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A Study of a Virgin Islands Grouper Fishery Based on a Breeding Aggregation

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INTRODUCTION

Breeding aggregations of Nassau groupers, *Epinephelus striatus* and red hinds, *E. guttatus* offer a significant seasonal source of income in many areas of the Caribbean. Smith (1972) observed an aggregation of *E. striatus* in the Bahamas and estimated the population size at 150,000 fishes. In St. Thomas, U.S. Virgin Islands, one such aggregation has been under increasingly intense fishing pressure for the past 20 years. Another, reported from St. Croix, was fished for 10 years until 1971 when the fishes ceased to aggregate (Skov, personal communication). The St. Thomas aggregation occurs during two of the months between November and February at a point on the 100 fathom curve

Indian fish traps (described in Munro, 1974). The 1973-74 season brought a sharp decline in catch and initiated the present study which was undertaken in an attempt to assess the need for management action.

This study had three main objectives. The first objective was to estimate the number of fishermen and the amount of the catch since catch records are unavailable. The second objective was to assess the need for management action. The final objective was to gather sufficient information about the population to enable the development of a biologically sound management plan.

MATERIALS AND METHODS

We undertook a series of interviews with the fishermen and collected data from December 1974 until April 1976. During these interviews we ascertained the length of time they had been fishing, the number of traps used, the number

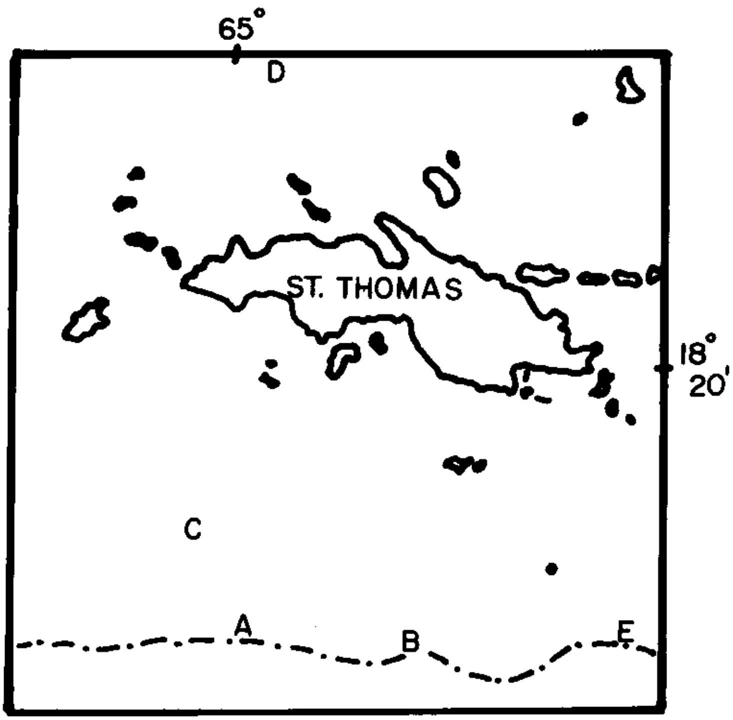

Figure 1. Map of St. Thomas, U.S. Virgin Islands, showing grouper bank (A) and reported *Mycteroperca venenosa* bank (B) where breeding aggregations occur along the 100 fathom curve (dashed line). Red hind *Epinephelus guttatus* breeding in 1976 occurred at point (C) and previously unreported *E. striatus* aggregations are shown at (D) and (E).

of traps lost, catch in the past, and a variety of other non-quantitative "soft" data. We also sexed and measured standard length (SL), and weight of as much of the catch as possible. Data on weight was somewhat restricted in that they interfered with the marketing of the fish. Measurements of standard length and weight were made with 1% precision. A partial survey of the catch was carried out in 1976-77 (Sylvester, *et al,* 1977) and 1978 (data collected by project master fisherman, J.A.L.).

Ovaries were removed when possible and returned to the lab where they were weighed to the nearest 0.1g. Counts of three 0.1 g subsamples were made in order to assess fecundity. Nikolsky's (1963) series of ovarian ripeness stages were used to assess ripeness. All counts were made from stage III ovaries.

Field activities consisted of a series of 47 fishing trips to the grouper bank from December 1974 to April 1976. On each of these trips we fished with handlines for at least 10 man-hours, hauled fish traps when possible, and censused the fishermen. Using SCUBA gear, we observed the habitat, behavior, and predator-prey relationships of the fishes.

Size-frequency distributions were constructed for the *Epinephelus striatus* data from both breeding aggregation periods as well as for our *E. striatus* catch from outside the bank. The standard length-frequency distribution for *E. guttatus* was constructed from our own catch.

These standard length-frequency distributions were analyzed for the presence of age classes with probit analysis (Harding, 1949). We assumed that they were annual.

The age classes were fitted to the Von Bertalanffy growth equation:

$$L_t = L_{\infty} (1\text{-}e^{-k(t-t_0)}); \qquad (1)$$

where: L_t is the standard length at time t

L_{∞} is the asymptotic standard length,

k is a coefficient of catabolism

t_0 the time at which $L_t = O$, and

e is the base of natural logartithms.

The methodology used in this analysis is outlined in Moe (1969).

In 1976 we attempted to verify the results of the growth analysis by counting annuli from otoliths (sagitta). The otoliths were removed, cleared in glycerine, and annular counts were made under a dissecting microscope by a panel of four investigators. We assumed that the bands were annual due to the energetic cost of the breeding aggregation. The results were analyzed by regression analysis.

We analyzed the size-frequency distribution for mortality coefficients Z from the equation:

$$N_t = N_{t-1} (e^{-Zt}); \qquad (2)$$

where:

N is the number of fishes at time $_t$ and $_{t-1}$,

e is the base of natural logarithms, and

Z is the coefficient of mortality.

We used the method of Olsen and Koblick (1975) where the age group mean and standard deviation are used to derive a probability function for the modal size class. This function is then used to derive N_t and N_{t-1}.

Standard length (*SL* in cm) weight (*W* in grams) relationships were calculated for both *E. striatus* and *E. guttatus*, using a program in a pocket calculator which fit the data to the power curve.

$$W= a(SL)^b \qquad (3)$$

where: a and b are constants.

RESULTS

Interviews with the fishermen revealed that the grouper bank has been handlined sporadically since at least 1910. The current intensive trap fishery began in 1966 when three fishermen began to fish with traps throughout the breeding season. This number increased to four in 1968, five in 1970, and seven in 1972. By the season of 1974 there were nine boats in the fishery. In 1976 there were 13 boats. No data are available for the handlining fishery although it is clear that handline fishing is centered around times of high trap catch.

Catch results for 1974-75 and 1976 are given in Table 1. Total catch in 1974-75 (14,460 kg) was higher than in 1976 (4,930 kg) even though fishing took place over a 78 day period instead of 110 days. A total of 13 trap boats fished in 1976 for an average of 2.25 boats on the bank daily. They caught 3.74 fish per boat day, whose average weight was 5.20 kg. The handline fishery was almost nonexistent in 1976. During the 1974-75 season when only nine boats fished on the grouper bank they caught an average of 8.8 fish daily with an average weight of 4.86 kg. The handline fishery accounted for 3460 kg in 1974-75 (23 percent of the total catch). There was a reduction in total catch from 1975-76 of 56 %. Catch per unit effort (CPUE in kg/boat) dropped 76%.

Trap fishermen set an average (for both years) of 9.7 fish traps (SD = 3.1, N = 20) and lost an average of 3.3 traps (SD = 2.3, N = 20) during the aggregation period. Traps were set for as little as 20 minutes when the groupers were entering traps.

Catch during both seasons (Fig. 2) followed a lunar trend. Eighty-seven percent of the catch came between first and last lunar quarters. The catch on the day of the full moon was less than the day preceding the full moon during five of the six lunar periods covered. This trend was reported by fishermen

Table 1. Summary of catch statistics for a St. Thomas Nassau grouper fishery (Standard deviations shown in parentheses)

Statistic	1974-75	1975-76
Fishing Period	12/24/74 to 3/11/75	12/10/75 to 4/6/76
Average # trap boats/day	3.3 (1.9)	2.3 (3.2)
# days in season	78	110
Total # trap boats	9	13
Average daily catch (fish)	8.8 (11.1)	3.7 (5.6)
Average season trap catch (kg/boat)	1,220	370
Average # handline boats/day	2.3 (2.6)	0.2 (0.7)
Average daily handline catch (fish)	4.6 (9.3)	0.1 (0.2)
Average fish weight (kg)	4.86	5.20
Total Trap Catch (kg)	11,000	4,870
Total Handline Catch (kg)	3,460	60
Total Catch (kg)	14,460	4,930

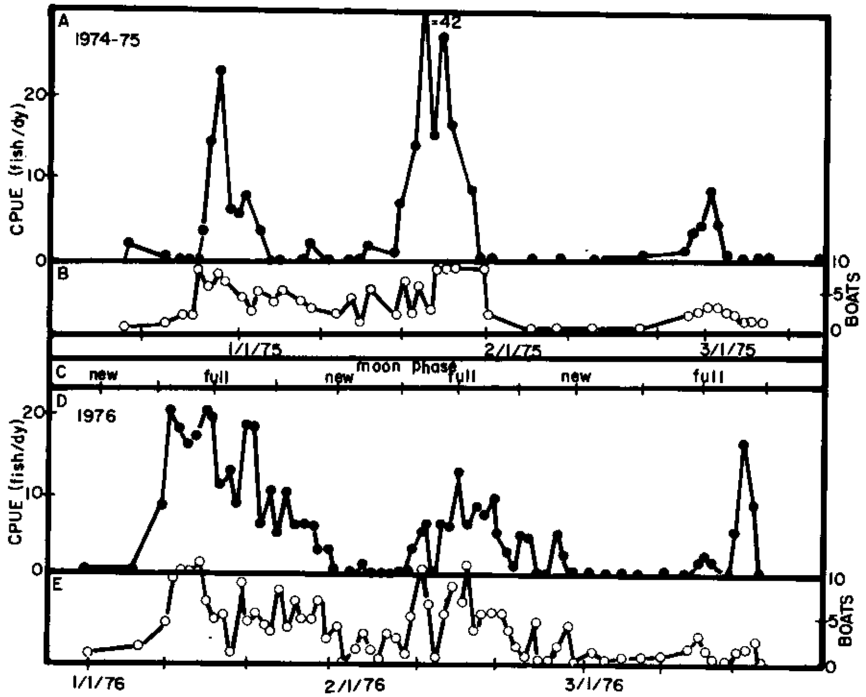

Figure 2. Catch per unit effort (A) and (D). Effort (B and E) for the 1974-75 and 1975-76 breeding aggregations of *E. striatus*. The two years' data are on a time axis that is aligned on similar lunar periods (C).

and substantiated here by the McNemar test for the significance of changes ($\chi^2 = 3.2$, $p < 0.05$)

The *E. striatus* size frequency distributions for both years were combined with additional catch data from 93 fishes caught during the remainder of the study period (Fig. 3) and the results analyzed by probit analysis (Harding, 1949) for the presence of size classes. Total sample size was 816 groupers. The results indicated eight size classes with mean standard lengths (in cm) of 23.5, 37, 43.5, 50, 54.3, 60.3, 66.5, and 73. Five very large (91 to 96 cm) fishes were caught and measured in 1975.

When the means for the grouper size classes were plotted after the method of Walford (1946) (Fig. 4a) initial estimates of growth parameters were derived to fit the Von Bertalanffy growth equation (Equation 1).

The parameter L_∞ derived from the Walford plot (the time at which $L_t = L_{t+1}$) was 97.4 cm standard length. The coefficient of catabolism k (equal to the natural logarithm of the slope of the Walford regression line, 0.83) was 0.185. The Walford plot was significant at the 0.01 level ($r = .96$, $p < .01$).

The parameter t_0 (the time at which $L_t = O$) was derived after the method of Moe (1969) from a regression of $\ln(L_\infty - L_t)$ against age ($t = 1, 2, 3, 4, 5, 6, 7, 8$

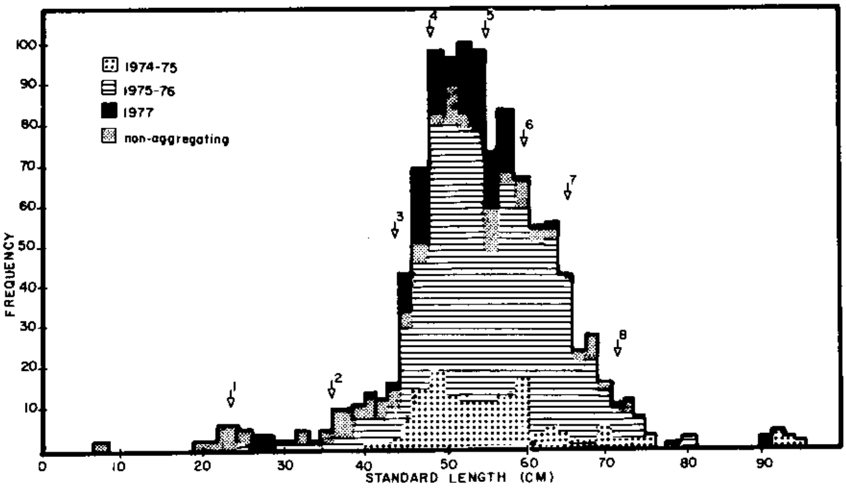

Figure 3. Standard length-frequency distribution for Nassau grouper, *E. striatus* from breeding aggregations of 1974 to 1977 and from non-aggregating groupers casught from 1974 to 1976. The arrows denote size class means that were derived by probit analysis (Harding, 1949). The calculated age is shown alongside each arrow. Total sample size is 961 fishes.

yrs.) (Fig. 4b). The slope of this line (slope = -0.183) is an estimate of k and t_o is derived from the regression equation when $L_t = O$:

$$Y = (b + Kt_o) \tag{4}$$

where: Y is ln (L_{∞}-L_t)
b is the intercept of the regression line
t_o is the equal to 0.488 years.

The Von Bertalanffy growth equation for *E. striatus* and plot of the projected growth curve are shown in Figure 4c.

The otolith counts varied between the four investigators but a regression of the average of the four against the standard length (Fig. 5) was significant at P = .01 (r = .82, df = 35, slope = 0.12 and intercept = -1.39).

Regression of the count average against age (calculated from the growth curve) was also significant at the 0.01 level (r=.82, df=35). The slope of this regression was 0.71 and the intercept was 1.1.

During both aggregation periods over 80% of the catch was made up of age 4-, 5- and 6-year fishes. Also in both years, age 7 fishes immigrated onto the bank during the second lunar month.

The sex ratio of 571 groupers of known sex was 48% males. Although Table 2 indicates that older fish were females, this difference is not statistically significant ($\chi^2 = 14.8$), and we assume a 1 to 1 sex ratio. The mean standard length size of the male groupers (58.5 cm) was not significantly different from females (58.9 cm) when tested by ANOVA (F = 0.23,df = 1,569).

Mortality coefficients were calculated after the method of Olsen and Kob-

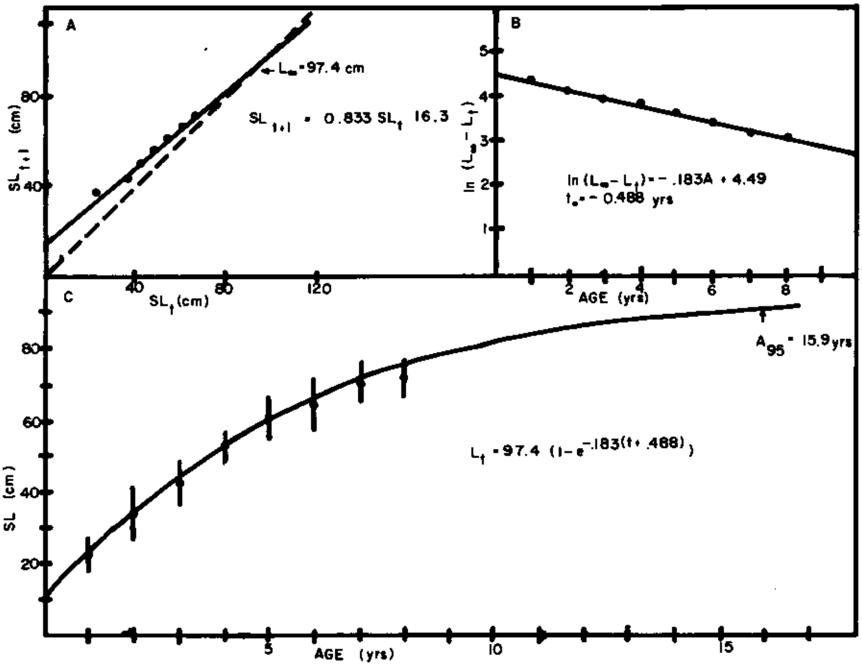

Figure 4. A. Walford plot (Walford, 1946) of *E. striatus* standard lengths at time t and t'. The point at which the regression line (significant at the 0.01 level) meets the diagonal is the asymptotic maximum size (L_∞) and the natural logarithm of the slope (= coefficient of catabolism) is an initial estimate of K in the VonBertalanffy equation. B. A plot of the natural logarithm of ($L_\infty - L_t$) against age is used to obtain a more accurate estimate of K and t_0 (the time at which L_t equals zero) for the VonBertalanffy equation. C. The solid line is the plot of VonBertalanffy equation for Nassau grouper growth. The open circles are size class means from probit analysis of the size-frequency distribution (Figure 3) given with one standard deviation. The parameter A_{95} is the age at which 95% of the asymptotic size is attained and is a measure of longevity.

lick (1975) for equation 2. This technique utilizes the frequency of individuals in the modal size class of each age group along with the age group mean and standard deviation, to derive a probability function which is used to estimate the abundance within the size class.

The results are shown in Figure 6. The regression of mortality coefficient (Z) on mean standard length in the interval was significant at the 0.01 level (r = .78, df = 9). This figure indicates that the fish are being recruited to the breeding aggregation until at least their fifth year (SL = 58 cm). The mortality coefficient is then positive and fishing mortality becomes much greater than natural mortality.

We calculated fishing mortality for 1974-75 breeding aggregation since visual estimates of population size was available. Average total mortality (2) for the recruited size classes during the 1974-75 aggregation was 1.280 yr.$^{-1}$. The catch for that year was approximately 3000 groupers (total catch / average weight). The observed breeding aggregation was not more than 2000 group-

Table 2. Size class relative abundance (proportion) from Nassau grouper *Epinephelus striatus* breeding aggregations from the U.S. Virgin Islands (Age class derivation is in text; proportion of males in each size class is also shown).

		Lunar Month					
Age	SL (cm)	Dec 1974	Jan 1975	Jan 1976	Feb 1976	Combined	% Males
1	23.5	0	0	0	0	0	0
2	37.0	0	.02	.02	.01	.009	33
3	43.5	.06	.02	.10	.13	.060	25
4	50.0	.21	.26	.27	.20	.179	43
5	54.3	.22	.19	.23	.31	.227	49
6	60.5	.33	.35	.25	.28	.249	47
7	66	.09	.15	.08	.24	.190	58
8	72	.03	.01	.04	0	.066	45
9	76	0	0	.01	0	.013	25
10	80	0	0	.01	0	.005	33
>10		.06	0	0	0	.002	40
Sample Size		.61	114	301	95	571	48*

*Total sample χ^2=14.8, P =n.s.

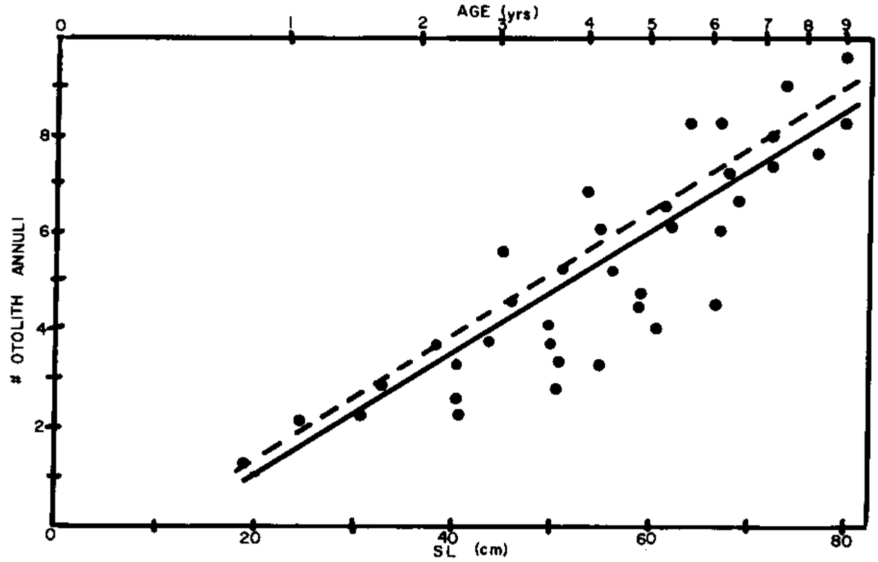

Figure 5. Regression analysis of 37 otolith annuli (an average of four different counts) against standard length is shown by the solid line. The dashed line represents a regression of annular counts on calculated age.

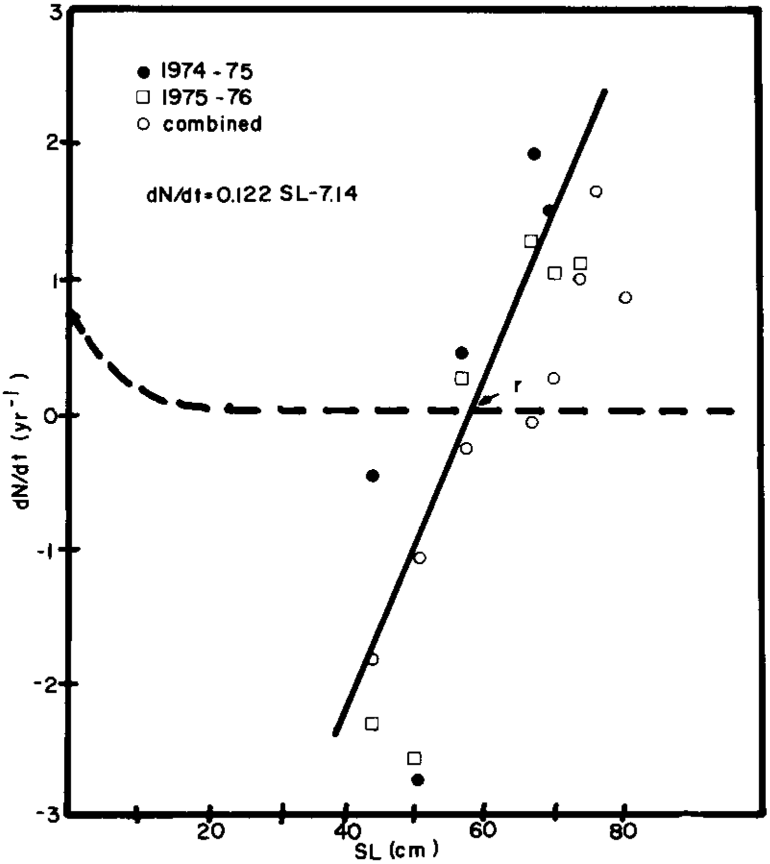

Figure 6. The rate of change in size class abundance (dN/dt) from text equation 2 is shown plotted against standard length. The data come from the standard length-frequency distribution for the 1974-75 and 1975-76 breeding aggregations of Nassau groupers. Only the seperate year's data were used in the calculation of the regression equation. Point *r* is the age at which fishing mortality becomes greater than Ursin's (1966) coefficient of physiological natural mortality. The dN/dt values after this point were used to calculate the instantaneous coefficient of total mortality (*Z*).

ers. Fishing mortality (F) (during the 1974-75) breeding aggregation was calculated for the 2000 fish population estimate (catch plus survivors) from equation (2) and was 0.916 yr^{-1}. This natural mortality figure is high in that it includes fishing mortality over the remaining nine months of the fishery. We have no estimate of the mortality which occurs when the fish disperse after the aggregation period.

Predation induced mortality is also included in the natural mortality figure. Another unmeasured mortality factor is the number of groupers killed by the 30 to 50 "ghost traps" lost on the bank annually. In the case of the breeding aggregation predation is also a function of fishing effort and grouper aggregation size, and shark abundance. We feel that the 1975-76 observations of sharks directly attacking the school may be explained by the large numbers of sharks attracted by fishing pressure to an aggregation depleted by fishing. The relative abundances of predator to prey were such that shark feeding shifted from dependence on fishing pressure to direct attack on the aggregation. We observed less than 10 sharks on the grouper bank in 1974-75. In 1975-76 10-20 large sharks were observed.

Ninety-nine percent of the 141 ovaries examined prior to January 28, 1975, were stage III. After this date 71% of the 27 ovaries were stage V (empty or partially empty). During the 1975-76 aggregation period, 99% (of 217) ovaries examined prior to February 1976 were stage III. After February we observed 15 out of 56 (the remainder were stage III) ovaries that appeared to be resorbing their roe. No evidence of spawning was either observed or reported during 1976.

Fecundity counts from 42 stage III *E. striatus* ovaries (126 subsamples) give a mean value of 4.97 eggs/mg (SD = 2.32). Average ovary weight was 970 g (SD = 2.52, N = 157). Average calculated egg production was 4.8×10^6 eggs. Roe weight was not significantly correlated with standard length (r = .24, df =157). The eggs are approximately 0.1 mm in diameter.

The regressions of $\log_{10}$(weight) on $\log_{10}$(standard length) indicate that for the 241 *E. striatus* ranging from between 18 and 76 cm SL the length-weight equation was:

$$\text{Weight in g} = 0.0097\,(\text{Standard Length in cm})^{3.233}$$

The regression was significant at the 0.01 level (r = 0.93)

For 414 *E. guttatus* ranging from 12 to 43 cm SL, the equation was:

$$\text{Weight in g} = 0.0029\,(\text{Standard Length in cm})^{3.606}$$

The regression was significant at the 0.01 level (r = 0.97).

We caught 434 *E. guttatus* in the period between December 20, 1974, and April 15, 1975. In 1975-76 *E. guttatus* reportedly aggregated outside the sampling area and we caught only 31 fishes. No analysis of these 1976 data was undertaken. The 1974-75 catch by sexual state is shown in Table 3.

Male red hinds (mean SL = 29.1 cm, SD = 4.34, N = 44) were larger than female red hinds (mean SL = 28.4 cm, SD = 5.9, N = 220). This difference was significant at the P = 0.05 level (t = 1.977, df = 262). Female red hinds were significantly larger than the average for fishes of indeterminate sex (mean SL = 24.3 cm, Sd = 4.3, N = 55). This difference was significant at the P = 0.01 level (t = 12.6, df = 273). Sixty-nine percent of all the small hinds (20 cm or less in SL) were caught in December and January. No hinds larger than 34 cm SL were caught after February and 85% of these larger animals were caught during December and January.

The results of the probit analysis of the *E.guttatus* size-frequency distribution (Fig. 7) indicated a unimodal population with a slight skew towards the smaller sized fish (mean SL = 26.2 cm, SD = 3.8).

There were definite trends in the sex ratio (Table 4) and ovarian ripeness (Table 4) in the *E. guttatus* sample. The sample was almost 98% female fishes until nearly the middle of the second lunar month of the 1974-75 aggregation period when there was an influx of males. From this time period, male fish increased in abundance. Thereafter, the catch consisted of fish with gonads

Table 3. Ovarian ripeness (percent) (after the method of Nikolsky, 1963) of female *E. guttatus* caught between December 20, 1974 and April 18, 1975

Gonad Stage	Lunar Month			
	12/20-1/15	1/16-2/15	2/15-3/17	3/17-4/18
I	2.7	1.3	42.8	33.0
II	20.8	6.7	37.5	67.0
III	70.0	45.0	19.7	0.0
IV	6.5	39.0	0.0	0.0
V	0.0	8.0	0.0	0.0
Sample size	146	118	16	3

which were macroscopically unidentifiable. This trend was also apparent in ovarian ripeness. Stage IV gonads were only observed in the week preceding January 29, 1975, and stage V only during the week following.

Fecundity counts for 73 *E. guttatus* (219 subsamples) indicated an average of 3.70 eggs per mg of ovary (SD = 0.89). For the 26.2 cm average standard length fish with an ovary weight of 54.7 g (SD = 28.3, N = 262) we expect an egg production of 2.02 X 10^5 eggs. The eggs are small, approximately 0.3 mm in diameter and are probably planktonic.

Diving observations of the bottom indicated a series of coral ridges, parallel to the 100 fathom curve. These ridges were usually 100 m across and separated by bands of calcareous sand which ranged from 50 to 300 m in width. The bottom was made up of small (less than 1 m in diameter) plates of coral. *Montastrea annularis* was the dominant form.

Other predators observed in the area included the yellowfin grouper, *Mycteroperca venenosa;* reef shark, *Carcharhinus springeri;* Blacktip shark, *C. limbatus;* Nurse shark, *Ginglymostoma cirratum;* baracuda, *Sphyraena baracuda;* and Kingfish, *Scomberomorus cavalla;* A large white shark, *Carcharodon carcharias,* was observed in 1976. Potential food fish for the groupers included the yellowtail snapper, *Ocyurus chrysurus,* Parrot fish, *Sparisoma viride,* creole wrasse, *Clepticus parrae,* and creole fish, *Paranthias furcifer.*

On January 27, 1975, we observed the actual breeding aggregation in 40 m of water (Fig. 8). The grouper aggregation was over a small (about one ha.) reef area separated by a narrow (30 m) sand bank from the surround reef area. The school was conical, extending from the bottom (50 m) to about 20 m in depth. The fish on the bottom were actively swimming with both of the color patterns noted by Smith (1972) in evidence. The animals in mid-water were stationary. No other species was observed in the school. No similar aggregation of *E. guttatus* was ever observed. The fishermen interviewed reported that catch is very localized and feel that there is only one aggregation on the

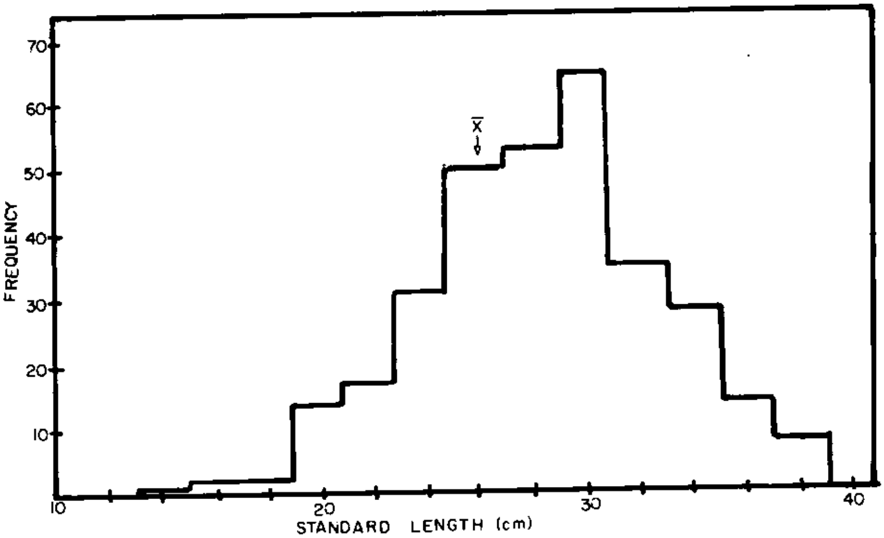

Figure 7. Standard length-frequency distribution for red hinds *Epinephelus guttatus* caught during the 1974-75 breeding aggregation.

bank. The aggregation observed was much smaller than Smith's (1972). A liberal estimate of the population size would be 2000 fishes. The school was made up entirely of *E. striatus*. Reef sharks, although abundant, were not feeding on any but hooked groupers. On February 14, 1976, we observed a school of about 10 reef sharks feeding actively on an estimated school of 500 to 1000 *E. striatus* .

DISCUSSION AND CONCLUSIONS

The St. Thomas spawning aggregation of Nassau groupers and red hinds has been under increasingly intense fishing pressure for the last 10 years. No historic catch data are available from 1966 to the winter of 1974 outside of fishermen's accounts of frequent 1000-kg catches and a reported decline starting with the 1973-74 season. In 1974-75 we noted a discontinuity in the size-frequency distribution between the 1967 year class and older fish whose estimated ages were between 15 and 20 years. Coincidentally, this gap began with the first year of trap fishing.

The 1975-76 season brough a 31% increase in trap effort which yielded a 56% decrease in trap catch and a 76% decrease in CPUE. Handline catch was only 2% of the 1974-75 handline total, resulting in a 66% decrease in total catch.

We consider that the decrease in total catch with increased effort, the discontinuity in the 1974-75 age structure, the increased individual fish size of the 1976 catch, and particularly the spawning failure in 1976 indicate that this fishery is in need of management action. If we use the visual estimate of the 1974-75 spawning aggregation (1000 to 2000 fishes at the end of the aggrega-

Table 4. Sexual state (percent) of 375 Epinephelus guttatus caught between December 20, 1974 and May 16, 1975

	Lunar Month				
Sex	12/20-1/15	1/16-2/15	2/16-3/17	3/17-4/15	4/16-5/16
Male	2.1	19.6	29.7	25.9	0.0
Female	97.9	79.3	61.2	10.1	0.0
Undeveloped gonads*	0.0	2.1	10.1	64.0	100.0
Sample Size	149	149	27	28	22

*Sex not apparent on macroscopic examination

tion period), then fishing mortality accounted for between 60 and 75% of the population. The trap fishery accounted for 76% of the fishing mortality in 1974-75 and 99.5% in 1976.

Sylvester et al. (1977) undertook a partial survey of the fishery and found that the 1976-77 fishery involved 15 boats over a 97 day period. He calculated (calculations not shown) that the catch of Nassau groupers and red hinds was 10,010 kg. The project master fisherman (JAL) feels that the Nassau grouper portion of the catch was less than 500 fish or around 2500 kg. The master fisherman censused the 1977-78 fishery on 14 occasions (140 catches) and reported that the 10 boats caught less than 50 groupers (around 500 kg). The high catch was 13 groupers. The handline catch was near zero during both years. Red hinds were abundant on the bank during both the 1976-77 and 1977-78 aggregation periods.

Another comparative measure available for all four aggregation periods is the highest daily catch. In the 1974-75 aggregation a high catch of 63 groupers was observed. During the 1975-76 aggregation, the high catch was between 20 and 25 groupers while the final year high was only 13 groupers. The final year also marked a 33% decrease in effort over the previous year.

The fishery also has an indirect effect on the grouper aggregation in that large predators also aggregate to feed on the catch. It may well be that the large numbers of aggresive sharks prevented formation of the spawning aggregation in 1976. This may also account for the absence of *E. guttatus* from the bank in 1976. St. Croix fishermen feel that the shark abundance was responsible for the end of that aggregation.

Our findings on serranid hermaphroditism are in keeping with Smith's (1968) work. Smith (personal comm.) says that complete sex change may be disadvantageous to a long live fish in that it can prevent age class reproduction. We found no evidence of size-related fecundity to support the hypothesis that sex change is favorable if one sex gains in fertility more rapidly with age (Warner, et al. 1975)

A question arises regarding the role of sex change as a mechanism for the

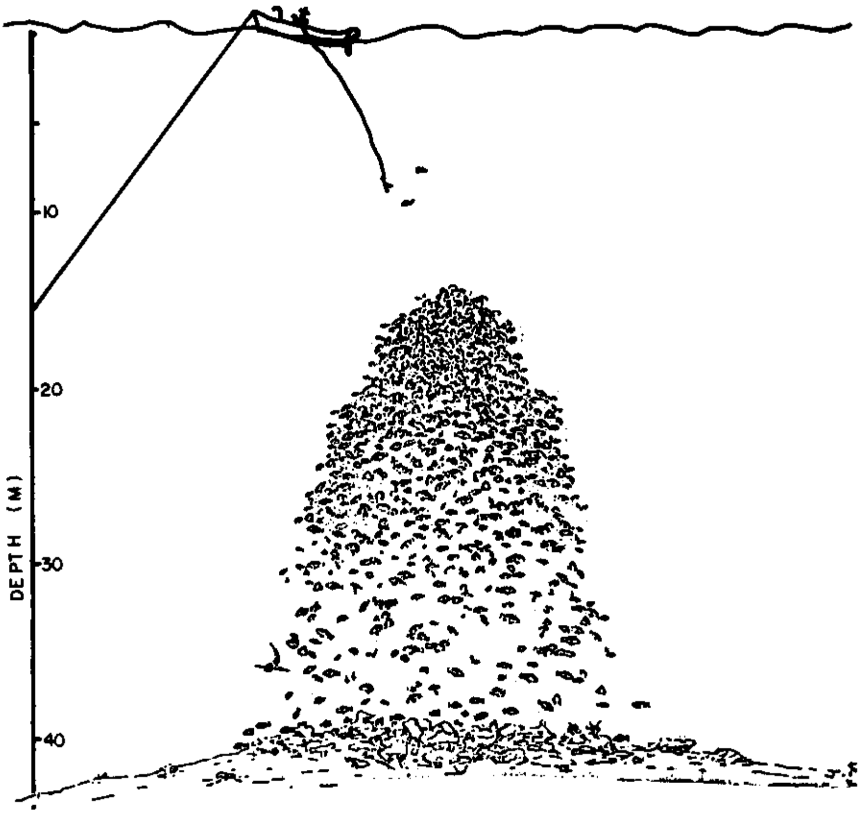

Figure 8. An artist's reconstruction of a breeding aggregation of Nassau groupers *(Epinephelus striatus)* that was observed by divers in 40 meters of water on January 27, 1975. The aggregation was on the edge of the 100 fathom curve, 8 miles south of St. Thomas, U.S. Virgin Islands.

population regulation. These periods of dense aggregation would seem an ideal time for some sort of phermonal group selection mechanism to operate. Certainly our data for *E. guttatus* suggest that sex change is accelerated at these times. Any rate regulation would certainly effect changes in population reproductive rate.

Other aggregation sites have been reported (Sylvester, et.al. 1977). Further investigation of these could answer questions about whether or not the aggregation presently under study represents a unit stock. We feel that the size class gap in the 1974-75 data supports this hypothesis. We also feel that the data indicate an unnecessary missed change for management. Hopefully, exploitation of other aggregations will not follow this pattern.

We would like to make a final observation on the impact of tropical fish poisoning, ciguatera, on the local fishery. The yellowfin grouper, *(Mycteroperca venenosa),* an excellent eating fish which is also a frequent poisoner, aggregates on the same bank during the same months immediately following the Nassau grouper - red hind aggregation. Unlike these two highly exploited species, the *M. venenosa* aggregation is subjected to near-zero fishing effort. A simple assay, were it available, could open this species to the same level of exploitation as *E. guttatus* and *E. striatus* and offer a source of income to local fishermen.

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