Variability in Reef Fishery Resources in the U.S. Virgin Islands Based on Fisheries-Independent Trap Sampling

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ABSTRACT

Three sets of fisheries-independent data using fish traps were collected in the U.S. Virgin Islands from 1988 to 1992. These data were collected using standardized fish traps (1.5 inch mesh) in three discrete areas: 1) north of St. Thomas (NORTH), 2) south of St. John (SOUTH), and 3) inshore at St. John (INSHORE).

The sampling effort north of St. Thomas represented a replication of a trap study conducted in 1975-1976. Results demonstrated a 36.3% decline in catch per unit effort in this area with a CPUE of 2.303 kg/trap in 1975-1976 and 1.466 kg/trap in 1989-1990.

Comparison of data among areas demonstrated important differences in shelf resources. Catch rates were significantly greater inshore (7.45 fish/trap) than offshore (NORTH: 4.78, SOUTH: 5.56 fish/trap.). Herbivorous fishes (surgeonfishes and parrotfishes) dominated catches inshore whereas predaceous fishes (grunts, groupers, squirrelfishes) were predominant offshore. Of the 77 species captured among sampling areas, 70 species were captured inshore with 61 and 48 species captured NORTH and SOUTH, respectively.

Differences in relative abundance of fishes in catches were noted between the northern and southern insular shelf areas. NORTH had lower catch rates and a greater proportion of groupers in catches, whereas, SOUTH had a greater proportion of squirrelfishes in catches.

An analysis of catch per trap by soak time was conducted for the three data sets. Soak times of 7-8 days yielded greatest catch per trap for INSHORE and SOUTH. NORTH demonstrated greatest catch per trap for soak time of 8 ans 11 days.

Fisheries dependent data collected in the U.S. Virgin Islands since 1982 do not provide reliable information on fisheries resources., especially for effort estimates. However, Fisheries-independent monitoring provides extremely valuable data for documenting trends in fisheries.

INTRODUCTION

Fish traps are the most common gear used in the commercial and artisanal fishery in the U.S. Virgin Islands. Numerous assessments and evaluations have demonstrated declining fishery resources in the area but unfortunatley little data on catch and effort exist to accurately substantiate declines. Fisheries-dependent monitoring has been conducted in the U.S. Virgin Islands since 1982, but the data are not reliable and effort data are meager. Fisheries-independent

monitoring using accepted methods and design were recognized as a valuable analysis and management.

Fisheries-independent monitoring of coral reef fishes in the Virgin Islands was initiated in 1988 to provide a baseline of information on the abundance, species composition and catch per unit effort (CPUE). Data from this program were needed to provide a basis for the design of a sound monitoring program.

An adequate monitoring program is needed in order to document the changes and trends in fishery resources which are caused by fishing and by natural phenomena. One of the most interesting events during this monitoring period was the effect of Hurricane Hugo, which hit the Virgin Islands on September 17 and 18, 1989. The category 5 hurricane passed directly over the island of St. Croix (56 km south of St. John) and the eastern end of Puerto Rico. Wind speeds of over 225 km/hour and storm waves of over 6 m were observed on the south side of St. Thomas and St. John.

METHODS

Site Descriptions

The sampling sites selected for trap sampling were: 1) the shelf area north of St. Thomas (NORTH), 2) the shelf area south of St. John (SOUTH), and 3) a fringing reef between Greater and Lesser Lameshur Bays on the south side of St. John (INSHORE). St. Thomas and St. John are remnants of volcanic formations which lie on an insular shelf with Puerto Rico and the British Virgin Islands. The shelf extends from the shore to ca. 25 km on the north side and ca. 11 km on the south side. The shelf edge drops precipitously from 20-50 m to abyssal depths along the southern (Caribbean) side and has a more gradual slope along the northern (Atlantic) side to the Puerto Rican trench. The shelf platform is relatively uniform ranging in depth from 20-30 m offshore from island features, although numerous banks and reefs are present on the shelf. The offshore sampling sites (NORTH and SOUTH) were open shelf areas with large offshore banks and numerous small patch reefs. The banks and reefs are usually dominated by sparse hard coral and/or gorgonian-dominated pavement. The inshore sampling area (INSHORE) was a weel-developed fringing reef with a high percentage of live coral, dominated by *Montastrea annularis*.

Sampling Methods

Fisheries-independent monitoring was initiated in 1988 to obtain information on species composition, abundance and catch per unit effort (CPUE) at various areas across the insular shelf. These data were used to develop the sampling design used for sustained fisheries-independent monitoring used in the SEAMAP-Caribbean Program.

Trap sampling in the three areas was conducted using the same trap design. Trap design was the Antillean arro-head design. Trap dimension was ca. 1.0 x

1.0 x 0.5 m. Traps were constructed of hexagonal wire mesh with mesh size of 38.1 mm (1.5 inches).

The number of individuals by species was recorded per trap. Individuals were measured for total length (TL) mm and for weight to the nearest g. Traps which were opened or lost during the sampling period were excluded from analysis.

Trap sampling was conducted from February 1988 to June 1989 at the NORTH site in the area used for a previous study (Olsen and LaPlace, 1981). Ten to twelve traps were hauled repeatedly at varied soak times from 2 to 18 days.

Sampling at the SOUTH site was conducted from August 1989 to June 1990. Six traps were haules weekly at pre-selected quadrants within a grid.

An average of six fish traps were hauled weekly at the INSHORE site from May 1989 through June 1992. Trap sets targeted the halo zone next to the reef between 12-20 m in order to standardize sampling and to avoid damage to coral structure. Since samples at the INSHORE site were taken within the Virgin Islands National Park, fishes were released after length measurements were taken and usually released without harm. Individual weights were estimated using length-weight relationships given in Bohnsack and Harper (1988).

On several dates, captured fishes at the INSHORE site were tagged with FLOY tags and released. Data were recorded on recaptures in order to calculate proportion of total fish recaptured and to attempt to obtain growth rates. However, due to small sample size and other assumption restrictions (*e.g.* open system, movement of fishes, etc.), estimations of assemblage size (or species abundance) within the area was not appropriate.

Data Analysis

Data were analyzed using dBase III+, Quattro Pro. Paradox, Reflex, and Systat on microcomputers. Non-parametric tests (Mann-Whitney U tests) were employed for statistical analyses. Several size classes of fishes were used in analysis. Arbitrary classes of fishes are presented in order to demonstrate differences between small-sized species and small juveniles of larger-sized species (<10 cm) and larger fishes (>10 cm).

The passage of Hurricane Hugo in September 1989 had a profound effect on inshore habitats. Data from the INSHORE site were analyzed to assess hurricane effects.

RESULTS

A total of 77 species were captured from the three sites during the sampling period. The NORTH site, 61 species and 2897 individuals were captured in 509 trap hauls. Overall CPUE in the area was 4.79 fish/trap. Honeycomb

Table 1. Species trapped during studies. Data include number trapped (NUM), proportion of total observed (PROP), frequency of occurrence (FREQ), and average length in mm TL (AVLEN).

Genus species	NORTH				SOUTH				INSHORE			
	NUM	PROP	FREQ	AVLEN	NUM	PROP	FREQ	AVLEN	NUM	PROP	FREQ	AVLEN
Acanthurus bahianus	29	0.0107	0.031	206.8	69	0.0605	0.09	172.7	580	0.145	0.259	164.8
Acanthurus chirugus	87	0.0245	0.087	243.4	15	0.0132	0.043	232.7	112	0.0277	0.109	167.9
Acanthurus coeruleus	154	0.0571	0.159	210	84	0.0737	0.181	190.1	870	0.2152	0.361	160
Aluterus scriptus	1	0.0004	0.002	379	16	0.0132	0.057	340	3	0.0007	0.004	103.3
Arisotremus virginicus	4	0.0015	0.008	257.5								
Balistes vetula	207	0.0787	0.212	381.8	55	0.0482	0.171	347.8	4	0.001	0.008	207.8
Bothus lunatus	1	0.0004	0.002	290					1	0.0002	0.002	215
Bodianus rufus	1	0.0004	0.002	485					4	0.001	0.008	310
Caranx bartholomaei	109	0.0404	0.09	238.1	141	0.1237	0.219	231	144	0.0356	0.089	211.5
Calamus calamus									139	0.0344	0.072	217.9
Caranx latus									1	0.0002	0.002	660
Cantherhines macroceros	1	0.0004	0.002	354					1	0.0002	0.002	135
Calamus pennatula	85	0.0315	0.02	220.8					2	0.0005	0.004	197.5
Cantherhinus pullus	2	0.0007	0.002	185	1	0.0009	0.005	170	12	0.003	0.015	139.9
Caranx ruber	7	0.0026	0.006	337.9	1	0.0009	0.005	245	10	0.0025	0.013	122.9
Calamus sp.	24	0.0059	0.008	232.3					32	0.0079	0.017	201.1
Chaetodon capistratus	1	0.0004	0.002	105					11	0.0027	0.013	116.4
Chaeticlipterus faber					3	0.0028	0.005	533.3				
Chaetodon striatus	8	0.0022	0.008	131.2					7	0.0017	0.013	122.9
Diodon holocanthus					1	0.0009	0.005		4	0.001	0.004	246.2
Diodon hystrix	1	0.0004	0.002	450					6	0.002	0.008	343.1
Epinephelus adscensionis	1	0.0004	0.002	370	1	0.0009	0.005	305	3	0.0007	0.008	415.3
Epinephelus afer									16	0.004	0.017	224.3
Epinephelus cruentatus	2	0.0007	0.004	290					12	0.003	0.017	239.9
Epinephelus fulvus	71	0.0263	0.108	249.5	40	0.0351	0.105	256.1	5	0.0012	0.009	221
Epinephelus guttatus	262	0.0971	0.348	290	50	0.0439	0.181	291	63	0.0158	0.092	258.5
Epinephelus morio	2	0.0007	0.004	402.5					2	0.0005	0.004	292.5
Epinephelus striatus	2	0.0007	0.002	495	1	0.0009	0.005	540	22	0.0054	0.038	397.5

Table 1. Continued.

Genus species	NORTH NUM	NORTH PROP	NORTH FREQ	NORTH AVLEN	SOUTH NUM	SOUTH PROP	SOUTH FREQ	SOUTH AVLEN	INSHORE NUM	INSHORE PROP	INSHORE FREQ	INSHORE AVLEN
Microspathodo chrysurus									1	0.0002	0.002	135
Mulloidichthys martinicus	64	0.0237	0.087	254	34	0.0296	0.082	270.7	26	0.0084	0.038	252.9
Mycteroperca interstitialis									10	0.0025	0.013	288.6
Mycteroperca tigris					1	0.0009	0.005	397	1	0.0002	0.002	275
Mycteroperca venenosa	1	0.0004	0.002	318	8	0.007	0.038	375	24	0.0059	0.088	411
Ocyurus chrysurus	8	0.003	0.01	329.4	1	0.0009	0.005	285	76	0.0188	0.062	235.5
Pomacanthus arcuatus	38	0.0133	0.045	234.5	7	0.0081	0.019	221.4	27	0.0087	0.042	192.2
Pomacanthus paru	22	0.0062		283.3	2	0.0018	0.005	217.5	11	0.0027	0.015	169.3
Priacanthus arenatus	2	0.0007	0.004	250					3	0.0007	0.002	225
Priacanthus cruentatus	7	0.0028	0.01	291					1	0.0002	0.002	205
Pseudopeneus maculatus	2	0.0007	0.004	237.5	3	0.0028	0.006	238.7	43	0.0108	0.043	216.6
Rhombopolites aurobens	2	0.0007	0.002	227.5								
Scaruscoeruleus	2	0.0007	0.002	321								
Scarus croicensis	1	0.0004	0.002	330	11	0.0096	0.01	219	7	0.0017	0.005	235.7
Scarus taeriopterus	1	0.0004	0.002		7	0.0061	0.03	235	50	0.0124	0.057	238.7
Scarus vetula									22	0.0054	0.028	264.1
Sparisoma aurofrenatum	10	0.0037	0.008	224.7	6	0.0058	0.019	220	385	0.0952	0.14	217
Sparisoma chrysopterum	149	0.0552	0.139	294.7	9	0.0079	0.033	268.9	108	0.0257	0.088	249.4
Sparisoma rubripinne	5	0.0019	0.008	335	2	0.0018	0.005	315	22	0.0054	0.011	237.2
Sparisoma viride	16	0.0059	0.02	317.5	17	0.0149	0.057	251.7	93	0.023	0.109	238.8
NUMBER OF FISH	2897				1140				4042			
NUMBER OF SPECIES	81				48				70			

Table 2. Continued.

GENUS SPECIES	COMMON	NUMBER	PROP	FREQ	AVLEN
Acanthurus chirurgus	doctorfish	112	0.0277	0.109	167.9
Sparisoma chrysopterum	redtail parrotfish	108	0.0267	0.083	249.4
Holocentrus rufus	longspine squirrelfish	96	0.0238	0.089	194.2
Sparisoma viride	stoplight parrotfish	93	0.023	0.109	238.8
Lactophyrs triqueter	smooth trunkfish	86	0.0213	0.111	175.6

Table 3. Comparison of rank by frequency of occurrence of 15 species among the three sampling sites. NUMBER is total number of fish trapped, PROP is proportion of total number, FREQ is frequency of occurrence and AVLEN is average length (mm TL).

GENUS SPECIES	COMMON	NUMBER	PROP	FREQ	AVLEN
NORTH SIDE					
Epinephelus guttatus	red hind	262	0.0971	0.348	290
Haemulon plumeri	white grunt	205	0.076	0.279	257.6
Balistes vetula	queen triggerfish	207	0.0767	0.212	361.6
Holocentrus rufus	longspine squirrelfish	174	0.0645	0.159	296.1
Lactophrys polygonin	honeycomb cowfish	282	0.1045	0.151	251.2
Haemulon sciurus	bluestriped grunt	125	0.0463	0.147	271.4
Acanthurus coeruleus	blue tang	154	0.0571	0.139	210
Sparisoma chrysopterum	redtail parrotfish	149	0.0552	0.139	294.7
Haemulon flavolineatum	french grunt	173	0.0641	0.108	205.3
Epinephelus fulvus	coney	71	0.0263	0.108	249.5
Holocentrus adscensionis	longjaw squirrelfish	106	0.0393	0.098	279.6
Lutjanus synagris	lane snapper	182	0.0675	0.092	241.8
Caranx bartholomaei	yellow jack	109	0.0404	0.09	235.1
Acanthurus chirurgus	doctorfish	67	0.0246	0.067	243.4
Calamus pennatula	pluma	85	0.0315	0.02	220.6
Mulloidichthys martinicus	yellow goatfish	64	0.0237	0.057	264
SOUTH SIDE					
Holocentrus rufus	longspine squirrelfish	212	0.186	0.3	252.3
Caranx bartholomaei	yellow jack	141	0.1237	0.219	231
Lactophrys polygonin	honeycomb cowfish	95	0.0833	0.195	230.4
Acanthurus coeruleus	blue tang	84	0.0737	0.181	190.1
Epinephelus guttatus	red hind	50	0.0439	0.181	291
Balistes vetula	queen triggerfish	55	0.0482	0.171	347.8
Haemulon plumeri	white grunt	67	0.0588	0.152	261.4
Epinephelus fulvus	coney	40	0.0351	0.105	258.1
Haemulon sciurus	bluestriped grunt	48	0.0421	0.105	259.1
Acanthurus bahianus	ocean surgeonfish	69	0.0605	0.09	172.7
Mulloidichthys martinicus	yellow goatfish	34	0.0298	0.062	270.7
Haemulon flavolineatum	french grunt	62	0.0544	0.062	199.7
Aluterus scriptus	scrawled filefish	15	0.0132	0.057	340

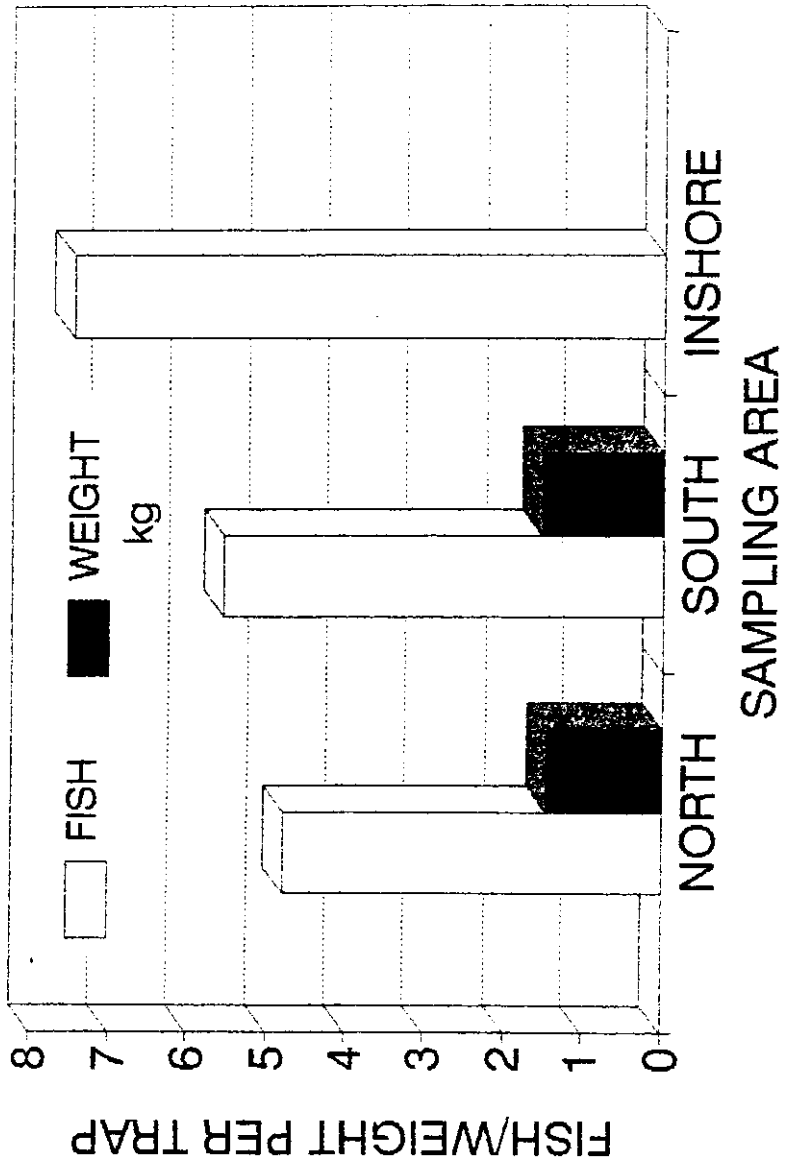

Figure 1. Catch as number of fish and as weight of fish per trap for the NORTH, SOUTH, and INSHORE sampling sites in the U.S. Virgin Islands.

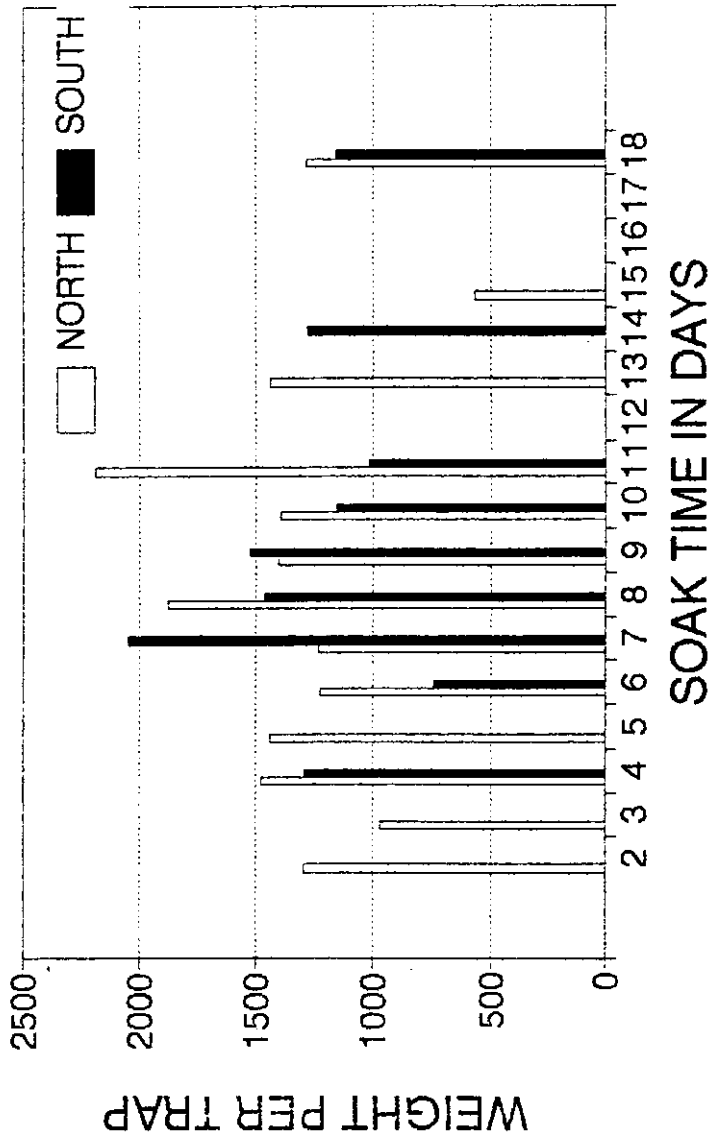

Figure 3. Variation in catch (weight of fish) per trap with soak time for the NORTH, SOUTH, and INSHORE sample sites in the U.S. Virgin Islands.

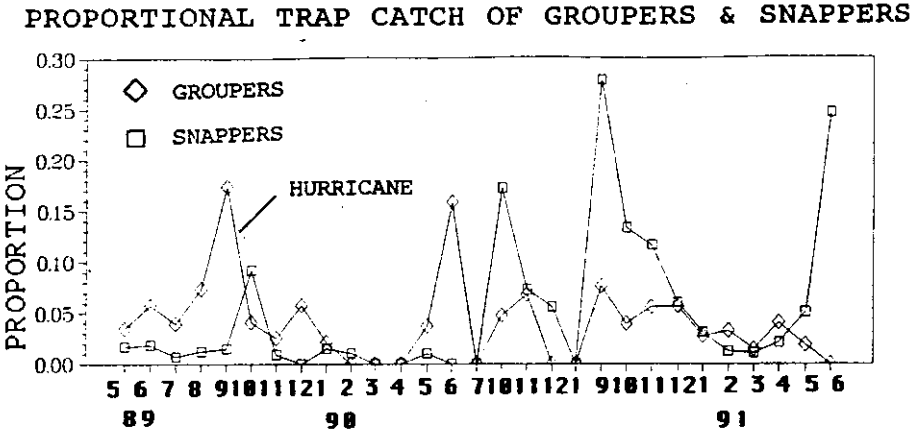

Figure 6. Variation in the proportion of groupers and snappers in trap catches at the INSHORE sampling site.

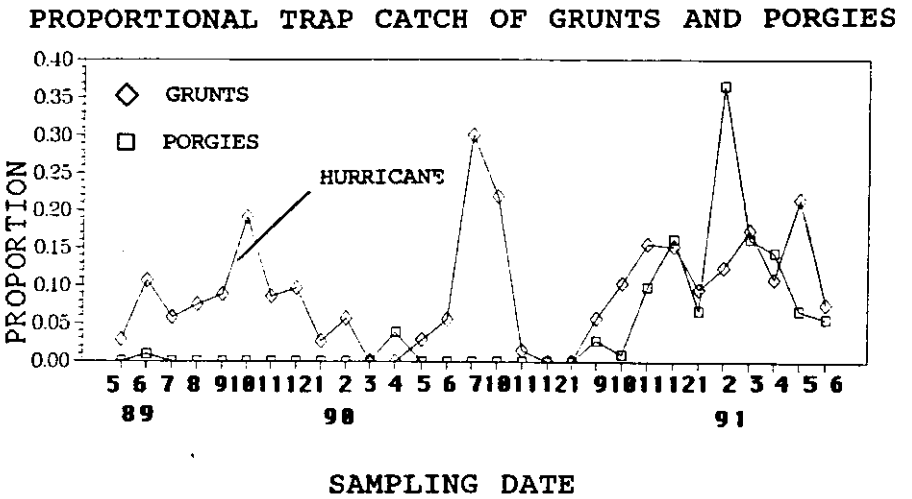

Figure 7. Variation in the proportion of grunts and porgies in trap catches at the INSHORE sampling site.

Table 4. Continued.

Species	Common Name	No. Fish Tagged	No. Fish Recaptured	Proportion Recaptured
Lactophyrs bicaudalis	spotted trunkfish	5		
Lactophyrs polygonin	honeycomb cowfish	5		
Lutjanus analis	mutton snapper	1		
Lutjanus griseus	grey snapper	5		
Lutjanus jocu	dog snapper	3		
Lutjanus mahogani	mahogani snapper	5		
Mulloidichthys martinicus	yellow goatfish	10		
Mycteroperca tigris	tiger grouper	1		
Ocyurus chrysurus	yellowtail snapper	42		
Pomacanthus paru	french angelfish	3		
Priacanthus arenatus	bigeye	3		
Pseudopeneus maculatus	spotted goatfish	25		
Sparisoma rubripinne	yellowtail parrotfish	5		
Total Number of Fish Tagged/Recaptured		1839	207	
Total Number of Species Tagged/Recaptured		59	29	

used during this study. From 1, 016 trap hauls, Olsen and LaPlace (1981) obtained a catch per unit effort of 2.303 kg/trap. During this study (1989-1990), a CPUE of 1.466 kg/trap was obtained representing a 36.3% decline in CPUE.

Results from this analysis of fisheries-independent data demonstrated profound differences among shelf areas, especially between nearshore and offshore areas. In design of monitoring projects, extreme attention must be given to factors such as soak time, area sampled, and habitat type. Data from monitoring should be critically analyzed in order to provide the best information for management.

The effect of Hurricane Hugo on fish populations was observed at the INSHORE site. Surgeonfishes (Acanthuridae) and parrotfishes (Scaridae) were the dominant fishes in total abundance and frequency occurrence in trap catches. The proportion of surgeonfishes in catches decreased after the storm due to the decline in the surgeonfish species blue tang (*Acanthurus coeruleus*). Ocean surgeonfish (*A. bahianus*) replaced blue tang in catches following the storm until the end of the study. Parrotfishes (Scaridae) increased in proportion of catch following the storm until the end of the study.

Additional changes in fish assemblage structure may be expected around St. John as habitats damaged by the storm recover and as other stresses occur, such as the great increase in development on St. John and the resulting siltation. As demonstrated during this study, frequent monitoring is needed to document more subtle yet important aspects of coral reef fish assemblage structure. Species abundances are constantly changing in response to habitat changes and