M. carcinus breeds during the summer months, the period July, August, and September being apparently the peak period of breeding activity. The rearing of juveniles from eggs has not as yet been successful, but we have succeeded in keeping the larvae alive for up to 14 days, and past the second larval moult. Larvae were reared for this period in plunger jars, and cultures of protozoa, single cell algae, and finely ground fish were supplied for food. It was found that larvae will not develop to even the first larval moult in fresh water alone, but require brackish water. Furthermore, it was found that the larvae will not live in water with pH above 8.5.

There are several problems which confront us in future work. The juvenile stages of the various species of the genus closely resemble one another, and to obtain specimens for stocking, juveniles of *M. carcinus* at least must be recognizable.

We believe it is now possible to recognize juvenile stages of *M. carcinus* from about 2 cm upwards, but the smaller stages have still to be described.

For the most practical stocking of a pond or tank, it would of course be most desirable to supply ovigerous females or freshly hatched larvae. This is perhaps the most important problem facing us. Further larval culture experiments are planned for the next breeding season.

While the current experiments have shown that growth of this species is rapid, and at least one crop each year may be possible, we feel that faster growth rates are possible on more suitable food. It has been found that both juveniles and adults will feed avidly on dried processed fish meal. Experiments are now in progress with this high protein food.

Finally, it is still necessary to follow the growth rates over the whole life cycle of a population, and to test the method in larger ponds on a commercial scale.

Tagging Reef Fishes in the Virgin Islands[1]

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OUR KNOWLEDGE OF THE HABITS of reef fishes in the Atlantic is very limited. Only the primarily taxonomic works of Beebe and Tee-Van (1928) and Longley and Hildebrand (1941) deal significantly with the habits of a number of species. The only tagging study of reef fishes in the Western Atlantic known to the author prior to the initiation of the present one was that from Bermuda reported by Bardach and Menzel (1957) and Bardach (1958).

The principal commercial fishery in the Virgin Islands is a trap fishery for reef fishes (Idyll and Randall, 1959). Many species comprise the catch. With so little known of the growth and movements of reef fishes, a decision was made to embark on a tagging program based largely on fishes taken in traps in the Virgin Islands. Rather than concentrate effort on just a few species, many were tagged. It was realized that data from some would be fragmentary.

The tagging was one phase of a marine biological-fisheries survey of St. John,

[1]Contribution 362 from The Marine Laboratory, University of Miami.

Virgin Islands (Figure 1), carried out by The Marine Laboratory of the University of Miami with support of Federal Aid in Fish Restoration (Dingell-Johnson project of the Virgin Islands), the National Science Foundation and the National Park Service. Tagging began in February, 1959, and continued until June, 1961.

No work was done with small species or juveniles of larger ones. Small fishes do not lend themselves well to tagging, and marking experiments generally require large samples which are difficult to obtain for most reef species. Thus the important early and characteristically rapid growth of young fishes is notably absent from this report. Such information must await life history studies of individual species or a more extensive program for many species than was possible under the circumstances of the present one.

Tagging was conducted at Lameshur Bay (Figure 2), which is located on the south shore of St. John. Reefs in the bay, as elsewhere around the island, are almost entirely fringing and not highly developed. Very few isolated patch reefs occur in St. John waters. Most of the bottom in bays consists of sea grass beds (*Thalassia* and *Syringodium*). For a chart of the marine environments of St. John, see Kumpf and Randall (1961).

The five tagging sites in Lameshur Bay are indicated by A to E (Figure 2). The shore reefs are interrupted by beaches at the heads of the two parts of the

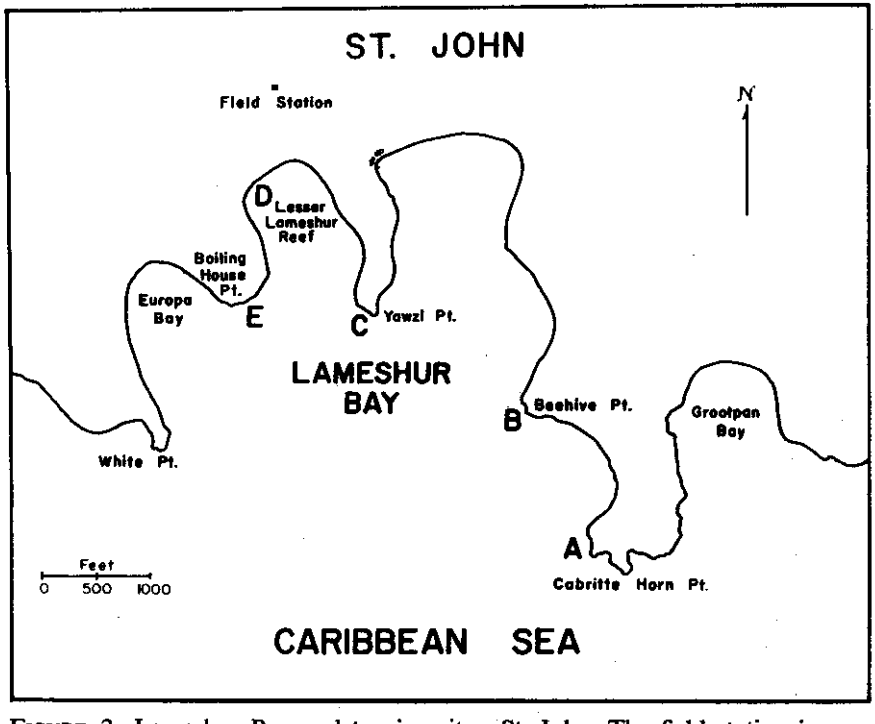

FIGURE 2. Lameshur Bay and tagging sites, St. John. The field station is now a district ranger station, Virgin Islands National Park.

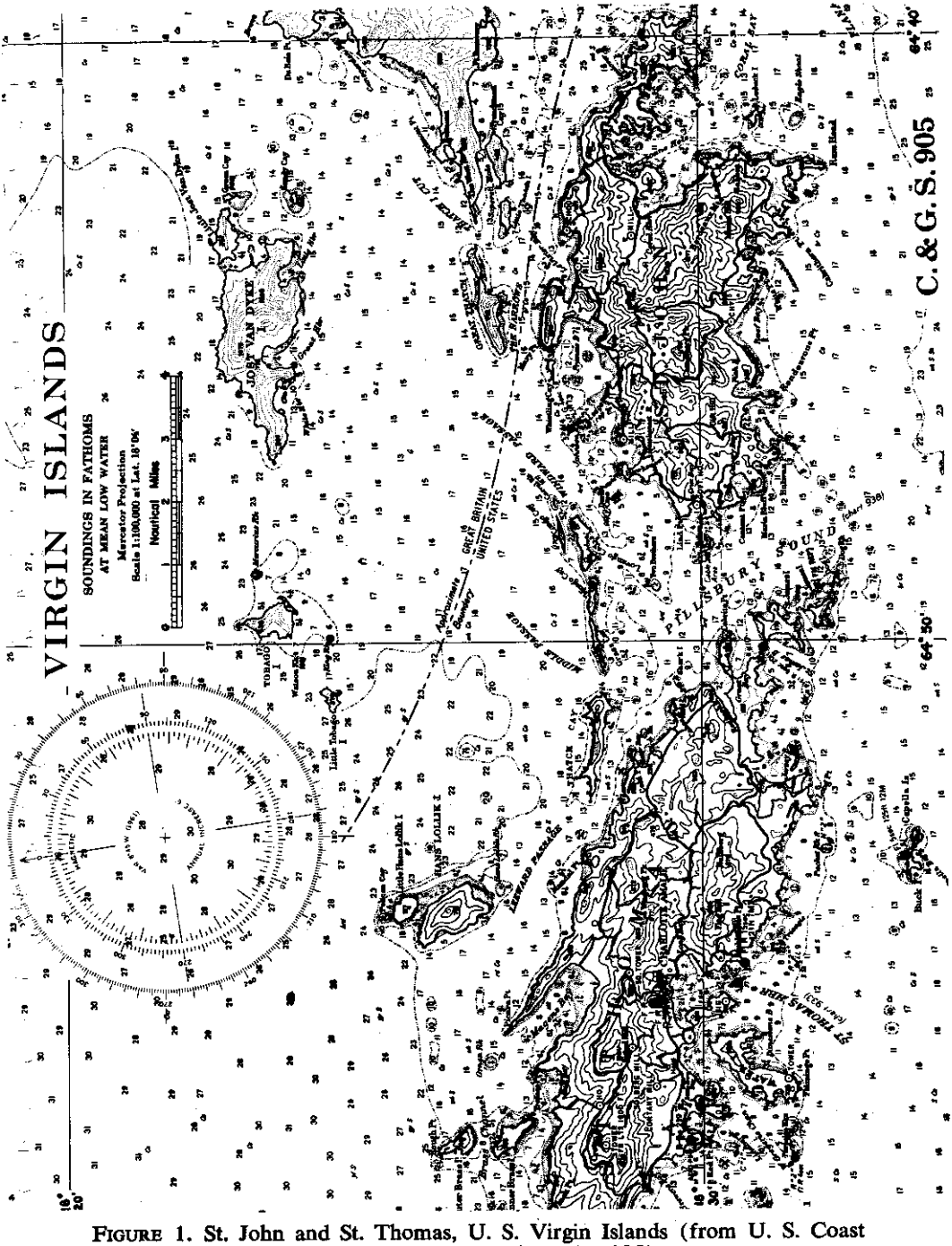

FIGURE 1. St. John and St. Thomas, U. S. Virgin Islands (from U. S. Coast and Geodetic Survey Chart No. 905).

bay. These open sandy stretches appear to represent barriers to the movement of some reef fishes; thus fishes have swum with greater frequency between A and B and D and E than C to B or D.

Little fishing takes place by local persons along the south shore of St. John; consequently the great majority of recoveries of tagged fishes were made by Marine Laboratory personnel. Since tagging activity was concentrated at Lameshur, less opportunity existed to catch fishes once they had moved away from the bay. Therefore the data are biased towards recovery of fishes at the five Lameshur tagging sites. In an effort to overcome this bias, spearfishing for tagged fishes was carried out all along the south shore of the island.

Nevertheless, it is apparent from the tagging results that reef fishes, in general, are nonmigratory. Such movements as are made are usually more-or-less localized. Over long periods, however, some fishes may make more extensive movements. Trapfishermen in the Virgin Islands know that the first catches from a trap set on a reef previously not fished may be exceptional, but the number of fishes taken soon diminishes. It is necessary to move the trap to another sector of reef at least several hundred yards away. Within a few months the trap can be moved back to the first locality and fairly good catches may again be made. These would seem to be the result of fishes moving into the region from adjacent reef areas. The same experience may be evident from hook and line fishing or spearfishing for reef fishes.

A further disadvantage to the tagging operation on St. John was the lack of any central fish market in St. John or St. Thomas. The presence of such a market would have been invaluable as a focus of activity for the recovery of tagged fishes and for giving publicity to the tagging program.

Tagging was publicized by direct contact with local fishermen, articles in the St. Thomas newspaper, and appearance on radio programs. Rewards for a tagged fish were 50 cents, later one dollar, plus the market value of the fish. Nevertheless the cooperation of local fishermen in the return of tagged fish was less than desired. Apathy and even suspicion of fisheries research were at times detectable among local people. The Virgin Islands has not had and does not now possess federal or local commercial fisheries investigations.

Tags were placed on 4093 fishes of 80 species. Most of the fishes were collected in chicken wire traps (Randall, 1960, Figure on p. 176) at depths of 5 to 40 feet, and all were released where captured. A few fishes were tagged after being caught with baited hook and line, by trolling lures, and by seine. Fork length (equivalent to total length for species with truncate or rounded caudal fins) was taken on a measuring board in millimeters from the tip of the snout or lower jaw with mouth closed (whichever the more anterior) to the end of the middle caudal rays.

Three different kinds of tags were used: Petersen disk tags, spaghetti tags, and dart tags. They bore the legend "Reward for Fish. Bring to National Park Service, V.I." and a number.

The disk tags (made by Howitt Plastics Co., Molalla, Ore.) were 3/8 or 1/2 inch in diameter and of five different colors for the five principal tagging localities in the bay. The tags were fastened through the back with a 60-lb. test monofilament nylon (Randall, 1956). Disk tags were placed primarily on compressed fishes or fishes which do not grow to large size, and hence could not bring growth pressure to bear against the disks.

Spaghetti tags (made by the Floy Tag and Manufacturing Co., Seattle)

consisted of soft tubular vinyl plastic 1/16 inch in diameter with monofilament nylon in the center. A loop was threaded through the back beneath the rear of the dorsal fin (Randall, 1960, Figure on p. 175) with a simple tagging tool modified from a screwdriver (a hole the size of the plastic tube was drilled near the end, and a sharp point was filed). The free ends of the plastic loop were clamped with a cylindrical 1/8-inch monel band (National Band and Tag Company, Newport, Ky.) on which the tag number was stamped. Tagging wounds were frequently large. Possibly the loop of the tags caught occasionally on rock or coral, and the wounds as a consequence may have enlarged. For this reason the use of spaghetti tags is not advised for future tagging of reef fishes.

Dart tags (Yamashita and Waldron, 1958; Everhart and Rupp, 1960: Figure 1) were of vinyl plastic tubing with nylon tip and barb. They were inserted into the back of the fish with a hollow needle in such a manner that the plastic streamer bearing the legend trailed posteriorly with a slight upward tilt. Less time was required to fix tags of this type to fishes, consequently it was used more often on less hardy species such as the goatfishes and parrotfishes for which rapid tagging is a necessity.

When it became apparent (from the recovery of individual fishes with tagging scars and the finding of loose tags on the bottom) that fishes were losing dart tags with greater frequency than disk or spaghetti tags, the Floy Tag and Manufacturing Company was asked to produce a double-barbed tag. The company complied, but results continued to be discouraging. Springer and McErlean (1961) also experienced poor results with dart tags in recent tagging of barracuda in the Florida Keys.

A total of 1247 recoveries of tagged fishes have been made in the Virgin Islands. A breakdown of the tagging and recoveries by the three tagging methods is given in Table 1.

Growth data are presented in tables and discussions for the various species. For growth purposes only the data from 284 fishes recovered after one month or more tag retention are given. For convenience, species accounts are presented alphabetically by family, genus, and species.

Length-weight curves are given for the following species: *Acanthurus bahianus, Balistes vetula, Lutjanus apodus, Sparisoma rubripinne, Epinephelus striatus,* and *Mycteroperca venenosa* (Figures 3 to 8). The length-weight relationships of other West Indian species of the same genera approximate these curves.

Because of uncertainty of the identification of porgies of the genus *Calamus,* data from the tagging of these sparid fishes are not reported.

TABLE 1

RELATIVE EFFICACY OF DIFFERENT TAGS ON VIRGIN ISLANDS REEF FISHES.

Type of Tag	Number of Fishes Tagged	Number of Recoveries	Percent of Recovery
Spaghetti	1568	647	41.3
Disk	1248	486	39.0
Dart			
Single Barb	916	83	9.1
Double Barb	361	31	8.6

Only after the tagging program was nearly completed was it discovered that two species of parrotfishes are classified by the name *Scarus croicensis* in recent works on the Scaridae; consequently the information from recoveries of tagged fishes of these species is not included in this report.

Tagging of certain fishes was notably unsuccessful. Only a single recovery was made of 173 jacks of the genus *Caranx* (81 *ruber*, 77 *fusus (=crysos)* and 15 *latus)*. Most of these were tagged with spaghetti tags following capture by hook and line. The one recovered jack, a specimen of *fusus*, was caught off eastern St. Thomas, nine miles from Lameshur, St. John. The fisherman who caught it threw away the tag and sold the fish; however his description of the tag and his ability to differentiate *fusus* would seem to authenticate the report. These three species of *Caranx* are roving predaceous fishes that are important in reef ecology because of their feeding in part on reef fishes. The low recovery rate is undoubtedly due to their greater movement than reef-dwelling fishes.

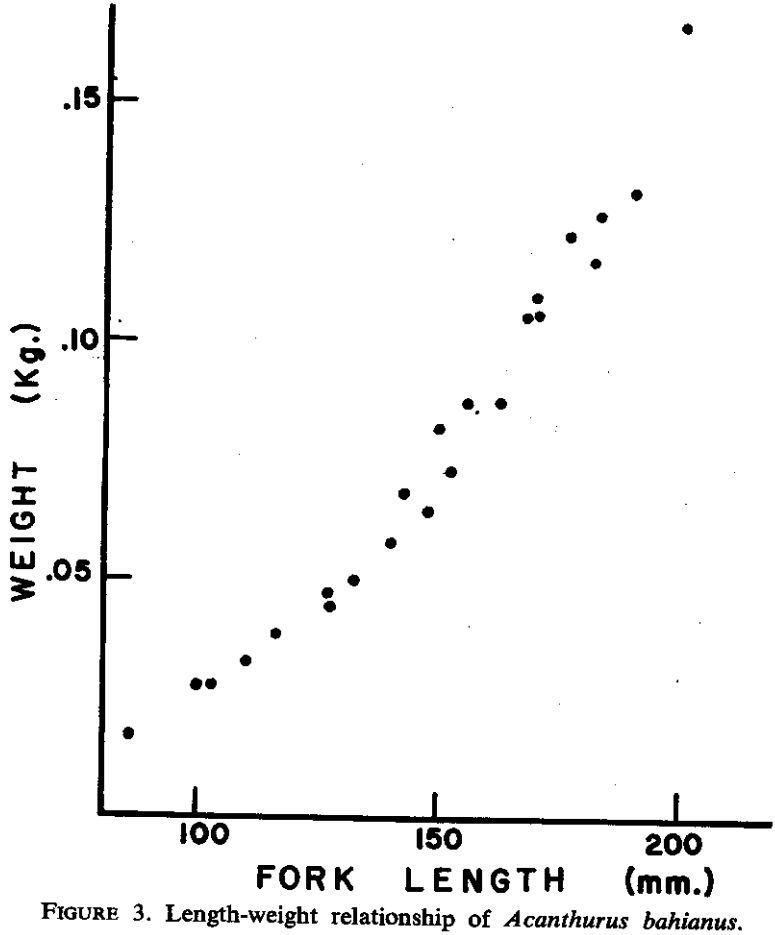

FIGURE 3. Length-weight relationship of *Acanthurus bahianus*.

Another species of fish for which tagging results have been poor, due apparently to a greater tendency to migrate, is the yellowtail snapper, *Ocyurus chrysurus*. Only 11 of 343 tagged fish were caught again.

The principal reason for low recovery rates of other fishes appears to have been tagging mortality. Not a single recovery or underwater sighting was made of 123 goatfish of the species *Mulloidichthys martinicus* which were tagged, and only two recoveries were made of 195 individuals of the other common goatfish, *Pseudupeneus maculatus*. None was made of 113 tagged parrotfish of the species *Sparisoma aurofrenatum*, although good results were obtained with other species of *Sparisoma*.

The tagging of the smaller species of grunts was also not productive. Only

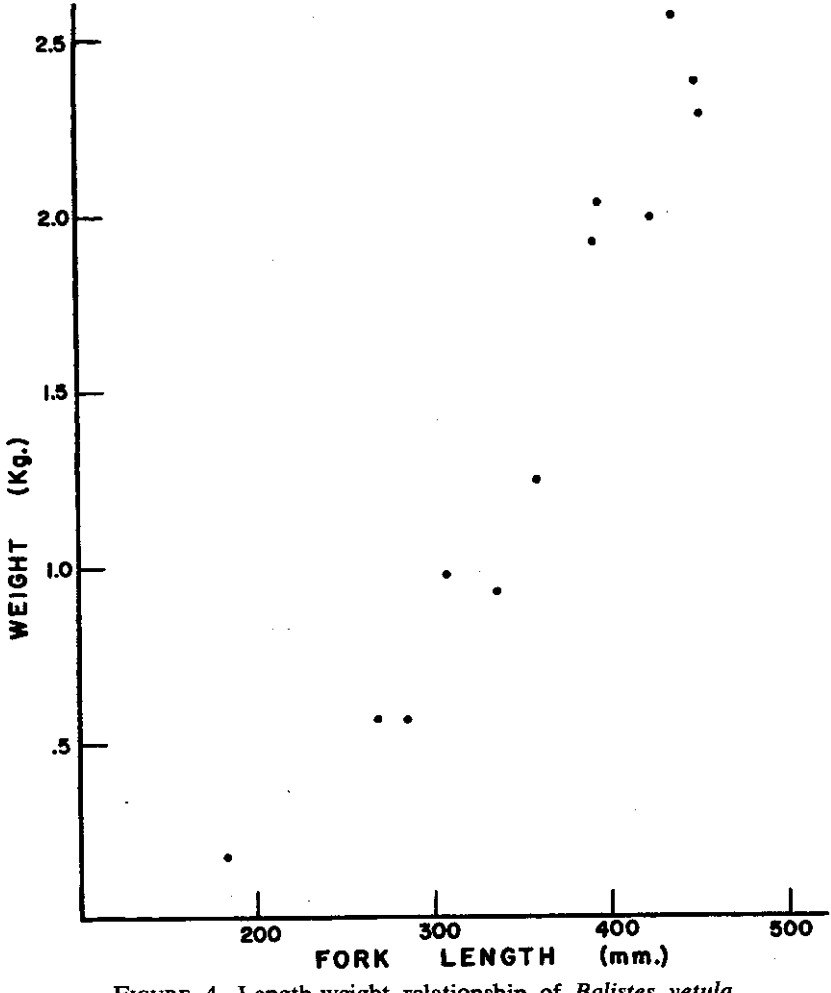

FIGURE 4. Length-weight relationship of *Balistes vetula*.

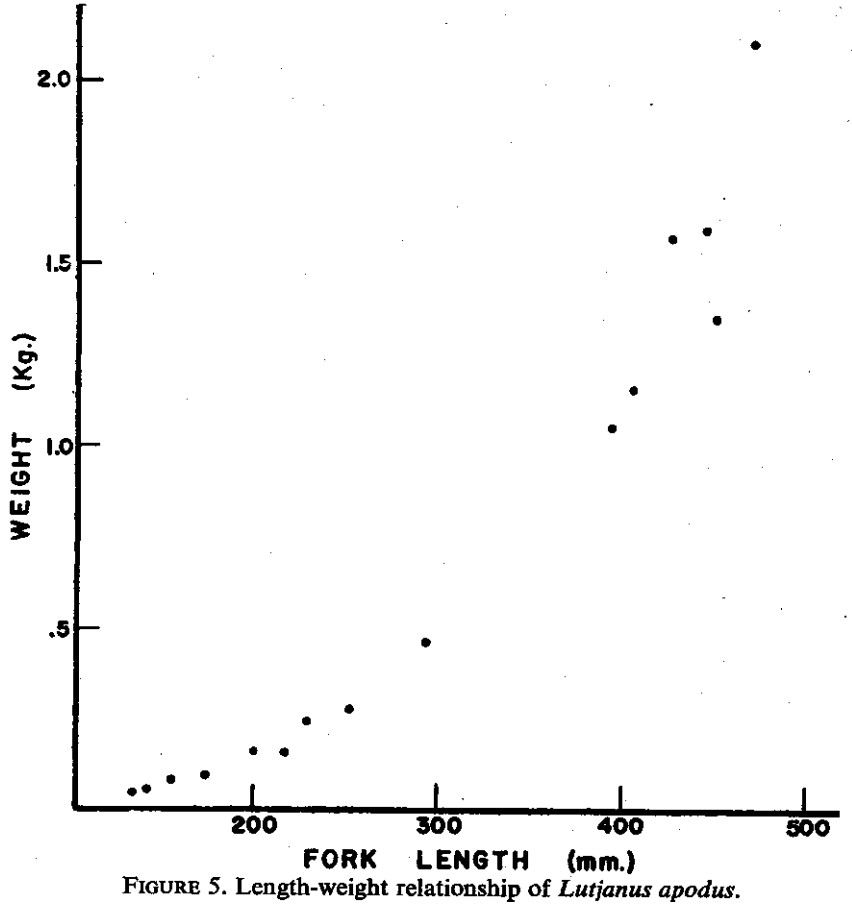

FIGURE 5. Length-weight relationship of *Lutjanus apodus*.

one specimen of *Haemulon aurolineatum* was obtained of 136 tagged and only four of 138 individuals of *H. flavolineatum*. Results with the common larger species of *Haemulon* were not much better. Nine recoveries were made of 75 bluestriped grunts *(H. sciurus)*, and 22 of 229 white grunts *(H. plumieri)* were recaptured. No recoveries were made of other species of grunts because few or none were tagged. Only two Caesar grunts *(H. carbonarium)* and no *H. album, H. macrostomum* or *H. parrai* were caught in the traps. Although not common, these fishes seem to occur more frequently than the low incidence in traps would indicate. Catches of snappers of the genus *Lutjanus* (except *synagris*) in traps were also out of proportion to the occurrence of these fishes on the reefs.

Some other fishes commonly seen on reefs are not prone to enter traps. Most conspicuous among these are the damselfishes (Pomacentridae). The well-known territorial habits of many species of this family probably explain in part the low catch. Only 12 damselfishes *(Abudefduf saxatilis* and *A. taurus)* were tagged from the traps.

Species of the serranid genus *Hypoplectrus* are rarely caught in traps and none was taken in those set for tagging fishes. It is suspected that these fishes may remain in relatively circumscribed sectors of reef.

Only nine of the relatively common trumpetfish *(Aulostomus maculatus)* were tagged, and none was caught again.

Most of the common wrasses of the reef are too small to be taken in the traps which were used. Fourteen puddingwife (*Halichoeres radiata*) were tagged, with one recovery. Eleven of the larger *H. bivittatus* were tagged from traps but none was recaptured. No Spanish hogfish (*Bodianus rufus*) and only three hogfish (*Lachnolaimus maximus*) were tagged. The latter species is relatively rare in the Virgin Islands.

Only one specimen of *Priacanthus cruentatus* and none of *P. arenatus* was tagged. Two adults of *cruentatus* were repeatedly seen in four feet of water beneath a branch of coral *(Acropora palmata)* at Lesser Lameshur Reef over a period of more than two years. Although a trap was frequently set nearby, neither was caught.

Certain fishes, particularly the groupers and surgeonfishes, showed a proclivity to re-enter traps, and the same fishes were often recovered many times. Fifty four individual fishes of 12 species were each recovered and released more than five times. These included the groupers *Mycteroperca venenosa* (one was captured 21 times, another 14), *M. tigris* (one was caught 21 times), *Epinephelus striatus, E. adscensionis,* and *Cephalopholis fulva;* the surgeonfishes *Acanthurus coeruleus, A. bahianus,* and *A. chirurgus;* the angelfishes *Pomacanthus aureus* and *P. arcuatus;* the parrotfishes *Scarus coeruleus* and *Sparisoma rubripinne;* and the dog snapper *Lutjanus jocu.*

The groupers often fed upon fishes while in the traps and it was presumed that the greater ease with which they could catch fishes in a trap may have been the attractive force that brought them back repeatedly. This, however, could not explain why herbivorous surgeonfishes and sponge-feeding angelfishes returned again and again to the same trap, for as long as they remained in a trap their food supply was very limited.

In spite of the apparent bountiful food supply in the traps for the large piscivorous fishes such as some of the groupers, they did not exhibit any better growth than fishes not spending long periods in traps and often did not grow at all or actually shortened in length. As would be expected, this lack of growth was also evident for some of the nonpiscivorous fishes. That actual shortening can occur during starvation was demonstrated for a Hawaiian surgeonfish by Randall (1961: 258).

The cessation of growth or shrinkage of fishes that have spent much time in fish traps naturally has a profound effect on growth rates as computed from recovery of tagged fish. For this reason the number of times that tagged fishes were recaptured is indicated in each table. Data from fish with repeated captures should not be given the same weight as that from fishes that have spent their time back in the sea away from traps. Had it been possible, tagging of fishes would have been carried out during short intensive periods of trapping rather than almost continuously.

More importance should be attributed to data from fishes recovered after long periods of tag retention. If a fish's growth is adversely affected from tagging, the effect is more apt to occur shortly after the tagging operation. Frequently, tagged fish showed little or no growth during the first month or so after release. Probably closer values to the normal growth could be obtained

by eliminating one month from the tagging period when computing the rate of growth. No such adjustments were made in the present paper, however.

Also, errors in measuring fishes are more significant for short periods of growth than long. The possible error in the initial measurement of a fish (which can be as great as 2 mm when obtaining the length of a large live fish in a small boat) is independent of the error the second time the fish is measured. If by chance these errors compound, the apparent difference in length could be as great as 4 mm from the true difference.

Individual fish, particularly among the Serranidae, which were frequently recaptured did not put up as much resistance to their measurement and the reading of their tag numbers (which often meant first a cleaning of algae from the tags) as when first captured (Randall, 1960). V. G. Springer (personal communication) also observed this during recent tagging of reef fishes in the Florida Keys.

Some tagged fishes such as *Holocentrus rufus* and *Haemulon* spp. have not shown what would seem to be normal growth even after long tagging periods and when not repeatedly captured in traps. Tagging wounds of these fishes were frequently large, but even when not, growth was at times negligible. There seems little doubt that tagging has had a deterring effect on the growth of some species.

The parrotfishes showed the most rapid growth of those fishes that were tagged. Underwater observation and quantitative poison stations seem to indicate that this family of fishes is the dominant one on a weight basis on shore reefs in the Virgin Islands; therefore it is probably the most important in terms of productivity. The parrotfishes are primarily herbivorous. They grind their plant food very finely with inorganic material in their efficient pharyngeal mill. This should mean a high utilization of the food value of the algae and sea grasses on which they graze. Parrotfishes were found more frequently in the stomachs of the larger carnivorous fishes than other reef fishes.

Because of the importance of the water temperature to the growth rate of marine poikilothermous organisms, biweekly sea temperatures were taken at the bottom at two localities in Lameshur Bay: near Lesser Lameshur Reef at a depth of 7 feet and Yawzi Point at a depth of 30 feet (Figure 2). These temperatures were averaged on a monthly basis and are recorded in Table 2.

Although the variation in mean monthly sea temperature on St. John did not exceed 2.8°C throughout any one year, there is evidence that a few fishes such as *Acanthurus bahianus* grow slightly faster during warmer months. Others such as *Epinephelus striatus* apparently do not. However, data for individual species are inadequate to permit an analysis of the effect of temperature on growth.

Thanks are due Herman E. Kumpf, James R. Chess, Robert E. Schroeder, and Gladston Matthias for sea temperature determinations and assistance in tagging, and Helen A. Randall for preparation of tags and recording of data.

ACANTHURIDAE

Acanthurus bahianus

A total of 281 individuals of *A. bahianus* were tagged; 196 recoveries were made, but 131 of these represent multiple captures of the same fish. Twenty one recoveries were made of tagged fish at large for one month or more (Table 3). Initial tagging lengths of these ranged from 97 mm to 180 mm fork length.

TABLE 2

AVERAGE MONTHLY SEA TEMPERATURE (C) AT BOTTOM IN LAMESHUR BAY, ST. JOHN.

Month	Yawzi Point (Depth 30′)	Lesser Lameshur Bay (Depth 7′)
May, 1959	27.0	27.0
June, 1959	28.0	28.7
July, 1959	28.3	29.0
August, 1959	29.1	29.5
September, 1959	29.4	29.9
October, 1959	29.1	29.3
November, 1959	28.4	28.6
December, 1959	27.7	27.8
January, 1960	27.2	27.6
February, 1960	27.3	27.5
March, 1960	27.4	27.7
April, 1960	27.4	28.0
May, 1960	28.5	28.9
June, 1960	28.9	29.1
July, 1960	28.8	29.2
August, 1960	28.9	29.2
September, 1960	28.9	29.4
October, 1960	28.9	29.3
November, 1960	28.9	29.4
December, 1960	27.1	27.2
January, 1961	26.5	26.7
February, 1961	26.5	27.2
March, 1961	26.1	26.9
April, 1961	27.1	27.8
May, 1961	27.3	27.5

The average growth of tagged fish from 97 to 137 mm was 2.2 mm per month; of those from 140 to 180 mm it was 0.6 mm per month. If the individual fish registering no growth are ignored, these figures become 2.7 mm and 1 mm, respectively.

The five recovered fish that grew predominately in the warmer half of the year (June to November) increased their length at a rate of 2.7 mm per month. The nine which were at large with tags mostly during the cooler half of the year (December to May) grew 1.58 mm per month. The probability of obtaining a difference in growth rate of this magnitude by random sampling from a population in which there is no difference is 0.13 (test by group comparisons method) hence the difference is not statistically significant. Randall (1961) demonstrated that the growth of tagged *Acanthurus triostegus* in Hawaii ceased completely during winter months. Sea temperatures in Hawaii in winter months are around 24° C, hence about 3° C cooler than St. John waters during the coolest part of the year.

All but four of the 196 recoveries were from the same trap from which the fish were originally tagged. Two fish moved from Beehive Point to Cabritte Horn Point (B to A, Figure 2), another from Yawzi Point to Boiling House Point (C to E), and the fourth from Lesser Lameshur Reef to Boiling House

TABLE 3

RECOVERY OF TAGGED *Acanthurus bahianus*.

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	97	4/20/59	102	6/12/59	3	53	2.87
disk	105	5/29/59	109	7/ 1/59	2	33	3.69
disk	109	11/13/59	118	2/29/60	2	108	2.53
spaghetti	109	1/24/61	110	4/ 5/61	2	71	.43
disk	111	6/12/59	120	9/22/59	9	102	2.68
spaghetti	117	1/ 4/61	117	2/ 6/61	1	33	0
disk	124	8/13/59	155	5/11/60	1	272	3.46
spaghetti	125	12/ 7/60	125	1/25/61	4	49	0
spaghetti	125	1/ 4/61	126	2/ 6/61	1	33	.92
disk	128	6/12/59	136	7/30/59	3	48	5.07
disk	137	7/24/59	137	9/ 1/59	3	39	0
disk	140	4/23/59	143	6/15/59	5	53	1.72
disk	143	8/28/59	143	12/11/59	2	105	0
disk	161	4/ 7/59	161	9/ 3/59	2	149	0
disk	161	4/28/59	164	7/10/59	2	73	1.25
disk	163	4/13/59	165	6/15/59	6	63	.97
disk	170	4/ 7/59	172	7/22/59	2	106	.57
disk	175	4/29/59	176	6/ 8/59	5	40	.76
disk	177	4/22/59	180	8/11/59	4	111	.82
disk	179	4/27/59	179	6/24/59	5	58	0
disk	180	4/ 7/59	180	9/18/59	9	164	0

TABLE 4

RECOVERY OF TAGGED *Acanthurus chirurgus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	86	12/ 7/59	92	2/29/60	5	84	2.17
disk	100	5/26/59	103	6/26/59	1	31	2.94
disk	100	8/13/59	106	9/22/59	3	40	4.56
disk	112	12/31/59	115	2/23/60	1	54	1.69
disk	116	12/31/59	119	2/11/60	4	42	2.17
spaghetti	134	7/14/60	144	12/29/60	3	168	1.81
disk	155	7/ 7/59	158	8/11/59	1	35	2.61
disk	163	4/20/59	168	7/24/59	1	95	1.60
disk	174	4/14/59	184	8/ 3/59	4	111	2.74
disk	181	4/20/59	186	9/ 1/59	3	134	1.13

Point (D to E). No tagged fish were seen or taken outside Lameshur Bay. This surgeonfish, therefore, does not appear to undertake extensive movements. Bardach (1958) reported that divers in Bermuda followed browsing schools of *Acanthurus bahianus* and *A. chirurgus* for 30-minute periods and did not go beyond the confines of 500 square meters.

This species is the most abundant of the three surgeonfishes in the Virgin Islands, although not by a wide margin. It is the smallest species, reaching a standard length of about 170 mm and a fork length of about 200 mm.

Acanthurus chirurgus

A total of 108 individuals of *chirurgus* were tagged; 46 recoveries were made, although 21 of these were repeated captures of the same fish. As indicated in Table 4, there have been 10 recoveries of one month or more tagging duration.

The average growth of the 10 fish, 86 to 181 mm at time of tagging, was 2.3 mm per month.

Only one of the tagged fish displayed movement away from the tagging area. It swam from Yawzi Point to Boiling House Point like one of the *A. bahianus*. This movement probably took place more-or-less directly from one point to the other and not along the shore. The surgeonfishes are often seen straying away from the rock and coral at the shore into the sea grass beds to graze on epiphytic algae on the grasses and to a lesser extent on *Syringodium* directly. Although the fish do not normally venture more than about 50 feet from the shelter of the reef, occasional small groups may be seen more than 100 feet into the sea grass area. Surgeonfishes were never observed over sand flats far from reefs in the inshore part of Lameshur Bay. These sandy stretches are essentially devoid of plants of macroscopic size.

A. chirurgus reaches a fork length of nearly 300 mm.

Acanthurus coeruleus

A total of 161 blue tang were tagged. Coincidentally, there have been 161 recoveries, 117 of which are repeated captures of the same fish. One fish was caught 15 times.

The 19 tagged fish recaptured after a month at large (Table 5) grew an average of 0.94 mm per month. Ignoring ones with no growth, the rate is 1.28 mm per month.

The smallest tagged blue tang, a 93 mm fish, displayed a much higher growth rate, 6.38 mm per month, than the other 18 fish of Table 5. The possibility of error would seem obviated by the first recovery of this fish on August 25, 1959. It measured 108 mm in fork length at this time, thus the rate during the first segment (42 per cent) of the total tagging period was still rapid, 5.77 mm per month.

As with the previous two surgeonfishes, there have been no extensive movements. Only eight of the recoveries represented movement from the tagging sites. One fish moved from Cabritte Horn Point to Beehive Point (A to B of Figure 2), two from Boiling House Point to Yawzi Point (one of these was taken four times at Yawzi Point, the last time from the stomach of a barracuda), and two made excursions between Boiling House Point and Lesser Lameshur Reef. One of the latter was caught in traps eleven times and made four trips back and forth between these two localities, a distance one way of about 350 yards.

A. coeruleus attains a length nearly as great as *chirurgus*, but it is higher bodied.

TABLE 5

RECOVERY OF TAGGED *Acanthurus coeruleus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	93	6/12/59	129	12/ 1/59	2	172	6.38
spaghetti	96	8/1 /60	98	10/ 4/60	1	64	.95
disk	101	11/20/59	105	3/10/60	3	111	1.09
disk	130	7/22/59	148	8/12/60	11	387	1.41
disk	130	12/11/59	131	3/18/60	2	98	.31
disk	145	4/21/59	146	12/23/59	8	246	.12
disk	148	4/27/59	151	5/29/59	3	32	2.86
disk	152	4/10/59	154	6/12/59	1	62	.98
disk	159	4/21/59	159	7/24/59	3	94	0
disk	164	4/20/59	165	7/24/59	3	95	.32
disk	167	4/21/59	168	7/28/59	5	98	.31
disk	180	4/21/59	180	6/ 8/59	1	48	0
disk	182	4/17/59	183	6/ 8/59	9	52	.58
disk	183	4/22/59	184	5/22/59	4	30	1.02
disk	183	4/27/59	182	7/20/59	6	84	0
disk	184	4/21/59	184	10/14/59	7	176	0
disk	187	4/27/59	186	6/10/59	4	44	0
disk	189	4/22/59	190	5/22/59	4	30	1.02
disk	190	4/27/59	191	6/17/59	7	51	.59

TABLE 6

RECOVERY OF TAGGED *Balistes vetula*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	192	5/15/61	235	10/12/61	1	149	8.8
spaghetti	195	9/14/59	202	12/21/59	1	98	2.17
spaghetti	199	5/ 6/59	198	6/ 8/59	2	33	0
spaghetti	219	6/22/59	229	8/ 6/59	1	45	6.76
spaghetti	220	6/15/60	229	9/12/60	1	89	3.07
spaghetti	227	3/22/60	229	9/27/60	1	189	.32
spaghetti	256	2/11/60	275	9/27/60	1	229	2.53
spaghetti	261	12/17/59	292	4/26/60	1	131	7.20
spaghetti	292	4/26/60	385	6/19/61	3	419	6.74
spaghetti	302	3/15/60	310	6/ 8/60	2	85	2.87

TABLE 7

RECOVERY OF TAGGED *Holocanthus ciliaris*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	186	7/ 1/59	188	9/21/69	2	82	.74
disk	190	11/ 9/59	192	12/28/59	2	49	1.25
spaghetti	192	12/ 1/60	200	5/21/61	1	171	1.42
spaghetti	199	6/17/59	200	8/18/59	2	62	.49
dart	201	7/22/59	200	9/24/59	2	64	0
spaghetti	216	5/27/59	217	9/14/59	4	110	.28
spaghetti	217	6/17/59	217	7/22/59	2	35	0

BALISTIDAE

Balistes vetula

Fifty one queen triggerfish were tagged, and 23 recoveries were made. Nine of these represent recaptures of fish for a second or third time. Ten were at large with tags one month or more (Table 6). If the one fish that was recovered after 33 days and showed no growth is eliminated, the average growth rate for fish ranging from 192 to 302 mm fork length is 4.4 mm per month.

The most interesting of these ten tagged fish is the one which was at large nearly 14 months. It grew at an average rate of 6.8 mm per month. When first recovered on September 9, 1960, it measured 322 mm, hence had grown 30 mm in 4½ months. The second recovery occurred on October 4, 1960 and the fish had increased its length another 5 mm. When speared on June 19, 1961, it was 385 mm in fork length. The tagging wound was insignificant.

Only one of the 22 recoveries showed any movement among tagging sites. This fish migrated from Beehive Point to Cabritte Horn Point, a distance of about 450 yards. However, when an artificial reef of 800 concrete blocks was built in sea grass at a depth of 30 feet in Lameshur Bay nearly equidistant between Boiling House Point and Yawzi Point, one of the first two fishes which colonized this reef as adults was *Balistes vetula*. Six appeared on the reef within the first three weeks. Most reef fishes came to the reef only as juveniles.

The largest of 78 adult specimens collected in the Virgin Islands measured 480 mm in standard length (about 570 mm fork length). Nearly all of these had fed on the sea urchin *Diadema antillarum*.

CHAETODONTIDAE

Chaetodon capistratus

Sixty-nine foureye butterflyfish were tagged, mostly with disk tags. Only three recoveries were made. One of these grew from 73 mm fork length on November 13, 1959, to 86 mm on February 2, 1960. None moved from the tagging area.

Few butterflyfishes of the species *Chaetodon striatus* and *C. ocellatus* were tagged and none was recovered.

Bardach (1958) has concluded from tagging and observations in Bermuda that the chaetodontids in general spend their entire lives associated with a relatively small portion of the reef environment.

Holocanthus ciliaris

Sixteen queen angelfish were tagged. Eight recoveries were made of fish which retained their tags for one month or more (Table 7). Tagging wounds were usually extremely large. Some fish had a hole more than a centimeter in diameter at the narrowest point where the spaghetti tag passed through the body. Growth rates are low (Table 7), and it is believed that they are far below what would be normal for the species.

Only one fish showed any movement. It was speared half way between Boiling House Point and Lesser Lameshur Reef (between D and E of Figure 2).

Only one rock beauty *(Holocanthus tricolor)* was tagged. It was not caught again.

Pomacanthus aureus

Forty seven gray angelfish were tagged; 52 recoveries have been made, of which 28 were multiple captures of the same fish. One tagged fish was re-

covered nine times. Eight fish were at large one month or more with spaghetti tags (Table 8). Four of these showed insignificant growth. These four had either a short tagging period (two months or less) or were recaptured many times in traps, indicating long sojourn and hence starvation in the traps. The other four, with tagging periods up to nearly eight months, grew at a decreasing rate from 6.47 mm per month for a 144 mm fish to 1.56 mm per month for a 280 mm fish. *P. aureus* can attain a fork length of at least 450 mm.

Some of the tagged fish exhibited large tagging wounds. Two fish without tags were observed underwater which had a large "U"-shaped gap through the dorsal fin down into the back to a place where spaghetti tags are inserted. Undoubtedly these scars were the result of tagging and subsequent shedding of the tag.

None of the tagged angelfish was seen outside Lameshur Bay. One moved from Yawzi Point to Boiling House Point and three made movements between Beehive Point and Cabritte Horn Point (one fish made three such movements and another two).

Only nine French angelfish *(P. arcuatus)* were tagged. None of the five recoveries was of fish at large one month or more. None of the fish showed any movement.

ELOPIDAE

Megalops atlantica

Spaghetti tags were affixed to three tarpon at Lameshur. One was taken in a seine on the beach in Lesser Lameshur Bay and measured 965 mm fork length. Two others were caught with hook and line from a brackish mangrove slough on the western side of Greater Lameshur Bay. These measured 415 and 576 mm fork length. None was recovered, but one of the latter two was observed in the same slough a year later.

Small groups of larger tarpon were seen in inshore waters of St. John, often off points like Cabritte Horn. These tarpon did not seem to remain long in one area. That tarpon are capable of extensive migrations was demonstrated in the recovery of an adult off Louisiana that was tagged at Boca Grande, West Florida (Randall, 1959). Data on growth and other aspects of the biology of the tarpon may be found in Breder (1944) and Randall and Moffett (1958).

HOLOCENTRIDAE

Holocentrus ascensionis

Of 94 squirrelfish (*H. ascensionis*) tagged with disk or dart tags, 44 recoveries were made. Twenty-six of these were of fish caught a second or third time. Eleven from 137 to 213 mm bore their tags more than one month (Table 9). The average growth of these 11 fish was only 1.47 mm per month. This is undoubtedly less than normal, for included in the average were data from five fish which grew less than 1 mm or not at all.

The largest specimen of *H. ascensionis* collected in the Virgin Islands was 235 mm in standard length.

All of the fish were caught in the same traps where they were originally tagged.

Holocentrus rufus

One hundred twenty-five longspine squirrelfish were tagged, the largest 217 mm fork length. Specimens as large as 240 mm standard length (fork length

TABLE 8

RECOVERY OF TAGGED *Pomacanthus aureus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	144	5/18/59	195	1/ 6/60	1	233	6.47
spaghetti	174	1/ 6/60	282	6/ 9/61	2	529	6.21
spaghetti	194	12/31/59	196	10/27/60	9	301	.20
spaghetti	203	10/27/60	200	12/29/60	2	63	0
spaghetti	219	2/11/60	220	11/17/60	5	280	.11
spaghetti	232	12/29/60	254	6/15/61	1	168	4.00
spaghetti	261	12/29/60	260	2/20/61	1	53	0
spaghetti	280	2/11/60	287	6/27/60	1	136	1.56

TABLE 9

RECOVERY OF TAGGED *Holocentrus ascensionis*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	137	2/27/59	140	4/20/59	1	52	1.75
disk	140	2/27/59	152	5/ 5/59	2	67	5.46
disk	148	4/30/59	150	7/20/59	2	81	.75
disk	153	4/17/59	157	6/ 3/59	2	47	2.59
disk	154	2/27/59	152	6/ 2/59	3	95	0
disk	164	4/22/59	175	9/24/59	1	155	2.16
disk	165	2/27/59	165	5/ 7/59	2	69	0
dart	165	5/ 1/59	168	7/20/59	2	80	1.14
dart	168	1/ 1/60	169	2/18/60	2	48	.63
disk	199	4/30/59	202	7/20/59	1	81	1.13
dart	213	5/22/59	215	9/ 1/59	3	102	.59

about 260 mm) have been collected in the Virgin Islands. Twenty-one fish were caught again, and six of these a second time. Fifteen held their tags for one month or more (Table 10); five of these were at large five months or more, one of the latter for over a year and another for over one year and seven months. In spite of the long tag retention, no fish has shown significant growth. Eight did not grow at all. Although tagging wounds were usually small, tagging appears to have had a determined effect on growth.

Two of the tagged fish showed movements. One swam the short distance from Cabritte Horn Point to Beehive Point, the other from Yawzi Point to Friis Bay in Coral Bay, St. John, a distance of at least 4 miles. This was the 190 mm fish that was returned dried to the author in October, 1960, slightly more than a year after being tagged by a local fisherman who seemed certain of the place of capture although he could not remember the day in October when he caught the fish.

The spaghetti tag of one *H. rufus* was found in the stomach of a Nassau grouper *(Epinephelus striatus)* 350 mm in standard length caught at Lameshur. This squirrelfish was 185 mm in fork length when tagged nine months previously.

Twelve squirrelfish of the species *Myripristis jacobus* were tagged, but none was recovered.

LABRIDAE

Halichoeres radiata

Fourteen puddingwife were tagged, and one was recaptured. It was tagged with a spaghetti tag on January 8, 1960 at a fork length of 240 mm and caught again in the same place exactly two months later, at which time it measured 260 mm.

H. radiata is much the largest of the nine Western Atlantic species of *Halichoeres*. Specimens up to 355 mm in standard length have been collected in the Virgin Islands, and others even larger have been observed underwater.

LUTJANIDAE

Lutjanus apodus

Forty-seven schoolmasters were tagged, mostly with spaghetti tags. Twenty-five recoveries were made, of which 13 represent recaptures of individual fish a second, third, or fourth time.

Seven of these snappers were at large a month or more, one for over 21 months. Their growth was highly variable (Table 11), apparently reflecting in part the different size at tagging. The greatest growth, 5.73 mm per month, was registered for a 176 mm fish. A smaller (152 mm) fish, however, recovered three times in four months showed only 1.0 mm increase in fork length. The largest tagged fish, 329 mm fork length, grew 1.77 mm per month over a period of nearly nine months.

The largest of 78 specimens of *L. apodus* collected in the Virgin Islands with spears for stomach content and gonad analyses measured 445 mm standard length (fork length about 520 mm).

Of the 25 recoveries of tagged fish, 21 were made at the site of tagging or place of previous recovery. One fish moved from Boiling House Point to Lesser Lameshur Reef, and another from Cabritte Horn Point to Beehive Point. The remaining two movements were more noteworthy. One fish was speared 0.8

TABLE 10
RECOVERY OF TAGGED *Holocentrus rufus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	162	11/ 9/59	162	12/23/59	1	44	0
disk	175	6/ 1/59	174	11/ 9/59	1	161	0
disk	178	5/13/59	180	7/ 1/59	2	49	1.24
disk	180	8/ 3/59	180	9/10/59	1	38	0
disk	180	11/ 9/59	182	1/21/60	1	73	.83
disk	185	5/25/59	190	12/ 9/59	1	198	.77
disk	189	7/ 1/59	187	8/ 7/59	1	37	0
disk	190	9/24/59	185*	10/ ?/60	1	373+	
disk	192	5/25/59	190	9/10/59	2	109	0
disk	193	5/21/59	194	8/11/59	1	82	.37
disk	195	8/ 7/59	195	9/14/59	1	38	0
disk	200	4/21/59	200	12/21/59	2	244	0
disk	205	6/19/59	205	9/14/59	1	87	0
disk	206	11/ 9/59	210	2/18/60	2	101	1.20
disk	**	12/21/59	182	8/ 3/61	1	591	

*Specimen returned dried.
**Last numeral of tag number illegible. Fork length at tagging could have been 166, 175 or 180 mm.

TABLE 11
RECOVERY OF TAGGED *Lutjanus apodus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	152	2/29/60	153	6/27/60	3	119	.26
spaghetti	176	1/13/61	202	5/31/61	1	138	5.73
spaghetti	212	4/16/59	238	1/21/60	5	280	2.82
spaghetti	286	9/14/59	307	6/18/61	3	643	1.01
spaghetti	288	9/21/59	295	6/ 8/60	2	261	.82
spaghetti	317	7/ 6/60	318	8/17/60	3	42	.72
spaghetti	329	5/ 3/60	344	1/20/61	1	261	1.71

mile to the east of Cabritte Horn Point at Booby Rock, and the other was taken at the eastern end of Reef Bay 0.5 mile to the west of Boiling House Point.

Lutjanus griseus

Only six gray snappers were tagged. Although not as common as schoolmasters in the tagging areas, certainly more are found there than the low rate of catch in traps would indicate. Three of these fish were caught again, all at or near the place of tagging. One was recaptured twice and another three times. All were at large with their tags one month or more (Table 12). Growth of these three fish, 152 to 180 mm fork length, averaged 3.1 mm per month.

The largest *L. griseus* of 57 collected in the Virgin Islands measured 400 mm in standard length.

Lutjanus jocu

Only three dog snappers were tagged. One of these was caught again. It was taken a total of nine times over a period of nearly 11 months in the same trap from which it was first tagged. It measured 413 mm when tagged and only 415 mm when taken the last time.

The largest of 41 *L. jocu* collected with spears in the Virgin Islands measured 630 mm in standard length and weighed 17¼ pounds.

Lutjanus synagris

Ninety-three Lane snappers from 114 to 198 mm fork length were tagged, but only five were recovered. Most tagged fish were small, only 15 exceeding 170 mm, and it is believed that tagging mortality may have been high for the smaller fish. Most were tagged with disk tags.

Two fish held their tags for more than one month. One 158 mm fish tagged with disk tags on April 10, 1959, was caught again on June 8 at which time it was 152 mm fork length. The second, tagged with a dart tag on June 17, 1959, at a fork length of 141 mm was recovered on August 21 at a length of 151 mm.

Most of the *L. synagris* were tagged from Lesser Lameshur Reef (D of Figure 2). Small fish of this species were common at this locality, mingling with small grunts, in two to five feet of water. A school of adults, ranging from about 200 to at least 265 mm in standard length, could often be seen in 50 or 60 feet of water at the reef off Yawzi Point. The larger fish were never seen in shallow water. Some other snappers such as *L. apodus, L. griseus, L. jocu,* and *L. mahogani,* on the other hand, may be found as adults in only a few feet of water. Evermann and Marsh (1900: 179) recorded *synagris* from 220 fathoms off Mayaguez, Puerto Rico.

None of 19 mahogany snappers tagged at Lameshur was recovered.

Ocyurus chrysurus

Three hundred forty-three yellowtail snappers were tagged, but only 13 recoveries were made. Two of these were of fish taken a second time. Six recovered fish held their tags for more than one month (Table 13), but only two showed significant growth, 5.26 and 6.63 mm per month.

One tagged yellowtail snapper moved from Boiling House Point to Lesser Lameshur Reef, and two others were observed underwater between these localities. A 193 mm tagged fish was caught by hook and line off Booby Rock, 1 mile from the tagging locality at Beehive Point. Another was taken off Ram Goat Cay, western St. John, 7 miles from Lameshur. The recovery was reported by David O. Karraker, naturalist of the Virgin Islands National Park.

TABLE 12

RECOVERY OF TAGGED *Lutjanus griseus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	152	11/17/59	165	2/18/60	2	81	4.88
spaghetti	165	3/15/60	180	11/24/60	3	254	1.80
spaghetti	180	2/11/60	185	4/ 8/60	1	57	2.67

TABLE 13

RECOVERY OF TAGGED *Ocyurus chrysurus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	121	11/17/59	153	5/20/60	1	185	5.26
dart	138	11/17/59	140	3/22/60	2	126	.48
spaghetti	144	1/18/60	145	2/29/60	1	42	.72
spaghetti	146	3/22/60	146	5/11/60	1	50	0
dart	165	11/17/59	235	10/ 3/60	2	321	6.63
spaghetti	193	7/15/60	193	3/12/61	1	240	0

No tag was obtained, nor was the tag number recorded. The fish was said to be about 8 inches long.

O. chrysurus is abundant in the Virgin Islands where it is among the most highly-prized of food fishes. It is more of a mid-water fish than the other snappers, as its body form might indicate, and is probably more inclined to migrate. It feeds primarily on plankton at least in the smaller sizes. The largest specimen collected at St. John was 440 mm in standard length.

MONACANTHIDAE

Amanses pullus

Eight orange-spotted filefish were tagged and two were recovered, both in the same traps where first caught. One tagged with a disk tag on November 9, 1959, at a length of 172 mm grew to 177 mm by March 18, 1960. The other was tagged with a spaghetti tag on November 2, 1960, at a length of 181 mm and was recovered on March 20, 1961, at which time it measured 183 mm.

A current study of the taxonomic status of this Atlantic fish has revealed that it very closely related to, if not synonymous with, the Indo-Pacific *Amanses sandwichiensis*.

MULLIDAE

Pseudupeneus maculatus

Two recoveries were made of 195 tagged spotted goatfish. Both were tagged with dart tags, one at a fork length of 200 mm and the other at a fork length of 210 mm. Neither showed any growth after tagging periods of 3 weeks and 2½ months, respectively.

No recovery was made of 123 yellow goatfish (*Mulloidichthys martinicus*). As mentioned previously, goatfishes are not hardy, and the poor results may be due to tagging mortality.

OSTRACIIDAE

Lactophrys bicaudalis

Nine spotted trunkfish were tagged with spaghetti tags. A 298 mm one tagged at Lesser Lameshur Reef on October 22, 1959 was recovered in a trap nearly 1200 yards away off the dock in Greater Lameshur Bay on June 22, 1961. It was only 299 mm long. There was essentially no tagging wound; that is, no gap could be seen between the hole in the carapace and the tubing of the tag. It is difficult to believe that a tag would affect the growth of a trunkfish, but certainly more growth than 1.0 mm would be expected in a fish of this size over a period of 20 months. *L. bicaudalis* attains a length of at least 400 mm.

Two other trunkfishes were recovered among eight which were not identified to species and could have been *bicaudalis*. One grew from 215 to 217 mm in four months, the other from 261 to 272 mm in slightly over three months. The latter migrated from Beehive Point to Lesser Lameshur Reef.

Lactophrys triqueter

Twenty smooth trunkfish were caught in traps and tagged. Two were recovered, one after a short period and the other after 4 months (October to February). The latter grew from 125 mm in length to 146 mm.

L. triqueter is one of the most common of the four species of West Indian trunkfishes on or near reefs, consequently it dominated the catch in traps set at reefs.

When a trap was raised with fishes to be tagged, they were first placed in a net suspended from an inflated automobile inner tube. Several fishes at a time were then dipnetted to a washtub of water in the skiff. Gladston Matthias, a St. John fisherman who assisted in tagging operations, informed the author that a smooth trunkfish should not be placed in the tub with other fishes or they would die. Conversation with aquarists has revealed that some are aware of the capacity of this trunkfish to elicit a toxin into the water. Supposedly this fish will not affect others once it is established in an aquarium, providing it is not disturbed.

POMADASYIDAE

Haemulon plumieri

Two hundred twenty nine white grunts were tagged. Only 27 recoveries were made, five of these being recaptures of the same fish. Eight of the tagged fish were tagged for periods of one month or more (Table 14). None showed growth approaching what would be expected for the species.

All but three of the 27 recoveries showed no movement from the tagging area. One fish moved from Cabritte Horn Point to Yawzi Point, another from Beehive Point to Cabritte Horn Point, and the third from Boiling House Point to Europa Bay.

Haemulon sciurus

Nine recoveries were made of 75 tagged bluestriped grunts. Four fish held their tags for one month or more, but none showed significant growth (Table 15). One moved from Lesser Lameshur Reef to Boiling House Point and another was seen between these two localities but was not collected.

SCARIDAE

Scarus coeruleus

One hundred sixteen blue parrotfish were tagged. Thirty-three recoveries were made, of which 13 were repeated captures of the same fish. Of these fish, 14 were recovered after tagging periods of one month or more (Table 16). Their growth and that of some of the other parrotfishes was rapid compared with the values obtained for the other reef fishes, in general. The average rate for these 14 fish, 188 to 313 mm in fork length at the time of tagging, was 7.2 mm per month, and three registered growth in excess of 10 mm per month.

Only two of the recovered tagged fish moved away from the tagging sites. One swam from Beehive Point to Cabritte Horn Point, and the other (the last fish of Table 16) from Beehive Point to Lovango Cay, 2 miles north of Cruz Bay, St. John, and a minimal distance of 8 miles from Lameshur.

The largest *S. coeruleus* collected in the Virgin Islands measured 440 mm in standard length (fork length about 515 mm) and weighed 7⅜ pounds. It was a male with a prominent hump on the forehead. Very few of the large adult *coeruleus* were seen compared to smaller individuals.

Scarus guacamaia

Only four rainbow parrotfish were tagged. One which was tagged with a spaghetti tag at Boiling House Point on August 12, 1960, at a fork length of 437 mm was speared by the author in Europa Bay, over 300 yards from the tagging site, on June 22, 1961. At recovery it measured 516 mm fork length

TABLE 14

RECOVERY OF TAGGED *Haemulon plumieri*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	150	9/ 3/59	152	11/20/59	1	78	.78
spaghetti	164	3/28/60	165	5/ 3/60	1	36	.85
disk	177	5/21/59	177	7/ 7/59	1	47	0
spaghetti	188	7/ 6/60	187	9/12/60	1	68	0
spaghetti	205	2/11/60	204	4/14/60	2	63	0
spaghetti	224	12/29/60	229	6/16/61	1	169	.90
spaghetti	231	8/ 4/60	230	10/13/60	1	70	0
spaghetti	263	3/22/60	268	9/12/60	1	174	.87

TABLE 15

RECOVERY OF TAGGED *Haemulon sciurus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	143	7/24/59	140	9/24/59	1	62	0
dart	205	3/ 6/61	206	6/ 2/61	1	88	.35
disk	213	4/10/59	210	5/11/59	1	31	0
disk	215	4/10/59	217	6/19/59	1	70	.87

(and weighed 6 pounds, 2 ounces), thus its average growth was nearly 7.7 mm per month.

Another tagged *guacamaia* of about the same size was seen underwater at Boiling House Point in late September, 1961, which could have been only the other fish tagged the same day and place as the specimen discussed above.

The rainbow parrotfish is not common in the Virgin Islands. The largest specimen collected measured 600 mm standard length. The weight was later reported to the author as 22 pounds.

No recoveries were made of the few tagged *Scarus coelestinus*, a species closely related to *guacamaia*.

Scarus vetula

Six recoveries were made of 41 queen parrotfish which were tagged, two of these being a fish caught with its tag a second and third time. Three fish held their tags for one month or more (Table 17). They showed rapid growth ranging from nearly 11 to over 18 mm per month.

One of the four fish moved from Boiling House Point to Lesser Lameshur Reef. After release at the latter locality it was caught in Europa Bay. The others were caught in the same traps from which they were tagged.

Sparisoma chrysopterum

Forty-one individuals of *Sparisoma chrysopterum* were tagged, with 19 recoveries, four of which were of fish caught two times after tagging. Three fish were at large with their tags one month or more. They grew at rates ranging from 20 mm per month for a 155 mm fish to 8.7 mm per month for a 182 mm fish (Table 18). This species does not reach large size. The largest recorded by Schultz (1958) is 285 mm standard length.

Only one movement was noted away from a tagging area and this only from Lesser Lameshur Reef to Boiling House Point.

Sparisoma rubripinne

Seventy-one redfin parrotfish were tagged. Twenty-nine recoveries were made, 12 of which were multiple captures of the same fish. Nine fish held their tags one month or more (Table 19). They grew at an average rate of 8.1 mm per month. The lowest value, 3.13 mm per month, was of a fish recaptured six times.

If the average length of the eight fish of Table 19 is converted to approximate weight with the use of Figure 6, the average increase in length of 8.1 mm per month will result in an annual weight increase of nearly 2¼ times the starting weight of the fish.

Although no *rubripinne* were taken in traps away from the tagging sites, several with tags have been observed underwater between Lesser Lameshur Reef and Boiling House Point. A movement for spawning is made by this species throughout the year from inshore waters to reef fronts that project into moderately deep water such as those off points of the southern shore of St. John (Randall and Randall, MS). One reef off the west end of Reef Bay extends nearly 500 yards from shore to a depth of 70 feet. The fish are not seen on this reef in morning hours, and it is believed that they come from inshore portions of the same reef in the early afternoon and return at the end of the day. This could mean, therefore, a diurnal migration of as much as 1000 yards.

S. rubripinne reaches moderate size, the largest being males in the *axillare* color phase. The largest of numerous specimens collected in the Virgin Islands was 325 mm standard length.

Sparisoma viride

Seventy-seven individuals of *Sparisoma viride* (mostly in the red-bellied *abilgaardi* color phase) were tagged, but only seven recoveries were made, two of these being the second captures of the same fish. Three of these fish were at large with their tags one month or more (Table 20). Their growth ranged from 7.7 mm per month for a 187 mm fish to 3.5 mm per month for a 236 mm fish. None of the tagged fish moved out of tagging areas.

This is the largest of the species of *Sparisoma*. Adult males may attain a fork length of at least 400 mm.

SERRANIDAE

Cephalopholis fulva

One hundred eleven coneys were tagged; 41 recoveries were made, of which 12 were multiple captures of the same fish. Twenty of these fish held their tags one month or more (Table 21). Growth was not rapid, particularly in sizes greater than 220 mm in length. Fish of this size are mature adults, and growth would not be expected to be rapid as the species nears its maximum size. The largest specimen seen in the Virgin Islands was the 295 mm fish of Table 21. Bardach, Smith, and Menzel (1958: 44) recorded the largest size in Bermuda as about 14 inches (35 cm); however a larger size might be expected there because of the cooler water in Bermuda. They noted that the change-over in sex from female to male occurred at a smallest size of 8 inches.

One of the tagged Virgin Islands *C. fulva* moved from Cabritte Horn Point to Beehive Point. The remaining 40 recoveries were all from the same trap from which the fish were originally tagged.

Epinephelus adscensionis

Twenty-one rock hinds were tagged and 29 recoveries were made, 17 of which were repeated captures of the same fish. Six of these fish held their tags for one month or more (Table 22). Growth was variable, ranging from 0 to 3 mm per month. With the exception of a fish recovered seven times, the zero growth was recorded for the hinds with the shorter tagging periods.

The largest *E. adscensionis* collected in the Virgin Islands measured 395 mm in standard length (total length about 480 mm) and weighed 4 pounds.

The recoveries were all from the tagging area except one. This fish moved from Lesser Lameshur Reef almost to Reef Bay, a distance of nearly 1 mile. Another fish caught several times in the trap at Lesser Lameshur Reef, always with abdomen distended from trap fish on which it had been feeding, was moved to Boiling House Point. It appeared two days later again in the trap at Lesser Lameshur Reef.

Epinephelus guttatus

Seventy-two red hinds were tagged; 41 recoveries were made, of which 17 were multiple captures of the same fish. Fifteen were at large with their tags for one month or more (Table 23). Growth was highly variable and ranged from 0 to 5 mm per month. Fish with dart tags appeared to show better growth than those with spaghetti tags.

Bardach and Menzel (1957: 108) reported the annual weight increment of 22 tagged red hinds of 300 mm or more in length in Bermuda to vary between

TABLE 16

RECOVERY OF TAGGED *Scarus coeruleus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	188	6/17/59	201	8/ 5/59	1	49	8.07
dart	215	5/19/59	249	8/13/59	2	86	12.00
spaghetti	220	9/ 4/59	232	7/25/60	2	325	1.12
spaghetti	222	10/19/60	276	7/30/61	2	284	5.78
dart	225	5/29/59	238	7/ 7/59	1	39	10.15
spaghetti	225	8/11/60	253	11/24/60	3	105	8.11
disk	232	5/ 5/59	263	8/28/59	5	115	8.20
spaghetti	232	10/19/60	240	11/24/60	2	36	6.78
spaghetti	240	12/31/59	266	3/ 3/60	1	63	12.56
spaghetti	262	6/27/60	303	11/24/60	1	150	8.31
dart	265	5/27/59	267	7/ 7/59	1	41	1.48
spaghetti	270	5/ 3/60	320	11/24/60	1	205	7.41
spaghetti	280	5/ 3/60	320	11/24/60	2	205	5.93
spaghetti	313	12/ 1/59	368	12/ 7/60	1	372	4.49

TABLE 17

RECOVERY OF TAGGED *Scarus vetula*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	140	6/30/60	169	8/17/60	1	48	18.36
spaghetti	208	9/ 3/59	276	3/10/60	2	189	10.93
dart	248	8/ 7/59	265	9/24/59	1	48	10.75

TABLE 18
RECOVERY OF TAGGED *Sparisoma chrysopterum*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	155	5/18/59	226	9/ 3/59	1	108	19.97
dart	176	5/18/59	197	7/30/59	1	73	8.75
disk	182	4/20/59	194	6/ 1/59	2	42	8.71

TABLE 19
RECOVERY OF TAGGED *Sparisoma rubripinne*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	175	2/27/61	180	4/ 5/61	1	37	4.10
spaghetti	195	2/11/60	210	3/15/60	1	33	13.83
spaghetti	195	12/ 7/60	223	2/ 6/61	1	61	13.71
dart	200	2/14/61	230	5/26/61	1	101	9.00
spaghetti	211	11/ 2/60	299	8/17/61	2	288	9.28
spaghetti	211	11/ 9/60	220	12/19/60	2	40	6.84
spaghetti	229	12/19/60	240	4/ 5/61	6	107	3.13
spaghetti	239	11/14/60	245	12/19/60	1	35	5.22
spaghetti	266	2/18/60	297	6/21/60	1	124	7.60

TABLE 20
RECOVERY OF TAGGED *Sparisoma viride*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	187	7/ 7/59	202	9/ 4/59	1	59	7.74
spaghetti	235	3/28/60	251	8/ 1/60	2	126	3.80
spaghetti	236	3/28/60	251	8/ 4/60	2	129	3.53

TABLE 21

RECOVERY OF TAGGED *Cephalopholis fulva*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	188	5/25/59	190	11/13/59	1	172	.35
dart	199	6/17/59	203	9/ 4/59	1	79	1.54
dart	201	8/ 5/59	213	12/23/59	1	140	2.61
spaghetti	207	3/10/60	209	6/ 2/60	1	84	.62
dart	210	7/ 1/59	212	8/18/59	2	48	1.27
dart	220	8/ 5/59	225	12/23/59	1	140	1.08
spaghetti	223	9/21/59	224	12/23/59	1	93	.36
disk	223	5/21/59	225	8/ 5/59	3	76	.80
dart	228	8/ 5/59	227	12/31/59	1	148	0
spaghetti	236	10/13/60	234	3/13/61	1	151	0
dart	255	8/ 5/59	256	12/21/59	1	138	.22
dart	255	8/ 5/59	255	12/23/59	1	140	0
spaghetti	258	2/11/60	256	5/20/60	2	99	0
dart	259	7/ 1/59	258	9/14/59	7	75	0
spaghetti	260	11/20/59	260	1/ 6/60	1	47	0
spaghetti	261	3/15/60	260	10/24/60	2	223	0
dart	268	8/ 5/59	269	3/22/60	2	230	.13
spaghetti	271	11/ 2/60	280	9/28/61	1	330	.83
spaghetti	273	2/11/60	271	5/ 3/60	1	82	0
spaghetti	295	11/27/59	295	1/21/60	1	55	0

TABLE 22
RECOVERY OF TAGGED *Epinephelus adscensionis*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	217	6/ 8/59	225	3/ 8/60	7	274	.89
spaghetti	222	9/14/59	237	2/11/60	3	150	3.05
spaghetti	249	3/ 8/60	249	6/14/60	1	98	0
spaghetti	303	6/ 8/59	302	9/14/59	4	98	0
spaghetti	370	5/21/60	378	10/19/60	1	151	1.61
spaghetti	379	6/ 8/59	378	7/14/59	2	36	0

TABLE 23
RECOVERY OF TAGGED *Epinephelus guttatus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
disk	213	4/13/59	214	6/22/59	1	70	.44
spaghetti	218	5/11/59	237	9/14/59	3	126	4.58
dart	226	7/22/59	260	8/11/60	2	386	2.67
spaghetti	228	7/30/59	227	9/ 1/59	2	33	0
spaghetti	237	7/25/60	260	1/11/61	4	170	4.18
spaghetti	249	4/17/59	247	8/ 5/59	1	110	0
spaghetti	249	9/21/60	251	2/20/61	1	152	.40
spaghetti	265	5/13/59	264	8/ 3/59	1	82	0
spaghetti	274	8/18/59	271	12/28/59	2	132	0
dart	277	8/11/59	300	12/28/59	1	139	5.04
spaghetti	280	7/ 1/59	279	9/14/59	2	75	0
spaghetti	283	2/18/60	285	4/14/60	2	56	1.09
spaghetti	290	5/21/60	291	6/27/60	1	37	.82
dart	303	9/18/59	310	11/27/59	5	70	3.04
spaghetti	304	9/14/59	304	10/24/59	3	40	0

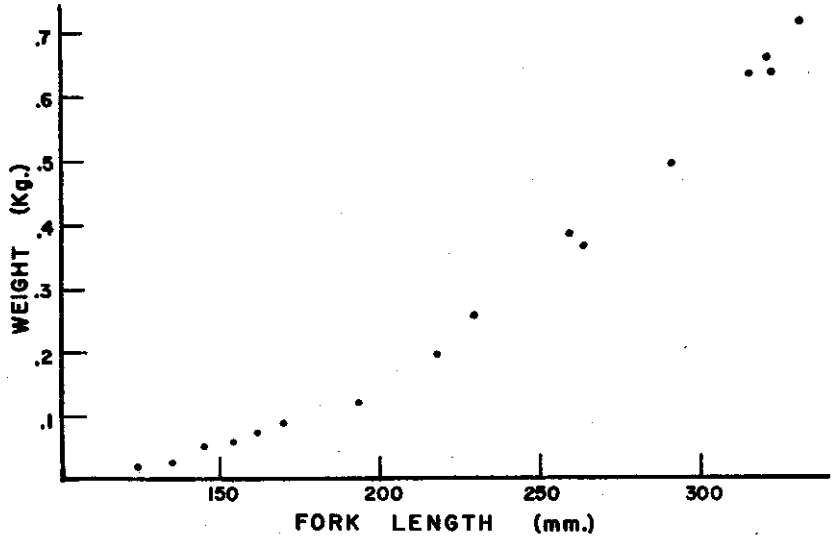

FIGURE 6. Length-weight relationship of *Sparisoma rubripinne*.

20 and 25 per cent for fall and winter months and 40 per cent for the period March to September.

Only two of the red hinds tagged at Lameshur Bay moved out of the tagging areas. One went from Cabritte Horn Point to Beehive Point and the other from Boiling House Point to Europa Bay. Bardach (1958) demonstrated that this species shows a tendency to return to its home reef if displaced from it. Of 12 recaptures of tagged fish displaced to an adjacent reef about 70 meters away, nine found their way back to their home reef.

E. guttatus is the most common grouper in the Virgin Islands. The largest of 82 adults collected in inshore waters measured 450 mm in standard length (total length about 550 mm).

Epinephelus striatus

One hundred twenty-four Nassau groupers were tagged at Lameshur Bay, and 176 recoveries were made, 102 of which were multiple captures of the same fish. Forty of the groupers were at large with their tags one month or more (Table 24). If the two fish which did not grow at all are eliminated (each have tagging periods only slightly greater than one month) and the average growth rates of the remaining 38 fish in three size groups, each with a range of 75 mm, are computed, a progressive decline in rate is apparent as follows: 175-250 mm: 4.55 mm per month; 251-325 mm: 3.5 mm per month; 326-451 mm: 1.92 mm per month.

Estimates may be made of the weight increase of these three groups of fish by use of the length-weight curve of Figure 7. Fish of the first group (mean length 215 mm) more than double their weight in one year. Fish of the second group (mean length 297 mm) increase their weight by about 50 per cent, and those of the third group (mean length 370 mm) by about 25 per cent. Bardach and Menzel (1958: 109) estimated the yearly weight increment of seven

Nassau groupers tagged in Bermuda to range from 20 to 55 per cent, with an average of about 38 per cent. These fish were in a 700 gram weight group. Virgin Islands tagged fish in this weight group would show an annual increase in weight of about 28 per cent. In view of the meager data from both areas, this comparison is favorable.

There is no evidence from the data of Table 24 that the growth rate of *E. striatus* is greater during months when the sea temperature is warmest (June to November—see Table 2). Nineteen fish which were at large with their tags primarily in summer and fall grew an average of 3.4 mm per month. The remaining 19 fish, which grew mostly during the cooler winter and spring months, increased their length at an average rate of 3.54 mm per month.

Only five tagged Nassau groupers have made movements out of the tagging areas. One fish moved from Cabritte Horn Point to Beehive Point and a second from Lesser Lameshur Reef to Yawzi Point. The other migrations have been more extensive. One fish swam from Boiling House Point to Reef Bay, a distance of nearly one mile; another went from Beehive Point to Reef Bay, covering a minimal distance of 1.3 miles. The last fish, 430 mm in total length when tagged on April 21, 1959, at Lesser Lameshur Reef, was recaptured in less than a month at Boiling House Point and caught there two more times, the last being May 22. Twelve days later it was 10 miles to the west off Buck Island, St. Thomas. The fish was caught by an employee of the National Park Service in St. Thomas, and the tag was returned to the author.

Like the red hind, Bardach (1958) has shown that this species recognizes its home reef and can return if displaced from it. Ten of 11 fish transplanted to a reef 70 meters away returned to their home reef.

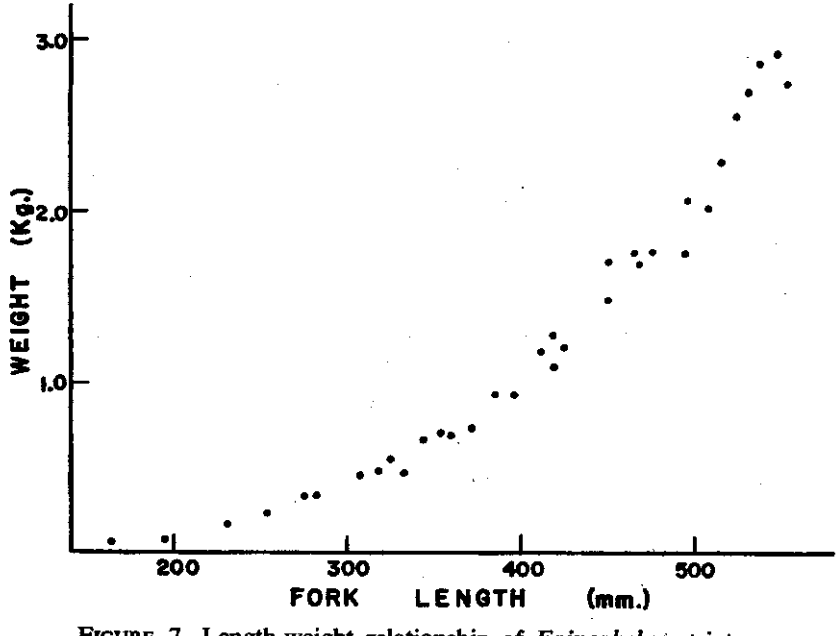

FIGURE 7. Length-weight relationship of *Epinephelus striatus*.

TABLE 24 (*Continued*)

RECOVERY OF TAGGED *Epinephelus striatus*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	175	4/20/59	180	7/ 7/59	1	78	1.95
spaghetti	195	3/22/60	264	8/17/61	2	513	4.08
dart	196	5/29/61	200	8/ 7/61	1	70	1.74
spaghetti	198	11/20/59	207	1/ 6/60	2	47	5.82
spaghetti	204	1/ 4/60	252	10/ 3/60	1	273	5.33
dart	204	4/24/61	220	6/18/61	1	55	8.96
spaghetti	213	4/20/59	230	9/ 1/59	1	134	3.87
spaghetti	230	11/20/59	241	12/28/59	2	38	8.80
spaghetti	232	3/28/60	256	9/12/60	2	168	4.35
spaghetti	237	3/28/60	238	5/11/60	2	44	.67
spaghetti	246	5/27/59	255	8/13/59	2	78	3.51
spaghetti	250	10/ 4/60	297	6/18/61	1	257	5.56
spaghetti	252	8/27/59	252	9/29/59	2	33	0
spaghetti	254	5/25/59	317	3/ 8/60	6	288	6.64
spaghetti	255	4/14/60	295	9/ 5/61	1	509	2.39
spaghetti	276	5/29/59	280	9/10/59	7	104	1.17
spaghetti	280	5/ 3/60	286	6/21/60	4	49	3.72
spaghetti	292	5/25/59	301	9/10/59	3	108	2.54
spaghetti	295	8/21/59	330	1/ 4/60	2	136	7.84
spaghetti	298	5/18/59	304	8/18/59	2	92	1.98
spaghetti	299	12/21/59	304	1/29/60	6	39	3.91
spaghetti	302	4/10/59	322	7/22/59	5	103	5.90
spaghetti	302	11/ 9/60	332	4/19/61	1	161	5.67
spaghetti	307	1/15/60	314	4/ 4/60	2	80	2,56
spaghetti	309	11/20/59	366	1/11/61	9	52	3.33
disk	314	4/10/59	311	5/19/59	2	39	0
spaghetti	314	6/15/59	321	9/29/59	4	106	2.01

(continued)

TALE 24 *(continued)*

spaghetti	314	1/15/60	355	8/17/60	2	215	5.78
spaghetti	316	8/17/60	322	11/27/60	1	102	1.78
spaghetti	320	1/29/60	324	4/18/60	2	80	1.52
spaghetti	325	4/ 4/60	327	6/21/60	2	78	.75
spaghetti	330	1/18/60	333	2/29/60	2	42	2.17
spaghetti	340	2/ 2/60	341	3/15/60	6	42	.72
spaghetti	343	3/22/60	348	9/15/60	2	177	.86
spaghetti	357	9/21/59	365	1/26/60	3	127	1.91
spaghetti	358	7/14/59	365	9/ 1/59	7	49	4.34
spaghetti	364	5/28/59	372	9/10/59	8	105	2.32
spaghetti	378	7/ 1/59	382	9/ 1/59	6	62	1.96
spaghetti	410	12/ 9/59	413	2/ 2/60	5	55	1.66
spaghetti	451	11/24/59	455	2/ 2/60	12	70	1.74

TABLE 25

RECOVERY OF TAGGED *Mycteroperca tigris*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	324	5/25/59	325	7/22/59	5	58	.58
dart	331	6/17/59	329	7/20/59	1	33	0
spaghetti	341	7/10/59	341	8/25/59	4	46	0
spaghetti	347	12/17/59	345	3/15/60	7	89	0
spaghetti	407	5/19/59	406	8/ 7/59	21	80	0
spaghetti	482	4/ 4/60	482	5/27/60	6	53	0

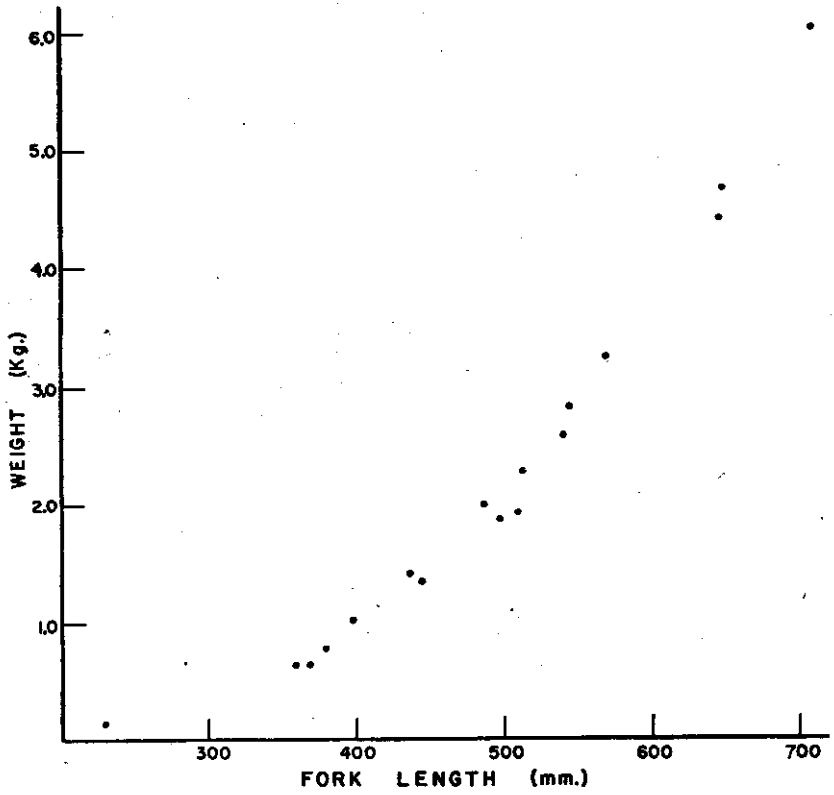

FIGURE 8. Length-weight relationship of *Mycteroperca venenosa*.

The largest of 170 specimens collected with spears in the Virgin Islands measured 635 mm in standard length (total length about 730 mm). The larger fish tend to occur in deeper water. Bardach, Smith and Menzel (1958: 48) discussed size and apparent population differences with depth and area in Bermuda waters and the fishery implications thereof. They record the species in Bermuda to a weight of 55 pounds.

The Nassau grouper is one of the most important commercial fishes in the West Indian region. It also has considerable value as a game fish.

The closely related red grouper (*Epinephelus morio*) is very rare in the Virgin Islands.

Mycteroperca tigris

Twenty tiger groupers were tagged. Fifty-eight recoveries were made, 47 of which were multiple recoveries of the same fish. Six fish were at large with tags one month or more (Table 25), but did not grow. The lack of growth may be associated with the many recoveries of these fish (and hence long sojourn in traps). The largest of 46 other fish of this species collected in the Virgin Islands was 450 mm in standard length (about 540 mm fork length). Bardach, Smith and Menzel (1958) record sizes up to nearly 800 mm in fork length and

TABLE 26
RECOVERY OF TAGGED *Mycteroperca venenosa*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
spaghetti	295	11/24/59	350	11/24/60	11	366	4.58
spaghetti	295	4/26/60	295	6/ 2/60	1	37	0
spaghetti	307	10/27/60	314	12/29/60	1	63	3.37
spaghetti	319	5/18/59	322	6/26/59	4	39	2.34
disk	322	2/27/59	321	5/13/59	4	75	0
spaghetti	331	7/14/59	380	6/21/60	3	343	4.36
spaghetti	331	9/10/59	333	2/11/60	9	154	.40
spaghetti	339	11/24/59	335	1/29/60	14	66	0
spaghetti	345	7/10/59	347	11/13/59	21	125	.49
spaghetti	355	12/21/59	361	4/ 4/60	3	105	1.74
spaghetti	357	8/21/59	357	12/ 1/59	8	102	0
spaghetti	357	8/25/59	358	11/27/59	5	94	.32
spaghetti	359	5/27/59	360	7/ 1/59	2	35	.87
spaghetti	360	8/ 7/59	368	2/ 2/60	1	179	1.36
spaghetti	367	5/ 3/60	368	6/27/60	3	55	.55
spaghetti	368	6/19/59	415	2/ 2/60	4	228	6.27
spaghetti	375	2/18/60	474	1/16/61	3	333	9.08
spaghetti	376	1/ 6/60	376	2/22/60	4	47	0
spaghetti	380	11/ 9/60	376	12/29/60	3	50	0
spaghetti	384	2/11/60	390	4/ 8/60	1	57	3.20
spaghetti	419	1/18/60	427	5/11/60	2	114	2.04
spaghetti	454	3/ 8/60	515*	8/15/61	1	525	3.53
spaghetti	503	7/14/59	505	9/ 1/59	2	49	1.24
spaghetti	505	8/21/59	571	5/24/60	1	277	7.25

*Fish not seen. Tag returned with weight of fish given as 9½ lbs. Fork length obtained from length-weight graph (Fig. 8).

TABLE 27

RECOVERY OF TAGGED *Petrometopon cruentatum*

Type of Tag	Length at Tagging	Date at Tagging	Length at Recovery	Date at Recovery	Times Recovered	Tagging Period (days)	Growth per Month (mm)
dart	269	6/15/59	270	12/23/59	1	191	.16
spaghetti	270	6/ 8/60	270	10/19/60	3	133	0
spaghetti	289	3/22/60	295	7/23/60	1	123	1.48

a weight of 20 pounds in Bermuda, and also give curves relating length and weight and standard length, fork length, and total length.

One fish, 407 mm fork length, was caught 21 times. It was tagged off Cabritte Horn Point, then moved to Beehive Point for one capture and back to Cabritte Horn for 19.

Mycteroperca venenosa

Eighty yellowfin groupers were tagged, and 114 recoveries were made. Eighty-seven of these were repeated captures of the same fish. Twenty-four fish were recovered after being in the sea one month or more with their tags (Table 26). Six of these fish showed no growth. These all had relatively short tagging periods, mostly two months or less. Most of the other fish showing little growth were ones with short tagging periods. The six fish exhibiting the greatest growth, an average of 5.85 mm per month, were those with the longest tagging periods, 277 to 525 days.

Two of the tagged fish made movements between Cabritte Horn Point and Beehive Point. A third fish was speared on January 16, 1961, in Grootpan Bay, ¾ miles from Beehive Point where it was tagged 11 months previously. Before being taken in Grootpan Bay it was recovered two times at Beehive Point, the last on May 15, 1960, at which time it measured 380 mm. This fish grew faster than any other of the tagged ones recovered. After its last Lameshur recovery it increased its length at the rate of 10.4 mm per month. Another fish migrated within one month from Boiling House Point nearly 1 mile to Reef Bay and still another from Boiling House Point to a point 2 miles south of the southwest corner of St. John, a minimum distance of 4 miles from the point of release. This fish was tagged on March 8, 1960, and recovered in the fish trap of a St. Thomas fisherman on August 15, 1961. It weighed 9½ pounds at recovery. The other tagged yellowfin groupers were all caught where released.

The largest of 95 specimens of *M. venenosa* collected in the Virgin Islands measured 690 mm in standard length (about 850 mm fork length).

Other than the tiger grouper, the other species of *Mycteroperca* which occur in the Virgin Islands are rare, at least in inshore waters. Only a single specimen of *M. bonaci* was collected, only one of *M. rubra,* and only a few of *M. interstitialis.*

Petrometopon cruentatum

Forty-four graysby were tagged, but only five recoveries were made of three fish. Table 27 gives the tagging data of these fish. One moved from Cabritte Horn to Beehive Point.

Like *Cephalopholis fulva, P. cruentatum* is a small grouper. The largest of 62 collected in the Virgin Islands measured 260 mm in standard length (fork length about 320 mm). This is the same length as the largest shown in the length-weight curve of Bardach, Smith and Menzel (1958: fig. 14) (weight 575 grams).

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