Visual Assessment of Reef Fish Stocks in the Vicinity of Discovery Bay, Jamaica

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ABSTRACT

The north coast of Jamaica is fringed by a narrow submarine shelf, never more than a kilometer wide. Artisanal reef fishing is therefore concentrated into a narrow area and its impact is believed to be relatively high. The status of reef fish populations was determined in the vicinity of Discovery Bay. A non-destructive stationary visual census technique was used to document the reef fish community composition. A habitat map was constructed from aerial photographs to assist in selecting census sites.

During 101 censuses, 15,231 fish were counted. Thirty seven families were represented by 103 species. Families that comprised more than 1% of the observed individuals were, Pomacentridae (44.96%), Labridae (31.87%), Scaridae (12.23%), Serranidae (4.18%), Holocentridae (3.66%), Acanthuridae (2.67%), Haemulidae (1.97%), Clupeidae (1.76%) and Mullidae (1.03%). Length-frequency histograms were compiled for six species of fish, namely, *Acanthurus bahianus*, *Holocentrus rufus*, *Sparisoma viride*, *Sparisoma aurofrenatum*, *Epinephelus cruentatus*, and *Mulloidichthys martinicus*. Critical length parameters between Jamaica and Looc Key, Florida, USA (mean length, minimum length and maximum length) were similar for five of six target species. *Sparisoma viride* were larger at Looe Key. These baseline data on the current state of the reef fish population will play an important role in monitoring and detecting any future changes in distribution and abundance.

KEY WORDS: Jamaica, management, over-exploitation, reef fish, stock assessment, visual census.

INTRODUCTION

Tropical coastal ecosystems can be highly productive, and this productivity is chiefly exploited through coral reef fisheries. In many such fisheries, fish stocks are believed to have decreased due to habitat destruction and over-exploitation. Over-exploitation is believed to be particularly acute on the north coast of Jamaica because fishing impact is concentrated on the limited area of the narrow island shelf (Munro,1983). Very little quantitative information on underwater fish stock assessment exists. Studies that have been done are on a very small scale, are patchy and still remain unpublished. Also, before proper fisheries management strategies can be implemented, studies of the fish populations are important.

Since Brock (1954) introduced the concept of visual census it has become an important non-destructive technique in fish stock assessment (Kaufman, 1983; Bohnsack *et al.*, 1987). Estimates of fish abundance and species density are useful tools in monitoring and detecting changes in the fish stock (McCormick and Choat, 1987; Russ and Alcala, 1989). The goal of this research is to provide an estimate of the total fish abundance along the northern shore of Jamaica in the area fished by Discovery Bay fishermen. These data will serve as a baseline for future monitoring to detect changes that occur in the reef fish stocks.

METHODS

Before data collection began, all divers were trained in fish identification and conducted several trial censuses over a three month period to become familiar with the fish community and the stationary censusing technique. Replicate counts were taken until good corroboration was attained.

Censuses were conducted from April 2, 1991 to October 18, 1991 between 0800 hrs and 1800 hrs using the stationary visual census technique of Bohnsack and Bannerot (1986) with the following changes. The fish were noted in the first two minutes of a total census time of ten minutes. A check for cryptic species was done at the end of ten minutes. All fishes were counted by a diver hovering over the bottom at sites randomly selected within each habitat. A tape measure was laid on the bottom for a distance of STET 7.3 m. This represented the radius of a circle forming part of an imaginary cylinder extending from the surface to the bottom. The diver was stationed at the centre of the circle. Individual species were then counted. During the census fork lengths for six target species were estimated by comparing fishes to a 15 cm ruler attached perpendicular to the far end of a meter rule. The target species were *Acanthurus bahianus* (ocean surgeon), *Holocentrus rufus* (squirrelfish), *Sparisoma viride* (stoplight parrotfish), *Sparisoma aurofrenatum* (redband parrotfish), *Mulloidichthys martinicus* (yellow goatfish) and *Epinephelus cruentatus* (graysby). New species entering the area during counting were noted and added to the list along with cryptic species.

Sampling site selection was enhanced by using a habitat map constructed from black and white aerial photographs of the area. All sampling was conducted from Peartree Bottom to Rio Bueno, on the north coast of Jamaica (Figure 1). The reef could be discerned with clarity to a depth of approximately 20 m. In order to facilitate allocation of sampling effort the areas covered by coral reef, seagrass beds and sand were found with the aid of a digitizer. The number of censuses done in each habitat was proportional to the area of each habitat.

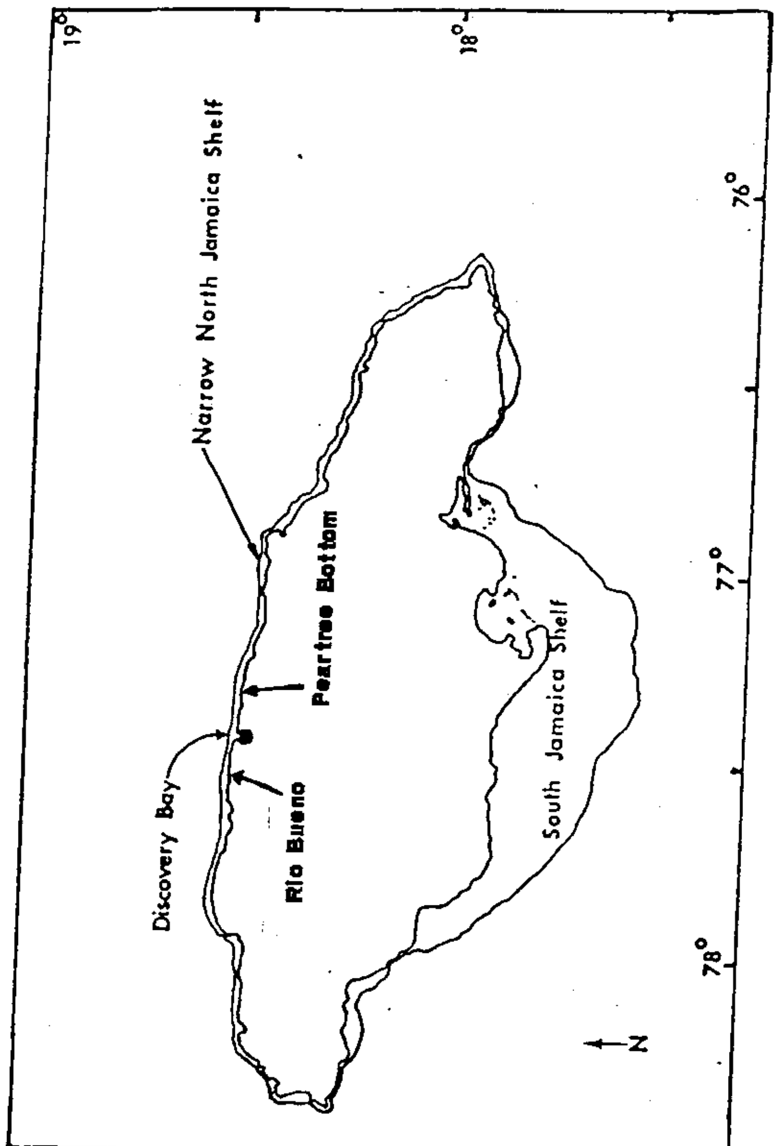

Figure 1. Location of research sites along the North Jamaica shelf.

RESULTS

We completed 72 counts over coral reef, 22 counts over sand, and 7 counts over seagrass. The total number of fish censused was 15,231 during these 101 censuses. Thirty seven families were represented by 103 species (Table 1). Families that comprised more than 1% of the observed individuals were, Pomacentridae (44.96%), Labridae (31.87%), Scaridae (12.23%), Serranidae (4.18%), Holocentridae (3.66%), Acanthuridae (2.67%), Haemulidae (1.97%), Clupeidae (1.76%) and Mullidae (1.03%) (Table 2). Percentages for some economically important families are Lutjanidae (0.05%), Carangidae (0.68%), Sphyraenidae (0.8%) and Scombridae (0.03%). Two planktivores *Chromis cyanea* (blue chromis) and *Clepticus parrai* (Creole wrasse) accounted for 34.63% and 23.84%, respectively, of the total abundance. Both species are rarely harvested.

For the six target species, length frequency histograms were compiled (Figures 2-7). All the measured fish were found over coral reef and sand. Table 3 shows that 333 ocean surgeons were measured with maximum length observed (L_{max}) = 22 cm, minimum length observed (L_{min}) = 3 cm, mean length (L_{mean}) = 12.6 cm. Ninety-seven yellow goatfish were measured with L_{max} = 28 cm, L_{min} = 8 cm, L_{mean} = 17.02 cm. Two hundred and seventy-three squirrelfishes were measured with L_{max} = 25 cm, L_{min} = 8 cm, and L_{mean} = 15.2 cm. One hundred and eighty-six graysbys were measured with L_{max} = 27 cm, L_{min} = 6 cm and L_{mean} = 14.97 cm. Five hundred and ninety-seven redband parrotfishes were measured with L_{max} = 25 cm, L_{min} = 3 cm and L_{mean} = 13.66 cm. One hundred and eighty-six stoplight parrotfishes were measured with L_{max} = 28 cm, L_{min} = 3 cm and L_{mean} = 13.6 cm. Critical length parameters of the six target species obtained using a similar stationary census technique at Looe Key, Florida, are presented in Table 3 for comparison.

DISCUSSION

The reef fish communities in the study area are highly diverse, even with the noticeable absence of the larger serranids, pomacanthids and certain species of lutjanids and parrotfishes. Munro (1983) and Koslow *et al.* (1988) suggest that the decrease in numbers or near absence of larger carnivorous species such as snappers, groupers, jacks, and sharks may also serve as an indicator of intense fishing pressure. This was later confirmed by Munro and Williams (1985) and Russ and Alcala (1989). Restructuring of dominant fish groups may occur after removal of the larger carnivores. However, restructuring may not be immediately evident in Jamaica because previously less desirable families (holocentrids and acanthurids) are now commercially important.

Parameters such as maximum length observed and minimum length observed are useful indicators of fishing pressure and recruitment size, respectively. Selective fishing pressure leads to a reduction in the mean size of

Table 1. Phylogenetic distribution of number of individuals of catch observed species based on censuses of 15,231 individuals.

FAMILY	SPECIES	COMMON NAME	NO. OF FISH
Lutjanidae	*Lutjanus analis*	Mutton snapper	1
	L. apodus	Schoolmaster	5
	L. mahogoni	Mahogany	1
	Ocyurus chrysurus	Yellowtail	1
Serranidae	*Epinephelus cruentatus*	Graysby	217
	E. fulvus	Coney	64
	Hypoplectrus indigo	Indigo hamlet	63
	H. unicolor	Butter	13
	H. guttavarius	Shy	24
	H. gemma	Blue	3
	H. nigricans	Black	7
	H. gummigatta	Golden	2
	H. chlorurus	Yellowtail	4
	H. puella	Barred	106
	Serranus tabacarius	Tobaccofish	73
	S. tigrinus	Harlequin bass	56
	S. tortugarum	Chalk bass	5
Carangidae	*Caranx ruber*	Bar jack	103
Mullidae	*Mulloidichthys martinicus*	Yellow goatfish	93
	Pseudopeneus maculatus	Spotted	64
Haemulidae	*Haemulon flavolineatum*	French grunt	283
	H. plumeri	White	9
	H. carbonarium	Caesar	6
Scombridae	*Scomberomorus cavalla*	King mackerel	3
	S. regalis	Cero	1
Sphyraenidae	*Sphyraena barracuda*	Great barracuda	3
	S. picudilla	Southern sennet	120
Balistidae	*Balistes vetula*	Queen triggerfish	1
	Canthidermis sufflamen	Ocean triggerfish	3
	Melichthys niger	Black durgon	31
	Xanthichthys ringens	Sargassum trigger	7
Monacanthidae	*Cantherhines macroceros*	Whitespotted file	4
	C. pullus	Orangespotted	2
Scaridae	*Scarus croicensis*	Striped parrotfish	378
	S. taeniopterus	Princess	390
	S. vetula	Queen	7
	Sparisoma aurofrenatum	Redband	564
	S. viride	Stoplight	167
	S. chrysopterum	Redtail	7
	S. rubripinne	Yellowtail	4
	S. radians	Bucktooth	22
	S. atomarium	Greenblotch	323

Table 1. Continued

FAMILY	SPECIES	COMMON NAME	NO. OF FISH
Pomacanthidae	*Holacanthus tricolor*	Rock beauty	42
	Centropyge argi	Cerubfish	2
Pomacentridae	*Chromis cyaneus*	Blue chromis	5275
	C. multilineatus	Brown chromis	408
	Pomacentrus planifrons	Threespot damsel	387
	P. partitus	Bicolor	508
	P. leucosticus	Beaugregory	1
	P. fuscus	Dusky	161
	P. variabilis	Cocoa	1
	Abudefduf saxatilis	Seargeant major	12
	Microspathodon chrysurus	Yellowtail	95
Labridae	*Clepticus parrai*	Creole wrasse	3631
	Thalassoma bifasciatum	Bluehead	898
	Halichoeres garnoti	Yellowhead	213
	H. bivittatus	Sippery dick	34
	H. cyanocephalus	Yellowcheek	24
	H. maculipinna	Clown wrasse	9
	H. poeyi	Blackear wrasse	3
	H. radiatus	Puddingwife	3
	Doratonotus megalepis	Dwarf wrasse	1
	Hemipteronotus martinicensis	Rosy razorfish	3
	H. splendens	Green	6
	Bodianus rufus	Spanish hogfish	29
Cirrhitidae	*Amblycirrhitus pinos*	Redspotted hawkfish	3
Holocentridae	*Holocentrus rufus*	Squirrelfish	278
	H. ascensionis	Longspine squirrel	18
	H. marianus	Longjaw squirrel	76
	H. coruscus	Reef squirrelfish	5
	H. vexillarius	Dusky squirrelfish	1
	Myripristis jacobus	Blackbar soldier	179
Acanthuridae	*Acanthurus bahianus*	Ocean surgeon	332
	A. chirurgus	Doctorfish	10
	A. coeruleus	Blue tang	65
Gerreidae	*Gerres cinereus*	Yellowfin mojarra	2
Priacanthidae	*Priacanthus cruentatus*	Glasseye snapper	10
	P. arenatus	Bigeye	5
Sciaenidae	*Equetus punctatus*	Spotted drum	1
	Odontoscion dentex	Reef croaker	5
Chaetodontidae	*Chaetodon capistratus*	Foureye butterfly	9
	C. striatus	Banded butterfly	3
Synodontidae	*Synodos saurus*	Bluestriped lizard	1
	S. intermedius	Sand diver	1

Table 1. Continued

FAMILY	SPECIES	COMMON NAME	NO. OF FISH
Tetraodontidae	*Canthigaster rostrata*	Sharpnose puffer	54
	Sphoeroides spengleri	Bandtail	1
Diodontidae	*Diodon holocanthus*	Balloonfish	6
	Chilomycterus antillarum	Bridled burrfish	1
Grammidae	*Gramma loreto*	Fairly basslet	27
Malacanthidae	*Malacanthus plumeri*	Sand tilefish	35
Aulostomidae	*Aulostoma maculatus*	Trumpetfish	21
Fistulariidae	*Fistularia tabacaria*	Cornetfish	2
Gobiidae		Goby	9
Opistognathidae	*Opistognathus aurifrons*	Yellowhead jawfish	9
Scorpaenidae	*Scorpaena plumeri*	Spotted scorpion	1
Apogonidae		Cardinalfish	1
Bothidae	*Bothus lunatus*	Peacock Flounder	4
Muraenidae	*Gymnothorax vicinus*	Purplemouth moray	1
Ophichthidae	*Myrichthys acuminatus*	Sharptail eel	2
Grammistidae	*Rypticus saponaceus*	Greater soapfish	1
Clupeidae	*Harangula humeralis*	Redear herring	200
	Sadinella anchovia	Spanish herring	60
	Opisthonema oglinum	Atlantic thread	1
	Etrumeus teres	Round herring	7
Syngnathidae	*Syngnathus pelagicus*	Sargassum pipefish	1

Table 3. Critical length parameters of the six target species from Discovery Bay, Jamaica and Looe Ket, Florida, U.S.A. N = sample size; mean = mean length; min=minimum length observed; max = maximum length observed. All lengths measured to the nearest cm. Looe Key data from Bohnsack *et al.*, 1987.

SPECIES	DISCOVERY BAY				LOOE KEY		
	N	mean	min	max	mean	min	max
Ocean surgeon	333	12.6	3	22	11.8	3	20
Stoplight parrotfish	168	13.6	3	28	19.5	2	43
Squirrelfish	273	15.2	8	25	16.1	13	20
Redband parrotfish	597	13.7	3	25	13.8	2	25
Graysby	186	15.0	6	27	16.2	6	28
Yellow goatfish	97	17.0	8	28	18.8	7	30

Table 2. Percentage composition of the reef fish assemblage at the family level on the fringing reef of north Jamaica. Nine families, Scorpaenidae; Fistulariidae; Synodontidae; Gerreidae; Apogonidae; Muraenidae; Ophichthidae; Grammidae and Syngnathidae, each comprised 0.01% of the reef fish censused.

FAMILY	PERCENTAGE %
Pomacentridae	44.96
Labridae	31.87
Scaridae	12.22
Serranidae	4.18
Holocentridae	3.66
Acanthuridae	2.67
Haemulidae	1.97
Clupeidae	1.76
Mullidae	1.03
Sphyraenidae	0.81
Carangidae	0.68
Tetraodontidae	0.36
Pomacanthidae	0.29
Balistidae	0.28
Malacanthidae	0.23
Grammidae	0.18
Aulostomidae	0.14
Priacanthidae	0.10
Chaetodontidae	0.08
Gobiidae	0.06
Opistognathidae	0.06
Diodontidae	0.05
Lutjanidae	0.05
Monacanthidae	0.04
Sciaenidae	0.04
Scombridae	0.03
Bothidae	0.03

target species (Craik, 1981; Munro, 1983) and that spearfishing selects against larger individuals. Critical size parameters between Jamaica and Looe Key are similar for five of the six target species. However, stoplight parrotfish were much larger at Looe Key (Bohnsack *et al.*, 1987). Stoplight parrotfish grow to a much larger size than the other species, and large individuals have likely been selectively removed by spear and pot fishermen in Jamaica. Although my study is incomplete, indications are that the north shore of Jamaica is intensely fished. In conclusion, the baseline data collected will serve as a quantitative description of the fish fauna from Pear Tree Bottom to Rio Bueno. The present research will allow comparisons to be made over time or between areas as this is particularly

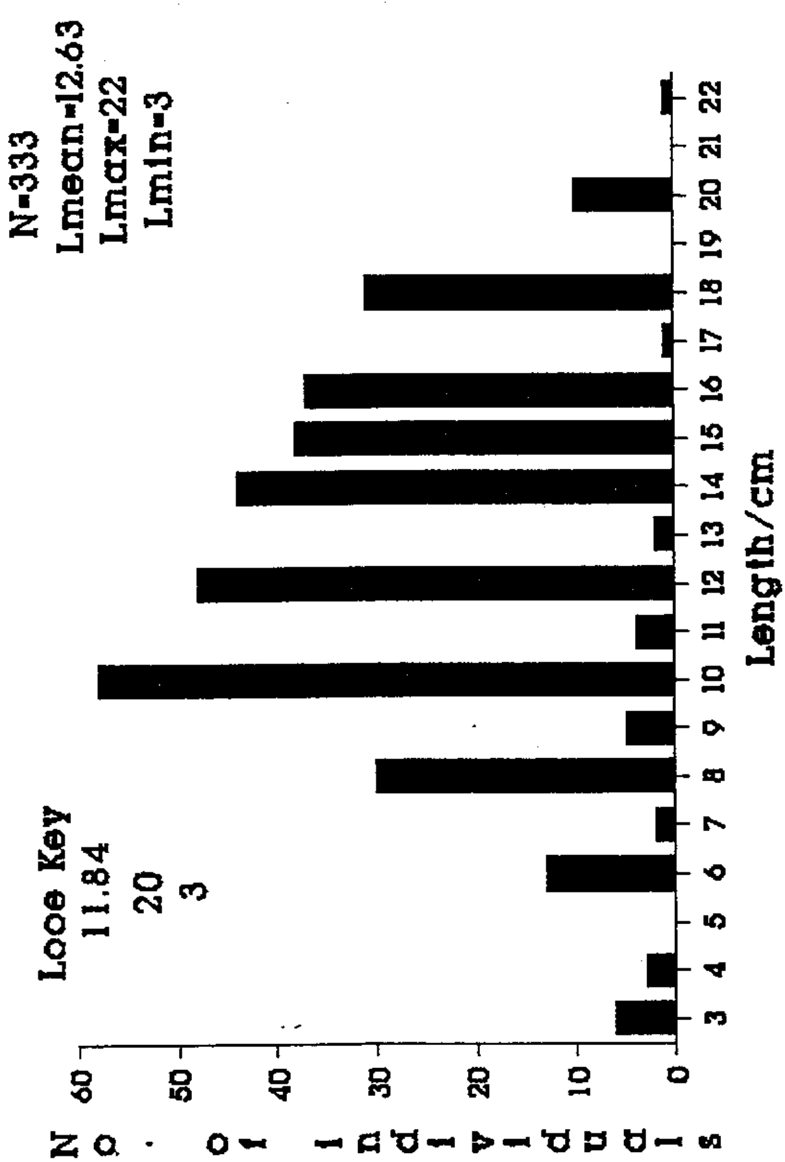

Figure 2. Size structure of *Acanthurus bahianus*. Lengths to nearest cm.

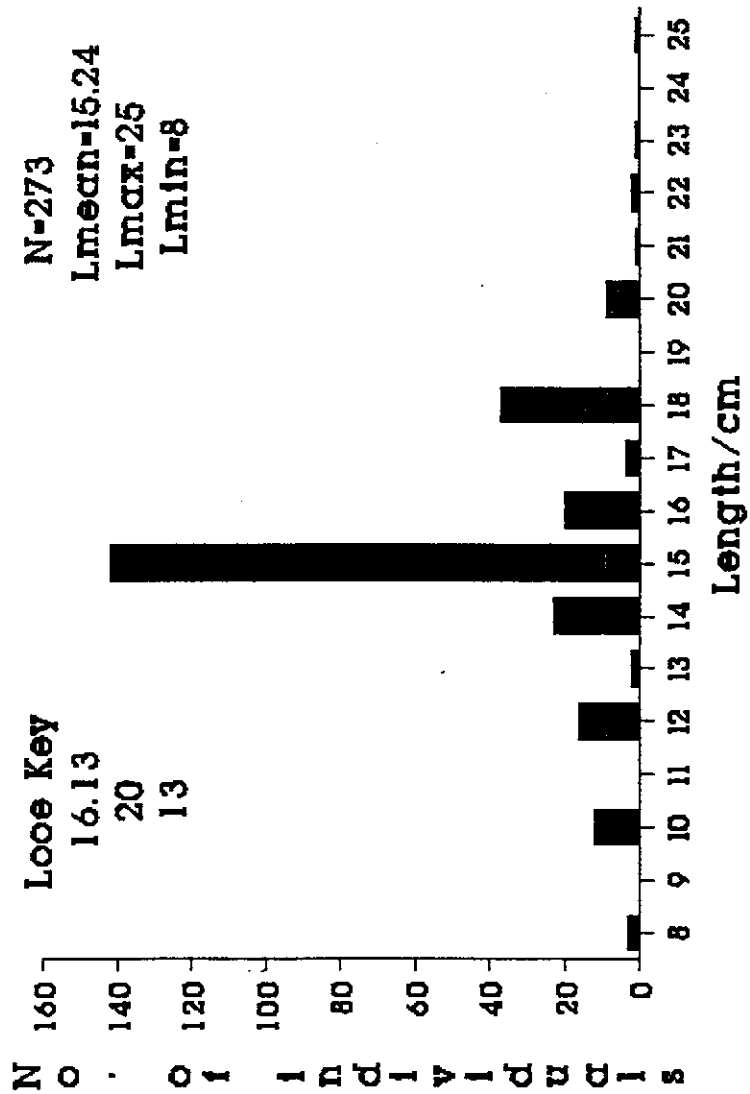

Figure 3. Size structure of *Holocentrus rufus*. Lengths to nearest cm.

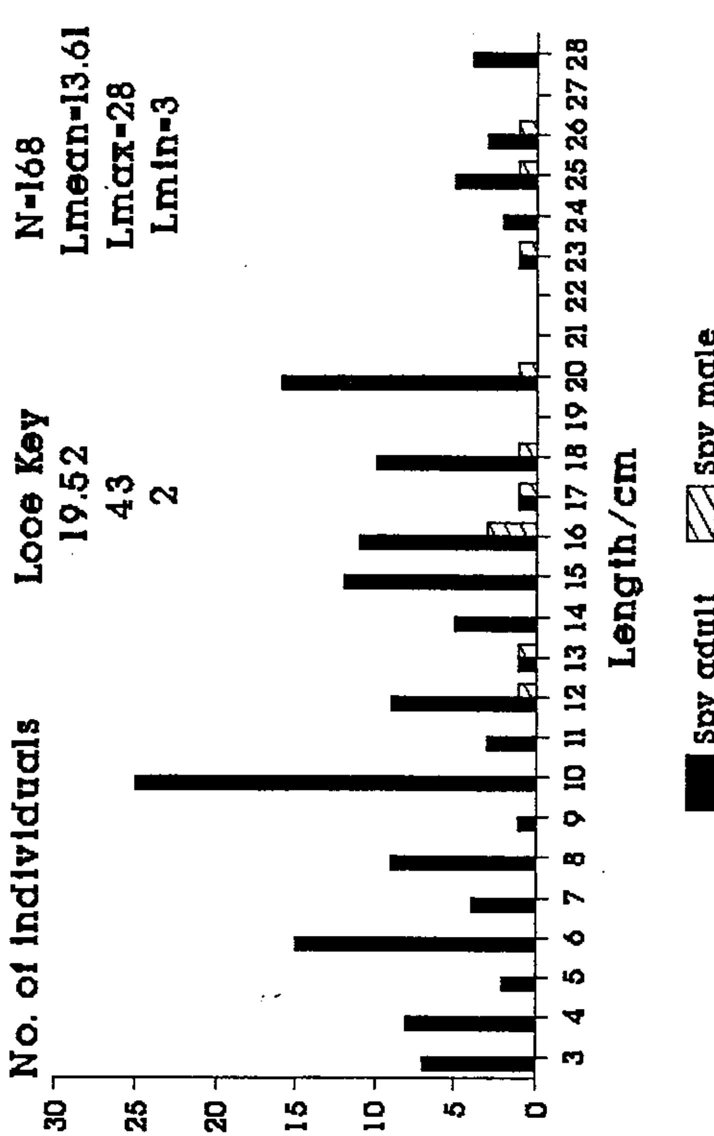

Figure 4. Size structure of *Sparisoma viride*. Lengths to nearest cm.

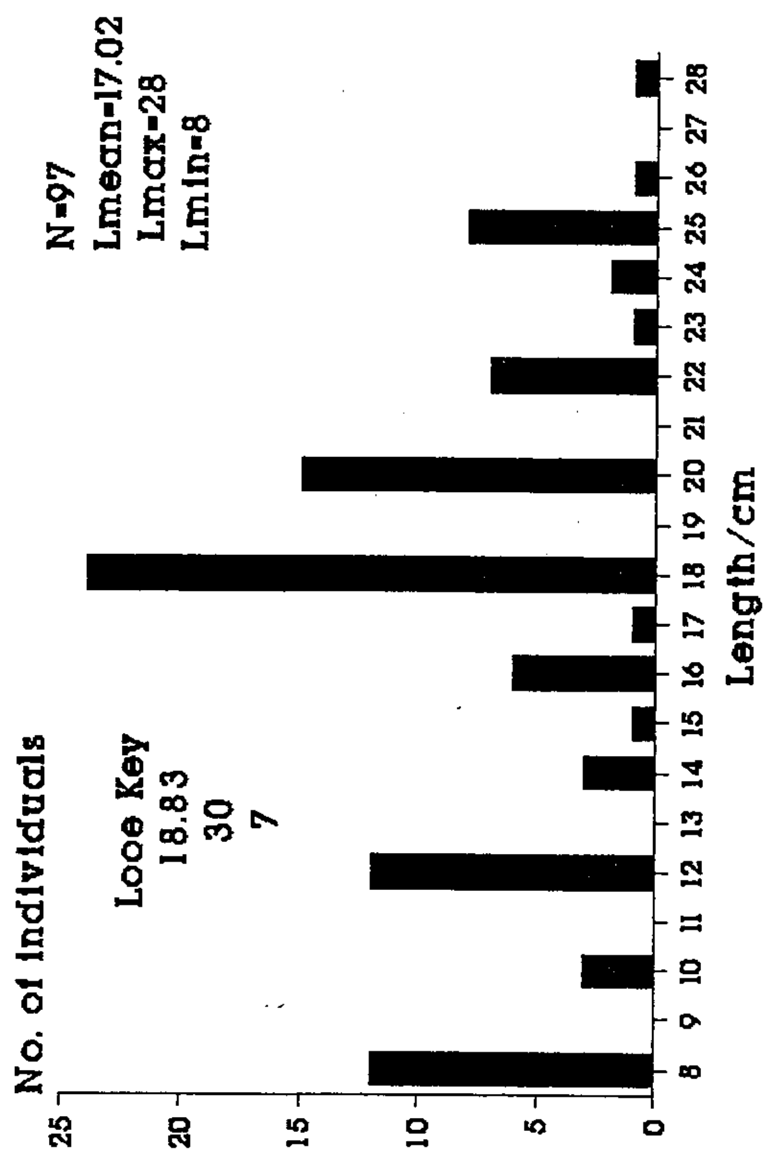

Figure 5. Size structure of *Mulloidichthys martinicus.* Lengths to nearest cm.

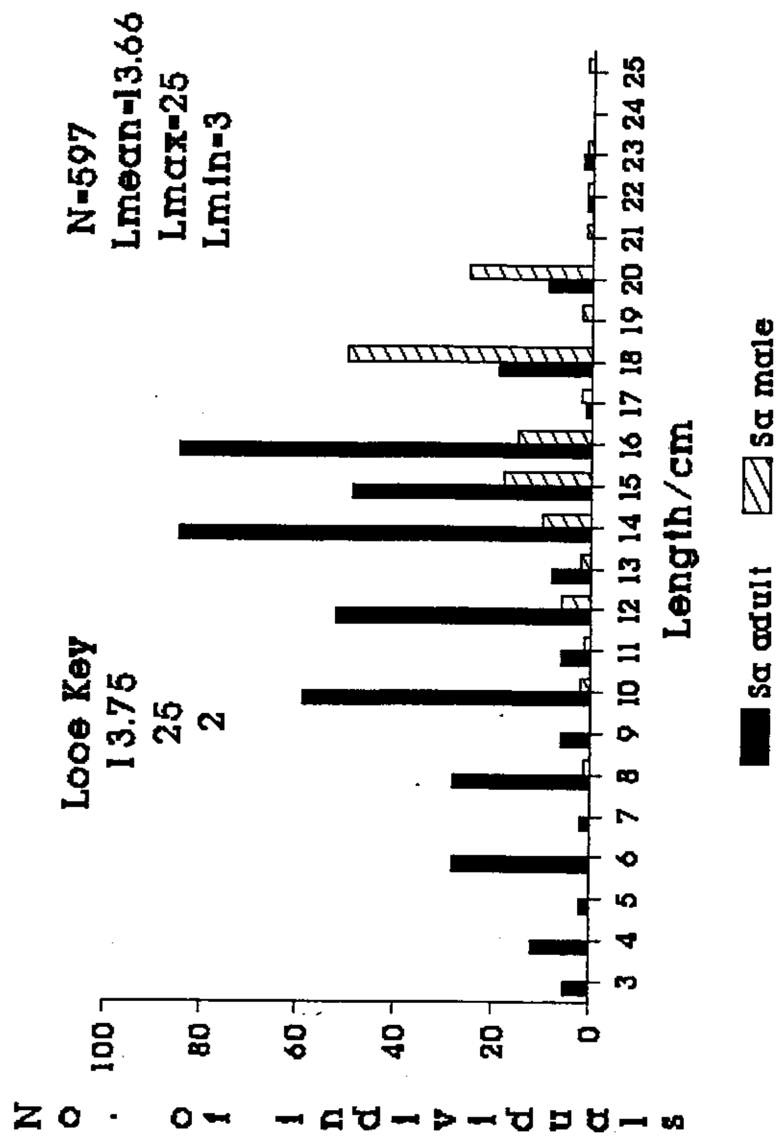

Figure 6. Size structure of *Sparisoma aurofrenatum*. Lengths to nearest cm.

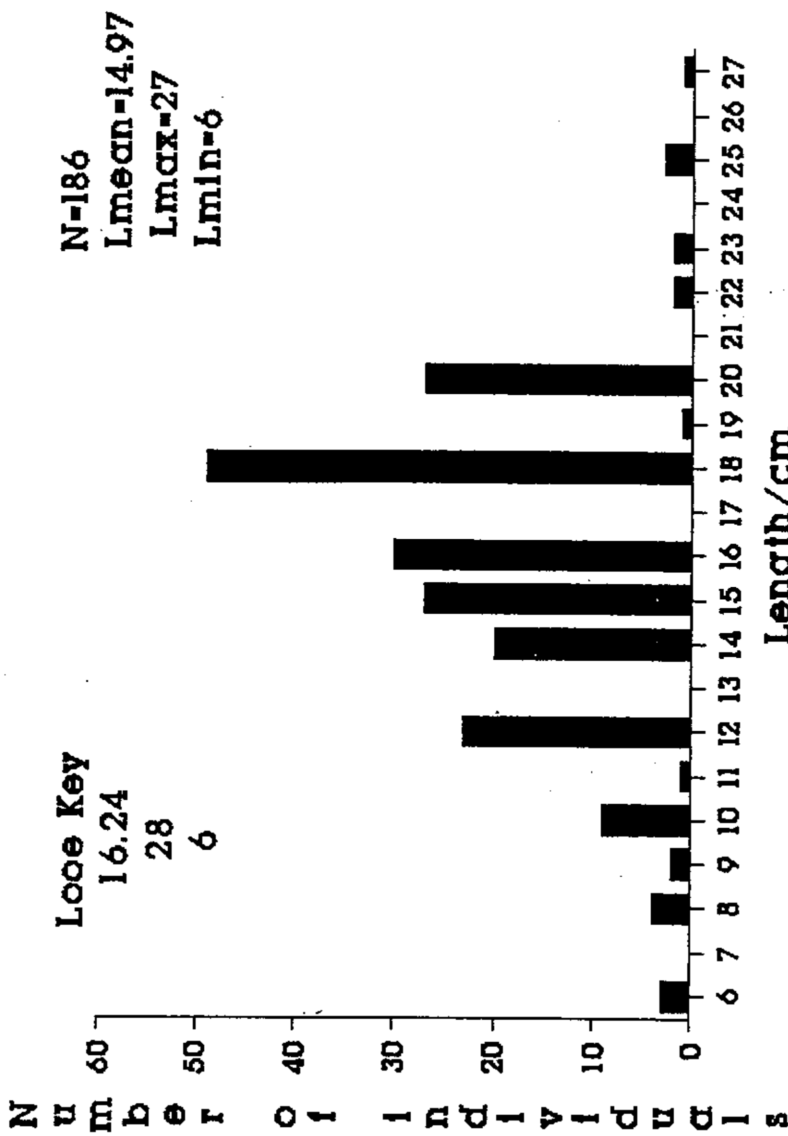

Figure 7. Size structure of *Epinephelus cruentatus*. Lengths to nearest cm.

useful in monitoring any changes due to physical forces such as storms and man-made forces such as pollution and fisheries management strategies.

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