Nearshore Habitats as Nursery Grounds for Recreational Important Fishes

Recreational Fishery Habitat Assessment Study
October 1, 1995 to September 30, 2000

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NEARSHORE HABITATS AS NURSERY GROUNDS FOR RECREATIONAL IMPORTANT FISHES.

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Abstract

Six protected backreef embayments on St. Croix's northeast and southeast coasts were sampled to determine species composition and juvenile fish abundance, The study sites on the northeast end consisted of Cottongarden Bay, Teague Bay and Yellowcliff Bay. They were sampled monthly from October 1998 to September 1999. The study sites on the southeast end of St. Croix consisted of Turner Hole Bay, Robin Bay, and Great Pond Bay. These were sampled monthly from July 2000 to September 2000. Juvenile reef *fish* assemblages were sampled using three complementary sampling methods: visual strip transect census, fish traps, and beach seine net. By comparing juvenile fish communities from distinct habitats (patch reef, seagrass, rubble, algal plains, and sand) within the six embayments, significant differences in fish densities and number of species per area were identified. Patch reef habitats had more species per area than any other habitat. Juvenile fish commonly observed in embayments included scarids, labrids and haemulids, The slippery *dick, Halichoeres bivittatus,* the *bucktooth* parrotfish, S. *radians,* the spotted goatfish, *Pseudupeneus maculatus,* and newly settled *Haemulon* unknown were among the most abundant species found in embayments. The juvenile phase of certain economically important reef fishes appear to prefer these nearshore embayments.

Key Words: juvenile fish, nursery, and recruitment

INTRODUCTION

The role of coastal habitats as nursery grounds for coral reef fishes and many invertebrates is well documented (Springer and Mcerlean 1962; Austin 1971; Macnae *1974;* Beumer 1978; Rooker and Dennis 1991; and Dennis 1992): Nearshore habitats such as mangrove systems, seagrass meadows, and backreef areas are composed of multi-species communities. The ecological relationships within these communities are wide-ranging and complex. Basically, they provide shelter, refuge, and food for a great number of organisms (Phillips and Menez 1988) including early stages of many organisms (Ogden and Zieman 1977; Shulman 1984 and 1985; Boulon 1992; and Lindeman 1999). The ecological importance of nearshore habitats in backreef areas as nursery areas for recreational and commercial important fishes have been well documented (Ogden and Zieman *1977;* Zieman et al. 1982; Robblee and Zieman 1984; Rooker and Dennis 1991; and Nagelkerken et al 2000). Economically important species such as grunts, parrotfishes, some species of snappers and groupers, spiny lobsters, and queen conch have been reported to use these habitats for nursery grounds (Boulon 1986; Stoner and Waite 1990; and Appeldoorn et al 1997).

This report documents results of a study of fish assemblages in nearshore habitats within backreef lagoon areas on the northeast and southeast ends of St. Croix, U.S. Virgin Islands. This information is essential in the management of these areas to sustain and enhance their ecological and fisheries value as nursery grounds.

Description of Study Sites

The three embayments on the northeast end of St. Croix sampled in this study included: Cottongarden Bay, Teague Bay, and Yellowcliff Bay. These bays are part of the Teague Bay bank-barrier reef system that extends from Pull Point to Lamb Point on the northeast coast of St. Croix (Figure 1). This extensive, nearly continuous reef complex forms a protective barrier against wind and wave energy for numerous shallow backreef embayments. The zonation pattern in these three embayments follows the characteristics of a typical backreef lagoon (see Burke et al 1989). The lagoon is characterized by seagrass and sediment-dwelling organisms dominated by molluscs and echinoderms. The dominant calcareous algae include *Penicillus* spp. *and Halimeda* spp. The abrupt transition from the lagoon to the backreef is marked by scattered corals *(Montastrea annularis* and *Porites* spp.), several species of gorgonians, and fleshy algae. Lagoon depths range from a maximum of approximately 8 m (west of Teague Point) to 1 m in the backreef at both eastern and western ends of the lagoon.

The three embayments on the southeast end of St. Croix sampled in this study included: Turner Hole Bay, Robin Bay, and Great Pond Bay. These embayments are part of the southeast end bank-barrier reef system that extends from East Point to Vagthus Point (Figure 2). Turner Hole and Robin Bay are similar (Hubbard 1989). They are almost 1000 m long and approximately 300 m *wide* over most of their lengths. Most of the bottom of the lagoon is covered by seagrasses *(Thalassia testudinum* and *Syringodium* *filiforme)* occurring in beds of varying density. *Halimeda* spp., *Penicillus* spp. and various species of turf like algae are also locally abundant within the seagrass beds. In the deeper portions of the lagoon, areas of sand or thin grass cover are dominated by 10 to 20 cm high sand mounds formed by the burrowing shrimp, *Callianassa* spp. Other benthic organisms include widely scattered colonies *of Porites astreoides, M annularis,* and *Diploria* spp. The third bay, Great Pond Bay, is approximate 2 km long and bounded on its landward side by the baymouth bar and seaward by a continuous coral-algal reef (Bruce et al 1989). The inshore portion of the lagoon (a distance of 30 to 100 m from shore) is covered by the seagrass, T. *testudinum,* and lesser amounts of S. *filiforme.* Seaward of that, the majority of the lagoon floor is sand with numerous sand mounds produced by the burrowing *shrimp Callianassa* spp. Scattered patches of S. *filiforme occur* along with the algae, *Dictyota* spp., and *Penicillus* spp. Scattered coral heads, including *M. annularis, Diploria strigosa* and *Siderastrea* spp., also occur in the lagoon.

METHODS

Sampling

Sampling Periods - The nearshore nursery habitats in three protected backreef embayments on St. Croix's northeast coast (Cottongarden Bay, Teague Bay and Yellowcliff Bay) were sampled monthly from October 1998 to September 1999. The embayments on the southeast end of St. Croix (Turner Hole Bay, Robin Bay and Great Pond Bay) were sampled monthly from July 2000 to September 2000. This limited sampling period in-the southeast was due to staff shortages and time constraints.

Sampling Grid - For each bay, a 20 x 20 m grid pattern was laid over a nautical chart of each embayment. Grid intersecting points were labeled with consecutive numbers. This numbered grid was the basis for selecting transect survey sites and trap sites (see below).

Transect Sites - Once a month during the survey period, 10 sites per embayment were randomly selected based on the numbered grid pattern described above. The sample size (10) for transects was based on a preliminary fish census (see Rogers et al 1994).

Prior to each transect survey, the compass bearing for the transect line was randomly selected. GPS coordinates were not recorded for each transect site. Instead, each location was determined by line of sight with landmarks on the shore. Once at the site, one end of the 50 m transect line tape (marked at 1 cm intervals) was dropped in the water (using a small weight), and the transect line tape was laid by the diver in the direction of the randomly selected compass bearing. A different compass bearing was randomly selected for each of the 10 monthly transect sites in a month. At each transect site, two different surveys were completed: (1) a benthic survey, and (2) a fish census. These are discussed in detail below.

Any transect site that had previously been surveyed was discarded and another randomly selected site was chosen until 10 previously not sampled sites were selected. Sites selected for fish traps (see below) were excluded from the universe of possible transect sites within each embayment.

Each month, 10 additional sites were randomly selected as new transect sites for each embayment. The compass bearing of each new transect site was randomly selected.

Benthic Surveys - Benthic substrate surveys were conducted at each transect site. The benthic habitat categories selected for this survey included: patch reef, rubble, sand, algal plain, and seagrass (see Adams and Ebersole, in press). These habitat classifications are defined in Appendix A.

Habitat categories were recorded along the 50 m transect line to the nearest cm. The transect line reading (to the nearest cm) was recorded when habitat category changed. For areas of mixed substrate composition, the habitat category that dominated the particular area was recorded as the habitat category.

The percentage composition of each habitat category (for each transect) was estimated by summing the length of line with a habitat category and dividing by the total length of the transect line (50 m).

Fish Census – At each transect site, a fish census was completed by two divers swimming the 50 m transect line. One diver inspected 2 m to the left of the transect line. The other diver inspected 2 m to the right of the transect line. For the 50 m transect line a total of 200 m^2 (50 m x 4 m) was surveyed at each site, Each diver recorded major habitat category type (see Appendix A), fish species present, number of fish present for each species, and size categories of fish observed along the 50 m transect line to the nearest cm.

For most fish species, size categories used here were <5 cm total length (TL), 5-10 cm TL, and >10 cm TL. For small fish species such as wrasse, grunts, gobies, blennids, cardinal fish and damselfish, an additional size category was added (< 3 cm TL). For these small fish species, fish < 3 cm TL were identified as newly settled fish, Since fish < 3 cm TL were difficult to identify to the species level, identification was limited to the genus level. These are indicated here as species unknown. Data was pooled at the genus level for subsequent analysis.

For each transect site, fish densities within habitats were calculated by summing the number of fish within a habitat and dividing by the total area of that habitat within the transect area (50 m x 4 *m x* percentage of a habitat from benthic survey).

Fish Traps – Fish traps used in this study were rectangular (92 cm x 57 cm x 19 cm) and made from vinyl-coated wire with 1.3 cm bar mesh. Each trap had one escape panel (15 x 10 cm). The outside rectangular funnel entrance opening measured 23 cm high x 25 cm wide, The funnel was 45.7 cm deep from the outside rectangular opening to the inside oval entrance, The inside funnel opening was 10.2 cm high by 7.6 cm wide. Each trap was baited with approximately 0.5 lb herring per trap.

For each embayment, ten fish trap sites were randomly selected each month based on the 20 m x 20 m grid (see above). If a grid number was selected as a transect site (see above), it was omitted and never used as a fish trap site. Each trap was fished for 24 hours. All fish caught were identified and measured (total length) to the nearest millimeter, then released. The habitat where each fish trap was set was not recorded.

Each month, 10 new fish trap sites were randomly selected for each embayment. Once a grid site was used as a trap site, that grid site was omitted and not included in universe for subsequent trap site selection.

Beach Seine — The beach seine net measured 30.5 m x 122 cm and had weights and floats attached. The net mesh size was 1.3 cm stretch mesh. Two PVC pipes (1.75 meters long each) were fixed vertically at each end of the net.

Two beach seine hauls were conducted monthly in each embayment. In the first month, the two seine-hauls were done on the east side of each embayment. The following month, the two seine-hauls were done on the west side of each embayment. For subsequent months, the seine haul sites alternated from the east side to the west side of the embayment. At each seine-haul site, the two seine-hauls were done about 10 to 20 m apart.

For each seine-haul, one end of the seine net was fixed onshore. The other end of the net was manually pulled out into the water perpendicular to shore. Once the net was fully extended, the seaward-end of the seine net was pulled to shore in an are with the shore-end of the net fixed. The total area of the sweep was about 730 m^2 (π x 30.5 m^2 /4). All fish caught in the seine net were identified, enumerated, measured (total length) to the nearest millimeter, and released at the point of capture.

Data Analysis

Visual Census — The distribution of fish density and number of species per area estimates (pooled embayment, transect site and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If fish density and number of species per area estimates failed the normality test even after log (x +1) and square root transformations, non-parametric statistics were used to analyze the data. Fish density and number of species per area estimates for each embayment were then compared using the non-parametric Kruskall-Wallis One-Way ANOVA on ranks (Sokal and Rohlf 1981). If significant differences were detected, then Dunn's multiple comparison procedure was used to detect differences in mean fish density and number of species per area between embayments.

The Shannon-Weaver Diversity Index H' (Shannon and Weaver 1949) and the evenness index J' (Pielou 1978) were applied to fish density estimates for each habitat and embayment. These two indices were calculated for each northeast St. Croix embayment by month (pooled transect site data), then for each northeast St. Croix embayment by habitat (pooled transect site and month data), Since southeast St. Croix embayments were only surveyed for 3 months, these indices were calculated on fish density data (pooled by transect site and month).

H' and J' estimates (pooled embayment, transect site and monthly data) were then checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science *1997).* If H' and J' estimates failed the normality test even after log (x +1) and square root transformations, the Kruskall-Wallis One-way ANOVA was used to compare data. If significant differences were detected then Dunn's multiple comparison procedure was used to detect differences in diversity and evenness indices between habitats.

Differences in densities of fish by fish length (size class) among habitats and embayments were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If fish densities by size class failed the normality test even after log (x +1) and square root transformations, a two-way ANOVA on ranks was applied to detect differences in fish densities by size class among and within embayments (pooled transect site and monthly data). If significant differences were detected using the ANOVA test, then Dunn's multiple comparison procedure was used to detect differences in fish densities by size class among and within embayments.

A two-way ANOVA on ranks was used to detect differences in fish densities between fish length (size class) and habitats (pooled embayment, transect site, and monthly data). If significant differences were detected, then Dunn's multiple comparison procedure was used to identify differences in fish densities between specific fish lengths (size classes) and habitats.

Similarities of fish species present between habitats were measured using the Percent Similarity formula (PS) based on fish abundance (Gauch 1982). Transect site, month and embayment data were pooled for this comparison.

The four most common species observed in all northeast embayments were selected for further examination, For each of these species; monthly changes in fish densities for each embayment were compared. Monthly changes in densities of recruits (<5 cm TL) of each of these species were also compared.

For each key fish species, the distribution of fish density estimates for each embayment (pooled transect site and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If fish density estimates for each embayment failed the normality test even after log (x +1) and square root transformations, they were then compared using the nonparametric test Kruskall-Wallis One-Way ANOVA on ranks. Dunn's multiple comparison procedure was used to detect differences in mean densities of each key species between embayments.

Fish Traps – The distribution of fish and species trap catch rates estimates (pooled embayment, trap site and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If the distribution of fish and species trap catch rates for each embayment failed the normality test even after log (x +1) and square root transformations, they were then compared using the non parametric test Kruskall-Wallis One-Way ANOVA on ranks. Dunn's multiple comparison procedure was used to detect differences in mean fish and species trap catch rates between embayments.

The four most common species caught in fish traps in all northeast embayments were selected for further examination. For each of these species, monthly changes in fish densities for each embayment were compared.

The distribution of trap catch rate estimates for each key species (pooled embayment, trap site and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If the distribution of trap catch rates for each key species (pooled trap site and monthly data) failed the normality test even after log (x +1) and square root transformations, they were then compared using the non parametric test Kruskall-Wallis One-Way ANOVA on ranks. Dunn's multiple comparison procedure was used to detect differences in mean trap catch rates between embayments for each key species.

Seine Nets — The distribution of fish and species seine haul catch rate estimates (pooled embayment, seine-haul and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997).). If fish and species seine-haul catch rates for each embayment failed the normality test even after log (x +1) and square root transformations, they were then compared using the non parametric test Kruskall-Wallis One-Way ANOVA on ranks. Dunn's multiple comparison procedure was used to detect differences in mean fish and species seine-haul catch rates between embayments.

Three key species caught in seine-hauls were identified. Changes in monthly catch rates of the most abundant species caught with seine net were compared by embayment.

For the three most abundant species, the distribution of seine-haul catch rate estimates (pooled embayment, seine-haul and monthly data) were checked for normality using the Kolmogorov-Smirnov normality test (SPSS Science 1997). If the distribution of seine-haul catch rates for each key species for each embayment failed the normality test even after log (x +1) and square root transformations, they were then compared using the non parametric test Kraskall-Wallis One-Way ANOVA on ranks. Dunn's multiple comparison procedure was used to detect differences in mean seine-haul catch rates between embayments for each key species.

RESULTS

Northeast Coast

Visual Strip Transect Census

For Cottongarden Bay (pooled transect site and monthly data), a total of 4,471 fishes were observed representing 54 species and 21 families (see Table 1). The most abundant fish was the slippery dick, *Halichoeres bivittatus* (38%) followed by the bucktooth parrotfish, *Sparisoma radians* (29%). For Teague Bay (pooled transect site and monthly data), a total of 7,829 fishes were observed representing 66 species and 25 families (see Table 1). The most abundant genus was grunts, *Haemulon* unknown (38%) followed by the slippery dick, *H. bivittatus (*13%). Yellowcliff Bay (pooled transect site and monthly data), a total of 7,388 fishes were observed representing 74 species and 27 families (see Table 1). Small (< 3 cm TL) newly settled grunts (Haemulidae) accounted for 33% of fish observed, Differentiation of these very small grunts to the species level was not possible. The slippery dick, *H. bivittatus (27%)* was the second most abundant fish.

In Cottongarden Bay, seagrass was the dominant habitat sampled (Figure 3) covering almost 94% of the substrate found on transects. It was also the dominant habitat in Teague Bay transects, accounting for 84% of the habitat found. Yellowcliff Bay substrate was also dominated by seagrass (60%). In Cottongarden Bay, Teague Bay, and Yellowcliff Bay patch reef accounted for 4%, 2%, 6% of the substrate surveyed respectively (Figure 3).

Peaks in monthly mean fish density were different for each embayment (Figures 4a). Monthly trends in species densities were similar for the three northern embayments (see Figure 4b). Species diversity (H') and evenness (J') mean values were similar for the three northern St. Croix embayments (see Figures 5a and b).

There were no significant differences in fish density, number of species per area, diversity and evenness indices between embayments (see Appendix B, numbers 1 to 4, $p>0.05$),

For Teague Bay and Yellowcliff Bay, patch reef habitats had the highest number of fish and fish species per area compared with other habitats in those bays (see Figures 6a and b). In Cottongarden Bay, rubble habitats had the highest fish and species densities compared with other habitats in this bay (Figures 6a and b).

Fish density and number of species per area estimates (pooled embayment, transect site and month data) for each habitat were significantly different (see Appendix B, numbers 5 and 6, $p<0.05$). Patch reef and rubble habitats had significantly higher fish densities and number of species per area than algal plains and sand habitats.

There were significant differences in H' between habitats (Figure 7a, see Appendix B, number 7, $p<0.05$), but J' showed no significant differences between habitats (Figure 7b, see Appendix B, number 8, $p>0.05$). H' was significantly higher in patch reefs than other habitats (Figure 7a, Appendix B, number 7, $p<0.05$).

There were significant differences in fish density between fish lengths (size classes) and habitat (Tables 2 and 3, and Appendix C, number 1, $p<0.05$). Patch reefs and rubble habitats had significantly more fish <5 cm TL than sand and seagrass habitats (Appendix C, number 2, $p<0.05$). Density of larger fish (5-10 cm TL and >10 cm TL) was significantly higher in patch reefs than in other habitats (Appendix C, numbers 3 and 4, $p<0.05$).

Among all northeast St, Croix embayments, divers counted more <5 cm TL fish in Yellowcliff Bay. More larger fish (>10 cm TL) were counted in Teague Bay (see Table 3).

There were no significant differences in fish densities between fish lengths (size classes) and embayments using pooled transect site and monthly data (see Table 3, Appendix C, number 10, $p>0.05$).

Results of the percentage similarity of species composition and fish densities between habitats (see Table 4) indicated that algal plains and seagrass beds shared the greatest similarity (69%) followed by seagrass and patch reefs (53%). The sand habitat was very dissimilar (Table 4) and apparently were the preferred habitat of certain species such as the rosy razorfish, *Hemipteronotus martinicensis,* and the bridled goby, *Coryphopterus glaucofraenum.*

Based on the total number of economically important fish species observed (see Table 1), 17 economically important species from the St. Croix fishery were selected for subsequent analysis. A comparison of length frequencies for each of these seventeen economically important species by habitat is made in Table 5. *Sparisoma viride, Scarus taeniopterus and Scarus iserti* (Table *5)* had higher densities of recruits (<5 cm TL) in patch reefs (0.92, 5.81, and 1.79 recruit/100 m^2, than juveniles and subadults (>10 cm TL) (0.28, 0.07, and 0 subadult/100 m^2, respectively). *Ocvurus chrysurus* recruit (< *5* cm TL) densities (see Table 5) were highest on seagrass (0.41 recruit/100 m^2) while larger individuals (>10 cm IL) were most abundant on patch reefs (0.74 subadult/100 m^2).

Densities of newly settled pants *Haemulon* unknown (<3 cm TL) were highest on rubble compared with other habitats (see Table 5). Fish counts for these small unidentified grunts were highest on seagrass. Seagrass represented the largest proportion of habitat surveyed here. Even though fish counts were higher in seagrass than rubble, density (per unit area) was lower.

The four most common species observed included: *Haemulon* unknown, *H. bivittatus, S. radians* and *O. chrysurus* (see Table 1). Monthly *Haemulon* unknown densities (for all fish size groups combined) appeared to peak in November 1998 and in June 1999 in Yellowcliff Bay (see Figure 8a). For *Haemulon* unknown recruits (< 5 cm TL), density peaks were similar (compare Figures 8a and b).

Monthly *H. bivittatus* densities (for all fish size groups combined) and recruit (<5 cm TL) densities are presented in Figures 9a and b. Density of *H. bivittatus* recruit (<5 cm TL) at Yellowcliff Bay had a distinctive peak in April 1999.

Monthly *S. radians* densities (for all fish size groups combined) and recruit (<5 cm TL) densities had a minor peak in October 1998 in all embayments (see Figures l0a and b). For Cottongarden Bay, both overall *S. radians* density and recruit (<5 cm TL) density had a major peak in May 1999 (see Figures 10a and b).

Monthly *O. chrysurus* densities (for all fish size groups combined) and recruit (<5 cm TL) densities had small peaks in October 1998 and August 1999 for Teague Bay and Yellowcliff Bay, respectively (see Figures 1 1a and b). In Cottongarden Bay, overall *O. chrysurus* density peaked in April 1999, but *O. chrysurus* recruit (<5 cm TL) densities showed no similar patterns (compare Figures 1 1a and b)

Densities of each of the four major species were compared by embayment. There was no significant difference in overall *O. chrysurus* densities between embayments (Appendix B, number 9, p>0.05). However, Cottongarden Bay had a significantly higher density of *S. radians* than the other embayments (Appendix B, number 10, p<0.05); (2) the density of grunt, *Haemulon* unknown, recruits (< *5* cm TL) in Yellowcliff Bay and Teague Bay were significantly higher than in Cottongarden Bay (Appendix B, number 11, p<0.05); and (3) Yellowcliff Bay had higher overall density of the slippery dick, *H. bivittatus* than in Cottongarden Bay (Appendix B, number 12, p<0.05).

<u>Fish Trap</u> - During this study period, 696 fish were caught by traps in Cottongarden Bay, These fishes represented 16 species and 12 families (Table 6). The spotted goatfish, *Pseudupeneus maculatus,* accounted for 38.6% of the total catch followed by the bucktooth parrotfish, S. *radians* (38.3%). In Teague Bay, 760 fishes representing 26 species and 14 families were trapped (Table 6). In Teague Bay, the French grunt, *H. flavolineatum* (31%) was the most commonly caught fish followed by the spotted goatfish, *P. maculatus* (19%). For Yellowcliff Bay, a total of 438 fish representing 19 species and 11 families were trapped. The spotted goatfish, *P.maculatus,* was the most

common fish trapped (47%) followed by the yellowtail snapper, *O. chrysurus* (9%).

The monthly mean catch per trap-day (for all embayments) ranged from 1.8 to 21.8 fish per trap-day (Figure 12a). Teague Bay catch per trap-day peaked in October and November 1998, while that in Cottongarden Bay peaked in January 1999 (see Figure 12a).

Monthly number of species caught per trap-day (for all embayments) is presented in Figure 12b. In Teague Bay, the number of species caught per trap-day peaked in October 1998.

There were no significant differences in the number of fish and number of species caught per trap-day between embayments (Appendix B, numbers 13 and 14, $p>0.05$).

H. flavolineatum, S. radians, P. maculatus and *O. chrysurus* were the most common species caught by trap in all embayments (Table *6). H. flavolineatum* catches peaked in November of 1998 in Teague Bay (see Figure 13a). For this species, no peak was evident for the other two embayments. *S. radians* catch per trap-day was highest in Cottongarden Bay in January 1999 (Figure 13b). Monthly catch per trap-day for Yellowcliff and Teague Bays did not showed any peaks. Monthly catch per trap-day of *P. maculatus* was low from October 1998 to April 1999, but increased in all three embayments from June to September *1999* (Figure 13c). Yellowtail snapper, *O. chrysurus,* monthly catch per trap-day peaked in October 1998 in Teague Bay and in December of 1999 in Yellowcliff Bay (Figure 13d).

For fish caught by trap, length (size class) frequency distributions of *H. flavolineatum, 0. chrysurus, P. maculatus* and S. *radians* show that trap sampling caught small fish (Figures 14 to 17). For reference, mean fish sizes at sexual maturity (length at which 50% of the population become mature for the first time) are noted in each of these figures. Results here suggest that in general, fish trapped were smaller than their mean size at sexual maturity (Munro 1983; Claro 1983; and Billings and Munro 1974).

There were no significant differences in catch per trap-haul between embayments for *H. flavolineatum, 0. chrysurus,* and P. m*aculatus* (Appendix B, numbers 15 to 17, $p>0.05$). However, Cottongarden Bay had a significantly higher mean number of S. *radians* caught per trap-day than Teague Bay (Appendix B, number 18, $p<0.05$).

Monthly changes in length (size class) frequency distribution of key fish species were not compared here because of the small number of fish caught each month.

<u>Beach Seine</u> - During this study period, 61 fish were caught by seine net in Cottongarden Bay. These fishes represented 9 species and 7 families (Table 7), The permit, *Trachinotus falcatus,* accounted for 26% of beach seine catches, followed by the slender mojarra, *Eucinostomus jonesi* (19%). In Teague Bay, 263 fishes representing 29 species and 19 families were caught. The horse-eye jack, *Caranx latus* accounted for 28% of the seine

catches followed by the slender mojarra, *E. jonesi* (19%). At Yellowcliff Bay, 10 fishes representing 4 species and 4 families were caught. The slender mojarra, *E. jonesi,* and the hound fish, *Tylosurus crocodilus,* dominated the species composition (50%, and 30%, respectively) of total fish caught by seine net (Table 7).

Mean monthly variations in fish caught per seine-haul for the three bays ranged from 0 to 29 fish/seine-haul (Figure 18a). In Teague Bay, CPUE was highest in May 1999 (29 fishes per seine-haul).

Mean monthly variations in species caught per seine-haul varied from 0 to 6 species per seine-haul (see Figure 18b). For mean monthly number of species per haul the largest peak was in March 1999 in Teague Bay (see Figure 18b).

There were significant differences in the number of fish and number of species caught per seinehaul (based on pooled seine-haul, monthly, and embayment data) between embayments (Appendix B, numbers 19 and 20, $p<0.05$). Teague Bay had significantly more fishes and species per seine-haul than any of the other sites (Appendix B, numbers 19 and 20, $p<0.05$, Figure 18b).

C. latus, T. falcatus and *E. jonesi* were the three most abundant species caught by seine nets in all embayments (Table 7). In Teague Bay, *C. latus* had a major catch per seine-haul peak in April 1999 (Figure 19a). In Teague and Cottongarden Bays, *E. jonesi* catch per seine-haul peaked in May 1999 (see Figure 19b). For *T. falcatus,* catch per seine-haul was highest from March to August 1999.

Length-frequency distributions of C. *latus, T. falcatus* and *E. jonesi* from seine hauls for all embayments are presented in Figures 20a to g. For reference, mean fish sizes at sexual maturity are noted in each of these figures. Results here suggest that fish caught by seine-haul were smaller than their mean size at sexual maturity (Thompson and Munro 1974; Garc*i*a-Cagide et al 1994)

There was no significant difference in the number fish caught per seine-haul for each key species *(C. latus, T. falcatus* and *E. jonesi),* between embayments based on pooled seine-haul, monthly, and embayment data (Appendix B, numbers 21 to 23, $p>0.05$).

Southeast Coast

Visual Strip Transect Census

During this survey period, a total of 1,628 fishes representing 39 species and 16 families were observed in Turner Hole (Table 8). The most abundant fish observed was the bluehead wrasse, *Thalassoma bifasciatum* (15%) followed by newly settled grunts, *Haemulon* unknown (13%). In Robin Bay, 309 fishes from 25 species and 14 families were observed during this survey period. In Robin Bay, the slippery dick, *H. bivittatus,* accounted for 30% of fish observed, followed by the bucktooth, S. *radians* (25% of fish observed), At Great Pond Bay, 1,285 fish representing 36 species and 12 families were observed during this survey. Newly settled (<3 cm TL) grunts (Haemulidae) accounted for 69% of the total fish observed abundance followed by the slippery dick, H. *bivittatus* (8%).

In Turner Hole, seagrass and sand accounted for 66% and 21% respectively of the habitat observed in transects (Figure 21). In Robin Bay, seagrass accounted for almost 92% of the substrate. Great Pond Bay was dominated by sand (75%). In Turner Hole, Robin Bay, and Great Pond Bay patch reef accounted for 5 %, 0.5% and 0.7% of the substrate surveyed respectively (Figure 21).

There were significant differences in fish density, number of species per area (pooled transect site, monthly, and embayment data), diversity index and evenness index estimates between embayments (see Appendix D, numbers 1 to 4, $p<0.05$). Turner Hole had a significantly higher (1) fish density, (2) number of species per area, and (3) diversity (H') than other embayments. Evenness (J') values for Great Pond were higher than those of other embayments (Appendix D, numbers 1 to 4, $p<0.05$),

For habitats and embayments (using pooled transect site and monthly data), fish density (Figure 22a) and number of species per area (Figure 22b) were highest in patch reef habitats. There were significant differences in fish densities and number of species per area between habitats using pooled transect site, monthly, and embayment data (see Appendix D, numbers 5 and 6, $p<0.05$). Patch reef and algal plain habitats had significantly higher fish densities than seagrass beds and sand habitats (see Figure 22a, Appendix D, number 5, $p<0.05$). Patch reef habitats had significantly higher number of species per area than seagrass and sand (see Figure 22b, Appendix D, number 6, $p<0.05$). Rubble and algal plain had significantly higher number of species per area than sand (see Appendix D, number 6, $p<0.05$).

There were significant differences in diversity index (H') and evenness index (J') estimates (pooled transect site, monthly, and embayment data) between habitats (see Appendix D, numbers 7 and 8, $p<0.05$). H' of patch reefs and rubble habitats had significantly higher values than that of sand and algal plain (see Figure 23a, Appendix D, number 7, $p<0.05$). Seagrass beds and algal plain had significantly higher evenness J' indices compared with sand habitats (Figure 23b, Appendix D, number 8, $p<0.05$).

Patch reefs and algal plain habitats had significantly higher recruit (<5 cm TL) densities than sand and seagrass habitats (Appendix E, number 1 and 2, $p<0.05$). Fish densities of 5-10 cm TL fish were significantly higher on patch reefs than seagrass, sand and algal plain habitats (Appendix E, number 3, $p<0.05$). Fish densities of fish >10 cm TL were significantly higher on patch reefs than in all other habitats except algal plain habitats (Appendix E, number 4, $p<0.05$).

Among all southeast St. Croix embayments, Great Pond Bay Bay had more <5 cm TL fish counted, while Turner Hole Bay had more larger fish (>10 cm TL) counted (Table 10).

Turner Hole and Great pond had significantly higher densities of recruits (< 5 cm TL) than Robin Bay (Appendix E, number 10 and 11, $p<0.05$). However Turner Hole had significantly higher densities of fish 5-10 cm TL and >10 TL than in other embayments (Appendix E, numbers 12 and 13, $p<0.05$).

Results of the percentage similarity of species composition and fish densities between habitats (see Table 11) indicated that patch reefs and rubble had the greatest similarity of species (88%) followed by algal plain and sand (72%).

Based on the total number of species observed (see Table 8), the top seventeen economically important species were selected. A comparison of length frequencies for each of these seventeen economically important species by habitat is made in Table 12. *S. viride,* and S. *taeniopterus* had higher recruit (<5 cm TL) densities in patch reefs (3.35, and 4.47 recruit/100m^2, respectively) than conspecific juveniles and subadults >10 cm TL (see Table 12). *O. chrysurus* recruit (<5 cm TL) densities were highest on seagrass (0.39 recruit/100m^2) while larger individuals (>10 cm TL) were primarily found on patch reefs (0.84 subadult/100m^2). In addition, algal beds had higher newly settled grunts densities (61.08 newly settled grunts/100m^2), than patch reefs (25.98 newly settled grunts/100m^2) and sand habitats (3.08 newly settled grunts/100m^2). Densities for larger *size* groups (>10 cm TL) for *H. flavolineatum and H. plumieri* were highest on patch reefs (2.79 and 3.79 subadults/100m^2, respectively) than in other habitat.

The four most *common species* observed included: *Haemulon* unknown, *H. bivittatus, S. radians* and *T. bifasciatum* (see Table 8). There were no significant differences in fish densities between embayments for *Haemulon* unknown, *S. radians,* and *T. bifasciatum* (Appendix D, numbers 9 to 11, $p>0.05$). However, for *H. bivittatus,* there was a significant difference between fish densities between embayments. Turner Hole Bay had a significantly higher density of *H. bivittatus* compared with Robin Bay (Appendix D, number 12, $p<0.05$),

<u>Fish Trap</u> - In Turner Hole Bay, 67 fishes were caught by traps. These fishes represented 13 species and 10 families (Table 13). The most common fish caught was the bucktooth parrotfish, *S. radians,* accounting for 38% of the total fish caught. At Robin Bay, 38 fishes representing 7 species and 6 families were caught by traps. The bucktooth parrotfish, S. *radians,* accounted for 63% of the total catch at Robin Bay. At Great Pond Bay, 12 fishes representing 5 species and 5 families were caught by trap. The doctorfish, *Acanthurus chirurgus,* accounted for 33% of the catch at Great Pond.

There was no significant difference in the number of fish caught per trap-haul and number of species caught per trap-haul between embayments (Appendix D, numbers 13 and 14, $p>0.05$).

A. chirurgus, S. radians, P. maculatus and *O. chrysurus* were the most common species caught in traps at all embayments (Table 13). Due to the small sample size and duration (only three months), differences in fish catch rates between embayments and months could not be examined.

Length-frequency distributions of key fish species caught in traps are presented in Figures 24a to d. Mean Size at sexual maturity for each of these key species (if available) was noted in Figures 24a to d. Peaks in length frequency for all key species caught were below the mean length for sexual maturity of those species (Claro 1983; and Garcia-Cagidae et al 1994).

Monthly changes in length frequency distribution of key fish species were not compared here because of the small number of fish caught each month.

<u>Beach Seine</u> - In Turner Hole, 9 fishes were caught by seine net representing 3 species and 2 families (Table 14). The permit, *T. falcatus,* accounted for 77% of Turner Hole seine catches. In Robin Bay, 10 fishes were caught representing 5 species and 5 families. The permit, *T. falcatus,* accounted for 50% of the catches in Robin Bay. At Great Pond Bay, 20 fishes representing 7 species and 6 families were caught. The herring, *Jenkinsia lamprotaenia,* and the school master, *Lutjanus apodus,* accounted for 35%, and 30% of the catch, respectively (Table 14).

There were no significant differences in the number of fish and number of species caught per seine-haul between embayments (Appendix D, numbers 15 and 16, $p>0.05$).

The two most common species caught in seine-hauls at all embayments were *T. falcatus* and L. *apodus* (Table 14). Due to limited data collected (only three months), variations in seine-haul catches between months and embayments could not be examined.

Length-frequency distributions of *T. falcatus* and *L. apodus* (using pooled seine-haul sets, monthly, and embayment data) are presented in Figures 25a and b. Mean size at sexual maturity for each of these key species was noted in Figures 25a and b. Peaks in length frequency for these two key species were below the mean length of sexual maturity of those species (Thompson and Munro 1983; Garcia-Cagide et al 1994).

DISCUSSION

In this study, many fish were found to utilize nearshore habitats as nursery areas, including *Haemulon* unknown, *H. aurolineatum, H. flavolineatum* and *S. taeniopterus* (see Table 5 and *12). S. radians, H. bivittatus* and *Haemulon* unknown, accounted for

>65% of all fishes observed by divers in the visual strip transect census in northeast St. Croix embayments. In southeast St. Croix embayments, *H. aurolineatum, H. bivittatus, S. radians and Haemulon* unknown accounted for more than 55% of all fishes observed by divers in the visual strip transect census.

Results of this study on St. Croix backreef lagoonal areas can be related to results from similar studies in other lagoonal areas (Ogden and Zieman 1977; Gladfelter and Gladfelter 1978; Brothers and McFarland 1981; Thayer et al 1987; Baelde 1990; and Dennis 1992). Comparisons of the ichthyofauna of the St. Croix bank barrier reef lagoons with other lagoon systems studied in the Caribbean indicate structural similarities, with some marked differences. Stoner (1986) found that soleids and gerreids dominated a mangrove lagoon system in Joyuda, Puerto Rico. However, haemulids, scarids, and labrids (the most abundant fishes found in this study) were a minor component. There were no mangrove areas surveyed in this study. Yanes-Arancibia et al (1980), Thayer et al (1987), and Sogard et al (1989) found that engraulids, clupeids and gerreids dominated the species composition in Terminos Lagoon in western Yucatan and in seagrass beds adjacent to Florida Bay mangrove system. Baelde (1990) found that gerreids, engraulids and sparids dominated the *T. testudinum* beds in Guadulope.

Studies done on lagoons close to bank barrier reef lagoons showed distinct reef fish communities dominated by scarids, haemulids, and labrids. Sedberry and Cartier (1993) found that Haemulidae such as *Haemulon sciurus* and *H. flavolineatum* dominated the species composition in a survey of fish communities in barrier reef lagoons in Belize. In a Tortola study (Mackey 1999), juvenile fish assemblages on barrier reef lagoons were dominated by *H. aurotineatum* and *H. flavolineatum.* In Curazao, Nagelkerken et al (2000) found *H. flavolineatum* and *S. iserti* were the dominant species of reef fish in barrier reef lagoons.

The differences in dominant species between these studies may be related to physical conditions and proximity to the main reef. The lagoons sampled by Stoner (1986), Yanez-Aranciba et al (1980), Thayer et a1 (1987) Sogard et al (1989) and Baelde (1990) had more restricted access to open water, had more estuarine conditions (lower salinity), and did not have extensive nearby barrier reef formations. This was the case in Belize (Sedberry and Cartier 1993), Tortola (Mackey 1999), Curazao (Nagelkerken et al 2000) and St. Croix (Ogden and Zieman 1977; and Gladfelter and Gladfelter 1978, Robblee and Zieman 1984; and Shulman 1984).

In the Caribbean, the interaction of seagrass beds and mangrove ecosystems with coral reef fish species constitutes an additional factor influencing the structure of shallow water fish communities (Robblee and Zieman 1984; and Gladfelter and Gladfelter 1978). The relationship between seagrass beds and coral reefs is well documented, in particular the foraging behavior of coral reef fishes over seagrass beds (Ogden and Zieman 1977; Robblee and Zieman 1984; and Shulman 1984).

The more abundant fish species found in this study were primarily herbivores and planktivores (see Table 1 and 9). Some of these dominant species are recreationally and commercially important to the local nearshore fishery. Most fish (86%) inhabiting the backreef lagoon areas in the northeast coast embayments (Cottongarden Bay, Teague Bay and Yellowcliff Bay) were small (<10 cm TL). Very few (14%) embayment fish observed were over 10 cm TL. This is also true of the southeast embayments (Turner Hold Bay, Robin Bay, and Great Pond Bay) where there were few fish (7%) over 10 cm TL. Results here indicated that backreef lagoon areas play an important role as a nursery grounds for economically important species in the early stages of their life cycle.

Previous studies on Teague Bay bank barrier reef lagoon have shown the importance of these areas for juvenile reef fishes (Shulman 1984; McFarland et al 1985; and Shulman and Ogden 1987). According to Shulman and Ogden (1987), post settlement mortality of newly settled *H flavolineatum* recruits was high (90%). Despite this, Shulman and Ogden (1987) reported that the mean annual recruitment at Teague Bay bank barrier reef lagoon was among the highest rates for this species yet reported for reef fishes ($44/m^2$). In that study. *H. flavolineatum* recruit abundance increased with increasing distance from the reef They attributed this to the large number of juvenile grunts utilizing shallow lagoonal habitats. According to Shulman and Ogden (1987), the number of predators decreased with increased distance from the reef as the number of predators in shallow lagoon waters was lower than on reefs. Additional protection of recruits was also provided by water turbidity and seagrass shoots. Spatial separation of juveniles from adults that reside on the reef also reduced intraspecific competition and could increase survival rates during recruitment (Shulman and Ogden 1987).

At the sites studied here, fish species formed distinct communities within seagrass, sand, patch reefs, algal plains and rubble habitats. The seagrass and algal plain habitats at all embayments were dominated by small resident fish such as *Halichoeres spp., S. radians* and juveniles of non-resident, economically important species such as *Haemulon* unknown. and *O. chrysurus.* Rubble and patch reef habitats harbored a higher number of species per unit area and were mostly dominated by small juvenile damselfish, parrotfish, grunts, and doctorfish.

The differences in fish size distributions of some dominant economically important species between habitats suggested different habitat preferences by those fish species. Many local economically important coral reef fish (S. *taeniopterus, S. iserti, Acanthurus chirurgus,* and *A. bahianus)* recruits were found on patch reefs, rubble and seagrass habitats. Species such as newly settled grunts *Haemulon* unknown, *O. chrysurus* and *Lutjanus synagris* recruits were mostly found in seagrass beds (Tables 5 and 12). Densities of larger (>10 cm TL) fish (S. *taeniopterus, S. iserti and O. chrysurus)* were low on patch reefs and seagrass beds (Tables 5 and 12). These results may reflect temporary and successive utilization of seagrass beds and patch reefs by juveniles of various species that move elsewhere as they grow larger. This was the case for *O. chrysurus, S. taeniopterus* and S. *iserti.*

The present study suggests that nursery habitats are not limited to mangrove habitats, but include other nearshore habitats such as patch reefs and rubble areas. In this study, patch reefs and rubble habitats had the highest densities of fish recruits. However, total counts of fish recruits were higher on seagrass beds and algal plains. This was because of the dominance of these habitats in embayments surveyed (Table 2 and Table 9). Recent Caribbean studies of nearshore fish assemblages suggest that patch reefs and rubble areas appear to be important shelter sites for juvenile fishes in mangrove and seagrass dominated lagoons (Risk 1997, Nagelkerkern et al 2000, Adams and Ebersole, in press).

Seasonal changes in the density of fishes and the number of species per area in northeast St. Croix embayments were observed in most cases (Figures 4a and b, and 8a to 11b). Previous studies done at Teague Bay (Rogers and Salesky 1981; and Carpenter 1986) found that during the waimer months (from July to November) there was a significant increase in algal cover and biomass that probably stimulated increases in the invertebrate population. This increase in food availability may favor herbivores (such as *S. radians, S. iserti, S. taeniopterus),* omnivores (such as *H. bivittatus, Haemuion* unknown) and small carnivorous fishes such as O. *chrysurus.*

Seasonal variations may also be related to the reported correlation between increased larvae/juvenile fish settlement and recruitment and summer increases in the number of species and fish present (Williams and Sale 1981; and Doherty and Williams 1988). In this study, summer recruitment pulses were evident for some species such as *Haemulon* unknown although the magnitude of these pulses varied between embayments (Figure 8b).

Recent studies in St. Croix on larval fish supply and microhabitat characteristics have had contrasting results (Caselle and Warner 1996; Tolimieri 1995, 1998a and b; Tolimieri et al. 1998; Risk 1997; and Nemeth 1997). Caselle and Warner (1996) found that microhabitat characteristics were correlated with the abundance of *T. bifasciatum,* but did not explain recruitment of *T. bifasciatum* at all sites around St, Croix. On the north windward shore, recruitment rates increased from east to west while on the south leeward side, recruitment rates increased from west to east. They concluded that along the two shores of St. Croix, physical transport processes were more important determinants of the spatial patterns of recruitment than habitat selection. In contrast, Tolimieri (1995) could not show any microhabitat selection during recruitment of *Stegastes planifrons.*

Microhabitat use may be an important factor in establishing consistent patterns of recruitment. Tolimieri (1998a and b) found that S. *viride* and *S. iserti* recruitment rates at Teague Bay were correlated with microhabitat characteristics at a smaller spatial scale. Tolimieri et al (1998) studied recruitment patterns of different reef fish species throughout the north coast of St. Croix.

They concluded that some of the recruitment patterns of *T. bifasciatum* could be explained by larval transportation. However, the recruitment rates for *S. viride, S. planifrons, Scarus* spp. and *Stegastes* spp. did not conform to the predicted spatial recruitment patterns stated by Caselle and Warner (1996), This suggested that other factors such as habitat selection may be influencing recruitment patterns for some species.

Recruitment studies for the ocean surgeonfish, A. *bahianus,* and the bicolor damselfish, *Stegastes partitus,* at Teague Bay (Risk 1997 and Nemeth 1997) suggest that there are several post-settlement factors at work. These factors may include the ability of post-settlement stage fishes to select habitat, the level of competition for food, and spatial distribution of resources. Larval supply alone appears to be insufficient to explain the abundance and distribution of reef fish populations in St. Croix (Risk 1997 and Nemeth 1997).

Lower overall fish recruitment observed in Cottongarden Bay may be due to lower larval supply but also to a shortage of suitable habitat. *Haemulon* unknown recruits were rare in Cottongarden Bay. This may be due to the homogeneity of the habitat (almost 95% seagrass, see Figure 3). In this embayment, suitable habitats for fish recruits such as patch reefs, algal plain, and rubble
areas were scarce. Yellowcliff Bay had more complex habitat composition and harbored twice the number of fish recruits observed as Cottongarden Bay (Table 3),

The three methods used to sample nearshore habitats yield satisfactorily although somewhat different results due to biases inherent in each method (Boulon 1992). Fish traps tended to under represent certain species (such as *H. bivittatus)* that apparently avoided traps or were small enough to pass through the trap mesh and not to be caught (Mackey 1999). However, traps allowed accurate total length measurements of the most abundant species. Baitfish such as the false pilchard, small permits and slender mojarras were more abundant in seine net catches than in transects and fish traps. However, seines were limited to areas adjacent to the shore without rocky and hard bottom substrates. The visual census method can provide a list of species in an area. It is possible to collect some length frequency information based on visual estimates of fish size. However, visual estimates are not as accurate as actually measuring each fish. Nevertheless, by utilizing these three methods at the same time, a more complete view of the finfish community can be achieved than from any one method alone.

It is apparent from this study that the backreef lagoon areas of Cottongarden Bay, Teague Bay Yellowcliff Bay, Turner Hole Bay, Robin Bay, and Great Pond Bay are important nurseries for many economically important fishes. While variability among sites and months were documented, general trends were similar. Results here document the importance of these nearshore habitats for juvenile fishes. Most fish sampled by trap and beach seine nets were smaller in size then their mean size at sexual maturity (for trap catches see Figures 14 to 17 and 24a to d, for beach seine catches see Figures 20a to land 25a and b), Since the majority of juvenile fishes in nearshore habitats are economically important species, these habitats must be conserved to ensure the continued viability of the fisheries in St. Croix.

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Table 1. Total Number of Fish and Species Observed, and Percentage (Number of a Fish Species Observed/Total Number of Fish Observed in an Embayment) for Each Northeast St. Croix Embavment (120 Transects Per Embavment) from October 1998 and September 1999 Based on Pooled Monthly and Transect Site Data.

FAMILY	SPECIES	Cottongarden Bay No. of Fish	Cottongarden Bay Percent	Teague Bay No. of Fish	Teague Bay Percent	Yellowcliff Bay No. of Fish	Yellowcliff Bay Percent
Acanthuridae	*Acantharus bahianus*	61	1.36	16	0.20	34	0.46
	Acanthurus chirurgus	120	2.68	64	0.82	281	3.80
	Acanthurus coeruleus	41	0.92	3	0.04	26	0.35
Apogonidae	*Apogon unk.*	*	*	*	*	3	0.04
Aulostomidae	*Aulostomus maculatus*	3	0.07	1	0.01	*	*
Balistidae	*Balistes vetula*	*	*	*	*	1	0.01
Bleniidae	*Labrisomus unk.*	*	*	1	0.01	*	*
Bothidae	*Bothus lunatus*	*	*	1	0.01	*	*
Carangidae	*Caranx bartholomaei*	1	0.02	*	*	2	0.03
	Caranx crysos	1	0.02	8	0.10	7	0.09
	Caranx ruber	7	0.16	7	0.09	11	0.15
	Selar crumenophthalmus	*	*	400	5.11	*	*
Chaetodontidae	*Chaetodon capistratus*	18	0.40	34	0.43	91	1.23
	Chaetodon ocellatus	*	*	*	*	1	0.01
	Chaetodon striatus	1	0.02	2	0.03	2	0.03
Dactylopteridae	*Dactylopterus volitans*	*	*	1	0.01	*	*
Dasyatidae	*Dasyatis americana*	*	*	1	0.01	*	*
Diodontidae	*Diodon hystrix*	*	*	*	*	2	0.03
Engraulidae	*Anchoa lyolepis*	*	*	*	*	200	2.71
Gerreidae	*Gerres cinereus*	1	0.02	3	0.04	1	0.01
	Eucinostomus jonesi			14	0.18	*	*
Gobiidae	*Gobiosoma unk.*	1	0.02	1	0.01	5	0.07
	Coryphopterus glaucofraenum	*	*	7	0.09	13	0.18
	Gobiosoma genie	*	*	20	0.26	*	*
	Coryphopterus unk.	*	*	*	*	7	0.09
	Gnatholepis thompsoni	*	*	*	*	1	0.01
Gramistidae	*Rypticus saponaceus*	*	*	1	0.01	*	*
Haemulidae	*Haemulon unk.*	45	1.01	2983	38.10	2465	33.36
	Haemulon aurolineatum	6	0.13	921	11.76	210	2.84
	Haemulon carbonarium	13	0.29	*	*	3	0.04
	Haemulon chrysargyreum	5	0.11	*	*	*	*
	Haemulon flavolineatum	87	1.95	471	6.02	109	1.48
	Haemulon plumieri	129	2.89	41	0.52	10	0.14
Pomacandithae	*Holacanthus ciliaris*	*	*	*	*	2	0.03
Holocentridae	*Holocentrus adscensionis*	15	0.34	8	0.10	37	0.50
	Myripristis jacobus	12	0.27	5	0.06	4	0.05
Labridae	*Doratonotus megalepsis*	1	0.02	3	0.04	*	*
	Halichoeres unk.	7	0.16	20	0.26	33	0.45
	Halichoeres bivittatus	1687	37.73	1058	13.51	1967	26.62
	Halichoeres garnoti	12	0.27	33	0.42	58	0.79
	Halichoeres maculipinna	7	0.16	*	*	*	*
	Halichoeres poeyi	84	1.88	48	0.61	75	1.02
	Halichoeres radiatus	*	*	*	*	1	0.01

Table 1 (Continued). Total Number of Fish and Species Observed, and Percentage (Number of a Fish Species Observed/Total Number of Fish Observed in an Embayment) for Each Northeast St. Croix Embayment (120 Transects Per Embayment) from October 1998 and September 1999 Based on Pooled Monthly and Transect Site Data.

		Cottongarden Bay		Teague Bay		Yellowcliff Bay	
FAMILY	SPECIES	No. of Fish	Percent	No. of Fish	Percent	No. of Fish	Percent
Labridae	*Hemipteronotus martinicensis*	*	*	156	1.99	197	2.67
	Hemipteronotus splendens	*	*	*	*	8	0.11
	Thalassoma bifasciatum	218	4.88	11	0.14	44	0.60
Lutjanidae	*Lutjanus apodus*	5	0.11	1	0.01	*	*
	Lutjanus griseus	*	*	2	0.03	3	0.04
	Lutjanus mahogoni	3	0.07	7	0.09	14	0.19
	Lutjanus synagris	1	0.02	14	0.18	4	0.05
	Ocyurus chrysurus	115	2.57	221	2.82	162	2.19
Monacanthidae	*Monacanthus ciliatus*	14	0.31	7	0.09	9	0.12
Malacanthidae	*Malacanthus plumieri*	*	*	*	*	1	0.01
Mullidae	*Mulloidicthys martinicus*	*	*	203	2.59	*	*
	Pseudupeneus maculatus	113	2.53	26	0.33	76	1.03
Muraenidae	*Gymnothorax moringa*	1	0.02	*	*	*	*
Ophichthidae	*Ophichthus spp.*	*	*	5	0.06	*	*
	Ophichthus ophis	*	*	*	*	1	0.01
Ostraciidae	*Lactophrys polygonia*	*	*	1	0.01	*	*
	Lactophrys triqueter	1	0.02	*	*	1	0.01
Paralichtydae	*Paralichthys tropicus*	*	*	*	*	1	0.01
Pomacanthidae	*Pomacanthus paru*	*	*	*	*	2	0.03
Pomacentridae	*Abudefduf saxatilis*	*	*	*	*	3	0.04
	Microspathodon chrysurus	15	0.34	5	0.06	10	0.14
	Stegastes unk.	*	*	*	*	12	0.16
	Stegastes diencaeus	*	*	*	*	1	0.01
	Stegastes fuscus	*	*	21	0.27	55	0.74
	Stegastes leucostictus	2	0.04	191	2.44	153	2.07
	Stegastes partitus	19	0.42	11	0.14	79	1.07
	Stegastes planifrons	2	0.04	3	0.04	25	0.34
	Stegastes variabilis	12	0.27	5	0.06	21	0.28
Scaridae	*Cryptotomus roseus*	58	1.30	53	0.68	82	1.11
	Scarus unk.	*	*	*	*	17	0.23
	Scarus iserti	41	0.92	42	0.54	46	0.62
	Scarus taeniopterus	138	3.09	94	1.20	89	1.20
	Sparisoma aurofrenatum	13	0.29	*	*	27	0.37
	Sparisoma radians	1289	28.83	496	6.34	443	6.00
	Sparisoma rubripinne	3	0.07	*	*	*	*
	Sparisoma viride	*	*	6	0.08	49	0.66
	Sparisoma chrysopterum	*	*	*	*	3	0.04
Sciaenidae	*Equetus acuminatus*	2	0.04	*	*	2	0.03
Scombridae	*Scomberomorus regalis*	1	0.02	*	*	*	*
Serranidae	*Alphestes afer*	12	0.27	1	0.01	*	*
	Epinephelus guttatus	10	0.22	5	0.06	11	0.15

Table 1 (Continued). Total Number of Fish and Species Observed, and Percentage (Number of a Fish Species Observed/Total Number of Fish Observed in an Embayment) for Each Northeast St. Croix Embayment (120 Transects Per Embayment) from October 1998 and September 1999 Based on Pooled Monthly and Transect Site Data.

FAMILY	SPECIES	Cottongarden Bay No. of Fish	Cottongarden Bay Percent	Teague Bay No. of Fish	Teague Bay Percent	Yellowcliff Bay No. of Fish	Yellowcliff Bay Percent
Serranidae	*Epinephelus striatus*	*	*	1	0.01	*	*
	Hypoplectrus spp	*	*	1	0.01	2	0.03
	Hypoplectrus nigricans	*	*	1	0.01	*	*
	Hypoplectrus indigo	*	*	1	0.01	*	*
	Hypoplectrus puella	*	*	*	*	1	0.01
	Hypoplectrus unicolor	*	*	1	0.01	1	0.01
	Serranus tabacarius	*	*	1	0.01	*	*
	Serranus tigrinus	6	0.13	5	0.06	20	0.27
Sphyraenidae	*Sphyraena barracuda*	*	*	*	*	2	0.03
Synodontidae	*Synodus spp.*	1	0.02	9	0.11	3	0.04
	Synodus foetens	*	*	1	0.01	3	0.04
Tetradontidae	*Canthigaster rostrata*	10	0.22	27	0.34	30	0.41
	Sphoeroides spengleri	1	0.02	18	0.23	13	0.18
	Total Number of Fish	4471		7829		7388	
	Total Number of Species	54		66		74	

Mean (Standard Error) Community Parameters of fish censused with visual transects during October 1998 to September 1999. All months were pooled.

	Cottongarden Bay	Teague Bay	Yellowcliff Bay
No. of fish/100m^2	19.51 (1.99)	32.75 (5.37)	30.43 (4.81)
No of species/100m^2	2.93 (0.21)	2.95 (0.18)	3.48 (0.23)
Diversity Index	0.63 (0.04)	0.58 (0.04)	0.67 (0.04)
Evenness	0.70 (0.02)	0.66 (0.02)	0.65 (0.02)

*none observed

Table 2. Number of Fish Observed and Number of Fish Densities By Size Groups and By Habitat Based on Pooled Monthly, Transect Site and Northeast St. Croix Embayment Data (October 1998 to September 1999).

Habitat	Area* (m^2)	Habitat Cover (%)	No. of Species Observed	No. of Fish Observed (Mean No. Fish/100 m^2) <5 cm	5-10 cm	>10 cm	Total	Density Fish / 100m^2	Species / 100m^2
Seagrass	57326	79.62	81	8492 (14.8)	3907 (6.8)	1334 (2.32)	13733	24	0.1
Algal Plain	9052	12.57	58	1662 (18.4)	409 (4.5)	1019 (11.25)	3090	34.1	0.6
Patch Reef	2836	3.94	63	1019 (35.9)	832 (29.3)	349 (12.3)	2200	77.5	2.2
Sand	2462	3.42	12	207 (8.4)	47 (1.9)	25 (1.01)	279	11.3	0.5
Rubble	324	0.45	31	324 (100)	44 (13.6)	18 (5.55)	386	119.1	9.5
Total	72000			11704	5239	2745	19688		

*note: Area = Total area of habitat surveyed in transects.

Table 3. Number of Fish Observed and Fish Densities By Fish Size Groups and Northeast St. Croix Embayments; Number of Species per 100 m^2 by Embayment; and Number of Fish Observed and Fish Densities by Fish Size Groups by Habitat and Northeast St. Croix Embavment (October 1998 to September 1999)

Site	Bay Size (*1) (km^2)	Survey Area(*2) (m^2)	No. of Species Observed	No. of Fish Observed (Fish/100m^2) <5 cm	5-10 cm	>10 cm	Total	Species /100m^2
Cottongarden Bay	0.41	24,000	54	1956 (8.1)	1873 (7.8)	642 (2.7)	4471 (18.6)	0.2
Teague Bay	0.76	24,000	66	4687 (19.5)	1555 (6.5)	1587 (6.61)	7829 (32.6)	0.2
Yellowcliff Bay	0.32	24,000	74	5061 (21.1)	1811 (7.5)	516 (2.15)	7388 (30.8)	0.3
Total		72,000		11704 (16.3)	5239 (7.3)	2745 (3.8)	19688 (27.3)	

	Habitat Area (*3) (km^2)	Habitat Surveyed (*4) (m^2)	No. of Fish Observed (Fish/100 m^2) <5 cm	5-10 cm	>10 cm	Overall
Cottongarden Bay						
Seagrass	0.37	22293	1329 (6.0)	1419 (6.4)	455 (2)	3203 (14.4)
Algal Plain	0.0	19	5 (26.3)	0	1 (5.3)	6 (31.6)
Patch Reef	0.02	1144	512 (44.8)	425 (37.2)	182 (15.9)	1119 (97.8)
Sand	0.01	411	0	0	1 (0.2)	1 (0.2)
Rubble	0.01	133	110 (82.7)	29 (21.8)	3 (2.3)	142 (106.8)
Teague Bay						
Seagrass	0.64	20548	4089 (19.9)	1315 (6.4)	559 (2.7)	5963 (29.0)
Algal Plain	0.08	2294	351 (15.3)	111 (4.8)	947 (41.3)	1409 (61.4)
Patch Reef	0.02	266	167 (62.8)	59 (22.2)	59 (22.2)	285 (107.1)
Sand	0.02	879	75 (8.5)	70 (8)	22 (2.5)	167 (19)
Rubble	0	13	5 (38.5)	0	0	5 (38.5)
Yellowcliff Bay						
Seagrass	0.20	14614	2956 (20.2)	974 (6.7)	232 (1.6)	4162 (28.5)
Algal Plain	0.08	6180	1462 (23.7)	323 (5.2)	89 (1.4)	1874 (30.3)
Patch Reef	0.02	1360	281 (20.7)	446 (32.8)	171 (12.6)	898 (66)
Sand	0.01	1724	149 (8.6)	45 (2.6)	9 (0.5)	203 (11.8)
Rubble	0.01	122	213 (174.6)	23 (18.9)	15 (12.3)	251 (205.7)

*notes:

1. Area Estimated using a planimeter:
2. Survey area is the area surveyed by the benthic visual survey within each embayment.
3. Habitat Area = Bay Size estimated using a planimeter x Habitat Percent Cover estimated from benthic visual transects.
4. Habitat Surveyed is the area of each habitat surveyed by the benthic visual survey within each embayment.

Table 4. Percent Similarity Values Between Habitats Sampled Based on Percent Similarity of Species Composition and Fish Densities From Pooled Monthly, Transect Site, and Northeast St. Croix Embayment Data (October 1998 to September 1999).

	Rubble	Sand	Algal Plain	Patch Reef	Seagrass
Rubble		11	37	45	44
Sand			15	10	15
Algal Plain				24	**69**
Patch Reef					**53**
Seagrass					

Table 5. Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Northeast St. Croix Embayments, Based on Pooled Monthly, Transect Site, and Embayment Data between October 1998 and September 1999.

		No. of Fish in Each Fish Size Groups					No. of Fish/100m^2				
Species	**Family Acanthuridae**										
A. bahianus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	9	15	53	77	0	0.32	0.53	1.86	2.71
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	2	0	0	2	0	0.22	0	0	0.02
	Seagrass	0	25	4	11	40	0	0.04	0.007	0.02	.07
	Total	0	36	19	64	119					
A.chirurgus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	43	74	76	193	0	1.51	2.61	2.68	6.8
	Rubble	0	36	5	10	51	0	11.11	1.54	3.08	15.7
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	8	37	12	12	0	0.08	0.41	0.13	0.13
	Seagrass	0	143	55	22	220	0	0.25	0.09	0.04	0.38
	Total	0	230	171	120	476					
A. coeruleus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	25	30	14	69	0	0.88	1.05	0.49	2.43
	Rubble	0	2	0	0	2	0	.62	0	0	0.62
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	4	4	0	8	0	0.007	0.007	0	0.01
	Total	0	31	34	14	79					
	Family Haemulidae										
H. aurolineatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	5	21	26	52	0	0.17	0.74	0.92	1.83
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	18	30		600	648	0.2	0.33	0	6.62	7.15
	Seagrass	0	386	145	2	533	0	0.67	0.25	0.35	0.92
	Total	18	421	166	628	1233					
H. carbonarium	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	6	7	13	0	0	0.21	0.25	0.46
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	6	0	6	0	0	0.001	0	0.001
	Total	0	0	6	7	13					
H. flavolineatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	88	60	27	175	0	3.10	2.11	0.95	6.17
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	100	100	0	0	0	1.10	1.10
	Seagrass	0	91	300	9	400	0	0.16	0.52	.01	0.69
	Total	0	179	360	136	675					
H. plumieri	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	16	32	50	98	0	0.56	1.13	0.02	0.03
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	66	11	1	78	0	0.11	0.02	0.02	0.14
	Total	0	82	43	51	176					

Table 5 (Continued). Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Northeast St. Croix Embayments, Based on Pooled Monthly, Transect Site, and Embayment Data between October 1998 and September 1999.

	No. of Fish in Each Size Group						No. of Fish/100m^2				
Species	**Family Haemulidae**										
Haemulon spp	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	39	101	1	4	145	1.37	3.56	0.03	0.14	5.11
	Rubble	156	3	0	0	159	48.14	0.92	0	0	49.07
	Sand	3	0	0	0	3	0.12	0	0	0	0.12
	Algal Plain	705	66	1	0	772	7.78	0.73	0.01	0	8.52
	Seagrass	4351	393	70	0	4814	7.58	0.68	0.12	0	8.39
	Total	5254	563	72	4	5893					
O. chrysurus	Family Lutjanidae										
	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	4	29	21	54	0	0.14	1.02	0.74	1.9
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	4.00	0	0	4	0	0.16	0	0	0.16
	Algal Plain	0	13	18	2	33	0	0.14	0.19	.02	0.36
	Seagrass	0	236	156	57	449	0	0.41	0.27	.09	0.78
	Total	0	257	203	80	540					
L. mahogoni	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	7	5	0	12	0	0.24	0.17	0	0.42
	Rubble	0	2	0	0	2	0	0.61	0	0	0.61
	Sand	0	5	0	0	5	0	0.20	0	0	0.2
	Algal Plain	0	2	0	0	2	0	0.21	0	0	0.02
	Seagrass	0	11	5	0	16	0	0.02	.008	0	0.03
	Total	0	27	10	0	37					
L. synagris	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	3	0	3	0	0	0.03	0	0.03
	Seagrass	0	11	2	4	17	0	0.02	0.03	0.007	0.03
	Total	0	11	5	4	20					
L. griseus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	3	3	0	0	0	0.03	0.03
	Seagrass	0	0	0	2	2	0	0	0	0.03	0.03
	Total	0	0	0	5	5					0
L. apodus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	1	0	1	0	0	0.002	0	0.002
	Total	0	0	1	0	1					
	Family Scaridae										
S. iserti	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	51	22	0	73	0	1.79	0.77	0	2.57
	Rubble	0	10	0	0	10	0	3.08	0	0	3.08
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	18	0	0	18	0	0.2	0	0	0.2
	Seagrass	0	58	21	3	82	0	0.1	0.04	.005	0.1
	Total	0	137	43	3	183					

Table 5 (Continued). Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Northeast St. Croix Embayments, Based on Pooled Monthly, Transect Site, and Embayment Data between October 1998 and September 1999,

		No. of Fish in Each Size Group					No. of Fish/100m^2				
Species	**Family Scaridae**										
S. taeniopterus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	165	62	2	229	0	5.81	2.18	0.07	0.08
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	5	1	0	6	0	0.05	0.01	0	0.06
	Seagrass	0	92	6	1	99	0	0.16	0.01	0.002	0.17
	Total	0	262	69	3	334					0
S. aurofrenatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	2	10	14	26	0	0.07	0.35	0.49	0.91
	Rubble	0	0	2	0	2	0	0	0.61	0	0.62
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	3	3	0	0	0	0.003	0.003
	Seagrass	0	2.	0	8	10	0	0.003	0	0.001	0.001
	Total	0	4	12	25	41					
S. viride	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	26	51	8	85	0	0.92	1.79	0.28	2.99
	Rubble	0	0	1	0	1	0	0	0.36	0	0.31
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total	0	26	52	8	86					

Table 6. Total Number of Fish and Species Caught by Fish Trap and Percentage (Number of a Fish Species Caught/Total Number of Fish Caught in an Embayment) for Each Northeast St. Croix Embayment (120 trap-days/embayment) between October 1998 and September 1999 Based on Pooled Monthly Data

		Cottongarden Bay		Teague Bay		Yellowcliff Bay	
FAMILY	**SPECIES**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**
Acanthuridae	*Acanthurus chirurgus*	10	1.44	18	2.37	7	1.60
	Acanthurus coeruleus	*	*	*	*	6	1.37
Aulostomidae	*Aulostomus maculatus*	2	0.29	5	0.66	7	1.60
Chaetodontidae	*Chaetodon capistratus*	8	1.15	14	1.84	18	4.11
	Chaetodon striatus	1	0.14	*	*	*	*
Gerreidae	*Eucinostomus jonesi*	*	*	4	0.53	*	*
	Gerres cinereus	*	*	1	0.13	*	*
Haemulidae	*Haemulon aurolineatum*	*	*	43	5.66	9	2.05
	Haemulon chrysargyreum	*	*	32	4.21	*	*
	Haemulon flavolineatum	3	0.43	239	31.45	24	5.48
	Haemulon plumieri	10	1.44	27	3.55	16	3.65
Holocentridae	*Holocentrus adscensionis*	54	7.76	25	3.29	8	1.83
	Myripristis jacobus	8	1.15	3	0.39	19	4.34
Labridae	*Halichoeres bivittatus*	3	0.43	3	0.39	*	*
Lutjanidae	*Lutjanus analis*	*	*	5	0.66	*	*
	Lutjanus mahogani	1	0.14	3	0.39	7	1.60
	Lutjanus synagris	*	*	35	4.61	15	3.42
	Ocyurus chrysurus	32	4.60	79	10.39	40	9.13
Monacanthidae	*Monacanthus ciliatus*	5	0.72	10	1.32	*	*
Mullidae	*Pseudupeneus maculatus*	269	38.65	146	19.21	209	47.72
Muraenidae	*Gymnothorax moringa*	6	0.86	2	0.26	1	0.23
Pomacanthidae	*Pomacanthus paru*	*	*	5	0.66	*	*
	Stegastes leucostictus	*	*	1	0.13	*	*
Scaridae	*Sparisoma radians*	267	38.36	38	5.00	30	6.85
Sciaenidae	*Sciaenops oculatus*	*	*	2	0.26	*	*
Serranidae	*Alphestes afer*	16	2.30	*	*	2	0.46
	Epinephelus guttatus	*	*	1	0.13	1	0.23
	Epinephelus striatus	*	*	1	0.13	1	0.23
Sparidae	*Archosargus rhomboidalis*	1	0.14	*	*	*	*
Tetradontidae	*Canthigaster rostrata*	*	*	5	0.66	1	0.23
	Sphoeroides spengleri	*	*	13	1.71	17	3.88
	Total Number of Fishes	696		760		438	
	Total Number of Species	16		26		19	

Mean (Standard Error) Community Parameters of fish caught with traps during October 1998 to September 1999. All months were pooled.

	Cottongarden Bay	Teague Bay	Yellowcliff Bay
No. of fish/trap-day	5.70 (1.06)	6.36 (1.09)	4.20 (0.64)
No. of species/trap-day	1.49 (0.12)	1.87 (0.15)	1.36 (0.12)

*not caught

Table 7. Total Number of Fish and Species Caught by Seine Net and Percentage (Number of a Fish Species Caught/Total Number of Fish Caught in an Embayment) for Each Northeast St. Croix Embayment (24 seine hauls/embayment) between October 1998 and September 1999 Based on Pooled Monthly Data.

		Cottongarden Bay		Teague Bay		Yellowcliff Bay	
FAMILY	**SPECIES**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**
Acanthuridae	*Acanthurus chirurgus*	*	*	1	0.38	*	*
Albulidae	*Albula vulpes*	*	*	2	0.76	*	*
Belonidae	*Tylosorus crocodrilus*	4	6.56	1	0.38	3	30
Carangidae	*Caranx hippos*	*	*	2	0.76	*	*
	Caranx latus	10	16.39	74	28.14	*	*
	Selar crumenophtalmus	5	8.20	1	0.38	*	*
	Selene vomer	*	*	1	0.38	*	*
	Trachinotus falcatus	23	37.70	5	1.90	*	*
Chaetodontidae	*Chaetodon capistratus*	*	*	*	*	1	10
Clupeidae	*Harengula humeralis*	1	1.64	14	5.32	*	*
	Harengula clupeola	4	6.56	6	2.28	*	*
Dactylopteridae	*Dactylopterus volitans*	*	*	2	0.76	*	*
Engraulidae	*Anchoa unk.*	*	*	6	2.28	*	*
	Hypoatherina harringtonensis	*	*	4	1.52	*	*
Exocoetidae	*Hemiramphus braciliencis*	1	1.64	3	1.14	*	*
Gerreidae	*Eucinostomus jonesi*	12	19.67	51	19.39	5	50
Haemulidae	*Haemulon flavolineatum*	*	*	4	1.52	*	*
Lutjanidae	*Lutjanus analis*	*	*	2	0.76	*	*
	Lutjanus apodus	*	*	8	3.04	*	*
	Lutjanus mahogani	*	*	7	2.66	*	*
	Lutjanus synagris	*	*	1	0.38	*	*
	Ocyurus chrysurus	*	*	27	10.27	*	*
Monacanthidae	*Monacanthus ciliatus*	*	*	2	0.76	*	*
Mullidae	*Pseudupeneus maculatus*	*	*	3	1.14	*	*
Pomacentridae	*Abudefduf saxatilis*	1	1.64	*	*	*	*
	Microspathodon chrysurus	*	*	1	0.38	*	*
	Stegastes unk.	*	*	1	0.38	*	*
Scaridae	*Sparisoma radians*	*	*	3	1.14	1	10
Sparidae	*Calamus bajonado*	*	*	2	0.76	*	*
Sphyraenidae	*Sphyraena barracuda*	*	*	12	4.56	*	*
Synodontidae	*Synodontus unk.*	*	*	1	0.38	*	*
Tetradontidae	*Sphoeroides spengleri*	*	*	16	6.08	*	*
	Total Number of Fish	61		263		10	
	Total Number of Species	9		29		4	

Mean (Standard Error) Community Parameters of fish caught with seine nets during October 1998 to September 1999.

	Cottongarden Bay	Teague Bay	Yellowcliff Bay
No. of fish/seine haul	2.65 (0.66)	10.20 (2.35)	0.42 (0.04)
No. of species/seine haul	1.13 (0.21)	3.37 (0.39)	0.17 (0.02)

*not caught

Table 8. Total Number of Fish and Species Observed, and Percentage (Number of a Fish Species Observed/Total Number of Fish Observed in an Embayment) for Each Southeast St. Croix Embayment (30 Transects Per Embayment) from July 2000 to September 2000 Based on Pooled Monthly and Transect Site Data.

FAMILY	SPECIES	Turner Hole Bay No. of Fish	Turner Hole Bay Percent	Robin Bay No. of Fish	Robin Bay Percent	Great Pond Bay No. of Fish	Great Pond Bay Percent
Acanthuridae	*Acantharus bahianus*	16	0.98	4	1.29	7.00	0.54
	Acanthurus chirurgus	189	11.61	7	2.27	12.00	0.93
	Acanthurus coeruleus	15	0.92	*	*	10	0.78
Apogonidae	*Apogon unk.*	1	0.06	1	0.32	*	*
	Apogon stellatus	*	*	*	*	2.00	0.16
Aulostomidae	*Aulostomus maculatus*	1	0.06	*	*	*	*
	Caranx ruber	3	0.18	2	0.65	25.00	1.95
Chaetodontidae	*Chaetodon capistratus*	3	0.18	2	0.65	3.00	0.23
Gerreidae	*Gerres cinereus*	1	0.06	1	0.32	*	*
Gobiidae	*Coryphopterus glaucofraenum*	2	0.12	*	*	7.00	0.54
Haemulidae	*Haemulon unk.*	215	13.21	74	23.95	883.00	68.72
	Haemulon aurolineatum	210	12.90	*	*	75.00	5.84
	Haemulon carbonarium	*	*	*	*	1.00	0.08
	Haemulon chrysargyreum	*	*	*	*	20	1.56
	Haemulon flavolineatum	59	3.62	1	0.32	51.00	3.97
	Haemulon plumieri	44	2.70	*	*	*	*
	Haemulon sciurum	*	*	*	*	6.00	0.47
	Haemulon striatum	*	*	*	*	7.00	0.54
Holocentridae	*Holocentrus unk.*	34	2.09	3	0.97	*	*
	Myripristis jacobus	21	1.29	1	0.32	*	*
Labridae	*Bodiamus rufus*	*	*	*	*	1.00	0.08
	Doratonotus megalepsis	*	*	1	0.32	*	*
	Halichoeres unk.	*	*	*	*	*	*
	Halichoeres bivittatus	207	12.71	93	30.10	104.00	8.09
	Halichoeres garnoti	9	0.55	*	*	*	*
	Halichoeres poeyi	4	0.25	*	*	*	*
	Hemipteronotus martinicensis	*	*	*	*	2.00	0.16
	Hemipteronotus splendens	*	*	*	*	2.00	0.16
	Thalassoma bifasciatum	241	14.80	14	4.53	12.00	0.93
Lutjanidae	*Lutjanus mahogani*	2	0.12	*	*	1.00	0.08
	Lutjanus synagris	1	0.06	*	*	3.00	0.23
	Ocyurus chrysurus	22	1.35	*	*	2.00	0.16
Monacanthidae	*Monacanthus ciliatus*	*	*	3	0.97	1.00	0.08
Mullidae	*Pseudupeneus maculatus*	8	0.49	2	0.65	*	*
Ophichthidae	*Myrichthys ocellatus*	*	*	1	0.32	*	*
Ostraciidae	*Lactophrys triqueter*	*	*	1	0.32	*	*
Pomacentridae	*Chromys cyanea*	2	0.12	*	*	*	*
	Microspathodon chrysurus	7	0.43	1	0.32	*	*
	Stegastes fuscus	19	1.17	7	2.27	2.00	0.16
	Stegastes leucostictus	90	5.53	2	0.65	7.00	0.54
	Stegastes partitus	18	1.11	*	*	3.00	0.23
	Stegastes planifrons	4	0.25	*	*	*	*
	Stegastes variabilis	*	*	*	*	1.00	0.08
Scaridae	*Cryptotomus roseus*	*	*	2	0.65	1.00	0.08

Table 8 (Continued). Total Number of Fish and Species Observed, and Percentage (Number of a Fish Species Observed/Total Number of Fish Observed in an Embayment) for Each Southeast St, Croix Embayment (30 Transects Per Embayment) from July 2000 to September 2000 Based on Pooled Monthly and Transect Site Data.

		Turner Hole Bay		Robin Bay		Great Pond Bay	
FAMILY	**SPECIES**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**	**No. of Fish**	**Percent**
Scaridae	*Scarus iserti*	1	0.06	*	*	7.00	0.54
	Scarus taeniopterus	17	1.04	*	*	8.00	0.62
	Sparisoma aurofrenatum	12	0.74	1	0.32	*	*
	Sparisoma radians	104	6.39	76	24.60	5.00	0.39
	Sparisoma viride	16	0.98	5	1.62	7.00	0.54
	Sparisoma chrysopterum	7	0.43	*	*	*	*
Sciaenidae	*Equetus acuminatus*	5	0.31	*	*	*	*
Serranidae	*Epinephelus fulvus*	6	0.37	*	*	*	*
	Epinephelus guttatus	11	0.68	*	*	1.00	0.08
	Serranus tabacarius	1	0.06	*	*	*	*
	Serranus tigrinus	*	*	*	*	3.00	0.23
Tetradontidae	*Canthigaster rostrata*	*	*	1	0.32	2.00	0.16
	Sphoeroides spengleri	*	*	3	0.97	1.00	0.08
	Total Number of Fish	1628		309		1285	
	Total Number of Species	39		25		36	

Mean (standard error) community parameters of fish censused with visual transects during July 2000 to September 2000. All months were pooled

	Turner Hole Bay	Robin Bay	Great Pond Bay
No. of fish/100m^2	26.6 (4.40)	5.90 (1.49)	19.45 (5.21)
No. of species/100m^2	3.75 (0.52)	1.55 (0.29)	1.70 (0.27)
Diversity Index	0.76 (0.09)	0.30 (0.07)	0.28 (0.07)
Evenness	0.62 (0.05)	0.63 (0.06)	0.69 (0.05)

*not observed

Table 9. Number of Fish Observed and Densities By Size Groups and By Habitat Based on Pooled Monthly, Transect Site, and Southeast St. Croix Embayment Data (July to September 2000).

Habitat	**Area* (m^2)**	**Habitat Cover (m^2)**	**No. of Species Observed**	**No. of Fish Observed (Mean No. Fish/100m^2) <5 cm**	**5-10 cm**	**>10 cm**	**Total**	**Density Fish / 100m^2**	**Species / 100m^2**
Seagrass	10126	56.26	23	450 (4.4)	151 (1.5)	35 (0.34)	636	6.3	0.2
Sand	6131	34.06	9	199 (3.2)	0	29 (0.47)	228	3.7	0.1
Algal Plain	1164	6.47	19	1002 (86.1)	42 (3.6)	0	1044	89.6	0.2
Patch Reef	358	1.99	41	697 194.7)	378 (105.6)	155 (43.3)	1230	343.5	11.5
Rubble	221	1.23	14	39 (17.6)	62 (28)	12 (5.4)	113	51.1	6.3
Total	18000			2387	633	231	3251		

*note: Total area of habitat surveyed in transects.

Table 10. Number of Fish Observed and Fish Densities By Fish Size Groups and Southeast St. Croix Embayments; Number of Species per 100 m^2 by Embayment; and Number of Fish Observed and Fish Densities by Fish Size Groups by Habitat and Southeast St. Croix Embavment (July to September 2000).

Site	Bay Size (*1) (km^2)	Survey Area(*2) (m^2)	No. of Species Observed	No. of Fish Observed (Fish/100m^2) <5 cm	5-10 cm	>10 cm	Total	Species /100m^2
Turner Hole Bay	0.37	6,000	39	998 (16.6)	463 (7.7)	172 (2.86)	1633 (27.2)	0.6
Robin Bay	0.64	6,000	25	177 (2.9)	104 (1.7)	29 (0.5)	310 (5.2)	0.4
Great Pond Bay	2.30	6,000	36	1212 (20.2)	66 (1.1)	30 (0.5)	1308 (21.8)	0.6
Total		18,000		2387 (13.3)	633 (3.5)	231 (1.3)	3251 (18.1)	
	Habitat Area (*3) (km^2)	**Habitat Surveyed (*4) (m^2)**		**No. of Fish Observed (Fish/100 m^2) <5 cm**	**5-10 cm**	**>10 cm**	**Overall**	
Turner Hole Bay								
Seagrass	0.24	3,938		230 (5.8)	63 (1.6)	30 (0.8)	323 (8.2)	
Algal Plain	0.02	300		163 (54.3)	7 (2.3)	0	170 (56.7)	
Patch Reef	0.02	288		564 (195.6)	331(114.9)	127 (44.1)	1022 (354.9)	
Sand	0.07	1,253		2 (0.2)	0	3 (0.2)	5 (0.4)	
Rubble	0.01	221		39 (17.6)	62 (28.1)	12 (5.4)	113 (51.1)	
Robin Bay								
Seagrass	0.58	5,521		121 (2.2)	87 (1.6)	5 (0.1)	213 (3.9)	
Algal Plain	0.01	22		10 (45.5)	0	0	10 (45.5)	
Patch Reef	0.01	29		46 (158.6)	17 (58.6)	23 (79.3)	86 (296.6)	
Sand	0.04	428		0	0	1 (0.2)	1 (0.2)	
Rubble	0.00	0		0	0	0	0	
Great Pond Bay								
Seagrass	0.23	598		99 (16.6)	1 (0.2)	0	100 (16.7)	
Algal Plain	0.32	842		829 (98.5)	35 (4.2)	0	864 (102.6)	
Patch Reef	0.02	41		87 (212.2)	30 (73.2)	5 (12.2)	122 (297.6)	
Sand	1.73	4,519		197 (4.4)	0	25 (0.6)	222 (4.9)	
Rubble	0.00	0		0	0	0	0	

*notes:

1. Area Estimated using a planimeter.
2. Survey area is the area surveyed by the benthic visual survey within each embayment.
3. Habitat Area = Bay Size estimated using a planimeter x Habitat Percent Cover estimated from benthic visual transects.
4. Habitat Surveyed is the area of each habitat surveyed by the benthic visual survey within each embayment.

Table 11. Percent Similarity Values Between Habitats Sampled Based on Percent Similarity of Species Composition and Fish Densities From Pooled Monthly, Transect Site, and Southeast St. Croix Embayment Data (July to September 2000)

	Rubble	Sand	Algal Plain	Patch Reef	Seagrass
Rubble		3	8.8	88	48
Sand			72	11	42
Algal Plain				32	48
Patch Reef					26
Seagrass					

Table 12. Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Southeast St. Croix Embayments, Based on Pooled Monthly, Transect Site, and Embayment Data between July and September 2000

		No. of Fish in Each Fish Size Group					**No. of Fish/100m^2**				
Species	**Family Acanthuridae**										
A. bahianus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	4	9	3	16	0	1.73	2.51	0.83	4.47
	Rubble	0	5	4	0	9	0	2.24	1.81	0	4.07
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	2	0	0	2	0	0.17	0	0	0.17
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total	0	11	13	3	27					
A. chirurgus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	67	80	31	178	0	18.71	22.4	8.65	49.72
	Rubble	0	3	0	1	4	0	1.35	0	0.45	1.81
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	2.00	6	1	10	19	1.98	0.06	0.09	0.09	0.18
	Total	2.00	76	81	42	201					
A. coeruleus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	2	8	0	10	0	0.56	2.23	0	2.79
	Rubble	0	0	0	1	1	0	0	0	0.45	0.45
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	14	0	0	0	14	0.14	0	0	0	0.14
	Total	14	2	8	1	25					
	Family Haemulidae										
H. aurolineatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	75	0	0	75		20.94	0	0	20.94
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	121	0	57	178	0	10.39	0	4.89	15.29
	Seagrass	0	32	0	0	32	0	0.31	0	0	0.32
	Total	0	228	0	57	285					
H. chrysargyreum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	20	0	0	20	0	1.72	0	0	1.72
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total	0	20	0	0	20					

Table 12 (Continued). Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Southeast St. Croix Embayments, Based on Pooled Monthly, Transect Site, and Embayment Data between July and September 2000

		No. of Fish in Each Fish Size Group					No. of Fish / 100m^2				
Species	**Family Haemulidae**										
H. flavolineatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	49	11	55	0	0	13.68	3.07	15.36
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	50	0	0	0	0	429.55	0	0	0
	Seagrass	0	1	0	0	1	0	0.99	0	0	0.09
	Total	0	51	49	11	56					
H. plumieri	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	5	14	10	24	0	2.26	3.91	2.79	6.70
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	15	0	0	15	0	0.15	0	0	0.14
	Total	0	20	0	0	20					
Haemulon unk.	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	93	0	1	1	2	25.97	0	0.28	0.28	0.56
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	188	0	0	0	188	3.06	0	0	0	3.06
	Algal Plain	711	6	0	0	717	61.08	0.51	0	0	61.59
	Seagrass	185	0	0	0	185	1.83	0	0	0	1.83
	Total	1177	6	1	1	1092					
	Family Lutjanidae										
O. chrysurus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	1	11	3	15	0	0.28	3.07	0.84	4.19
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	1	0	1	2	0	0.08	0	0.08	0.17
	Seagrass	0	4	3	0	7	0	0.39	0.03	0	0.7
	Total	0	6	14	4	24					
L. mahogoni	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	2	0	0	2	0	0.56	0	0	0.56
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	1	0	0	1	0	0.09	0	0	0.09
	Total	0	3	0	0	3					
L. synagris	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	1	1	0	0	0	0.28	0.28
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	1	0	0	1	0	0.01	0	0	0.01
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	1	0	0	1	0	0.09	0	0	0.09
	Total	0	2	0	1	3					
L. griseus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	3	3	0	0	0	0.26	0.26
	Seagrass	0	0	0	2	2	0	0	0	0.02	0.02
	Total	0	0	0	5	5					

Table 12. (Continued). Number of Fish per Size Group and Fish Densities of Economically Important Species By Habitat for Southeast St. Croix Embavments, Based on Pooled Monthly, Transect Site, and Embayment Data between July and September 2000.

		No. of Fish in Each Fish Size Group					No. of Fish / 100m^2				
Species	**Family Lutjanidae**										
L. apodus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	0	0	0	0	0	0	0	0	0
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	1	0	1	0	0	0.09	0	0.09
	Total	0	0	1	0	1					
	Family Scaridae										
S. iserti	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	1	0	0	1	0	0.28	0	0	0.28
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	3	4	0	7	0	0.26	0.34	0	0.6
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total	0	4	4	0	8					
S. taeniopterus	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	16	0	0	16	0	4.47	0	0	4.47
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	8	8	0	0	0	0.69	0.69
	Seagrass	0	1	0	0	1	0	0.09	0	0	0.09
	Total	0	17	0	8	25					
S. aurofrenatum	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	5		8	13	0	1.39	0	2.23	3.63
	Rubble	0	0	0	0	0	0	0	0	0	0
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total		5		8	13					
S. viride	Habitat	<3cm	<5cm	5-10cm	>10cm	Total	<3cm	<5cm	5-10cm	>10cm	Total
	Patch Reef	0	12	9.00	4	25	0	3.35	2.51	1.12	6.98
	Rubble	0	2		1	3	0	0.9	0	0.45	1.36
	Sand	0	0	0	0	0	0	0	0	0	0
	Algal Plain	0	0	0	0	0	0	0	0	0	0
	Seagrass	0	0	0	0	0	0	0	0	0	0
	Total	0	14	9	5	28					

Table 13. Total Number of Fish and Species Caught by Fish Trap and Percentage (Number of a Fish Species Caught/Total Number of Fish Caught in an Embayment) for Each Southeast St. Croix Embayment (30 trap-days/embayment) between July and September 2000 Based on Pooled Monthly Data.

FAMILY	SPECIES	Turner Hole Bay No. of Fish	Turner Hole Bay Percent	Robin Bay No. of Fish	Robin Bay Percent	Great Pond Bay No. of Fish	Great Pond Bay Percent
Acanthuridae	*Acanthurus chirurgus*	13	19.40	*	*	4	33.33
Aulostomidae	*Aulostomus maculatus*	*	*	*	*	*	*
Bothidae	*Paralichthys spp*	*	*	1	2.63	*	*
Chaetodontidae	*Chaetodon capistratus*	5	7.46	*	*	3	25.00
Haemulidae	*Haemulon flavolineatum*	4	5.97	3	7.89	1	8.33
	Haemulon plumieri	1	1.49	*	*	*	*
Holocentridae	*Holocentrus unk.*	3	4.48	5	13.16	1	8.33
	Myripristis jacobus	*	*	2	5.26	*	*
Labridae	*Halichoeres bivittatus*	1	1.49	*	*	*	*
Lutjanidae	*Lutjanus synagris*	*	*	*	*	3	25.00
	Ocyurus chrysurus	10	14.93	*	*	*	*
Monacanthidae	*Monacanthus ciliatus*	*	*	1	2.63	*	*
Mullidae	*Pseudupeneus maculatus*	7	10.45	2	5.26	*	*
Pomacanthidae	*Pomacanthus paru*	1	1.49	*	*	*	*
Scaridae	*Sparisoma radians*	15	22.39	24	63.16	*	*
Serranidae	*Alphestes afer*	2	2.99	*	*	*	*
	Epinephelus guttatus	1	1.49	*	*	*	*
Sparidae	*Calamus bajonado*	4	5.97	*	*	*	*
	Total Number of Fishes	67.00		38		12	
	Total Number of Species	13.00		7		5	

Mean (Standard Error) Community Parameters of fish caught with traps during July 2000 to September 2000. All months were pooled.

	Turner Hole Bay	Robin Bay	Great Pond Bay
No. of fish/trap-day	1.53 (0.79)	2.30 (0.79)	0.45 (0.22)
No. of species/trap-day	1.00 (0.27)	0.43 (0.12)	0.33 (0.15)

*not caught

Table 14. Total Number of Fish and Species Caught by Seine Net and Percentage (Number of a Fish Species Caught/Total Number of Fish Caught in an Embayment) for Each Southeast St. Croix Embayment (6 seine hauls/embayment) between July and September 2000 Based on Pooled Monthly Data.

FAMILY	SPECIES	Turner Hole Bay No. of Fish	Turner Hole Bay Percent	Robin Bay No. of Fish	Robin Bay Percent	Great Pond Bay No. of Fish	Great Pond Bay Percent
Acanthuridae	*Acanthurus bahianus*	*	*	*	*	1	5
Carangidae	*Trachinotus falcatus*	7	78	5	50	*	*
	Trachinotus goodei	1	11	*	*	*	*
Clupeidae	*Jenkinsia lamprotaenia*	*	*	*	*	7	35
Gerreidae	*Eucinostomus jonesi*	*	*	2	20	2	10
	Gerres cinereus	*	*	*	*	1	5
Lutjanidae	*Lutjanus apodus*	*	*	1	10	6	30
Monacanthidae	*Monacanthus ciliatus*	*	*	1	10	*	*
Ostraciidae	*Lactophrys polygonia*	1	11	*	*	*	*
Sciaenidae	*Umbrina coroides*	*	*	1	10	*	*
Sphyraenidae	*Sphyraena barracuda*	*	*	*	*	2	10
Tetradontidae	*Sphoeroides spengleri*	*	*	*	*	1	5
	Total Number of Fish	9		10		20	
	Total Number of Species	3		5		7	

Mean (Standard Error) Community Parameters of fish caught with seine nets during July 2000 to September 2000. All months were pooled.

	Turner Hole Bay	Robin Bay	Great Pond Bay
No. of fish/seine haul	1.83 (0.91)	1.67 (0.95)	3.50 (1.91)
No. of species/seine haul	1.33 (0.61)	0.83 (0.40)	1.33 (0.61)

*not caught

Figure 1. Location of the three northeast St. Croix (U. S. V.I.) embayments surveyed (Cottongarden Bay, Teague Bay, and Yellowcliff Bay)

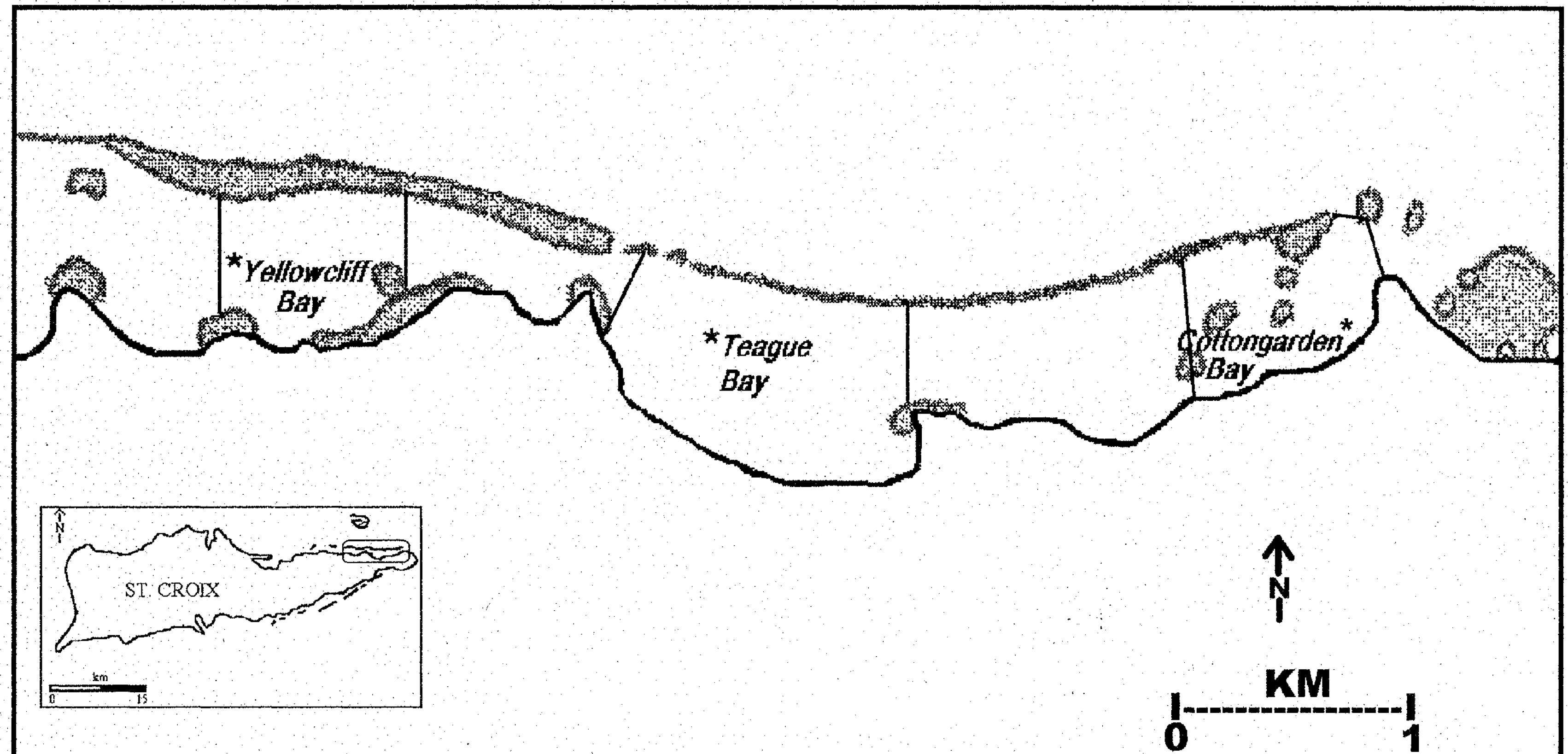


Figure 2. Location of the three southeast St. Croix (U.S.V.L) embayments surveyed (Turner Hold Bay, Robin Bay, and Great Pond Bay)

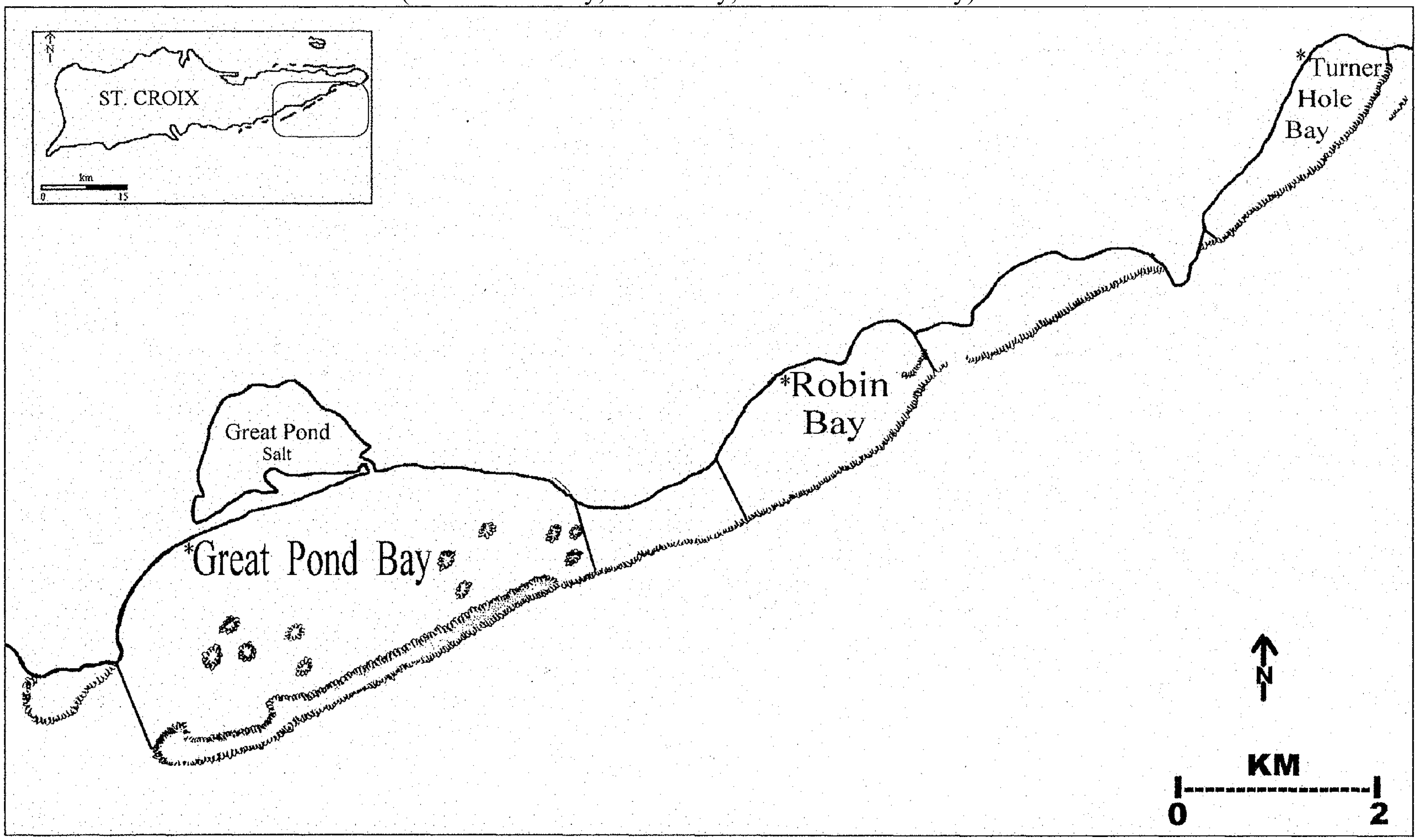


Figure 3. Substrate Percentage Composition for Northeast St. Croix Embayments based on Pooled Month and Transect Site Data (Total Area of Each Embayment Surveyed = 24,000 m^2).

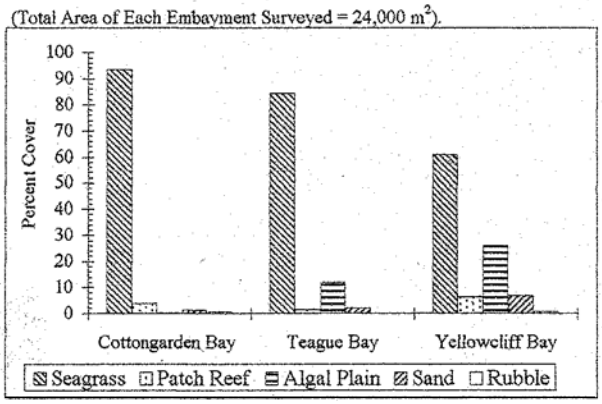


Figure 4a. Mean Monthly Fish Densities For Each Northeast St. Croix Embayment based on Pooled Transect Site Data.

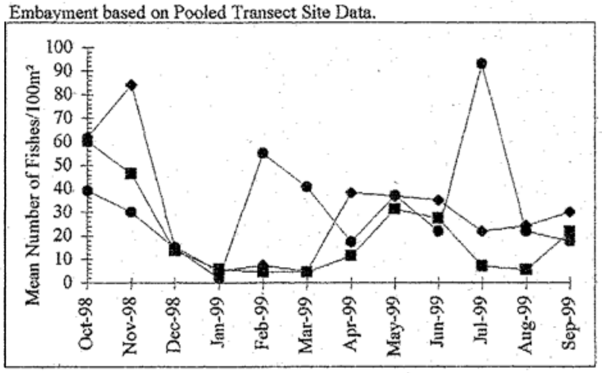


Figure 4b. Mean Monthly Density of Species for Each Northeast St. Croix Embayment based on Pooled Transect Site Data.

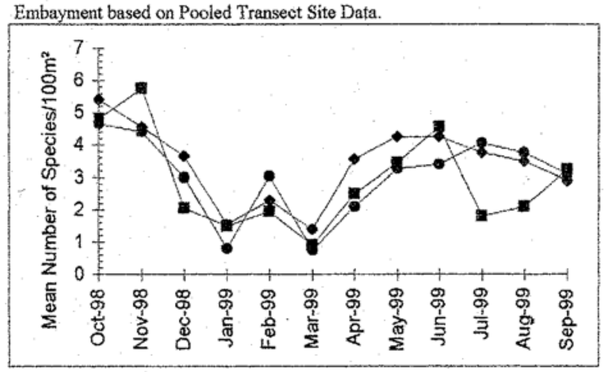


Figure 5a. Monthly Shannon Wiener Diversity Index For Each Northeast St. Croix Embayment based on Pooled Transect Site Data.

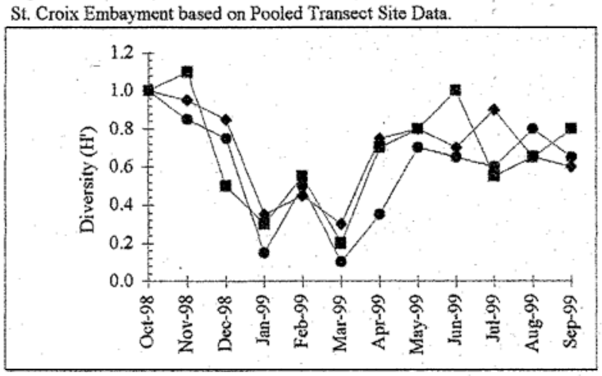
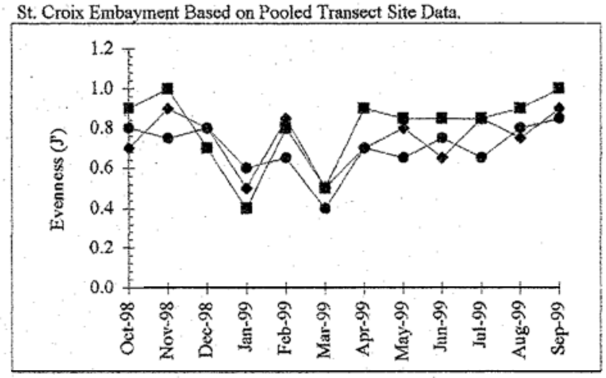


Figure 5b. Monthly Pielou Evenness Index For Each Northeast St. Croix Embayment Based on Pooled Transect Site Data.



Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 6a. Mean Fish Densities For Northeast St. Croix Embayment By Habitat Based on Pooled Monthly and Transect Site Data.

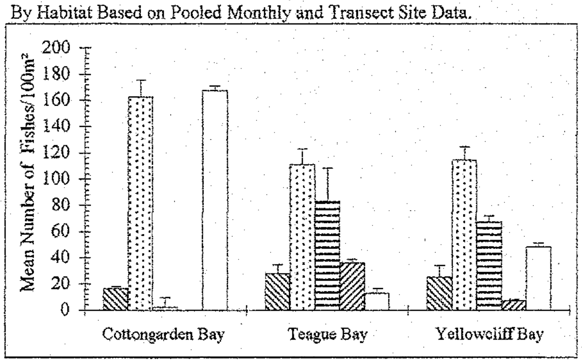


Figure 6b. Mean Species Densities For Northeast St. Croix Embayments By Habitat Based on Pooled Monthly and Transect Site Data.

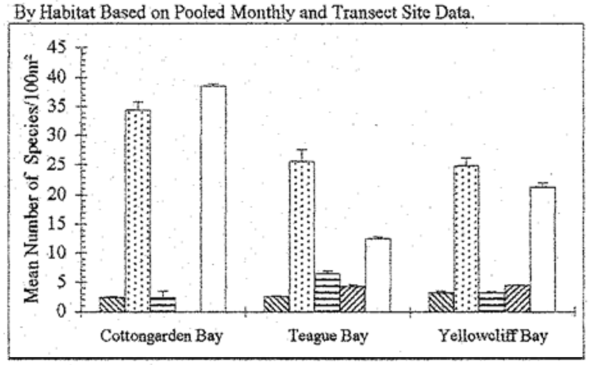


Figure 7a. Diversity Indexes (H') For Northeast St. Croix Embayments By Habitat Based on Pooled Monthly and Transect Site Data.

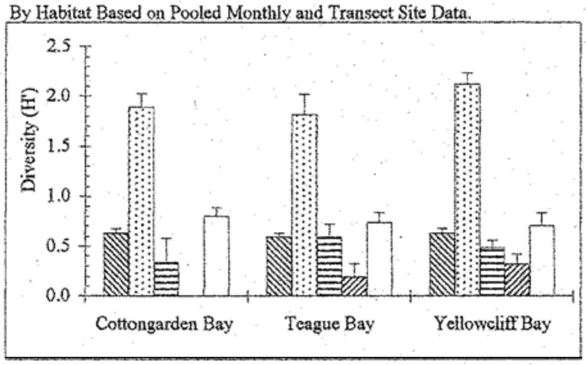
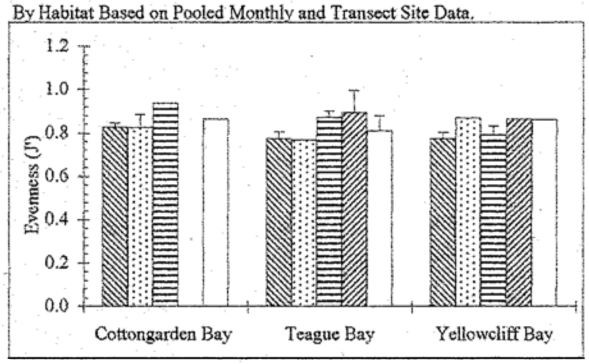


Figure 7b. Evenness Index (J') For Northeast St. Croix Embayments By Habitat Based on Pooled Monthly and Transect Site Data.



Legend:

Seagrass Patch Reef Algal Plain Sand Rubble

Figure 8a. Mean Monthly *Haemulon unk.* Densities for Northeast St. Croix Embayments Based on Pooled Transect Site and Size Group Data.

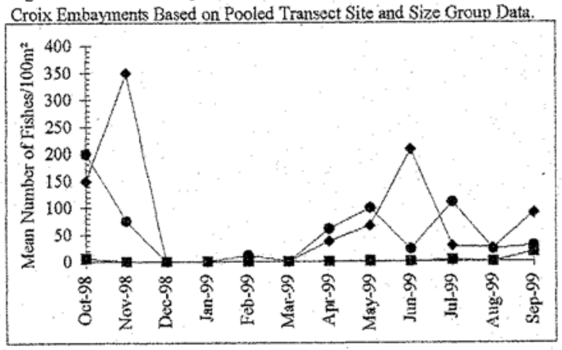


Figure 8b. Mean Monthly *Haemulon unk.* Recruit (< 5 cm TL) Densities for Northeast St. Croix Embayments Based on Pooled Transect Site Data.

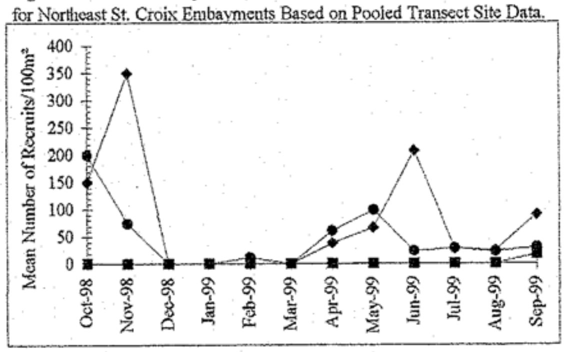


Figure 9a. Mean Monthly *Halichoeres bivittatus* Densities for Northeast St. Croix Embayments Based on Pooled Transect Site and Size Group Data.

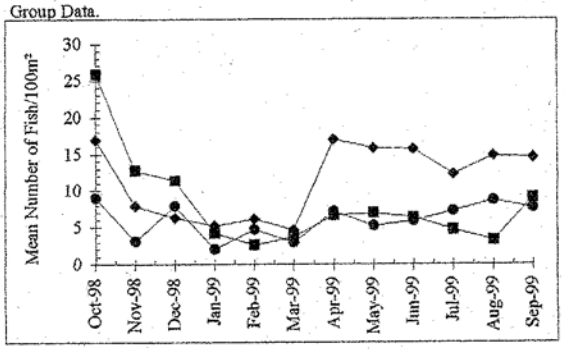
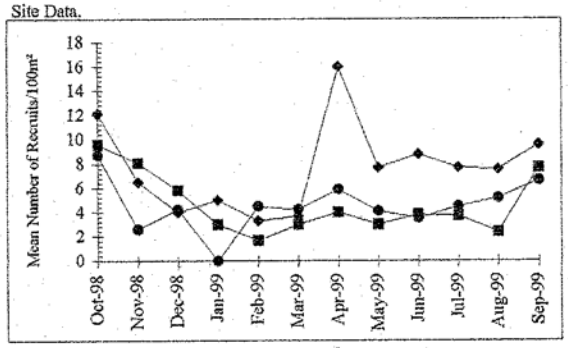


Figure 9b. Mean Monthly *Halichoeres bivittatus* Recruit (<5 cm TL) Densities for Northeast St. Croix Embayments Based on Pooled Transect Site Data.



Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 10a. Mean Monthly *Sparisoma radians* Densities for Northeast St. Croix Embayments Based on Pooled Transect Site and Size Group Data.

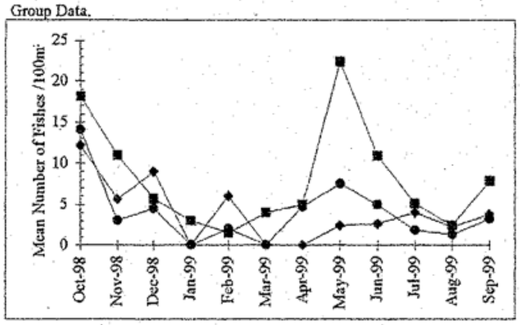


Figure 10b. Mean Monthly *Sparisoma radians* Recruit (<5 cm TL) Densities for Northeast St. Croix Embayments Based on Pooled Transect Site Data.

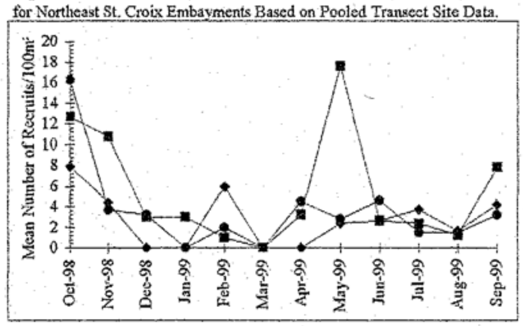


Figure 11a. Mean Monthly *Ocyurus chrysurus* Densities for Northeast St. Croix Embayments Based on Pooled Transect Site and Size Group Data.

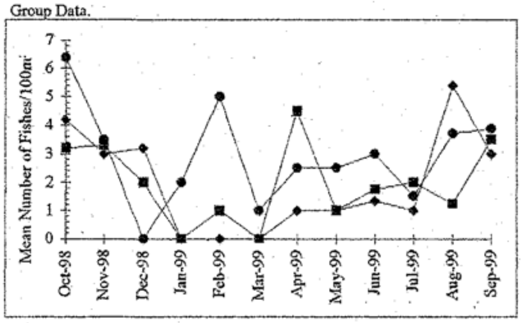
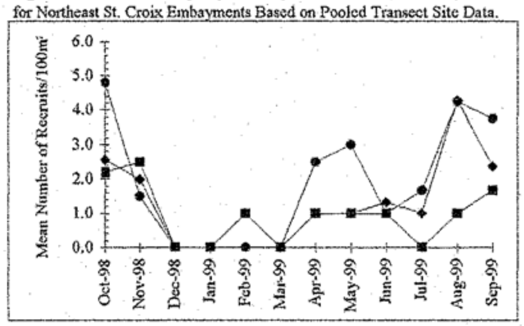


Figure 11b. Mean Monthly *Ocyurus chrysurus* Recruit (<5cm TL) Densities for Northeast St. Croix Embayments Based on Pooled Transect Site Data.



Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 12a. Mean Number of Fish Caught Per Trap-Day in Northeastern St. Croix Embayments by Month (Pooled Trap-day Data).

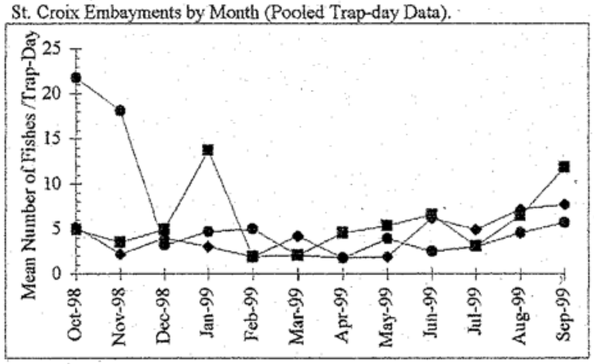
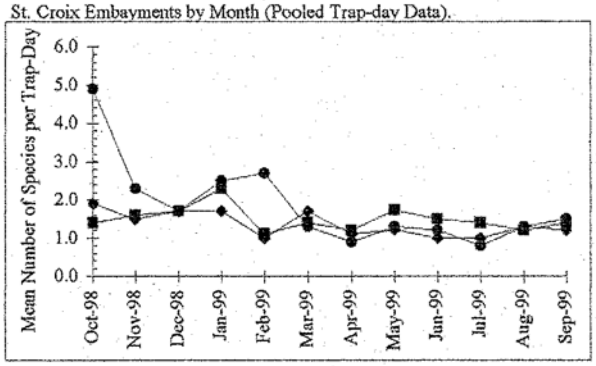


Figure 12b. Mean Number of Species Caught Per Trap-day in Northeast St. Croix Embayments by Month (Pooled Trap-day Data).



Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 13a. Monthly Mean Number of *Haemulon flavolineatum* Caught Per Trap-Day for Northeast St. Croix Embayments Based on Pooled Trap-day Data.

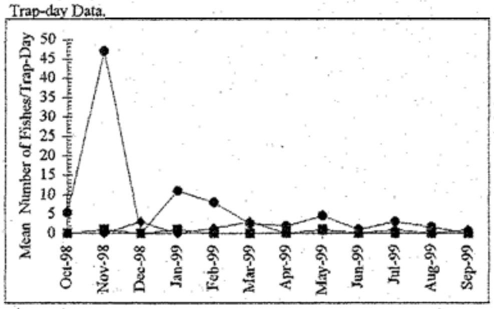


Figure 13b. Monthly Mean Number of *Sparisoma radians* Caught Per Trap-Day for Northeast St. Croix Embayments Based on Pooled Trap-day Data.

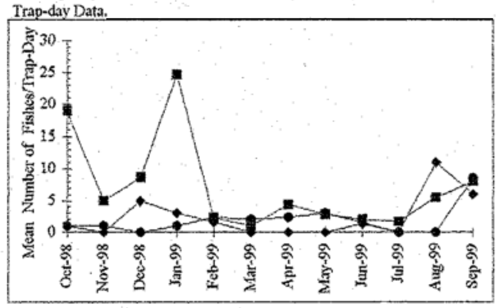


Figure 13c. Monthly Mean Number of *Pseudupeneus maculatus* Caught Per Trap-Day for Northeast St. Croix Embayments Based on Pooled Trap-day Data.

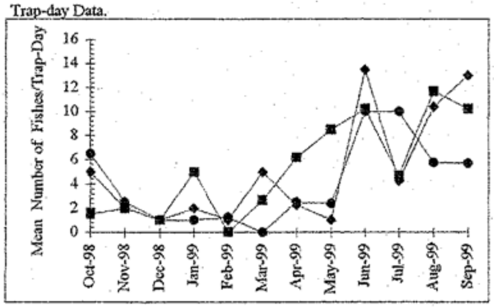
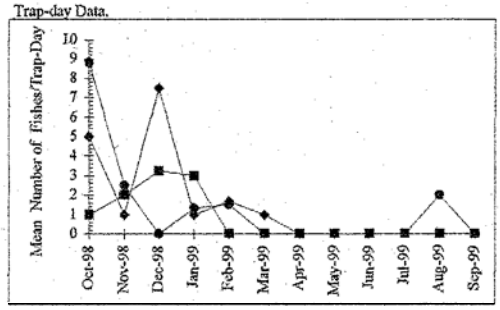
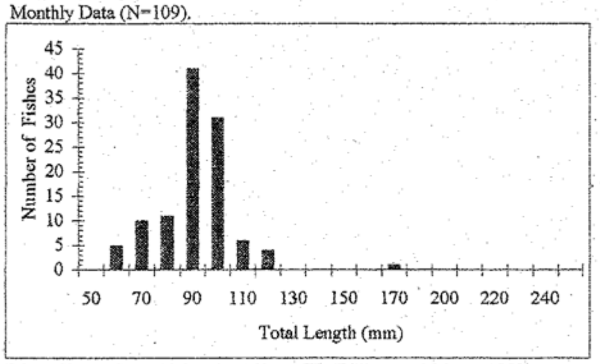


Figure 13d. Mean Number of *Ocyurus chrysurus* Caught Per Trap-Day for Northeast St. Croix Embayments Based on Pooled Trap-day Data.



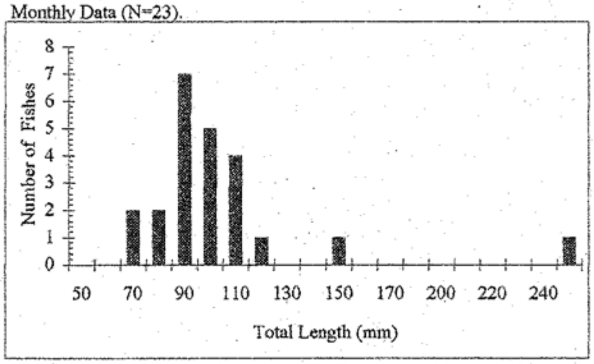
Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 14a. Length Frequency Distribution of *Haemulon flavolineatum* Caught by Traps in Cottongarden Bay Based on Pooled Trap-day and Monthly Data (N=109).



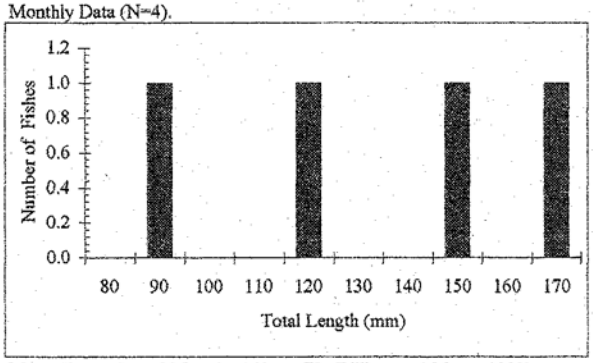
Mean Size at Sexual Maturity 160mm TL (Billings and Munro 1983)

Figure 14b. Length Frequency Distribution of *Haemulon flavolineatum* Caught by Traps in Teague Bay Based on Pooled Trap-day and Monthly Data (N=23).



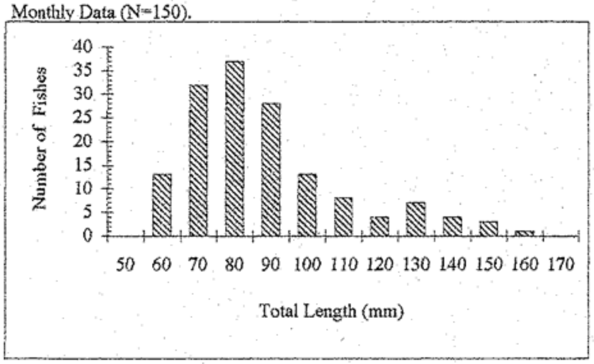
Mean Size at Sexual Maturity 160mm TL (Billings and Munro 1983)

Figure 14c. Length Frequency Distribution of *Haemulon flavolineatum* Caught by Traps in Yellowcliff Bay Based on Pooled Trap-day and Monthly Data (N=4).



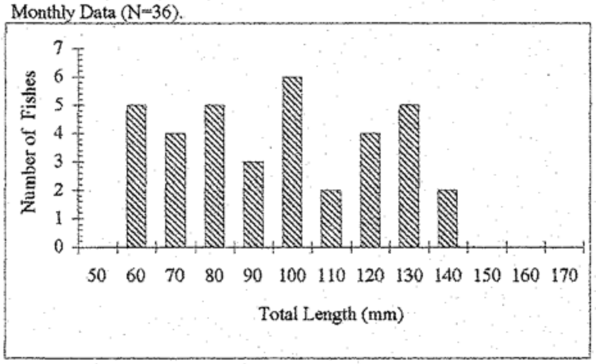
Mean Size at Sexual Maturity 160mm TL (Billings and Munro 1983)

Figure 15a. Length Frequency Distribution of *Sparisoma radians* Caught by Traps in Cottongarden Bay Based on Pooled Trap-day and Monthly Data (N=150).



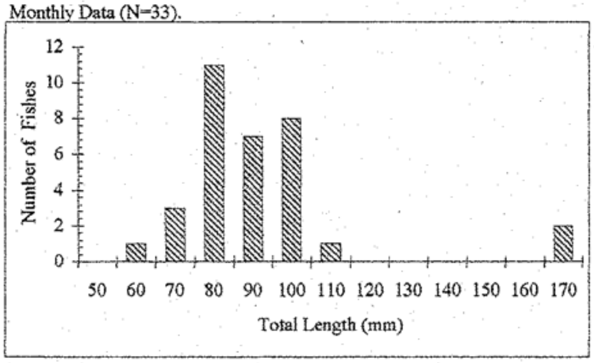
Mean Size at Sexual Maturity = No Information Available

Figure 15b. Length Frequency Distribution of *Sparisoma radians* Caught by Traps in Teague Bay Based on Pooled Trap-day and Monthly Data (N=36).



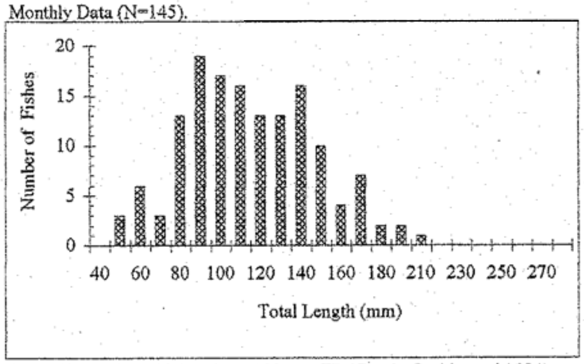
Mean Size at Sexual Maturity = No Information Available

Figure 15c. Length Frequency Distribution of *Sparisoma radians* Caught by Traps in Yellowcliff Bay Based on Pooled Trap-day and Monthly Data (N=33).



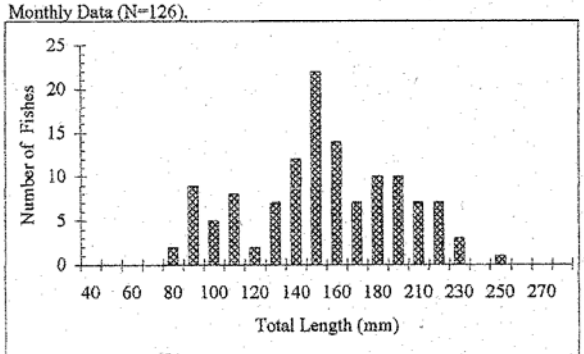
Mean Size at Sexual Maturity = No Information Available

Figure 16a. Length Frequency Distribution of *Pseudupeneus maculatus* Caught by Traps in Cottongarden Bay Based on Pooled Trap-day and Monthly Data (N=145).



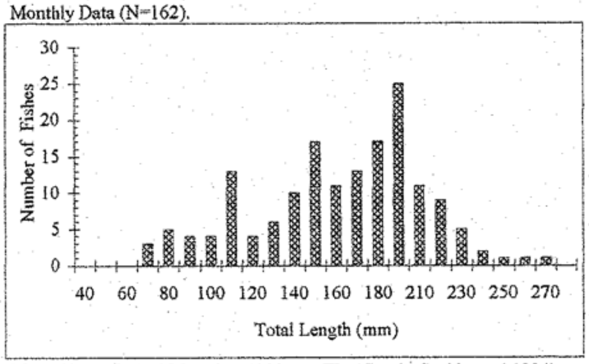
Mean Size at Sexual Maturity = 180 mm TL (García-Cagide et al 1994)

Figure 16b. Length Frequency Distribution of *Pseudupeneus maculatus* Caught by Traps in Teague Bay Based on Pooled Trap-day and Monthly Data (N=126).



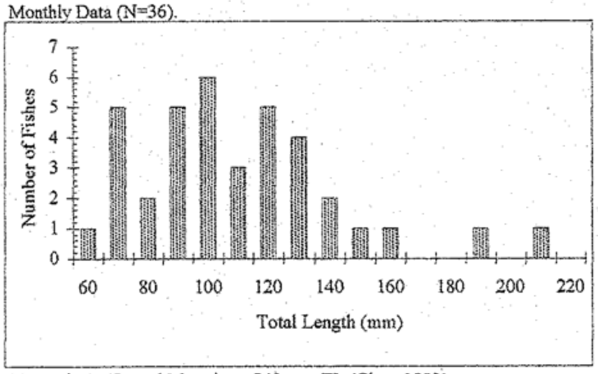
Mean Size at Sexual Maturity = 180 mm TL (García-Cagide et al 1994)

Figure 16c. Length Frequency Distribution of *Pseudupeneus maculatus* Caught by Traps in Yellowcliff Bay Based on Pooled Trap-day and Monthly Data (N=162).



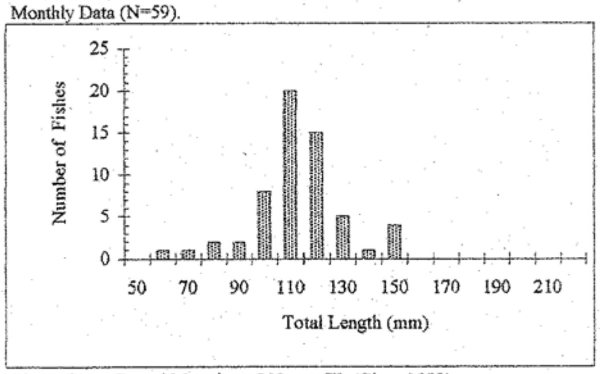
Mean Size at Sexual Maturity = 180 mm TL (García-Cagide et al 1994)

Figure 17a. Length Frequency Distribution of *Ocyurus chrysurus* Caught by Traps in Cottongarden Bay Based on Pooled Trap-day and Monthly Data (N=36).



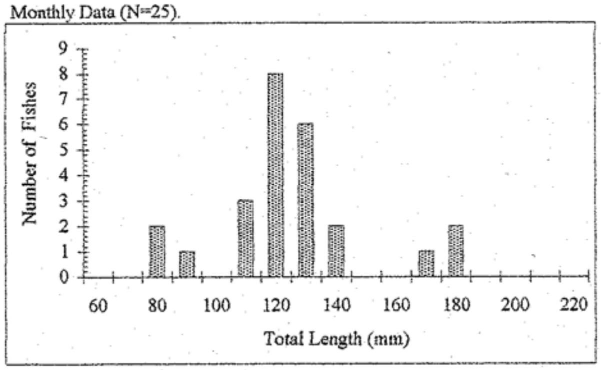
Mean Size at Sexual Maturity = 240 mm TL (Claro 1983)

Figure 17b. Length Frequency Distribution of *Ocyurus chrysurus* Caught by Traps in Teague Bay Based on Pooled Trap-day and Monthly Data (N=59).



Mean Size at Sexual Maturity = 240 mm TL (Claro 1983)

Figure 17c. Length Frequency Distribution of *Ocyurus chrysurus* Caught by Traps in Yellowcliff Bay Based on Pooled Trap-day and Monthly Data (N=25).



Mean Size at Sexual Maturity = 240 mm TL (Claro 1983)

Figure 18a. Mean Monthly Number of Fish Caught Per Seine-Haul for Northeast St. Croix Embayments Based on Pooled Seine-Haul Data.

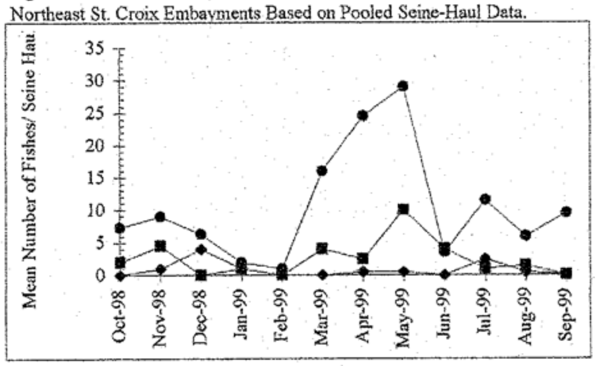
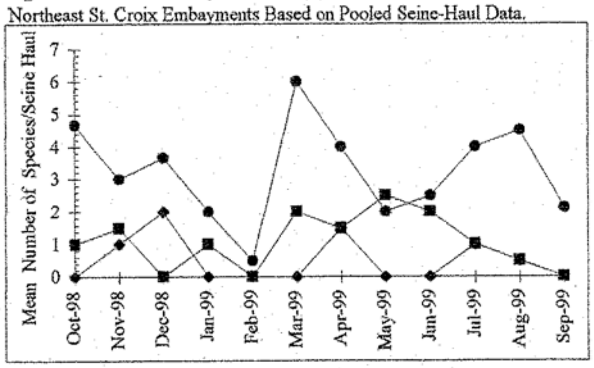


Figure 18b. Mean Monthly Number of Species Caught Per Seine-Hauls for Northeast St. Croix Embayments Based on Pooled Seine-Haul Data.



Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 19a. Monthly Mean Number of *Caranx latus* Caught per Seine Net-Haul for Northeast St. Croix Embayments Based on Pooled Seine Net-Haul Data.

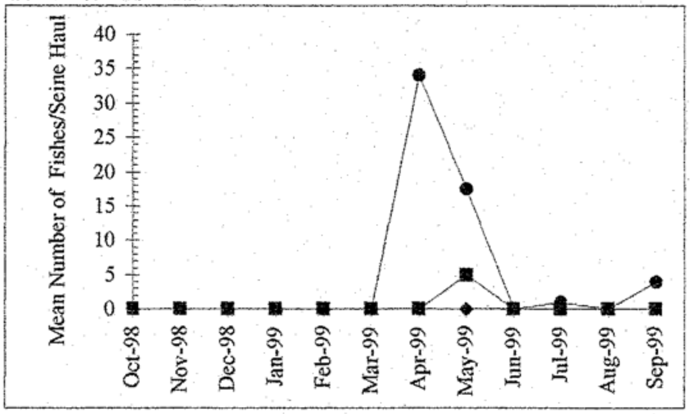


Figure 19b. Monthly Mean Number of *Eucinostomus jonesi* Caught per Seine Net-Haul for Northeast St. Croix Embayments Based on Pooled Seine Net-Haul Data.

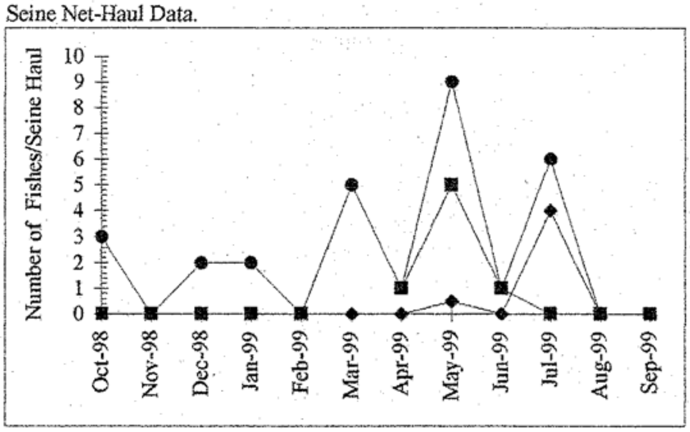
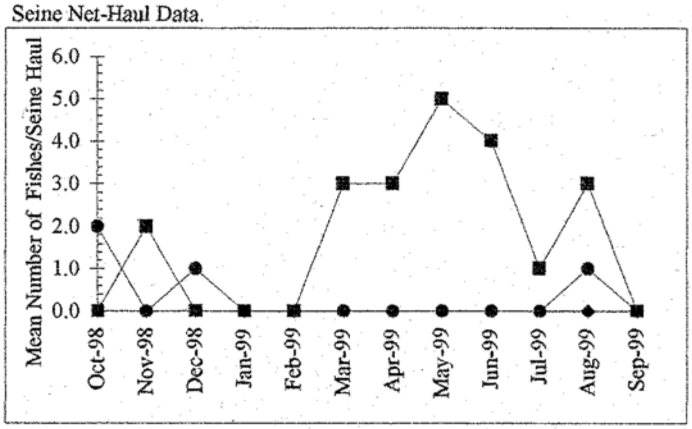
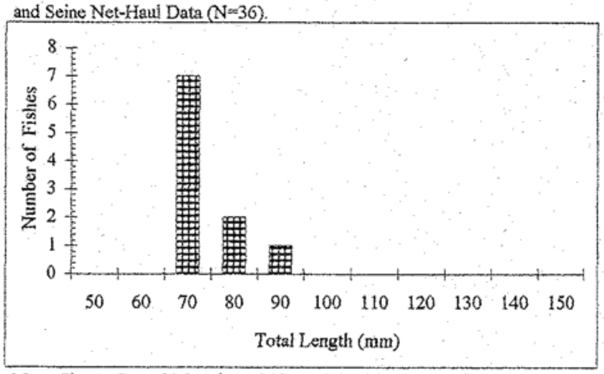


Figure 19c. Monthly Mean Number of *Trachinotus falcatus* Caught per Seine Net-Haul for Northeast St. Croix Embayments Based on Pooled Seine Net-Haul Data.



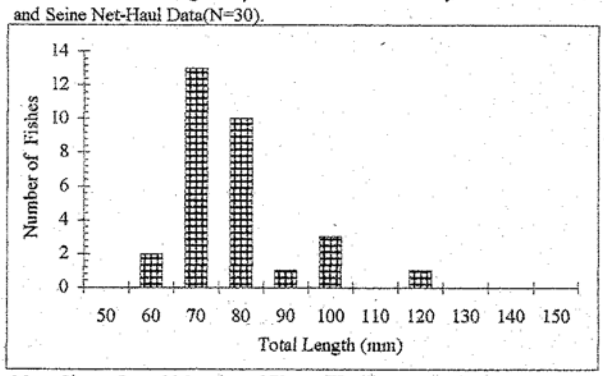
Legend: ■Cottongarden Bay ●Teague Bay ◆Yellowcliff Bay

Figure 20a. Length Frequency Distribution of *Caranx latus* Caught by Seine Net-Hauls in Cottongarden Bay Based on Pooled Monthly and Seine Net-Haul Data (N=36).



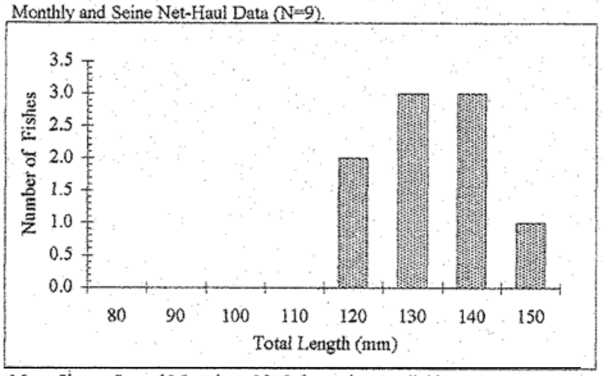
Mean Size at Sexual Maturity = 370 mm TL (Thomson and Munro 1974)

Figure 20b. Length Frequency Distribution of *Caranx latus* Caught by Seine Net-Hauls in Teague Bay Based on Pooled Monthly and Seine Net-Haul Data(N=30).



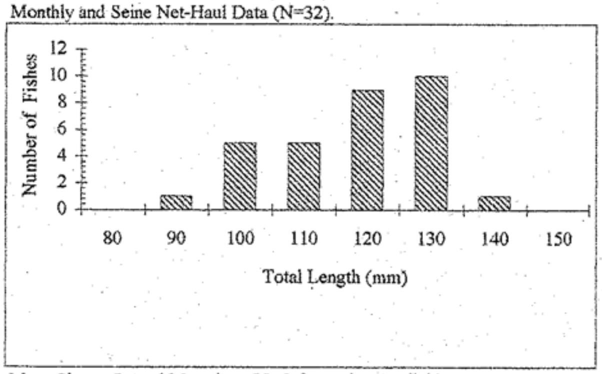
Mean Size at Sexual Maturity = 370 mm TL (Thomson and Munro 1974)

Figure 20c. Length Frequency Distribution of *Eucinostomus jonensi* Caught by Seine Net-Hauls in Cottongarden Bay Based on Pooled Monthly and Seine Net-Haul Data (N=9).



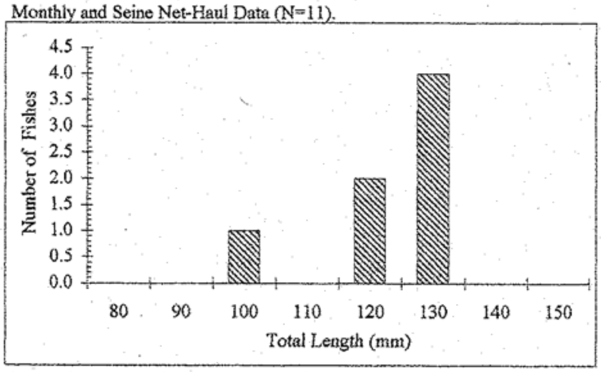
Mean Size at Sexual Maturity = No Information Available

Figure 20d. Length Frequency Distribution of *Eucinostomus jonensi* Caught by Seine Net-Hauls in Teague Bay Based on Pooled Monthly and Seine Net-Haul Data (N=32).



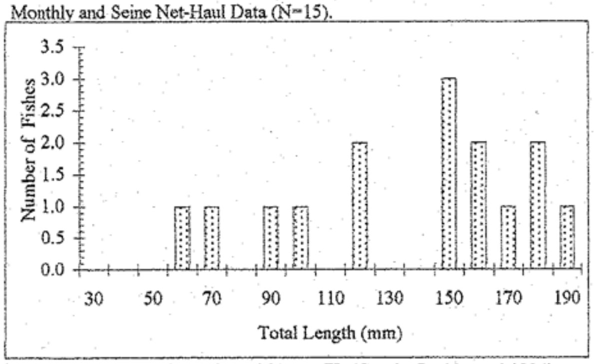
Mean Size at Sexual Maturity = No Information Available

Figure 20e. Length Frequency Distribution of *Eucinostomus jonensi* Caught by Seine Net-Hauls in Yellowcliff Bay Based on Pooled Monthly and Seine Net-Haul Data (N=11).



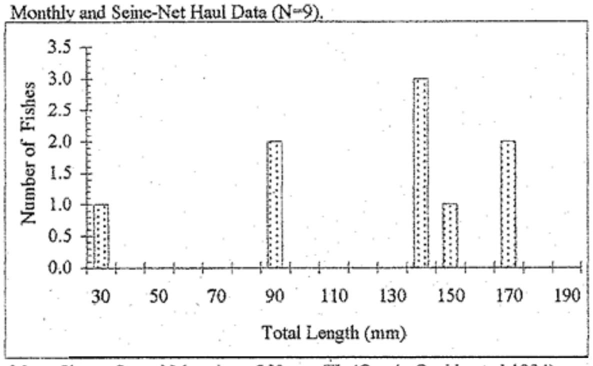
Mean Size at Sexual Maturity = No Information Available

Figure 20f. Length Frequency Distribution of *Trachinotus falcatus* Caught by Seine Net-Hauls in Cottongarden Bay Based on Pooled Monthly and Seine Net-Haul Data (N=15).



Mean Size at Sexual Maturity = 250 mm TL (García-Cagide et al 1994) Cited in FishBase Ver.1.2 (1995)

Figure 20g. Length Frequency Distribution of *Trachinotus falcatus* Caught by Seine Net-Hauls in Teague Bay Based on Pooled Monthly and Seine-Net Haul Data (N=9).



Mean Size at Sexual Maturity = 250 mm TL (García-Cagide et al 1994)

Figure 21. Substrate Percentage Composition for Southeast St. Croix Embayments Based on Pooled Month and Transect Site Data (Total Area of Each Bay Covered on Transects = 6,000m^2).

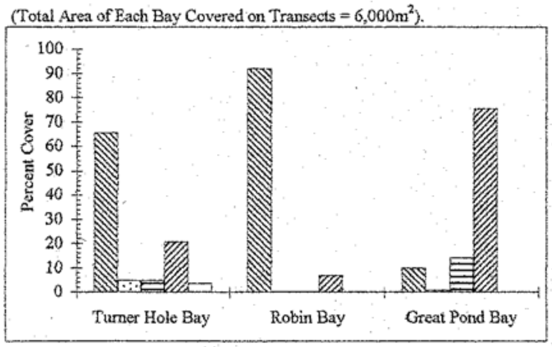


Figure 22a. Mean Fish Densities by Habitat for Each Southeast St. Croix Embayment Based on Pooled Monthly and Transect Site Data.

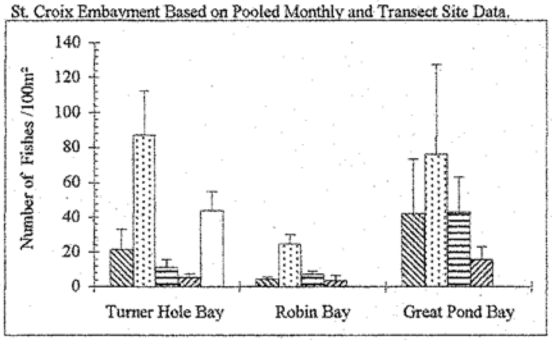


Figure 22b. Mean Species Density by Habitat for Each Southeast St. Croix Embayment Based on Pooled Monthly and Transect Site Data.

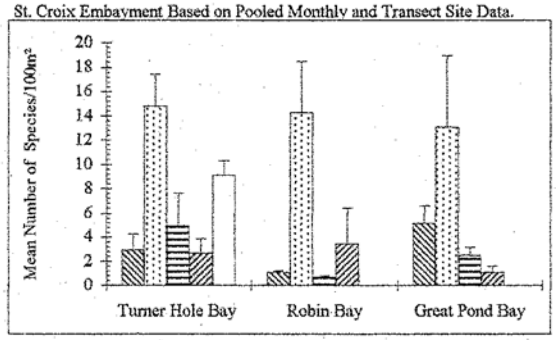


Figure 23a. Shannon Wiener Diversity Indexes (H') by Habitat for Each Southeast St. Croix Embayment Based on Pooled Monthly and Transect Site Data.

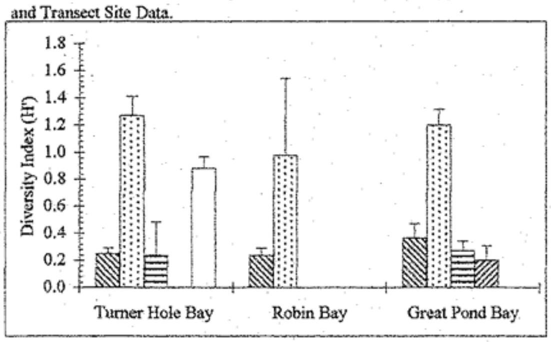
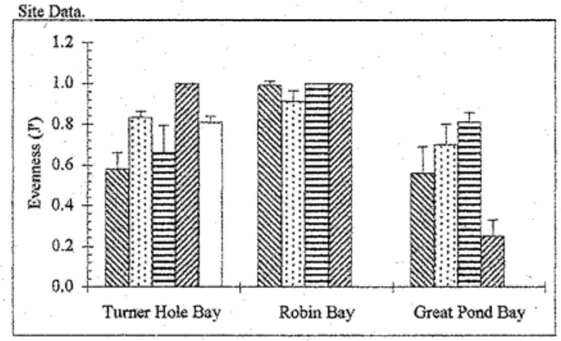


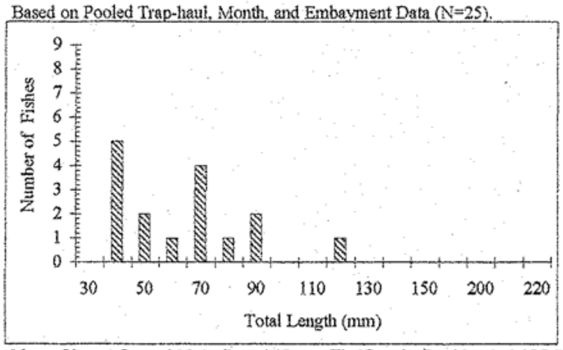
Figure 23b. Evenness Index (J') by Habitat for Each Southeast St. Croix Embayment Based on Pooled Monthly and Transect Site Data.



Legend:

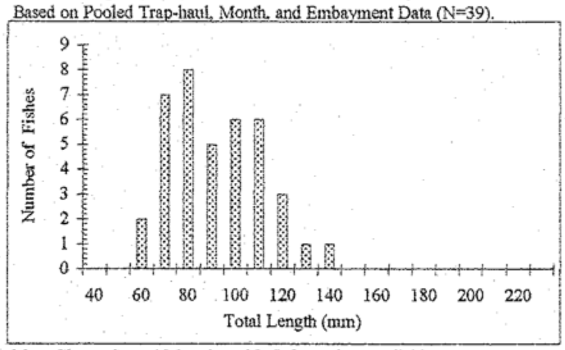
Seagrass, Patch Reef, Algal Plain, Sand, Rubble

Figure 24a. Length Frequency Distribution of *Acanthurus chirurgus* Caugth by Traps in Southeast St. Croix Embayments Based on Pooled Trap-haul, Month, and Embayment Data (N=25).



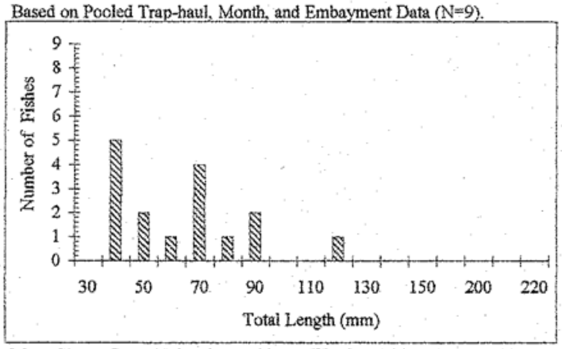
Mean Size at Sexual Maturity = 140 mm TL (García-Cagide et al 1994)

Figure 24b. Length Frequency Distribution of *Sparisoma radians* Caugth by Traps in Southeast St. Croix Embayments Based on Pooled Trap-haul, Month, and Embayment Data (N=39).



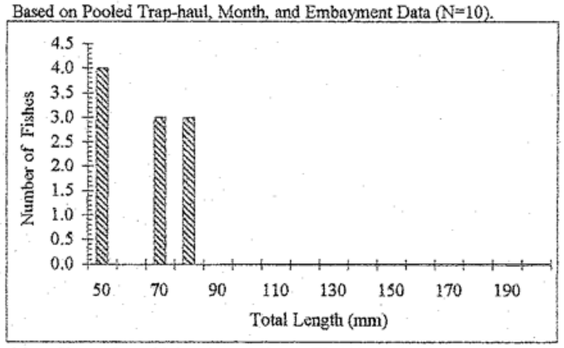
Mean Size at Sexual Maturity = No Information Available

Figure 24c. Length Frequency Distribution of *Pseudupeneus maculatus* Caugth by Traps in Southeast St. Croix Embayments Based on Pooled Trap-haul, Month, and Embayment Data (N=9).



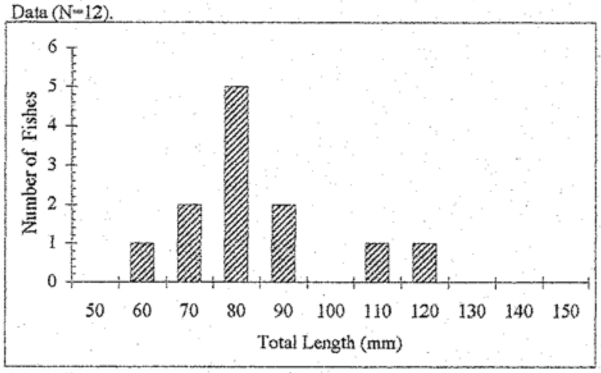
Mean Size at Sexual Maturity = 180 mm TL (García-Cagide et al 1994)

Figure 24d. Length Frequency Distribution of *Ocyurus chrysurus* Caugth by Traps in Southeast St. Croix Embayments Based on Pooled Trap-haul, Month, and Embayment Data (N=10).



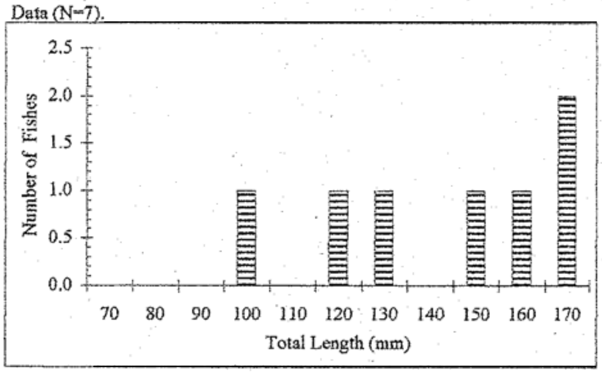
Mean Size at Sexual Maturity = 240 mm TL (Claro 1983)

Figure 25a. Length Frequency Distribution of *Trachinotus falcatus* Caught by Seine Net-Hauls in Southeast St. Croix Embayments Based on Pooled Seine-haul, Month, and Embayment Data (N=12).



Mean Size at Sexual Maturity = 250 mm TL (Garcia et al 1994)

Figure 25b. Length Frequency Distribution of *Lutjanus apodus* Caught by Seine Net-Hauls in Southeast St. Croix Embayments Based on Pooled Seine-haul, Month and Embayment Data (N=7).



Mean Size at Sexual Maturity = 250 mm TL (Thomson and Munro 1983)

APPENDIX A
Definition of Embayment Habitat Types

Habitat Type	Definition of Each Habitat (after Adams and Ebersole, In Press)
Patch Reef	Isolated, high calcareous structure (not part of the contiguous reef) with a vertical profile that often, but not always contains live coral cover. The most important characteristic is vertical relief
Rubble	Low-relief calcareous structure composed primarily of dead/dying coral fragments that are not attached to the substrate. Rubble habitat may occur over extended areas or as isolated fragments within seagrass, sand, or algal plain habitats
Seagrass	Monospecific or nearly monospecific, stands of *Thalassia testudinum,* with varying densities *of Syringodium filiforme* mixed in.
Sand	Areas of open sand with no or very little (<10% cover) plants or coralline material represented.
Algal Plain	Sand bottom dominated *by Dictyota spp., Halimeda spp., Penicillus spp., Acanthophora spp.,* and *Udotea spp.,* which may include sparse stands of *S. filiforme* and *T. testudinum.*

Appendix B

Summary of Normality Test, One-way ANOVA, and Multiple Comparison Test Results for the Northeast Coast of St. Croix, USVI

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG
CP=Cottongarden Bay, TB=Teague Bay, YB=Yellowcliff Bay

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Kruskall-Wallis One Way ANOVA (*2)	Dunn's Multiple Comparison Test
1	Fish density between embayments (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
2	Number of species density between embayments (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
3	Diversity index between embayments (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
4	Evenness index between embayments (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
5	Fish density between habitats (visual census)	Failed	Significant differences ($p<0.05$)	Significant differences ($p<0.05$) in fish density, PR>AP, PR>S, R>AP, R>S
6	Number of species density between habitats (visual census)	Failed	Significant differences ($p<0.05$)	Significant differences ($p<0.05$) in number of species density, PR>AP, PR>S, R>AP, R>S
7	Diversity index between habitats (visual census)	Failed	Significant differences ($p<0.05$)	Significant differences ($p<0.05$) in diversity index, PR>AP, PR>S, PR>SG, PR>R
8	Evenness index between habitats (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
9	*O. chrysurus* densities between embayments (visual census)	Failed	Not significant ($p>0.05$)	Not applicable
10	*S. radians* densities between embayments (visual census)	Failed	Significant differences ($p<0.05$)	Significant differences ($p<0.05$) in fish density, CP>TB, CP>YC

Appendix B (continued)

Summary of Normality Test, One-way ANOVA, and Multiple Comparison Test Results for the Northeast Coast of St. Croix, USVI

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG
CP=Cottongarden Bay, TB=Teague Bay, YB=Yellowcliff Bay.

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Kruskall-Wallis One Way ANOVA (*2)	Dunn's Multiple Comparison Test
11	*Haemulon* unk. densities between embayments (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in fish density, YB>CP, TB>CP
12	*H. bivittatus* densities between embayments (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.5) in fish density, YB>CP
13	Number of fish caught per trap-day between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
14	Number of species caught per trap-day between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
15	*H. flavolineatum catch* rates between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
16	*O. chrysurus* catch rates between embayments (fish trap)	Failed	Not significant (p>0.05)	(Not applicable
17	*P. maculatus* catch rates between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
18	*S. radians* catch rates between embayments (fish trap)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in catch rates, CP>TB
19	Number of fish caught per haul between embayments (seine-haul)	Failed	Significant a differences	Significant differences (p<0.05) in number of fish caught per haul, TB>CP, TB>YB
20	Number of species caught per haul between embayments (seine-haul)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in number of species per haul, TB>CP, TB>YB

Appendix B (continued)
Summary of Normality Test, One-way ANOVA, and Multiple Comparison Test
Results for the Northeast Coast of St. Croix, USVI

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Kruskall-Wallis One Way ANOVA (*2)	Dunn's Multiple Comparison Test
21	*C. latus* catch rates between embayrnents (seine-haul)	Failed	Not significant ($p>0.05$)	Not applicable
22	*T. falcatus* catch rates between embayments (seine-haul)	Failed	Not significant ($p>0.05$)	Not applicable
23	*E. jonesi* catch rates between embayments (seine-haul)	Failed	Not significant ($P>0.05$)	Not applicable

CP=Cottongarden Bay. TB=Teague Bav YR=Yellowcliff Bav
Notes:
1. Data must fail normality test in order to apply ANOVA on Ranks.
2. ANOVA results must be significant in order to apply Dunn's Multiple Comparison Test.

Appendix C.

Summary of Normality Test, Two way ANOVA, and Multiple Comparison Test
Results for the Northeast Coast of St. Croix, USVI.

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG
CP=Cottongarden Bay, TB=Teague Bay, YB=Yellowcliff Bay.

No.	Comparison	Kolmogorov -Smirnov Normality Test (*1)	Two way ANOVA on Ranks (*2)	Dunn's Multiple Comparison Test
	Fish densities by Habitat and by Size Class	Failed	Significant differences (p<0.05) by treatment and between treatments	1. Significant differences (p<0.05) in fish density, PR>S, PR>SG, PR>AL, PR>R. 2. <5 cm TL fish density significantly higher (p<0.05) than all other size class densities (pooled habitats)
2	Fish densities by habitat for <5 cm TL fish			Significant differences (p<0.05) in fish density, PR>S, PR>SG;
3	Fish densities by habitat for 5-10 cm TL fish			Significant differences (p<0.05) in fish density in PR>AP, PR>S, PR>R, PR>SG
4	Fish densities by habitat for >10 cm TL fish			Significant differences (p<0.05) in fish density in PR>AP, PR>S, PR>R, PR>SG
5	Fish densities by size class for seagrass habitat			<5 cm TL fish density significantly higher (p<0.05) than densities of all other fish size classes in seagrass
6	Fish densities by size classes for patch reef habitat			<5 cm TL and 5-10 cm TL fish densities significantly higher (p<0.05) than >10cm TL fish density in patch reefs
7	Fish densities by size classes for algal plain habitat			<5 cm TL fish density significantly higher (p<0.05) than all other size classes in algal plains
8	Fish densities by size class for rubble habitat			<5 cm TL fish density significantly higher (p<0.05) than all of the size classes in rubble habitat

Appendix C (continued).

Summary of Normality Test, Two way ANovA, and Multiple Comparison Test
Results for the Northeast Coast of St. Croix. USVI.

Patch reef=PR, algal plain=A.P, sand=S, R=rubble, seagrass=SG
CP=Cottongarden Bay, TB=Teague Bay, YB=Yellowcliff Bay.

No.	Comparison	Kolmogorov -Smirnov Normality Test (*1)	Two way ANOVA on Ranks (*2)	Dunn's Multiple Comparison Test
9	Fish densities by size class for sand habitat			Not significant (p>0.05)
10	Fish densities by embayment and by size class	Failed	No significant differences (p>0.05) by treatments or between treatments	Not applicable
11	Fish densities by embayment for <5cm TL fish			Not significant (p>0.05)
12	Fish densities by embayment for 5-10 cm TL fish			Not significant (p>0.05)
13	Fish densities by embayment for >10 cm TL fish			Not significant (p>0.05)
14	Fish densities by size classes for Cottongarden Bay			Not significant (p>0.05)]
15	Fish densities by size classes for Teague Bay			Not significant (p>0.05)
16	Fish densities by size classes for Yellowcliff Bay			Not significant (p>0.05)

Notes:

1. Data must fail normality test in order to apply ANOVA on Ranks.
2. ANOVA results must be significant in order to apply Dunn's Multiple Comparison Test.

Appendix D.

Summary of Normality Test, One-way ANOVA, AND MULTIPLE COMPARISON TEST
Results for the Southeast Coast of St. Croix USVI.

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG
Turner Hole=TH, Robin Bay=RB, Great Pond Bay=GP.

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Kruskall-Wallis One Way *ANOVA* (*2)	Dunn's Multiple Comparison Test
1	Fish density between embayments (visual census) 1	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in fish density, TH>RB, TH>GP
2	Number of species density between embayments (visual census)	I Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in number of species density, TH>RB, TH>GP
3	Diversity index between embayments (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in diversity index, TH>RB, TH>GP
4	Evenness index between embayments (visual	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in evenness index, GP>TH, GP>RB
5	Fish density between habitats (visual census)	Failed	Significant differences (p<0.05)	Significant differences {p<0.05) in fish density, PR>SG, PR>S, AP>SG, AP >S
6	Number of species density between habitats (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in number of species density, PR>SG, PR>S, R>S, AP>S
7	Diversity index between habitats (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in diversity index,
8	Evenness index between habitats (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in evenness index, SG>S, AP>S
9	*Haemulon unk.* densities between embayments (visual census)	Failed	Not significant (p>0.05)	Not applicable

Appendix D (continued).
Summary of Normality Test, One-way ANOVA, AND MULTIPLE COMPARISON TEST
Results for the Southeast Coast of St. Croix, USVI.

Patch reef=PR, algal plain=AP, sand=S, R.=rubble, seagrass=SG Turner Hole=TH, Robin Bay=RB, Great Pond Bay=GP.

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Kruskall-Wallis One Way ANOVA (*2)	Dunn's Multiple Comparison Test
10	*S. radians* densities between embayments (visual census)	Failed	Not significant (p>0.05)	Not applicable
11	*T. bifasciatum* densities between embayments (visual census)	Failed	Not significant (p>0.05)	Not applicable
12	*H. bivittatus* densities between embayments (visual census)	Failed	Significant differences (p<0.05)	Significant differences (p<0.05) in fish density, TH>RB
13	Number of fish caught per trap-day between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
14	Number of species caught per trap-day between embayments (fish trap)	Failed	Not significant (p>0.05)	Not applicable
15	Number of fish caught per haul (seine-haul)	Failed	Not significant (p>0.05)	Not applicable
16	Number of species caught per haul between embayments (seine-haul)	Failed	Not significant (p>0.05)	Not applicable

* Notes:
1. Data must fail normality test in order to apply ANOVA on Ranks.
2. ANOVA results must be significant in order to apply Dunn's Multiple Comparison Test.

Appendix E
Summary of Normality Test, Two-way .ANOVA, and Multiple Comparison Test Results for the Southeast Coast of St. Croix, USVI.

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG Turner Hole=TH, Robin Bay=RB, Great Pond Bay=GP.

No.	**Comparison**	**Kolmogorov-Smirnov Normality Test (*1)**	**Two Way ANOVA on Ranks (*2)**	**Dunn's Multiple Comparison Test**
1	Fish densities by habitat and by size class	Failed	Significant differences ($p<0.05$) by treatment and between treatments	1. Significant differences ($p<0.05$) in fish densities, PR>R 2. <5 cm TL fish densities significantly higher ($p<0.05$) than all other size class densities (habitats pooled)
2	Fish density by habitat for <5 cm TL fish			Significant differences ($p<0.05$) in fish density, PR>S, PR>SG, AP>S, AP>SG
3	Fish density by habitat for 540 cm TL fish			Significant differences, ($p<0.05$) in fish densities, *PR>SG,* PR>S, *PR>AP*
4	Fish density by habitat for >10 cm TL fish			(Significant differences, ($p<0.05$) in fish densities, PR>S, PR>R, PR>SG
5	Fish density by size class for seagrass habitat			Not significant ($p>0.05$)
6	Fish density by size class for patch reef habitat			<5 cm TL and 5-10 cm TL fish densities significantly higher ($p<0.05$) than >10cm TL fish density in patch reefs
7	Fish densities by size classes for algal plain habitat			<5 cm TL fish density significantly higher ($p<0.05$) than all size classes in algal plains

Appendix E (continued)

Summary of Normality Test, Two-way ANOVA, and Multiple Comparison Test Results for the Southeast Coast of St. Croix, USVI.

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG Turner Hole=TH, Robin Bay=RB, Great Pond Bay=GP.

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Two Way ANOVA on Ranks (*2)	Dunn's Multiple Comparison Test
8	Fish densities by size class for rubble habitat			<5 cm TL and 5-10 cm TL fish densities significantly higher (P<0.05) than >10cm TL fish density in rubble
9	Fish densities by size classes for sand habitat			Not significant (p>0.05)
10	Fish densities by embayment and by size class	Failed	Significant differences (p<0.05) by treatment and betweens treatments	1. Significant differences (p<0.05) in fish densities, TH>RB, TH>GP 2. <5 cm TL fish density significantly higher (p<0.05) than all other size class densities (pooled embayments)
11	Fish density by embayment for <5 cm TL fish			Significant differences (p<0.05) in fish densities, TH>RB, GP>RB
12	Fish density by embayment for 5-10 cm TL fish			Significant differences (p<0.05) in fish densities, TH>RB, TH>GP
13	Fish density by embayment for >10 cm TL fish			Significant differences (p<0.05) in fish densities,
14	Fish density by size class for Turner Hole			<5 cm TL fish density significantly higher (p<0.05) than >10cm TL fish density in Turner Hole
15	Fish density by size class for Robin Bay			<5 cm TL fish density significantly higher (p<0.05) than >10cm TL fish density in Robin Bay

Appendix E (continued)
Summary of Normality Test, Two-way ANOVA, and Multiple Comparison Test
Results for the Southeast Coast of St. Croix, USVI.

Patch reef=PR, algal plain=AP, sand=S, R=rubble, seagrass=SG Turner
Hole=TH, Robin Bay=RB, Great Pond Bav=GP,

No.	Comparison	Kolmogorov-Smirnov Normality Test (*1)	Two Way ANOVA on Ranks (*2)	Dunn's Multiple Comparison Test
16	Fish densities by size classes for Great Pond			<5 cm TL and 5-10 cm IL fish densities significantly higher ($p<0.05$) than >10cm TL fish density in Great Pond Bay

* Notes:
1. Data must fail normality test in order to apply ANOVA on Ranks.
2. ANOVA results must be significant in order to apply Dunn's Multiple Comparison Test.