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INGLE, R.M.

FAIRLEIGH DICKINSON UNIVERSITY

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**RESULTS OF THE  
TAGGING OF SALT WATER  
FISHES IN FLORIDA**

*by*

**Robert M. Ingle, Robert F. Hutton *and* Robert W. Topp**

**September, 1962**

**Florida State Board of Conservation Marine Laboratory  
St. Petersburg, Florida**

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## FOREWORD

FISHING is Florida's oldest industry. Florida saltwaters produce a greater variety of marine products, including game and food fishes, than any other State. The combined value of the commercial and sports fisheries, established by state-wide professional surveys, is at least \$300,000,000 yearly. The whole state, and all 35 coastal counties in particular, share in this wealth — a gift of Nature — so long as they judiciously exploit their shorelines, saltwaters and submerged bottoms. The State Board of Conservation has a vested interest in seeing that this is done. It is charged with the supervision, conservation and development of the different fisheries through scientific management, control and aquaculture based on research. The job is difficult. Problems are acute because rapid urbanization has accelerated lucrative water-front development and unfavorable changes in marine environments.

Damage to our multi-million dollar fisheries is not inherent in urbanization unless planning is poor and short-sighted and destructive dredging, filling and pollution are condoned because of apathy, ignorance or greed.

Coastal, estuarine and island development *can* be planned to best serve conservation. The State Board of Conservation stands ready to aid and advise counties, other governmental units and private interests in the best known way to sustain and further marine productivity.

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## INTRODUCTION

A fishing contest of unusually large proportions and generously subsidized by private funds furnished the opportunity for making large-scale tagging and recovery studies. Strong financial support for tagging expenses, advertising, rewards, prizes and other incidental costs resulted in a breadth of scope usually unattainable.

Fish were tagged in the fresh and salt waters throughout Florida. This report deals only with the work done in salt water.

Originally, plans called for the tagging of the same number of salt water species in each zone. Actually, the last two zones (III & IV) received significantly less tags than the other two (I & II).

Useful information was obtained on growth (or lack of it), migrations, efficacy of specific types of tags on several previously untagged animals, comparative fishing pressures in different areas, and, information on costs of conducting such a largescale study.

# RESULTS OF THE TAGGING OF SALT WATER FISHES IN FLORIDA\*

by

Robert M. Ingle, Robert F. Hutton *and* Robert W. Topp  
Florida State Board of Conservation Marine Laboratory  
Maritime Base, Bayboro Harbor, St. Petersburg, Florida

## I. NOTES ON TAGGING SALT WATER FISHES ALONG THE SOUTHWEST COAST OF FLORIDA\*\*

(ZONE I)

### METHODS AND MATERIALS

Starting in December 1960 the Jos. Schlitz Brewing Company in cooperation with the Florida State Board of Conservation and the Florida Game and Fresh Water Fish Commission sponsored a fish-tagging program in the form of a "fishing contest." The Schlitz Company was mainly interested in the "contest" from the promotional aspect for the sale of their product, but they were also interested in the research value to the State fisheries.

Supervision of the tagging of salt water species was handled by the Conservation Department. The Game and Fresh Water Fish Commission was in charge of tagging fresh water species. The Conservation Department entered into the program with the idea that the "contest" would benefit not only the tourist trade of the State but the fisheries research programs as well. When the Conservation Department decided to enter the program there was relatively little time available before actual tagging was to start. With this in mind it was readily recognized that time did not permit detailed plans to be formulated and that the first year's work would be that of a pilot program with relatively few conclusions reached.

Consequently the salt water tagging program was designed primarily to study movements of fishes and if possible to obtain some information on fishing mortality, growth and efficiency of tags used. Certain deficiencies in the program were anticipated and are dealt with later in the paper. Long-range objectives are to assess the salt water fisheries with respect to migration, abundance, mortality (natural and fishing) and growth for certain of the more valuable species.

\* This technical journal was financed by the Jos. Schlitz Brewing Company, Milwaukee, Wis.

\*\* This section (Zone I) of the report was presented at the Sixth Game Fish Conference of the International Oceanographic Foundation held at Miami Beach, November 15, 1961.

Contribution No. 66, Fla. Board Cons. Lab.

Although the first year's work was in the nature of a pilot program available evidence allows us to make certain tentative conclusions. Also, the results of this tagging program substantiates the validity of certain conclusions drawn from other tagging programs in the State. The purpose of this section is to report the results to date (October 1, 1961) of the 1960-61 fish-tagging program conducted in Zone I along the southwest coast of Florida. Since much of our data is too voluminous to include here our original records are on file for ready reference at the State Marine Laboratory, St. Petersburg, and at the Conservation Department main office, Tallahassee.

The State was arbitrarily divided into four "zones". The "zones" for salt water species were as follows:

- ZONE I. Northern Hernando County Line to Everglades City.
- ZONE II. Everglades City to the northern Indian River County Line.
- ZONE III. *West Coast:* Northern Hernando County Line to the Wacassassa River.  
*East Coast:* Northern Indian River County Line to the northern Flagler County Line.
- ZONE IV. *West Coast:* Wacassassa River to the western Escambia County Line.  
*East Coast:* Flagler County Line to the northern Nassau County Line.

Tagging of salt water species began in Zone I on December 2, 1960, and stopped in Zone IV on May 5, 1961. More than 3000 individuals including more than 20 species were tagged by Messrs. Joseph Humphreys, Howard Foulk, Victor Springer, Andrew McErlean and Cassius Peddie. A total of 1001 tagged-fish were released in Zone I by January 4, 1961. At least 13 species were represented in varying numbers, depending upon their availability and adaptability to the tagging program.

During the period of the contest (January 1 to March 31, 1961, in Zone I) the Schlitz Company was to redeem all salt water tagged-fishes returned for values ranging from a minimum of \$25 to a possible maximum of \$10,000. The value of each tag was known only to the Schlitz officials until the fish was recaptured and turned in to the officials. A reward of \$25 was paid for each tagged fish returned prior to January 1, 1961. Tagged fishes returned after the end of the contest (March 31, 1961, in Zone I), and through December 31, 1962, would be redeemed by the same Company at \$3 each. The Schlitz Company decided that the first tagged fish caught after midnight December 31, 1960, and verified through a Schlitz wholesale dealer would have a bonus value of \$1000.

To be eligible for a monetary reward all tagged fishes caught during the contest had to be returned with the tag intact. The following information for all returned tagged-fishes was included on a Fishing Contest Release Form:

*Date of catch:*  
*Fish caught by:*  
*Florida address:*  
*Exact location where fish was caught:*  
*Length to 1/2":*  
*Tag No.:*  
*Value:*

Each contestant receiving a reward was required to sign the Release

Form acknowledging the accuracy of the information and that he had complied with all the rules of the contest.

Probably more publicity was given to this tagging program than any other fish-tagging program ever conducted. In Zone I a dinner and press conference was held in Tampa before the official opening of the contest. The various news media, including outdoor and fishing editors of newspaper, radio and television, were invited. At this conference details of the contest were reported. Publicity for the contest was handled by the public relation firm, Barkin, Herman and Associates, Milwaukee, Wisconsin. The contest including all four Zones previously mentioned, was presented as the "\$500,000 Florida Fishing Contest". It was open to tourists and residents alike. Full page advertisements of the contest were carried in newspapers throughout the country. Much additional publicity was given by the various news media.

Fishes used for tagging were caught in gill nets, cast nets or on hook and line by commercial fishermen or on hook and line by sports fishermen. Only fishes that appeared in a healthy condition were tagged and released. In most cases fishes were released in areas of heavy sports fishing activity. Fishes that were released in areas other than where originally caught were transported in a 250 gallon recirculating water trailer. In some cases fishes were held overnight in bait tanks or in a portable floating fish cage (2' x 4' x 4') made of hardware cloth. If the fishes held in captivity overnight appeared healthy they were tagged and released.

Two types of tags were used. In Zone I all weakfish (*Cynoscion nebulosus*) were marked with yellow internal plastic streamer "anchor" tags (see Moffett, 1961). Other species were tagged with red Petersen disk tags (18 mm. dia.) consisting of two plastic disks, secured in place, one on each side of the back just under the anterior part of the dorsal



Plate 1. Petersen Tag.



Plate 2. Face of Internal Streamer Tag

fin, by a nickel pin that passed through the fish. Plates 1 and 2 show the types of tags used and the legend and type of identification serial number used.

For recording purposes the "A" on each tag was used to differentiate tags used by the Conservation Department from those used by the Game and Fresh Water Fish Commission.

Measurements of fishes were in millimeters after placing the anterior end of the fish (not necessarily the tip of the snout) against the edge of a standard fish measuring board. Standard length measurements were made to the base of the caudal fin (i. e. posterior edge of hypural plate). For species having truncate tails such as Red Fish and Weakfish total lengths were measured to the center of the posterior edge of the tail. Total length measurements for species such as Mullet, having caudal fin lobes of approximately equal length, were made along the horizontal line to the intersection of a line drawn from the tip of the dorsal lobe to the tip of the ventral lobe. For specimens having unequal caudal fin lobes measurements were taken on a horizontal line starting at the anterior end to the intersection of a perpendicular line drawn to the posterior end of the longer caudal fin lobe. In most cases fishes were frozen prior to being returned to the State Laboratory for final measurements.

## RESULTS BY SPECIES

### SPOTTED SEATROUT, *Cynoscion nebulosus* (Cuvier).

A total of 513 spotted seatrout were tagged in Zone I from December 5, 1960, through January 4, 1961. Tagged fish were returned from December 24, 1960, through August 17, 1961. The greatest distance traveled was 233 miles by a fish released one mile north of the Matlacha Bridge in Lee County on December 16, 1960 and recaptured three miles west of Shired Island in Dixie County (Zone IV) on June 30, 1961. The distance was traveled in 197 days with an average speed of 1.18 miles per day. Little tendency was shown for the movement of long distances. 80.0% of the recovered seatrout were captured less than five miles from the point of release. 97.5% were captured less than 20 miles from the point of release. The numbers of fish tagged and recaptured by county are listed in Table I.

Of the 513 seatrout tagged in Zone I, 120 were returned by August 17, 1961, with a recovery rate of 23.4%. Three specimens were returned on January 1, 1961. Only one fish was returned within ten days of release. Table II and Figure 1 show the returns by 30 day periods. The longest period of time a fish was free was 243 days. It was caught less than five miles from where it was released.

Many specimens showed a length shrinkage and others showed a length increment. Length shrinkage and other factors influencing length measurements will be discussed later. Table III lists the ten specimens showing the greatest amount of length increment (mm.).

**TABLE I.**  
**Numbers of Seatrout Returned by County**

| County       | Number Tagged | Number Recaptured | Percentage    |
|--------------|---------------|-------------------|---------------|
| Hernando     | 41            | 4                 | 9.8 %         |
| Pasco        | 15            | 1                 | 6.7 %         |
| Pinellas     | 178           | 26                | 14.6 %        |
| Hillsborough | 2             | 0                 | 0.0 %         |
| Manatee      | 48            | 16                | 33.3 %        |
| Sarasota     | 138           | 36                | 26.1 %        |
| Charlotte    | 0             | 0                 | 0.0 %         |
| Lee          | 86            | 37                | 43.0 %        |
| Collier      | 5             | 0                 | 0.0 %         |
| <b>TOTAL</b> | <b>513</b>    | <b>120</b>        | <b>23.4 %</b> |

**TABLE II.**  
**Numbers of Seatrout Returned by 30 Day Periods**

| Days    | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures (see Figure 1) |
|---------|-------------------|-----------------------|---------------------------------------------|
| 1- 30   | 42                | 35.3 %                | 1.623                                       |
| 31- 60  | 38                | 31.9%                 | 1.580                                       |
| 61- 90  | 22                | 18.5%                 | 1.342                                       |
| 91-120  | 7                 | 5.9%                  | .845                                        |
| 121-150 | 4                 | 3.4%                  | .602                                        |
| 151-180 | 1                 | .8%                   | 0.000                                       |
| 181-210 | 4                 | 3.4 %                 | .602                                        |
| 211-240 | 0                 | 0.0%                  | -----                                       |
| 241-270 | 2                 | 1.7%                  | .301                                        |
| TOTAL   | 120               | 100.0 %               |                                             |

**TABLE III.**  
**Ten Recaptured Seatrout Showing the Greatest Length Increment (MM.)**

| Date      | Release |     | No. Days Free | Length Increment |     |
|-----------|---------|-----|---------------|------------------|-----|
|           | SL      | TL  |               | SL               | TL  |
| 20/XII/60 | 321     | 377 | 22            | 2                | 8   |
| 17/XII/60 | 315     | 367 | 88            | 4                | 11  |
| 5/XII/60  | 307     | 364 | 135           | 5                | 10  |
| 20/XII/60 | 366     | 426 | 135           | 11               | 10  |
| 16/XII/60 | 312     | 367 | 137           | 11               | 22  |
| 21/XII/60 | 303     | 357 | 47            | 16               | 20  |
| 17/XII/60 | 322     | 379 | 16            | 18               | 21  |
| 17/XII/60 | 390     | 341 | 38            | 50               | 58  |
| 7/XII/60  | 262     | 307 | 44            | 78               | 93  |
| 20/XII/60 | 280     | 329 | 70            | 112              | --- |

(see Table V for actual values)

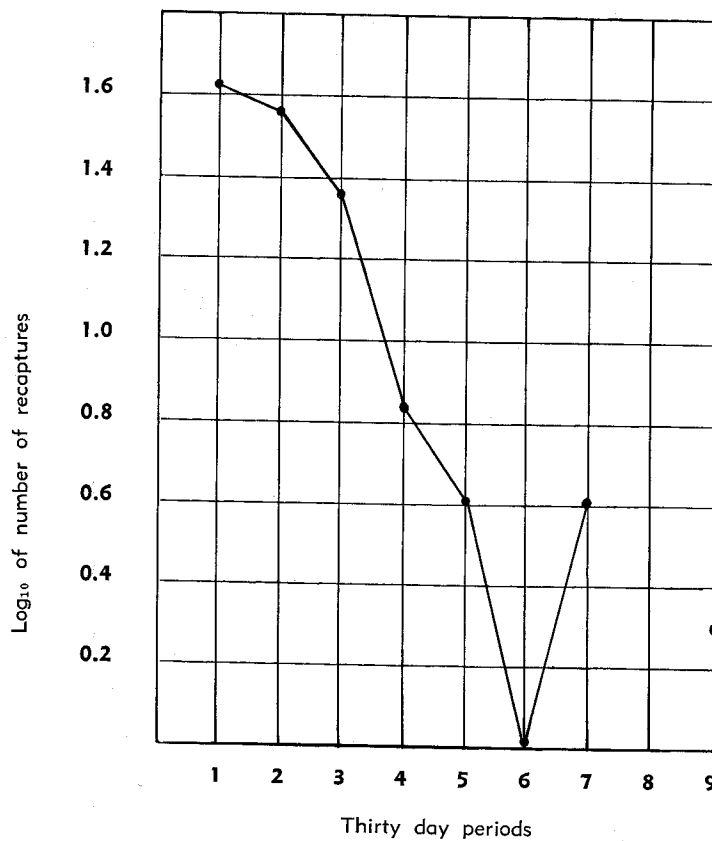


**FIGURE 1. NUMBERS OF RECAPTURED WEAKFISH BY  
THIRTY DAY PERIODS**

(see Table II for actual values)

REDFISH, CHANNEL BASS, *Sciaenops ocellata* (Linnaeus):

Tagged redfish were released in Zone I from December 2, 1960, through January 3, 1961. Recaptured specimens were returned from December 7, 1960, through June 22, 1961. The longest distance traveled by a redfish was 112 miles in 186 days, an average of 0.60 miles per day. This fish was released on December 19, 1960, at City Island, Sarasota Bay, and was recaptured at Cedar Keys. Another tagged-specimen also free for 186 days was caught less than five miles from the release site as were 91.3% of the tagged specimens returned. 87.3% of the tagged specimens were captured less than 20 miles from the release site. The numbers of fish tagged and recaptured by county are listed in Table IV.

150 of 270 (55.6%) tagged redfish were returned. Eighteen of the recaptured fish were returned on January 1, 1961. One tag from a redfish was found entangled in a gill net, and there was a discrepancy between the release and recapture identity of another tagged specimen. These tags were deducted from the total number of fish tagged. These two tags were not considered in the compilation of data. Table V and Figure 2 show the returns by 30-day periods.

Thirty-three redfish free from 41 to 186 days before recapture showed an average increase in length of 29.2 mm. The ten fish exhibiting the greatest length increase are listed in Table VI. Only two redfish free for more than 40 days showed a length shrinkage. One fish free for 59 days and another free for 115 days showed a length shrinkage of 22 mm. and 7 mm. (average 14.5 mm.) respectively.

TABLE IV.  
Numbers of Redfish Returned by County

| County       | Number Tagged | Number Recaptured | Percentage |
|--------------|---------------|-------------------|------------|
| Hernando     | 3             | 0                 | 00.0%      |
| Pasco        | 6             | 4                 | 66.7%      |
| Pinellas     | 40            | 28                | 70.0%      |
| Hillsborough | *45           | *29               | 64.4%      |
| Manatee      | 0             | 0                 | 00.0%      |
| Sarasota     | 82            | 57                | 69.5%      |
| Charlotte    | 5             | 4                 | 80.0%      |
| Lee          | 22            | 13                | 59.1%      |
| Collier      | 65            | 15                | 23.1%      |
| TOTAL        | 270           | 150               | 55.6%      |

\* Does not include one tag found entangled in gill net.

**TABLE V.**  
**Numbers of Redfish Returned by 30 Day Periods**

| Days         | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures (see Figure 2) |
|--------------|-------------------|-----------------------|---------------------------------------------|
| 1- 30        | 83                | 55.7%                 | 1.919                                       |
| 31- 60       | 28                | 18.8%                 | 1.447                                       |
| 61- 90       | 20                | 13.4%                 | 1.301                                       |
| 91-120       | 9                 | 6.0%                  | 0.954                                       |
| 121-150      | 6                 | 4.0%                  | 0.778                                       |
| 151-180      | 1                 | 0.7%                  | 0.000                                       |
| 181-210      | 2                 | 1.3%                  | 0.301                                       |
| <b>TOTAL</b> | <b>149</b>        | <b>100.0%</b>         |                                             |

NOTE: The above total does not include one fish for which the recapture date was not recorded.

**TABLE VI.**  
**Ten Recaptured Redfish Showing the Greatest Amount of Length Increment (MM.)**

| Date      | Release TL | No. Days Free | Length Increment TL |
|-----------|------------|---------------|---------------------|
| 4/XII/60  | 380        | 106           | 34                  |
| 7/XII/60  | 358        | 176           | 97                  |
| *7/XII/60 | 373        | 186           | 115                 |
| 18/XII/60 | 233        | 137           | 123                 |
| 18/XII/60 | 351        | 139           | 56                  |
| 19/XII/60 | 356        | 139           | 39                  |
| 19/XII/60 | 302        | 89            | 42                  |
| 31/XII/60 | 350        | 89            | 47                  |
| 1/ 1/61   | 385        | 58            | 40                  |
| 1/ 1/61   | 343        | 140           | 49                  |

\* Late recovery (Recovered June 10, 1961).

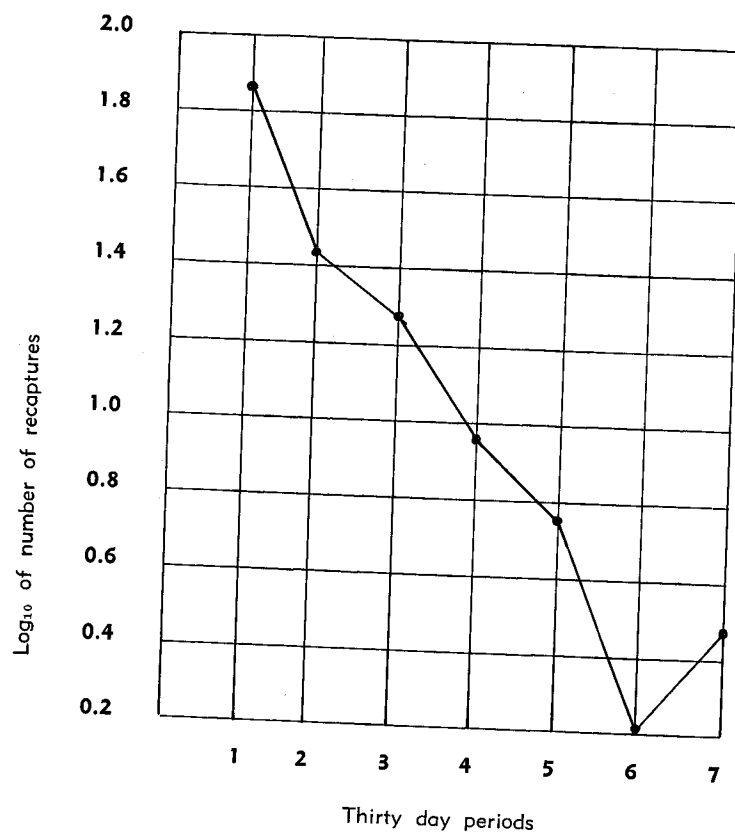


**FIGURE 2. NUMBERS OF RECAPTURED REDFISH  
BY THIRTY DAY PERIODS**

(see Table V for actual values)

SHEEPSHEAD, *Archosargus probatocephalus* (Walbaum)

A total of 55 sheepshead were tagged in Zone I from December 6, 1960, through December 31, 1960. Eighteen fish were recaptured from December 27, 1960, through August 27, 1961, showing a recovery rate of 32.7%. Sheepshead were released in five counties in Zone I. The number of fish tagged and recaptured by county is shown in Table VII.

Only one of the recaptured fish traveled more than 20 miles. This fish, released at Punta Gorda in Charlotte County on December 21, 1960, was recovered at Pine Island in Lee County on January 8, 1961. This rather large individual (total length: 430 mm. at release) traveled 25 miles in 19 days, covering an average distance of 1.32 miles per day.

The longest period that a fish was free was 250 days. This fish was released at the North Jetty in Nokomis (Sarasota County) on December 21, 1960, and recaptured on August 27, 1961, at Siesta Key, Sarasota County, less than ten miles from the point of release. The remaining 16 fish (88.4%) were recaptured within five miles of the point of release.

Table VIII and Figure 3 show the returns by 30 day periods. Here the straight line relationship is not shown when plotting the 30 day periods against the logarithms of the returns. However, the proper relationship becomes evident in the other Zones, where sufficient data is available.

Of the 18 fish recaptured 11 showed a length increment, two showed a length shrinkage and data was not available on the remaining five specimens. Of the two specimens showing a length shrinkage one was free for 30 days and the other 19 days. Table IX lists the 11 specimens with a length increment.

TABLE VII.  
Numbers of Sheepshead Returned by County

| County       | Number Tagged | Number Recaptured | Percentage |
|--------------|---------------|-------------------|------------|
| Hernando     | 0             | 0                 | 00.0%      |
| Pasco        | 0             | 0                 | 00.0%      |
| Pinellas     | 9             | 5                 | 55.6%      |
| Hillsborough | 12            | 2                 | 16.7%      |
| Manatee      | 0             | 0                 | 00.0%      |
| Sarasota     | 9             | 5                 | 55.6%      |
| Charlotte    | 4             | 1                 | 25.0%      |
| Lee          | 0             | 0                 | 00.0%      |
| Collier      | 21            | 5                 | 23.8%      |
| TOTAL        | 55            | 18                | 32.7%      |

**TABLE VIII.**  
**Numbers of Sheepshead Returned by 30 Day Periods**

| Days     | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures (see Figure 3) |
|----------|-------------------|-----------------------|---------------------------------------------|
| 1- 30    | 3                 | 16.7%                 | 0.477                                       |
| 31- 60   | 2                 | 11.1%                 | 0.301                                       |
| 61- 90   | 7                 | 38.9%                 | 0.845                                       |
| 91-120   | 2                 | 11.1%                 | 0.301                                       |
| 121-150  | 2                 | 11.1%                 | 0.301                                       |
| 151-over | 2                 | 11.1%                 | 0.301                                       |
| TOTAL    | 18                | 100.0%                |                                             |

**TABLE IX.**  
**Eleven Sheepshead Showing a Length Increment (MM.)**

| Release   |     | No. Days Free | Increment Length TL |
|-----------|-----|---------------|---------------------|
| Date      | TL  |               |                     |
| 6/XII/60  | 186 | 130           | 45                  |
| 11/XII/60 | 251 | 31            | 32                  |
| 9/XII/60  | 258 | 73            | 36                  |
| 9/XII/60  | 177 | 111           | 55                  |
| 19/XII/60 | 266 | 73            | 27                  |
| 21/XII/60 | 285 | 7             | 16                  |
| 30/XII/60 | 259 | 69            | 18                  |
| 31/XII/60 | 250 | 62            | 27                  |
| 31/XII/60 | 233 | 72            | 18                  |
| 31/XII/60 | 234 | 66            | 9                   |
| 31/XII/60 | 225 | 59            | 47                  |

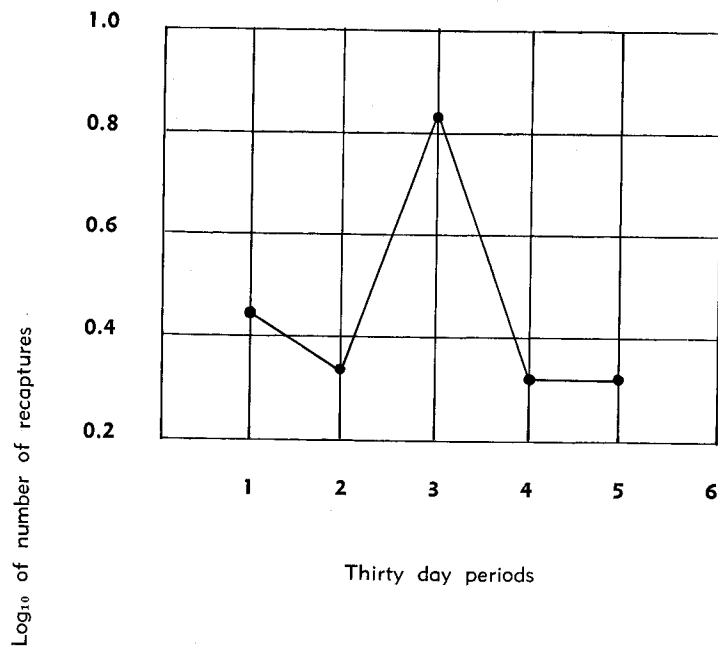


**FIGURE 3. NUMBERS OF RECAPTURED SHEEPSHEAD  
BY THIRTY DAY PERIODS**

(see Table VII for actual values)

# BLACK OR STRIPED MULLET, *Mugil cephalus* Linn.

Black mullet were tagged and released in Zone I from December 6, 1960, through December 19, 1960. Thirty of 75 fish were recovered (40.0%) from December 16, 1960, through April 15, 1961. There was a discrepancy between the release and recapture identity of one tagged specimen. This specimen was not considered in the compilation of data. The numbers of returns by county in Zone I are shown in Table X.

The greatest distance traveled was approximately 23 miles by a fish released on December 11, 1961, at Sand Key in Boca Ciega Bay, Pinellas County, and recaptured on February 16, 1961, south of Gandy Bridge in Pinellas County. This fish was caught 68 days after release, and traveled an average distance of 0.34 miles per day. The longest period of time that a fish was free was 122 days. It was recaptured less than five miles from the point of release.

64.3% of the mullet were recaptured less than five miles from the point of release, and 96.4% were recaptured less than 20 miles from the point of release. One tag from a black mullet was found entangled in a net. This tag was deducted from the total number of fish tagged. It was not considered in the compilation of data.

Table XI and Figure 4 show the returns by 30 day periods.

Of 30 recaptured black mullet 22 showed a length increment, seven a length shrinkage and data was not available for one specimen. Eleven specimens free for more than 61 days all showed a length increment. These 11 specimens and their respective length increments are shown in Table XII.

**TABLE X.**  
**Numbers of Mullet Returned by County**

| County         | Number Tagged | Number Recaptured | Percentage |
|----------------|---------------|-------------------|------------|
| Hernando       | 0             | 0                 | 00.0%      |
| Pasco          | 0             | 0                 | 00.0%      |
| Pinellas       | 41            | 13                | 31.7%      |
| * Hillsborough | 2             | 2                 | 100.0%     |
| Manatee        | 0             | 0                 | 00.0%      |
| Sarasota       | 4             | 1                 | 25.0%      |
| Charlotte      | 0             | 0                 | 00.0%      |
| Lee            | 28            | 14                | 50.0%      |
| TOTAL          | 75            | 30                | 40.0%      |

\* Does not include one tag found entangled in net.

**TABLE XI.**  
**Numbers of Mullet Returned by 30 Day Periods**

| Days    | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures (see Figure 4) |
|---------|-------------------|-----------------------|---------------------------------------------|
| 1- 30   | 11                | 36.7%                 | 1.041                                       |
| 31- 60  | 6                 | 20.0%                 | 0.778                                       |
| 61- 90  | 9                 | 30.0%                 | 0.954                                       |
| 91-120  | 3                 | 10.0%                 | 0.447                                       |
| 121-150 | 1                 | 3.3%                  | 0.000                                       |
| TOTAL   | 30                | 100.0%                |                                             |

**TABLE XII.**  
**Length Increments (MM.) of Eleven Black Mullet Free for More Than 61 Days**

| Release   |     | No. Days Free | Length Increment TL |
|-----------|-----|---------------|---------------------|
| Date      | TL  |               |                     |
| 6/XII/60  | 387 | 90            | 29                  |
| 6/XII/60  | 410 | 111           | 33                  |
| 6/XII/60  | 343 | 65            | 22                  |
| 9/XII/60  | 371 | 111           | 54                  |
| 9/XII/60  | 362 | 68            | 27                  |
| 11/XII/60 | 370 | 79            | 17                  |
| 11/XII/60 | 366 | 68            | 28                  |
| 11/XII/60 | 390 | 81            | 42                  |
| 16/XII/60 | 284 | 64            | 24                  |
| 16/XII/60 | 305 | 113           | 46                  |
| 16/XII/60 | 274 | 122           | 43                  |

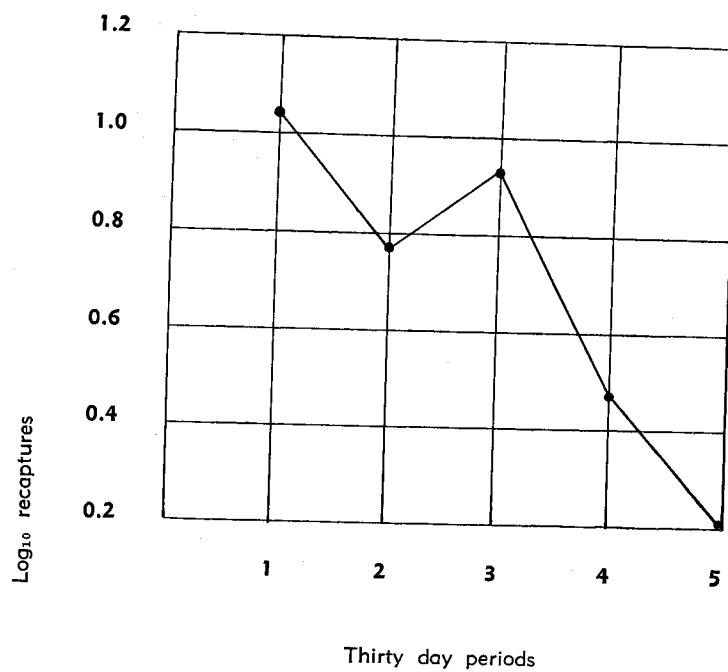


**FIGURE 4. NUMBERS OF RECAPTURED BLACK MULLET  
BY THIRTY DAY PERIODS**

(see Table IX for actual values)

## MISCELLANEOUS SPECIES

Table XIII lists a number of miscellaneous species of which less than 25 specimens of each species were tagged and released.

Seven of 22 (31.8%) tagged grey snapper, *Lutjanus griseus* (L.), were recaptured between 15 and 53 days from the release date. There was a discrepancy between the release and recapture identity of one tagged specimen. This specimen was not considered in the compilation of data. Only one of the eight recaptured specimens was caught more than five miles from the release site. This one specimen traveled from Naples Beach to Wiggins Pass a distance of less than ten miles. Seven of the eight recaptured fish showed an average length increment of 11.7 mm. while one specimen free for 15 days exhibited length shrinkage.

One flounder, *Paralichthys albiguttus* Jordan & Gilbert, free for 69 days was recaptured less than five miles from release. It exhibited a length increment of 10 mm.

One southern sea bass, *Centropristes melanus* (Ginsburg), free for 57 days was caught about 26 miles from the release site. This specimen showed a length increment of 2 mm.

One sea drum, *Pogonias cromis* (L.), released in Collier County was free for 26 days and was recaptured less than five miles from the release site. One specimen released in Pasco County and free for 21 days was recaptured less than ten miles from the release site. Both specimens showed a length shrinkage.

One sea catfish, *Galeichthys felis* (L.), released at New Pass, Sarasota County, was recaptured less than ten miles away in Sarasota Bay 78 days later. Another specimen was free for 81 days before recapture. The exact recapture location was not available. The specimens free for 78 and 81 days showed a length increment of 31 mm. and 36 mm. respectively.

TABLE XIII. DATA FOR MISCELLANEOUS SPECIES

| Species                                                                     | Number Tagged | Number Returned | %      | Mean Distance Traveled | Mean No. Days Free |
|-----------------------------------------------------------------------------|---------------|-----------------|--------|------------------------|--------------------|
| <b>Grey Snapper</b><br>( <i>Lutjanus griseus</i> (L.))                      | 22            | 7               | 31.8%  | 6                      | 33.9               |
| <b>Flounder</b><br>( <i>Paralichthys albiguttus</i> (Jordan & Gilbert))     | 13            | 1               | 7.7%   | 5                      | 69.0               |
| <b>Sea Bass</b><br>( <i>Centropistes melanus</i> (Ginsburg))                | 24            | 1               | 4.2%   | 26                     | 57.0               |
| <b>Sea Drum</b><br>( <i>Pogonias cromis</i> (L.))                           | 2             | 2               | 100.0% | 8                      | 23.5               |
| <b>Sea Catfish</b><br>( <i>Galeichthys felis</i> (L.))                      | 6             | 2               | 33.3%  | 10                     | 79.5               |
| <b>Southern Kingfish</b><br>( <i>Menticirrhus americanus</i> (L.) sp. inq.) | 4             | 0               | 00.0%  | ----                   | ----               |
| <b>Snook</b><br>( <i>Centropomus undecimalis</i> (Bloch) sp. inq.)          | 3             | 0               | 00.0%  | ----                   | ----               |
| <b>Spadefish</b><br>( <i>Chaetodipterus faber</i> (Broussonet))             | 5             | 0               | 00.0%  | ----                   | ----               |
| <b>Silver Mullet</b><br>( <i>Mugil</i> sp.)                                 | 4             | 0               | 00.0%  | ----                   | ----               |

## DISCUSSION

All fishes returned to the Laboratory were identified to species. In Zone I Laboratory identifications differed in three cases from the field identifications. It does not seem likely that the field identifications were in error since the fishes involved (mullet, sheepshead, redfish, snapper) are well-known species, but rather that one of the following two things occurred:

1. There was a recording error, or
2. There was an exchange of tags. To be eligible for a cash award the fish was to be returned with tag attached. Since in at least two cases tags alone were found entangled in nets, it is conceivable that additional tags were found and subsequently attached to fishes.

Even if one included the three cases mentioned above as misidentifications resulting in a 0.9 per cent error of the fishes returned, the data presented here would not be appreciably changed.

Because of the \$1000 bonus award for turning in the first fish captured after midnight December 31, 1960, it has been suggested that some fishes were caught in December and turned in on January 1. Also, it is possible that some fishes caught in December may have been turned in after December 31, 1961, so as to be eligible for awards higher than the \$25 paid for fishes returned in December. With this in mind we analyzed the returns of fishes released after the last day of December, 1960 (see Table XIV). Of 88 fishes tagged after December none were returned within ten days and only one was returned within 14 days of release. In general this is in agreement with the returns of fishes tagged and released in December, 1960.

**TABLE XIV.**  
**Data on Fishes Released After December 31, 1960**

| Date Released   | Number Released | Species          | No. Days Free | Total Number Recaptured |
|-----------------|-----------------|------------------|---------------|-------------------------|
| January 1, 1961 | 27              | Redfish          | 80)           | 6                       |
|                 |                 |                  | 140)          |                         |
|                 |                 |                  | 18)           |                         |
|                 |                 |                  | 58)           |                         |
|                 |                 |                  | 88)           |                         |
|                 | 4               | Sheepshead       | 109)          |                         |
|                 | 1               |                  | Snook         |                         |
| January 3, 1961 | 14              | Seatrout         | 13            | 1                       |
|                 | 3               | Redfish          |               |                         |
|                 | 2               | Mangrove Snapper | 16            | 1                       |
| January 4, 1961 | 37              | Seatrout         | 21)           | 4                       |
|                 |                 |                  | 44)           |                         |
|                 |                 |                  | 68)           |                         |
|                 |                 |                  | 57)           |                         |
| <b>TOTAL</b>    | <b>88</b>       |                  |               | <b>12</b>               |

One of the rules of the Schlitz contest was that to be eligible for a cash award all fishes, with the exception of mullets, were to be caught by hook and line. It is very likely that there was some falsification of data concerning the method of capture. However, because of the nature of the program, method of capture was not considered vitally important in our studies on growth, movement and mortality, except where the falsification of data may have been extended beyond the method of capture.

#### *Movement:*

Tagged spotted seatrout recaptured in Zone I showed little evidence of movement with more than 98% of the fish traveling less than 20 miles from the release site. This tends to substantiate the findings of Moffett (1961) and Iversen and Moffett (1961), who gave evidence that spotted seatrout populations in west Florida do not migrate great distances although, in some cases, a few fish did move long distances.

Over 96% of the black mullet recaptured were less than 20 miles from the release site. This is in agreement with the findings of Broadhead (1953), Broadhead and Mefford (1956) and Idyll and Sutton (1952). They found that most of the tagged black mullet did not travel far, usually less than 20 miles.

This study indicates that redfish, sheepshead and grey snapper, like the spotted seatrout and the black mullet, do not, with the exception of a few individuals, normally travel great distances. The only recaptured sheepshead which traveled over 10 miles was a specimen originally taken in the Gulf of Mexico and transported to brackish water at Punta Gorda. One possibility for its greater distance traveled, as compared with other recaptured specimens, was that it preferred high salinity waters.

At the time of this writing there was insufficient evidence to draw even tentative conclusions on movements of several other tagged species released in small numbers during this program.

Additional data on movement of fishes in Zone I is anticipated with the return of fishes free for relatively long periods of time.

#### *Fishing Mortality:*

The following factors probably had an effect on the assessment of fishing mortality:

1. High rewards (\$25 minimum to possible maximum of \$10,000 per tagged fish).
2. Extensive publicity.
3. Tagged-fish releases were made in areas of heavy fishing pressure.
4. Only the larger fish of a species were tagged.

Table XV summarizes that data on returns for each of the major species tagged.

In the Schlitz program 81 spotted seatrout were tagged in the Pine Island area and at the end of about four months approximately 38.4% of these were returned. Iversen and Moffett (*op. cit.*) estimate the abundance and mortality of a spotted seatrout population. They reported 5,409 fish tagged and released in the vicinity of Pine Island (Ft. Myers) during the period January 6 through 20, 1961. Recovery rate was 23.1 per cent from January 21 through May 31, 1961, a period of slightly over four months. Evidence is available that not all tagged spotted seatrout recaptured in the study by Iversen and Moffett (*op. cit.*) were reported to them. This was mainly because of the low reward (\$0.75)

offered. A Quarterly Report (July 1 - September 30, 1961) from The Marine Laboratory, University of Miami, to the State Board of Conservation, stated that 28 per cent of the tags from the Pine Island area were returned by September 30, 1961. Likewise, because of reasons previously mentioned the Schlitz program probably increased temporarily the number of people fishing.

Thus, we have two tagged fish studies. One with a high monetary return and heavy publicity, the other with more nominal rewards and only the usual public awareness. Returns of 38.4% and 28.0% respectively were noted for these two programs. Using the lower return in mathematical calculations fishing mortality was estimated (Iversen and Moffett, 1961). It appears that a higher return figure and concomitantly higher fishing mortality may now be estimated.

These results are to receive more detailed evaluation.

The rate of recovery of black mullet in Zone I (40.0% in about four months) far exceeds the rate obtained in the tagging program reported by Broadhead and Mefford (*op. cit.*) in which a State-wide recovery of 22.8% during a five-year period was reported. However, these same workers reported a 37.0 percentage recovery in the Panama City area.

The most amazing rate of recovery in Zone I of the Schlitz program was that of the redfish. 55.6 per cent of the tagged redfish were returned in approximately 6½ months.

Taking into account all species tagged in this program the rate of recovery by October 1, 1961, was approximately 33 per cent.

TABLE XV.  
Summary of Data on Returns of Certain Species

|                  | Number Released | Number Returned | % Return | Max. No. of Months Free |
|------------------|-----------------|-----------------|----------|-------------------------|
| Spotted Seatrout | 513             | 119             | 23.2     | 8                       |
| Redfish          | 270             | 150             | 55.6     | 6½                      |
| Mullet           | 75              | 30              | 40.0     | 4                       |
| Sheepshead       | 55              | 18              | 32.7     | 8                       |
| Snapper          | 22              | 7               | 31.8     | 2                       |

#### Growth:

Only general observations on growth have been included in this report. Growth will be discussed more fully in a later report. Several important factors influencing observations on growth in this program were:

1. Because of the nature of the contest only the larger fish of a particular species were tagged. (Scales samples were not used in growth studies).

2. In Zone I fishes turned in as having been caught on January 1 should not be considered since there is evidence that some of these fishes were caught prior to January 1. The reason for turning them in on January 1 was to collect the \$1000 bonus award for turning in the first tagged fish after the "official" opening of the contest.

3. Length shrinkage. Randall (1961) lists five sources which contribute to variations in a series of measurements:

- (a) Error in initial measurements.
- (b) Error in recapture measurement.
- (c) Shrinkage due to starvation.
- (d) Growth.
- (e) Variation in shrinkage after death.

(a) and (b) constituted valid sources of variation throughout the Schlitz program. Human error can cause variations in successive measurements of the same fish by the same person. Larger differences are obtained when the successive measurements are made by different persons, as was sometimes unavoidably the case for the release-recapture measurements in this program.

Variation in shrinkage after death probably accounted for most of the shrinkages observed in the Schlitz Tagging Program. Several observers have reported that a definite shrinkage does occur due to dessication, icing, or freezing. Randall (*op. cit.*) measured 17 convict surgeonfish following partial drying and/or freezing. These fish were all 1-7 mm. shorter than when first measured. In a marking experiment with Yellowtail Flounders, Lux (1960) measured recaptured fish in a landed condition. He noted a mean shrinkage of 1.16% for fish caught two weeks after release. In an experiment to show these effects more directly, Lux (*op. cit.*) measured 72 live Yellowtail Flounders, then froze and remeasured the fish. All fish were shorter at the second measurement, with the mean shrinkage being 1.47% of the total length. Similar results were obtained by Moffett (1959), who showed the mean shrinkage of seatrout (*Cynoscion nebulosus*) after preservation on ice was 2 mm. (0.61%) and the shrinkage after freezing was 5 mm. (1.53%). In Zone II of the Schlitz Tagging Program (preliminary analysis) total mean shrinkage for barracuda was 8.51 mm. (1.35%). A much higher value was shown (1.92%) for fish recaptured within 30 days of the time of release.

Another important source of variation in measurement was not considered by Randall (*op. cit.*). This was damage to fish. Damaged fish should be eliminated from consideration in growth studies.

#### *Improvements in the 1961-62 Tagging Program:*

As was previously mentioned the 1960-61 tagging program was considered to be that of a pilot program because there was little time available for adequate planning before tagging started. With the cooperation of the sponsor several modifications and improvements have been scheduled for the 1961-62 program, through which more meaningful data may be obtained. It is hoped that these improvements will facilitate the valid assessment of several parameters in the forthcoming program. The following modifications have been introduced this year:

1. The employment of a single team (a biologist and an assistant) to handle the tagging program should eliminate any gross discrepancies from the data, and provide more accurate length measurements.
2. Since there was an indication during last year's tagging that some fish may have been held for several days in order to collect the \$1000 first-fish-award, this award has been eliminated from the 1961-62 program.
3. Some tagged fish undoubtedly will be caught prior to the official opening of the contest on January 1, 1962. In the 1960-61 contest

- these fish were worth \$25 to the catcher; this year the fish will be worth the full reward regardless of the early capture date.
4. Experimental work (length shrinkage studies, mortality experiments with tagged and untagged fishes, etc.) will be conducted.
  5. A higher number of fishes will be tagged.

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## II. NOTES ON TAGGING SALT WATER FISHES IN SOUTH FLORIDA (ZONE II)

### INTRODUCTION

The tagging of salt water fishes in South Florida commenced in January 1961. The program, sponsored by the Jos. Schlitz Brewing Company, was organized as described in the first part of this report. The reader is referred to that section for details concerning the sponsorship, publicity, supervision, methods and materials.

The purpose of this section of the paper is to report the results to date (December 1, 1961) of the 1960-61 fish tagging program conducted in Zone II. As in Zone I, certain tentative suggestions and conclusions have been made regarding the nature of the results. One must bear in mind, however, that these conclusions are based on the results of only one season of tagging. It is quite probable that the forthcoming program will confirm and strengthen some of these conclusions, and disprove and invalidate others.

### TAGGING IN ZONE II

Zone II extends from Everglades City to the northern Indian River County Line. This excludes Everglades National Park, since park service policy prohibited the tagging of fishes in that area.

A total of 999 fishes were tagged in Zone II from January 8, 1961 through January 31, 1961. This figure does not include one fish in which an apparent discrepancy had occurred in the release-recapture data. Tagged fishes were recovered from January 14, 1961 through September 9, 1961.

### RESULTS BY SPECIES

#### SPOTTED SEATROUT, *Cynoscion nebulosus* (Cuvier):

A total of 74 seatrout were released in five of the eight counties of Zone II from January 8, 1961 through January 28, 1961. Eleven of these tagged fish were returned (14.9%) from February 18, 1961 through August 10, 1961. The numbers of this species tagged and recaptured in Zone II by county are listed in Table XVI.

As in the other zones, little tendency was shown for movement of long distances. 77.8% of the recaptured seatrout in Zone II were recovered less than five miles from the point of release, with only one fish travelling a distance of twenty miles. This fish was released in Manatee Bay in Monroe County on January 28, 1961, and recaptured at Goulds Canal on March 30, 1961. The distance was travelled in 62 days, with an average speed of 0.32 miles per day.

Only two seatrout were recaptured (18.2%) in Zone II within thirty days of release, whereas in Zone I 42 of the 119 fish (35.3%) were recovered within thirty days. No fish were returned in Zone II until 27 days of freedom had elapsed.

The longest period of time that a seatrout was free was 212 days. This fish was recaptured 1½ miles from the point of release. It was the only seatrout in which a substantial length increment was shown. Table XVII shows the length changes of the eight fish for which data is available.

**TABLE XVI.**  
**Seatrout Tagged and Recaptured in Zone II**

| County       | Number Tagged | Number Recaptured | Percentage |
|--------------|---------------|-------------------|------------|
| Indian River | 2             | 0                 | 00.0%      |
| St. Lucie    | 25            | 4                 | 16.0%      |
| Martin       | 0             | 0                 | 00.0%      |
| Palm Beach   | 0             | 0                 | 00.0%      |
| Broward      | 1             | 0                 | 00.0%      |
| Dade         | 22            | 5                 | 22.7%      |
| Monroe       | 31            | 2                 | 6.5%       |
| Collier      | 0             | 0                 | 00.0%      |
| TOTAL        | 74            | 11                | 14.9%      |

**TABLE XVII.**  
**Eight Recaptured Seatrout Showing Changes in Length (MM.)**

| Release Date | No. Days |     | Change in Length |    |     |
|--------------|----------|-----|------------------|----|-----|
|              | SL       | TL  | Free             | SL | TL  |
| 22/1/61      | 302      | 357 | 28               | -9 | -11 |
| 22/1/61      | 303      | 356 | 28               | -5 | -10 |
| 22/1/61      | 257      | 305 | 109              | -4 | -7  |
| 28/1/61      | 355      | 413 | 62               | -4 | -1  |
| 11/1/61      | 315      | 371 | 40               | -3 | 1   |
| 13/1/61      | 354      | 417 | 96               | 6  | --- |
| 10/1/61      | 356      | 419 | ---              | 9  | 8   |
| 11/1/61      | 289      | 343 | 212              | 52 | 56  |

MANGROVE SNAPPER, *Lutianus griseus* (Linn.):

Over half the fishes tagged in Zone II were mangrove snappers. 532 snappers were tagged from January 8, 1961 through January 31, 1961. 121 of these were recaptured (22.7%) from January 30, 1961 through April 29, 1961. The numbers of this species tagged and recaptured by county are listed in Table XVIII.

The greatest distance travelled was only twenty miles, by a fish released at Port Everglades in Ft. Lauderdale (Broward Co.) on January 24, 1961 and recaptured at MacArthur Causeway in Miami (Dade County) on March 1, 1961, 37 days after release. The mangrove snapper travelled an average distance of 0.54 miles per day. This is the only instance in which a fish travelled more than ten miles. 97.5% of the recovered fish were captured less than five miles from the point of release. The longest period of time that a fish was free was 101 days.

In one instance there was a discrepancy in the release-recapture identity of a specimen released as a snapper. This individual is not included in the total number of released fish.

More than two-thirds of the snappers were recovered between 16 and 45 days of release (30 days). See Tables XIX, XX and Figure 5 for returns by five and thirty day periods.

Most of the length changes were increases, with an average increment of 7.5 mm. Among the 61 fish with available length data twelve shrinkages were noted. Table XXI lists the ten specimens showing the greatest amount of length increment (mm.).

TABLE XVIII.  
Snapper Tagged and Recaptured in Zone II

| County       | Number Tagged | Number Recaptured | Percentage |
|--------------|---------------|-------------------|------------|
| Indian River | 54            | 10                | 18.5%      |
| St. Lucie    | 0             | 0                 | 00.0%      |
| Martin       | 15            | 4                 | 26.7%      |
| Palm Beach   | 82            | 31                | 37.8%      |
| Broward      | 64            | 17                | 26.6%      |
| Dade         | 121           | 42                | 34.7%      |
| Monroe       | 196           | 17                | 8.7%       |
| Collier      | 0             | 0                 | 00.0%      |
| TOTAL        | 532           | 121               | 22.7%      |

TABLE XIX.

Mangrove Snapper (*Lutianus griseus*, Linn.)

## Returns by five day periods

| Days  | Number<br>Recaptured | %    | Days    | Number<br>Recaptured | %     |
|-------|----------------------|------|---------|----------------------|-------|
| 1- 5  | 1                    | 0.8  | 56-60   | 2                    | 1.7   |
| 6-10  | 8                    | 6.7  | 61-65   | 2                    | 1.7   |
| 11-15 | 7                    | 5.9  | 66-70   | 3                    | 2.5   |
| 16-20 | 12                   | 10.1 | 71-75   | 1                    | 0.8   |
| 21-25 | 16                   | 13.4 | 76-80   | 1                    | 0.8   |
| 26-30 | 16                   | 13.4 | 81-85   | 1                    | 0.8   |
| 31-35 | 12                   | 10.1 | 86-90   | 0                    | 0.0   |
| 36-40 | 15                   | 12.6 | 91-95   | 1                    | 0.8   |
| 41-45 | 12                   | 10.1 | 96-100  | 1                    | 0.8   |
| 46-50 | 4                    | 3.4  | 101-105 | 1                    | 0.8   |
| 51-55 | 3                    | 2.5  | Total   | 119                  | 100.0 |

TABLE XX.

## Returns by thirty day periods

| Days   | Number<br>Recaptured | %     |
|--------|----------------------|-------|
| 0- 30  | 60                   | 50.4  |
| 31- 60 | 48                   | 40.3  |
| 61- 90 | 8                    | 6.7   |
| 91-120 | 3                    | 2.5   |
| Total  | 119                  | 100.0 |

FIGURE 5. MANGROVE SNAPPER (*Lutianus griseus*, Linn.)

Returns by five day periods

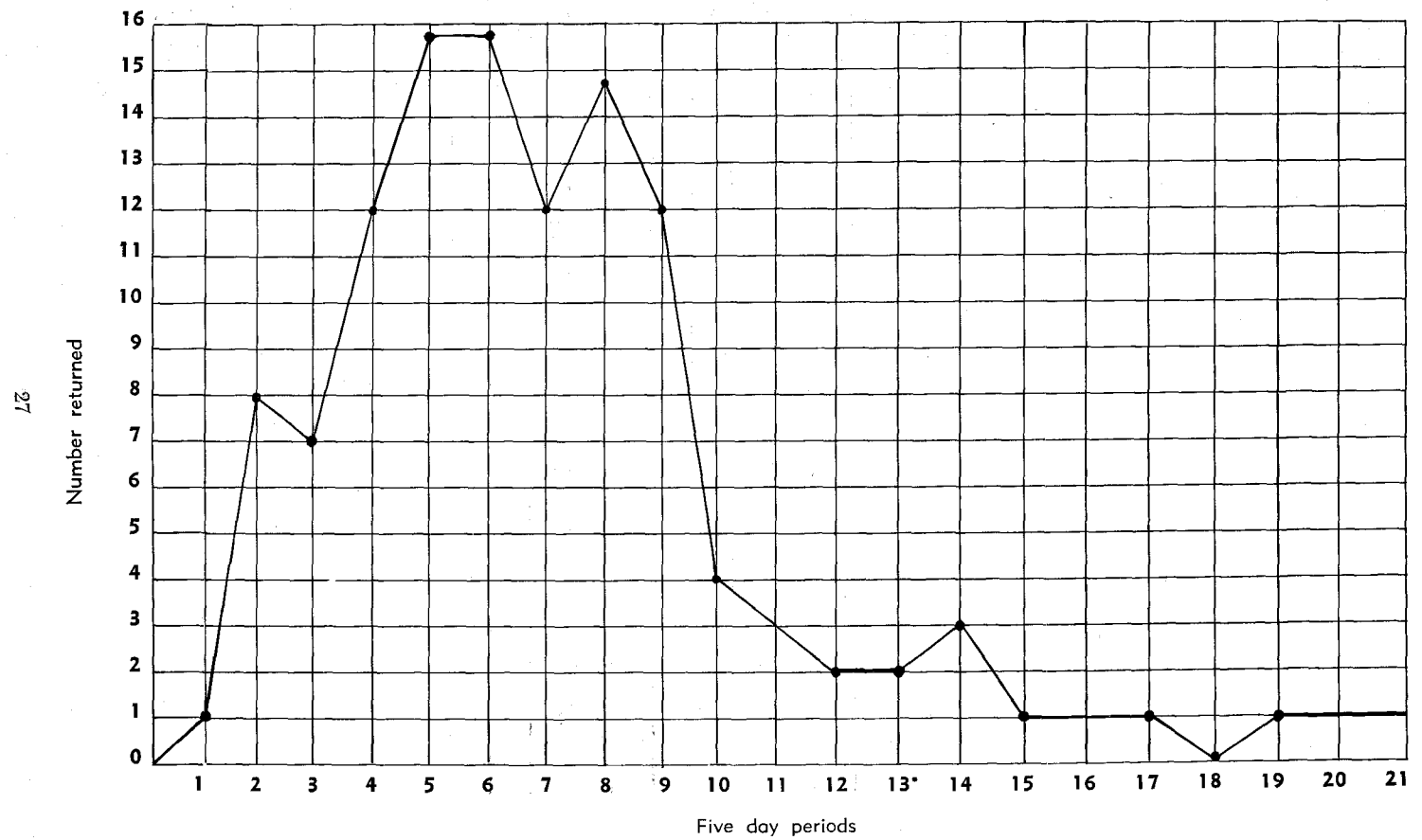


**TABLE XXI.**  
**Ten Recaptured Snappers Showing the Greatest Length Increment (MM.)**

| Release |     | No. Days<br>Free | Length<br>Increment<br>TL |
|---------|-----|------------------|---------------------------|
| Date    | TL  |                  |                           |
| 31/1/61 | 187 | 48               | 13                        |
| 22/1/61 | 255 | 34               | 13                        |
| 24/1/61 | 192 | 38               | 13                        |
| 24/1/61 | 279 | 40               | 14                        |
| 15/1/61 | 255 | 26               | 15                        |
| 14/1/61 | 304 | 19               | 17                        |
| 15/1/61 | 255 | 94               | 28                        |
| 28/1/61 | 206 | 54               | 31                        |
| 15/1/61 | 186 | ---              | 36                        |
| 15/1/61 | 192 | ---              | 60                        |

GREAT BARRACUDA, *Sphyraena barracuda* (Shaw):

A total of 202 barracuda were tagged in Zone II. Two of these individuals were tagged at Snapper Point on Goulds Canal (Dade County) on January 8, 1961, and one was tagged at the same location on January 23, 1961. None of these three individuals was recaptured. The remaining 199 fish were tagged in Monroe County from January 31, 1961 through February 15, 1961, the majority being released in the vicinity of Key Largo. Tagged fish were caught from February 13, 1961 through July 7, 1961. 31 of the 202 tagged fish were recaptured during this time, with a recovery rate of 15.6%.

The greatest distance travelled was 32 miles, by a fish released on February 12, 1961 and recaptured on May 20, 1961, 98 days later. This fish travelled an average distance of 0.32 miles per day. The longest period of time that a fish was free was 157 days. It was recaptured less than ten miles from the point of release. Table XXII shows the returns by 30 day periods.

Only two fish (6.5%) travelled a net distance greater than 10 miles. 77.4% of the recovered barracuda were captured less than five miles from the point of release.

Measurements were recorded for 27 of the 31 recaptured barracudas. An increase in length took place in five fish, whereas 22 of the 27 fish showed a decrease. Table XXIII shows the changes in length for the recaptured fish.

TABLE XXII.  
Numbers of Barracudas Returned by 30 Day Periods

| Days    | Number Recaptured | Percentage |
|---------|-------------------|------------|
| 0- 30   | 8                 | 25.8       |
| 31- 60  | 12                | 38.7       |
| 61- 90  | 4                 | 12.9       |
| 91-120  | 5                 | 16.1       |
| 121-150 | 1                 | 3.2        |
| 151-180 | 1                 | 3.2        |
| TOTAL   | 31                | 100.0      |

**TABLE XXIII.**  
**Changes in Length of Recaptured Barracuda**

| Release TL (MM.) | No. Days Free | Growth (MM.) |
|------------------|---------------|--------------|
| 593              | 115           | 33           |
| 842              | 130           | 28           |
| 657              | 110           | 13           |
| 520              | 111           | 10           |
| 542              | 85            | 05           |
| 401              | 56            | -01          |
| 392              | 50            | -02          |
| 644              | 29            | -04          |
| 507              | 97            | -04          |
| 542              | 85            | -05          |
| 585              | 45            | -09          |
| 380              | 6             | -09          |
| 695              | 24            | -10          |
| 715              | 12            | -10          |
| 706              | 35            | -11          |
| 526              | 32            | -11          |
| 498              | 50            | -13          |
| 470              | 21            | -13          |
| 750              | 75            | -14          |
| 742              | 14            | -16          |
| 761              | 13            | -16          |
| 710              | 39            | -17          |
| 811              | 81            | -19          |
| 732              | 19            | -21          |
| 886              | 54            | -33          |
| 920              | 38            | -38          |
| 696              | 98            | -44          |

Mean Length at Release 632 mm.  
Mean Shrinkage 8.51 mm.  
Standard Deviation 17.0 mm.  
Percent Shrinkage 1.35%

**SHEEPSHEAD, *Archosargus probatocephalus* (Walbaum):**

69 sheepshead were tagged in Zone II from January 10, 1961 through January 19, 1961. In addition, one fish was tagged on January 28, 1961, making a total of 70 sheepshead released in Zone II. Tagged fish were caught from January 14, 1961, through September 9, 1961. 27 of the released fish (38.6%) were recovered. The numbers of sheepshead tagged and recaptured by county are listed in Table XXIV.

The greatest distance travelled was 13 miles, by a fish released in the St. Lucie River in Martin County on January 16, 1961 and recaptured at Jensen Beach in Martin County on February 1, 1961. The distance was travelled in 17 days, with an average speed of 0.76 miles per day. The longest period of time that a sheepshead was free was 243 days. This fish was recaptured less than five miles from the point of release.

No tendency was shown for the movement of long distances. 84.5% of the recaptured fish travelled less than 10 miles and 80.8% of the fish showed a movement of less than five miles. These results are in keeping with those obtained in other zones.

12 of the 26 sheepshead (45.2%) were recaptured within 30 days of release. Table XXV and Figure 6 show the returns of 30 day periods.

Of the 27 recaptured sheepshead 13 showed a length increment, three showed a decrement, and data was not available for 11 specimens. Table XXVI shows the 16 sheepshead for which data is available, along with their respective changes in length.

**TABLE XXIV.**  
**Sheepshead Tagged and Recaptured**  
**Zone II**

| County       | Number Tagged | Number Recaptured | Percentage |
|--------------|---------------|-------------------|------------|
| Indian River | 27            | 6                 | 22.2%      |
| St. Lucie    | 18            | 14                | 77.8%      |
| Martin       | 11            | 7                 | 63.6%      |
| Palm Beach   | 13            | 0                 | 00.0%      |
| Broward      | 0             | 0                 | 00.0%      |
| Dade         | 0             | 0                 | 00.0%      |
| Monroe       | 1             | 0                 | 00.0%      |
| Collier      | 0             | 0                 | 00.0%      |
| TOTAL        | 70            | 27                | 38.6%      |

**TABLE XXV.**  
**Numbers of Sheepshead Returned by 30 Day Periods**

| Days         | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures (see Figure 6) |
|--------------|-------------------|-----------------------|---------------------------------------------|
| 0- 30        | 12                | 46.2%                 | 1.079                                       |
| 31- 60       | 5                 | 19.2%                 | 0.699                                       |
| 61- 90       | 2                 | 7.7%                  | 0.301                                       |
| 91-120       | 3                 | 11.5%                 | 0.477                                       |
| 121-150      | 1                 | 3.8%                  | 0.000                                       |
| 151-180      | 0                 | 0.0%                  | -----                                       |
| 181-210      | 1                 | 3.8%                  | 0.000                                       |
| 211-240      | 1                 | 3.8%                  | 0.000                                       |
| 241-over     | 1                 | 3.8%                  | 0.000                                       |
| <b>TOTAL</b> | <b>26</b>         | <b>100.0%</b>         |                                             |

**TABLE XXVI**  
**Sixteen Recaptured Sheepshead Showing Amount of Change in Total Length (MM.)**

| Release Date | TL  | No. Days Free | Length Change |
|--------------|-----|---------------|---------------|
| 11/1/61      | 245 | 17            | 55            |
| 14/1/61      | 250 | 61            | 25            |
| 14/1/61      | 258 | 52            | 25            |
| 10/1/61      | 264 | 22            | 25            |
| 16/1/61      | 272 | 55            | 22            |
| 11/1/61      | 241 | 16            | 20            |
| 10/1/61      | 274 | 6             | 16            |
| 10/1/61      | 250 | 5             | 15            |
| 10/1/61      | 238 | 32            | 14            |
| 11/1/61      | 202 | 22            | 9             |
| 13/1/61      | 203 | 47            | 8             |
| 13/1/61      | 226 | 203           | 4             |
| 10/1/61      | 241 | 243           | 2             |
| 11/1/61      | 263 | 240           | -1            |
| 11/1/61      | 202 | 15            | -5            |
| 16/1/61      | 236 | 17            | -8            |

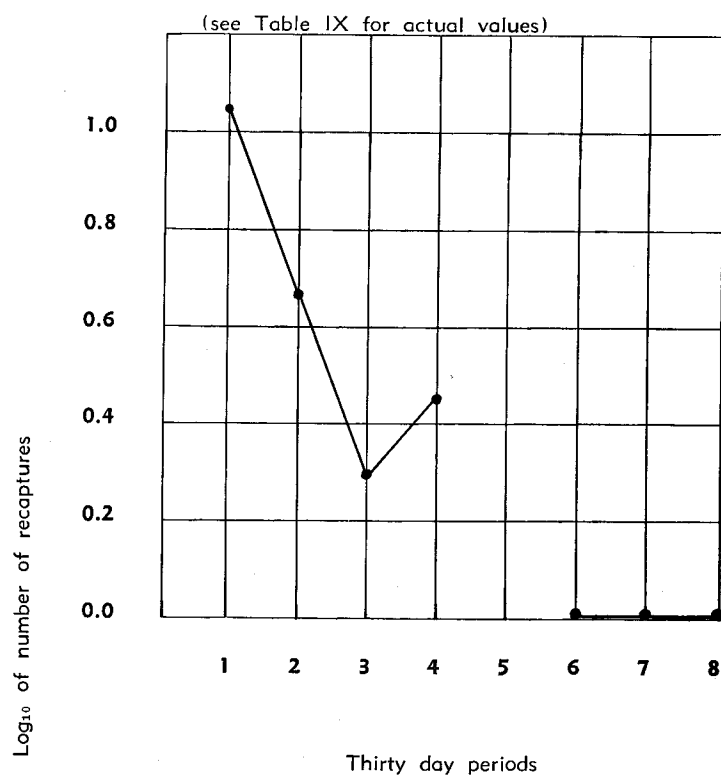


**FIGURE 6. NUMBER OF RECAPTURED SHEEPSHEAD  
BY THIRTY DAY PERIODS**

(see Table XXV for actual values)

## MISCELLANEOUS SPECIES.

Table XXVII lists a number of miscellaneous species of which less than 26 specimens of each species were tagged and released.

Five of the 26 tagged black mullet, *Mugil cephalus* (L.) were recaptured (19.2%) between 7 and 47 days from the release date. None of the recaptured mullet were caught more than five miles from the release site. Three of the recaptured fish showed increments of 16, 23, and 28mm. One specimen, at large only seven days, showed a shrinkage of 10 mm. Data was not available for the remaining specimen.

Six of the eighteen tagged redfish *Sciaenops ocellata* (L.) were recaptured (33.3%) between 21 and 76 days from the release date. None of the recaptured redfish were caught more than five miles from the release site. The three recaptured fish for which data was available showed an average increment of 19 mm.

Ten of the 17 tagged sea drum, *Pogonias cromis* (L.) were recaptured (58.8%) between 3 and 125 days from the release date. Only one of the recaptured sea drums was caught more than five miles from the point of release. This one specimen travelled fourteen miles from Vero Beach to Fort Pierce in 88 days, averaging 0.16 miles per day. The change in length of the recaptured sea drum ranged from -18mm. to 20 mm., with an average length change of +0.3 mm.

Two snook, *Centropomus undecimalis* (Bloch), free for 62 and 63 days, were both caught less than five miles from the release site. One specimen showed a length increment of 6mm. Growth data was not available for the other.

Two whiting, *Menticirrhus americanus* (L.), were tagged at Fort Pierce. Both fish were recaptured. Recapture data (measurements and location) were not available for one specimen which was free for 69 days. The other, free for 7 days, showed a shrinkage of 14 mm. This specimen was caught less than five miles from the release site.

One red grouper, *Epenephelus morio* (Cuv. & Val.), free for 60 days, was recaptured less than five miles from the release site. It exhibited a shrinkage of 2mm.

One sea catfish, *Galeichthys felis* (L.) was returned in Zone 11. However, a discrepancy was involved in the release-recapture identities and this specimen was not considered in the compilation of data.

**TABLE XXVII.**  
**Data for Miscellaneous Species in Zone II**

| Species                                                        | Number Tagged | Number Returned | %     | Mean Distance Travelled | Mean No. Days Free |
|----------------------------------------------------------------|---------------|-----------------|-------|-------------------------|--------------------|
| <b>Snook</b><br><i>Centropomus undecimalis</i> (L.) sp. inq.   | 24            | 2               | 8.3   | <5                      | 62.5               |
| <b>Black Mullet</b><br><i>Mugil cephalus</i> (L.)              | 26            | 5               | 19.2  | <5                      | 21.4               |
| <b>Redfish</b><br><i>Sciaenops ocellata</i> (L.)               | 18            | 6               | 33.3  | <5                      | 53.8               |
| <b>Sea Drum</b><br><i>Pogonias cromis</i> (L.)                 | 17            | 10              | 58.8  | <6                      | 49.3               |
| <b>Red Grouper</b><br><i>Epenephelus morio</i> (Cuv. & Val.)   | 6             | 1               | 16.7  | <5                      | 60.0               |
| <b>Whiting</b><br><i>Menticirrhus americanus</i> (L.) sp. inq. | 2             | 2               | 100.0 | <5                      | 38.0               |
| <b>Grunt</b><br><i>Haemulon</i> sp.                            | 2             | 0               | 00.0  | ---                     | ---                |
| <b>Porgy</b><br><i>Calamus</i> sp.                             | 4             | 0               | 00.0  | ---                     | ---                |
| <b>Sea Catfish</b><br><i>Galeichthys felis</i> (L.)            | 1             | 0               | 00.0  | ---                     | ---                |
| <b>Sand Trout</b><br><i>Cynoscion arenarius</i> (Ginsburg)     | 7             | 0               | 00.0  | ---                     | ---                |
| <b>Permit</b><br><i>Trachinotus falcatus</i> (L.)              | 1             | 0               | 00.0  | ---                     | ---                |
| <b>Bluefish</b><br><i>Pomatomus saltatrix</i> (L.)             | 2             | 0               | 00.0  | ---                     | ---                |
| <b>Croaker</b>                                                 | 11            | 0               | 00.0  | ---                     | ---                |

## DISCUSSION

In one instance a discrepancy was noted between the release and recapture identities of an individual. This specimen was recorded as a mangrove snapper, *Lutianus griseus* (L.) at release, and as a sea catfish, *Galeichthys felis* (L.) when returned to the laboratory after recapture. It is doubtful that the field identification was in error in the case of such widely differing species. A more plausible explanation would be either a recording error or an exchange of tags. The latter possibility has been considered in the discussion section of the Zone I report. In all such cases, including the one mentioned above, the specimens involved were not considered in the compilation of data.

As in Zone I a \$1,000 bonus was offered for the first fish captured after the start of the contest (in the case of Zone II, midnight, January 31, 1961). After this date the entries became eligible for higher cash awards than the \$25 paid for fishes returned in January. It has been suggested that some fishes caught in January were withheld until after the opening date in order to be eligible for the bonus and the larger cash awards. The returns listed below during the ten day period from January 27, 1961 through February 5, 1961 indicate that such was indeed the case.

| DATE             | No. FISH RETURNED |
|------------------|-------------------|
| January 27, 1961 | 1                 |
| January 28, 1961 | 1                 |
| January 29, 1961 | 0                 |
| January 30, 1961 | 1                 |
| January 31, 1961 | 2                 |
| February 1, 1961 | 16                |
| February 2, 1961 | 3                 |
| February 3, 1961 | 2                 |
| February 4, 1961 | 3                 |
| February 5, 1961 | 4                 |

Since this introduced a substantial bias into the recapture data the possibility has been precluded from the forthcoming program by the elimination of the \$1,000 bonus award.

### *Movement:*

Spotted seatrout showed little evidence of extensive movement in Zone II, with 77.8% of the recaptured fish travelling less than five miles, and only one fish of the eleven recaptured specimens travelling a distance of twenty miles. These results are in keeping with those of Zone I, and substantiate the findings of Iversen and Tabb (1960), who suggest the existence of separate subpopulations of seatrout largely on the basis of age and growth data.

Mangrove snappers in Zone II showed an even smaller tendency for movement from the release site. Of the 121 recaptured fish only one fish travelled more than ten miles, with 97.5% of the recovered fish being captured less than five miles from the point of release.

Only two barracudas travelled a net distance greater than ten miles. 77.4% of the recovered fish were captured less than five miles from the point of release. This is in agreement with the study of Springer and McErlean (1961), who reported an "insignificant net movement" in 73.3% of the recaptured barracudas.

It appears from this study that sheepshead, redfish, drums and black

mullet likewise do not display a tendency for the movement of great distances. However, with the return of fishes free for relatively longer periods of time, additional data, along with exceptions to the above indications, may quite possibly occur.

Table XXVIII shows the movement of fishes in Zone II for species of which more than five specimens have been recovered.

#### *Fishing Mortality:*

The discussion section of Zone I lists the factors which had a probable effect on the assessment of fishing mortality in that zone. These factors are generally applicable in Zone II also. However, even after these factors have been properly weighed the rate of returns appear higher than usually obtained in tagging programs. Future evaluation of the factors involved may indicate that the estimates of fishing mortality are greater than is generally supposed.

The rate of recovery of seatrout in Zone II (14.9%) is considerably smaller than the rate of 23.2% obtained in Zone I. The fact that the trout released in Zone I were subject to an additional month of high tourist visitation may partially account for the difference.

The recovery rate of mangrove snappers at some of the specific release locations was considerably higher than the overall rate. 19 of the 40 fish released at Palm Beach were recaptured (47.5%) and 11 of the 17 released at Snapper Point on the Goulds Canal in Dade County were recaptured (64.7%). In contrast to this only 17 of the 196 snappers (8.7%) released in the Florida Keys (Monroe County) were recaptured. This low rate can possibly be attributed to both the lower fishing pressure and the increased predation in this area. Moreover, where greater predatory pressure exists (such as from the barracuda in the Florida Keys) an additional mortality due to tagging is often encountered (Ricker, 1948, Beverton & Holt, 1957). This mortality may also have substantially affected the rate of returns.

**TABLE XXVIII.**  
**Movement of Fishes in Zone II**

| Species                 | Number Tagged | Number Recaptured | Movement |          |         | Greatest Distance Travelled |
|-------------------------|---------------|-------------------|----------|----------|---------|-----------------------------|
|                         |               |                   | < 20 mi. | < 10 mi. | < 5 mi. |                             |
| <b>Mangrove Snapper</b> | 532           | 121               | 100.0%   | 98.3%    | 97.5%   | 20 mi.                      |
| <b>Barracuda</b>        | 202           | 31                | 93.5%    | 93.5%    | 77.4%   | 32 mi.                      |
| <b>Sheepshead</b>       | 70            | 26                | 100.0%   | 84.6%    | 80.8%   | 13 mi.                      |
| <b>Seatrout</b>         | 74            | 11                | 100.0%   | 88.9%    | 77.8%   | 20 mi.                      |
| <b>Sea Drum</b>         | 17            | 10                | 100.0%   | 90.0%    | 90.0%   | 14 mi.                      |
| <b>Redfish</b>          | 18            | 6                 | 100.0%   | 100.0%   | 100.0%  | 5 mi.                       |
| <b>Black Mullet</b>     | 26            | 5                 | 100.0%   | 100.0%   | 100.0%  | 5 mi.                       |

The recovery rate of 15.6% for the barracuda is more than twice that of 6.4% obtained by Springer and McErlean (1961). Besides the reasons already proposed, another reason for the observed difference may in

this case be the fact that the lower rate obtained by Springer and McErlean included the results from dart tags, which in this program proved unsatisfactory for the tagging of barracudas. Only 3.0% of the barracudas tagged with darts were returned, whereas 8.1% of the disc-tagged fish were returned.

Springer and McErlean (*op. cit.*) did not consider it advisable to tag specimens less than 400 mm. in total length, and discontinued this practice due to lack of returns in their program. However, the recovery rate for fish in the 300-400 mm. length class in the Schlitz program was 13.4%, not appreciably lower than the overall rate of 15.6% for barracudas.

On November 14, 1961, a barracuda tagged (Petersen tag) by Springer and McErlean (*op. cit.*) was caught off the Village of West End, Grand Bahama Island, by Mrs. Mildred Caliguiri. The total length of this fish when released at Molasses Reef, Key Largo, Florida, on November 11, 1960, was 679 mm. At recapture, according to Mrs. Caliguiri, the total length of the specimen measured 2 feet 7 inches and weighed 6¼ pounds. The fish had travelled a distance of approximately 150 miles.

The overall rate of recovery for all fishes in Zone II was 21.5%. Table XXIX summarizes the data on returns for each of the major species tagged.

#### *Growth:*

The length of each fish was recorded both at release and upon return to the laboratory after recapture. In some cases damage to the recaptured individuals eliminated them from consideration of growth data.

One of the more striking factors in the length analyses was the observed shrinkage which occurred among several species. The barracudas were the most notable in this respect, showing a mean shrinkage of 8.51 mm. (1.35%) for all recaptured individuals. A value of 1.92% was obtained for specimens recaptured within thirty days of release. The section on growth in the Zone I report discusses this phenomenon more fully, comparing the above results to those of similar programs. Experiments are currently being conducted to examine these effects more closely.

#### *Improvements in the 1961-62 tagging program:*

The improvements outlined in the discussion section of Zone I will be applicable to all zones in the forthcoming tagging program.

TABLE XXIX.  
Summary of Data on Returns of Certain Species

| Species          | Number Released | Number Returned | % Returned | Max. No. of Months Free |
|------------------|-----------------|-----------------|------------|-------------------------|
| Mangrove Snapper | 532             | 121             | 22.7 %     | 3                       |
| Great Barracuda  | 202             | 31              | 15.6 %     | 5                       |
| Sheepshead       | 70              | 26              | 38.6 %     | 8                       |
| Seatrout         | 74              | 11              | 14.9 %     | 7                       |

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## III. NOTES ON THE TAGGING OF SALT WATER FISHES IN ZONE III

### INTRODUCTION

The tagging of salt water fishes in the 1960-61 Schlitz Tagging Program was carried out in Zone III from February 22, 1961, through March 12, 1961. The organization of the program is described in detail in the introduction to the Zone I report.

The purpose of this section is to report the results of the 1960-61 program in Zone III through December 31, 1961, along with a discussion of these results.

### TAGGING IN ZONE III

Zone III includes the coastal areas of Flagler, Volusia and Brevard Counties of Florida's east coast, and Citrus and southern Levy County on the west coast. The two areas are in some cases treated separately because of both the geographical separation and the probable existence of distinct sub-populations of some species.

A total of 500 fishes were tagged in Zone III. 200 fishes were tagged on the west coast from February 22, 1961 through March 4, 1961 and 300 fishes were tagged on the east coast from March 4, 1961 through March 12, 1961. Tagged fishes were recovered in both sections of Zone III from March 1, 1961 through November 11, 1961.

### RESULTS BY SPECIES

SPOTTED SEATROUT, *Cynoscion nebulosus* (Cuvier):

A total of 325 seatrout were tagged and released in four of the five counties of Zone III from February 24, 1961, through March 11, 1961. 25 of these tagged fish (7.7%) were recaptured from March 1, 1961

through May 16, 1961. Table XXX shows the number of seatrout tagged and recaptured in Zone III by county.

As in Zones I and II, little tendency was shown for movement of long distances. 13 of the 14 recaptured specimens for which data is available travelled less than five miles from the point of release. One exception was shown by a specimen released at the mouth of the Homosassa River on March 27, 1961, and recaptured at Placida, Florida on March 27, 1961. The distance was travelled in 28 days with an average speed of 4.3 miles per day.

8 of the 14 seatrout for which data is available (57.0%) were captured within 30 days of release. Zones I and II showed 35.3% and 18.2% respectively.

The longest period of time that a seatrout was free was 78 days. This specimen was recaptured less than five miles from the point of release.

Table XXXI lists seven specimens for which time-growth data are available.

**TABLE XXX.**  
**Numbers of Seatrout Returned by County**

| County  | Number Tagged | Number Recaptured | Percentage |
|---------|---------------|-------------------|------------|
| Flagler | 0             | 0                 | -----      |
| Volusia | 50            | 0                 | 0.0%       |
| Brevard | 150           | 17                | 11.3%      |
| Levy    | 19            | 0                 | 0.0%       |
| Citrus  | 111           | 8                 | 7.2%       |
| TOTAL   | 330           | 25                | 7.6%       |

**TABLE XXXI.**  
**Seven Recaptured Seatrout for Which Complete Growth Data Are Available**

| Release<br>Date | SL  |     | TL    |     | No. Days |     | Length Increment |    |
|-----------------|-----|-----|-------|-----|----------|-----|------------------|----|
|                 | SL  | TL  | Free  | SL  | Free     | TL  | SL               | TL |
| 28/ II/61       | 328 | 388 | 22    | -05 |          | -08 |                  |    |
| 28/ II/61       | 358 | 420 | 43    | -09 |          | 00  |                  |    |
| 7/III/61        | 280 | 328 | 15    | -01 |          | -06 |                  |    |
| 5/III/61        | 255 | 306 | ----- | 02  |          | -03 |                  |    |
| 28/ II/61       | 364 | 423 | 2     | -06 |          | 02  |                  |    |
| 5/III/61        | 260 | 311 | 15    | -02 |          | -04 |                  |    |
| 28/ II/61       | 345 | 403 | 2     | -01 |          | 04  |                  |    |

**SHEEPSHEAD, *Archosargus probatocephalus* (Walbaum):**

A total of 81 sheepshead were tagged and released in Zone III from February 26, 1961 through March 12, 1961. 31 of these were recaptured (35.6%) from March 3, 1961 through November 11, 1961.

Volusia County showed the largest representation of both tagged and recaptured specimens, with a recapture rate of 38.0%. Only two sheepshead were recaptured (11.8%) from the 17 specimens released on the west coast of Zone III. The numbers of this species tagged and recaptured by county are listed in Table XXXII.

Only two specimens travelled more than five miles from the point of release. Both fish were released at Gray Mare Pass, Citrus County on February 27, 1961 and both were recaptured at Cat Island, Citrus County, March 3, 1961, five days later. They showed a net movement of less than ten miles. The remaining 29 fish, all of which were tagged and recaptured on the east coast of Zone III were all recovered less than five miles from the point of release. The longest period of time that a sheepshead was free was 237 days.

17 of the 30 specimens for which data is available (56.7%) were recaptured within 30 days of release. Table XXXIII and Figure 7 show the returns by 30 day periods.

Nearly all the length changes were increases, with an average standard length increment of 18.7 mm.

It was necessary to change five of the measurements from total length to standard length by multiplying by a factor of 0.848. This correction factor was derived from the ratio of total length to standard length in a random sample of 30 sheepshead released in zone three.

This correction may be stated:

$$\left( \frac{\sum_{i=1}^{30} (SL)_i}{n} \right) \times \left( \frac{\sum_{i=1}^{30} (TL)_i}{n} \right) = \text{total length of individual to be corrected.}$$

Among the 29 sheepshead with available length data two shrinkages were noted. Table XXXIV lists ten specimens showing the greatest amount of length increment (mm.).

**TABLE XXXII.**  
**Numbers of Sheephead Returned by County**

| County  | Number Tagged | Number Recaptured | Percentage |
|---------|---------------|-------------------|------------|
| Flagler | 0             | 0                 | -----      |
| Volusia | 57            | 24                | 42.1 %     |
| Brevard | 7             | 5                 | 71.4 %     |
| Levy    | 0             | 0                 | -----      |
| Citrus  | 17            | 2                 | 11.8 %     |
| TOTAL   | 81            | 31                | 35.6 %     |

**TABLE XXXIII.**  
**Numbers of Sheephead by 30 Day Periods**

| Days    | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures<br>(see Figure 7) |
|---------|-------------------|-----------------------|------------------------------------------------|
| 1- 30   | 17                | 56.6 %                | 1.230                                          |
| 31- 60  | 4                 | 13.3 %                | 0.602                                          |
| 61- 90  | 3                 | 10.0 %                | 0.477                                          |
| 91-120  | 1                 | 3.3 %                 | 0.000                                          |
| 121-150 | 0                 | 0.0 %                 | -----                                          |
| 151-180 | 1                 | 3.3 %                 | 0.000                                          |
| 181-210 | 0                 | 0.0 %                 | -----                                          |
| 211-240 | 4                 | 13.3 %                | 0.602                                          |
| TOTAL   | 30                | 100.0 %               |                                                |

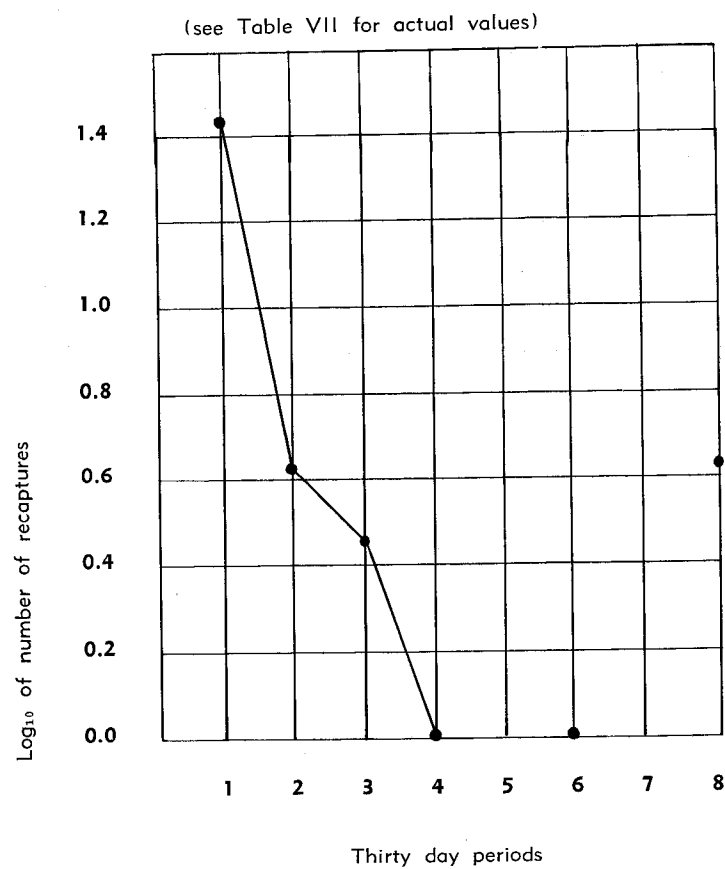


**FIGURE 7. NUMBER OF RECAPTURED SHEEPSHEAD  
BY THIRTY DAY PERIODS**

(see Table XXXIII for actual values)

**TABLE XXXIV.**  
**Ten Recaptured Sheepshead Showing the Greatest Standard**  
**Length Increment (MM.)**

| Release   |     | No. Days<br>Free | Increment<br>Length<br>SL |
|-----------|-----|------------------|---------------------------|
| Date      | SL  |                  |                           |
| 8/III/61  | 180 | 62               | 17                        |
| 12/III/61 | 205 | 103              | 23                        |
| 11/III/61 | 152 | 9                | 25                        |
| 12/III/61 | 220 | 87               | 30                        |
| 8/III/61  | 169 | -----            | 31                        |
| 11/III/61 | 177 | 221              | 39                        |
| 11/III/61 | 115 | 231              | 63                        |
| 12/III/61 | 168 | 225              | 78                        |
| 12/III/61 | 201 | 237              | 101                       |
| 11/III/61 | 158 | 153              | 107                       |

#### LISA

#### BLACK OR STRIPED MULLET, *Mugil cephalus* (Linn.)

A total of 47 black mullet were released in two of the five counties of Zone III. 35 mullet were released in Citrus County on the west coast from February 22 through February 26, 1961 and 12 mullet were released in Brevard County on the east coast on March 6 and 7, 1961. A total of eleven tagged fish were returned (23.4%), all of which were released and recaptured in Citrus County. These eleven recovered specimens represent 31.4% of the 35 fish released in that county. No specimens were recovered from Brevard County.

Only one of the recaptured specimens (9.1%) travelled a net distance greater than five miles. This specimen was released at Crystal River on February 24, 1961 and recovered on the Homosassa River 77 days later on May 2, 1961, less than ten miles from the point of release. The longest period of time that a fish was free was 89 days.

Only two of the eleven mullet (11.0%) were recaptured within thirty days of release. Table XXXV and Figure 8 show the returns by thirty day periods. A relationship in reverse of the expected values is shown when plotting the thirty day periods against the logarithm of the returns. However, where sufficient data is available (see Zone I) the proper relationship becomes evident.

All of the nine black mullet for which growth data is available showed a substantial increase in length, with a mean increase of 32.6 mm. Table XXXVI lists the nine specimens and their corresponding length increments.

**TABLE XXXV.**  
**Numbers of Black Mullet Returned by 30 Day Periods**

| Days  | Number Recaptured | Percentage Recaptured | Log <sub>10</sub> Recaptures<br>(see Figure 8) |
|-------|-------------------|-----------------------|------------------------------------------------|
| 1-30  | 2                 | 18.2%                 | 0.301                                          |
| 31-60 | 3                 | 27.3%                 | 0.447                                          |
| 61-90 | 6                 | 54.5%                 | 0.778                                          |
| TOTAL | 11                | 100.0%                |                                                |

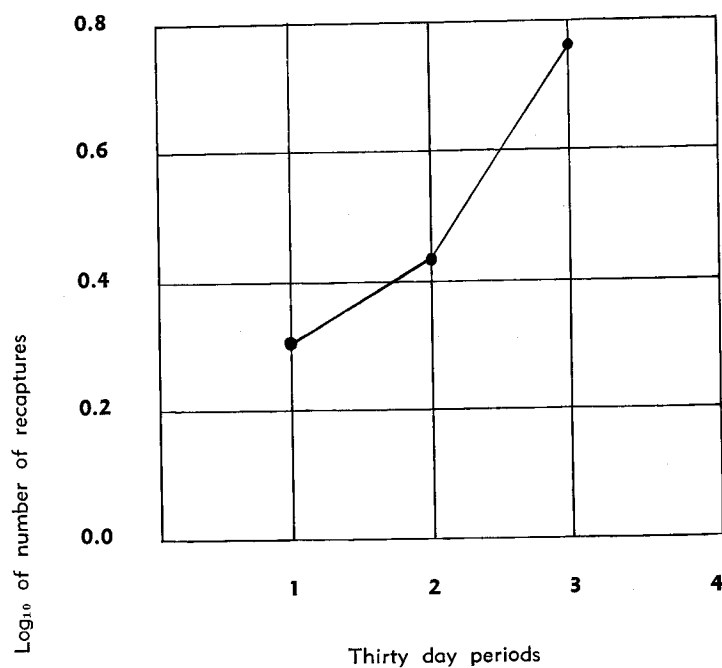


**FIGURE 8. NUMBER OF RECAPTURED BLACK MULLET  
 BY THIRTY DAY PERIODS**

(see Table XXXV for actual values)

**TABLE XXXVI.**  
**Nine Recaptured Black Mullet Showing the Length Increments (MM.)**

| Release Date | TL  | No. Days Free | Change in Length TL |
|--------------|-----|---------------|---------------------|
| 24/II/61     | 298 | 29            | 23                  |
| 26/II/61     | 333 | 61            | 23                  |
| 24/II/61     | 305 | 50            | 30                  |
| 24/II/61     | 285 | 68            | 32                  |
| 24/II/61     | 316 | 67            | 33                  |
| 26/II/61     | 337 | 39            | 33                  |
| 24/II/61     | 364 | 80            | 36                  |
| 26/II/61     | 400 | 39            | 37                  |
| 24/II/61     | 319 | 77            | 46                  |

**REDFISH, CHANNEL BASS, *Sciaenops ocellata* (Linn.)**

A total of 19 redfish were tagged on the west coast of Zone III from February 24, 1961 through March 1, 1961. Eighteen redfish were released in Citrus County and one was released in Levy County. Six of the tagged specimens were recovered (31.6%) from March 1, 1961 through May 17, 1961, five in Citrus County and one in Levy County.

All of the recaptured redfish were recovered less than five miles from the point of release. The longest period of time that a fish was free was 81 days. All but one of the recaptured specimens showed an increase in length. Table XXXVII shows the length changes for the recaptured specimens.

**TABLE XXXVII.**  
**Six Recaptured Redfish Showing Amount of Change in Length (MM.)**

| Release Date | SL    | TL  | No. Days Free | Length SL | Change TL |
|--------------|-------|-----|---------------|-----------|-----------|
| 24/ II/62    | ----- | 358 | 18            | ----      | -31       |
| 24/ II/62    | ----- | 335 | 28            | ----      | 09        |
| 26/ II/62    | ----- | 396 | 57            | ----      | 34        |
| 27/ II/62    | 270   | 326 | 22            | 29        | 39        |
| 1/III/62     | 282   | 340 | 77            | 43        | ----      |
| 26/ II/62    | ----- | 395 | 81            | ----      | 53        |

# MISCELLANEOUS SPECIES

Five of the thirteen tagged sea drum, *Pagonias cromis* (L.) were recaptured (38.5%). All five specimens were recovered on the east coast of Zone III, and represent 45.4% of the eleven specimens tagged there. They were all recaptured within five miles from the point of release and within 31 days of the date of release. Two specimens showed a length shrinkage, one showed a length increase and one showed no change. Data was not available for the remaining specimen.

Two whiting, *Menticirrhus americanus* (L.), free for nine and ten days were both caught less than five miles from the release site. The two specimens showed length changes of 7 and -1 mm. respectively.

Table XXXVIII lists the numbers of species tagged and recaptured in Zone III, along with the percentage of recovery, mean distance travelled and mean number of days free.

**TABLE XXXVIII.**  
**Data for Species Tagged and Recaptured in Zone III**

| Species                                                           | Number Tagged | Number Returned | %     | Mean Distance Travelled (miles) | Mean No. Days Free |
|-------------------------------------------------------------------|---------------|-----------------|-------|---------------------------------|--------------------|
| <b>Spotted Seatrout</b><br><i>Cynoscion nebulosus</i> (Cuv.)      | 325           | 25              | 7.7%  | 13.9                            | 29.9               |
| <b>Sheepshead</b><br><i>Archosargus probatocephalus</i> (Walbaum) | 75            | 26              | 35.6% | <5                              | 60.3               |
| <b>Black Mullet</b><br><i>Mugil cephalus</i> (L.)                 | 47            | 11              | 23.4% | <6                              | 56.4               |
| <b>Redfish</b><br><i>Sciaenops ocellata</i> (L.)                  | 19            | 6               | 31.6% | <5                              | 47.2               |
| <b>Sea Drum</b><br><i>Pagonias cromis</i> (L.)                    | 13            | 5               | 38.5% | <5                              | 12.0               |
| <b>Mangrove Snapper</b><br><i>Lutianus griseus</i> (L.)           | 8             | 0               | 00.0% | -----                           | -----              |
| <b>Whiting</b><br><i>Menticirrhus americanus</i> (L.)             | 5             | 2               | 40.0% | <5                              | 9.5                |
| <b>Grunt</b><br><i>Haemulon</i> sp.                               | 1             | 0               | 00.0% | -----                           | -----              |
| <b>Spadefish</b><br><i>Chaetodipterus faber</i> (Broussonet)      | 1             | 0               | 00.0% | -----                           | -----              |
| <b>Sea Catfish</b><br><i>Galeichthys felis</i> (L.)               | 1             | 0               | 00.0% | -----                           | -----              |

## DISCUSSION

As in Zones I and II there is a possibility that some fishes caught before the official opening date of the contest were withheld for the \$1000 first-fish bonus and the larger cash awards. The first ten fishes caught in Zone III are listed below, indicating that such may have been the case.

| Number fish returned | Date      |
|----------------------|-----------|
| 3                    | 1/III/61  |
| 2                    | 3/III/61  |
| 1                    | 9/III/61  |
| 2                    | 12/III/61 |
| 2                    | 13/III/61 |

### *Movement:*

Tagged spotted seatrout showed little evidence of movement in Zone III, with all but one of the recaptured specimens (92.9%) travelling a net distance of less than five miles. These results are in agreement with those of Zones I and II and they further substantiate the findings of Moffett (1961) and Iversen & Tabb (1961), who suggest that spotted seatrout populations in Florida do not tend to migrate long distances.

Only one black mullet showed a net movement of more than five miles, agreeing with both the results of Zones I and II and the findings of Broadhead (1953) and Broadhead & Mefford (1956).

Sheepshead, redfish and drums in Zone III likewise showed little tendency for extensive migrations. Although future returns may display a greater net movement, the present results in Zone III indicate only a slight tendency for the movement of great distances.

Table XXXIX shows the movement of fishes in Zone III for species of which five or more specimens have been recovered.

**TABLE XXXIX.**  
**Movement of Fishes in Zone III**

| Species                 | Number Tagged | Number Recaptured | Movement |          |         | Greatest Distance Travelled |
|-------------------------|---------------|-------------------|----------|----------|---------|-----------------------------|
|                         |               |                   | < 20 mi. | < 10 mi. | < 5 mi. |                             |
| <b>Spotted Seatrout</b> | 325           | 25                | 92.9%    | 92.9%    | 92.9%   | 121 mi.                     |
| <b>Sheepshead</b>       | 75            | 26                | 100.0%   | 100.0%   | 93.3%   | <10 mi.                     |
| <b>Black Mullet</b>     | 47            | 11                | 100.0%   | 100.0%   | 90.9%   | <10 mi.                     |
| <b>Redfish</b>          | 19            | 6                 | 100.0%   | 100.0%   | 100.0%  | <5 mi.                      |
| <b>Sea Drum</b>         | 13            | 5                 | 100.0%   | 100.0%   | 100.0%  | <5 mi.                      |

### *Mortality:*

A recovery rate of 7.7% was obtained for seatrout in Zone III. This represents a rate of 8.5% for the east coast of Zone III and a rate of 6.2% for the west coast. The overall rate is approximately half the Zone II rate (14.9%) and one third of the Zone I rate (23.2%). Whether or

not the suggestion of lower fishing mortality for this species is valid throughout the Zone may be strengthened by the 1961-62 tagging program.

For some species the rate of recovery on the east coast differed appreciably from that of the west coast. For example 29 of the 64 sheepshead (45.3%) tagged on the east coast of Zone III were recovered, as compared to 2 of the 17 tagged specimens (11.8%) on the west coast. An analysis of the factors involved in such differences will not be made at this time.

The discussion sections of Zones I and II list some of the factors which may have had effects on the assessment of fishing mortalities in those Zones. Some of these factors are also generally applicable in Zone III.

The overall rate of recovery for Zone III was 15.0%.

#### Growth:

Every specimen was measured at the time of release and remeasured following recapture and freezing. Damaged specimens were not considered in growth evaluations.

Some cases of shrinking were found among nearly every species. This phenomenon, along with other causes for change of length treated in the discussion sections of Zone I and II, is likewise applicable here.

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## IV. NOTES ON THE TAGGING OF SALT WATER FISHES IN ZONE IV

### INTRODUCTION

The tagging of salt water fishes in the 1960-61 Schlitz Tagging Program was carried out in Zone IV from March 12, 1961 through May 5, 1961. Details of the organization of the program are presented in the introduction to the Zone I report.

The purpose of this section is to report the results of the 1960-61 program in Zone IV through December 31, 1961. A discussion of these results is included.

### TAGGING IN ZONE IV

Zone IV includes the northeast portion of Florida from the northern Flagler County line to the northern Nassau County line. On the west coast it extends from the Wacasassa River (Levy County) to the western Escambia County line.

A total of 501 fishes were tagged in Zone IV. 439 fishes were tagged on the west coast of Zone IV from March 17, 1961 through March 22, 1961 and from April 29, 1961 through May 5, 1961. 62 fishes were tagged on the east coast of Zone IV on March 12, 1961. Tagged fishes were recovered on the west coast of Zone IV from April 1, 1961 through November 14, 1961. No fishes were recovered on the east coast of Zone IV.

### RESULTS BY SPECIES

#### SPOTTED SEATROUT, *Cynoscion nebulosus* (Cuv. & Val.):

179 spotted seatrout were tagged in Zone IV. 50 of these specimens were released in Duval County and St. Johns County on the east coast of Zone IV on March 12, 1961. The remaining 129 seatrout were released on the west coast of Zone IV from March 17, 1961 through March 22, 1961 and from April 29, 1961 through May 5, 1961. Eight of the 179 tagged specimens (4.5%) were recaptured from April 3, 1961 through July 20, 1961. Since all the recaptured specimens were taken on the west coast of Zone IV, they represent 6.2% of the 129 specimens tagged in that area. This value is somewhat lower than that of 11.4% for similarly tagged seatrout on the west coast obtained by Moffett (1961). However, our value of 6.2% is somewhat greater than that obtained by Moffett for seatrout tagged in the same general area at a corresponding time of year.

The longest distance travelled by a seatrout released and recaptured in Zone IV was 22 miles, by a specimen released on April 29, 1961 at Nanatalla Beach and recaptured on May 3, 1961 at Peridido Rocks. The distance was travelled in 31 days, with an average speed of 0.97 miles per day.

Table XL lists the release-recapture data for the eight spotted seatrout returned in Zone IV

TABLE XL.

Release — Recapture Data on Spotted Seatrout, *Cynoscion nebulosus* (Cuv. & Val.) Returned in Zone IV

| Release    |                      |     | Recapture |                      |       | Growth |       | Distance<br>From<br>Release<br>Point | Number<br>Days<br>Free |
|------------|----------------------|-----|-----------|----------------------|-------|--------|-------|--------------------------------------|------------------------|
| Date       | Measurements<br>(mm) |     | Date      | Measurements<br>(mm) |       | (mm)   |       |                                      |                        |
|            | TL                   | SL  |           | TL                   | SL    | TL     | SL    |                                      |                        |
| 19/ III/61 | 498                  | 423 | 3/ IV/61  | 492                  | 418   | −05    | −06   | <5                                   | 16                     |
| 19/ III/61 | 374                  | 318 | 9/ V/61   | 376                  | 320   | 02     | 02    | <5                                   | 52                     |
| 19/ III/61 | 385                  | 328 | 8/ V/61   | 377                  | 322   | −03    | −08   | <5                                   | 51                     |
| 19/ III/61 | 326                  | 272 | 1/ VI/61  | -----                | ----- | -----  | ----- | <5                                   | 75                     |
| 29/ IV/61  | 351                  | 305 | 3/ V/61   | -----                | ----- | -----  | ----- | 14                                   | 5                      |
| 29/ IV/61  | 385                  | 332 | 29/ V/61  | -----                | ----- | -----  | ----- | 30                                   | 31                     |
| 1/ V/61    | 366                  | 311 | 20/VII/61 | -----                | ----- | -----  | ----- | 23                                   | 81                     |
| 2/ V/61    | 361                  | 311 | 11/ V/61  | -----                | ----- | -----  | ----- | 7                                    | 10                     |

## OTHER SPECIES

Four of the 53 tagged black mullet, *Mugil cephalus* (Linn.) were recaptured (7.5%). The three for which data is available were recovered less than five miles from the point of release. Growth data is not available.

Five spots, *Leiostomus xanthurus* (Lacepede) were recaptured from the 45 specimens released in Zone IV (11.1%). All were recaptured within ten miles from the point of release. One specimen, released at the Bay Bridge in Pensacola Bay on April 30, 1961 was recaptured 198 days later on November 14, 1961 less than five miles from the point of release. It exhibited a standard length increment of 17 mm, representing a 10.4% increase in length while at large.

Three of the 125 sea catfish, *Galeichthys felis* (Linn.) were recaptured (2.4%). One specimen travelled 50 miles from the Panama City Bridge to the East Pass at Destin in 38 days, with an average of 1.32 miles per day. No growth data is available.

One of the three sea drums, *Pagonias cromis* (Linn.) was recaptured 14 days after being released. This rather large individual (770 mm S. L.) was recaptured within five miles of the point of release and showed a decrease of 1 mm and 19 mm in total length and standard length respectively.

Table XLI lists the recapture data on all recaptured specimens (excluding seatrout) in Zone IV.

## DISCUSSION

### *Movement, Growth and Mortality:*

Growth data has been presented when available for each recaptured specimen in Tables XL and XLI. The paucity of available growth data does not warrant the establishment of any conclusions at this time.

Two reasons have been suggested for the scant returns in Zone IV:

1. The tagging did not correspond either to the season of peak tourist visitation or to the period of high sports fishing activity. Moreover, many of the species were those not generally sought after commercially.
2. Because of poor fishing conditions at the time of tagging, specimens were quite difficult to obtain, especially those species which were well suited to the tagging program.

Table XLII lists the numbers of fishes tagged and returned by species in Zone IV.

TABLE XLI.

Release - Recapture Data on All Recaptured Specimens (Excluding Seatrout) in Zone IV

| Species                                         | Date       | Release Measurements |       | Growth |       | Distance<br>From<br>Release<br>Point | Number<br>Days<br>Free |
|-------------------------------------------------|------------|----------------------|-------|--------|-------|--------------------------------------|------------------------|
|                                                 |            | TL                   | SL    | TL     | SL    |                                      |                        |
| <b>Black Mullet</b><br>Mugil cephalus (Linn.)   | 29/ IV/61  | 345                  | 265   | -----  | ----- | <5                                   | 1                      |
| <b>Black Mullet</b><br>Mugil cephalus (Linn.)   | 30/ IV/61  | 285                  | 215   | -----  | ----- | <5                                   | 16                     |
| <b>Black Mullet</b><br>Mugil cephalus (Linn.)   | 2/ V/61    | 365                  | 291   | -----  | ----- | -----                                | 65                     |
| <b>Black Mullet</b><br>Mugil cephalus (Linn.)   | 4/ V/61    | 344                  | 270   | -----  | ----- | <5                                   | 99                     |
| <b>Spot</b><br>Leiostomus xanthurus (Lacepede)  | 30/ IV/61  | 211                  | 165   | -----  | ----- | <5                                   | 5                      |
| <b>Spot</b><br>Leiostomus xanthurus (Lacepede)  | 30/ IV/61  | 204                  | 161   | -----  | ----- | <5                                   | 33                     |
| <b>Spot</b><br>Leiostomus xanthurus (Lacepede)  | 30/ IV/61  | 206                  | 164   | -----  | ----- | <5                                   | 45                     |
| <b>Spot</b><br>Leiostomus xanthurus (Lacepede)  | 30/ IV/61  | 205                  | 163   | -18    | 17    | <5                                   | 198                    |
| <b>Spot</b><br>Leiostomus xanthurus (Lacepede)  | 1/ V/61    | 218                  | 167   | -----  | ----- | <10                                  | 32                     |
| <b>Sea Catfish</b><br>Galeichthys felis (Linn.) | 29/ IV/61  | -----                | ----- | -----  | ----- | <10                                  | 8                      |
| <b>Sea Catfish</b><br>Galeichthys felis (Linn.) | 30/ IV/61  | -----                | ----- | -----  | ----- | <10                                  | 7                      |
| <b>Sea Catfish</b><br>Galeichthys felis (Linn.) | 3/ V/61    | -----                | ----- | -----  | ----- | 50                                   | 38                     |
| <b>Sea Drum</b><br>Pagionias cromis (Linn.)     | 19/ III/61 | 894                  | 770   | -01    | -19   | <5                                   | 14                     |

TABLE XLII.

Numbers of Fishes Tagged and Recaptured by Species in Zone IV

| Species                                                              | Number Tagged | Number Recaptured | Percentage Recaptured |
|----------------------------------------------------------------------|---------------|-------------------|-----------------------|
| <b>Spotted Seatrout</b><br><i>Cynoscion nebulosus</i> (Cuv. & Val.)  | 179           | 8                 | 4.5                   |
| <b>Sea Catfish</b><br><i>Galeichthys felis</i> (Linn.)               | 125           | 3                 | 2.4                   |
| <b>Black Mullet</b><br><i>Mugil cephalus</i> (Linn.)                 | 53            | 4                 | 7.5                   |
| <b>Spot</b><br><i>Leiostomus xanthurus</i> (Lacepede)                | 45            | 5                 | 11.1                  |
| <b>Sheepshead</b><br><i>Archosargus probatocephalus</i> (Walbaum)    | 31            | 0                 | 0.0                   |
| <b>Silver Trout</b><br><i>Cynoscion regalis</i> (Bloch & Schneider)  | 16            | 0                 | 0.0                   |
| <b>Whiting</b><br><i>Menticirrhus americanus</i> (Linn.)             | 15            | 0                 | 0.0                   |
| <b>Blue Runner</b><br><i>Caranx crysos</i> (Mitchill)                | 9             | 0                 | 0.0                   |
| <b>Bluefish</b><br><i>Pomatomus saltatrix</i> (Linn.)                | 7             | 0                 | 0.0                   |
| <b>Flounder</b><br><i>Paralichthys albiguttus</i> (Jordan & Gilbert) | 5             | 0                 | 0.0                   |
| <b>Grunt</b><br><i>Haemulon</i> sp.                                  | 3             | 0                 | 0.0                   |
| <b>Common Pompano</b><br><i>Trachinotus carolinus</i> (Linn.)        | 3             | 0                 | 0.0                   |
| <b>Sea Drum</b><br><i>Pagionias cromis</i> (Linn.)                   | 3             | 1                 | 33.3                  |

TABLE XLII, Continued

|                                                               |            |           |            |
|---------------------------------------------------------------|------------|-----------|------------|
| <b>Mangrove Snapper</b><br>Lutianus griseus (Linn.)           | 2          | 0         | 0.0        |
| <b>Silver Mullet</b><br>Mugil sp.                             | 1          | 0         | 0.0        |
| <b>Gafftopsail Catfish</b><br>Bagre marinus (Linn.)           | 1          | 0         | 0.0        |
| <b>Spanish Mackerel</b><br>Scomberomorus maculatus (Mitchill) | 1          | 0         | 0.0        |
| <b>Redfish</b><br>Sciaenops ocellata (Linn.)                  | 1          | 0         | 0.0        |
| <b>Sea Bass</b><br>Centropristes melanus (Ginsburg)           | 1          | 0         | 0.0        |
| <b>TOTAL</b>                                                  | <b>501</b> | <b>21</b> | <b>4.2</b> |

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