatus*: max. size = 43 cm TL, max. age = 13 y, TL_m = 16 cm TL (age = 3.5 y), reef-associated, non-migratory, resilience = medium, min. population doubling time = 1.4 - 4.4 years, protogynous, most change sex between 20 and 23 cm (ages 4 and 5), with sexual transition occurring immediately after spawning
- Rock hind, *E. adscensionis*: max. size = 61 cm TL, max. age = 12 y, TL_m = 25 cm TL, reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous
- Red hind, *E. guttatus*: max. size = 76 cm TL, max. age = 17 y, TL_m = 25 cm TL (age = 3 y), reef-associated, spawning aggregations, resilience = medium, min. population doubling time = 1.4 - 4.4 years, protogynous, females rest on or close to the bottom, while males patrol around an area that consists of 1 to 5 females and defend this territory from other males
- Nassau, *E. striatus*: max size = 122 cm TL, max. age = 29 y, TL_m = 48 cm TL, reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous, most males and females display a bicolored pattern during spawning, courtship behavior involves vertical spiral movement, short vertical runs followed by rapid aggregation then rapid dispersal and horizontal runs near the bottom
- Red grouper, *E. morio*: max. size = 125 cm TL, max. age = 25 y, TL_m = 50 cm TL, reef-associated, spawning aggregations, resilience = low, min. population

doubling time = 4.5 - 14 y, protogynous, sex change occurs at 75.5 cm TL and 9.5 y of age

- Goliath grouper, *E itajara*: max. size = 259 cm TL, max. age = 37 y, TL_m = 113 cm TL (5.5 y), reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous
- Tiger grouper, *M. tigris*: max. size = 101 cm TL, TL_m = 46 cm TL (6.5 y), reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous
- Yellowfin grouper, *M. venenosa*: max. size = 100 cm TL, TL_m = 51 cm TL, reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous
- Black grouper, *M. bonaci*: max. size = 150 cm TL, TL_m = 72 cm TL (5 y), reef-associated, spawning aggregations, resilience = low, min. population doubling time = 4.5 - 14 y, protogynous, age at sex change = 15.5 y

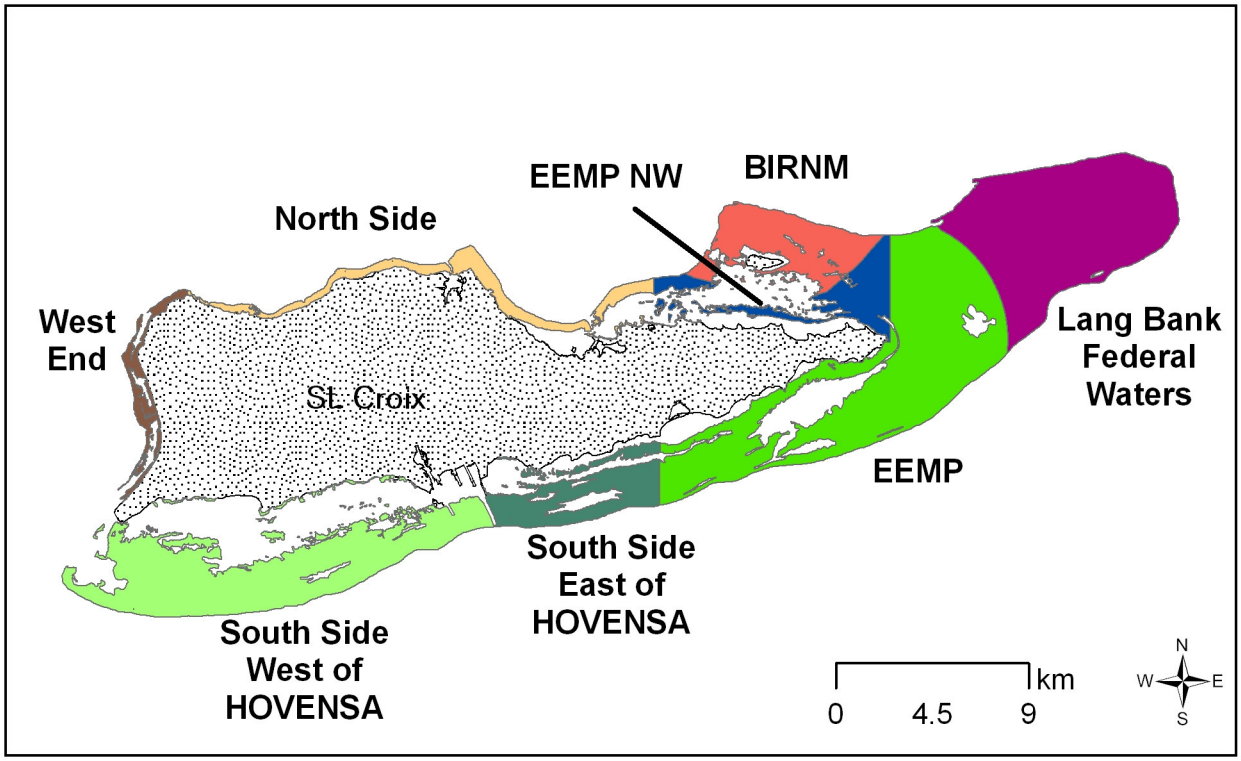

Figure 1. The study area was comprised of all hardbottom bank habitats shallower than approximately 30 m within the St. Croix shelf and was based on NOAA habitat maps (Kendall et al. 2001, NOAA 2001). The study area was divided into eight strata.

Table 1. The study area was divided into eight strata. The area of each stratum was calculated based on NOAA habitat maps (Kendall et al. 2001, NOAA 2001).

Stratum name	Area [ha]
BIRNM	1790.7
EEMP NW	1256.6
EEMP	6558.4
Lang Bank Federal Waters	5531.8
South Side East of HOVENSA	1523.5
South Side West of HOVENSA	4779.3
West End	462.8
North Side	1113.5

Results

Surveys were conducted from October 16 to November 3, 2006. Five to eight survey transects were conducted per stratum, totaling 35 transects (Figure 2). The NOAA Biogeography Program conducted a total of 137 and 87 surveys during the period of October 2002 to March 2005 within BIRNM and EEMP NW, respectively (Figure 3).

The only groupers found were graysbys, coneys, and red hinds, except for three juvenile yellowfin groupers that were observed in one NOAA transect within the EEMP NW stratum. None of the other six grouper species were seen in any of the surveys.

Mean juvenile and adult population densities of graysby, coney, and red hind groupers within the eight strata are given in Tables 2 and 3 and are represented graphically in Figures 4 and 5. The actual juvenile and adult counts per transect and transect locations are shown in Figures 6 – 11. Coney groupers were the most abundant of the three species and juveniles and adults occurred throughout all strata. Graysby and red hind groupers occurred throughout nearly all strata as well, but in lower densities. Graysbys were not found in the EEMP stratum. At BIRNM juvenile and adult graysby and adult red hind populations were significantly lower than those of coneys ($P < 0.05$). At EEMP NW adult graysby and red hind populations were significantly lower than adult coneys ($P < 0.05$). The variances in the data within the other strata were too large to detect any density differences. At BIRNM juvenile coney densities were significantly lower ($P < 0.05$) and adult coney densities significantly higher ($P < 0.05$) than at the South Shore East of HOVENSA stratum. The variance in the data among the strata was

too large to detect any other density differences. Nevertheless, graysby groupers appeared especially abundant within the West End stratum.

Coral species richness and percent benthic cover per stratum are given in Table 4. Coral species richness and percent coral and bluegreen algae cover per stratum are illustrated in Figures 12 – 14. Pie charts of the benthic cover are shown in Figures 15 – 22. Highest mean coral species-richness values were found at Lang Bank Federal Waters and the North Side. Highest mean coral-coverage measures were seen at Lang Bank Federal Waters, North Side, and BIRNM. Maximum coral coverage at individual sites within a stratum was found at BIRNM, followed by North Side, and Bang Bank Federal Waters (see Appendix for individual site data for six of the eight strata). Mean bluegreen algae cover was highest within the southern strata (Lang Bank Federal Waters, EEMP, South Side East of HOVENSA, and South Side West of HOVENSA). Macro and turf algae made up the majority of the benthic cover.

Additional data collected were not analyzed but are provided for completeness in the Appendix.

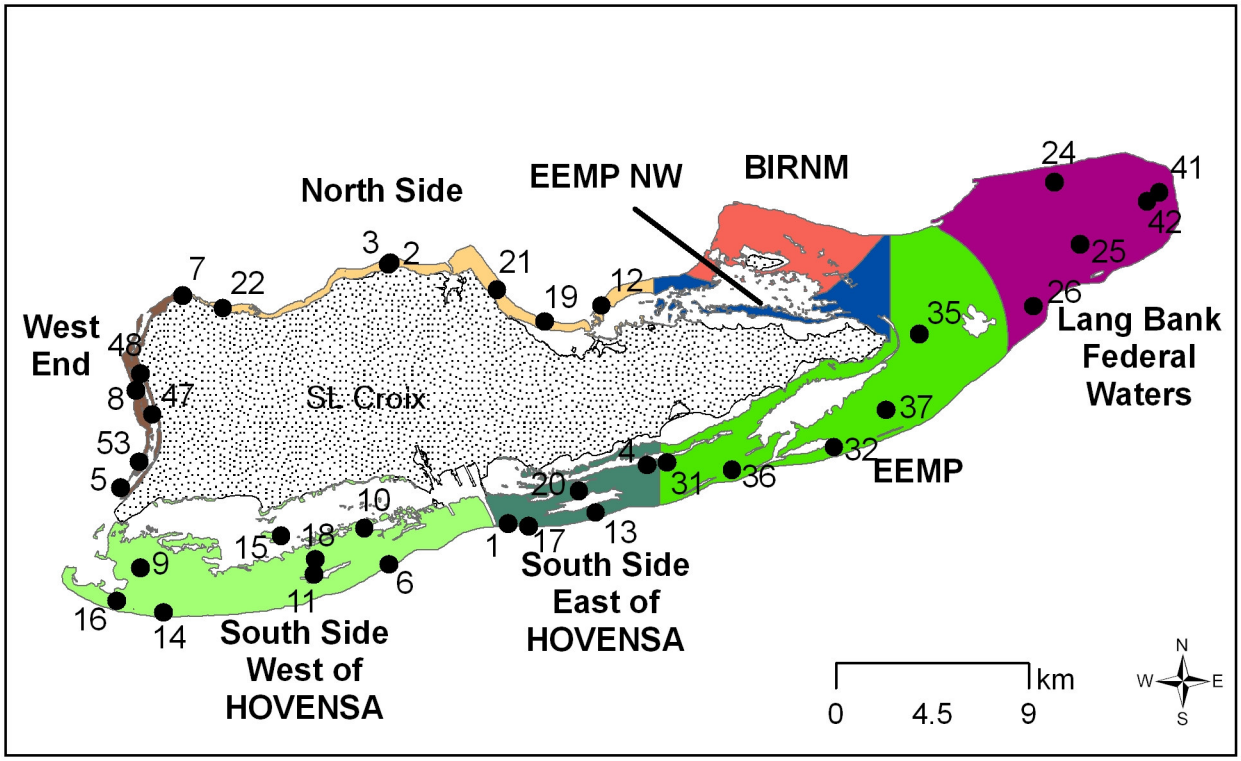

Figure 2. TOC survey locations within bank hardbottom habitats conducted in October and November of 2006. Five to eight transects were surveyed per stratum, totaling 35 transects. The survey locations are labeled with their site name.

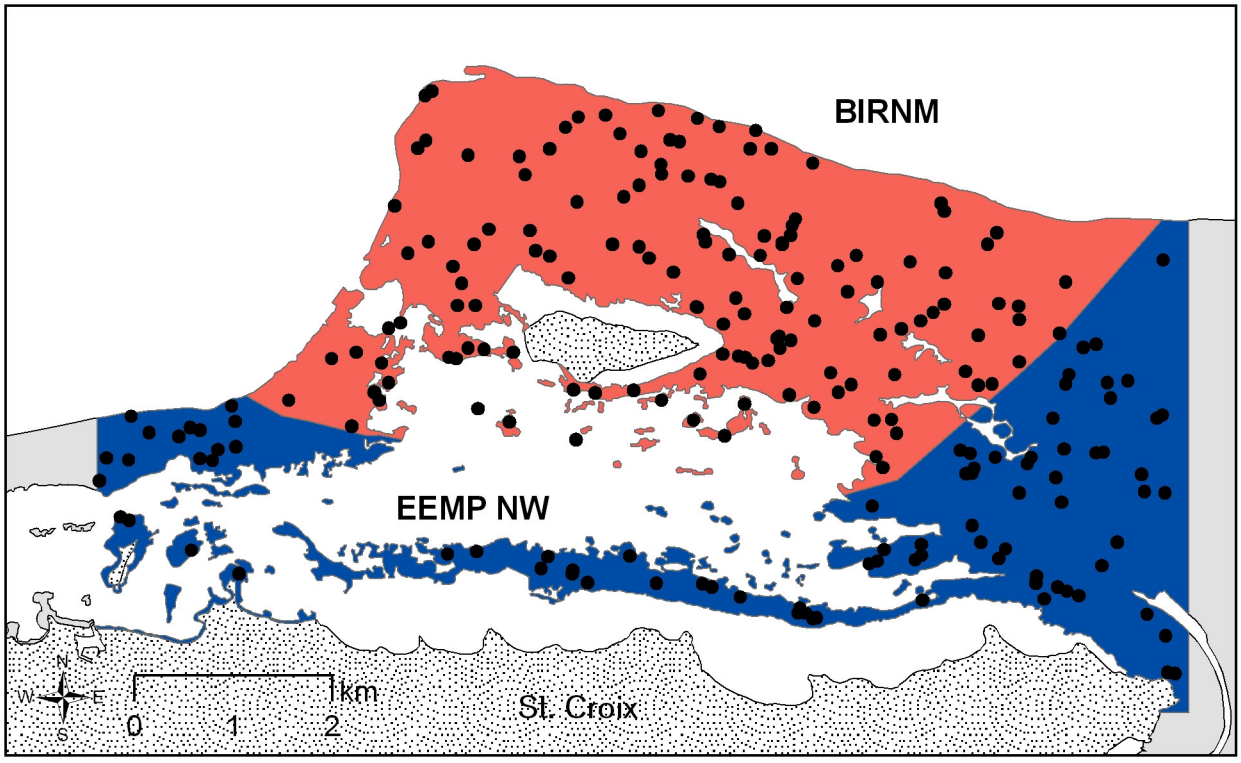

Figure 3. NOAA Biogeography Program survey locations within bank hardbottom habitats conducted during the period of October 2002 to March 2005. A total of 137 and 87 transects were surveyed within BIRNM and EEMP NW, respectively.

Table 2. Mean juvenile population densities of graysby, coney, and red hind groupers within the eight strata. Values are given with the 95% confidence interval. TL = total fish length. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

		Juvenile density ± 95% confidence interval [fish ha^{-1}]		
Stratum	n	Graysby (<15 cm TL)	Coney (<15 cm TL)	Red hind (<25 cm TL)
BIRNM	137	5.1 ± 6.2	47.4 ± 16.4	23.4 ± 9.4
EEMP NW	87	5.7 ± 4.9	55.2 ± 30.7	26.4 ± 12.2
EEMP	5	0 ± 0	60 ± 48	20 ± 39.2
Lang Bank Federal Waters	5	0 ± 0	180 ± 258.5	0 ± 0
South Side East of HOVENSA	5	0 ± 0	260 ± 319.7	100 ± 107.4
South Side West of HOVENSA	8	0 ± 0	150 ± 82.8	37.5 ± 51.6
West End	6	66.7 ± 96.9	16.7 ± 32.7	33.3 ± 41.3
North Side	6	0 ± 0	183.3 ± 128.2	33.3 ± 41.3

Table 3. Mean adult population densities of graysby, coney, and red hind groupers within the eight strata. Values are given with the 95% confidence interval. TL = total fish length. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

		Adult density ± 95% confidence interval [fish ha^{-1}]		
Stratum	n	Graysby (≥15 cm TL)	Coney (≥15 cm TL)	Red hind (≥25 cm TL)
BIRNM	137	16.1 ± 9.1	244.5 ± 60.9	10.9 ± 5.6
EEMP NW	87	11.5 ± 12.6	140.2 ± 42	26.4 ± 18
EEMP	5	0 ± 0	120 ± 144	20 ± 39.2
Lang Bank Federal Waters	5	20 ± 39.2	340 ± 252.5	0 ± 0
South Side East of HOVENSA	5	20 ± 39.2	180 ± 130	0 ± 0
South Side West of HOVENSA	8	12.5 ± 24.5	50 ± 52.4	0 ± 0
West End	6	83.3 ± 78.7	16.7 ± 32.7	0 ± 0
North Side	6	0 ± 0	116.7 ± 155.3	16.7 ± 32.7

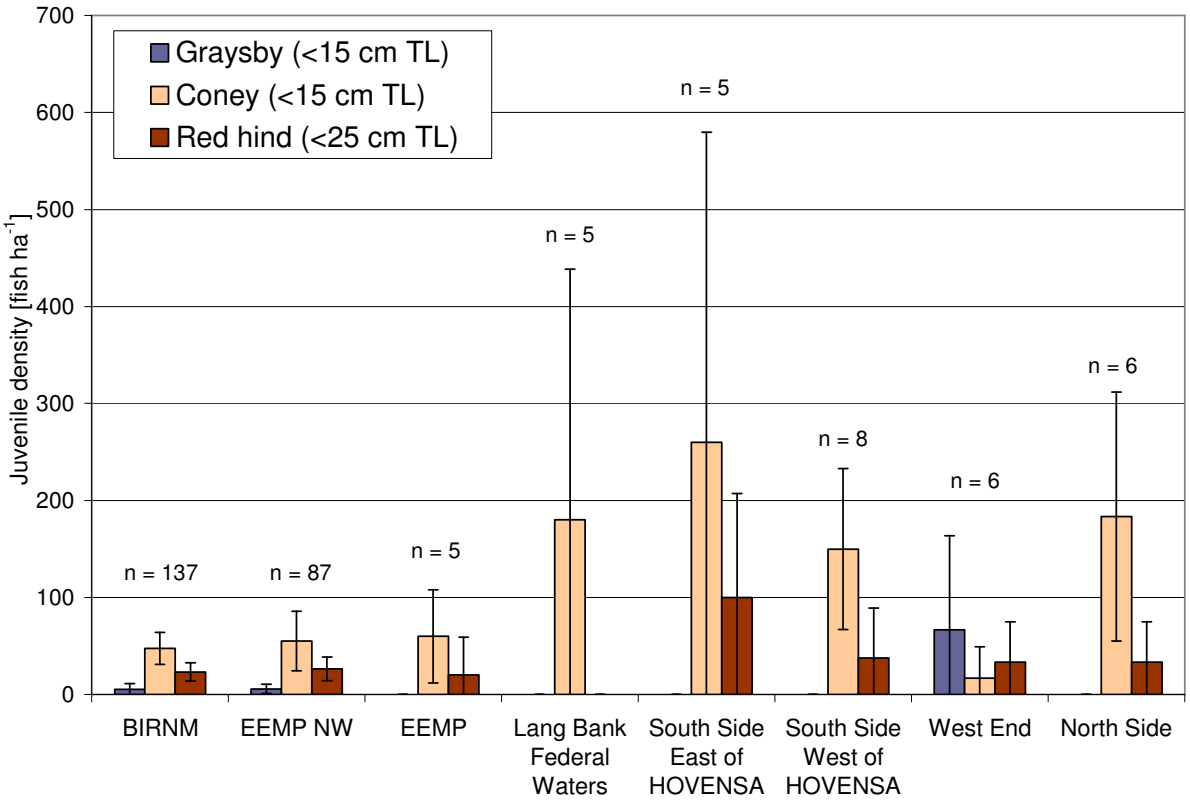

Figure 4. Mean juvenile population densities of graysby, coney, and red hind groupers within the eight strata. The error bars represent the 95% confidence interval. The sample size is shown above the error bar. TL = total fish length. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

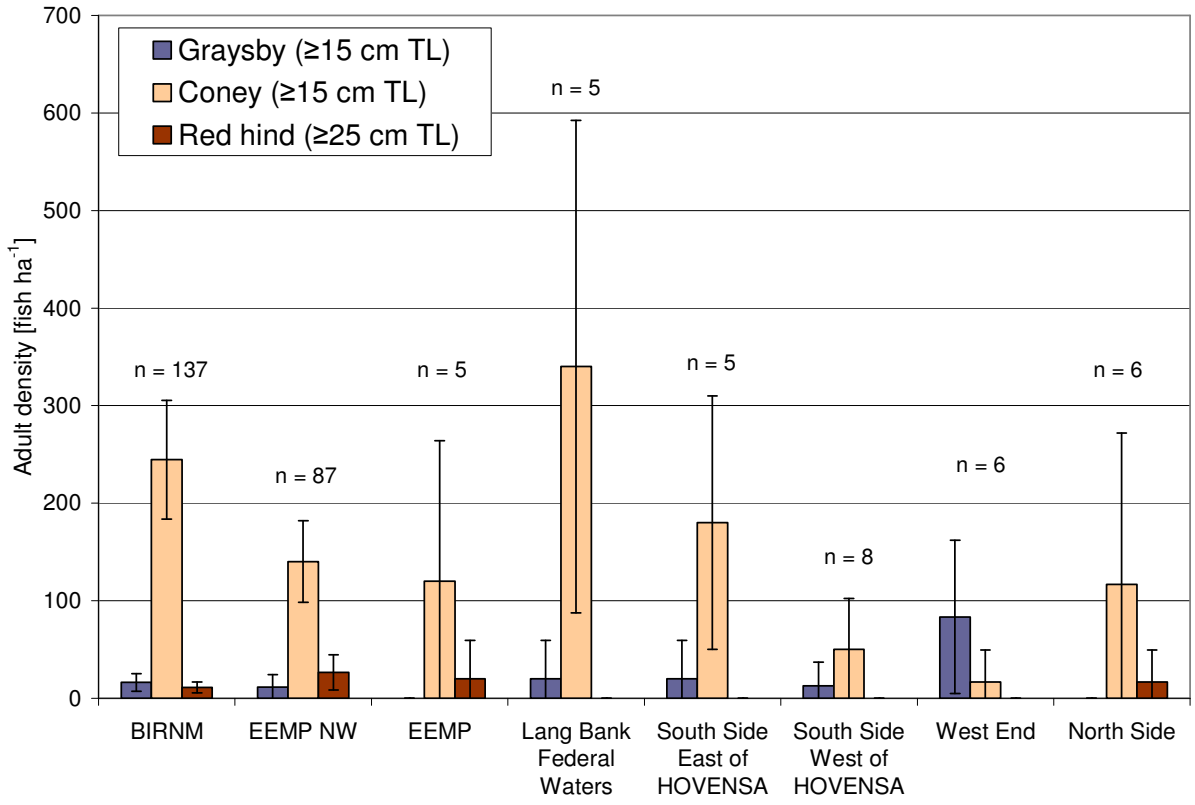

Figure 5. Mean adult population densities of graysby, coney, and red hind groupers within the eight strata. The error bars represent the 95% confidence interval. The sample size is shown above the error bar. TL = total fish length. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

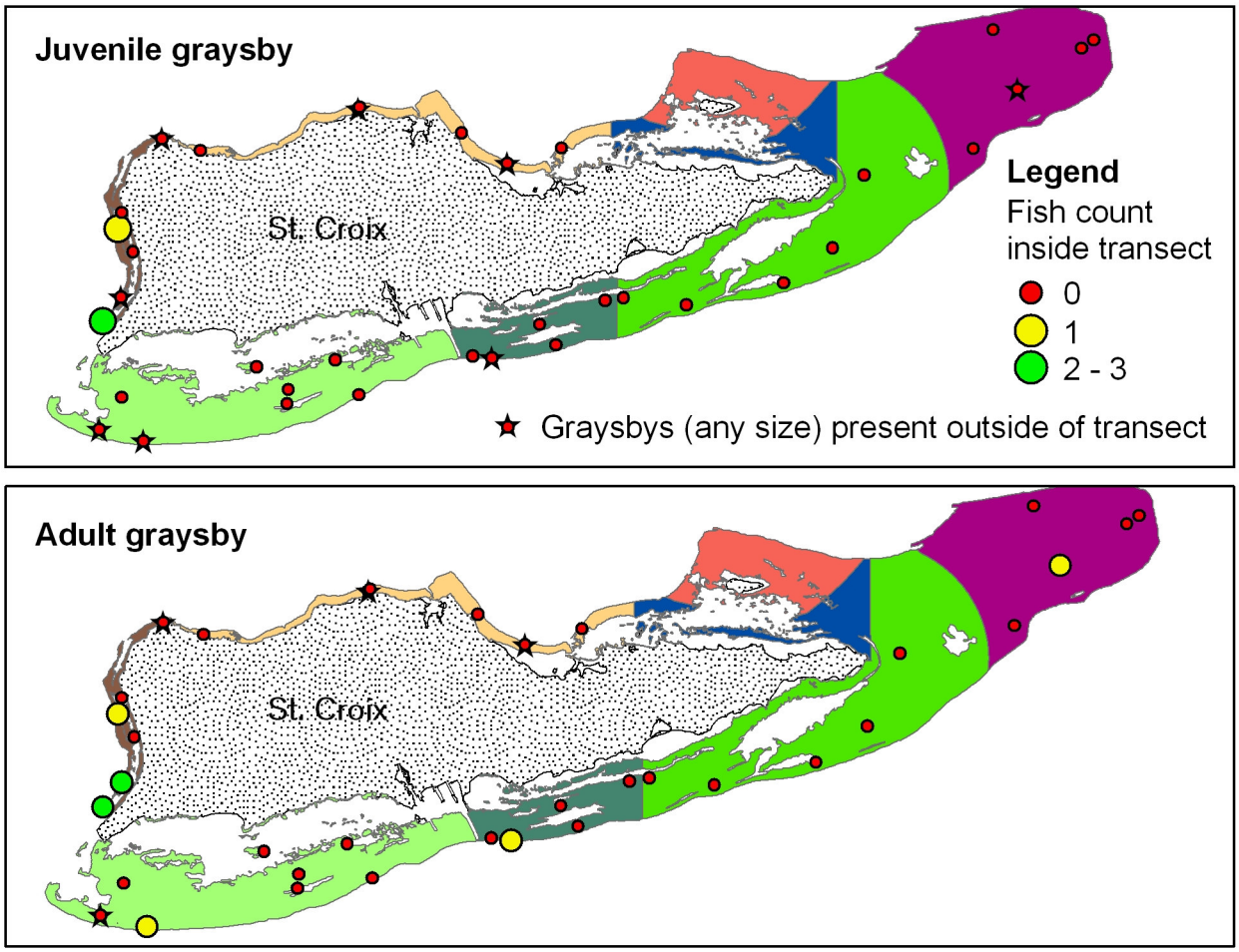

Figure 6. Graysby juvenile and adult counts per transect within six of the eight strata.

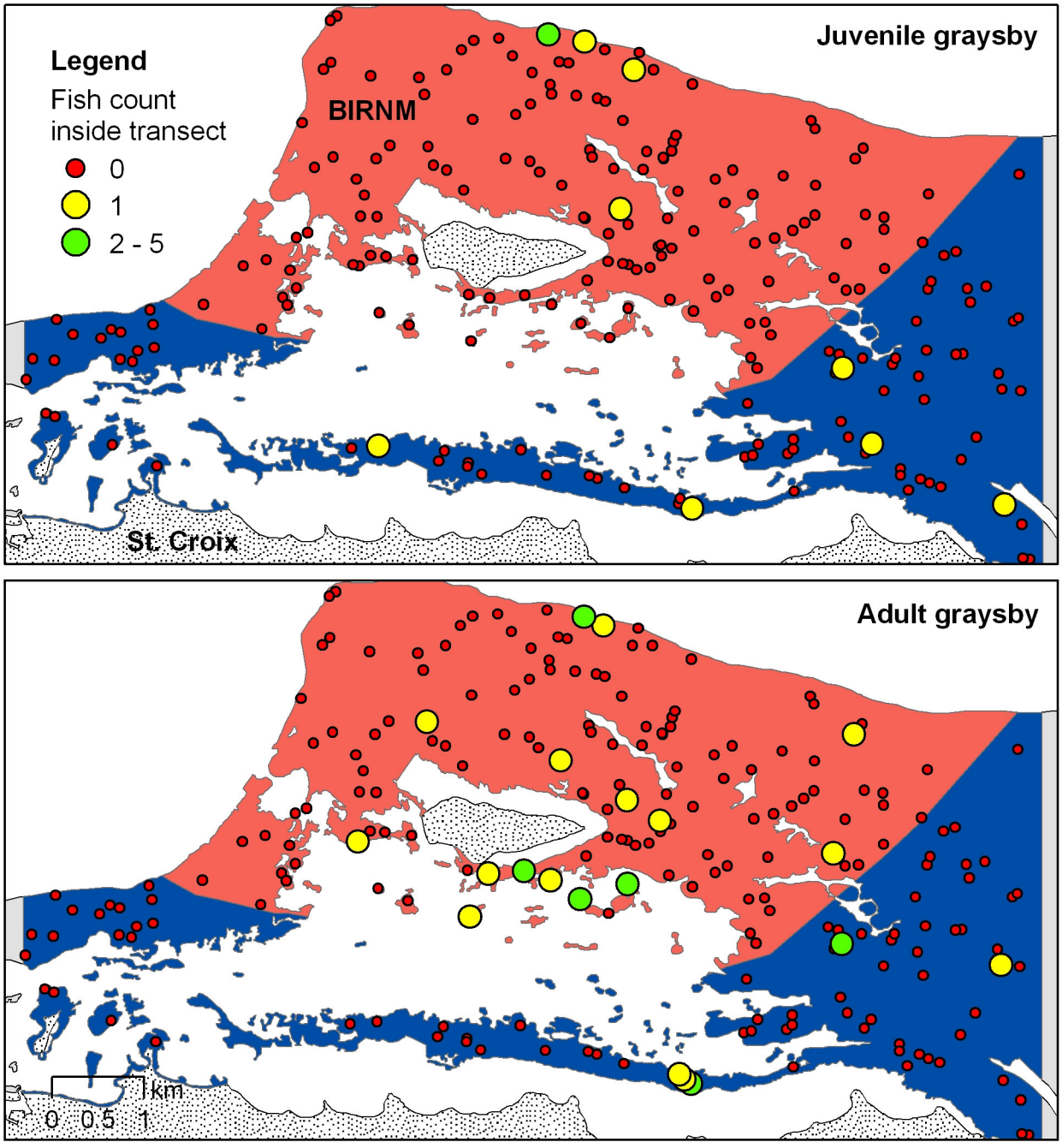

Figure 7. Graysby juvenile and adult counts per transect within two of the eight strata. Data were derived from NOAA unpublished raw data.

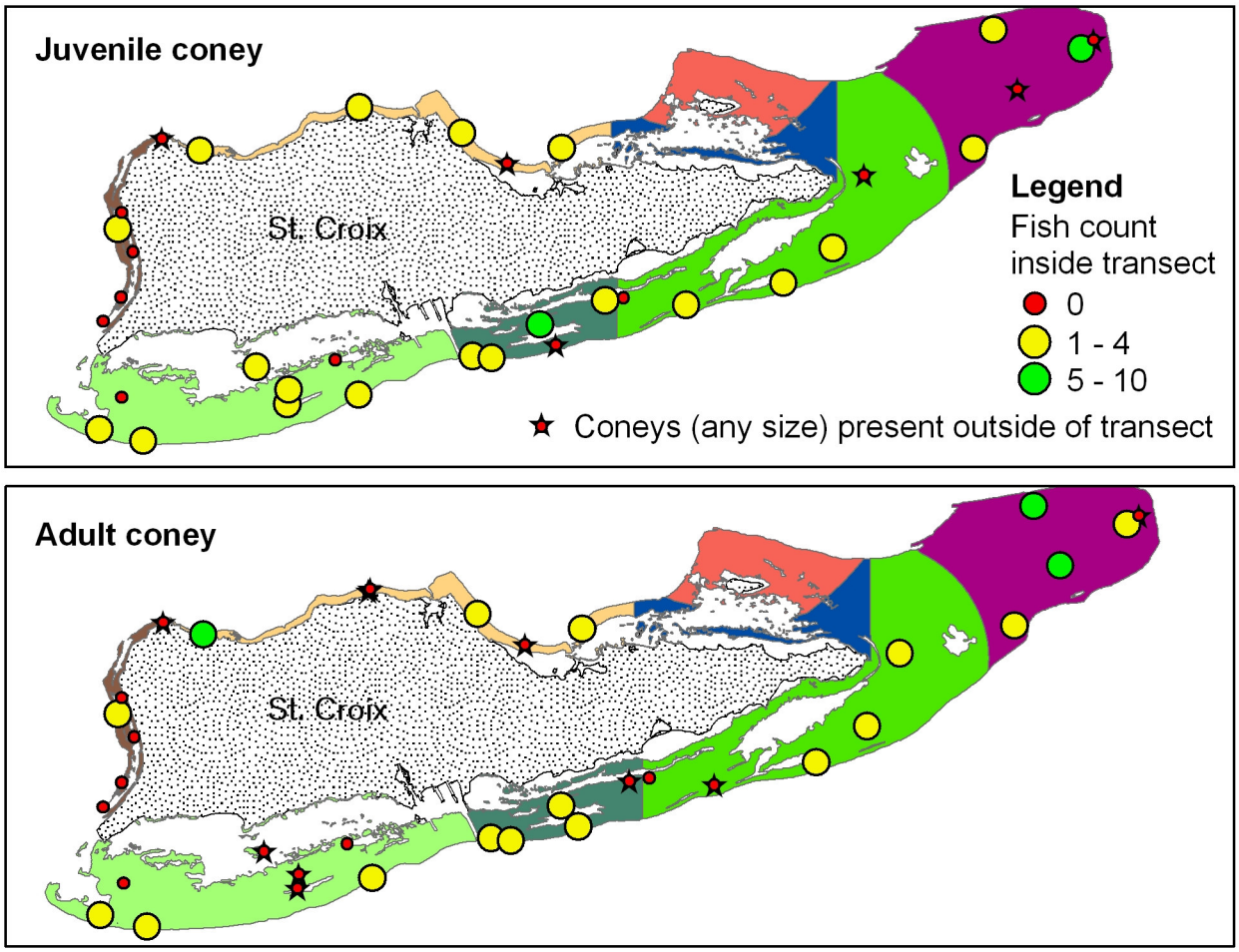

Figure 8. Coney juvenile and adult counts per transect within six of the eight strata.

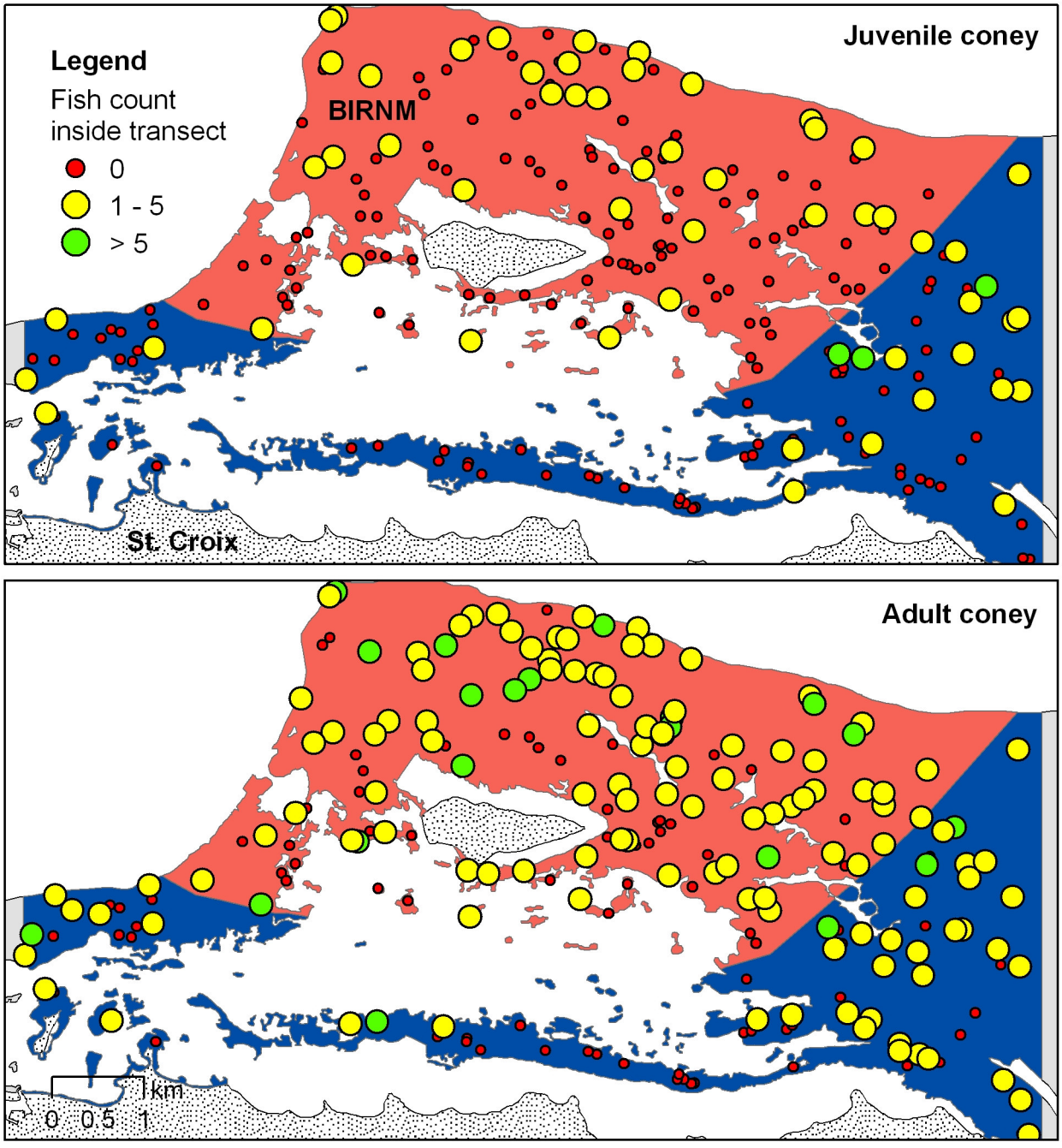

Figure 9. Coney juvenile and adult counts per transect within two of the eight strata. Data were derived from NOAA unpublished raw data.

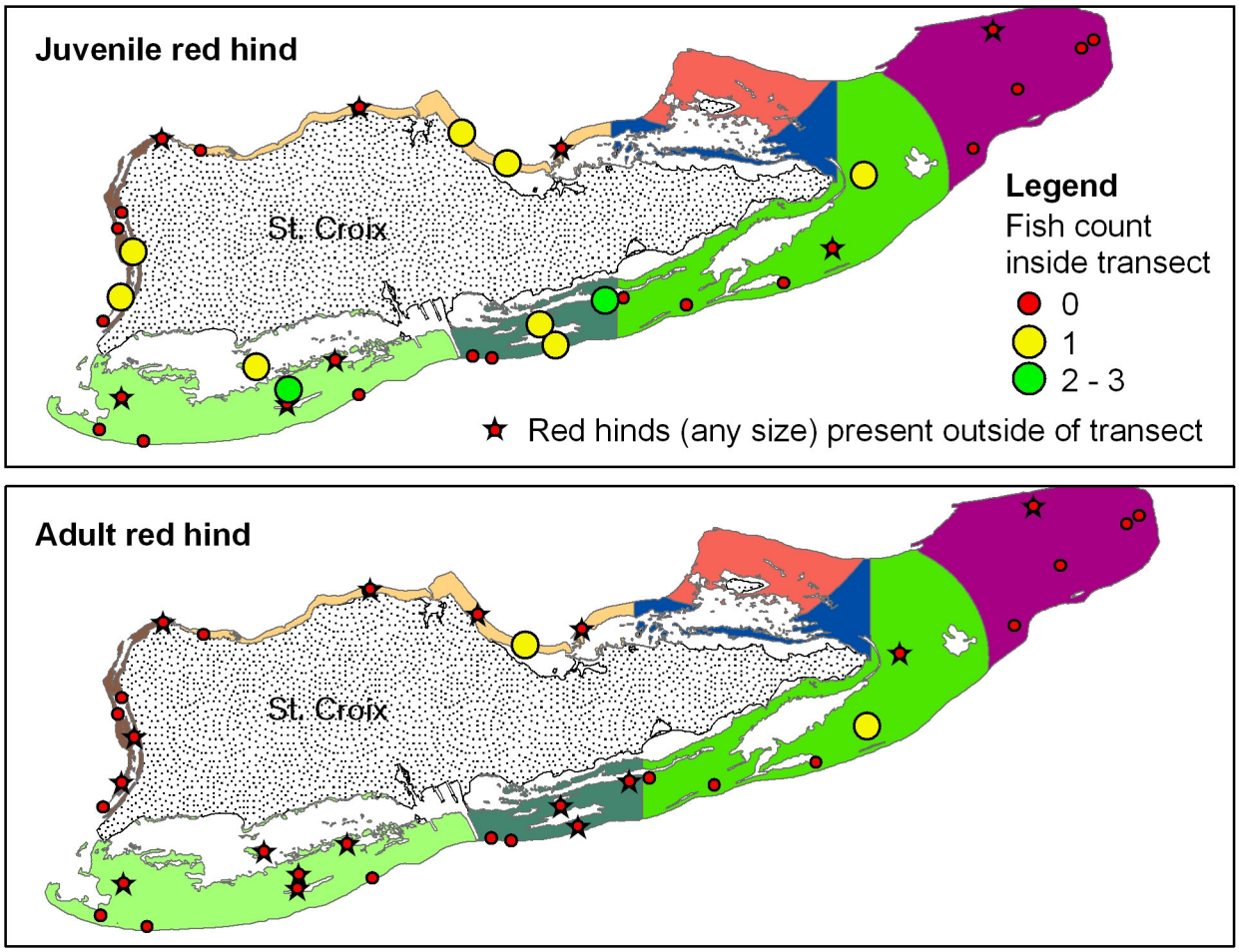

Figure 10. Red hind juvenile and adult counts per transect within six of the eight strata.

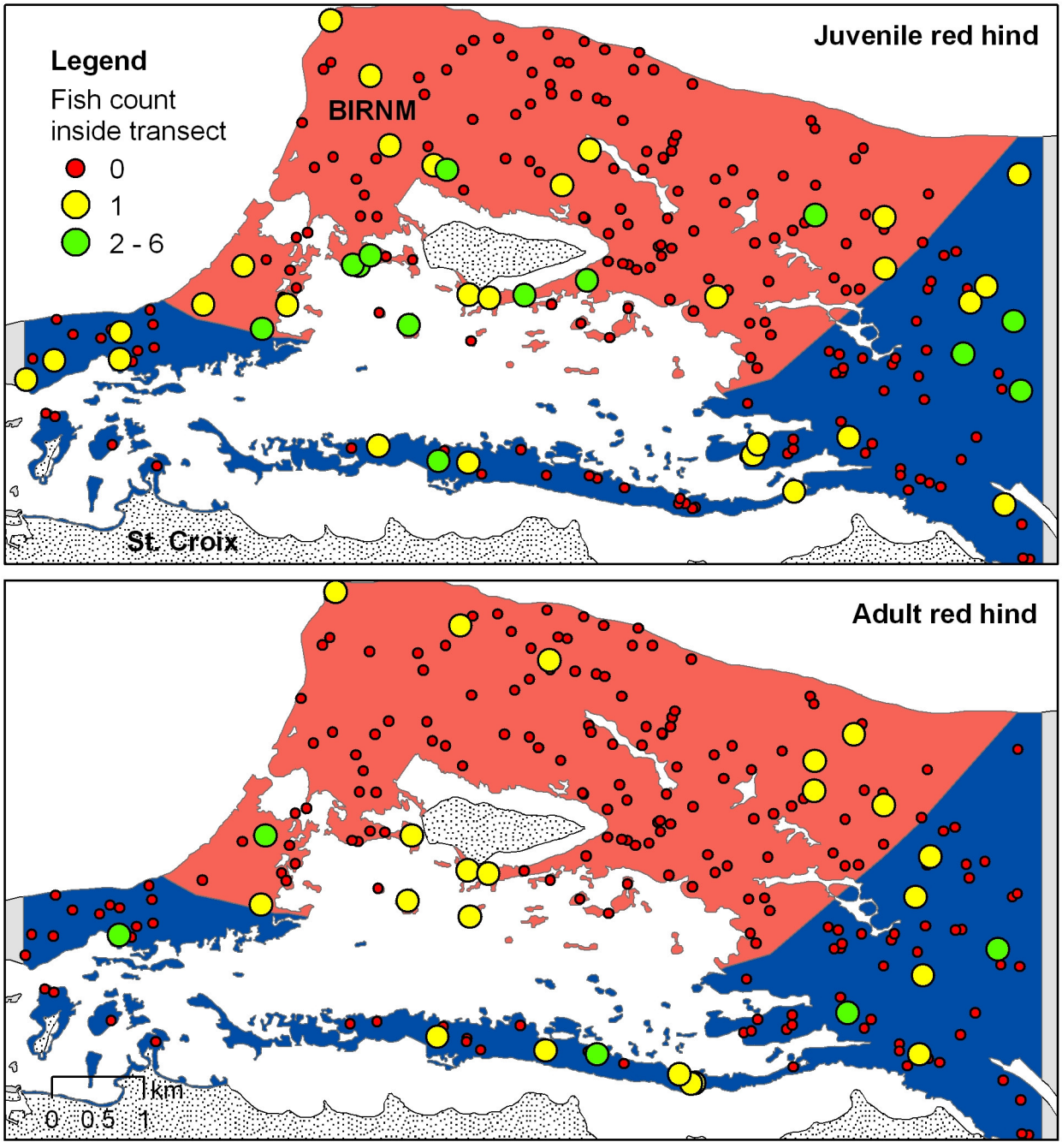

Figure 11. Red hind juvenile and adult counts per transect within two of the eight strata. Data were derived from NOAA unpublished raw data.

Table 4. Mean benthic cover within the eight strata. Values are given with the 95% confidence interval. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

Stratum	n	Coral species richness	Percent coral	Percent sponge	Percent gorgonian	Percent macro-algae	Percent bluegreen algae	Percent turf algae	Percent fire coral	Percent other cover	Percent bare substrate
BIRNM	130	5.1	5.5	1.9	3.1	13.9	0.8	38.5	0.6	0.9	34.7
		± 0.5	± 1.1	± 0.7	± 0.6	± 2.9	± 0.5	± 5.1	± 0.3	± 1.1	± 5.6
EEMP NW	87	5.9	2.8	2.7	1.1	19.7	1.2	35.0	0.5	0.0	37.0
		± 0.6	± 0.6	± 0.5	± 0.3	± 3.6	± 0.7	± 5.6	± 0.2	± 0	± 6.4
EEMP	5	4.4	1.4	2.6	2.5	11.6	8.1	42.5	0.1	0.0	31.2
		± 2.3	± 1.3	± 2.5	± 2.5	± 8.9	± 5	± 22.6	± 0.1	± 0.1	± 22.2
Lang Bank Federal Waters	5	9.8	8.9	6.3	7.4	7.0	6.0	59.7	0.5	0.3	3.9
		± 0.7	± 4.4	± 2.4	± 4.1	± 3.2	± 5.1	± 9.3	± 0.5	± 0.4	± 2.7
South Side East of HOVENSA	5	6.4	2.0	3.7	1.7	16.4	8.1	48.6	0.3	0.4	18.8
		± 3.5	± 1.3	± 2.8	± 1.8	± 15.6	± 8.6	± 18	± 0.3	± 0.7	± 12.4
South Side West of HOVENSA	8	5.1	3.2	3.3	1.1	16.0	10.2	39.8	0.2	1.1	25.3
		± 2.5	± 2.5	± 2.6	± 1	± 7.3	± 11.5	± 14.1	± 0.1	± 1.2	± 13.1
West End	6	5.8	4.4	8.4	0.6	4.9	0.4	61.8	0.0	0.0	19.5
		± 2.1	± 3.3	± 5	± 0.5	± 5.7	± 0.6	± 13.1	± 0	± 0	± 10.7
North Side	6	9.0	7.8	2.6	3.3	10.7	1.0	60.3	0.5	0.4	13.4
		± 2.2	± 4.9	± 1	± 2	± 7.7	± 2	± 16.9	± 0.6	± 0.3	± 17

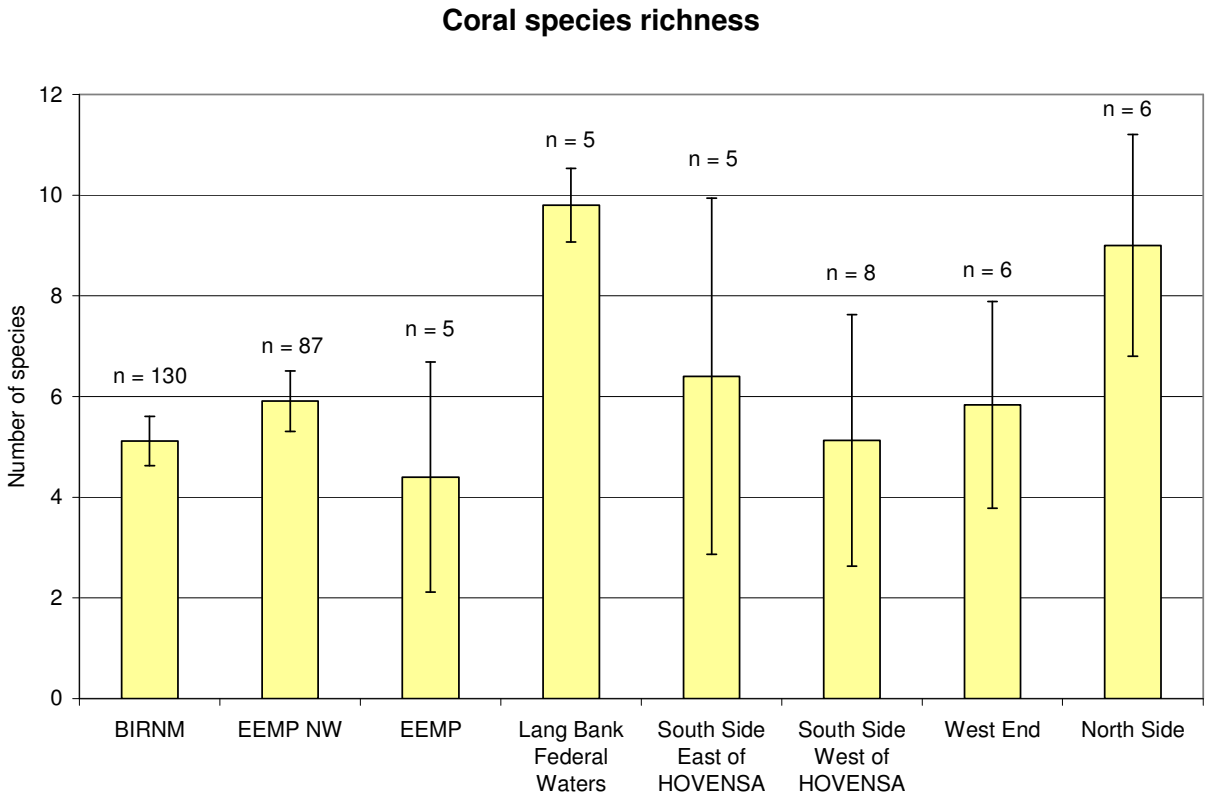

Figure 12. Comparison of coral species richness among the eight strata. The error bars represent the 95% confidence interval. The sample size is shown above the error bar. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

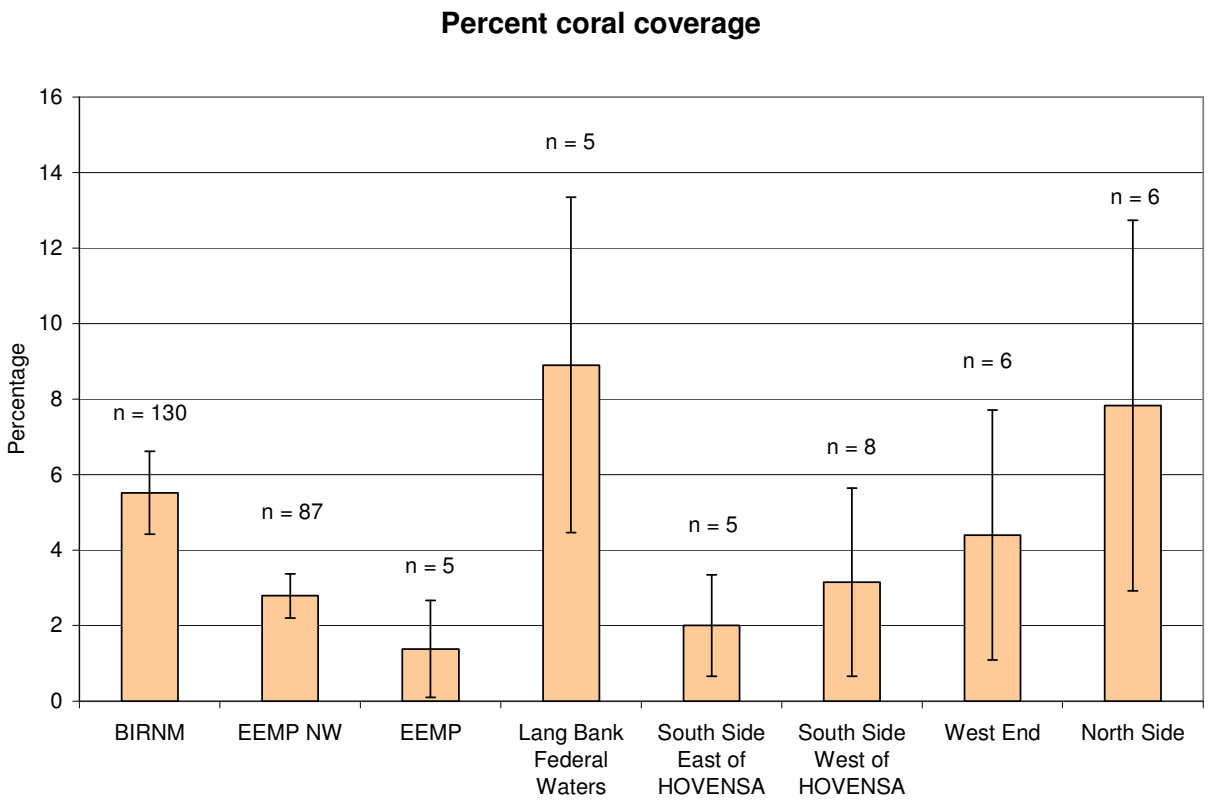

Figure 13. Comparison of percent coral coverage among the eight strata. The error bars represent the 95% confidence interval. The sample size is shown above the error bar. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

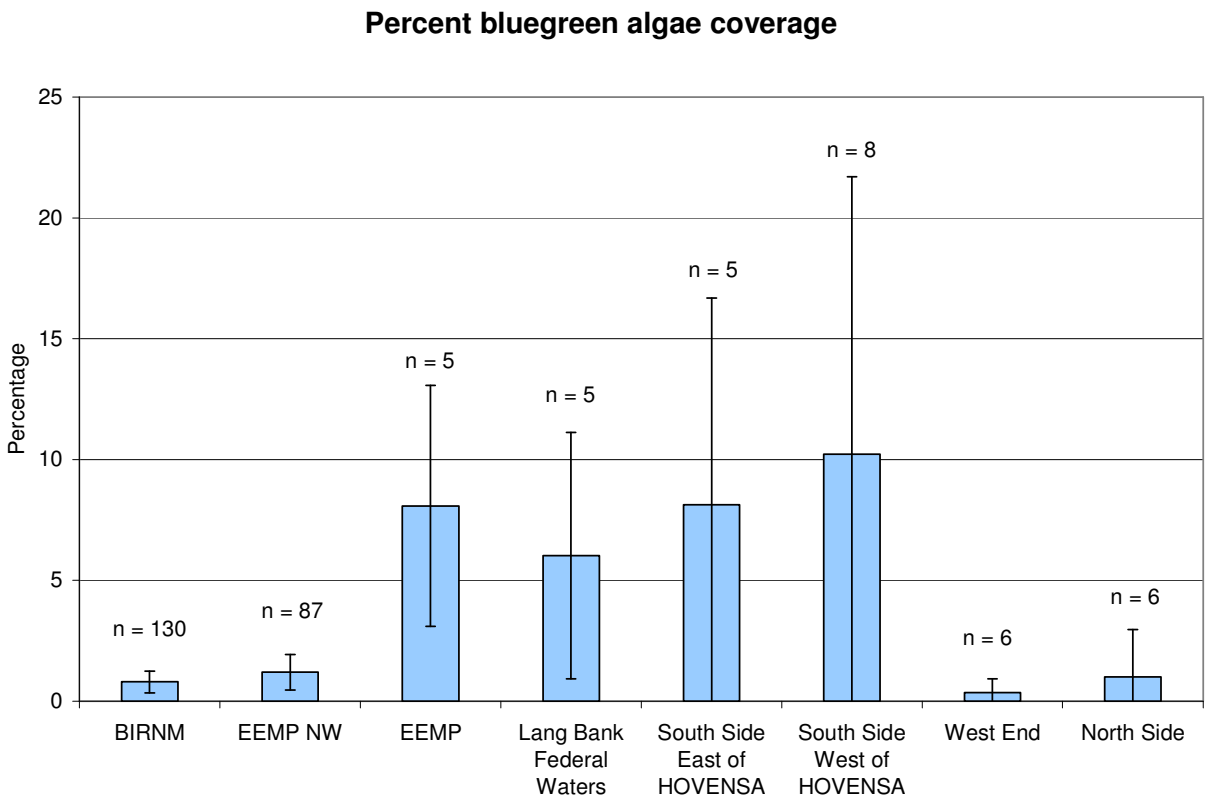

Figure 14. Comparison of bluegreen algae coverage among the eight strata. The error bars represent the 95% confidence interval. The sample size is shown above the error bar. Data for BIRNM and EEMP NW were derived from NOAA unpublished raw data.

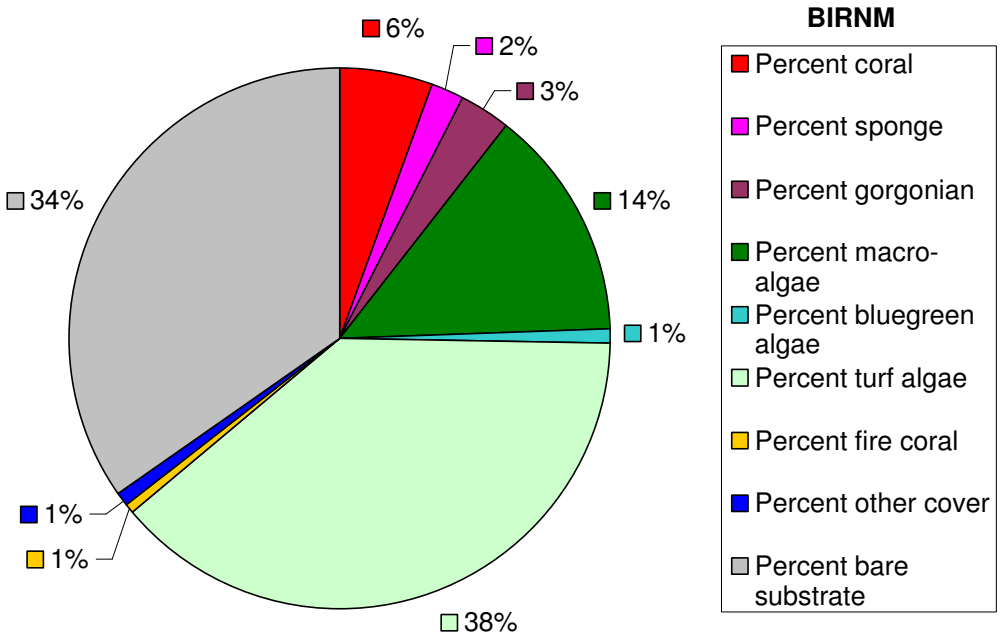

Figure 15. Mean benthic cover percentage within the BIRNM stratum (n = 130).

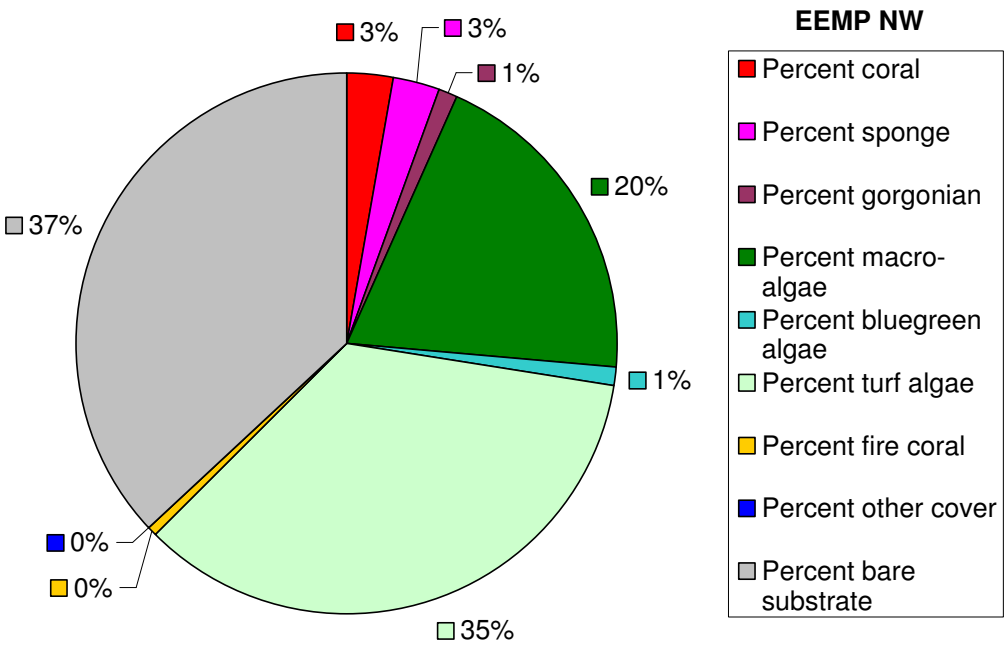

Figure 16. Mean benthic cover percentage within the EEMP NW stratum (n = 87).

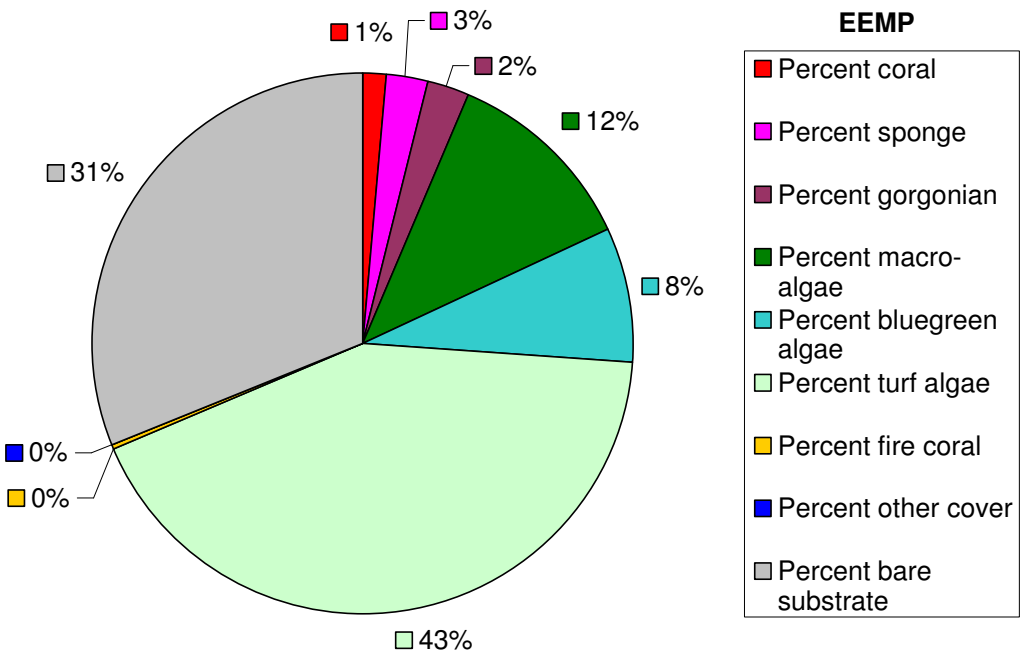

Figure 17. Mean benthic cover percentage within the EEMP stratum (n = 5).

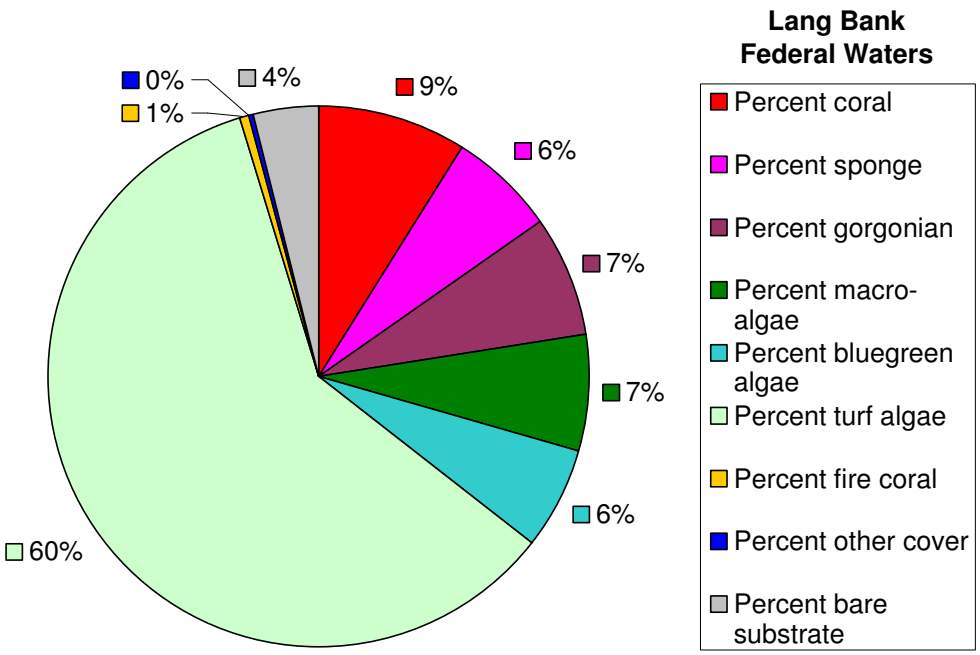

Figure 18. Mean benthic cover percentage within the Lang Bank stratum (n = 5).

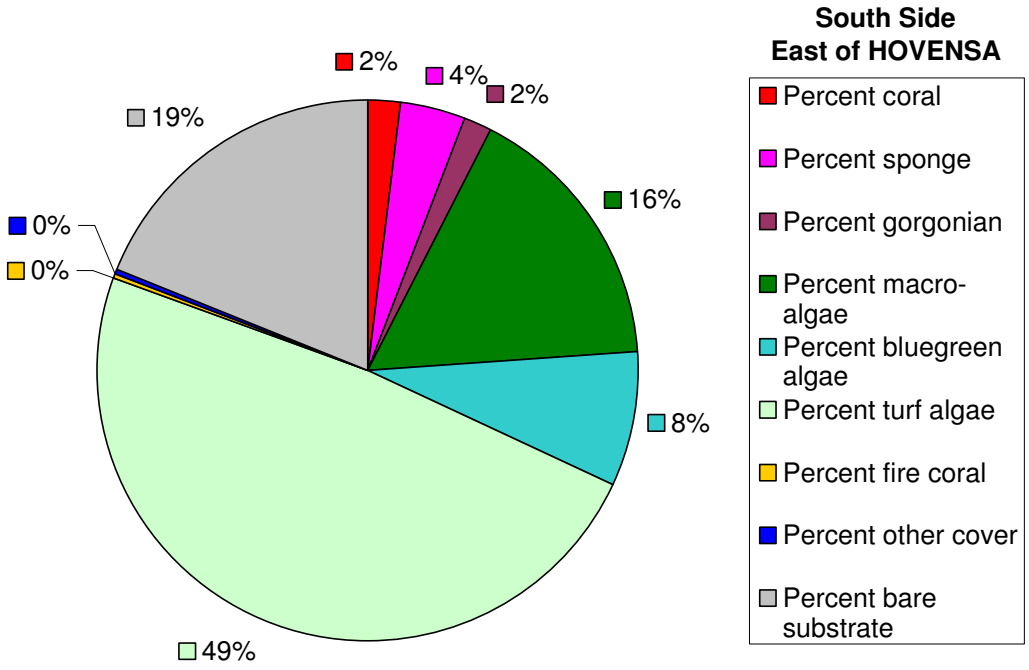

Figure 19. Mean benthic cover percentage within the South Side East of HOVENSA stratum (n = 5).

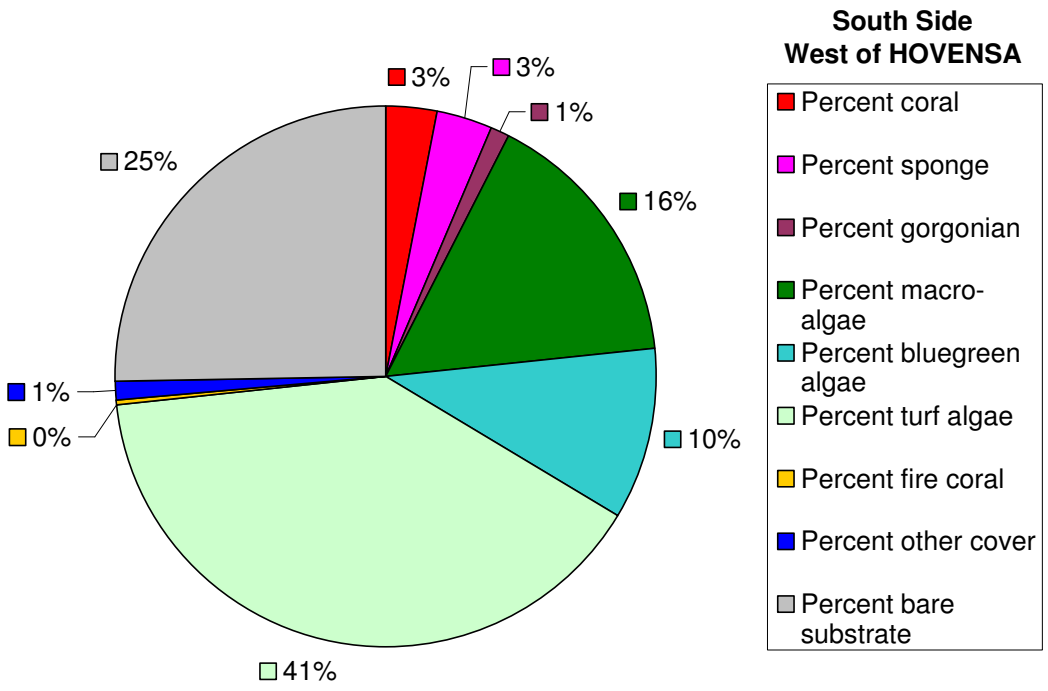

Figure 20. Mean benthic cover percentage within the South Side West of HOVENSA stratum (n = 8).

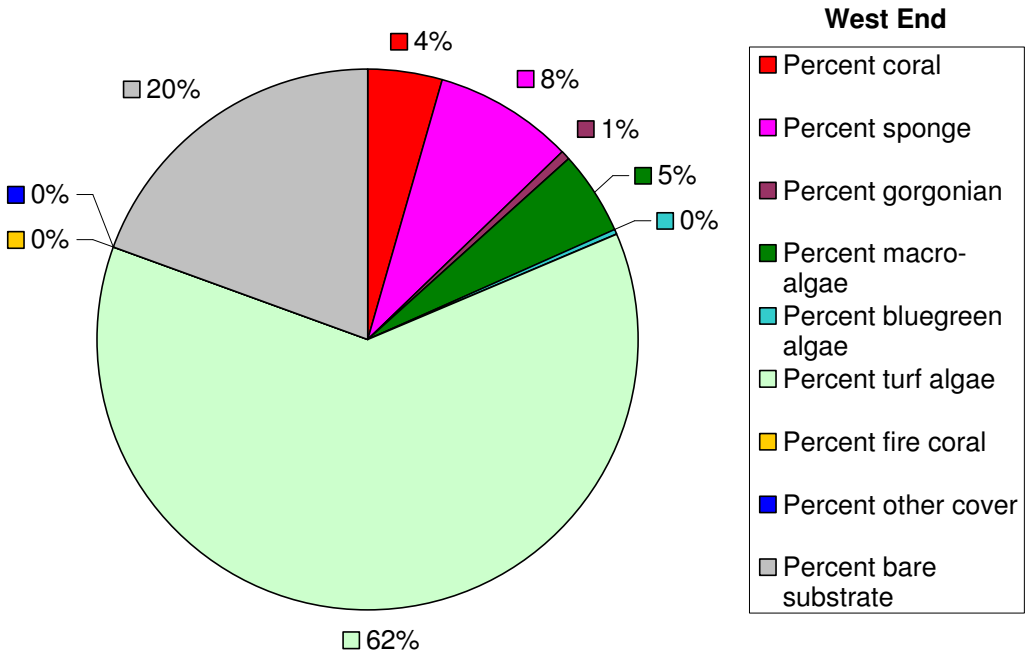

Figure 21. Mean benthic cover percentage within the West End stratum (n = 6).

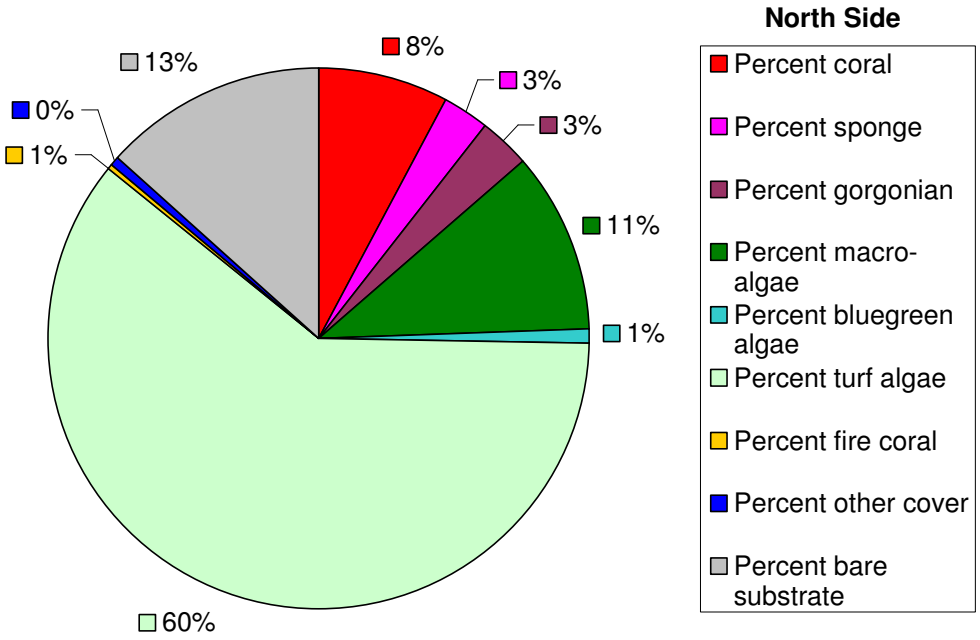

Figure 22. Mean benthic cover percentage within the North Side stratum (n = 6).

Discussion

In 1931 the USVI fishing fleet was made up of primarily row boats and one motorboat (Fiedler and Jarvis 1932), and the grouper spawning aggregations sites were probably untouched. The USVI pot fishery regularly caught red hind, rock hind, black, goliath, Nassau, red, tiger, and yellowfin groupers (Fiedler and Jarvis 1932). During the past decades several of the grouper populations were overfished and consequently crashed (Olsen and LaPlace 1978, Appeldoorn et al. 1992, Beets and Friedlander 1992, Jeffrey et al. 2005). This led to a shift of the grouper catches to primarily coneys, which were not mentioned in Fiedler and Jarvis (1932), and red hinds (Beets and Friedlander 2003, Jeffrey et al. 2005).

This study confirmed through fishery-independent data that the remaining grouper species on St. Croix were primarily coney, red hind, and graysby. Only on rare occasions could rock hind, Nassau, tiger, and yellowfin groupers be seen (Kendall et al. 2004, personal observations). Coney and graysby groupers are both non-migratory species that mature at relative small sizes (about 15 cm total length), making them less vulnerable to overfishing than the other grouper species that migrate to spawning aggregation sites and mature at larger sizes. Red hind groupers mature at about 25 cm total length and St. Croix's populations spawn close to the tip of Lang Bank. Unlike on St. Thomas and St. John, St. Croix's red hind population density remained low during the past decade, despite the establishment of a spawning aggregation site closure on Lang Bank in 1993. Within the data presented here, no red hinds were greater than 35 cm total length, even though they could grow to over double that size. One possible

reason for the difference among the islands may be the fact that St. Croix sits on its own island shelf and is isolated from other islands by deep water, thereby not allowing reef fish exchange with the exception of larval flow. The recovery of the St. Croix red hind population may therefore take longer, especially given the continuing legal fishing pressure outside of the spawning aggregation closure. Recent studies on St. Croix cautioned that the closure boundaries may not include a sufficient buffer zone around the spawning aggregation site and a concentration of fishing effort along those boundaries may cause high fishing mortality (Nemeth et al. In press b). This would additionally slow down the recovery process. Furthermore, there also may be a lack of compliance with the Lang Bank seasonal closure that would hinder a recovery.

St. Croix's seasonal closure for red hinds only addresses one grouper species. For the other large grouper species that are nearly extirpated, little Territorial protection is offered. If St. Croix's populations of large groupers are to recover, we believe that a moratorium should be placed on the catch of all grouper species, with the exception of coney and graysby. Target densities would need to be defined, above which a moratorium on a given species could be lifted. This would also require identifying an appropriate monitoring method, establishing a minimum sampling effort needed, and ensuring needed funding. We also believe that all grouper spawning aggregation sites should be closed to fishing, even after a moratorium is lifted. It is critical that all management regulations be evaluated for effectiveness and compliance.

Coney, graysby, and red hind groupers used bank hardbottom habitats both as nursery grounds and adult habitat. It was common to see juveniles and adults within the same survey transect. Grouper densities appeared to differ among strata, however, the high variances and the low sample sizes within each stratum, generally did not allow for detection of significant differences. Overall adult coney and graysby densities were higher than juvenile densities, whereas juvenile red hind density was higher than that of adults. Smaller individuals being more cryptic could explain this. Since red hinds were considered juveniles up to 25 cm total length, but coneys and graysbys only up to 15 cm, red hind juveniles may be outside of shelter more often, therefore increasing their chance of detection.

This study was a first attempt to assess St. Croix's grouper populations within bank hardbottom habitats using a fishery-independent, stratified random sampling approach. Macro, turf, and bluegreen algae dominated the associated hardbottom habitats. Percent coral coverages were low and ranged from 1.4% ± 1.3% to 8.9% ± 4.4%. The additional habitat characterization data may provide useful data in evaluating the current state of St. Croix's coral reefs. As Pandolfi et al. (2005) stated for the US coral reefs, St. Croix's reefs may well be on the slippery slope to slime: overfishing of megafauna releases population control of smaller fishes and invertebrates, creating booms and busts. This in turn can increase algal overgrowth, or overgrazing, and stress the coral architects, likely making them more vulnerable to other forms of stress. We believe that a successful recovery of St. Croix's large grouper species is an important step in stopping our coral reef degradation trend.

Citation

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Appendix

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND007	Lat: 17.77096	Lon: -64.87494	Depth: 30 ft	Hank Tonnemacher
	Date: 10/16/2006	Time: 10:12		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	17
Transect bearing:	95 °	% Sand:	0
Small holes:	0.8	% Rubble:	0
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	2.31	0.61	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.02	0.02	
% macroalgae:	1.20	0.97	2
% gorgonian:	1.50	0.89	14
% sponge:	14.20	8.64	0
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	80.77	9.03	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Apal present, lots of coneys arount site

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND022	Lat: 17.76573	Lon: -64.85709	Depth: 26 ft	Hank Tonnemacher
	Date: 10/16/2006	Time: 11:15		Philippe Mayor

Col Pav & Sand Chan		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	22
Transect bearing:	288 °	% Sand:	0
Small holes:	0.8	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	13.74	1.26	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	2.00	0.57	
% macroalgae:	0.00	0.00	0
% gorgonian:	4.40	1.36	44
% sponge:	2.00	0.84	7
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.30	0.20	
% macroinvertebrate:	0.00	0.00	
% turf algae:	77.56	2.24	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	5	2				
Min. size [cm]:	15	8				
Max siz. [cm]:	18	10				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Apal present

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND002	Lat: 17.78472	Lon: -64.78463	Depth: 20 ft	Hank Tonnemacher
	Date: 10/16/2006	Time: 12:39		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	2	Hardbottom height [cm]:	26
Transect bearing:	140 °	% Sand:	0
Small holes:	0.6	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	1.52	0.50	
% diseased coral:	0.00	0.00	
% bleached coral:	0.04	0.04	
% fire coral:	0.40	0.19	
% macroalgae:	19.00	9.25	4.8
% gorgonian:	1.40	0.73	10
% sponge:	3.80	1.27	6
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.80	0.80	
% macroinvertebrate:	0.40	0.40	
% turf algae:	72.64	9.60	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	10

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Apal present

RND003

Lat:	17.78547	Lon:	-64.78395	Depth: 30 ft	Hank Tonnemacher
Date:	10/16/2006	Time:	13:36		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	26
Transect bearing:	149 °	% Sand:	0
Small holes:	0	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	3.60	1.06	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.04	0.04	
% macroalgae:	13.40	4.31	5
% gorgonian:	2.00	1.22	22
% sponge:	2.70	1.74	3
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	78.26	4.17	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		3				
Min. size [cm]:		10				
Max siz. [cm]:		12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

RND021

Lat:	17.77457	Lon:	-64.73681	Depth: 36 ft	Hank Tonnemacher
Date:	10/16/2006	Time:	14:42		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	30
Transect bearing:	59 °	% Sand:	0
Small holes:	0.4	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 12

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	15.26	4.61	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.52	0.16	
% macroalgae:	8.60	2.60	4.6
% gorgonian:	5.00	1.48	56
% sponge:	4.40	2.66	9
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.20	0.20	
% macroinvertebrate:	0.00	0.00	
% turf algae:	66.02	4.09	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	1

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	4				1
Min. size [cm]:	15	9				12
Max siz. [cm]:	15	12				12

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND010

Lat:	17.67388	Lon:	-64.79412	Depth: 21 ft	Hank Tonnemacher
Date:	10/17/2006	Time:	10:45		Philippe Mayor

Col Pav		% hardbottom:	88.4
Rugosity:	1	Hardbottom height [cm]:	13
Transect bearing:	245 °	% Sand:	9
Small holes:	3.2	% Rubble:	2.6
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 4

	Mean	SE	Height [cm]
% bare substrate:	38.00	3.39	
% live coral:	1.46	0.43	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.00	0.00	
% macroalgae:	11.20	1.71	11.4
% gorgonian:	0.50	0.39	10
% sponge:	0.04	0.04	0
% seagrass:	0.00	0.00	0
% blue-green algae:	13.80	8.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.96	0.29	
% turf algae:	34.04	6.07	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	114

	Coney		Graysby		Red hind	
Presence/absence:	☐		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of Diadema

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND006	Lat: 17.65864	Lon: -64.78305	Depth: 50 ft	Hank Tonnemacher
	Date: 10/17/2006	Time: 11:30		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	2	Hardbottom height [cm]:	28
Transect bearing:	50 °	% Sand:	0
Small holes:	2.4	% Rubble:	0
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	14.40	4.57	
% live coral:	6.82	0.61	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.16	0.08	
% macroalgae:	9.80	1.50	5
% gorgonian:	1.80	1.10	24
% sponge:	6.00	1.87	17
% seagrass:	0.00	0.00	0
% blue-green algae:	48.00	5.83	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	13.02	1.72	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	3				
Min. size [cm]:	15	10				
Max siz. [cm]:	15	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Area dark due to blue-green algae

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND011

Lat: 17.65424 Lon: -64.81593 Depth: 48 ft Hank Tonnemacher
Date: 10/17/2006 Time: 12:40 Philippe Mayor

Scat Coral & Rock in Sand		% hardbottom:	82
Rugosity:	1	Hardbottom height [cm]:	7
Transect bearing:	192 °	% Sand:	16
Small holes:	0	% Rubble:	2
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 2

	Mean	SE	Height [cm]
% bare substrate:	57.00	8.89	
% live coral:	0.10	0.08	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.00	0.00	
% macroalgae:	15.00	2.43	10.8
% gorgonian:	0.00	0.00	0
% sponge:	3.40	1.21	8
% seagrass:	0.00	0.00	0
% blue-green algae:	1.20	1.20	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	4.00	1.14	
% turf algae:	19.30	7.32	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		2				
Min. size [cm]:		8				
Max siz. [cm]:		13				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of sargassum; shallow sand over hardbottom

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND019	Lat: 17.76127	Lon: -64.71589	Depth: 60 ft	Hank Tonnemacher
	Date: 10/17/2006	Time: 14:45		Philippe Mayor

Col Pav & Sand Chan		% hardbottom:	60.6
Rugosity:	3	Hardbottom height [cm]:	52
Transect bearing:	286 °	% Sand:	33.4
Small holes:	2.2	% Rubble:	6
Large holes:	1.6	% Fine sediments:	0

Biotic

Coral count: 12

	Mean	SE	Height [cm]
% bare substrate:	33.40	14.61	
% live coral:	10.06	2.59	
% diseased coral:	0.00	0.00	
% bleached coral:	0.60	0.40	
% fire coral:	0.00	0.00	
% macroalgae:	23.00	14.61	5
% gorgonian:	0.10	0.10	2
% sponge:	1.10	0.68	9
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.30	0.30	
% macroinvertebrate:	0.00	0.00	
% turf algae:	31.44	10.49	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:					1	1
Min. size [cm]:					25	15
Max siz. [cm]:					25	15

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

RND012

Lat: 17.76823 Lon: -64.69084 Depth: 20 ft Hank Tonnemacher
Date: 10/17/2006 Time: 15:45 Philippe Mayor

Scat Coral & Rock in Sand		% hardbottom:	43.4
Rugosity:	2	Hardbottom height [cm]:	14
Transect bearing:	267 °	% Sand:	45.6
Small holes:	1.2	% Rubble:	11
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 7

	Mean	SE	Height [cm]		Count
% bare substrate:	47.00	14.63		Mature queen conch:	0
% live coral:	2.22	0.51		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	0
% fire coral:	0.34	0.19			
% macroalgae:	0.00	0.00	0		
% gorgonian:	6.60	2.14	36		
% sponge:	1.70	0.49	11		
% seagrass:	0.00	0.00	0		
% blue-green algae:	6.00	6.00			
% zoanthid:	0.20	0.20			
% macroinvertebrate:	0.00	0.00			
% turf algae:	35.94	10.50			

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	2				
Min. size [cm]:	15	8				
Max siz. [cm]:	15	10				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND015

Lat:	17.67047	Lon:	-64.83036	Depth: 20 ft	Hank Tonnemacher
Date:	10/18/2006	Time:	10:25		Philippe Mayor

Col Pav		% hardbottom:	86
Rugosity:	1	Hardbottom height [cm]:	6
Transect bearing:	253 °	% Sand:	14
Small holes:	0	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 1

	Mean	SE	Height [cm]
% bare substrate:	42.00	4.90	
% live coral:	0.26	0.19	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.16	0.16	
% macroalgae:	17.40	7.37	5
% gorgonian:	0.00	0.00	0
% sponge:	0.40	0.24	3.2
% seagrass:	3.80	1.85	6
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	35.98	3.39	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		1				1
Min. size [cm]:		10				8
Max siz. [cm]:		10				8

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND018	Lat: 17.66043	Lon: -64.81542	Depth: 30 ft	Hank Tonnemacher
	Date: 10/18/2006	Time: 11:15		Philippe Mayor

Col Pav		% hardbottom:	86.4
Rugosity:	1	Hardbottom height [cm]:	22
Transect bearing:	7 °	% Sand:	9.4
Small holes:	3	% Rubble:	4.2
Large holes:	1	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]		Count
% bare substrate:	9.40	5.22		Mature queen conch:	0
% live coral:	0.70	0.19		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	3
% fire coral:	0.50	0.39			
% macroalgae:	12.80	3.38	12.6		
% gorgonian:	0.10	0.10	4		
% sponge:	1.00	0.52	4		
% seagrass:	0.00	0.00	0		
% blue-green algae:	0.10	0.10			
% zoanthid:	0.00	0.00			
% macroinvertebrate:	0.00	0.00			
% turf algae:	75.40	7.37			

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		1				2
Min. size [cm]:		12				9
Max siz. [cm]:		12				15

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND014

Lat:	17.63746	Lon:	-64.88191	Depth: 69 ft	Hank Tonnemacher
Date:	10/18/2006	Time:	12:30		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	3	Hardbottom height [cm]:	58
Transect bearing:	12 °	% Sand:	0
Small holes:	5.4	% Rubble:	0
Large holes:	1.6	% Fine sediments:	0

Biotic

Coral count: 7

	Mean	SE	Height [cm]
% bare substrate:	7.60	5.81	
% live coral:	4.98	0.63	
% diseased coral:	0.00	0.00	
% bleached coral:	3.20	0.97	
% fire coral:	0.00	0.00	
% macroalgae:	21.00	1.87	4
% gorgonian:	1.80	1.20	14
% sponge:	4.60	1.83	16
% seagrass:	0.00	0.00	0
% blue-green algae:	2.60	1.08	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	54.22	8.56	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	2	1			
Min. size [cm]:	15	10	15			
Max siz. [cm]:	15	12	15			

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of Lobophora

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND009	Lat: 17.65632	Lon: -64.89212	Depth: 28 ft	Hank Tonnemacher
	Date: 10/18/2006	Time: 13:40		Philippe Mayor

Col Pav		% hardbottom:	82.6
Rugosity:	1	Hardbottom height [cm]:	6
Transect bearing:	29 °	% Sand:	17.4
Small holes:	0.4	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 2

	Mean	SE	Height [cm]		Count
% bare substrate:	28.00	2.55		Mature queen conch:	0
% live coral:	0.26	0.14		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	0
% fire coral:	0.00	0.00			
% macroalgae:	38.00	6.63	5.8		
% gorgonian:	0.00	0.00	0		
% sponge:	0.40	0.24	1		
% seagrass:	0.00	0.00	0		
% blue-green algae:	0.00	0.00			
% zoanthid:	0.00	0.00			
% macroinvertebrate:	0.00	0.00			
% turf algae:	33.34	8.36			

	Coney		Graysby		Red hind	
Presence/absence:	☐		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of Halimeda

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND016

Lat: 17.64232 Lon: -64.90237 Depth: 60 ft Hank Tonnemacher
Date: 10/18/2006 Time: 14:30 Philippe Mayor

Spur & Groove		% hardbottom:	92
Rugosity:	3	Hardbottom height [cm]:	50
Transect bearing:	122 °	% Sand:	8
Small holes:	3.2	% Rubble:	0
Large holes:	0.8	% Fine sediments:	0

Biotic

Coral count: 11

	Mean	SE	Height [cm]
% bare substrate:	6.00	1.00	
% live coral:	7.34	1.66	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.32	0.19	
% macroalgae:	2.40	1.44	4.2
% gorgonian:	4.20	0.66	50
% sponge:	10.60	1.94	38
% seagrass:	0.00	0.00	0
% blue-green algae:	16.00	6.78	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	53.14	6.68	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	2	3				
Min. size [cm]:	15	8				
Max siz. [cm]:	15	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

RND042

Lat:	17.81413	Lon:	-64.45179	Depth: 60 ft	Hank Tonnemacher
Date:	10/20/2006	Time:	9:50		Philippe Mayor

Col Pav		% hardbottom:	96.2
Rugosity:	1	Hardbottom height [cm]:	24
Transect bearing:	4 °	% Sand:	3.8
Small holes:	1.4	% Rubble:	0
Large holes:	0.4	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	4.60	0.40	
% live coral:	7.88	2.27	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.70	0.20	
% macroalgae:	8.00	0.95	5
% gorgonian:	4.20	1.62	40
% sponge:	9.20	1.28	44
% seagrass:	0.00	0.00	0
% blue-green algae:	14.20	4.72	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	51.22	4.59	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	7				
Min. size [cm]:	15	10				
Max siz. [cm]:	15	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND041

Lat:	17.81784	Lon:	-64.44646	Depth: 80 ft	Hank Tonnemacher
Date:	10/20/2006	Time:	10:45		Philippe Mayor

Spur & Groove		% hardbottom:	100
Rugosity:	3	Hardbottom height [cm]:	52
Transect bearing:	10 °	% Sand:	0
Small holes:	3.4	% Rubble:	0
Large holes:	2.6	% Fine sediments:	0

Biotic

Coral count: 10

	Mean	SE	Height [cm]
% bare substrate:	0.00	0.00	
% live coral:	8.78	1.72	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.02	0.02	
% macroalgae:	3.00	0.55	3.2
% gorgonian:	2.40	1.36	23
% sponge:	8.20	4.55	17
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	77.60	3.27	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND005	Lat: 17.68991	Lon: -64.90117	Depth: 73 ft	Hank Tonnemacher
	Date: 10/31/2006	Time: 9:50		Philippe Mayor

Patch Reef		% hardbottom:	61
Rugosity:	2	Hardbottom height [cm]:	72
Transect bearing:	0 °	% Sand:	38
Small holes:	1.8	% Rubble:	1
Large holes:	2.8	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	38.00	14.37	
% live coral:	7.50	3.05	
% diseased coral:	0.00	0.00	
% bleached coral:	0.40	0.40	
% fire coral:	0.00	0.00	
% macroalgae:	0.00	0.00	0
% gorgonian:	0.24	0.19	10
% sponge:	15.10	4.00	62
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	38.76	9.44	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☐		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:			2	3		
Min. size [cm]:			15	10		
Max siz. [cm]:			15	12		

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of sponges. Sand to E, S, and W

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND008	Lat: 17.73095	Lon: -64.89485	Depth: 28 ft	Hank Tonnemacher
	Date: 10/31/2006	Time: 11:38		Philippe Mayor

Col Pav		% hardbottom:	82.6
Rugosity:	2	Hardbottom height [cm]:	36
Transect bearing:	10 °	% Sand:	12.4
Small holes:	6.4	% Rubble:	5
Large holes:	0.6	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]
% bare substrate:	12.40	3.17	
% live coral:	4.62	1.65	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.14	0.10	
% macroalgae:	16.60	4.77	8
% gorgonian:	0.00	0.00	0
% sponge:	5.40	1.33	20.6
% seagrass:	0.00	0.00	0
% blue-green algae:	1.80	0.80	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	59.04	5.02	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	1	1	1		
Min. size [cm]:	15	8	15	12		
Max siz. [cm]:	15	8	15	12		

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Lots of dead MOAN with turf algae

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND048

Lat:	17.73794	Lon:	-64.89309	Depth: 8 ft	Hank Tonnemacher
Date:	10/31/2006	Time:	12:40		Philippe Mayor

Col Pav		% hardbottom:	95.2
Rugosity:	1	Hardbottom height [cm]:	11
Transect bearing:	192 °	% Sand:	4.8
Small holes:	0.8	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 3

	Mean	SE	Height [cm]
% bare substrate:	30.00	5.48	
% live coral:	0.32	0.20	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.00	0.00	
% macroalgae:	0.90	0.56	3
% gorgonian:	0.00	0.00	0
% sponge:	2.00	1.19	5.6
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	66.78	6.09	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney	Graysby	Red hind
Presence/absence:	☐	☐	☐

	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

No groupers anywhere to be seen

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND047	Lat: 17.72082	Lon: -64.88751	Depth: 20 ft	Hank Tonnemacher
	Date: 10/31/2006	Time: 13:30		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	1
Transect bearing:	88 °	% Sand:	0
Small holes:	0	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 4

	Mean	SE	Height [cm]
% bare substrate:	20.00	1.58	
% live coral:	0.74	0.28	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.00	0.00	
% macroalgae:	0.00	0.00	0
% gorgonian:	0.70	0.70	3
% sponge:	1.26	0.44	9.6
% seagrass:	0.00	0.00	0
% blue-green algae:	0.00	0.00	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	77.30	1.31	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	2

	Coney		Graysby		Red hind	
Presence/absence:	☐		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						1
Min. size [cm]:						15
Max siz. [cm]:						15

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

RND053

Lat:	17.70071	Lon:	-64.89308	Depth: 60 ft	Hank Tonnemacher
Date:	10/31/2006	Time:	14:15		Philippe Mayor

Linear Reef		% hardbottom:	83.6
Rugosity:	3	Hardbottom height [cm]:	78
Transect bearing:	129 °	% Sand:	16.4
Small holes:	4.2	% Rubble:	0
Large holes:	3	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	16.80	5.51	
% live coral:	10.10	3.04	
% diseased coral:	0.00	0.00	
% bleached coral:	0.50	0.39	
% fire coral:	0.00	0.00	
% macroalgae:	10.80	4.27	5
% gorgonian:	1.00	1.00	1
% sponge:	12.20	3.89	49
% seagrass:	0.00	0.00	0
% blue-green algae:	0.30	0.30	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	48.30	4.97	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☐		☑		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:			2			1
Min. size [cm]:			15			13
Max siz. [cm]:			18			13

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND001	Lat: 17.67634	Lon: -64.73096	Depth: 50 ft	Hank Tonnemacher
	Date: 11/1/2006	Time: 10:00		Philippe Mayor

Col Pav		% hardbottom:	97
Rugosity:	1	Hardbottom height [cm]:	9
Transect bearing:	199 °	% Sand:	3
Small holes:	0.6	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 3

	Mean	SE	Height [cm]
% bare substrate:	38.00	3.74	
% live coral:	0.64	0.30	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.70	0.27	
% macroalgae:	3.80	0.58	6
% gorgonian:	4.10	1.93	29
% sponge:	5.70	1.30	20
% seagrass:	0.00	0.00	0
% blue-green algae:	9.60	2.73	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	37.46	1.75	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	2	2				
Min. size [cm]:	15	12				
Max siz. [cm]:	20	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Sand next to hardbottom

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND017	Lat:	17.67537	Lon:	-64.72207	Depth:	60 ft	Hank Tonnemacher
	Date:	11/1/2006	Time:	11:20			Philippe Mayor

Col Pav		% hardbottom:	98.4
Rugosity:	1	Hardbottom height [cm]:	19
Transect bearing:	10 °	% Sand:	1.2
Small holes:	1.4	% Rubble:	0.4
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 11

	Mean	SE	Height [cm]
% bare substrate:	29.40	14.68	
% live coral:	3.08	1.97	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.50	0.16	
% macroalgae:	1.10	0.98	2
% gorgonian:	3.80	1.32	40
% sponge:	8.30	4.55	24
% seagrass:	0.00	0.00	0
% blue-green algae:	24.40	14.29	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	29.42	15.44	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	1	1			
Min. size [cm]:	15	10	15			
Max siz. [cm]:	15	10	15			

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Next to sandy area

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND020	Lat: 17.6903	Lon: -64.70011	Depth: 30 ft	Hank Tonnemacher
	Date: 11/1/2006	Time: 12:40		Philippe Mayor

Col Pav		% hardbottom:	98
Rugosity:	1	Hardbottom height [cm]:	11.4
Transect bearing:	140 °	% Sand:	1.2
Small holes:	6	% Rubble:	0.8
Large holes:	0.4	% Fine sediments:	0

Biotic

Coral count: 10

	Mean	SE	Height [cm]
% bare substrate:	9.40	1.17	
% live coral:	2.00	0.29	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.20	0.08	
% macroalgae:	46.00	5.10	12
% gorgonian:	0.30	0.20	6
% sponge:	3.00	1.06	9.2
% seagrass:	0.00	0.00	0
% blue-green algae:	4.60	2.91	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	34.50	2.48	

	Count
Mature queen conch:	0
Immature queen conch:	0
Spiny lobsters:	0
Longspine sea urchins:	1

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	4	9				1
Min. size [cm]:	15	10				12
Max siz. [cm]:	26	12				12

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND004	Lat: 17.70146	Lon: -64.67033	Depth: 36 ft	Hank Tonnemacher
	Date: 11/1/2006	Time: 13:40		Philippe Mayor

Col Pav		% hardbottom:	92.6
Rugosity:	1	Hardbottom height [cm]:	13
Transect bearing:	217 °	% Sand:	0.8
Small holes:	2.8	% Rubble:	6.6
Large holes:	0.4	% Fine sediments:	0

Biotic

Coral count: 2

	Mean	SE	Height [cm]		Count
% bare substrate:	11.40	2.73		Mature queen conch:	0
% live coral:	0.36	0.14		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	0
% fire coral:	0.00	0.00			
% macroalgae:	17.00	3.29	5		
% gorgonian:	0.00	0.00	0		
% sponge:	1.00	0.63	2		
% seagrass:	0.00	0.00	0		
% blue-green algae:	0.40	0.24			
% zoanthid:	0.00	0.00			
% macroinvertebrate:	1.80	0.86			
% turf algae:	68.04	5.34			

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		1				3
Min. size [cm]:		12				10
Max siz. [cm]:		12				16

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND013

Lat:	17.68133	Lon:	-64.69274	Depth: 40 ft	Hank Tonnemacher
Date:	11/1/2006	Time:	14:45		Philippe Mayor

Col Pav		% hardbottom:	100
Rugosity:	1	Hardbottom height [cm]:	21.4
Transect bearing:	291 °	% Sand:	0
Small holes:	1.8	% Rubble:	0
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 6

	Mean	SE	Height [cm]
% bare substrate:	5.60	1.17	
% live coral:	3.86	2.76	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.10	0.06	
% macroalgae:	14.20	3.34	3.4
% gorgonian:	0.40	0.40	4
% sponge:	0.66	0.19	4
% seagrass:	0.00	0.00	0
% blue-green algae:	1.60	0.81	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	73.58	2.39	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	2					1
Min. size [cm]:	15					15
Max siz. [cm]:	18					15

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

1 lg PAAR outside of transect in sm hole

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND031 Lat: 17.70265 Lon: -64.66162 Depth: 39 ft Hank Tonnemacher
Date: 11/2/2006 Time: 10:10 Philippe Mayor

Scat Coral & Rock in Sand		% hardbottom:	4
Rugosity:	1	Hardbottom height [cm]:	4
Transect bearing:	10 °	% Sand:	89.2
Small holes:	0	% Rubble:	6.8
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 0

	Mean	SE	Height [cm]		Count
% bare substrate:	70.80	2.52		Mature queen conch:	3
% live coral:	0.00	0.00		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	0
% fire coral:	0.00	0.00			
% macroalgae:	27.40	2.98	10		
% gorgonian:	0.00	0.00	0		
% sponge:	0.00	0.00	0		
% seagrass:	0.00	0.00	0		
% blue-green algae:	0.00	0.00			
% zoanthid:	0.00	0.00			
% macroinvertebrate:	0.20	0.20			
% turf algae:	1.60	0.68			

	Coney		Graysby		Red hind	
Presence/absence:	☐		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:						
Min. size [cm]:						
Max siz. [cm]:						

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

No groupers. Lots of Laurencia and Halimeda. 4 milk conch in transect

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND036

Lat:	17.69978	Lon:	-64.63291	Depth: 65 ft	Hank Tonnemacher
Date:	11/2/2006	Time:	11:10		Philippe Mayor

Col Pav		% hardbottom:	95.6
Rugosity:	1	Hardbottom height [cm]:	7
Transect bearing:	226 °	% Sand:	4.4
Small holes:	0.2	% Rubble:	0
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]
% bare substrate:	31.80	8.70	
% live coral:	0.78	0.62	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.14	0.10	
% macroalgae:	1.40	0.93	3
% gorgonian:	0.20	0.20	3
% sponge:	0.40	0.29	2
% seagrass:	0.00	0.00	0
% blue-green algae:	15.00	2.24	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	50.28	10.10	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:		1				
Min. size [cm]:		10				
Max siz. [cm]:		10				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Col pavement with sand cover

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND032	Lat:	17.70956	Lon:	-64.58829	Depth:	64 ft	Hank Tonnemacher
	Date:	11/2/2006	Time:	12:30			Philippe Mayor

Col Pav		% hardbottom:	50.2
Rugosity:	1	Hardbottom height [cm]:	24
Transect bearing:	10 °	% Sand:	33.8
Small holes:	2.6	% Rubble:	16
Large holes:	0.6	% Fine sediments:	0

Biotic

Coral count: 7

	Mean	SE	Height [cm]
% bare substrate:	33.20	12.50	
% live coral:	3.04	1.43	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.32	0.21	
% macroalgae:	8.40	4.63	4
% gorgonian:	5.20	2.27	29
% sponge:	1.80	0.49	11
% seagrass:	0.00	0.00	0
% blue-green algae:	10.40	2.48	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	37.64	8.49	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1	1				
Min. size [cm]:	18	12				
Max siz. [cm]:	18	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

2 lg PAAR outside of transect crawling across open

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND037	Lat: 17.72545	Lon: -64.56569	Depth: 78 ft	Hank Tonnemacher
	Date: 11/2/2006	Time: 14:00		Philippe Mayor

Col Pav		% hardbottom:	86.8
Rugosity:	1	Hardbottom height [cm]:	18
Transect bearing:	266 °	% Sand:	12
Small holes:	2.2	% Rubble:	1.2
Large holes:	0	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]		Count
% bare substrate:	17.00	3.39		Mature queen conch:	0
% live coral:	2.88	1.33		Immature queen conch:	0
% diseased coral:	0.00	0.00		Spiny lobsters:	0
% bleached coral:	0.00	0.00		Longspine sea urchins:	0
% fire coral:	0.28	0.10			
% macroalgae:	5.60	1.03	5		
% gorgonian:	5.80	2.33	28		
% sponge:	6.90	2.56	18		
% seagrass:	0.00	0.00	0		
% blue-green algae:	9.80	3.09			
% zoanthid:	0.00	0.00			
% macroinvertebrate:	0.00	0.00			
% turf algae:	51.74	3.29			

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	4	1			1	
Min. size [cm]:	15	10			30	
Max siz. [cm]:	20	10			30	

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND035	Lat: 17.75756	Lon: -64.55148	Depth: 70 ft	Hank Tonnemacher
	Date: 11/3/2006	Time: 9:40		Philippe Mayor

Col Pav		% hardbottom:	96.2
Rugosity:	1	Hardbottom height [cm]:	22
Transect bearing:	217 °	% Sand:	3
Small holes:	1.4	% Rubble:	0.8
Large holes:	0.2	% Fine sediments:	0

Biotic

Coral count: 5

	Mean	SE	Height [cm]
% bare substrate:	3.00	1.34	
% live coral:	0.20	0.09	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.02	0.02	
% macroalgae:	15.40	2.71	12
% gorgonian:	1.20	0.46	25
% sponge:	3.80	1.23	7.4
% seagrass:	0.00	0.00	0
% blue-green algae:	5.20	1.02	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	71.18	3.89	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	1					1
Min. size [cm]:	15					18
Max siz. [cm]:	15					18

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND026	Lat: 17.76953	Lon: -64.50136	Depth: 60 ft	Hank Tonnemacher
	Date: 11/3/2006	Time: 11:00		Philippe Mayor

Col Pav		% hardbottom:	96
Rugosity:	1	Hardbottom height [cm]:	31
Transect bearing:	245 °	% Sand:	2
Small holes:	5.6	% Rubble:	2
Large holes:	1	% Fine sediments:	0

Biotic

Coral count: 11

	Mean	SE	Height [cm]
% bare substrate:	4.60	1.44	
% live coral:	6.20	1.63	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	1.40	0.58	
% macroalgae:	5.80	1.74	5
% gorgonian:	12.20	1.77	49
% sponge:	7.10	1.52	11.2
% seagrass:	0.00	0.00	0
% blue-green algae:	9.60	2.02	
% zoanthid:	0.40	0.29	
% macroinvertebrate:	0.00	0.00	
% turf algae:	52.70	4.88	

	Mature queen conch:	Immature queen conch:	Spiny lobsters:	Longspine sea urchins:
Count:	0	0	0	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	4	1				
Min. size [cm]:	15	12				
Max siz. [cm]:	20	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Nice reef

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND025	Lat:	17.79586	Lon:	-64.48107	Depth:	80 ft	Hank Tonnemacher
	Date:	11/3/2006	Time:	12:30			Philippe Mayor

Col Pav		% hardbottom:	95
Rugosity:	2	Hardbottom height [cm]:	46
Transect bearing:	98 °	% Sand:	3.2
Small holes:	4.2	% Rubble:	1.8
Large holes:	1.8	% Fine sediments:	0

Biotic

Coral count: 10

	Mean	SE	Height [cm]
% bare substrate:	2.00	2.00	
% live coral:	15.00	5.21	
% diseased coral:	0.00	0.00	
% bleached coral:	2.40	1.12	
% fire coral:	0.00	0.00	
% macroalgae:	5.40	1.60	1.6
% gorgonian:	5.40	1.89	56.4
% sponge:	4.50	1.47	11.4
% seagrass:	0.00	0.00	0
% blue-green algae:	4.30	1.85	
% zoanthid:	0.96	0.78	
% macroinvertebrate:	0.00	0.00	
% turf algae:	60.04	3.45	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☑		☐	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	5		1			
Min. size [cm]:	15		15			
Max siz. [cm]:	20		15			

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Grouper population assessments within the hardbottom bank habitats of St. Croix

RND024	Lat:	17.82196	Lon:	-64.49268	Depth:	40 ft	Hank Tonnemacher
	Date:	11/3/2006	Time:	14:00			Philippe Mayor

Col Pav		% hardbottom:	87.8
Rugosity:	1	Hardbottom height [cm]:	30
Transect bearing:	7 °	% Sand:	6.8
Small holes:	2.8	% Rubble:	5.4
Large holes:	1	% Fine sediments:	0

Biotic

Coral count: 9

	Mean	SE	Height [cm]
% bare substrate:	8.20	4.61	
% live coral:	4.18	1.06	
% diseased coral:	0.00	0.00	
% bleached coral:	0.00	0.00	
% fire coral:	0.52	0.31	
% macroalgae:	12.80	2.06	5
% gorgonian:	12.60	2.23	46
% sponge:	2.60	0.68	10
% seagrass:	0.00	0.00	0
% blue-green algae:	2.00	0.71	
% zoanthid:	0.00	0.00	
% macroinvertebrate:	0.00	0.00	
% turf algae:	57.10	1.40	

	Mature queen conch:	0
	Immature queen conch:	0
	Spiny lobsters:	0
	Longspine sea urchins:	0

	Coney		Graysby		Red hind	
Presence/absence:	☑		☐		☑	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Count:	7	1				
Min. size [cm]:	15	12				
Max siz. [cm]:	20	12				

	Rock hind	Nassau	Tiger grouper
Presence/absence:	☐	☐	☐

Outside: 1 lg PAAR in hole, 3 nurse sharks, lg EPGU (>30 cm)