

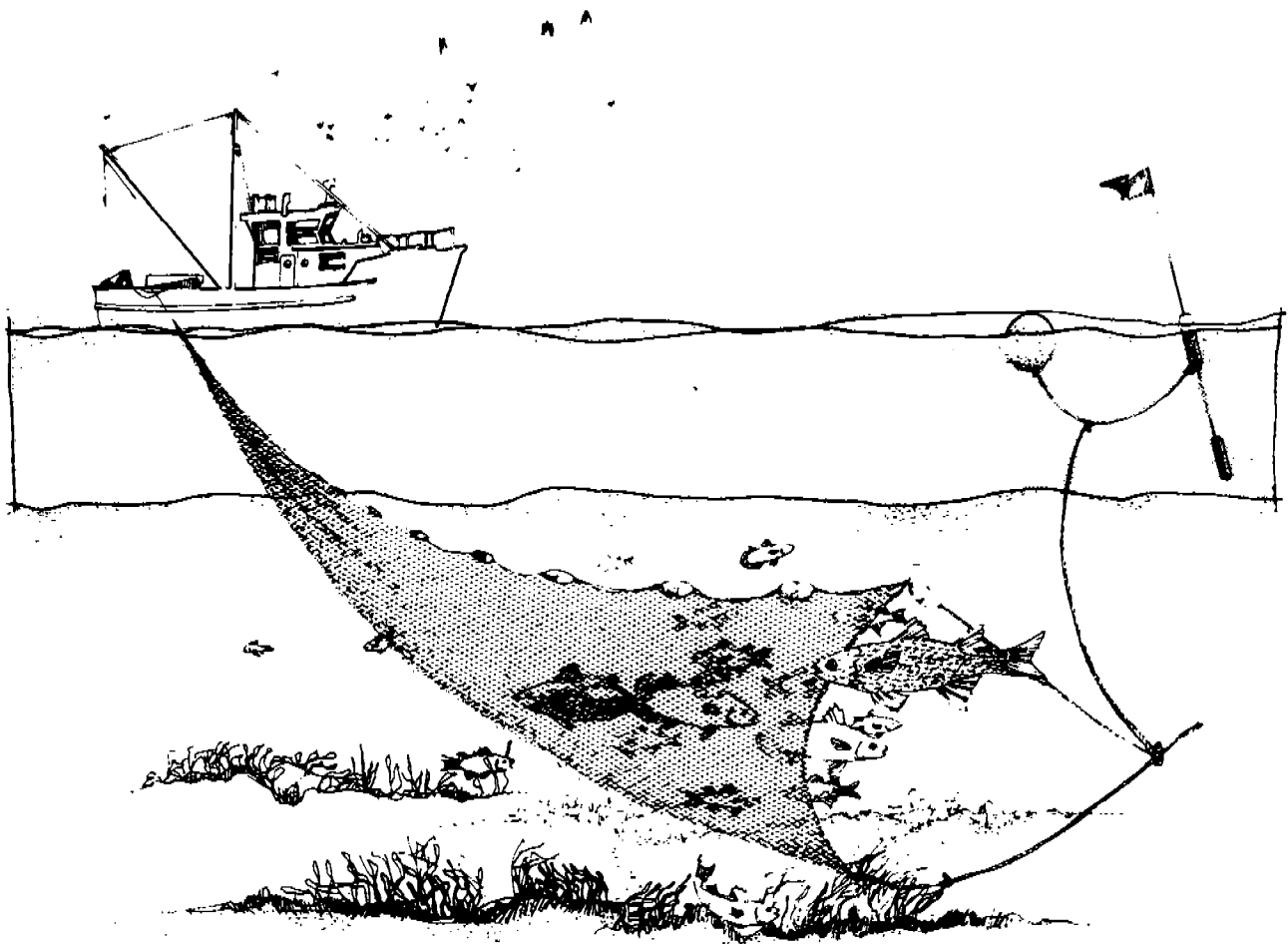
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Biological Report 82(11.39)  
May 1985

TR EL-82-4

**Species Profiles: Life Histories and  
Environmental Requirements of Coastal Fishes  
and Invertebrates (South Florida)**

**WHITE MULLET**



Fish and Wildlife Service  
U.S. Department of the Interior

Coastal Ecology Group  
Waterways Experiment Station  
U.S. Army Corps of Engineers

This is one of the first reports to be published in the new "Biological Report" series. This technical report series, published by the Research and Development branch of the U.S. Fish and Wildlife Service, replaces the "FWS/OBS" series published from 1976 to September 1984. The Biological Report series is designed for the rapid publication of reports with an application orientation, and it continues the focus of the FWS/OBS series on resource management issues and fish and wildlife needs.

Species Profiles: Life Histories and Environmental Requirements  
of Coastal Fishes and Invertebrates (South Florida)

WHITE MULLET

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Waterways Experiment Station  
U.S. Army Corps of Engineers  
Vicksburg, MS 39180

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National Coastal Ecosystems Team  
Division of Biological Services  
Research and Development  
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Washington, DC 20240

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## PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

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U.S. Army Engineer Waterways Experiment Station  
Attention: WESER-C  
Post Office Box 631  
Vicksburg, MS 39180

## CONVERSION TABLE

### Metric to U.S. Customary

| <u>Multiply</u>                      | <u>By</u>    | <u>To Obtain</u>      |
|--------------------------------------|--------------|-----------------------|
| millimeters (mm)                     | 0.03937      | inches                |
| centimeters (cm)                     | 0.3937       | inches                |
| meters (m)                           | 3.281        | feet                  |
| kilometers (km)                      | 0.6214       | miles                 |
| square meters (m <sup>2</sup> )      | 10.76        | square feet           |
| square kilometers (km <sup>2</sup> ) | 0.3861       | square miles          |
| hectares (ha)                        | 2.471        | acres                 |
| liters (l)                           | 0.2642       | gallons               |
| cubic meters (m <sup>3</sup> )       | 35.31        | cubic feet            |
| cubic meters                         | 0.0008110    | acre-feet             |
| milligrams (mg)                      | 0.00003527   | ounces                |
| grams (g)                            | 0.03527      | ounces                |
| kilograms (kg)                       | 2.205        | pounds                |
| metric tons (t)                      | 2205.0       | pounds                |
| metric tons                          | 1.102        | short tons            |
| kilocalories (kcal)                  | 3.968        | British thermal units |
| Celsius degrees                      | 1.8(°C) + 32 | Fahrenheit degrees    |

### U.S. Customary to Metric

|                                 |                 |                   |
|---------------------------------|-----------------|-------------------|
| inches                          | 25.40           | millimeters       |
| inches                          | 2.54            | centimeters       |
| feet (ft)                       | 0.3048          | meters            |
| fathoms                         | 1.829           | meters            |
| miles (mi)                      | 1.609           | kilometers        |
| nautical miles (nmi)            | 1.852           | kilometers        |
| square feet (ft <sup>2</sup> )  | 0.0929          | square meters     |
| acres                           | 0.4047          | hectares          |
| square miles (mi <sup>2</sup> ) | 2.590           | square kilometers |
| gallons (gal)                   | 3.785           | liters            |
| cubic feet (ft <sup>3</sup> )   | 0.02831         | cubic meters      |
| acre-feet                       | 1233.0          | cubic meters      |
| ounces (oz)                     | 28.35           | grams             |
| pounds (lb)                     | 0.4536          | kilograms         |
| short tons (ton)                | 0.9072          | metric tons       |
| British thermal units (Btu)     | 0.2520          | kilocalories      |
| Fahrenheit degrees              | 0.5556(°F - 32) | Celsius degrees   |

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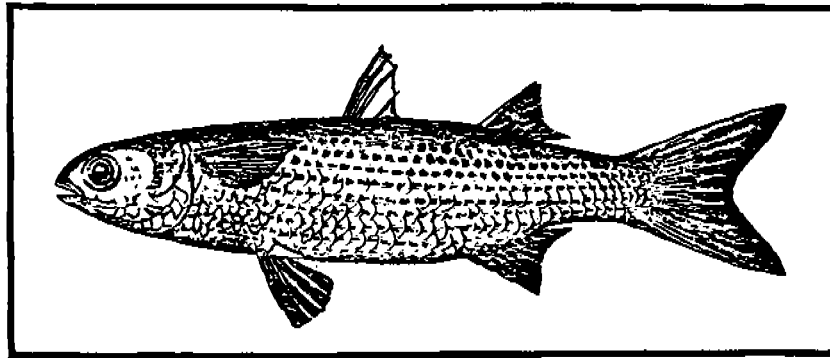


Figure 1. White mullet.

## WHITE MULLET

### NOMENCLATURE/TAXONOMY/RANGE

Scientific name . . . . . Mugil curema  
 Valenciennes, 1836  
 Preferred common name . . White mullet  
 (Figure 1)  
 Other common names . . . Silver mullet  
 Class . . . . . Osteichthyes  
 Order . . . . . Perciformes  
 Family . . . . . Mugilidae

Geographic range: Atlantic and Eastern Pacific; in the Western Atlantic from Canada to Uruguay; adults rare north of Florida (Figure 2).

### MORPHOLOGY/IDENTIFICATION AIDS

Dorsal fin IV + I spines, 8 rays; anal fin III spines, 9 rays (II, 10 in juveniles). Lateral line scale count 33-39 (usually 38-39). Anal and second dorsal fins scaled; origin of first dorsal fin midway between middle of caudal base and tip of snout; caudal fin often has dark posterior border; sides of body silvery without conspicuous stripes; back blue or olive; gold spot on opercle usually apparent; adipose eyelid present (Hoesel and Moore 1977; Rivas 1980).

The white mullet and striped mullet are easily separated taxonomically. The white mullet has 9 anal rays and the pectoral fin lengths are 77%-84% of the head lengths; the striped mullet has 8 anal rays and the pectoral fins are 66%-74% of the head length.

### REASON FOR INCLUSION IN SERIES

The white mullet, the second most common species of the family Mugilidae in Florida waters, constitutes a measurable proportion of the commercial mullet catch, and is a popular bait-fish in the sport fishery for bill-fish. Because white mullet feed primarily on living and dead vegetable matter, as do the more numerous striped mullet (Mugil cephalus), they are ecologically important as primary consumers in the food chains of coastal and estuarine waters.

### LIFE HISTORY

#### Spawning

In 1954, a school of thousands of spawning white mullet was observed



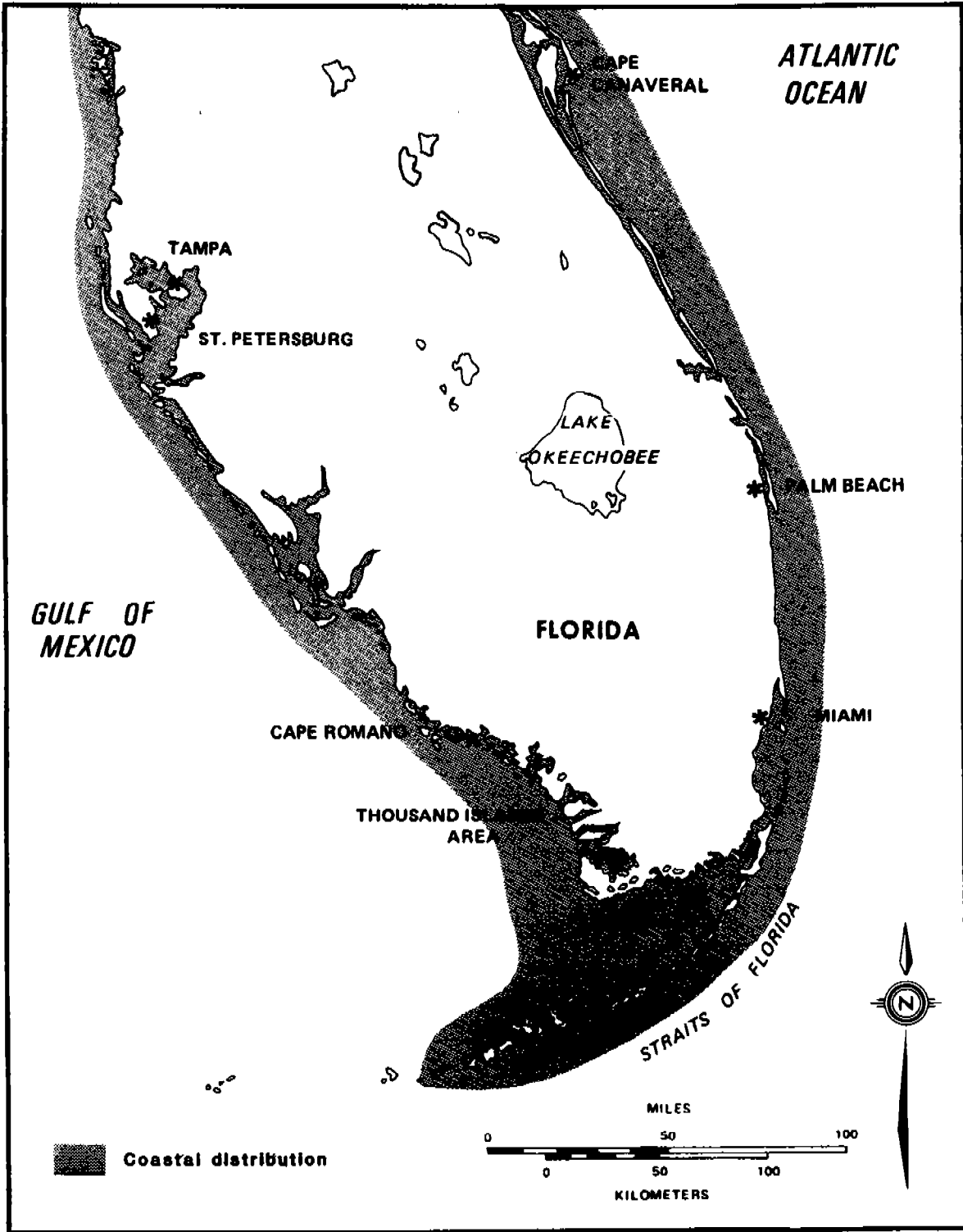


Figure 2. Distribution of white mullet in the South Florida Region.

at night on the surface in about 60 m of water off south Florida (Anderson 1957). Eggs and early larvae were collected near the surface from that depth out to the axis of the Gulf Stream and northward to North Carolina. Eggs have been collected in Biscayne Bay (Houde et al. 1976). On the basis of the distribution of larvae, Anderson (1957) concluded that white mullet in Florida spawn primarily from April through June (extremes, March through September). Based on gonad development, Mefford (1955) assumed that white mullet spawn from April through June. In the Gulf of Mexico off Texas, Moore (1974) collected white mullet with gonads in post-spawning condition in late spring and early fall, but not in the summer, and suggested the possibility of an interrupted spawning season or two populations that spawn at different times. Two spawning seasons, summer and winter, were reported for Cuban waters (Alvarez-Lajonchere 1976).

Unfertilized white mullet eggs average 0.82 mm in diameter. The shell has a finely etched or scratched appearance, the yolk is an opaque mass with little or no perivitelline space, and there is a pale yellow oil globule averaging 0.03 mm in diameter atop the yolk mass. Soon after fertilization the egg increases to an average diameter of 0.90 mm. Dimensions of the egg and oil globule are relatively constant until the egg hatches 40-42 h after fertilization (Anderson 1957). Alvarez-Lajonchere (1976) presented the following fecundity equation for Cuban white mullet, where  $F$  = number of eggs and  $W$  = weight in grams:  $F = 959.54439W - 102947.552$ .

#### Larvae and Juveniles

Newly hatched larvae lack a mouth, fins, and eye pigment. About 32 h after hatching, when the larvae are about 2.6 mm long (all lengths are total lengths [TL] unless otherwise indicated), the pectoral fin buds begin to appear and the mouth forms.

Full complements of fin rays in anal and both dorsal fins characterize larvae 5.3 mm long, and the two spines and ten rays are discernible in the anal fin of larvae about 14.5 mm long. Larvae retain the "II, 10" anal fin until about 30-40 mm long, when they may be considered juveniles; the "III, 9" anal fin is thereafter retained through maturity (Anderson 1957). Laboratory-reared fish were 36 mm long 36 days after hatching (Houde et al. 1976). Larvae begin appearing inshore along beaches and in estuaries when about 25 mm long and 28 days old (Anderson 1957). By the end of their first year, juveniles probably reach a length of 200 mm standard length (SL), and become sexually mature. Young white mullet carried north by the Gulf Stream have been reported as far north as Canada (Alvarez-Lajonchere 1976).

Juveniles enter the estuaries and live in the inner marshes for the summer of their first year; they emigrate seaward when water temperatures begin dropping in the fall. Young mullet along the Atlantic coast migrate southward to Florida or further in the fall. Juveniles become scarce along the coast of Texas after October (Moore 1974) and along Georgia's coast after mid-December (Anderson 1957). Immigrants from Georgia probably migrate to inshore waters of Florida, and the Texas mullet probably migrate to Mexican waters, where they reside until the following spring.

#### Adults

After their first year, white mullet are rarely collected north of Florida (Anderson 1957). Males taken from a school of spawning fish off the south Florida coast averaged 189 mm SL; females averaged 209 mm SL (Anderson 1957). A positive correlation between length and the percentage of mullet that are mature is illustrated in Figure 3. The average length of white mullet

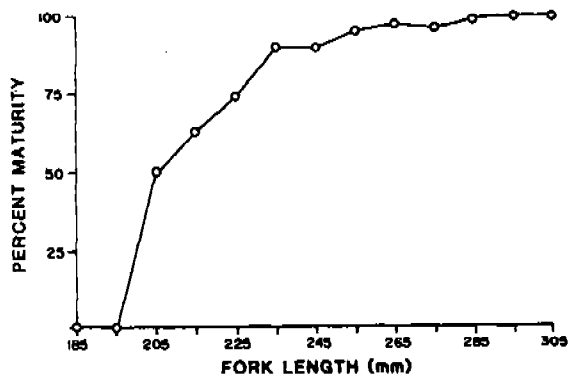


Figure 3. The cumulative percent of mature white mullet for each length group (Mefford 1955).

caught by commercial fishermen in Florida was about 250 mm SL, and the maximum was about 350 mm SL (Mefford 1955). Males in Cuban waters greatly outnumber females at lengths shorter than 31 cm FL. There were no sexual differences in the length-weight relationship (Alvarez-Lajonchere 1976). In Florida, Mefford (1955) reported a sex ratio of about 1:1. It is likely that white mullet along the gulf and Atlantic coasts are separate populations (Rivas 1980).

#### GROWTH CHARACTERISTICS

Using larvae and juveniles collected in Georgia by seining, Anderson (1957) estimated a growth rate of about 17 mm per month. Richards and Castagna (1976), using similar material from Virginia, estimated the growth rates to be 17.5-19.5 mm for each half-month of the summer, or more than double Anderson's value. The growth rate of 17 mm per month over 1 year appears to correspond well to the size at that age, but it is also possible for a higher summer growth rate and a much slower winter growth rate to result in the same size at 1 year. Using length-weight data from Mefford (1955) and assuming a length of 200 mm at age I, Richards and Castagna (1976) developed the following growth equations:

$$L_t = 360 (1 - e^{-0.78(t+0.06)})$$

$$W_t = 615 (1 - e^{-0.78t})^3$$

where  $L_t$  = fork length in mm,  $t$  = time in years, and  $W_t$  = weight in grams. For each of the first 5 years, the first equation yields fork lengths of 203, 288, 327, 345, and 353 mm, and the second yields weights of 98, 303, 454, 537, and 578 g. Alvarez-Lajonchere (1976), attempting to age white mullet by dorsal spine sections, estimated the following fork lengths for Cuban mullet at ages one through four, respectively: 232, 285, 333, and 364 mm. He also reported a length-weight equation of  $W = 0.0330 L^{2.738}$ . The length-weight relationship of white mullet in Florida is illustrated in Figure 4.

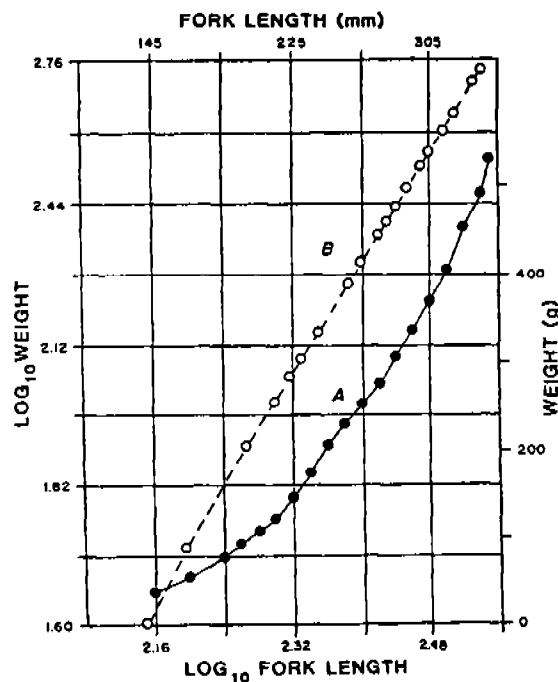


Figure 4. Length-weight relationships for white mullet in Florida. A = absolute values, B = log<sub>10</sub> values (from Mefford 1955).

## THE FISHERY

White mullet are not highly prized as food, but they are valuable as bait in the billfish sport fishery. Most fishermen in charter boats purchase mullet for bait, but some use castnets to catch their own.

In Florida, most of the commercial white mullet are taken by the striped mullet fishery. In years when the white mullet are unusually abundant, the catch is sorted by species; but apparently some fishermen and retailers do not always separate the two species at the market. The data for white mullet landings from 1958 to 1981 are given in Table 1.

The gears used most often to catch white mullet and striped mullet are trammel nets, gill nets, and seines. See the Species Profile for striped mullet (*Mugil cephalus*) for a brief description of these nets and their use. There are no regulations or closed seasons on white mullet.

### ECOLOGICAL ROLE

Data on the food and feeding habits of white mullet are scarce. White and striped mullet often feed on the same food at the same times and places. Larval white and striped mullet feed and thrive on microcrustaceans. Houde et al. (1976) reported that a culture of white mullet larvae thrived on copepod nauplii and copepodites. As larvae grow, their ingestion of bottom sediments, detritus, and algae increases. Juveniles do not usually feed on microcrustaceans but juveniles (35-80 mm long TL) of both species may feed on dinoflagellates such as *Kryptoperidinium* sp. (Odum 1968); like adults, they rely on trituration in their gizzard-like, pyloric stomachs to break down food particles. The stomach contents of both juvenile and adult white and striped mullet in Texas were very similar, both in the items present (sediment particles, detritus,

Table 1. Annual landings (pounds) of white mullet in Florida, 1958-81. (1958-76 data from Florida Dep. of Natural Resources; 1977-81 data from National Marine Fishery Service.)

| Year | Coast   |           | Combined  |
|------|---------|-----------|-----------|
|      | East    | West      |           |
| 1958 | 180,199 | 958,129   | 1,138,328 |
| 1959 | 147,754 | 669,271   | 817,025   |
| 1960 | 178,485 | 423,479   | 601,964   |
| 1961 | 185,145 | 470,441   | 655,586   |
| 1962 | 74,277  | 465,964   | 540,241   |
| 1963 | 59,821  | 664,664   | 724,485   |
| 1964 | 41,923  | 544,875   | 586,798   |
| 1965 | 100,848 | 792,282   | 893,130   |
| 1966 | 164,697 | 697,432   | 862,129   |
| 1967 | 218,293 | 1,088,584 | 1,306,877 |
| 1968 | 294,356 | 1,039,877 | 1,334,233 |
| 1969 | 260,486 | 758,277   | 1,018,763 |
| 1970 | 322,055 | 501,297   | 823,352   |
| 1971 | 241,532 | 624,664   | 866,196   |
| 1972 | 165,352 | 435,306   | 600,658   |
| 1973 | 197,209 | 609,227   | 806,436   |
| 1974 | 579,102 | 606,862   | 1,185,964 |
| 1975 | 311,871 | 531,859   | 843,730   |
| 1976 | 296,495 | 746,285   | 1,042,780 |
| 1977 | 141,595 | 524,080   | 665,675   |
| 1978 | 129,950 | 698,734   | 828,684   |
| 1979 | 179,022 | 594,289   | 773,311   |
| 1980 | 393,841 | 498,974   | 892,815   |
| 1981 | 378,856 | 282,444   | 661,300   |

diatoms, green algae, and blue-green algae) and in the proportions of each item (Moore 1974).

Information on predation and competition that specifically concerns white mullet is scarce, but in one instance Richards and Castagna (1976) reported collecting juveniles with injuries probably sustained during attacks by predators such as weakfish (*Cynoscion regalis*), bluefish (*Pomatomus saltatrix*), and red drum (*Sciaenops ocellata*). In Florida, major predators of adults are piscivorous fish and birds. No evidence for interspecific competition exists.

## ENVIRONMENTAL REQUIREMENTS

### Temperature

White mullet have been collected at water temperatures of 19 to 36°C in Texas (Moore 1974), 20.1 to 31.5°C in Virginia (Richards and Castagna 1976), and 19.5 to 35.4°C in Florida (Kilby 1955). The species is tropically adapted (Moore 1974), and experimental evidence suggests a high (28°C or somewhat greater) optimum temperature for white mullet (Moore 1973). The decreasing water temperatures in late fall may induce juveniles to emigrate from estuaries north of Florida, but changes in photoperiod have not been ruled out as important stimuli (Anderson 1957).

### Salinity

On the peninsular gulf coast of Florida, Kilby (1955) reported catching juvenile white mullet in salinities ranging from 4 to 25 ppt. In a study in Texas, white mullet adults were abundant only in salinities of 25 to 36 ppt (Moore 1974). Few enter brackish waters in the northern Gulf of Mexico. However, I have collected adult white mullet from freshwater in Crystal River, Florida (unpubl. data).

Relevant data on the effects of dissolved oxygen, substrate, depth, currents, diseases, and parasites on white mullet are sorely lacking.

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| 15. Supplementary Notes<br>*U.S. Army Corps of Engineers Report No. TR EL-82-4.  |  |  |    | 13. Type of Report & Period Covered           |
| 16. Abstract (Limit: 200 words)<br>Species profiles are literature summaries of the taxonomy, morphology, distribution, life history, biological and physical environments, and environmental requirements of coastal species of fishes and aquatic invertebrates. They are designed to assist in environmental impact assessment. The white mullet ( <u>Mugil curema</u> ) is a valuable baitfish. Adults spawn offshore, and are seldom found at low salinities. Juveniles spend the summer of their first year in estuaries. White mullet are caught with trammel nets, gill nets, and seines. About 660,000 pounds were landed in 1981. The species is adapted to tropical temperatures, with an optimum of about 28 °C. |  |  |    |   |
| 17. Document Analysis  |  |  |    |   |
| a. Descriptors   |  |  |    |   |
| Fishes                      Feeding<br>Estuaries                  Grow   |  |  |    |   |
| b. Identifiers, Open Ended Terms   |  |  |    |   |
| White mullet                      Life history<br><u>Mugil curema</u> Spawning<br>Salinity requirements              Habitat requirements<br>Temperature requirements  |  |  |    |   |
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